

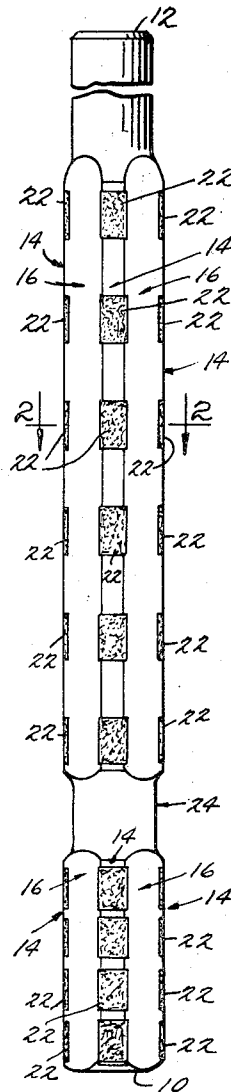
[54] **DRILL STRING MEMBER AND METHOD FOR MANUFACTURE**[72] Inventor: **Bill G. Parker**, 212 Saxon Drive, Lafayette, La. 70501[22] Filed: **Nov. 18, 1969**[21] Appl. No.: **877,754**[52] U.S. Cl. **308/4 A, 175/323**[51] Int. Cl. **F16c 17/00**[58] Field of Search **308/4 A; 175/325, 323; 138/178, 177; 166/241; 287/108; 285/333**[56] **References Cited****UNITED STATES PATENTS**

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Primary Examiner—Martin P. Schwadron**Assistant Examiner**—Ronald H. Lazarus**Attorney**—Cushman, Darby & Cushman[57] **ABSTRACT**

A bottom hole stabilizer, or similar drill string member, is provided with three substantially straight longitudinal ribs on its surface, and the ribs are spaced apart to leave annular flow areas between rib sections. The member is formed as an integral construction by milling flat bottom grooves into a tubular blank having a circular outside periphery when viewed in cross section. The flat bottom grooves are milled into the blank for a sufficient distance to provide substantial annular flow area while also leaving a relatively broad rib section between each annulus area. The member is especially useful for packing a hole just above the drilling bit of a drill string.

9 Claims, 3 Drawing Figures

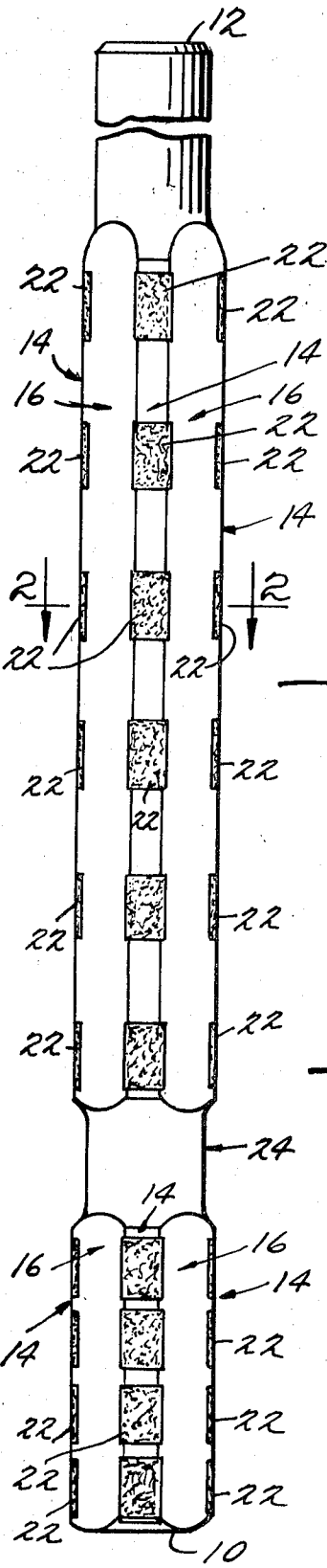


Fig. 1.

Fig. 2.

