United States Patent

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[54] **ROCK DRILL BIT**
6 Claims, 4 Drawing Figs.

[52] **U.S. Cl.** **175/237,** 173/90, 175/395, 175/418
[51] **Int. Cl.** **E21c 13/06**
[50] **Field of Search** 175/417, 418, 415, 237, 395; 173/90

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ABSTRACT: A rock drill bit having helical side cutting edges and radial bottom cutting edges, and having an inside cavity for receiving cooling mud, with diametrically opposite downwardly and outwardly inclined outward passages connecting the inside cavity to diametrically opposite grooves between the side cutting edges. The bottom of the bit has a central mud return passage leading to the inside cavity and provided with a ball check valve.

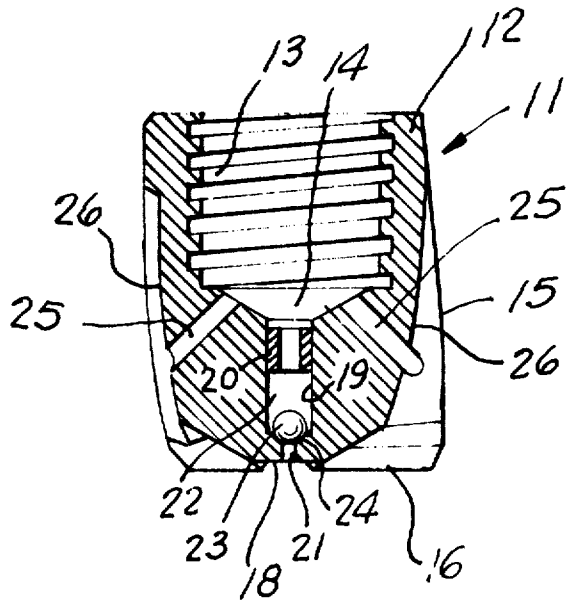


FIG. 1.

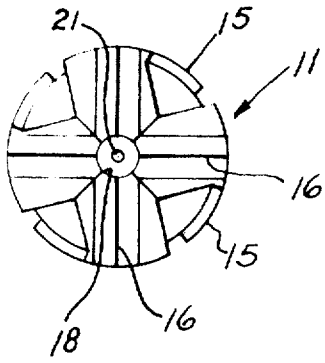


FIG. 3.

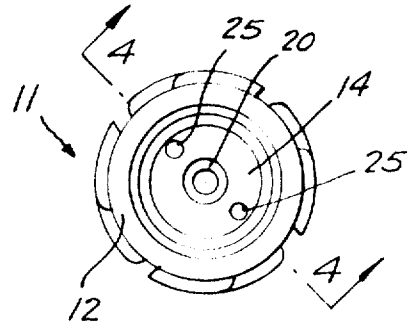


FIG. 2.

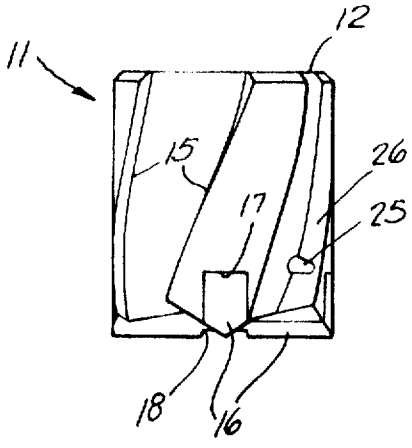
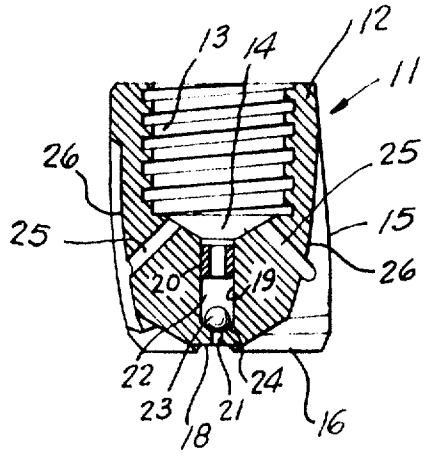


FIG. 4.



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ROCK DRILL BIT

This invention relates to rock-drilling bits, and more particularly to rock-drilling bits of the type provided with means for conveying suitable flushing liquids to the cutting edges of the bit.

A main object of the invention is to provide a novel and improved rock-drilling bit which is simple in construction, which is provided with means for conveying cooling mud or other cooling liquid to the cutting edges thereof, and which is further arranged so that the cooling mud or liquid can circulate through the bottom portion of the drill bit while the drill bit is in operation, thereby providing an efficient cooling action.

A further object of the invention is to provide an improved rock-drilling bit which is inexpensive to manufacture, which is durable in construction, which is economical to use, and which provides an effective cooling action to its cutting edges so as to maintain such cutting edges sharp over long periods of use of the bit.

