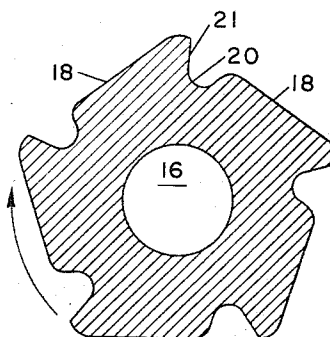
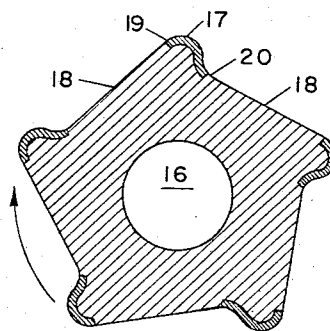
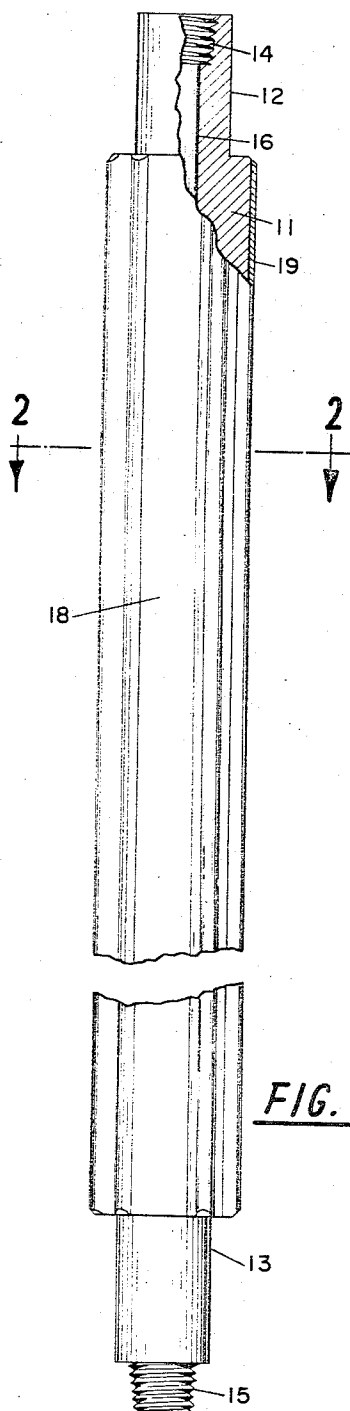


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J. E. ORTLOFF
ROTARY DRILL COLLAR
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John E. Ortloff INVENTOR

BY *James E. Reed*
ATTORNEY

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ROTARY DRILL COLLAR

John E. Ortloff, Tulsa, Okla., assignor to Esso Production Research Company, a corporation of Delaware
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2 Claims. (Cl. 64—1)

This application is a continuation-in-part of Ser. No. 262,053, filed in the United States Patent Office on Mar. 1, 1963, now abandoned.

The present invention relates to apparatus for drilling boreholes in the earth and is particularly concerned with an improved drill collar for use in the rotary drilling of oil wells, gas wells and similar boreholes.

The drill collars employed in oilfield rotary drilling operations are heavy tubular members, generally of uniform length, which are connected at the lower end of the drill string in order to apply weight to the bit, maintain tension in the upper part of the string, and control borehole deviation. Experience has shown that the inclusion in the drill string of at least one multisided collar having a square or pentagonal cross section is particularly effective. The square or pentagonal collars have advantages over circular collars because they provide high resistance to buckling without unduly restricting fluid circulation. The diagonal dimensions of a square collar perpendicular to the longitudinal axis, for example, can approach very closely the diameter of the borehole because the drilling mud can be returned to the surface through the spaces adjacent the four sides of the collar. The diameter of a circular collar, on the other hand, must be considerably smaller than that of the borehole to provide for mud return and hence the resistance to buckling will be less than in the case of the square collar. This advantage is often off-set by the high torque required to rotate a string containing a multisided drill collar in a borehole filled with fluid and entrained cuttings. In many cases the torque requirements for rotating the string limit the rotary speeds and bit weights which can be employed and thus do not permit the high drilling rates that might be obtained with a complete string of circular drill collars.

It is therefore an object of the present invention to provide an improved drill collar for use in the rotary drilling of oil wells, gas wells and similar boreholes. A further object is to provide a multisided collar which can be used to apply weight to a drill bit, maintain drill string tension, and control borehole deviation without unduly restricting the weight and rotary speed employed. A further object is to provide a square or pentagonal drill collar which can be rotated at high speed in the presence of fluid and entrained cuttings without excessive torque requirements. Still other objects will become apparent as the invention is described in greater detail hereafter.

The improved drill collar of this invention alleviates the difficulties associated with multisided collars available in the past. The multisided collar of the invention is characterized by rounded corners extending parallel to the longitudinal axis of the collar at equally spaced intervals about the periphery of the tool and by sides extending inwardly near their trailing edges with respect to planes which contact the outer surfaces of the collar at the adjacent corners bounding the sides and are parallel to said axis. Studies have shown that this construction substantially reduces the tendency for cuttings entrained in the drilling fluid to become trapped between the drill collar and the surrounding borehole wall as the drill string is rotated and that high torque requirements caused by the presence of trapped cuttings are thus eliminated. This permits the use of higher rotary speeds and bit weights

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than are generally feasible with conventional multisided collars without sacrificing the improved buckling resistance obtained with multisided collars. As a result, the collars of the invention are more effective for applying bit weight, maintaining drill string tension, and controlling borehole deviation than the multisided drill collars available in the past.

