

July 15, 1941.

J. T. PHIPPS

2,249,578

ROLLER BIT

Filed Nov. 18, 1939

2 Sheets-Sheet 1

Fig. 1.

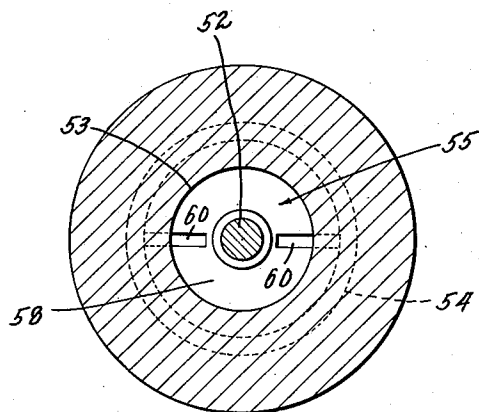
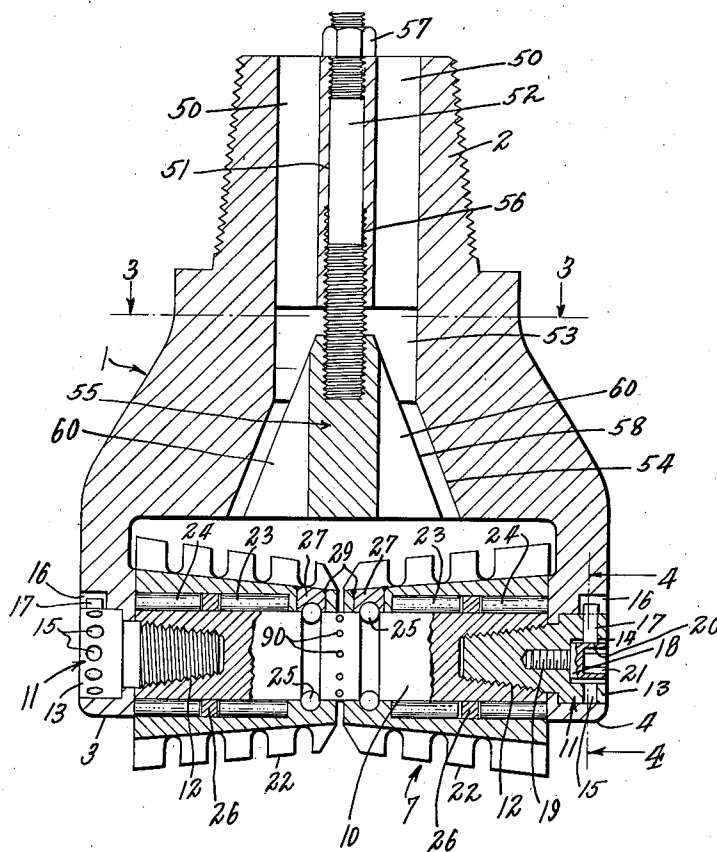


Fig. 3.

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Fig. 2.

