

Sept. 26, 1967

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3,343,890

APPARATUS FOR REDUCING CASING WEAR DURING DRILLING OPERATIONS

Filed Jan. 18, 1965

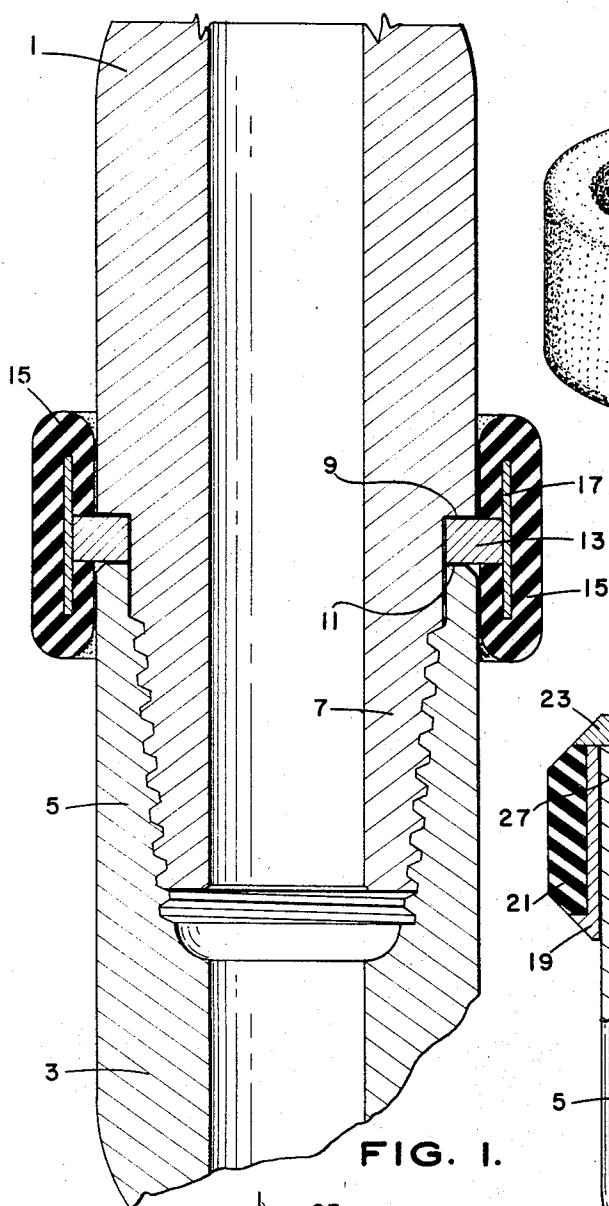


FIG. 1.

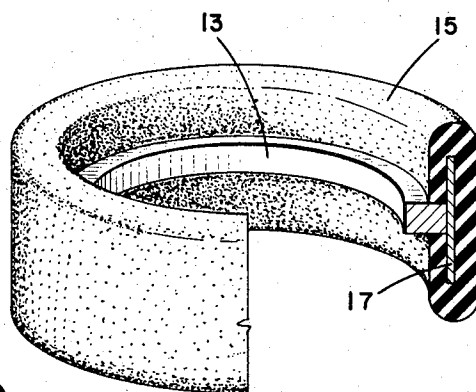


FIG. 2.

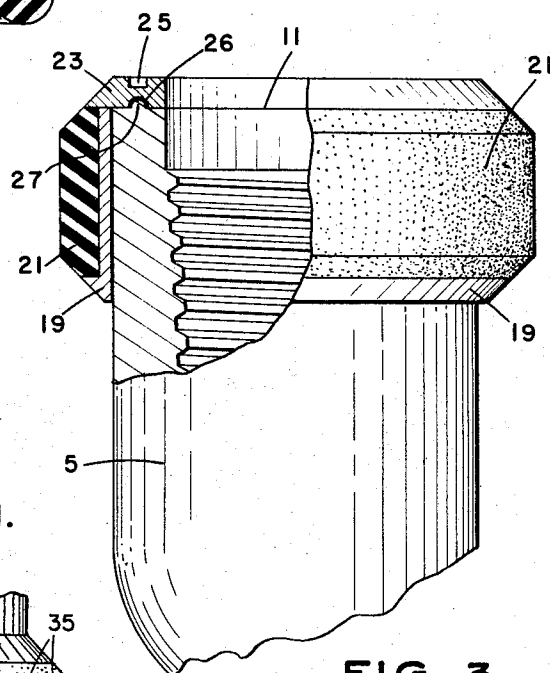


FIG. 3.

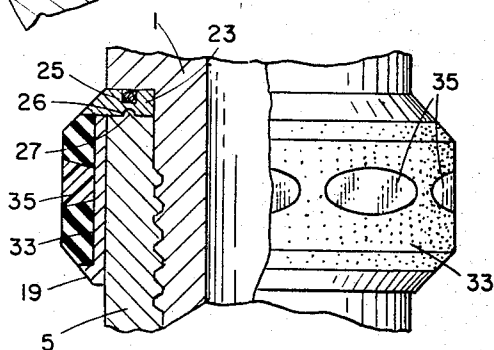


FIG. 4.

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Filed Jan. 18, 1965, Ser. No. 426,056
2 Claims. (Cl. 308—4)

This invention relates generally to the drilling of boreholes in the earth using the hydraulic rotary drilling technique, and more particularly to the prevention of abrasion between a drill pipe and the protective casing in the upper portion of a borehole.

In the drilling of boreholes in the earth using the hydraulic rotary drilling techniques, drilling fluid is continuously flowed through the bore of an elongated drill pipe and through a bit connected to the lower end of the drill pipe, and is returned upwardly through the annulus between the drill pipe and the walls of the borehole, carrying with it in suspension detritus such as rock cuttings, which is removed from the formation by the drilling process. The borehole that is drilled is never absolutely vertical but generally follows a helical or corkscrew path.