The nature and objects of the invention can best be understood by referring to the following detailed description of two drill collar embodiments and to the accompanying drawing, in which:

FIGURE 1 is a vertical elevation, partially in section, of a multisided drill collar having recessed sides which reduce the wedging and accumulation of solids between the drill collar surfaces and the borehole wall;

FIGURE 2 is a cross-sectional view of the drill collar of FIGURE 1 taken along the line 2—2;

FIGURE 3 is a cross-sectional view of a drill collar similar to that shown in FIGURES 1 and 2 illustrating an alternate cross-sectional configuration.

The drill collar depicted in FIGURE 1 of the drawing is a tubular member having an elongated intermediate section 11 and integral upper and lower sections 12 and 13. The upper and lower sections are relatively short in comparison to the intermediate section and are generally of somewhat smaller diameter than the intermediate section in order to permit the use of an overshot in the event that the drill collar should become stuck in the borehole. Upper section 12 is provided with connecting means 14, a standard API tool joint box for example, to permit attachment of the collar to the lower end of a section of drill pipe or drill collar. Connecting means 15, a standard API tool joint pin for example, is located near the lower end of lower section 13 to facilitate the connection of a drill bit or a collar below the tool. Other connecting means may be employed in lieu of those shown if desired. An axial passageway 16 extends through the upper, intermediate, and lower sections of the drill collar to permit the downward circulation of drilling fluid through the collar from the drill string above.

As can be seen more clearly from FIGURE 2 of the drawing, the intermediate section 11 of the drill collar depicted in FIGURE 1 has a generally pentagonal cross-section. It includes five rounded corners 17 equally spaced at angles of about 72° about the collar periphery. The corners extend parallel to the longitudinal axis of the collar. Intervening faces or sides 18, also parallel to the longitudinal axis, extend between the adjacent corners. A layer of tungsten carbide or similar hard surfacing material 19 may be applied to each corner in order to reduce wear at points of contact between the drill collar and the surrounding borehole wall. Each side or face 18 is recessed near its trailing edge with respect to a plane contacting the outer surfaces of the collar at the two adjacent corners and extending parallel to the longitudinal axis of the collar. The deepest point in the recess is located near the trailing edge of the face 18 as indicated by reference numeral 20. In any cross-section taken perpendicular to the longitudinal axis of the intermediate section of the collar, each side is thus a smooth line which extends inwardly from a point near the leading edge of the side to a point of maximum depth near the trailing edge as shown. The hard surfacing material 19 may extend into the recess in order to reduce erosion by the solids-laden fluid. Drilling fluid and entrained cuttings in the borehole surrounding the collar pass upwardly within the space defined by the sides of the collar and surrounding borehole wall. The recessed sides reduce the tendency of the cuttings to

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wedge in place and accumulate between the trailing edge of each side and the formation. This reduces friction between the collar and borehole wall and thus permits rotation of the collar in a borehole filled with cuttings and entrained solids at lower torque than would be required if the sides were not recessed.

The collar shown in FIGURES 1 and 2 is a five-sided collar of essentially pentagonal cross-section. It will be apparent that four-sided collars which have essentially square cross-sections may be provided with recessed sides similar to those shown on the five-sided collar.

FIGURE 3 of the drawing is a cross-sectional view of an alternate embodiment of the invention in which each side of the intermediate section is recessed by providing a narrow groove or channel near the trailing edge. As in the earlier embodiment, reference numeral 20 indicates the deepest point in the recess. Each groove or channel extends over about 30% of the side in which it is located. The rear surface of each channel, indicated by reference numeral 21, preferably extends radially or projects forward in the direction in which the drill collar is to be rotated. This configuration increases the tendency for cuttings which might otherwise accumulate between the surfaces and borehole wall to move upwardly with the circulating fluid, rather than becoming wedged between the collar and formation adjacent the corner. Other channel cross-sectional configurations which will have a similar effect may be devised. Again, the invention is applicable to square collars as well as to the pentagonal collar shown.

The effect of recessing the sides of square or pentagonal drill collars near their trailing edges can be seen by the results of field drilling operations carried out with pentagonal collars. Experience showed that conventional pentagonal collars with flat sides performed satisfactorily in relatively soft formations at rotary speeds up to about 60 revolutions per minute and that satisfactory drilling rates were obtained with little deviation. The torque required to rotate the drill string at speed greater than about 60 revolutions per minute was prohibitively high because of friction caused by the accumulation of cuttings between the flat sides of the collar and the borehole wall adjacent the corners. Fluid containing the cuttings was apparently forced to follow the sides of the collars as the tool rotated, resulting in the wedging of the cuttings between

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the corners of the collar and the formation. The inclusion of recessed sides on the collars adjacent the trailing edges as shown in the drawing provides clearance in the immediate vicinity of the corners so that the tendency toward wedging is greatly reduced.

What is claimed is:

1. A multisided drill collar containing a longitudinal passageway for the transmission of fluid and including means for connecting said collar in a rotary drill string, said collar having rounded corners extending parallel to its longitudinal axis at equally spaced intervals about its periphery and generally planar sides extending between said rounded corners, each of said generally planar sides being substantially tangent to a rounded corner at its leading edge and recessed with respect to the adjacent rounded corner at its trailing edge.

2. A multisided drill collar containing a longitudinal passageway for the transmission of fluid and including means for connecting said collar in a rotary drill string, said collar having rounded corners extending parallel to its longitudinal axis at equally spaced intervals about its periphery and substantially planar sides extending between said rounded corners, each of said substantially planar sides containing a longitudinal groove extending parallel to the longitudinal axis of said collar near the trailing edge of said side.

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CHARLES E. O'CONNELL, *Primary Examiner.*

J. A. LEPPINK, *Assistant Examiner.*