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ROLLER CUTTER BIT WITH FLUID FLUSHED BEARINGS

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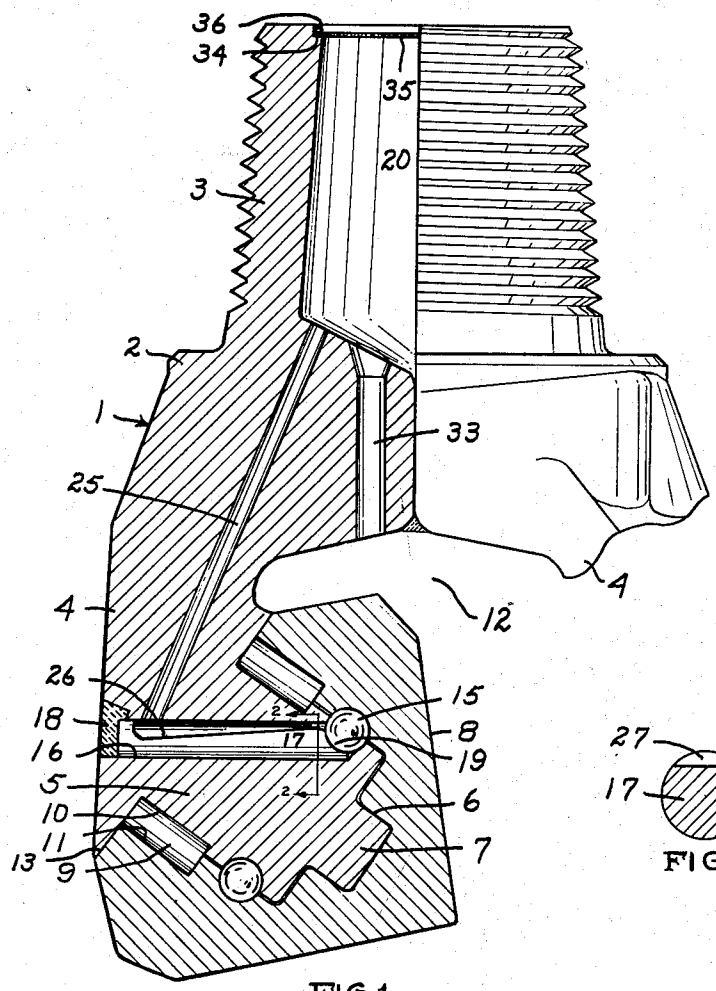


FIG. 1

FIG. 2

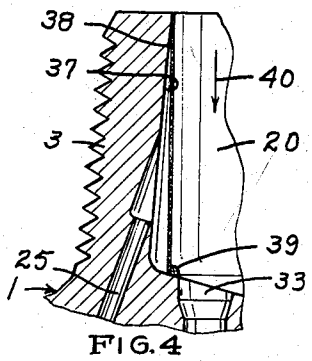


FIG. 4

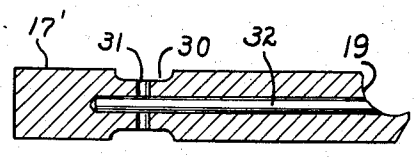


FIG. 3

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ROLLER CUTTER BIT WITH FLUID FLUSHED BEARINGS

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3 Claims. (Cl. 255—303)

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This invention relates to drill bits of the rotating cutter type and more particularly to this type of drill bit in which the rotating cutters enclose the free ends of the cutter shafts. In particular the invention comprehends a drill bit which is so constructed that at least a portion of a stream of gaseous fluid pumped downwardly through the drill stem, to which the bit is attached, is introduced to the interior of the rotating cutters whereby the cutter, shaft and bearings are lubricated, cooled and the bearing is kept free from foreign materials that would effect abrasion thereof.

In the conventional rotary method of drilling earth bores a flushing liquid, which frequently is mud or chemical laden, is pumped downwardly through the drill stem and thence through the flushing ports in the bit attached to the lower end of the drill stem. The flushing liquid impinges upon the drill cutters, the bottom and the sides of the bore being formed and then moves upwardly in the bore carrying the cuttings from the bore. The flushing liquid also serves to cool the parts of the bit and to lubricate the bit bearings.

Various difficulties are experienced in the use of a flushing liquid in rotary drilling. Operations are hampered from freezing when sub-freezing temperatures exist. In some areas it is extremely difficult to obtain water, or other liquid, in sufficient quantity for efficient operations. Also, in some activities, such as quarrying operations, the presence of a liquid in the bore hole after drilling is completed is extremely undesirable for subsequent operations.

The primary object of this invention is to obviate difficulties presently experienced in the rotary method of drilling of earth bores and particularly those difficulties above set forth. This object is accomplished by providing a roller cutter type of drill bit in which a gaseous flushing fluid is utilized and such fluid serves to cool and lubricate the cutters and bearings and to remove the cuttings from the well bore.