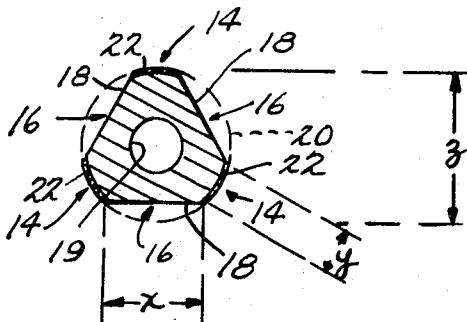
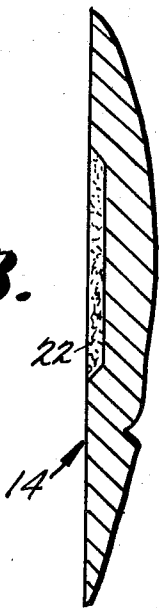


Fig. 3.



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DRILL STRING MEMBER AND METHOD FOR MANUFACTURE

BACKGROUND AND BRIEF DESCRIPTION OF INVENTION

It is known in this art to provide for drill collar and drill stabilizer constructions having rib sections formed on outside surfaces of the constructions. However, there has been substantial emphasis in this art on the use of particular rib configurations for drill string members, depending upon intended uses of the members as drill collars or as stabilizers. As is known in this art, drill collars are typically used in a drill string to add weight to the drilling bit; and stabilizers are mainly used to pack the hole and to stabilize the operation of the drilling bit. Typically, only two stabilizers are positioned immediately above a drilling bit, while a larger number of drill collars are positioned above the stabilizers to add weight to the string.

It has become a practice in this art to use drill collar constructions having spiral groove formations for many drill collar requirements. Typical prior art patents showing such constructions include U.S. Pat. Nos. 2,999,552; 3,146,611 (disclosing an effective spiral); and 3,285,678 (showing a spiral rib and groove formation as used on a stabilizer). Stabilizers are provided with spiral surface formations or with a number of straight ribs, such as shown in U.S. Pat. Nos. 3,063,759 and 3,320,004. Stabilizers utilizing multiple straight ribs have generally required a relatively large number of such ribs, although constructions with as few as four equally spaced ribs have been used.

The present invention provides for a substantially improved construction for a drill string member wherein the member has characteristics of (a) greater wall contact with a fewer number of rib sections and (b) substantially greater annular area for the flow of drilling fluids. The drill string member of the present invention is especially useful as a bottom hole stabilizer where it is desired to maintain good contact with the wall of the hole without danger of sticking of the stabilizer in the hole. Also, these characteristics are useful for directional drilling operations, especially of the type carried out from an offshore platform from which many wells are drilled from the same location. In addition, the characteristics of the invention are useful in fast drilling operations such as in offshore formations consisting of broken sand and shale which result in very fast drilling. The improved drill string member of this invention maintains good wall contact because of the greater area of individual rib sections, and this helps to keep a drilling bit on target in fast drilling formations. At the same time, the invention provides extra annular flow area, and this characteristic is equally important in fast drilling operations. The stabilizer of this invention also functions to ream a hole as it follows a drilling bit, and this insures a better gauge hole and easier fitting of casing within the hole.

In accordance with the invention, a drill string member is formed from a tubular blank by milling three straight longitudinal grooves into the essentially circular surface of the blank. The grooves are milled by simply removing material from the blank, leaving flat-bottomed removal areas along the length of the blank. By removing material from three equally spaced sections around the circumference of the blank, three straight rib sections are left between the longitudinal groove areas. The milling is carried out to a sufficient depth to provide substantial annular flow area, but, it is also important that a relatively broad rib section be left between each pair of grooves. Typically, the width of each flat bottom groove, when viewed in transverse cross section, is approximately two to three times longer than the corresponding width of each adjacent rib section. Thus, the product of the present invention is essentially triangular in cross-sectional configuration, as distinguished from the generally square or round cross sections which have been emphasized in this art up to the present time. The drill string member of this invention is preferably formed as an integral structure, although it is recognized that three straight rib sections could be affixed to the surface of a tubular blank if desired.

It is acknowledged that square cross section drill string members and spiral groove drill collars have been formed by milling material from tubular blanks, in a fashion somewhat similar to that set forth above. However, the present invention is concerned with specifically providing for a triangular configuration with straight rib sections. It is believed that substantially improved characteristics are achieved with the triangular configuration of this invention because a reduction in the number of ribs permits the use of broader ribs and larger annular flow areas, thereby resulting in less danger of sticking and better stabilizing action. Also, it is important that the three ribs be straight and not spiralled so as to permit easy withdrawal of a stabilizer from a hole.

