United States Patent

[11] **3,550,972**

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[54] **ROCK BIT ASSEMBLY**
10 Claims, 6 Drawing Figs.

[52] **U.S. Cl.** **308/8.2**
[51] **Int. Cl.** **F16c 19/14**
[50] **Field of Search** 308/8.2

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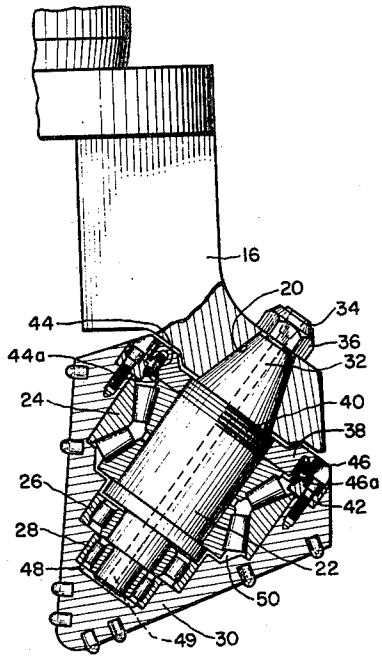
ABSTRACT: A rock bit mounted on an annular member, together with others thereof, by a single bolt or like mounting hardware, in cantilever fashion, in which removal of the single item of hardware demounts the bit. In addition, the bit is carried rotatably on a shaft, the bit and shaft defining therebetween a sealed chamber which is filled with lubricant.