Another object is the provision of a bit which utilizes a gaseous flushing fluid and in which at least a portion of such flushing fluid is conducted to the interior of the cutters to effect lubrication and cooling of the bearings and parts during its flow outwardly along the bearing to the exterior of the cutters.

A further object is to provide even distribution of the flushing fluid to the cutter bearings.

The invention also comprehends the provision of a bit having cutters which enclose the free ends

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of the cutter shafts and in which a gaseous fluid, admitted under pressure to the interiors of the cutters moves unidirectionally toward the bases of the cutters.

It is also an object to provide a bit through which a gaseous flushing fluid flows in divided paths, one of which passes through the bearing structure, the entire stream of fluid after passing through the bit serving to remove cuttings from the well bore.

The foregoing objects, together with other objects, will be more fully apparent from the following description, considered in connection with the accompanying drawings in which:

Fig. 1 is a fragmentary elevational view, partly in section, of a drill bit embodying the invention;

Fig. 2 is a sectional view through the ball retaining pin or plug, the view being taken on line 2—2 in Fig. 1;

Fig. 3 is a sectional view through a modified form of ball retaining pin providing a passage for conducting the flushing fluid to the interior of the rotating cutter and bearing therefor;

Fig. 4 is an enlarged sectional detail showing a modified structure for preventing clogging of the flushing fluid passageway.

In the drawings a well drill is shown generally at 1, such drill comprising a head 2 having a threaded pin 3 extending upwardly for attachment to the lower end of a drill string (not shown).

The head 2 has a plurality of downwardly extending legs 4 which terminate in downwardly and inwardly inclined shafts 5 whereby there is formed a recess 12 on the nether side of the bit head. The shafts 5 are substantially cylindrical but may be stepped toward their inner ends to provide one or more bearing surfaces such as the surface 6 on the pilot pin 7.

Suitable antifriction bearings are provided between the shaft 5 and the cutter 8 rotatably mounted on the shaft. A suitable bearing structure is shown as comprising an outboard roller bearing 9 engaging raceways or bearing surfaces 10, and 11 on the shaft and cutter respectively.

Inwardly toward the free end of the shaft 5 there is provided a ball type of antifriction bearing 15 positioned in complemental raceways on the shaft 5 and in the cutter 8. This bearing serves the dual function of assuming both radial and axial loads upon the shaft 5 and hence serves to retain the cutter upon the shaft. The balls of the bearing are introduced to the raceways through an opening 16 in the bit leg 4 and the shaft 5. When the raceways have been filled,

whereby the bearing 15 is complete, a plug or pin 17 is inserted into the opening 16 and secured in place as by the weld metal 18. It is to be noted that the inner end of the pin 17 is contoured at 19 to form a portion of the ball raceway in the shaft 5.

The cutter 8 may be of any conventional configuration except that, as above mentioned, it is desirable that it enclose the end of the shaft 5 so that uniform conditions of fluid flow through the drill are established and maintained.

The head 2 has a cavity or chamber 20 therein to receive gaseous drilling fluid pumped downwardly through the drill string to which the drill is attached. To accomplish desired results, a passage is provided to communicate between the cavity 20 and the interior of roller cutter 8. Such passage comprises a bore 25 extending from the cavity 20 to the opening 16. Pin 17 has its upper surface contoured at 26 to provide a continuation of the passage axially of the shaft 5. Preferably the contouring is deeper proximate the mouths of the bore 25 since the flushing fluid changes its direction of flow at this point. Thence, the contouring tapers upwardly along the pin so that the passage reaches its minimum cross section at 27 as best seen in Fig. 2.

An alternate construction of the pin is shown at 17' in Fig. 3. In this construction there is provided a groove 30 about the plug to underlie the lower end of the bore 25. The transverse passage 31 in the bottom of the groove 30 intersects the axial bore 32 which terminates in the arcuate end face or contour 19 on the pin which forms a portion of the raceway for the bearing 15.

In order to assist in proper cooling of the cutter 8, there is also provided a passage 33 in the bit head leading from the cavity 20 to the recess 12 on the nether side of the bit head proximate the cutter 8. It is to be understood that this passage will be so located that the flushing fluid may impinge directly upon the adjacent cutter or that it may jet directly upon the bottom of the well bore. The essential functions are the provision of adequate cooling and the removal of cuttings from within the well bore.

The passage leading to the periphery of the shaft 5 is of relatively small cross section and it is therefore desirable to assure that foreign matter cannot enter and clog this passage. To avoid such clogging a small counterbore 34 is provided in the upper end of the pin 3 to receive an annular screen 35 secured in place in a suitable manner such as by peening the metal of the bit head or by brazing or weld metal 36.

