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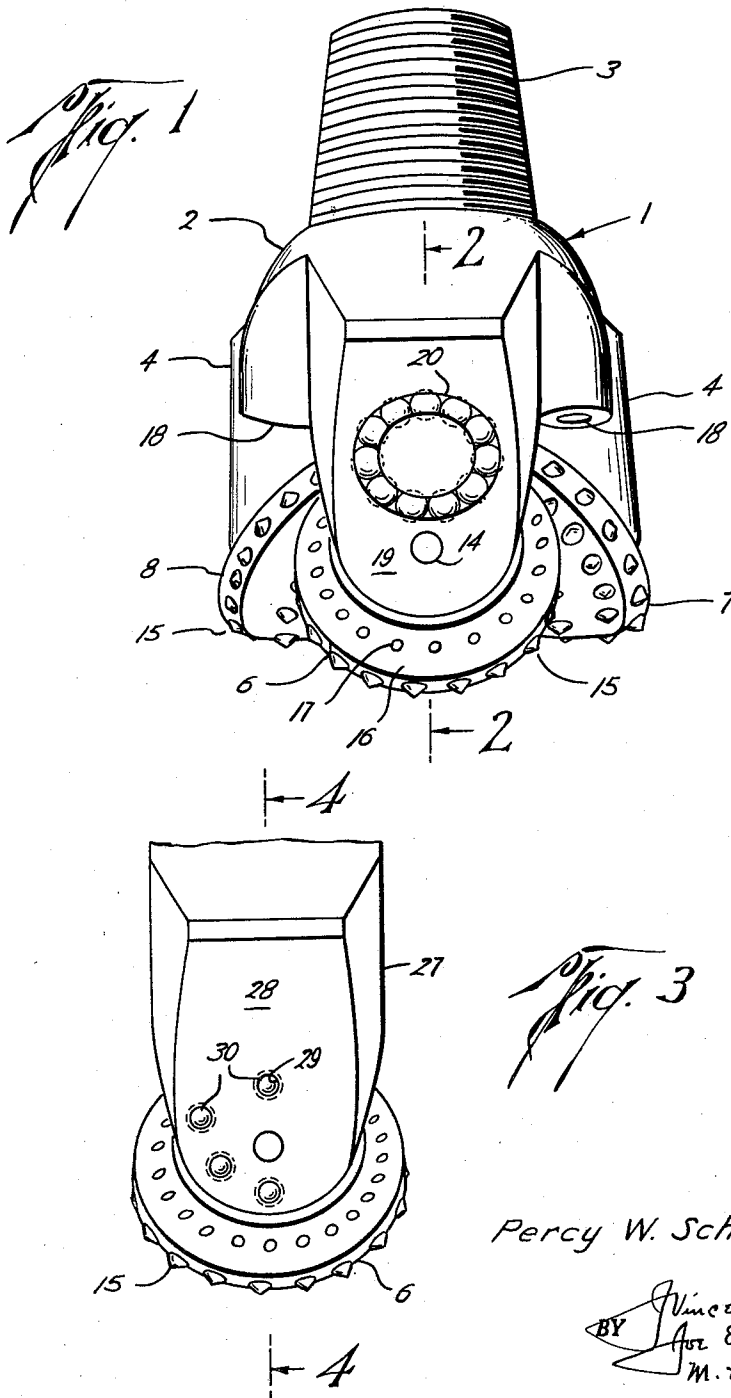
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3,130,801

