Oct. 6, 1953 W. G. GREEN 2,654,577

DRILL BIT

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Fig. 1.

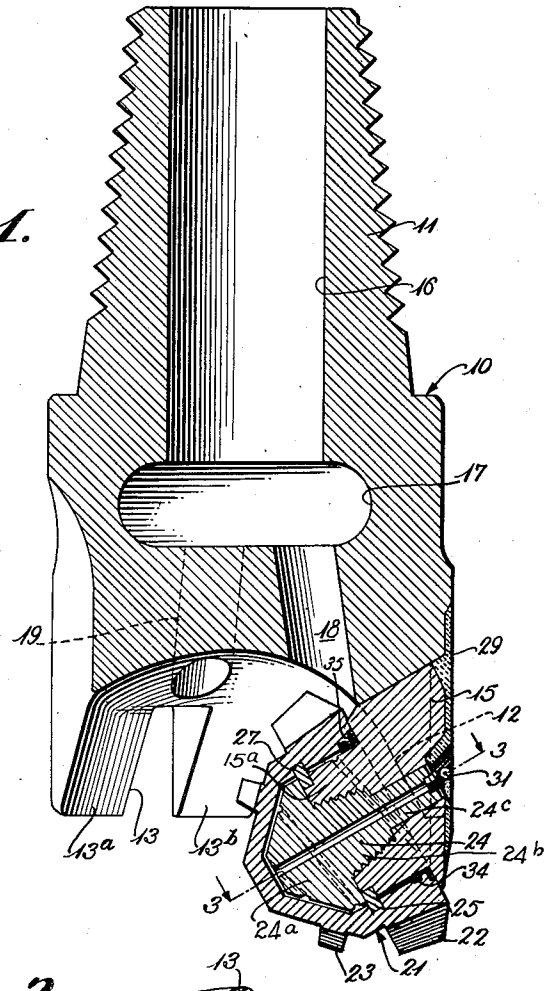
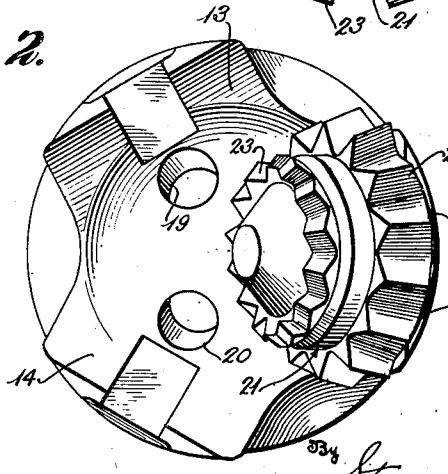


Fig. 2.



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Fig. 5.

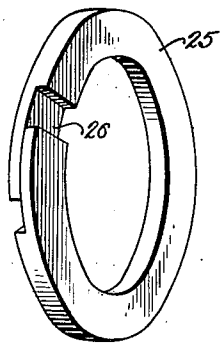


Fig. 3.

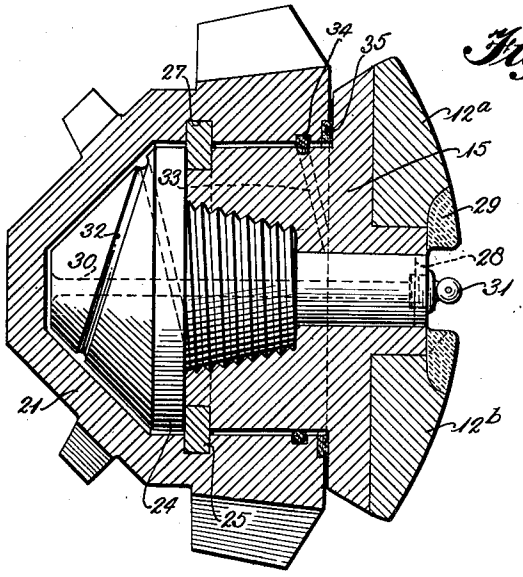


Fig. 6.