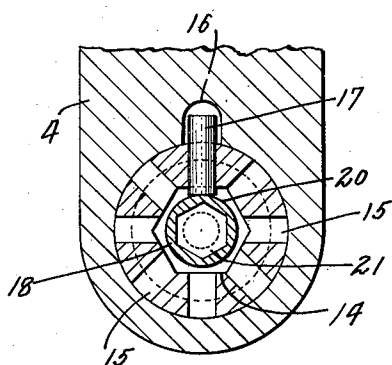
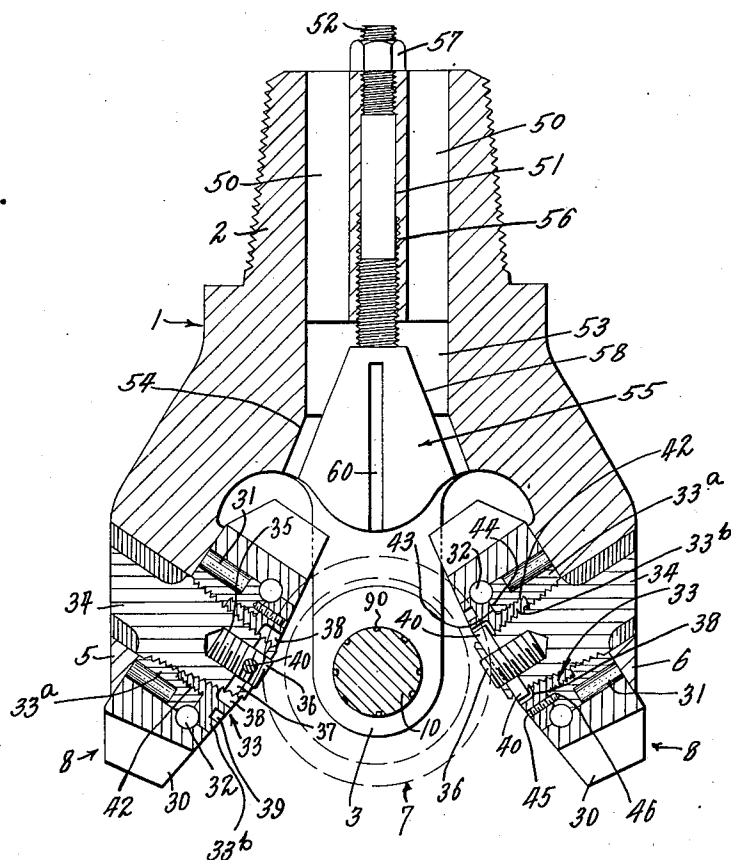


Fig. 4.

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UNITED STATES PATENT OFFICE

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ROLLER BIT

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Application November 18, 1939, Serial No. 305,118

4 Claims. (Cl. 255—71)

This invention relates to details of construction of roller bits for use in rotary drilling of wells.

An object of the invention is to provide a bit in which the rollers can be readily replaced without welding and which at the same time is exceptionally strong and sturdy.

Another object is to provide a roller bit with demountable rollers which in assembly does not involve critical adjustments or movements, thereby adapting it for assembly in the field by unskilled men.

Still another object is to improve circulation of the drilling fluid past the rollers, whereby they are kept clean of cuttings.

A more specific object is to provide an adjustable nozzle construction for directing the stream of drilling fluid past the rollers.

The manner in which the foregoing objects are achieved will appear from the following detailed description, with reference to the drawing of a specific embodiment of the invention, it being understood that various departures from the specific structures shown can be made without departing from the invention.

In the drawings:

Fig. 1 is a vertical sectional view through a roller bit in accordance with the invention;

Fig. 2 is a vertical sectional view taken at right angles to the view of Fig. 1;

Fig. 3 is a horizontal section taken substantially in the plane III—III of Fig. 1; and

Fig. 4 is a detailed vertical section taken substantially in the plane IV—IV of Fig. 1.

Referring first to Figs. 1 and 2, the bit therein depicted comprises a body member 1 having a substantially tubular internally threaded upper end portion 2 adapted to be screwed into a drill stem. At its lower end the body member 1 divides into a plurality of outwardly diverging arms 3, 4, 5 and 6. The arms 3 and 4 are juxtaposed to each other and support therebetween a cross roller assembly 7. The arms 5 and 6 are also juxtaposed to each other and are displaced 90° from the arms 3 and 4. Arms 5 and 6 each independently support a gauge cutter assembly 8, both of which are identical.

Referring now to Fig. 1, the cross roller assembly includes a heavy cross pin 10, the ends of which are squared and fit snugly against parallel surfaces of the lower ends of the body arms 3 and 4, respectively. This pin 10 is removably retained in position by a pair of screws 11 extending through the respective arms 3 and 4 and are screwed into threaded apertures 12

provided therefor in the opposite end of the cross pin 10. The outer ends of the openings in the arms 3 and 4 which receive the screws 11 are countersunk to receive the heads 13 of the screws so that the outer ends of the screws are substantially flush with the outer surfaces of the arms 3 and 4. The heads 13 are provided with hexagonal socket openings 14 (Fig. 4) for the reception of a wrench.

