Jan. 31, 1939. J. T. PHIPPS 2,145,573

ROLLER BIT

Filed Sept. 27, 1937

Fig. 1

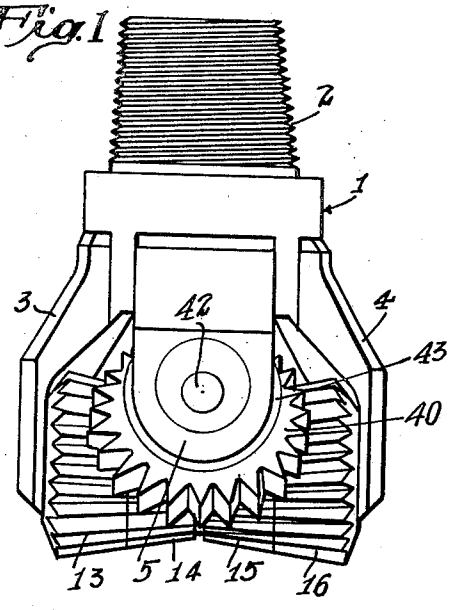


Fig. 2

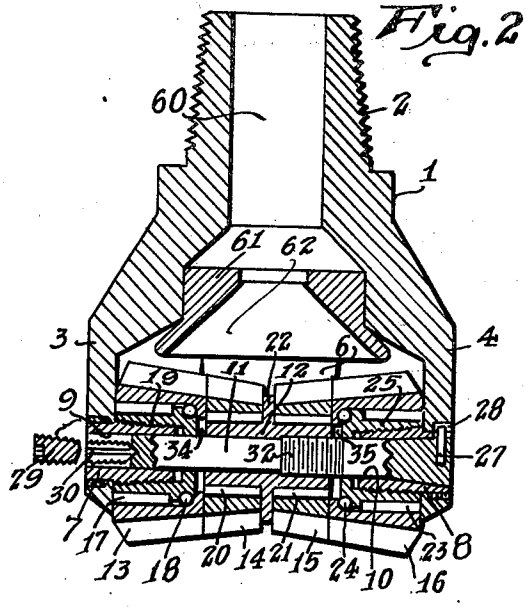


Fig. 3

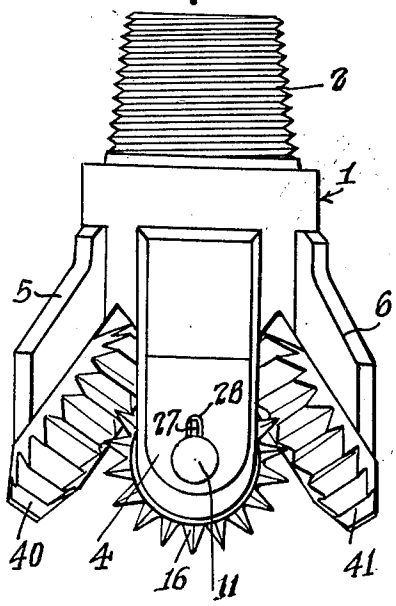
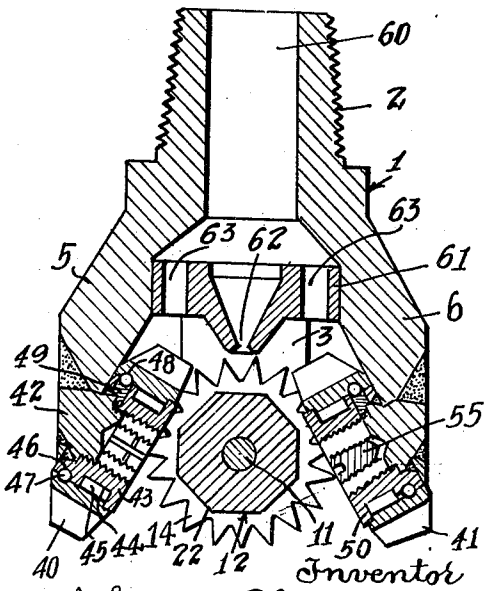


Fig. 4



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ROLLER BIT

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5 Claims. (Cl. 255—71)

This invention relates to roller bits for use in rotary drilling and has as a broad object to provide a roller bit construction which can be readily disassembled and reassembled to permit repairs or replacement of the wearing parts.

Another object is to provide a roller bit that is exceptionally strong and rigid and has large bearing surfaces for rotatably supporting the cutter rollers.