Usually, it is necessary to set a protective string of casing in the upper portion of the borehole prior to reaching total depth to prevent the entry of undesired fluids into the borehole or the loss of drilling fluids to surrounding earth formations. After the protective casing string has been set, it is the usual practice to proceed with drilling operations through the casing and into the geologic strata below. During the drilling process, considerable wear of the casing takes place as the result of abrasive action caused by the rotation and reciprocation of the string of drill pipe against the inner casing wall over a period of time. The fact that the borehole follows a corkscrew or helical path substantially increases the wearing action.

Various devices have been used in the past for the purpose of reducing casing wear brought about as the result of the action described above. For example, it has been known to strap wearable materials to the drill pipe that is softer than the surrounding casing so that the wearable material will be worn away rather than the casing. The wearable materials are strapped to the drill pipe at intervals therealong rather than being affixed to the pipe along its entire length. One reason that such devices have not met with wide acceptance is that, generally speaking, it has been quite difficult to securely affix such devices to the pipe string without damage to the pipe string.

Objects and features of the invention not apparent from the above discussion will become evident upon consideration of the following detailed description of the invention taken in connection with the accompanying drawings, wherein:

FIG. 1 illustrates one embodiment of the invention;

FIG. 2 is an enlarged perspective view of the wear protector illustrated in FIG. 1;

FIG. 3 illustrates another, preferred embodiment of the invention; and

FIG. 4 illustrates a third embodiment of the invention that is particularly useful when it is anticipated that varied wear conditions will be encountered as the drill string progresses down the well bore.

With reference now to FIG. 1, there is shown a pair of drill pipe sections 1 and 3 connected together by a pin and box coupling, the pin of drill pipe section 1 being designated by the reference numeral 7, and the box of drill pipe section 3 being designated by the reference numeral 5. The drill pipe sections are annular so that an

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axial bore extends therethrough, through which drilling fluids may be pumped, as described above. The pin end of drill pipe section 1 is faced so as to provide an annular recess between the opposed matching faces of the drill pipe sections when the joint is made up. An annular wear material support member 17 having a diameter somewhat greater than that of the pin and box coupling extends around the drill pipe at the coupling. An annular flange 13 is connected to the support member 17 and extends into the recesses between opposed faces 9 and 11. The thickness of the flange 13 is substantially that of the distance between the faces 9 and 11 so that the flange is supported and slightly squeezed therebetween. An annular band of a wear material 15 is affixed to the wear material support member 17, the band being formed of a material that is softer than the casing steel and has a low coefficient of friction with the casing steel. Preferably, the wear material is formed of Teflon in applications where it is required to be quite resilient, as when the casing material is quite rough. The advantage of Teflon, which is tetrafluoroethylene polymer, is that it does not absorb gas as does rubber and so does not have the tendency to blow up or split, as is exhibited by rubber when a considerable amount of gas or other hydrocarbons is in the drilling fluid. The wear material 15 may be molded to the support member 17, as shown in FIGS. 1 and 2, so that a portion of the wear material occupies the space between the support member 17 and the drill pipe section.

In the embodiment of the invention illustrated in FIG. 3, the support member 19 has a diameter only slightly greater than that of coupling section 5 so as to fit snugly on coupling section 5. It is to be noted that the support member 19 extends only around coupling section 5 and not around the upper drill string section 1. An annular ridge 27 projects from the face 11 of coupling section 5. Annular flange 23, which extends into the recess between the opposed faces of the drill string sections 1 and 5, is provided with annular grooves 25 and 26 in the upper and lower faces thereof so that an O-ring (not shown) can be fitted into the upper groove 25 to improve the seal between the face 9 of drill pipe section 1, and so that the lower groove 26 can matingly engage the annular ridge 27 projecting from face 11. The annular band of wear material 21 is affixed to support member 19 by cutting an annular groove in the support member 19 for receiving the band of wear material, as shown in FIG. 3. If desired, the wear material may be glued to the support member 19 using a highly adhesive glue such as an epoxy resin.

The band of wear material may comprise material other than Teflon and rubber. For example, as shown in FIG. 4, an inner band of aluminum 31 may be used as the wear material along with an outer band of rubber 33 glued thereto having a plurality of Teflon inserts 35 circumferentially spaced thereabout and extending through the rubber 33 and affixed to the aluminum band 31. In this manner the wear material can be matched to the wear conditions that exist in the borehole. The rubber and Teflon can be used when the upper portion of the casing is quite rough and, when they are worn away, the aluminum will be exposed for use when smooth casing surfaces are encountered in the lower portion of the casing string.

Although the embodiments disclosed in the preceding specification are preferred, other modifications will be apparent to those skilled in the art which do not depart from the scope of the broadest aspects of the invention.

What is claimed is:

1. In combination:

first and second drill pipe sections connected together by a box and pin coupling and having opposed an-

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nular faces therebetween at the ends thereof, said opposed faces being spaced apart when said sections are connected together;
an annular ridge projecting from each said faces;
an annular wear material support member fitted around 5
at least one of said sections at said coupling;
an annular flange projecting inwardly from said support member into the space between said annular faces and having annular grooves therein matingly engaging said annular ridges; and
10 an annular band of wear material affixed to said support member, said annular band of wear material comprising an annular aluminum band affixed to said support member, an annular rubber band affixed to said aluminum band, and a plurality of plastic inserts extending through said rubber band and affixed to said aluminum band.

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2. The combination of claim 1 wherein said plastic inserts are formed of tetrafluoroethylene polymer.

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