A main weakness of roller bits having demountable rollers has arisen from the difficulty of providing a rigid and positive connection between the roller-supporting pin and the body. In accordance with the present construction, I provide a positive lock for the pins 11. Thus the head 13 of each pin 11 is provided with a plurality of radial holes 15 extending from the socket 14 to the exterior surface of the head and a recess 16 is provided in each of the arms 3 and 4. After the screws 11 have been set up solid, by a wrench inserted in the socket 14, the screw is locked against loosening movement by inserting a pin 17 through one of the radial holes 15 and into the recess 16, the pin being inserted through the socket recess 14. To retain the lockpin 17 in position, a lock screw 18 is then screwed into a threaded aperture 19 provided in the screw 11. This lock screw 18 has a head, the peripheral surface 20 of which is cylindrical and bears against the pin 17. Screw 18 is in turn provided with a hexagonal socket 21 for the reception of a wrench. Obviously there can be no force tending to release the screw 19 so that it provides a positive lock for the retention of the lockpin 17. The latter, in turn, prevents any possible loosening movement of the associated screw 11.

The cross pin 10 rotatably supports a pair of roller members 22, both of which are identical, and each of which is rotatably mounted on the pin 10 by two sets of roller bearings 23 and 24, respectively, and a set of ball bearings 25. The two sets of roller bearings 23 and 24 are separated by a spacing washer 26 which is snugly fitted to the pin 10 and pressed thereon.

The ball bearings 25 constitute thrust bearings for preventing longitudinal movement of the rollers 22 on the pin 10 and transmit all thrust directly from the rollers 22 to the pin 10, thereby preventing wear between the outer ends of the rollers 22 and the inner surfaces of the arms 3 and 4.

It will be observed that the balls 25 are engaged half in a recess formed in the pin 10 and half in a recess formed in the inner surface of the associated roller 22. To provide for the in-

section of the balls 25, the roller 22 is, during an early stage of manufacture, drilled and provided with a snugly fitting plug 27 extending from the position of the ball race to the exterior surface of the roller, the plug of course preferably extending between cutting teeth on the outer surface of the roller. After the plug 27 has been inserted and fitted tightly, as described, the ball race in the roller is machined and also the outer surfaces of the roller and plug 27 are machined to form continuous flush surfaces. Thereafter, prior to assembly of the roller 22 on the pin 10, the plug 27 is knocked out and the balls 25 are introduced into the race through the opening. When all the balls are in place, the plug 27 is reinserted with its outer surface flush with the adjacent outer surface of the roller 22, thereby insuring that the inner surface of the plug 27 is flush with the adjacent surfaces of the roller. The plug 27 may then be positively secured in place by welding along the external juncture line, as indicated at 29.

Obviously the entire roller assembly 7 consisting of the pin 10, the two rollers 22, the ball bearings 25 and the roller bearings 23 and 24 is ready for assembly between the arms 3 and 4, and the only operation necessary to change from a worn roller assembly to a new one, is to first remove the lock bolt 18 from the screws 11, then retract the lock pins 17 through the socket recesses in the ends of the screws 11, after which the screws 11 may be removed by unscrewing them from the cross pin 10. The insertion of the new roller assembly is accomplished by simply reversing the procedure described.

The gauge roller assembly 8 consists of a cutting roller 30, rotatably supported by roller bearings 31 and ball bearings 32 on a two-part sleeve 33 which is threaded internally to screw onto a threaded stub shaft 34 rigidly attached to one of the arms 5 or 6. Stub shafts 34 may be secured to arms 5 and 6 by welding.

To lock the sleeve 33 on the stub shaft 34, a locking arrangement somewhat similar to that described with reference to the cross roller construction, is employed. Thus the shaft 34 is provided at its inner end with a threaded recess 35 for the reception of a screw 36, the latter being of the type known as the "Allen" set screw having a hexagonal socket in its end for the reception of a wrench. Extending radially from the threaded recess 35 are a plurality of holes 37, some of which are adapted to register with recesses 38 provided in the sleeve 33. The sleeve 33 is first tightened on the stub shaft 34 by means of a suitable wrench engaged in recesses 39 provided in the exposed surface of the sleeve. Thereafter a pair of pins 40 are inserted through the opening 35 into that pair of diametrically opposite radial holes 37 which are aligned with the recesses 38. The lock pins 40 are then retained in position by inserting the Allen set screw 36 and screwing it up tight.