The manner in which the foregoing objects are achieved will now be explained by describing in detail, with reference to the drawing, a specific embodiment of the invention.

In the drawing:

Fig. 1 is a side elevation view of a bit in accordance with the invention;

Fig. 2 is a vertical section through the bit, taken substantially in the plane of the axis of the main cutting rollers;

Fig. 3 is a side elevation of the bit in a position displaced 90° from the position shown in Fig. 1; and

Fig. 4 is a vertical sectional view through the bit, taken in a plane at right angles to the plane of Fig. 2.

Referring to the drawing, the roller bit therein disclosed comprises a body member 1 having a threaded stub 2 on the upper end thereof for attachment to a drill shaft and having four downwardly depending arms 3, 4, 5 and 6 thereon for supporting cutting rolls, arms 3 and 4 being juxtaposed to each other in spaced apart relation, and arms 5 and 6 likewise being in juxtaposed spaced apart relation relative to each other and displaced 90° about the body 1 from the arms 3 and 4, respectively. The arms 3 and 4 support a main cutting roller assembly and the arms 5 and 6 support auxiliary cutting rollers, in accordance with the usual practice.

Referring now to Fig. 2, arms 3 and 4, respectively, have inwardly extending stub shafts 7 and 8, respectively thereon which may be welded to the arms 3 and 4, respectively, and each stub shaft has an aperture extending therethrough, the aperture 9 in the stub shaft 7 being in alinement with the aperture 10 in the stub shaft 8 and both of these apertures being concentrically disposed with respect to the outer surfaces of the stub shafts. A main pin or cross shaft 11 extends through and is fitted in the apertures 9 and 10 and supports a bushing 12 positioned between the inner ends of the stub shafts 7 and 8, respectively. Positioned in alinement between the arms 3 and 4 are four cutting rollers 13, 14, 15 and 16, respectively. The cutting roller 13 is rotatably supported by rollers 17 and balls 18 on a bearing member 19, which is threaded to screw onto the stub shaft 7, the outer surface of the latter being threaded to receive the member 19. The cutting rollers 14 and 15 are rotatably mounted on bearing rollers 20 and 21, respectively, directly on the bushing 12. Cutting rollers 14 and 15 are separated longitudinally by a flange 22 on bushing 12, this flange 22 having its outer periphery cut in polygonal shape, or having teeth cut in its periphery, to permit engagement by a tool for turning the same during assembly and disassembly, as will be described later.

The cutting roller 16 is rotatably supported by bearing rollers 23 and balls 24 on a bearing member 25, which is threaded to screw onto the stub shaft 8.

When the structure described is assembled, the cross shaft 11 is solidly locked in the apertures 9 and 10 against any movement with respect to the arms 3 and 4, the bushing 22 is solidly locked against movement with respect to the cross shaft 11, and the bearing bushings 19 and 25 are firmly locked against movement on the stub shafts 7 and 8, respectively.

I secure these results in a demountable structure as follows:

The cross shaft 11 is rigidly fixed in the aperture 10 in stub shaft 8 by tapering the latter aperture from a large diameter at the outer end to a smaller diameter at the inner end thereof and correspondingly tapering the end portion of shaft 11 so that when the shaft is drawn to the left (as shown in Fig. 2) it wedges firmly in the aperture 10 in stub shaft 8. I further prevent any possible rotation of shaft 11 after it has been placed in position by providing a pin 27 in the end thereof, the end of the pin projecting from the shaft 11 into a recess 28 provided therefor in the arm 4.

To firmly lock the left end of the shaft 11 in the aperture 9 in the stub shaft 7, the latter aperture is flared slightly to a larger diameter at its outer end and the left end of the shaft 11 is counterbored and threaded to receive a tapered screw plug 29. The counterbored portion of the shaft 11 is also provided with radial slots 30 which divide the end of the shaft into segments which are expanded outwardly tightly against the walls of the aperture 9 when the screw plug 29 is screwed into the counterbore.

To lock the bushing 12 against movement with respect to the shaft 11, the latter is provided with threads 32 which engage with cooperating threads on the inner surface of the bushing 22

at the right end thereof. By applying a suitable wrench to the flange 22 on bushing 12, the bushing is screwed tightly onto the threaded portion 32 of shaft 11, clamping the right end of bushing 12 firmly against the inner end of the bearing member 25 on the stub shaft 8 on arm 4, and thereby preventing any possible movement, in operation, of the bushing 12.

