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F. KUUS

3,410,613

NON-ROTATING SINGLE-COLLAR DRILL PIPE PROTECTOR

Filed May 25, 1966

2 Sheets-Sheet 1

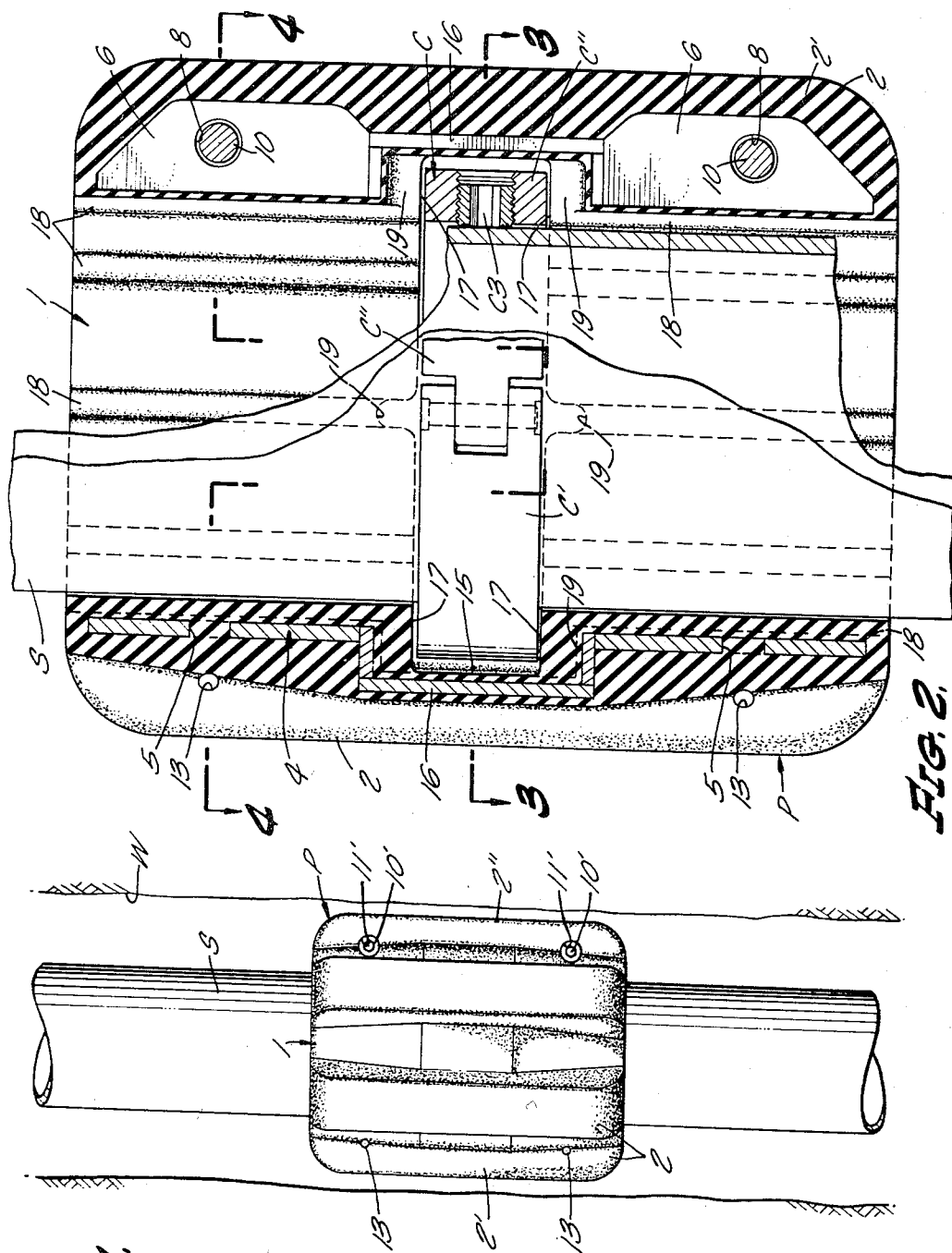


FIG. 1.

FIG. 2.

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FIG. 3.