These and other features and advantages of the invention will become apparent from the more detailed discussion which follows, and in that discussion reference will be made to the accompanying drawings as briefly discussed below.

BRIEF DESCRIPTION OF DRAWINGS

FIG. 1 is an elevational view of a single stabilizer member made in accordance with the present invention;

FIG. 2 is a transverse cross-sectional view of the member of FIG. 1, as seen generally at line 2—2; and

FIG. 3 is a detailed longitudinal cross section of a portion of a rib section of the member of FIG. 1, showing a typical construction which includes a wear-resistant facing on the surface of a rib section.

DETAILED DESCRIPTION OF INVENTION

Referring to FIGS. 1 and 2, the drill string member of this invention is of a typical elongate form suitable for threaded connection at each of its ends to a drill string. Opposite ends 10 and 12 of the elongate member may be provided with well-known threaded connections (not illustrated), and typically, a threaded box is provided at one end while a threaded pin is provided at the opposite end.

As shown in FIG. 2, the drill string member has a transverse cross-sectional configuration generally in the form of a triangle. However, the points of the triangle are rounded off, as shown, so as to present three separate rib sections 14 for contacting the wall of a bore. The rib sections 14 are straight and extend along the length of the member so as to be longitudinally aligned in a parallel relationship to a center axis of the member. Between each of the rib sections is an annular flow area 16 which, for purposes of this description, may be considered a groove having a flat bottom 18. It can be seen from FIG. 2, that each of the three grooves or annular flow areas 16 are equally spaced around the circumference of the elongate member so as to leave the rib sections 14 in equally spaced positions about the member. Also, it can be seen that the width x of each flat-bottomed groove 16 is approximately two to three times longer than the corresponding width y of each rib section. However, this is merely one way of describing the relationship between rib sections and grooves, and the important thing is to provide for substantial annular flow area for drilling fluids while, at the same time, providing for good wall contact area with the rib sections. Prior art arrangements, especially those using a square cross-sectional configuration, have found it necessary to substantially reduce the width of each rib section in order to avoid sticking of the ribs and to obtain good groove depth for a four-rib configuration. However, the present invention provides even greater annular flow area and wall contact area than the known square configuration drilling member, and therefore, the present invention represents a substantial improvement over prior constructions, especially for uses concerned with the stabilizing of a drill bit. Each rib section 14 of the invention is broad enough to contact a relatively large area of the hole wall, but sticking is prevented by the use of only three ribs which are straight and by the provision for large annular flow areas to reduce differential sticking.

Typical constructions and relationships for a stabilizer manufactured in accordance with the present invention are indicated below:

Example 1	
Outside diameter z of tubular member	6 1/4 inches
Width y of each rib section	1 1/2 inches
Area of annular flow*	8.49 sq. inches
Length of drill string member	72 inches
Example 2	
Outside diameter z	6 1/4 inches
Width y	1 1/2 inches
Area of annular flow*	7.74 sq. inches
Example 3	
Outside diameter z	6 1/4 inches
Width y	2 inches
Area of annular flow*	9.00 sq. inches
Example 4	
Outside diameter z	8 1/4 inches
Width y	2 1/2 inches
Area of annular flow*	14.92 sq. inches

EXAMPLE 5

Stabilizers in accordance with this invention can be manufactured to be used in various hole sizes, for example for hole size diameters of 6 1/4 inches, 6 3/4 inches, 9 7/8 inches or 12 1/4 inches. The diameter of the stabilizer can be within one-sixteenth inch (or even less) of the contemplated hole size. Prior art drill collars cannot be run with such close diameters to hole diameter, and thus, greater stabilizing action is available with the stabilizer of this invention.

* (*as viewed in the FIG. 2 cross section; area represented is for three grooves).

