Nov. 17, 1953 G. R. WATSON 2,659,577

ROCK DRILL BIT

Filed Oct. 23, 1950

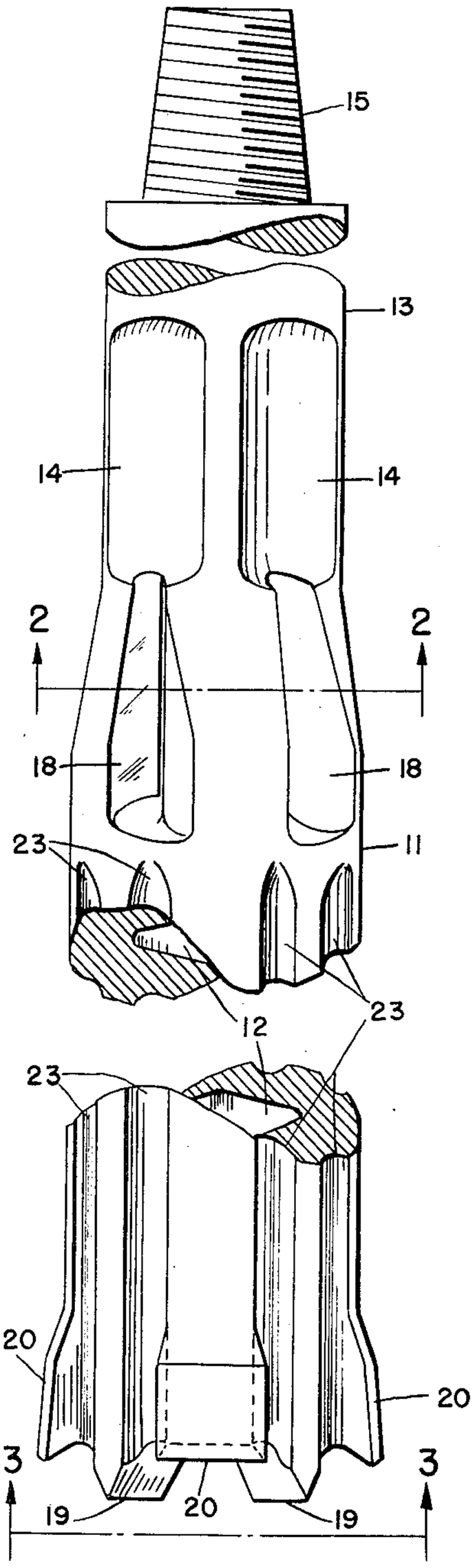

FIG. 1

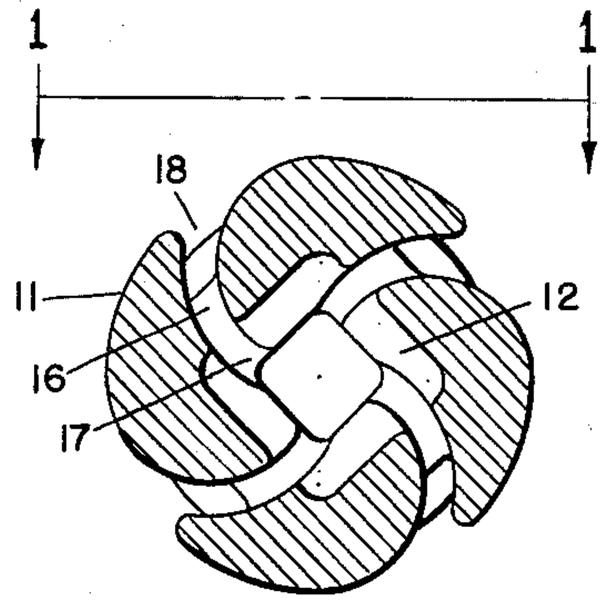

FIG. 2

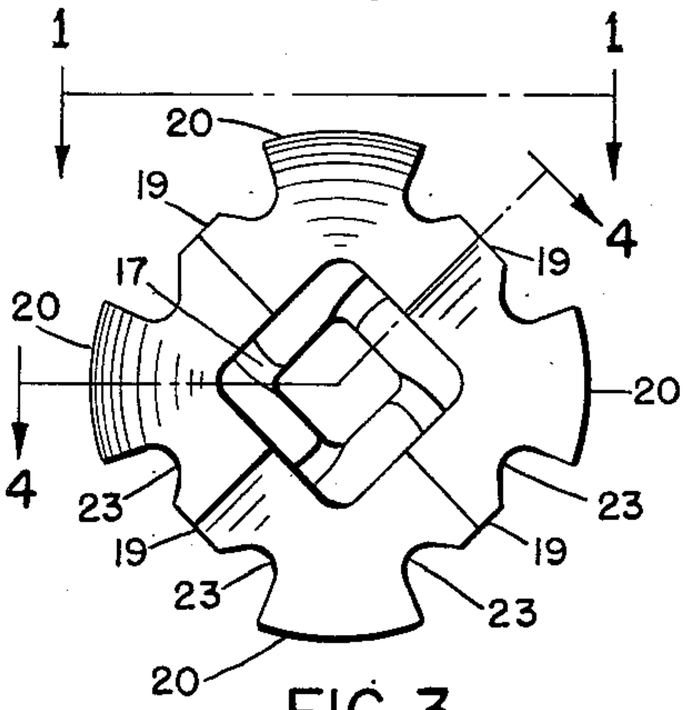

FIG. 3

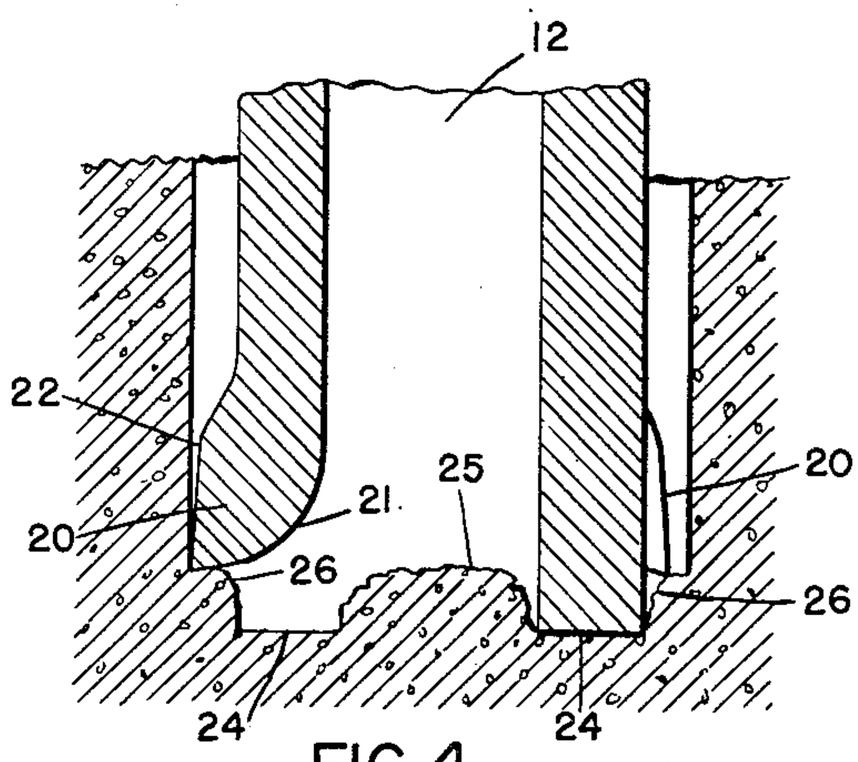

FIG. 4

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ROCK DRILL BIT

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14 Claims. (Cl. 255—63)

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My invention relates to new and useful improvements in rock drill bits, more particularly in percussion bits of the type used with cable-tool drills (sometimes known as churn drills) for use in drilling oil wells, water wells, blast holes, and other holes in the ground.

This is a continuation, as to all common subject-matter, of my copending application for Improvements in Rock Drill Bits, filed April 15, 1949, Serial No. 87,804, which was voluntarily abandoned November 28, 1950, without prejudice to this present application.

An object of my invention is to provide a percussion bit with a plurality of chipping cutters and a plurality of reaming cutters, all these cutters being so contrived and disposed as to dig the hole with the maximum of efficiency in the minimum of time.

Another object of my invention is to provide means for rotating the bit as it descends into the hole, so that its cutters will present a different contact with the bottom of the hole in each succeeding stroke.

In addition to my principal objects, above stated, I have worked out a number of novel and useful details, which will become readily evident as the description progresses.

My invention consists in the novel parts, and in the combination and arrangement thereof, which are defined in the appended claims, and of which one embodiment is exemplified in the accompanying drawings, which are hereinafter particularly described and explained.

Throughout the description the same reference number is applied to the same member or to similar members.

Figure 1 is a side view of the entire bit, in the vertical position which it occupies when drilling. This figure is seen in the direction of arrows 1—1 of Figures 2 and 3.

Figure 2 is a cross-section of my bit, taken at line 2—2 in Figure 1.

Figure 3 is a view of my bit from beneath, as indicated by arrows 3—3 in Figure 1, and

Figure 4 is a vertical cross-section of my bit and of the bottom portion of the hole which it is drilling, taken at line 4—4 in Figure 3.

In these figures, and more particularly Figure 1, we see that 11 is a hollow tubular body, constructed with relatively thick walls, and having a longitudinal cavity 12 extending from an opening at the working end of the bottom of the bit, to a narrowed solid section 13 near the top.