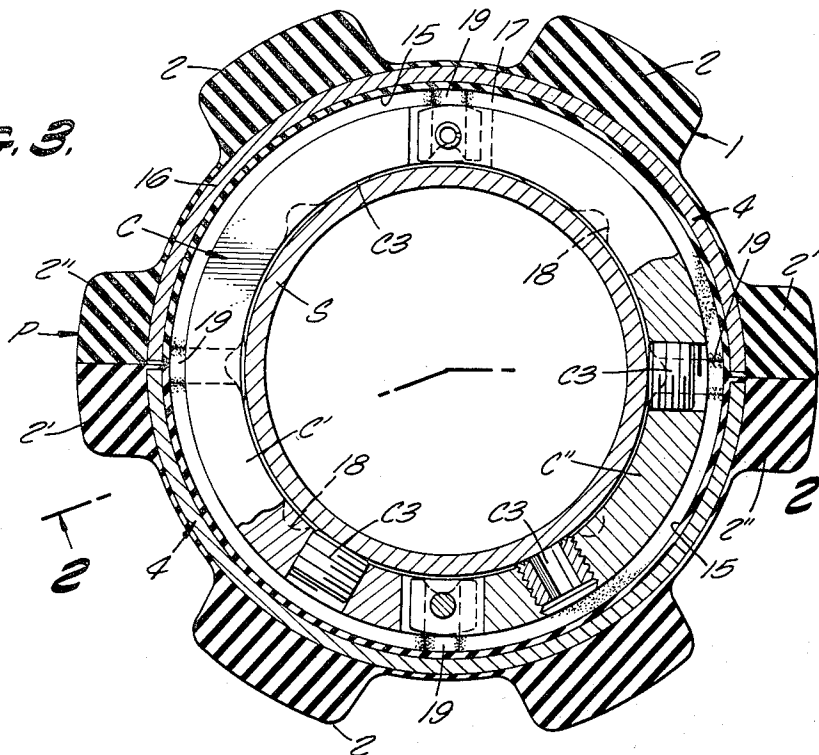
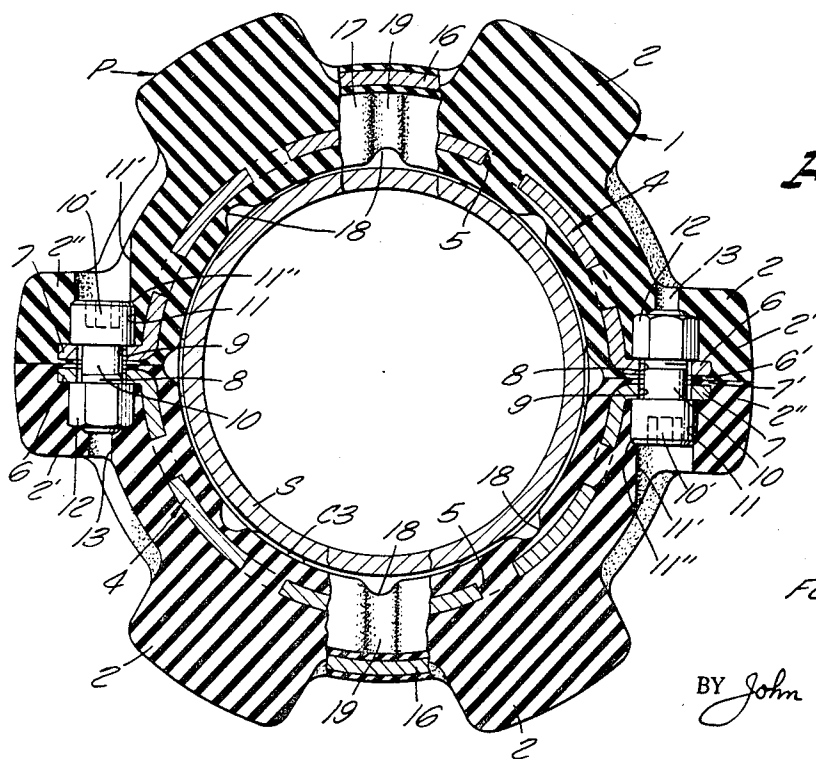


FIG. 4.



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3,410,613 NON-ROTATING SINGLE-COLLAR DRILL PIPE PROTECTOR

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7 Claims. (Cl. 308—4)

ABSTRACT OF THE DISCLOSURE

A tubular protector of elastomeric material for a well drilling string or pipe, the protector being formed of reinforced arcuate, complementary segments with means for assembling the segments about the pipe to form the tubular protector, the latter providing a reinforced annular groove intermediate its ends with annular shoulder faces at either end of the groove. To limit longitudinal movement of the protector along the drilling string, it is assembled about the pipe with the annular groove encompassing an annular stop ring secured to the pipe. To allow for relative rotation between the protector and the pipe and stop, clearance is provided therebetween; and also to enhance lubrication therebetween fluid flow grooves are provided along the inner periphery of the protector for the passage of lubricating fluid.