The inner ends of the bearing members 19 and 25 are provided with radial slots 34 and 35, respectively, which receive a suitable wrench for turning the bearing members during assembly and disassembly.

The roller elements described with reference to Fig. 2 are assembled as follows: First the bearing member 19, carrying the bearing rollers 17, the bearing balls 18 and the cutting roller 13, is screwed onto the stub shaft 7, and the assembly comprising the cutting rollers 16, bearing rollers 23, bearing balls 24 and bearing member 25 are placed in position by screwing the bearing member 25 onto the shaft 8. These operations are performed while the shaft 11, bushing 12 and the cutting roller elements supported thereon are removed. Then the assembly of the bushing 12, bearing rollers 20, cutting roller 14 and the bearing rollers 21 and cutting roller 15 is slid into position between the juxtaposed ends of the cutting rollers 13 and 16. Then the shaft 11 is inserted through the aperture 10 and the bushing 12 until the threads 32 thereon abut against the ends of the threads in bushing 12, after which the bushing 12 is rotated, by means of a suitable wrench applied to the flange 22, to screw the threaded portion of bushing 12 onto the threads 32 of shaft 11, this screwing action drawing the shaft 11 from right to left until it is seated solidly in the aperture 10 and the bushing 12 is drawn up tight against the bearing member 25. The shaft 11 is then firmly locked in the aperture 9 by inserting the screw plug 29 and screwing it up tight. While turning force is being applied to the plug 29 the outer face of the arm 3 may be struck with a hammer to move the arm in until the inner end of the bearing member 19 presses tightly against the end of the bushing 12, the arm 3 being secured in such inner position because of the left end of the shaft 11 being expanded outwardly against the tapered end portion of the aperture 9 by the plug 29. The structure shown in Fig. 2 may be disassembled by merely reversing the operation described; that is, first removing the plug 29, then rotating the bushing 12 to disengage the threaded portion thereof from the threads 32 on the shaft 11, this action automatically moving the pin to the right out of tight engagement with the stub shaft 8, completely removing the pin 11, then removing the bushing 12, and the elements supported thereon, and finally removing the bearing bushings 19 and 25 and the cutting rollers assembled thereon.

Referring now to Figs. 3 and 4, the arms 5 and 6 rotatably support a pair of auxiliary cutting rollers 40 and 41, respectively, each of which is mounted on its associated arm in the same manner. The structure will be described with reference to the arm 5 and the cutting roller 40. Thus referring to Fig. 4, arm 5 has solidly anchored thereto an inwardly and downwardly extending stub shaft 42, which may be welded into an aperture provided therefor in the arm 5, or attached to the arm in any desired manner. This stub shaft 42 is exteriorly threaded to receive an internally threaded bearing bushing 43, which bearing bushing has a race 44 therein for receiving bearing rollers 45 and a race 46 for bearing balls 47. The cutting roller 41 is provided with an annular race for the bearing balls 47 and with a cylindrical inner surface constituting a race bearing against the bearing rollers 45.

The balls 47 act as thrust bearings to prevent longitudinal movement of the cutter 40 along the bearing bushing 43. To permit insertion or removal of the balls 47, a radial passage 48 of diameter sufficient to pass the balls is provided in the bushing 43, extending from the central passage in the bushing into the race 46. This passage 48 is normally filled by a plug 49, the outer end of which is shaped to constitute a portion of the race 46, and the inner end of which is shaped to conform with the inner surface of the bushing 43. When the device is assembled as shown in the drawing, the plug 49 is locked against inward or rotary movement in passage 48 by contact with the juxtaposed portion of the outer surface of the stub shaft 42.

At its inner end the bearing bushing 43 is provided with a flange 50 extending radially past the rollers 45 and substantially completely enclosing the rollers to prevent as completely as possible the entry of dirt or grit into the roller races.

As previously indicated, the bearing bushing 43 is screwed onto the threaded portion of the stub shaft 42. The threaded portion of stub shaft 42 is normally of the same diameter at all longitudinal points, whereas the threaded portion of the bushing 43 is tapered so that it is of larger diameter at the end spaced farthest from the arm 5. The inner end of the stub shaft 42 is counterbored, slotted, and threaded to receive a screw plug 55 and when this screw plug 55 is screwed in tight it expands the segmented end of the stub shaft to cause the threads on the outer surface thereof to rigidly engage the threads on the inner surface of the bushing 43 throughout the length of the bushing and prevent any possible turning of the bushing 43 on the stub shaft.