DRILL BIT HAVING INSERTS FORMING A REAMER

Filed Feb. 9, 1961

2 Sheets-Sheet 1



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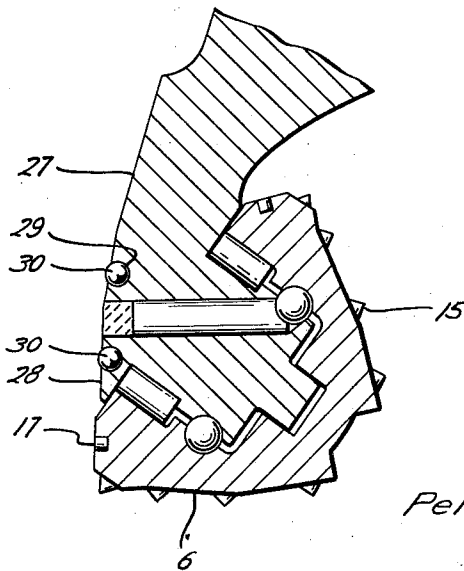
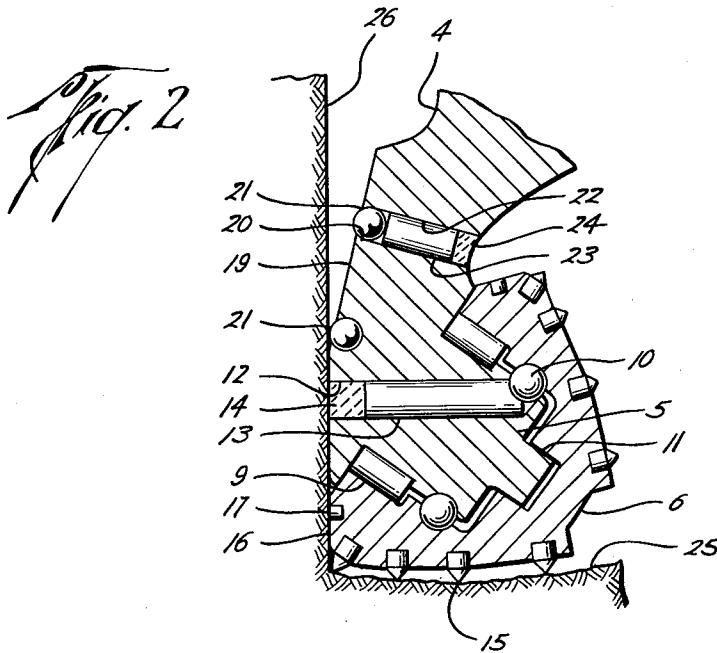
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DRILL BIT HAVING INSERTS FORMING A REAMER

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3,130,801 DRILL BIT HAVING INSERTS FORMING A REAMER

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This invention relates generally to roller drill bits and more particularly to a drill bit useful for drilling hard abrasive formations.

In the rotary drilling of bores in earth formations, a roller drill bit is connected to the lower end of a hollow drill stem which is lowered and rotated to cause the bit cutters to roll upon the bottom of a borehole to cut or crush the formation being encountered. A drilling fluid such as gas or liquid is circulated downwardly through the drill stem and bit, and rises to the surface of the earth in the space between the drill stem and the wall of the borehole. The drilling fluid thus circulating serves to cool the drill bit, and carry out of the borehole cuttings produced by the drilling operation. The cuttings are not always efficiently removed, particularly when air is used as a drilling fluid, because in certain formations such as taconite, the cuttings may be relatively large and heavy and tend to settle to the bottom of the hole, and pack around the drill bit. These particles are extremely abrasive so that frequently parts of the drill bit, particularly the depending legs, may be prematurely worn to such an extent that the useful life of the drill bit is impaired. The drill bit cutters have bottom cutting portions and gage portions to produce a uniform diameter well bore. The gage maintaining portion of the cutter also is subject to abrasive wear by these particles by reason of its action on the wall of the borehole.

A general object of this invention is to provide a new and improved roller drill bit wherein certain parts thereof are protected from destruction by formation erosion.

Another object is to provide a new and improved depending leg for a drill bit into which are disposed sintered tungsten carbide inserts.

Another object is to provide a new and improved depending leg for a roller drill bit wherein movable hard metal inserts are arranged in the outboard surface of the leg to assist in maintaining a uniform diameter of the borehole.

Another object is to provide hard metal balls rotatably retained in sockets in the leg of a rotary drill bit.