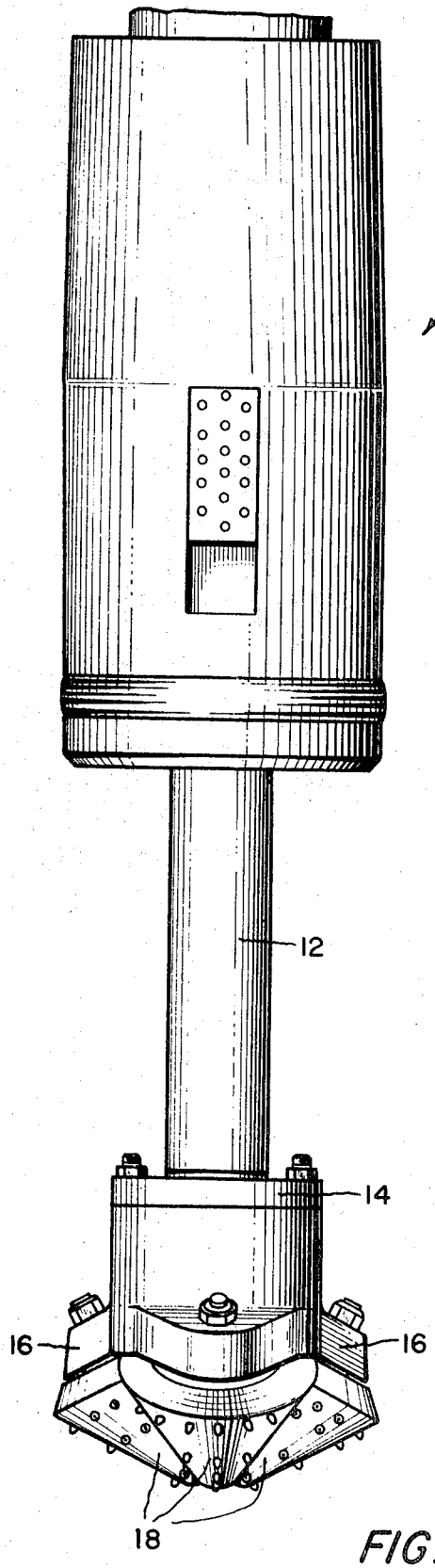


FIG. 1

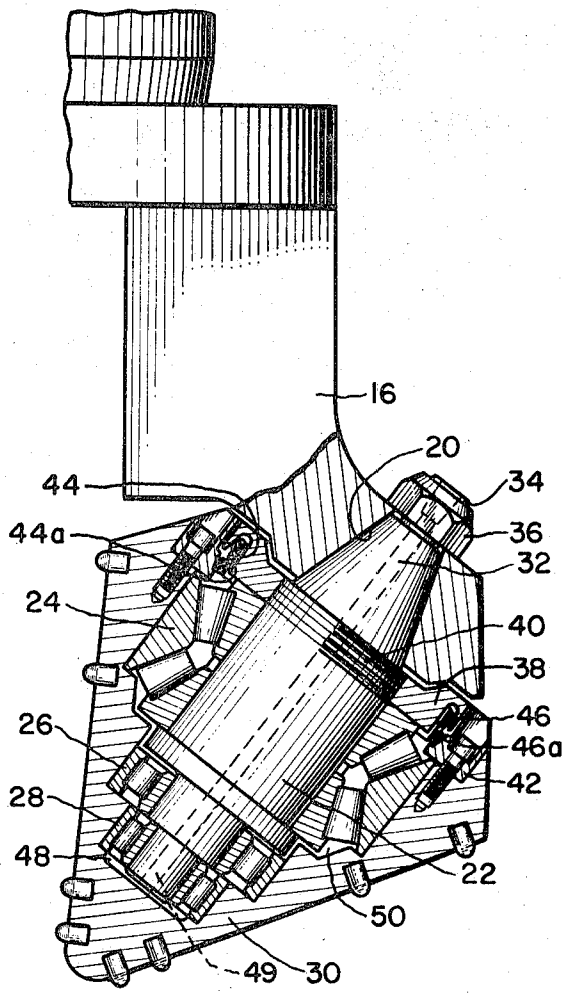


FIG. 2

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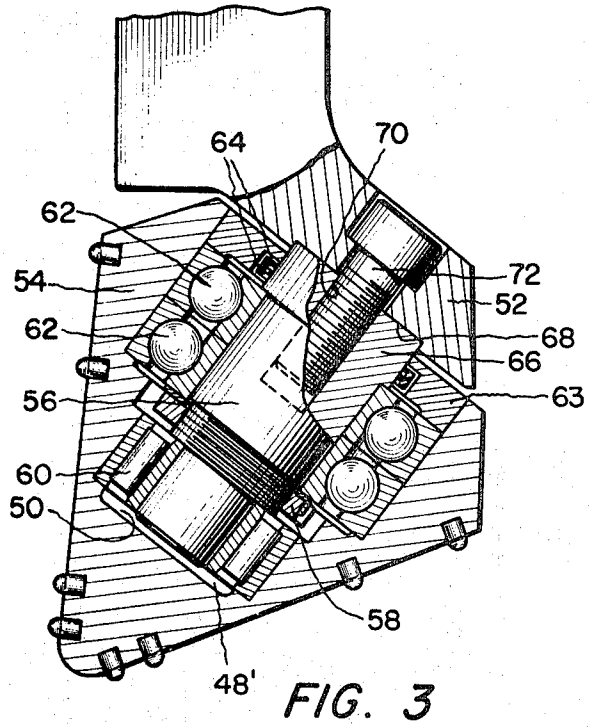