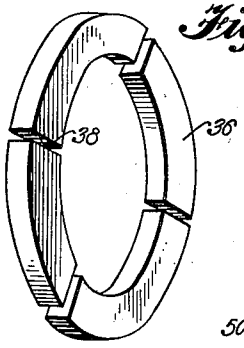
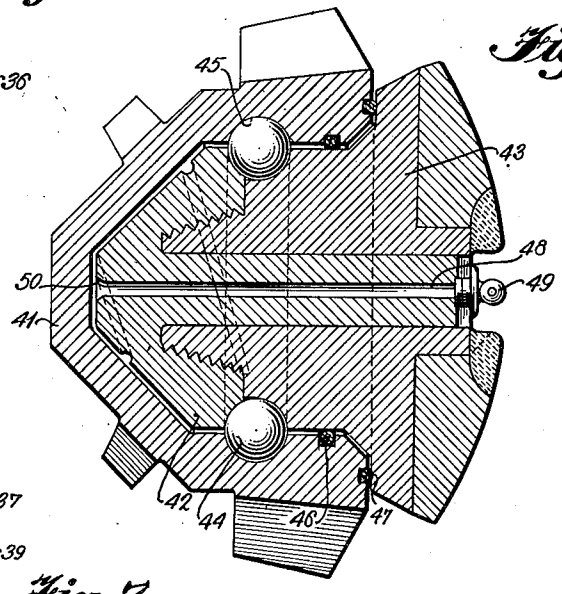


Fig. 4.



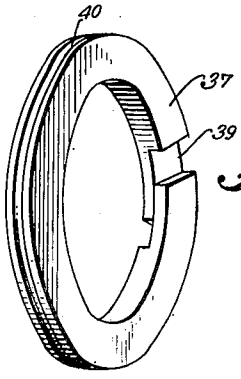


Fig. 7.

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Fig. 8.

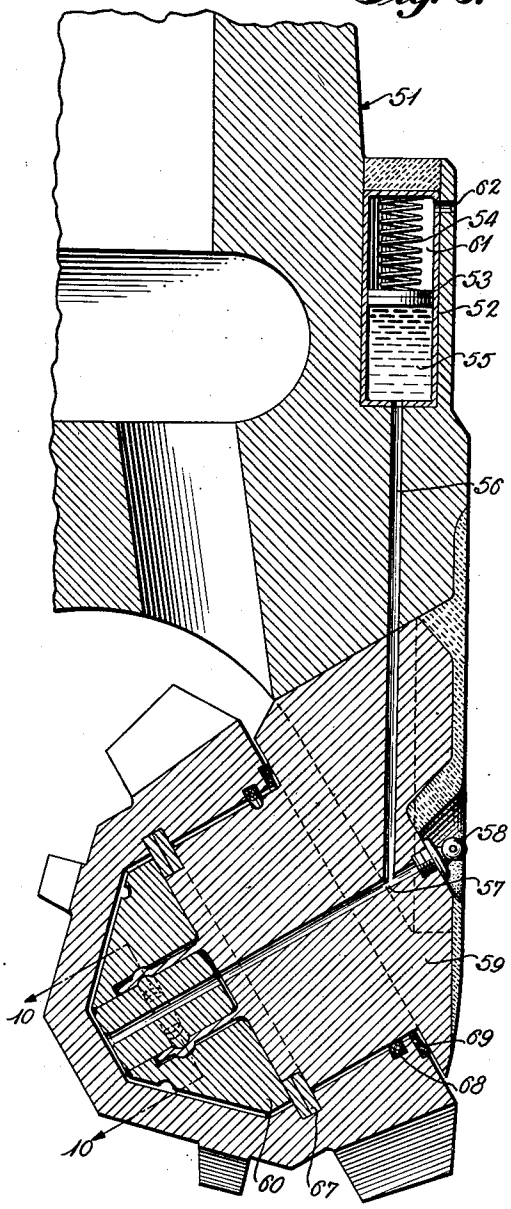


Fig. 9.

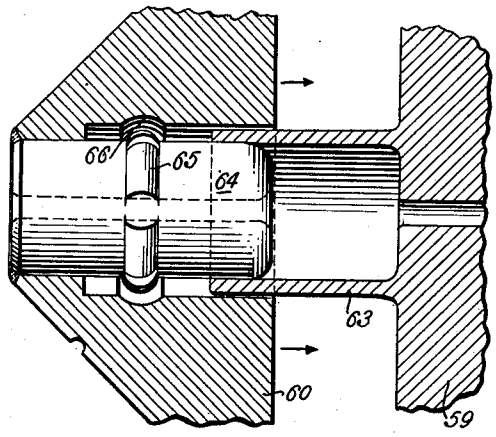
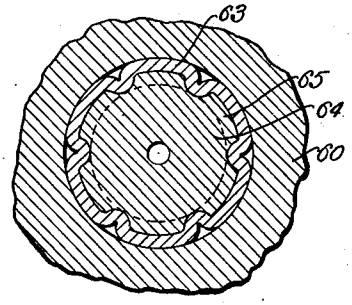


Fig. 10.