As previously mentioned, the sleeve 33 is formed in two pieces. The purpose of this is to provide for assembly of the ball bearings 32 in the race, half of which is formed in the inner surface of the cutting roller 30 and the other half of which is formed in the outer surface of the sleeve 33. The sleeve 33 therefore includes a first section 33a and a second section 33b which are screwed together by means of cooperating threads 42 provided on the two members. When the parts are screwed up solidly together, shoulders 43 and 44 on the sections 33a and 33b, respectively, seat

firmly together in a plane intersecting the ball race. Obviously, therefore, the balls 32 may be inserted in that half of the race formed in the roller 30 and the two sections of the sleeve 33 can then be entered into opposite ends of the roller 30 and screwed together to complete the ball race in the sleeve 33 and lock the roller to the sleeve.

Since the threads in the inner surface of the sleeve 33, which engage with the threads on the pin 34 are formed partly in the section 33a and partly in the section 33b, these two sections must always be assembled in the same exact relative positions if the threads in the two sections are to be continuous and are to fit the threads on the shaft 34. I insure that the threads in the two sections 33a and 33b will always be continuous by providing a positive lock between the sections 33a and 33b in the form of a set screw 45 which is screwed longitudinally through a threaded aperture provided therefor in the section 33b, the inner end of the screw engaging a recess 46 in the section 33a. In manufacture before the recess 46 is formed in the member 33a and before the threads are cut in the inner surfaces of the members 33a and 33b, these two members are screwed solidly together by means of their cooperating threads 42. Then the recess 46 is drilled through the threaded aperture in the member 33b and the set screw 45 is inserted. Thereafter the thread for engagement with the pin 34 is cut in both sections 33a and 33b in a single operation. The structure may thereafter be disassembled and reassembled as often as desired without in the slightest degree misaligning the threads in the sections 33a and 33b, since by always relatively rotating the sections 33a and 33b to bring the recess 46 in alignment with the set screw 45 threaded into the section 33b, the original relative position is restored.

As is well known roller bits are commonly secured to the lower end of a hollow drill string through which drilling fluid is continuously pumped, and some form of nozzle means is commonly employed to direct the drilling fluid at high velocity onto the drilling cutters to keep them clean. Heretofore the nozzle means employed have usually been fixed (that is not adjustable), and have directed the drilling fluid in either flat or solid, round streams against the cutting rollers. In accordance with my present invention, I provide for the discharge of a concentrically continuous diverging stream of fluid which is directed substantially toward the bottom corner of the hole being drilled, this hollow diverging stream intercepting the gauge rollers 30 and the outer ends of the cross roller 7. I provide additional jets for washing the inner portions of the roller sections 22.

To produce the foregoing effects, I provide in the upper portion of the body 1 four uniformly spaced fluid passages 50 symmetrically positioned about a central passage 51 which receives a bolt 52. At the lower ends the four passages 50 and the passage 51 terminate in a large cylindrical passage 53 which at its lower edge merges into a diverging passage 54 of conical shape, this passage terminating at the lower central surface of the body member 1 immediately above the cutting rollers.

Fluid enters the upper ends of the passages 50 from the hollow drill stem and passes through the cylindrical passage 53 and the conical passage 54. To distribute the fluid at high velocity in the desired manner, I provide a circulation bean 55 which is substantially of conical shape

and is supported upon the lower end of the bolt 52. Thus, as clearly shown in Fig. 1, the bolt 52 is threaded into the upper end of the bean 55 and is also screwed into threads 56 provided in the lower end of the holes 51. The upper end of the bolt 52 is threaded and provided with a lock nut 57 which secures the bolt 52 in any position into which it may be set.