A still further object of the invention is to provide an improved rock-drilling bit of the type employing circulating cooling mud or similar cooling fluid in the region of its cutting edges, the passages for circulating the cooling mud for liquid being so arranged as to minimize the possibility of their becoming clogged by rock chips or similar debris, whereby the bit can be maintained in an efficient operating condition over long periods of use.

Further objects and advantages of the invention will become apparent from the following description and claims, and from the accompanying drawing, wherein:

FIG. 1 is a bottom plan view of an improved rock-drilling bit constructed in accordance with the present invention;

FIG. 2 is a side elevational view of the rock-drilling bit of FIG. 1;

FIG. 3 is a top plan view of the bit of FIG. 1 and 2;

FIG. 4 is a vertical cross-sectional view taken substantially on the line 4—4 of FIG. 3.

In the art of drilling rock, concrete, or the like, it is found to be necessary to supply suitable cooling mud or liquid to a bit employed in this operation for the purpose of preventing undesirable temperature effects from damaging the cutting edges of the drill bit, since the heavy percussion forces applied to the drill bit tends to create high friction and accompanying high temperature effects. In order to efficiently cool the drill edges and other parts subjected to heavy percussion effects, it is necessary to provide an adequate supply of cooling mud or liquid thereto, and it is further advantageous to provide circulation of the cooling mud or cooling liquid so as to carry off the generated heat rapidly and effectively. In the prior art devices where circulation has been attempted, there is a tendency in many designs for the circulation passages to become clogged up by loose bits of rock or other debris generated by the operation of the drill mechanism. A prime purpose of the present invention is to provide an arrangement wherein the tendency of the passages to become clogged is reduced to a minimum.

Referring to the drawing, 11 generally designates an improved rock drill bit constructed in accordance with the present invention. The drill bit 11 comprises a main body 12 having an axial bore provided with internal threads 13, whereby the body 12 may be threadedly secured in a conventional manner to a suitable hollow drill shank, not shown, through which cooling mud or other cooling liquids, such as a mixture of air and water, may be conveyed to the drill bit cavity. This cooling mixture is thus furnished to the drill bit cavity and is deposited in the lower portion 14 thereof.

The body 12 is formed with spirally shaped side cutting teeth 15 which merge with radially extending bottom cutting teeth 16, which may comprise suitable hard metal inserts of tungsten carbide or other highly durable metal, the inserts being suitably secured in radial cavities 17 provided therefor in the bottom portion of the drill bit body 12.

The bottom of the drill bit body 12 is formed with a central recess 18, and said body is further formed with an axial bore 19 communicating with the bottom portion 14 of the main drill bit cavity through a short sleeve 20 secured in the top portion of the bore 19, as shown in Figure 4. The bottom end of the bore 19 communicates with the central bottom recess 18 through a reduced passage 21, thereby defining a check valve ball cavity 22. A check valve ball 23 is positioned in the cavity and normally rests on a substantially frustoconical bottom seat 24 provided therefor around the top end of the reduced passage 21. As will be apparent from FIG. 4, the ball 23 is free to rise in the central check cavity 19 and thus allows unrestricted flow upwardly through bore 19 and sleeve 20, but prevents downward flow through passage 21.

The body 12 is formed with a pair of diametrically opposite downwardly and outwardly inclined flow passages 25, 25 connecting opposite grooves 26 which are defined between adjacent cutting edges 15, to the bottom space 14 in the body 12 of the bit. Thus, the cutting edges 15 at the sides of the bit are defined by respective spirally shaped ribs, as above mentioned, which are of generally triangular cross section, and the passages 25, 25 open at the troughs between respective adjacent pairs of said spirally shaped portions carrying the side cutting edges 15. The passages 25, 25 are downwardly and outwardly inclined, approximately at angles of 45°, as shown in FIG. 4.

In operation, suitable cooling liquid or mud, such as a mixture including water and air is forced downwardly through the supporting shank and into the bottom portion 14 of the bit cavity, the cooling mixture flowing outwardly adjacent the cutting edges and impacting surfaces of the bit through the passages 25, 25. As will be readily understood, the bit is rotated as well as driven downwardly during its operation, and the cooling liquid passes downwardly through the grooves 26 and beneath the bit, eventually being forced upwardly past the check valve ball 23 into the passage 22 and thence through the sleeve 20 back into the space 14. During operation of the bit this process is repeated, thereby providing circulation of the cooling liquid material and promoting efficient cooling of the bit so as to prevent an excessive rise in temperature of the cutting edges thereof. The loosened material is forced upwardly in a conventional manner and removed at the surface of the bore hole, and the liquid pressure applied outwardly from the space 14 resists any tendency for fragments of material to lodge in the passages 25. It is also not possible for fragments of undesirable size to pass upwardly through the restricted passage 21, since said passage is quite small. Thus, the cooling liquid is circulated in an efficient manner responsive to the reciprocation and accompanying rotary action of the drill bit and excessive temperature rise of the cutting edge portions of the bit is thereby prevented.