The present invention relates to a drill string protector and more particularly to a drill string protector of the type adapted to remain stationary or non-rotative as the drill string rotates therein.

In the drilling of oil and/or gas wells and the like holes into the earth, it is the practice to fix on the drill string or drill pipe rubber sleeves which rotate with the drill string and constitute bushings or pipe protectors which serve to reduce friction caused by engagement of the drill string with the casing in the upper regions of the hole. Below the casing the use of such bushings is not practical since engagement of the protectors with the wall of the so-called open hole, that is, with the encased well wall, causes the rapid destruction of the rotating protector.

Nevertheless, it has been found desirable that the lower sections of the drill string which rotate in the open hole be provided with protective devices which will remain stationary while the drill string revolves therein, so that (1) the drill string will be protected from engagement with the open well bore wall so as to reduce wear, and (2) the drill string will be stabilized in the open hole to reduce the tendency of the string to deviate from the desired drilling direction.

More particularly, the present invention has as general objectives the provision of a nonrotating protective sleeve device within which the drill string may revolve, which (1) may be placed on the drill string at any desired location, (2) is so constructed that application of the sleeve to the drill string is a simple operation, and (3) is so constructed that following its installation the protector is not subject to loss of metal components in the hole or to becoming displaced from the drill string and, moreover, the protector is durable in construction.

More specifically, an object of the invention is to provide a protective sleeve applicable to any desired location on the drill string, for example, to a location intermediate the ends of a standard drill collar adjacent the lower end of the drill string, and without requiring the use in the drill string of a special sub or special length of drill collar to function as a mandrel or support for the protector. In accomplishing this objective, the protector is of a longitudinally split construction, of the

type disclosed in the application for Letters Patent of the United States, Ser. No. 529,073, filed Feb. 21, 1966, and is composed of complementary sections adapted to be assembled with one another about the drill string, and in accordance with the present invention is adapted to be held in a desired longitudinally extended region of the drill string by a single stop member on the drill string, such stop member being provided on the drill string or attached thereto in the form of a stop collar device which is applicable to the drill string or drill collar at any desired location.

Yet another specific object is the provision of a structure which is durable in the sense that it is preferably so constructed as to be relatively insensitive to side loads and shocks to which it is inherently subjected during use, and the structure also being such that wear of the protector caused by revolution of the drill string therein is reduced to a minimum, the protector being provided with an internal channel to accommodate the aforementioned stop collar, the walls of such channel being so formed as to facilitate the flow of drilling fluids past the stop collar, thus reducing abrasive wear.

Other objects and advantages of the invention will be hereinafter described or will become apparent to those skilled in the art, and the novel features of the invention will be defined in the appended claims.

Briefly, the invention includes a protector member capable of being applied about a portion of a well drilling string, the member comprising arcuate section segments of elastomeric material interconnected to form a tubular structure, rigid inserts in the segments, the tubular structure having walls providing an annular groove intermediate the ends of the structure communicating with its inner periphery, the walls having shoulder faces at either end of the groove, the shoulder faces being adapted to engage a stop on the drilling string projecting into the annular groove to prevent longitudinal movement of the protector member relative to the drilling string, wherein the improvement comprises: the rigid inserts providing an annular channel portion in the tubular structure substantially encompassing the annular groove to provide rigid support for the walls of the groove and its shoulder faces. Clearance may be provided between the protector and the drilling string and stop to allow relative rotation therebetween; and fluid flow grooves may be provided on the inner periphery of the protector extending from the ends into the annular groove to enhance the flow of lubricating fluid between the protector and the drilling string and stop.

In the drawings:

FIG. 1 is a view in elevation, showing a nonrotating protector made in accordance with the invention applied to a length of drill string and disposed in an open well bore;

FIG. 2 is a view partly in longitudinal section and partly in elevation, as taken substantially on the line 2—2 of FIG. 3, with the well pipe partially broken away;

FIG. 3 is a view in horizontal section, as taken on the line 3—3 of FIG. 2, with a portion of the stop collar broken away; and

FIG. 4 is a view in horizontal section, as taken on the line 4—4 of FIG. 2, with portions of the protector broken away to expose the channel adapted to receive the stop collar.