In the assembled unit the bearing rollers 45 receive the major portion of the forces applied to the cutting roller 40 in directions radial with respect to the axis of rotation. The ball bearings 47 take up the thrust and prevent any longitudinal motion of the cutting roller 40 with respect to the pin 42 and arm 5.

The auxiliary roller described may be readily disassembled by first removing the screw plug 55 and then screwing the bushing 43 off of the stub shaft 42. The bearing rollers 45, balls 47 and cutting roller 40 come away with the bushing 43 and after removal of the bushing, the cutting roller 40 may be removed from the bushing by first removing plug 49 from passage 48, dropping the balls 47 through passage 48 and then pulling the cutting roller 41 off the bushing 43.

In accordance with conventional practice, the body member 1 is provided with a central aperture 60 for the circulation of mud or other suitable cleaning fluid to carry away the cuttings, and plaster the walls of the hole that is drilled. This mud flows from the passage 60 through a nozzle 61 which is provided with a flat, fan-shaped opening 62 immediately above the main roller assembly for directing a thin, flat stream of fluid substantially over the entire length of the main roller assembly. The nozzle 61 is provided with auxiliary discharge apertures 63 positioned above the rollers 40 and 41 for directing fluid on those cutters.

Although the invention has been explained by describing in detail a specific embodiment there-

of, it is to be understood that various changes may be made from the specific structure shown without departing from the invention, and the latter is to be limited only to the extent as set forth in the appended claims.

I claim:

1. A roller bit comprising a frame member having a downwardly depending arm for supporting a cutting roller, said arm having a stub shaft anchored thereto and projecting therefrom, said stub shaft having a threaded counterbore therein and radial slots extending from the counterbore to the exterior surface, a cutting roller, a bushing, means rotatably supporting said cutting roller on said bushing, said bushing having internal threads and being screwed on said stub shaft, and a threaded plug screwed into said counterbore for expanding said stub shaft and locking the latter to said bushing.

2. A roller bit comprising a frame member having a downwardly depending arm for supporting a cutting roller, said arm having a stub shaft anchored thereto and projecting therefrom, said stub shaft having a threaded counterbore therein and radial slots extending from the counterbore to the exterior surface, a cutting roller, a bushing having internal threads screwed on said stub shaft, a threaded plug screwed in said counterbore in said stub shaft for expanding said stub shaft and locking the latter to said bushing, said cutting roller having a ball race in its inner surface, said bushing having a cooperating ball race opposite said ball race in said cutting roller, bearing balls between said races for rotatably retaining said cutting roller on said bushing, said bushing having a passage extending therethrough to the race therein, for insertion and removal of balls, and removable plug means for closing said passage to normally retain said balls in said race.

3. A roller bit as described in claim 2 in which said passage extends through said bushing from said ball race therein to the internal surface of the bushing, and the inner end of said plug in said passage abuts against and is retained in position by the surface of said stub shaft.

4. A roller bit comprising a frame member having a downwardly depending arm for supporting a cutting roller, said arm having a stub shaft thereon, said shaft having an axial recess therein opening to the outer end of the shaft, the portion of the shaft defining at least the outer portion of said recess being slotted and at least that portion of the shaft surrounding an inner portion of the recess being internally threaded, a cutting roller, a bushing, means rotatably supporting said roller on said bushing, the latter being fitted on said shaft, and a plug member having threads thereon engaging with the internally threaded portion of said shaft, the outer portion at least of said plug being of larger diameter than the inner diameter of the slotted portion of said shaft, whereby the latter is expanded by the plug member to lock the bushing on the shaft.

5. A roller bit comprising a frame member having a stub shaft projecting therefrom, a cutting roller, a bushing fitting on and supported by said shaft, bearing means for rotatably supporting said cutting roller on said bushing, said means including a ball race in said bushing and a cooperating race in said cutting roller, balls mounted between said races, said bushing having a passage for the insertion or removal of balls, the passage extending from the race in the bushing to the shaft-contacting surface thereof, and removable plug means in said passage having an outer end flush with said race in the bushing and an inner end flush with said shaft-contacting surface whereby the plug is retained in said passage by said shaft when the device is assembled, and means for releasably locking said bushing on said shaft.

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