FIG. 3

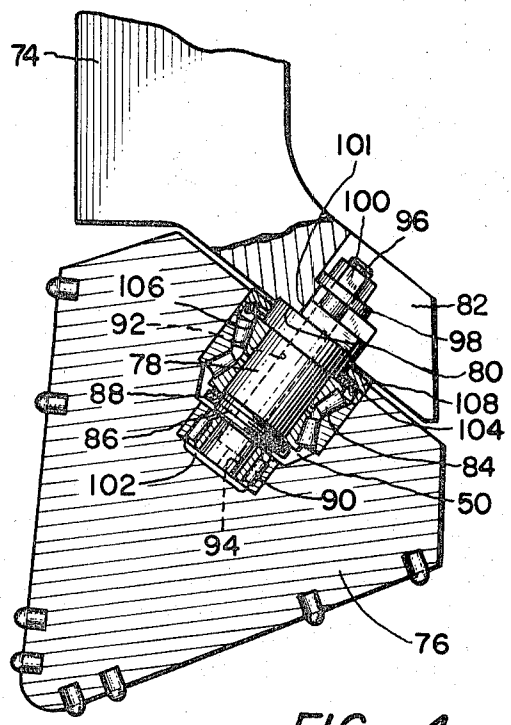

FIG. 4

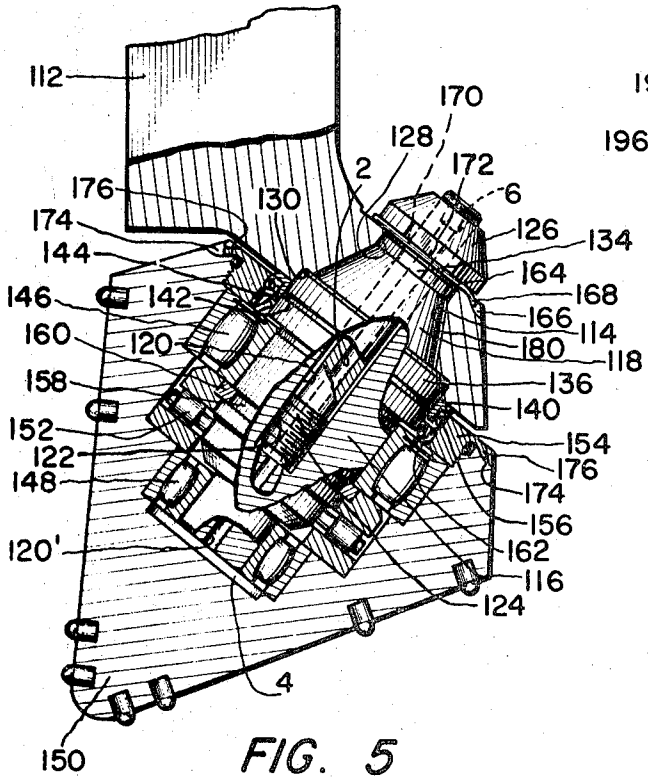

FIG. 5

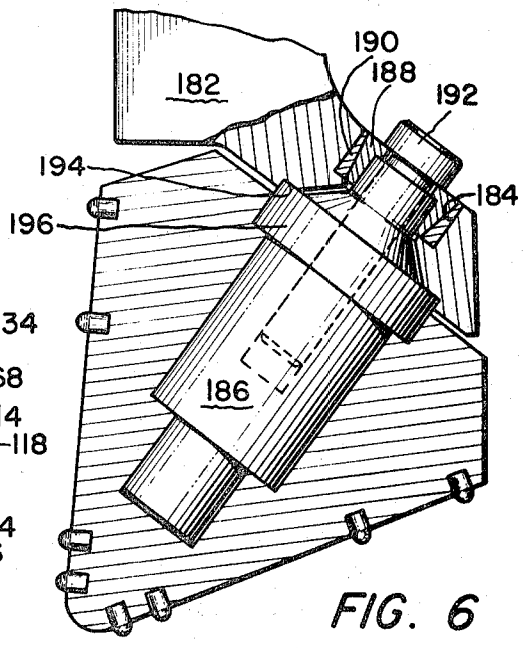

FIG. 6

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ROCK BIT ASSEMBLY

This invention pertains to a rock bit assembly useful in mining and tunneling operations and the like and in particular to a roller type rock bit assembly of a plurality of such assemblies carried forwardly of a mining or tunneling machine.

Rock bit assemblies known in the prior art rely on the flushing or circulating fluid to lubricate the rolling or bearing components thereof. However, ordinarily this practice of using circulating fluid as a lubricant has been inadequate, so much so that customarily the mortality of the bearings precedes that of the bit. Detritus is turbulently carried up in the fluid and finds its way, through interstices of the bit mounting, to the bearing components. Also, even when there is a bit failure, the rock bit assemblies as known in prior art are not readily replaceable from the mounting plate or mounting head to which they are secured. Customarily they are secured to trunnions welded to and extending from the mounting head, and it is required to remove the entire head in order to replace only one worn rock bit.

Therefore it is an object of this invention to teach a rock bit assembly which eliminates the use of circulating fluid as a lubricant.

Another object of this invention is to teach a rock bit assembly having self-contained lubricant.