The fluid is forced under pressure downwardly through passages 25. As the ball 23 vibrates as a result of the impact produced from the action of the associated percussion drilling machine, the fluid intermittently is forced upwardly through passage 22, and therefore, the fluid is intermittently forced downwardly to facilitate drilling and thereafter is forced upwardly to rid the drill hole of cuttings.

It will be understood that with the bit in operation, there will be liquid material in the bore hole, so that with each downward stroke of the bit, some of the liquid material will be forced upwardly into the check valve cavity 22, and eventually will be forced into the main bit cavity space 14, so that it can be recirculated outwardly through the diametrically opposite side passages 25, 25. This circulation continues as long as the bit is operated, assuming that an adequate supply of cooling mud or liquid is furnished to the bit through the hollow supporting shank.

The ball 23 not only functions as a check valve ball but also as a vibratory element, since said ball is of considerable mass, and acts to vibrate the lower portion of the bit so as to shake fragments of material off the bottom end thereof and prevent such fragments from passing upwardly through the valve cavi-

ty 19. Thus, materials such as clay, or the like, which might tend to thicken and clog in the passages 25, 25 of the bit are vibrated off the bottom surface of the bit by the repeated impacts of the ball 23 against the surfaces of its retaining cavity as the bit is reciprocated and rotated during its normal operation. The impact of the ball 23 against its seat and against the adjacent surfaces of its retaining cavity tends to shake particles of clay loose from the region adjacent the passage 21 and to cause such particles to drop down and away from the recess 18.

The vibratory action of the ball 23 is produced by the shock generated by the action of the associated percussion drilling machine (the machine forces the steel bit down and the bit stops suddenly as it hits the rock, which causes the ball 23 to have a start-stop, or vibratory, action).

In the operation of the bit, it is rotated in a counterclockwise direction, as viewed in FIG. 3, and the cooling mud or liquid discharging from the passages 25, 25 flows downwardly and rearwardly through the associated grooves 26 toward the regions beneath the radial cutting edge members 16 so as to effectively cool said cutting edges.

From the above description, it will be readily apparent while the drill bit is in operation, the circulating liquid maintains the various passages thereof clear and prevents said passages from being clogged by the clay or the loose material generated by the percussion strokes of the bit. Thus, the circulating liquid material provides a self-clearing action, as well as a cooling action on the drill bit.

While a specific embodiment of an improved rock drill bit has been disclosed in the foregoing description, it will be understood that various modifications within the spirit of the invention may occur to those skilled in the art. Therefore, it is intended that no limitations be placed on the invention except as defined by the scope of the appended claims.

What is claimed is:

1. A rock drill bit comprising a body adapted to be connected to a hollow supporting shank to receive cooling fluid therefrom, said body having a central cavity and a plurality of side cutting teeth having grooves therebetween, respective radial bottom cutting teeth mounted on the bottom of said body and merging with said side cutting teeth, said body being formed at its bottom portion with an axial bore communicating with said central cavity, said bore having a centrally apertured bottom wall opening adjacent the inner ends of said radial bottom teeth, said body having a plurality of side passages connecting said central cavity to said respective grooves between pairs of side cutting teeth, and a vibratory ball member loosely disposed in said axial bore and being sealingly engageable over the central aperture of said bottom wall, wherein said side cutting teeth are spirally curved, wherein said side passages are inclined downwardly and outwardly from said central cavity, wherein said side passages are located diametrically opposite each other, and wherein said axial bore is provided with stop means limiting upward movement of said vibratory ball member therein.

2. The rock drill bit of claim 1, and wherein said stop means comprises a sleeve member secured in the upper portion of said axial bore and having an inside diameter less than the diameter of the vibratory ball member.

3. The rock drill bit of claim 1, and wherein said side passages are inclined downwardly and outwardly at an angle of approximately 45° to the horizontal.

4. The rock drill bit of claim 1, and wherein the bottom wall of the axial bore is formed with a frustoconical ball seat around said central aperture.

5. The rock drill bit of claim 1, and wherein the underside of said body is formed with a central recess inwardly adjacent the inner ends of the radial bottom teeth, said central aperture opening centrally in said central recess.

6. The rock drill bit of claim 1, and wherein said central cavity of the body has a frustoconical downwardly convergent bottom wall surface, said axial bore merging with said bottom wall surface at the apex portion of said bottom wall surface, said side passages opening into the central cavity at said frustoconical bottom wall surface.