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UNITED STATES PATENT OFFICE

2,654,577

DRILL BIT

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Application September 26, 1947, Serial No. 776,314

2 Claims. (Cl. 255—304)

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This invention relates to drill bits and more particularly to deep well bits of the type which include a plurality of rotatable cone cutters mounted on the bit head.

In the art of deep well drilling it is customary to rotate in the bore hole a hollow drill bit having a head portion provided with forks in each of which is mounted a spindle for supporting, for free rotation, a cutter cone having serrated faces for cutting or abrading the ground or rock in which the well is being drilled. Mud is supplied centrally to the drill bit and is discharged over the cutters to wash away the cuttings and to lubricate the exterior of the cutters. In view of the great weight which is transmitted to the cutters through their respective spindles, a bearing problem of considerable magnitude is presented. In attempts to solve this problem resort has been had to various bearing arrangements. While some of the bearing arrangements involve anti-friction elements which render the cutters more freely rotatable, the resistance of these to heavy shock has not been heretofore entirely satisfactory, with the result that frequent and costly replacements of the cutter cone assemblies have been necessary.

Another problem related to the bearing structure is that of lubricating the bearing surfaces between the cutter and spindle. These are customarily lubricated during assembly and are not susceptible of subsequent lubrication without disassembly. Thus it may be that some of the bearing failures heretofore frequently encountered were due to failure of lubrication.

It is an object of the present invention to provide a drill bit having a cutter and spindle assembly which is characterized by ease of assembly and installation, great mechanical strength, adequate turning freedom on the part of the cutter, very high resistance to shock and high resistance to bearing failure. This construction will also provide for disassembly to permit replacement of the cutter cone and spindle where desired.

It is contemplated, according to the present invention, to provide an improved cutter assembly which is susceptible of easy lubrication without disassembly and which may be lubricated during use.

Other objects and advantages of the invention will be apparent upon consideration of the following detailed description of several embodiments thereof in conjunction with the annexed drawings wherein:

Figure 1 is a view in vertical section of a deep well drill bit constructed in accordance with the principles of the present invention, two of the cutter cones being removed for convenience of illustration;

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Figure 2 is a bottom plan view of the drill bit of Figure 1;

Figure 3 is a view in section taken along the line 3—3 of Figure 1;

Figure 4 is a view in section similar to Figure 3 but illustrating a modified type of connection between the cutter cone and its supporting assembly;

Figures 5, 6 and 7 illustrate modifications of a compressible ring which is used in associating the cutter cone and is supporting assembly;

Figure 8 is a fragmentary view in vertical section of a drill bit and modified type of cutter cone assembly;

Figure 9 is a view in vertical section illustrating a step in the assembly of the apparatus of Figure 8; and

Figure 10 is a view in section taken along the line 10—10 of Figure 8.

Now referring in greater detail to Figures 1, 2 and 3 of the drawings, the reference numeral 10 designates a bit head having a tapered threaded shank portion 11 adapted for attachment to the mud pipe of the drill rig and three forks 12, 13 and 14. The forks are provided respectively with tines 12*a* and *b*, 13*a* and *b* and 14*a* and *b*, defining between them a space for the reception of a wedge-shaped spindle head such as the spindle head 15 of the cutter cone assembly shown in Figures 1 and 3. The bit head is hollow and is provided with a mud channel 16, a manifold 17 and three mud discharge conduits 18, 19 and 20 for serving the several cutter cones to be mounted on the drill head.

The cutter cone assembly illustrated in Figures 1 and 3 is comprised of a cutter cone 21 provided with cutting teeth 22 and 23 arranged in rows about the outer surface. The exterior surface of the cutter cone and the teeth thereof are conventional, but the interior or base socket of the cone 21 is modified in accordance with the principles of the present invention so that the installation and operation of the cone affords certain advantages not heretofore known. Upon reference to Figures 1 and 3 it will be noted that the interior of the cutter cone 21 is generally cylindrical, terminating in a frusto conical end. The cutter cone is supported from a bearing assembly comprising a portion of the spindle head 15 and a spindle 24. The parts 15 and 24 are threaded together and hold between them a

bearing ring 25. The spindle 24 includes a frusto conical head 24a, a threaded section 24b and a reduced diameter shank 24c. Spindle head member 15 includes a threaded section 15a.