In some areas formation fluids may enter the bore hole when drilling is suspended. In such case particles may rise with the fluids through passage 33 and thence enter the bore 25. The same condition arises if the bit 1 is lowered into a well bore containing a liquid. To avoid this condition a modified structure may be provided as shown in Fig. 4. In this modification, the mouth of the bore 25 is provided in the side wall 37 of the cavity 20. A cylindrical screen 38 is positioned within the cavity. This screen fits closely within the cavity at its mouth and the opposite end abuts the bottom of the cavity to which it is secured as by weld or brazing metal 39. It is to be noted that this construction not only prevents particles from entering and clogging the bore 25 but also is so oriented that the downward flow of flushing fluid, as indicated by the arrow 40, tends to dislodge any particles which lodge upon and tend to clog the screen 38.

The operation of the drill bit embodying the invention is believed apparent from the foregoing description. By way of supplementation and reiteration it will be assumed that the bit 1 is secured to the lower end of a drill string. A gaseous fluid, preferably air, is supplied to the bit while the bit is rotated upon bottom and sufficient weight is applied thereto to produce efficient cutting action. The fluid enters the cavity 20 whence it is discharged through divided paths from the interior to the exterior of the bit. One of such paths comprises the passages 33 while the other path comprises the bore 25 and the passage formed by the contour 26 on the pin or plug 17 (Fig. 1) or the intersecting bores 31 and 32 in the pin 17' (Fig. 3). The fluid in the latter path is discharged into the cutter at a point proximate the ball bearing 15 to cool such bearing and, as well, the inner end of the shaft 5. This fluid moves unidirectionally within the cutter 8 toward the base of the cutter 8 and during such movement the roller bearings 9 and 15 are cooled.

It is to be noted that, as the bit rotates within an earth bore, there is a tendency for disintegrated material within the bore to enter the clearance space at 13 between the base of the cutter 8 and the opposed shoulder on the bit leg 4. The unidirectional flow of the gaseous flushing fluid within the cutter as above described overcomes this tendency and hence prevents abrasive material from entering the cutter. Also the flushing fluid contains a small amount of moisture and/or lubricant in vapor form whereby lubrication for the bearings is provided. Some lubricant is inherently supplied through the compressor supplying the flushing fluid and this may be intentionally supplemented, if desired, although it has been found that long life and efficient operation of a bit may be had when supplying compressed air to the bit in a volume that will provide such pressure conditions at the bit as will now be indicated.

Very satisfactory results can be obtained where there is a drop in pressure of approximately 70 pounds per square inch between the interior and the exterior of the bit. The volume of gaseous fluid thus supplied is adequate to maintain the bit in good operating condition and to remove the cuttings from the bore hole. This specific figure is of course given by way of illustration and not by way of limitation of the invention which broadly comprehends an earth boring drill in which a gaseous flushing fluid is utilized to effect adequate cooling of the bit, keep the bit clean, particularly the bearings thereof, and remove cuttings from the well bore.

The invention claimed is:

1. In a well drill, a head having a passageway therethrough, a downwardly extending leg thereon, an inwardly extending shaft on said leg, a roller cutter enclosing the inner end of said shaft, comlementary raceways on said shaft and in said cutter inwardly from the base of the cutter, and anti-friction bearings in said raceways, a bore extending longitudinally of the shaft to said complemental raceways, said bearings being insertible through said bore, a plug insertible into said bore to hold the bearings in the raceways, and means forming a passage for flushing fluid from said passageway to and axially of said plug to the interior of the cutter.

2. In a well drill, a head having an axially ex-

tending passageway therethrough, a downwardly extending leg thereon, a bore extending from said passageway into said leg, an inwardly extending shaft on said leg, a roller cutter enclosing the inner end of said shaft, complementary raceways on said shaft and in said cutter inwardly from the base of the cutter, anti-friction bearings in said raceways, an opening extending longitudinally of the shaft and transecting said bore, and a plug insertible into said opening, said plug having a portion of its periphery contoured to form, with the wall of the opening, a passage between said bore and the surface of the shaft proximate said bearings.

3. In a well drill, a head having an axially extending passageway therethrough, a downwardly extending leg thereon, a bore extending from said passageway into said leg, an inwardly extending shaft on said leg, a roller cutter enclosing the inner end of said shaft, complementary raceways on said shaft and in said cutter inwardly from the base of the cutter, anti-friction bearings in

said raceways, an opening extending longitudinally of the shaft and transecting said bore, and a plug insertible into said opening, said plug having intersecting axial and transverse bores, there being a peripheral groove on the plug communicating with the transverse bore and with said first mentioned bore when the plug is inserted within said opening thereby forming a continuous passage from said passageway to the periphery of the shaft proximate said bearings.

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References Cited in the file of this patent

UNITED STATES PATENTS

Number	Name	Date
1,247,839	Hughes	Nov. 27, 1917
1,334,632	Pickin	Mar. 23, 1920
1,816,203	Behnke	July 28, 1931
1,905,066	Scott	Apr. 25, 1933
2,293,259	Johnson	Aug. 18, 1942
2,329,745	Crook	Sept. 21, 1943