Like reference characters in the several views of the drawings and in the following description designate corresponding parts.

Referring to FIGS. 1 and 2, a nonrotating split protector or stabilizer made in accordance with the invention and generally designated P is shown as applied to a length of drill string S in embracing relation to a stop collar C, the drill string being within a well bore W which is uncased

or open and traverses the earth formation into which or through which the well is being drilled. Characteristically, the drill string S will be rotated to cause the advance of a drill bit (not shown) into the earth formation, as a drilling fluid or mud is circulated downwardly through the drill string and thence back to the earth's surface in the annular space between the drill string and the well bore. It is the function of the present protector to stabilize the drill string within the well bore and to preclude frictional engagement of the drill string with the well wall as the drill string revolves, but without restricting the upward flow of drilling fluid returning to the earth's surface.

Accordingly, the protector P comprises a generally cylindrical body 1 having a number of longitudinally extended, radially projecting and angularly spaced ribs 2 thereon. The body 1 is adapted to loosely fit about the pipe string to permit freedom of rotation of the pipe within the protector body.

The stop collar C limits longitudinal movement of protector P on the pipe S, and may be of any suitable type, but for illustrative purposes the collar is shown as comprising hinged collar half-sections C' and C'' adapted to be united about the pipe and secured in position by set screws C3. Such a collar is also disclosed in U.S. Patent No. 3,017,206, granted to H. A. Johnson, and is both durable and capable of sustaining substantial axial loads.

Referring now more particularly to FIGS. 3 and 4, it will be seen that the protector P is longitudinally split so as to be applicable to the pipe. In the illustrative embodiment, it is composed of similar half-parts or sections which are joined together along a longitudinal plane bisecting the body 1. Each half-part comprises a metal insert 4 embedded in the respective sections of cylindrical body 1, the latter being composed of a rubber composition. The inserts 4 are bonded within the rubber body and may have a suitable number of openings 5 or other surface irregularities to assist in the formation of a mechanical interlock between the rubber and the metal insert. A layer of rubber lines the inserts internally so as to be engageable with the pipe.

Along the longitudinally extended ends of each metal insert 4 it is provided with outwardly projecting flanges 6 and 7 which are embedded in half-sections 2' and 2'', respectively, of a rib 2, there being a layer of rubber at 6' and 7', respectively, of the mutually confronting flanges 6 and 7 when the protector parts are assembled about the pipe.

Referring to FIGS. 2 and 4 in particular, it will be noted that flange 6 is provided with a plurality of openings 8 in spaced relation along the flange and flange 7 is provided with similar openings 9, these openings 8 and 9 being alignable upon assembly of the protector so that a bolt 10 may extend through each pair of aligned openings.

Rib section 2'' in which flange 7 is embedded is formed with recesses 11 for accommodation of the bolt heads 10' which are preferably of the socket type, there being an access opening 11' into the recess 11. The access opening 11' is smaller than bolt head 10' so that a shoulder 11'' is formed constituting means for retaining bolt 10 captive in the recess 11 not only prior to assembly of the protector halves, but also following such assembly in the event that bolt 10 should inadvertently loosen during use of the protector. However, it will be noted that access opening 11' is of sufficient size as to enable the insertion of a driving tool therethrough into driving engagement with the socketed bolt head 10'.

Bolt 10 has a stem which, when the protector halves are disposed in opposing relation with rib sections 2' and 2'' of the sections abutting one another, will extend through flange openings 8 and 9 into a nut 12 in the respective rib sections 2, the nuts each being embedded in rib sections 2' and preferably being bonded to the rubber material but preferably being separate from the flange 6 so as to be free to partake of movement relative to the latter. In this connection, it will also be noted that open-

ings 8 and 9 in the flanges 6 and 7 are larger than the bolt stem so as to enable limited relative movement.

In alignment with the nuts 12, each rib section 2' is formed with a vent opening 13, which will prevent the entrapment of air, mud, or other fluid in the nuts. Thus, when bolts 10 are driven into the nuts, fluid will be displaced through the vents 13 so that pressure may not be developed which would tend to cause separation of the bond between the nuts 12 and rib sections 2'.