The structure and operation of the cutter cone assembly of Figures 1 and 3 can best be understood by reference to the mode of assembly of the apparatus which comprises first the step of inserting the frusto-conical head 24a of spindle 24 in the frusto conical end socket of the cutter cone 21. After the spindle has been placed in position a ring 25, which may be split at 26 as shown in Figure 5, is compressed to a reduced diameter and inserted in an annular groove at 27 within the cutter cone 21. Thereafter the spindle head 15 is moved axially toward the spindle 24 until the threads of 15a and 24b engage, and thereafter the spindle 24 is rotated to pull the spindle head 15 toward it. To this end shank 24c of spindle 24 is provided with a screw driver kerf or slot which is indicated in Figure 3 by the reference character 28. This operation may be performed either before or after the spindle head is inserted between the tines 12a and 12b of the fork 12. After the insertion of the wedge member between the tines of the fork 12, a weld at 29 is made in order to fasten the spindle head to the fork.

It will be noted that the spindle 24 is provided with a central channel or conduit at 30 and that the conduit is provided at one end with a fitting 31 through which a lubricant may be pumped to the bearing space between the spindle and the cutter head. To assist in the distribution of the lubricant between the spindle and the cutter, the spindle is provided with helically cut grooves at 32. Similarly, grooves 33 are cut in the portion of the spindle head which operates as a bearing for the cutter cone 21. Packing is provided at 34 and at 35 to prevent the rapid escape of the lubricant from the bearing surface during the operation of the drill. Similarly the ring 25 performs somewhat the same function.

It is now apparent that because the ring 25 is seated in the groove 27 and is likewise clamped between the spindle head and the spindle, the cutter cone 21 is locked against axial displacement. It is further apparent that a very large bearing surface is provided between the cutter cone and the spindle and spindle head so that satisfactory operation during long periods of use is achieved.

While in the foregoing description reference has been made to but a single cutting cone, it is apparent that each of the forks 12, 13 and 14 will be provided with a similar cone in the construction of the bit. Instead of a split ring such as is shown in Figure 5, it is apparent that a plurality of circumferentially spaced arcuate sections may be used to define a ring such as 36, shown in Figure 6 or that the split ring may be provided on its outer surface with a groove or channel 40 which serves as an oil retention groove and functions further to prevent the too rapid migration of the oil from the end of the channel 30 to the packing rings at 34 and 35, see Figure 7. The arcuate section type of ring is of particular utility in the case of small bits.

Now referring to Figure 4, there is shown a modified form of the invention involving a cutter cone 41, a spindle 42, a spindle head 43 and ball bearings 44. The cutter 41 corresponds generally in configuration to the cutter 21 except that instead of having a groove such as the groove 27 therein, it has an arcuate groove 45 defining a portion of a ball race. Complementary portions of the ball race are formed in the spindle 42 and in the spindle head 43, and the resulting ball race accommodates the balls 44 about which the cutter cone 41 can rotate, and which prevent axial displacement of the cutter head during operation. The attachment of the spindle head to the tines of the fork of the bit is the same as that described in connection with Figures 1–3 and therefore need not be further discussed or described in connection with Figure 4. As in the case of Figure 3, annular packing rings are provided to prevent the escape of lubricant, and these are designated by the reference characters 46 and 47. The spindle 42 is provided with a central passageway at 48 having a grease fitting 49 and an open end at 50 discharging into the bearing space between the cutter cone and the spindle. The assembly of the modified form of apparatus shown in Figure 4 corresponds to that described in connection with Figure 3 except that balls are inserted, rather than a ring, prior to the connection of the spindle 42 to the spindle head 43. Helical grooves for the distribution of lubricant correspond in structure and function to those described in connection with Figure 3.