Other objects will become apparent from the following description and the accompanying drawings, in which:

FIG. 1 is a side elevational view of a drill bit embodying the invention.

FIG. 2 is a sectional view taken along line 2—2 in FIG. 1.

FIG. 3 is a fragmentary view of a drill bit showing another embodiment of the invention.

FIG. 4 is a sectional view taken along line 4—4 in FIG. 3.

Referring to the drawings, a steel drill bit is shown generally at 1 comprising a bit head 2 and a hollow threaded pin 3 extending upwardly for attachment to the lower end of a drill stem (not shown). The head 2 has a plurality of downwardly extending legs 4 which terminate in downwardly and inwardly extending shafts 5. Steel roller cutters 6, 7 and 8 are rotatably mounted on the shafts 5.

As shown in FIG. 2, a suitable bearing structure is provided comprising roller bearings 9 and ball bearings 10 employed in complementary raceways on the shaft 5 and in the cutter 6. The inner end of the shaft 5 is re-

duced to provide a friction bearing pin 11. The ball bearings 10 are inserted in place through an opening 12 in the bit leg 4 and the shaft 5. A ball retaining plug 13 is then inserted into the opening 12, and secured in place by a weld 14.

The steel roller cutters 6, 7 and 8 are provided with a plurality of sintered tungsten carbide cutting elements 15 which may be secured in the cutter bodies by pressing them into sockets which are slightly smaller than the outside diameter of the inserts. The cutter 6 has a gage face 16 in which a row of wear resistant inserts 17 is provided.

The bit of the invention is particularly useful in drilling holes in taconite formations wherein explosives are inserted into the holes to blast apart the taconite. Usually these holes are drilled with a drilling rig which employs air as a circulating drilling fluid. The air is compressed and circulated downwardly through the drill stem (not shown), into the hollow threaded pin 3, through the bit head 2 and outwardly of the bit through nozzles 18. The taconite formations usually are unconsolidated and broken so that as the drill bit progresses through these formations, particles or cuttings removed therefrom by the drill bit may be large and heavy. In addition, there is a tendency for portions of the formation to flake off and fall from the side walls of the borehole. The particles of formation produced by the drill bit and those falling downwardly from the side walls of the hole may pack around the drill bit, and continued rotation of the drill bit may cause the particles to erode away certain parts thereof. The exterior surface 19 of the depending leg 4 and the gage face 16 of the cutter 6 are particularly subjected to such erosion.

In order to alleviate formation erosion of the leg 4, the outer surface 19 thereof may be provided with a circular raceway, or groove, 20. A plurality of sintered tungsten carbide balls 21 is inserted into the raceway 20 through a bore 22 in the leg 4, after which a ball retaining plug 23 is inserted into the bore 22 and secured by a weld 24. The width of the raceway 20 at the surface 19 is smaller in dimension than the diameter of the balls 21 to retain them within said raceway.

Referring to FIG. 2, the bottom of a borehole is shown at 25, and the side wall of the borehole is shown at 26. The plane of the raceway 20 is preferably inclined away from the wall of the borehole 26. The carbide balls 21 may be arranged to protrude outwardly beyond the surface 19 of the leg 4. As the drill bit 1 rotates on its axis, the balls 21 in the lower portion of the raceway 20 engage the side wall 26 to assist in maintaining the desired uniform diameter bore. Since the balls 21 are free to move or circulate in the raceway 20, the balls roll rather than scrape on the wall 26, to crush the formation. Even if the balls 21 are prevented from circulating freely about the raceway 20, because of the presence of formation cuttings or other detritus, the balls 21 in operation have a tendency to rotate because of the rolling action of the balls 21 on the wall 26 of the borehole. Thus the balls 21 may present new wear surfaces as drilling progresses to provide more effective wear resistant area to maintain the gage of the borehole. All of the balls 21 may be composed of a wear resistant material such as tungsten carbide; however, if desired, hardened steel balls or the like may be interposed alternately between the tungsten carbide balls 21.