Another object of this invention is to provide an improved rock bit assembly having a lubricant chamber therewithin and lubricant sealed within the chamber.

It is a further object of this invention to provide a rock bit assembly which is mounted in cantilever fashion on a mounting member supported by single means removable for mounting and demounting of the bit.

A feature of this invention comprises a rock bit assembly of the roller type having but a single bolt, stud, or like supporting hardware for carrying the bit on an annular member, together with complementary roller bits.

Another feature of this invention comprises providing a shaft for mounting bearings and the bit thereon, the shaft being formed for engaging supporting hardware and defining together with the bit a lubricant chamber in which is confined a lubricant.

Further objects and features of this invention will become more apparent by reference to the following description taken in conjunction with the accompanying FIGS. in which:

FIG. 1 is a side elevational view of the forward end of a mining machine carrying the rock bit assembly of the invention on a mounting annulus;

FIG. 2 is a longitudinal, cross-sectional view of one of the bits of FIG. 1; and

FIGS. 3, 4, 5, and 6 are longitudinal cross-sectional views of alternate embodiments of rock bit assemblies according to the invention.

As shown in FIG. 1 a mining machine 10 has extending forwardly thereof drive shaft 12 which terminates in a mounting head 14. The mounting head 14 secures thereto an annular member 16 which mounts thereon rock bits 18 of the roller type. Any one of the rock bits 18, and any one of said bits together with annular member 16 teach embodiments of the invention; specific descriptions of these embodiments follow.

As shown in FIG. 2 the annular member 16 has a tapered bore 20 in which is received the shaft 22. Shaft 22 mounts thereabout double tapered roller bearing 24 and straight roller bearings 26 and 28. Bit 30 is supported on the bearings for rotation relative to the shaft 22. Shaft 22 has a tapered portion 32 which is received in the tapered bore 20 and has a first threaded portion 34 on one end thereof, adjacent the smaller end of the taper, which projects extendably from member 16. Shaft 22 receives a nut 36 on its first threaded portion, and mounts an annular plate 38 about a second threaded portion 40 of the shaft. Portion 40 is formed adjacent the larger end of the tapered portion 32. Annular plate 38 is provided to retain bearing 24 in position. A mounting ring 42 is disposed in a recess in bit 18 and has hardware securing it to the bit. Mounting ring 42 supports sealing rings 44 and 44*a* together with

resilient seals 46 and 46*a* adjacent to plate 38. A lubricant chamber 48 is formed between the inner dimensions of bit 30 and the external diameters of shaft 22 and confines therewithin the bearings 24, 26 and 28 together with a lubricant 50.

The bit assembly shown in FIG. 2 is mounted in cantilever fashion on member 16, and is supported by the single threaded shaft 22. Shaft 22, of course, is readily removable from member 16, by removal of nut 36 from the threaded end 34 thereof.

Chamber 48 is fully closed against the entry of detritus. The smaller end of the chamber 48, adjacent bearing 28, is closed by the working end of bit 30. The larger, annular end of chamber 48 is closed is by plate 38, rings 44 and 44*a*, seals 46 and 46*a*, and ring 42.

Rings 44 and 44*a* are resiliently suspended in immediate adjacency to, yet spaced from plate 38. Rings 44 and 44*a* have tapered cross sections, and the tapering thereof, in cooperation with resilient seals 46 and 46*a*, urge said rings 44 and 44*a* to maintain a mutually contacting, but relatively slidable, juxtaposition. By this arrangement, seal 46*a* is free to rotate together with ring 42 and sealing ring 44*a*. Ring 44*a* slides rotatably on ring 44. Thus, through fixed seal 46 and rotating seal 46*a*, the chamber 48 is maintained closed to the admittance of detritus.

Shaft 22 has an axial passageway 49 extending fully therethrough the terminus of which, in the externally projecting end of shaft 22, has pipe threads formed therein to receive, selectively, a lube "fitting" or a breather-type plug (neither of which is shown). The fitting is temporarily fastened in the threaded end of passageway 49 for admitting a pressured charge of lubricant 50 into chamber 48. After charging the chamber 48 with lubricant 50, the plug, a filter type of breather plug, is fastened in place of the fitting. A filter type is cited to insure against the entry of dirt, under pressure, past the sealing elements, into the bearings 24, 26, and 28.