As indicated above, it is preferred that the drill string member of this invention be formed as an integral construction. This means that individual rib sections are included as an integral part of the elongate member making up the drill string member, and such a construction is substantially stronger and more reliable than those offered by the alternative procedure of affixing rib sections to a blank. It is known in this art to form spiral grooves into a tubular blank by milling the grooves into surfaces of the blank. The triangular shaped member of this invention can also be formed by milling grooves into a tubular blank.

As shown in FIG. 2, the basic blank is tubular with a bore 19 therethrough, and initially the blank has a circular cross-sectional shape as shown by the dashed line 20. A triangular shaped stabilizer member having the characteristics of substantial annular flow area and good wall contact area is formed by milling three, spaced-apart, flat-bottomed grooves in substantially straight paths along the outside surface of the steel elongate tubular blank. The milling is carried out to a sufficient depth to provide for the required annular area of each groove 16 while also leaving relatively broad rib section surfaces at 14. Preferably, the milling is carried out to a sufficient depth to form a groove having a flat bottom width which is approximately two to three times longer than the corresponding width of each adjacent rib section (when viewed in transverse cross section, as in FIG. 2).

In the further practice of the method of this invention, threaded connection means are formed at opposite ends of the elongate blank in accordance with known techniques. In addition, wear-resistant facings 22 are applied to faces of the rib section 14. FIG. 3 illustrates details of the application of a wear-resistant facing to a rib section, and it can be seen that each wear facing is imbedded into the surface of the rib section. In accordance with known techniques, grooves can be formed into the rib section surfaces to receive tungsten carbide mesh as a wear facing. The rib section surface may be preheated to approximately 500° F., and a 10-20 mesh tungsten carbide facing piece may be applied into the groove with an acetylene torch.

The stabilizer may also be provided with other configura-

tions known to this art, such as the necked-down area 24.

Although the invention has been described with reference to a particular embodiment and a particular method for producing the embodiment, it will be appreciated that alternative structures and procedures will become apparent to those skilled in this art to practice this invention. All such structures and procedures which may be considered equivalent to what has been disclosed are intended to be included in the scope of this invention as claimed herein.

What is claimed is:

1. An improved elongate member for use as a bottom hole stabilizer in a packed hole assembly for a drill string, said elongate member having a transverse cross-sectional configuration generally in the form of a triangle, and said elongate member having an outside surface configuration which includes three equally spaced-apart rib sections which are substantially straight and longitudinally aligned parallel to a center axis of the elongate member, and said elongate member further having three flow areas formed between said three rib sections for the full length of said member so as to provide for a circulation of drilling fluid and cuttings between a well bore and said member.

2. The improvement of claim 1 wherein said rib sections and said annular flow areas are formed by milling three straight, longitudinal grooves in equally spaced positions into the surface of a steel blank having a circular outside configuration when viewed in cross section.

3. The improvement of claim 2 wherein said elongate member is formed from a tubular blank having a bore therethrough.

4. The improvement of claim 1 wherein said rib sections are faced with a wear-resistant material.

5. The improvement of claim 1 wherein said elongate member is provided with threaded end portions for connecting the member into a drill string.

6. The improvement of claim 1 wherein said three rib sections have rounded surfaces for contacting the wall of a bore in a drilling operation.

7. The improvement of claim 1 wherein said annular flow areas are defined by flat-bottomed grooves milled into the surface of said elongate member, and wherein said rib sections are defined by unmilled sections left between each of the milled grooves.

8. A method for forming an integral elongate member having three straight, spaced-apart rib sections longitudinally positioned on an outside surface of the elongate member together with three straight annular flow areas positioned between the three rib sections, comprising the steps of

milling three spaced-apart, flat-bottomed grooves in substantially straight paths along the outside surface of an elongate tubular blank having a circular outside periphery in cross section, said milling being to a sufficient depth to provide substantial flow area for the entire length of the elongate blank while at the same time leaving relatively broad rib section surfaces for wall contact in a drilling operation,

applying wear-resistant facings to said rib section surfaces, and

forming threaded connection means at opposite ends of said elongate blank so that the finished member can be connected to a drill string as a bottom hole stabilizer in a packed hole assembly.

9. The method of claim 8 wherein the width of each flat-bottomed groove, when viewed in transverse cross section is approximately two to three times longer than the corresponding width of each rib section.

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