DRILL PIPE PROTECTION RINGS

Cross-Reference to Related Applications

This application claims the benefit of provisional application S.N. 60/095,003, filed on July 30, 1998, in the United States Patent & Trademark Office.

Technical Field

This invention relates in general to drill pipe and in particular to drill pipe protection rings.

Background of the Invention

During drilling, sections of drill pipe are secured together at their tool joints. The tool joints are the threaded connector portions of each section of pipe and have enlarged outer diameters at their connector portions. Certain types of high strength drill pipe, such as S-135 classification drill pipe, have one or more milled slots surrounding the outer diameter. The slots are circumferential, concave grooves which merely designate the material of the drill pipe and do not serve any other function. The slots have a variety of sizes, but are approximately 3/8 inch deep and ½ inch wide. Each slot has relatively sharp upper and lower corner edges and a curved base.

In one type of drilling, the drill pipe passes through a drilling head located at the drilling rig. The drilling head has a rotatable section that grips and seals around the drill pipe. When run through the drilling head, the sharp edges of the slots can severely damage the gripping and sealing members located inside the drilling head. Thus, an apparatus and/or method for reducing damage to the drilling head is needed.

Summary of the Invention

Drill pipe protection rings for filling the external slots in drill pipe are disclosed. The rings are formed from resilient elastomeric materials. In cross-section, each ring has

slightly convex inner and outer surfaces, and a series of circumferentially spaced-apart, hemispherical bumps located along its inner surface.

One ring is mounted within each slot on each drill pipe section. The rings stretch slightly while being installed, but form a tight fit once they are properly seated. When installed, the outer surfaces of the rings will protrude slightly outward from or beyond the slots. The hemispherical bumps help align and center the rings within the slots. Without the rings, the sharp edges of the slots on the drill pipes would cause severe damage as they passed through the drill head. However, with the rings the outer surfaces the slots are substantially filled to prevent their edges from cutting or gouging the elastomers.

Brief Description of Drawings

So that the manner in which the features, advantages and objects of the invention, as well as others which will become apparent, are attained and can be understood in more detail, more particular description of the invention briefly summarized above may be had by reference to the embodiment thereof which is illustrated in the appended drawings, which drawings form a part of this specification. It is to be noted, however, that the drawings illustrate only a preferred embodiment of the invention and is therefore not to be considered limiting of its scope as the invention may admit to other equally effective embodiments.

Figure 1 is a sectional side view of one type of a drilling head for receiving drilling pipe.

Figure 2 is an isometric view of a drill pipe protection ring constructed in accordance with the invention.

Figure 3 is a sectional side view of an end of a drill pipe.

Figure 4 is a partial sectional side view of a portion of the drill pipe of Figure 3 fitted with the drill pipe protection ring of Figure 2.

Figure 5 is a partial sectional side view of a portion of the drill pipe similar to Figure 3, but showing a slot with a shallower depth.

Best Mode for Carrying Out the Invention

Referring to Figure 1, a drilling head 11 has a body assembly 15 with a lower shoulder 12 that lands on an upward facing shoulder 14 in an external housing 13. Body assembly 15 is removably secured to housing 13 with an annular split ring or locking member 17. When a cam member 18 is rotated downward relative to body assembly 15, locking member 17 is forced radially outward and seats in a groove 19 in housing 13 to lock body assembly 15 from upward movement.

Body assembly 15 comprises an outer body 21 having an upper portion 21a and a lower portion 21b which are secured to one another at threads 22. Body assembly 15 also has a rotor or inner body 23 with an axial bore 25. Inner body 23 is rotatable relative to stationary outer body 21 on upper bearings 31 and lower bearings 33.

An annulus 41 extends between outer body 21 and an upper portion of inner body 23. A pair of inlet ports 43 and three outlet ports 45 communicate hydraulic fluid with annulus 41. Annulus 41 is sealed on an upper side by seal 46 and on a lower side by seal 49 which slidingly engage inner body 23. In the preferred embodiment, seal 46 is a carrier containing a dynamic rotating seal.