Lubricant 50 can be packed into chamber 48 on fabrication of the bit assembly; lubricant 50 can be supplied thereto before the emplacement of ring 42. Also, those skilled in the art will recognize other means of lubricating, pressure-lubricating the novel bit of my invention. As for instance, a lube "fitting" can be positioned in penetration of plate 38, in a recess, for pressure-lubricating the chamber 48 before mounting the bit assembly to member 16. It is not my purpose here to set forth all possible methods.

An alternate embodiment of the rock bit according to my invention comprises an annular member 52, shown in FIG. 3, for receiving a bit 54. Bit 54 is supported on a shaft 56. Shaft 56 is threaded externally, intermediate its length, to receive a bearing retaining nut 58, and carries a roller bearing 60 and angular contact bearings 62 in tandem. A further bearing retainer and seal carrier 63 is disposed at one end of the shaft and receives therein a pair of seals 64 for closing off the lubricant chamber 48'. Shaft 56 has an enlarged head portion 66 which is accommodated in a recess 68 formed in the annular member 52. Further shaft 56 has a tapped bore 70 for receiving a socket headed cap screw 72 for securing the shaft, together with the bearings and bit mounted thereon, in recess 68. The lubricant chamber 48' confines therewithin, by virtue of seals 64, lubricant 50.

Another embodiment of my novel rock bit is shown in FIG. 4 where an annulus 74 carries the bit 76 on a shaft 78. One end of the shaft 78 is disposed within a recess 80 formed in annulus 74 and is secured in a slotted mounting access 82 provisioned therefore in annulus 74. This embodiment uses a double tapered roller bearing 84 about the center of shaft 78 for rotation of the bit 76 relative to the shaft. Shaft 78 has a threaded portion 86 adjacent one end thereof which receives a bearing retaining nut 88. At the inner end thereof, i.e., the end opposite the supported end, shaft 78 mounts a straight roller bearing 90. Also, shaft 78 has a bolt hole 92 formed therein for receiving a fastening bolt. The inner end of shaft 78 has a bolt head socket 94 provisioned for nesting therein the head of

socket headed mounting bolt 96. Bolt 96 extends through shaft 78 and projects from annulus 74 where it receives a washer 98. Washer 98 is secured to the shaft and annulus 74 by means of a hexagonal nut 100.

Shaft 78 has a flatted portion 101 formed on the supported end thereof which "keys" or "polarizes" it in a given position in access 82. Accordingly, should it happen that bearings 84 and 90 fail, and seize, this keying or polarizing will prohibit any rotation of shaft 78.

Lubricant chamber 102 confines the lubricant 50 therewithin by virtue of the seal 104 disposed at the one end thereof. In addition a seal receiving ring 106 is spaced about shaft 78 and together with a bearing retaining ring 108, press fitted in bit 76, secures the seal 104 therewithin.

In FIG. 5 an annular member 112 has a tapered mounting bore 114 for receiving the shaft 116. Shaft 116 has a tapered end 118 for general mating therewith. Shaft 116 has formed therein an axial hole 120 with a tapped portion 122 for receiving therewithin a stud 124. Stud 124 receives the nut 126 on the projecting end thereof to secure the shaft 116 in the mounting bore 114.

The mounting bore 114 has a first constant diameter section 128 and a second constant diameter section 130 for receiving, by way of an interference fit, constant diameters 134 and 136 of shaft 116. The constant diameter section 136 of shaft 116 also receives a wear ring 140, and has thereabout a recess for mounting therewithin an O-ring seal 142. A seal receiving ring 144 is carried on the wear ring 140 to provide for sliding, relative rotation therebetween. In this embodiment two radial roller bearings 146 and 148 are mounted about the shaft to provide for relative rotation between bit 150 and shaft 116. Between the roller bearings 146 and 148 is disposed a thrust bearing 152. A bearing retaining ring 154 is arranged between bit 150 and ring 144; it has threads on the outer surface thereof for engagement with a threaded portion of bit 150 and retains bearing 146 in position. A seal 156 is disposed between ring 144 and retaining ring 154 to close off the lubricant chamber from the admittance of detritus. Shaft 116 has an annularly recessed portion 158 about midway along its length for receiving therein a spacer ring 160 which is used to position the bearings, and to resist the thrust created by bearings 152 and 146. In addition a lip-type seal 162 is sealingly arranged between retaining ring 154 and constant diameter section 136 for cooperation with seal 156.