The outer surface 58 of the bean 55 extends parallel to the juxtaposed conical surface 54 and the space between these two surfaces may be varied by raising or lowering the bean to any desired extent. In a 12½ inch bit I have found it desirable, ordinarily, to space the surface 58 from ⅛ to ⅜ of an inch from the surface 54.

The conical surface 58 of the bean 55 is interrupted by two diametrically opposite vertical grooves 60, which grooves provide for the supply of a stream of fluid to the central portion of the cross roller assembly 7. Obviously, therefore, the bean 55 is locked in such position that a plane extending through the two grooves 60 intercepts the axis of the cross roller assembly 7. As shown in Fig. 2, the lower portion of the bean 55 at points displaced 90° from the grooves 60 are cut away to provide ample clearance with the gauge cutters 8.

In the particular construction disclosed, the lowermost portion of the bean 55 extends below the level of the uppermost portions of the rollers 8 so that adjustment of the bean 55 (obtained as previously described by rotating the bean and the bolt 52) must be effected before the gauge cutters 8 are installed. However, by making the bean 55 slightly shorter it can be rotated to effect adjustment after the roller cutters have all been assembled.

The circulating system described has been found very effective in practice and in preventing fouling of any portions of the cutting rollers.

The adjustable feature is important, because, in order to obtain the greatest cleaning efficiency from the circulating fluid, it should be delivered at high velocity and high volume. Under conditions where the supply of fluid is limited, a smaller opening is desirable than where a larger supply of fluid is available at the bit. Thus, if the opening is too small for the supply of fluid available, the volume of flow is unnecessarily restricted. On the other hand, if the opening is too large relative to the supply of fluid available at the bit, then the velocity of discharge is unnecessarily low.

A very important feature of the invention is the construction involving the screws 12 for supporting the cross shaft 10. It permits of the use of a sturdy shaft of large diameter which is very resistant to bending. It is also advantageous to use tapered screws 12, as shown, because this increases the thickness of the pin surrounding the inner portion of the screw. The fact that the heads of screws 12 seat tightly against the

shoulders at the bottoms of the countersunk portion of the arm apertures and clamp the arms tightly against the flat end surfaces of the cross shaft, also contributes substantially to the rigidity of the arms and shaft, since they reinforce each other. The heads of the screws 12 are preferably fitted snugly in the arm apertures to prevent lateral movement therein.

At its midpoint, the cross pin 10 may be provided with shallow holes 90, for engagement by a suitable wrench to hold the shaft from turning when removing the screws 12, although this is not ordinarily necessary.

Obviously many changes may be made from the particular construction described in detail, which is merely illustrative of the invention, and the invention is therefore to be limited only to the extent set forth in the appended claims.

I claim:

1. A roller bit comprising a body member attachable at its upper end to a hollow drill stem and having adjacent its lower end a plurality of diverging arms supporting cutting rollers, said body member having a longitudinal fluid passage therethrough, the lower portion of said passage being of substantially circular cross section, a baffle member supported from said body member and positioned within said lower portion of said passage and defining therewith an annular nozzle for the discharge of fluid.

2. A roller bit as described in claim 1, with adjustable supporting means for vertically adjusting said baffle member to vary the opening of said nozzle.

3. A roller bit comprising a body member attachable at its upper end to a hollow drill stem and having adjacent its lower end two pairs of juxtaposed arms, one pair supporting a cross-roller cutter and the other pair supporting gauge roller cutters, said body member having a longitudinal fluid passage therethrough, the lower portion of said passage being of substantially circular cross section and terminating above the level of said roller cutters, a baffle member supported from said body member and positioned within said lower portion of said passage and defining therewith an annular nozzle for the discharge of fluid onto said rollers, said baffle member having slots therein, which slots lie in a vertical plane extending through the axis of said cross roller to provide additional jets of fluid on the cross roller intermediate the end portions thereof.

4. A roller bit as described in claim 1, in which said longitudinal fluid passage comprises a single large passage at the lower end, and a plurality of passages spaced from the central vertical axis of the body member, at the upper end, and bolt means centrally secured to said body member between said plurality of fluid passages therein and supporting said baffle member.

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