Inner body 23 has a centrally located packer or gripping member 51 with an inner portion 53 and an outer portion 55. Inner portion 53 comprises a solid annular elastomer which is supported by rigid segments. Inner portion 53 is free to move radially relative to inner body 23 between energized and unenergized states. The outer diameter of inner portion 53 abuts the inner diameter of outer portion 55. Outer portion 55 comprises a channel or annular elastomer with an annular cavity 63 which communicates with annulus 41.

A primary seal 71 extends from a lower end of inner body 23 and is spaced axially apart from gripping member 51. Seal 71 has a tubular member 72 which threadingly engages an outer portion of inner body 23. Seal 71 also comprises an elastomer 73 which has an axial passage and a frustoconical exterior. The internal diameter of elastomer 73 is smaller than the diameter of bore 25, gripping member 51, and the outer diameter of drill pipe. Seal 71 provides the primary seal for sealing drilling head 11 against the drill pipe. Gripping member 51 causes seal 71 to rotate with the drill pipe and provides an auxiliary or secondary seal for sealing drilling head 11 against the drill pipe.

Figure 3 shows a portion of a type of drill pipe 89 that may be run through drilling head 11. Sections of drill pipe 89 are secured together by tool joints 91. Tool joints 91 are the threaded connector portions of each section of pipe 89 and have enlarged outer diameters 93 at their connector portions. Certain types of high strength drill pipe 89, such as S-135 classification drill pipe, have one or more milled slots 95 surrounding their outer diameters 93. Slots 95 are circumferential, concave grooves which designate the material of drill pipe 89. Slots 95 do not serve any function other than identifying the type of pipe. Slots 95 have a variety of sizes, but are approximately 3/8 inch deep and ½ inch wide. The tolerances for slots 95 are not close. Each slot 95 has relatively sharp upper and lower corner edges 97 and a curved base. Slots 95 can be detrimental to the gripping member 51 and sealing member 73 of drilling head 15.

Referring now to Figure 2, a drill pipe protection ring 77 for filling slots 95 is shown. Ring 77 is formed from a resilient elastomeric material such as 85 Durometer urethane compound. As shown by the cross-sectional view of Figure 4, ring 77 has a slightly convex outer surface 79, a convex inner surface 81, and flat upper and lower surfaces 83, 85. Inner surface 81 is given its convex shape with upper and lower chamfers 81a. In the embodiment shown, outer surface 79 has two flat surfaces that join each other at a crest or peak. Ring 77 also has a plurality of circumferentially spaced-apart, hemispherical bumps 87 located along a midline of inner surface 81. The space between on inner surface 81 between the bumps 87 are flat in cross-section. Ring 77 has small protruding bumps 88 spaced apart from each other on the upper and lower surfaces 83, 85.

In operation (Figure 5), one ring 77 is located within each slot 95 on pipe 89. The elastomeric material of rings 77 stretches slightly to increase their diameter while being fitted around outer diameter 93 of tool joint 91. Rings 77 snap into slots 95 for a tight fit once they are properly seated. Rings 77 have a width and thickness which substantially fills slots 95. When installed, outer surfaces 79 of rings 77 will protrude slightly outward from or beyond slots 95. In Figure 4, slot 95 is slightly wider than ring 77. Bumps 87 help align and center ring 77 with a slot 95. In Figure 5, slot 95' has a shallower depth than the radial dimension of ring 77', as indicated by dashed line bump 87'. In these instances, bumps 87' deform slightly (not shown) so that ring 77' will fit substantially flush

with and only protrude slightly from the slot 95'. Small bumps 88 (Figure 2) on the top and bottom faces 83, 85 of ring 77 serve to vertically centralize ring 77 in oversized slots 95. In close-fitting slots 95, the top and bottom face bumps 88 would shear off during installation to allow a snug fit and good retention within slot 95.

With rings 77 in place, a string of drill pipe 89 is lowered through bore 25 of drill head 11 (not shown). Bore 25 is large enough to permit the enlarged diameter 93 of tool joints 91 to pass through. When tool joints 91 are lowered through seal 71, elastomer 73 flexes radially outward as the tool joint 91 passes through seal 71. As the tool joint 91 exits seal 71, seal 71 contracts back to its original shape and seals around the drill pipe.

If rings 77 were not installed, the sharp corner edges 97 of each slot 95 on pipe 89 may cause severe damage to the elastomers in drill head 11 as pipe 89 passed through them. However, the outer surfaces 79 of rings 77 are substantially flush with the outer surface 93 of tool joint 91, thereby preventing edges 97 from cutting or gouging the elastomers.