Now referring to Figures 8, 9 and 10, there is shown a modification of the construction in which the lubricant is differently applied to the bearing surface between the cutter cone and the spindle and in which the spindle and spindle head are not connected together by threading. In Figure 8 the portions of the main bit assembly which are shown, correspond in structure and function to those described in connection with Figure 1. Accordingly, the numeral 51 is used to designate generally the bit assembly. Within the bottom portion of the drill head 51 there is provided a pressure accumulator 52 comprising a storage tank divided into two working spaces by a piston 53. The piston is urged downwardly by a spring 54 and is moved upwardly by liquid in the working space 55 which communicates through a passageway 56 in the drill head and spindle head with a passageway 57 extending from a lubrication fitting 58 through the spindle head 59 and the spindle 60. The working space 61 having therein the spring 54 of the pressure accumulator 52, is provided with an air vent at 62. It can now be seen that when lubricant is provided under pressure at fitting 58, not only will it be pumped through the passageway to the bearing between the cutter cone and the spindle and spindle head, but it will also be forced upwardly through the passageway 56 to the working space 55, causing the piston 53 to move upwardly against the thrust of spring 54 until the space 55 is completely filled with lubricant. Thereafter when the drill is put into use, it is apparent that as the lubricant works out from underneath the cutter cone, an additional supply is rendered available by the stored energy in the spring 54 which will pump lubricant from the space 55 through the passageways 56 and 57 into the bearing space between the cutter cone and its supporting structure.

In addition to the lubrication features illustrated and described in connection with Figures 8–10 inclusive, it is noted that the spindle head 59 is connected to the spindle 60 by a boss and sleeve arrangement. A sleeve 63 on the spindle

head 59 extends between the spindle proper and a central, generally cylindrical boss member 64 attached thereto, or integral therewith. The boss 64 is provided with a series of spaced radial projections 65 disposed in an annular path about its outer surface. The surfaces of the members 65 are curved and a complementary curved groove is cut in the spindle 60. The circumferential spacing of the projection 65 allows for the distortion of the sleeve 63 which is indicated in Figure 10. It is now apparent that when the spindle 60 is to be attached to the spindle head 59, it is only necessary that the two be hammered together in the direction of the arrow indicated in Figure 9 to cause the sleeve 63 to be distorted in its passage around the spaced members 65 of the boss 64. This effects a relatively permanent locking of the core member to the wedge member while the locking of the cutter cone against axial movement relative to the supporting assembly is effected as in Figure 3 by the use of a dual ring assembly designated in the drawings at 67. The oil distribution grooves and packings correspond generally to those shown in the preceding figures.

It will be noted that the sealing gaskets 34 and 35 shown in Figure 3, the gaskets 46 and 47 shown in Figure 4, and the gaskets or packings 68 and 69 shown in Figure 8 are so located that the thrust incident to the rotation of the cutter cone tends to compress them to improve their efficacy in prevening outleakage of the lubricant.

While the invention has been described with respect to but a few embodiments thereof, it is apparent that various modifications lie within the scope of the invention as defined in the appended claims.

What is claimed is:

1. A drill bit comprising a head portion, a fork extending from said portion, a spindle head member secured to said fork at one end, a threaded section at the opposite end of said spindle head member, a spindle member including a frusto-conical head, a threaded section, and a shank forming a reduced portion of the outer end of the spindle member and adapted when assembled to extend substantially through an opening in the spindle head to the outer side of said head, a tightening tool slot in the end of said shank, said spindle head member threaded section engaging said spindle member threaded section by utilizing said tightening tool slot, a lubricating fitting positioned on the end of said shank, a longitudinal conduit in said spindle member leading from said lubrication fitting to the apex of said frusto-conical head, said spindle member defining a continuous bearing surface, said spindle head member defining a continuous bearing surface, said members defining therebetween a peripheral groove, a cutter cone mounted for relative rotation with said members, said cutter cone and spindle member being removable as a unit from said spindle head member, said cutter cone defining inner bearing surfaces complementary to the bearing surfaces of said members, and a groove in registry with said peripheral groove, and a ring bearing means located between said members and lying in said grooves in close fitting relationship to absorb the axial thrust of said cutter cone and to act as a seal to restrict the passage of oil between the bearing surfaces of the spindle member and the spindle head member.

2. A drill bit as in claim 1 in which said ring includes a split so that its circumference can be reduced during assembly and the spindle can be inserted in the cutter cone and the ring then inserted and expanded into the groove of the cutter cone and finally the spindle and spindle head connected together, said split being offset to present a continuous annular cross-section within its groove to restrict the passage of oil.

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