Stud 124 also receives a washer 164 thereabout between nut 126 and the supported end of shaft 116. The annular member 112 has a recess 166 which receives a tang 168 of washer 164. Washer 164 has a square hole 170 through the center thereof which surmounts a square extension 172 projecting from nut 126. Accordingly, through the cooperation of the square hole and extension, and with the tang 168 turned into recess 166, nut 126 is constrained against rotation relative to stud 124. In addition there are a plurality of recesses 174 formed in the bit 150. The recesses 174 receive tangs 176 extending from retaining ring 154 so as to secure retaining ring 154 against rotation relative to the bit. Finally it is to be noted that there is a space defined between shaft 116 and annular member 112 along the tapered portion thereof. This space defines a hydraulic chamber 180 which is used for removal of the shaft 116 from member 112. After having removed nut 126 it remains only to charge chamber 180 with fluid under pressure to force shaft 116 out of the mounting bore of the annular member 112. Fittings and the like, for introducing fluid to chamber 180, which can be in penetration of member 112, are not shown. Those skilled in the art to which the invention pertains are knowledgeable about methods and devices for fluid-pressurizing a chamber such as that of chamber 180. Therefore detailed discussion of this aspect is not given here.

Installation of the shaft 116 is accomplished by torquing nut 126 until the shaft 116 is fully seated in section 130. Torque is applied until sufficient force is developed to overcome friction at sections 128 and 130, until shaft 116 "bottoms" in section 130.

Stud 124 has a bore 2 formed axially there through, from end to end, provisioned for the pressure-lubricant-charging of the sealed lubricant chamber 4. The supported end of stud 124 has formed within bore 2 a tapered pipe thread section 6 for receiving, alternately, a lube "fitting" and a sealing plug. Thus, the rock bit assembly configuration of FIG. 5 can be lubricant charged after and during its rigid mounting on member 112. Normally, a sealing plug (not shown) will be secured in section 6. The plug is removed and supplanted with a lube fitting, and chamber 4 is pressure-lubricated, until the lubricant is observed "bleeding" between the sealing components whereupon the fitting is removed and the plug replaced.

In a still further alternate embodiment I show a simplified supporting arrangement for the emplacement and demounting of the rock bit. The bearings and lubricant chamber are not shown but can be of any one or any combination of the types shown in the prior embodiments. In this further embodiment of FIG. 6, I teach the use of an annular member 182 having a straight mounting bore 184 for receiving the rock bit shaft 186. The mounting end of shaft 186 receives thereabout a tapered, cup-shaped sleeve 188. Sleeve 188 also receives thereabout a tapered annulus 190. Shaft 186 is tapped to receive a bolt 192 used to pull shaft 186 into rigid mounting in annular member 182. Shaft 186 is received in a shouldered recess 194 formed in annular member 182, an enlarged portion 196 of shaft 186 nesting therein, and it also is received in the cup portion of sleeve 188. When bolt 192 is turned into the threaded portion of shaft 186 it forces tapered sleeve 188 and annulus 190 into intimate engagement and rigidly fastens shaft 186 in annular member 182.

Accordingly, while I have described my invention in connection with specific embodiments thereof, it is to be clearly understood that this is done only by way of example and not as a limitation to the scope of my invention as set forth in the objects thereof and in the accompanying claims.