Each of the protector body half-parts is internally grooved as at 15 so that when the half-parts are joined about the pipe S an annular channel is formed for reception of the stop collar C. In providing the channel, each metal cage section 4 is provided with a channel section 16 substantially medially thereof which terminates at the respective flanges 6 and 7 and as seen at the right in FIG. 2, may divide the flanges into spaced flanged sections. The rubber body or a layer thereof is molded in the channel sections 16 so as to provide rubber shoulders 17 spaced axially part and adapted to engage the collar C to limit axial movement of the protector relative to the pipe S. In addition, the channel 15 is sufficiently deep as to provide clearance between the collar C and the body in a radial direction, thus imposing no frictional resistance to rotation of the pipe and collar with the protector. It is preferred that a certain amount of drilling fluid pass between the protector and the pipe so as to serve as a lubricant and reduce wear. Therefore, the protector sections are provided with internal longitudinally extending grooves or flow channels 18 extending from opposite ends and communicating with radial grooves or channels 19 in the shoulders 17. These grooves 19 lead to the space defined between the outer periphery of the collar C and the bottom of the annular channel 15 so as to permit the through passage of drilling fluid. Moreover, as the pipe S rotates within the protector P, fluid will be carried from the longitudinal grooves 18 circumferentially to assure presence of lubricating drilling fluid between all relatively revolving surfaces, notwithstanding the fact that the pipe S would, in most cases, be laterally loaded into engagement with one internal side wall of the protector body.

It will now be evident that the present invention provides a split, nonrotating drill string protector which is simple in construction, being composed of identical half-sections, is simple to install, requiring merely the application of a stop collar to the pipe and tightening of a number of bolts, and is durable in use, being always lubricated and constructed to withstand heavy shock loads and vibration, as well as being safe in that it is not subject to loss of components within the well.

While specific structural details have been shown and described, it should be understood that changes and alterations may be resorted to without departing from the spirit of the invention as defined in the appended claims. It should also be understood that where the term "rubber" has been used, this may include synthetic rubbers and other elastomeric materials, plastics, and similar compositions.

I claim:

1. A protector member capable of being applied about a portion of a well drilling string, the member comprising arcuate section segments of elastomeric material interconnected to form a tubular structure, rigid inserts in said segments, the tubular structure having walls providing an annular groove intermediate the ends of the structure communicating with its inner periphery, said walls having shoulder faces at either end of the groove, said shoulder faces being adapted to engage a stop on the drilling string projecting into the annular groove to prevent longitudinal movement of the protector member relative to the drilling string, wherein the improvement comprises:

said rigid inserts providing an annular channel portion in said tubular structure substantially encompassing

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said annular groove to provide rigid support for the walls of the groove and the shoulder faces thereof.

2. A protector member as defined in claim 1 including:
(a) said rigid inserts comprising arcuate tubular section segments; and

(b) flanges extending longitudinally at either side of said tubular section segments and connected to said annular channel portion to provide support for said portion.

3. A protector member as defined in claim 1 wherein: said elastomeric material substantially covers and is bonded to said rigid inserts.

4. A protector member as defined in claim 3 wherein: said tubular structure provides fluid flow grooves in said elastomeric material extending longitudinally on the inner periphery of said structure from said ends into said annular groove and said shoulder faces, so as to provide for flow of lubricating fluid between the well drilling string and the inner position of said protector member.

5. A protector for a well drilling string adapted to surround loosely a portion of the string to permit rotation of the string within the protector, the latter being in the form of a tubular member comprising arcuate segments of elastomeric material, rigid inserts in the segments, the bore of the tubular member having a diameter greater than the diameter of the portion of the string which it surrounds, wherein the improvement comprises:

(a) said segments having arcuate groove portions extending circumferentially to form an annular groove in said tubular member and said groove portions having axially spaced shoulders for engagement with a projecting stop on said drilling string to limit

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longitudinal movement of said protector relative to said string; and

- (b) said rigid inserts providing an annular channel portion in said tubular member substantially encompassing said annular groove to provide rigid support for the walls of the groove and the shoulders thereof.

6. A protector as defined in claim 5 including:

a layer of elastomeric material disposed radially inwardly of said inserts for engagement with the drilling string and the projecting stop.

7. A protector as defined in claim 6 wherein:

said layer of elastomeric material includes fluid flow grooves extending from the ends of said tubular member into said annular groove to enhance the flow of fluid between said tubular member and the pipe string and stop.

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