Referring to FIGS. 3 and 4, another embodiment of the invention is shown wherein a depending leg 27 has an exterior surface 28 which has a plurality of spaced sockets 29. Hard metal balls 30 may be disposed in the sockets 29 whereupon the material of the leg 27 may be deformed around the lip of the socket 29, such as by staking, to retain the ball 30 within the socket 29. The

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balls 30 are arranged so that they may rotate within the sockets 29 as they come into contact with the wall 26 of the borehole during the drilling operation.

The invention is not limited to the embodiments shown. Various changes within the scope of the following claims will occur to those skilled in the art.

I claim:

1. In a well drill useful for drilling hard abrasive formations, a bit head having a plurality of downwardly extending roller cutter supporting legs, an inwardly and downwardly extending shaft on each of said legs, a roller cutter mounted on each of said shafts, the outboard portion of the said leg which faces the side wall of the borehole being drilled having an outwardly open circular ball raceway therein, a plurality of sintered tungsten carbide balls movable in said raceway and arranged to protrude outwardly beyond the surface of said leg which faces the sidewall of the borehole and to roll against said side wall, means whereby said balls may be inserted into said raceway, and means to retain said balls in said raceway, whereby said movable carbide balls will protect the surface of said leg from destruction by abrasive downwardly falling particles of the formation from the side wall of the borehole during continued rotation of the well drill and will assist in maintaining a uniform diameter of said borehole.

2. A well drill structure as set forth in claim 1 in which the plane of said raceway is inclined upwardly, inwardly and away from the side wall of said borehole.

3. In a well drill useful for drilling hard abrasive formations, a bit head having a plurality of downwardly extending roller cutter supporting legs, an inwardly and downwardly extending shaft on each of said legs, a roller cutter mounted on each of said shafts, the outboard portion of at least one of said legs which faces the side wall of the borehole being drilled has an outwardly open circular ball raceway therein, a plurality of sintered tungsten carbide balls movable in said raceway and arranged to protrude outwardly beyond the surface of said leg which faces the side wall of the borehole and to roll against said side wall, means whereby said balls may be inserted into said raceway, and means to retain said balls in said raceway, whereby said movable carbide balls will protect the surface of said leg from destruction by abrasive downwardly falling particles of the formation from the side wall of the borehole during continued rotation of the well drill and will assist in maintaining a uniform diameter of said borehole.

4. In a well drill useful for drilling hard abrasive formations, a bit head having a plurality of downwardly

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extending roller cutter supporting legs, an inwardly and downwardly extending shaft on each of said legs, a roller cutter mounted on each of said shafts, the outboard portion of the said leg which faces the side wall of the borehole being drilled having an outwardly open circular ball groove therein, a plurality of sintered tungsten carbide balls movable in said groove and arranged to protrude outwardly beyond the surface of said leg which faces the side wall of the borehole and to roll against said side wall, means whereby said balls may be inserted into said groove, and means to retain said balls in said groove, whereby said movable carbide balls will protect the surface of said leg from destruction by abrasive downwardly falling particles of the formation from the side wall of the borehole during continued rotation of the well drill and will assist in maintaining a uniform diameter of said borehole.

5. In a well drill useful for drilling hard abrasive formations, a bit head having a plurality of downwardly extending roller cutter supporting legs, an inwardly and downwardly extending shaft on each of said legs, a roller cutter mounted on each of said shafts, the outboard portion of the said leg which faces the side wall of the borehole being drilled having therein outwardly open spaced sockets, a plurality of sintered tungsten carbide balls movable in said sockets and arranged to protrude outwardly beyond the surface of said leg which faces the side wall of the borehole and to roll against said side wall, and means to retain said balls in said spaced sockets, whereby said movable carbide balls will protect the surface of said leg from destruction by abrasive downwardly falling particles of the formation from the side wall of the borehole during continued rotation of the well drill and will assist in maintaining a uniform diameter of said borehole.

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