I claim:

1. A rock bit assembly, comprising:
a rock bit;
means for mounting said bit thereon;
means providing cantilever support of said bit on said mounting means, including means providing for relative rotation between said bit and said mounting means;
said support means comprising single removable means for mounting and demounting of said bit;
said support means and said bit cooperatively defining lubricant chamber means therebetween; and
means sealing said chamber means against detritus; wherein
said chamber means confines lubricant therewithin;
said mounting means comprises an annular member having at least one tapered mounting bore formed therethrough;
said support means comprises a shaft having a tapered portion along a length thereof, adjacent one end thereof, in engagement with said bore, said shaft having threads formed in said one end, said one end projecting extendably from said bore; and
including a fastener in threaded engagement with said one end rigidly securing said shaft to said annular member; and
further including bearing means interpositioned between said shaft and said bit for effecting said rotation;
an annular plate adjustably and replaceably fastened adjacent one end of said tapered portion retaining said bearing means in position;
a mounting ring replaceably fastened to said bit restrainingly engaging said bearing means;
means resiliently supported in immediate adjacency to, and in spaced relationship from said plate for receiving seal means thereupon; and
means interpositioned between said ring and said seal-receiving means for sealing off said chamber.

2. A rock bit assembly, comprising:
a rock bit;
means for mounting said bit thereon;

means providing cantilever support of said bit on said mounting means, including means providing for relative rotation between said bit and said mounting means;

said support means comprising single removable means for mounting and demounting of said bit;

said support means and said bit cooperatively defining lubricant chamber means therebetween; and

means sealing said chamber means against detritus; wherein

said chamber means confines lubricant therewithin; and

said mounting means comprises an annular member having at least one mounting bore formed therethrough;

said support means comprises a shaft having one end thereof in engagement with said mounting bore;

said shaft having an axial hole formed therein, said hole having a threaded portion formed along a length thereof;

and including a stud threaded at either ends thereof, one end thereof in engagement with said threaded portion, and the other end thereof extendably projecting from said shaft and said member; and

a fastener in threaded engagement with said other end, rigidly securing said shaft to said annular member.

3. A rock bit assembly, according to claim **2**, wherein:

said mounting bore has a plurality of sections of constant diameter and a further section of varying diameter relative the axis of said shaft, and said one end of said shaft has a plurality of diameters corresponding with those of said plurality of sections which have mutually engaged interference fits therewith;

one shaft diameter of said plurality thereof carries a wear ring thereabout;

an O-ring seal interpositioned between said wear ring and said one shaft diameter;

a seal-receiving ring engagingly supported by said wear ring for relative rotation therebetween;

bearing means interposed between said shaft and said bit; and

a bearing retaining ring having first threads formed thereon;

said bit having second threads formed thereon threadably engaging said first threads;

said retaining ring having a surface engaging and constraining said bearing means in position.

4. A rock bit assembly, according to claim **3**, wherein:

said bearing retaining ring resiliently carries said seal-receiving ring; and including

resilient means interpositioned between said retaining and seal-receiving rings; and wherein

said shaft has a recessed portion for receiving spacer ring means therewithin, said spacer ring means and said retaining ring cooperate to position said bearing means, and to resist bearing thrust loads.

5. A rock bit assembly, according to claim **2**, wherein: said sealing means comprises a plurality of coaxial, resilient seals.

6. A rock bit assembly, according to claim **3**, wherein: said bearing means comprises both a plurality of radial roller bearings, and thrust bearing means.

7. A rock bit assembly, according to claim **6**, wherein: said thrust bearing means is interpositioned between the roller bearings of said plurality.

8. A rock bit assembly, according to claim **4**, wherein: said resilient means comprises said sealing means.

9. A rock bit assembly, according to claim **2**, wherein:

said annular member has a recess formed therein; and further including

a washer interpositioned between said fastener and said annular member;

said washer having a linear-sided hole formed therethrough; and

said fastener having a linear-sided extension formed thereon which receives said linear-sided hole thereabout,

said washer having a tang extending and deflected therefrom, and nested in said recess, prohibiting rotation of said nut and said washer relative to said stud.

10. A rock bit assembly, according to claim **3**, wherein:

said bit has a plurality of recesses formed therein; and

said retaining ring has a plurality of tangs extending and deflected therefrom, and nested in the recesses of said plurality thereof, prohibiting rotation of said retaining ring relative to said bit.