After installation and during drilling, gripping member 51 is energized to grip and provide a secondary seal around drill pipe 89, thereby causing body 23 to rotate with drill pipe 89. In its unenergized state, the inner diameter of inner portion 53 is greater than the diameter of drill pipe 89 but slightly smaller than the diameter 93 of tool joints 91. In an energized state, the inner diameter of inner portion 53 is smaller than the diameter of drill pipe 89. This is done by pumping hydraulic fluid through inlet ports 43. As the hydraulic fluid circulates through annulus 41 and out outlet ports 45, bearings 31, 33, upper seal 46 and lower seal 49 are simultaneously lubricated by the hydraulic fluid. The hydraulic fluid also enters cavity 63. This pressure energizes gripping member 51 by pressing radially inward against outer portion 55 which exerts pressure against inner portion 53.

The invention has several advantages. The rings reduce the chance for slots in the tool joints to cut the elastomers of a drilling head. The bumps on the inner surfaces of the rings help align and center them within the slots in the drill pipe. Without the rings, the sharp edges of the slots on the drill pipes may cause severe damage as they passed through the drill head. However, with the rings the outer surfaces the slots are substantially filled to prevent their edges from cutting or gouging the elastomeric members inside the drill head.

While the invention has been shown or described in only some of its forms, it should be apparent to those skilled in the art that it is not so limited, but is susceptible to various changes without departing from the scope of the invention.

We claim:

1. A well drilling string for use in drilling with a drill head that seals around the drill pipe during drilling, comprising:

a plurality of sections of drill pipe secured together at tool joints, at least some of the tool joints having an external, circumferential, identification slot;

a ring formed from an elastic, resilient material and located within the slot to avoid damaging sealing members located within the drill head.

2. The well drilling string of claim 1 wherein the ring has an outer diameter surface that is substantially flush with an exterior surface of the tool joint.

3. The well drilling string of claim 1 wherein the ring has a top face, a bottom face, and a generally convex inner diameter.

4. The well drilling string of claim 1, further comprising a plurality of circumferentially spaced-apart bumps on an inner diameter surface of the ring.

5. The well drilling string of claim 4 wherein the bumps are generally hemispherical in shape.

6. The well drilling string of claim 1 wherein the ring has an inner surface, a top face, and a bottom face, and wherein the inner surface is chamfered where it interfaces the top and bottom faces.

7. The well drilling string of claim 1 wherein the ring has top and bottom faces that are substantially flat.

8. The well drilling string of claim 1 wherein the ring has top and bottom faces, and a plurality of bumps on the top and bottom faces for vertically centralizing the ring within said slot.



9. The well drilling string of claim 1 wherein the ring is formed from a urethane compound.

10. An apparatus for use with drill pipe having external, circumferential, identification slots formed thereon, the apparatus comprising:

an annular member formed from an elastomeric material and having a top face, a bottom face, and inner and outer diameter surfaces;

a plurality of circumferentially spaced-apart bumps on the inner diameter surface of the annular member; and wherein

the annular member is adapted to seat in one of the slots in the drill pipe for substantially filling said slot to create a substantially flush outer surface in the drill pipe at said slot.

11. The apparatus of claim 10 wherein the bumps are generally hemispherical in shape.

12. The apparatus of claim 10, further comprising bumps on the top and bottom faces for vertically centralizing the annular member within said slot.

13. The apparatus of claim 10 wherein the top and bottom faces are substantially flat.

14. The apparatus of claim 10 wherein the inner and outer diameter surfaces are generally convex in cross-section.

15. A method for protecting elastomeric components located within a drill head from a drill pipe having at least one external, circumferential, identification slot, the method comprising:

(a) providing a flexible annular member;

(b) seating the annular member in the slot in the drill pipe to substantially fill said slot and create a substantially flush outer surface in the drill pipe at said slot.



16. The method of claim 15 wherein step (b) comprises aligning and centering the annular member in said slot with circumferentially-spaced protrusions on an inner diameter surface of the annular member.

17. The method of claim 15 wherein step (b) comprises vertically centering the annular member in said slot with a plurality of protuberances on top and bottom faces of the annular member.