The cavity 12 is preferably, but not necessarily, of square (or other polygonal-shaped)

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cross-section with slightly rounded corners. The object of the polygonal cross-section is to engage a correspondingly shaped portion of the die of the bit-dressing machine, when sharpening the bit, and thus prevent rotation of the bit out of true during dressing. The object of the rounded corners is to eliminate a tendency for any cracks within the walls, to start at that location.

The solid section 13 includes a wrench-square, provided with flat faces 14 for contact with the jaws of a wrench, and terminates in a tapered threaded portion 15, known as the pin, to which may be screwed the next tool of the string, such as a drill stem, a set of jars, or a rope-socket, none of which is here shown.

Immediately below the wrench-square portion, the body is frusto-conical, and the cavity is frusto-pyramidal. The principal object of this gradual narrowing of the cavity at this location is that such construction is less liable to start cracks than would an abruptly-ending cylindrical cavity.

In the portion of the body 11, just discussed, there are a plurality of spirally disposed elongated discharge ports 16, which extend from the cavity 12 outwardly through the walls of the body 11, as shown in Figure 2. These discharge ports 16 are preferably, but not necessarily, narrow at their inner ends 17, and flare to a wider opening 18 at the outer periphery of the body 11. These discharge ports 16 are spiral so that the sludge forced upwardly through cavity 12 and discharged through these ports, during the down-stroke of the bit will have a turbine action, thus imparting a rotary motion to the bit.

The object of having the discharge ports 16 preferably flare outwardly is to prevent fragments of rock from becoming lodged in them.

It will be noted from Figure 1 that the upper ends of the slot-like outer openings 18 of my spiral discharge ports 16 extend up into the face 14 of the wrench-square portion. The object of this is to facilitate the escape of sludge between the bit body and the sides of the hole.

In cable-tool drills employing conventional bits of the prior art, the progressively different presentation of the working end of the bit to the bottom of the hole which it is drilling, is accomplished by the fact that the helical construction of the rope which supports the bit causes the rope to unwind slightly as it stretches when lifting the bit; and to wind up again as it relaxes when dropping the bit. The swivel-joint in the convention rope-socket binds somewhat during lifting, and is free to swivel during dropping.

Thus we have a ratchet-action, which rotates the bit during lifting.

The lower working end of my bit body 11 terminates in a tubular drill head, which is provided with a plurality of downwardly extending chipping cutters 19, and a plurality of outwardly and downwardly extending reaming cutter 20. These two sorts of cutters are alternately arranged. The shape and presentation of each sort is believed adequately indicated by a comparison of Figures 1, 3 and 4. But the following features may be noted.

It is essential that the chipping cutters 19 extend downwardly beyond the reaming cutters 20. It is very advisable that the chipping cutters 19 do not extend laterally as far as the reaming cutters 20. Preferably the chisel edge of the chipping cutters should run radially of the bit. Preferably the chisel edge of the reaming cutters should be a circular arc, about the center of the bit as a center. Preferably the vertical section of the reaming cutters should be curved on the inner face 21 and straight on the outer face 22 as shown in Figure 4.

Between successive alternating chipping cutters 19 and reaming cutters 20, there may be provided longitudinal flutes 23, to facilitate the shaping of the cutters when sharpening them in a bit-dressing machine.

The action of the cutters is as follows: The chipping cutters 19 drill an annular depression 24 in the bottom of the hole. Due to these cutters not extending laterally as far as the reaming cutters 20, which define the cylindrical inner face of the hole, there is eliminated the cramping resistance to chipping which exists with conventional bits, due to the curving of the face of the hole toward the chipping cutter on each side thereof. A similar cramping resistance to chipping would exist if my chipping cutters 19 met in the center, as they do in a conventional star bit; thus the elimination of this is seen to be an added advantage derived from my central cavity 12.

By reason of the foregoing elimination of cramping and also the relatively-short length of the edges of my chipping cutters, the annular depression 24 progresses downward much more rapidly than does the bottom of a hole drilled by a conventional bit. If in addition to my chipping cutters not meeting in the center, none of them even extends to the center, the total length of the chipping edges is still further reduced, thus still further speeding-up the downward progression of the hole. The central core 25 is found to shatter as the result of the drilling around it, without slowing up the drilling as actually chipping this core would do. And meanwhile, the reaming cutters 20 chip off the ledge of rock 26 which lies just outside the annular depression, and do this with much less effort than if we were depending on the chipping cutters for this.

The rock chipped and ground by my two sorts of cutters, when mixed with water which it is customary to add to such holes during drilling, constitutes the sludge which passes upward through cavity 12 and out through the turbine orifices 16, to rotate my bit, all as already described.

Having now described and illustrated one form of my invention, I wish it to be understood that my invention is not limited to the specific form or arrangement of parts herein described and shown.

I claim:

1. In a percussion bit, the combination of: an elongated body, having a central longitudinal cavity polygonal in cross-section and narrowing gradually toward its upper end and not extending through the upper end of the body and terminating in a central opening at the lower working end of the bit; a plurality of spirally disposed longitudinally elongated discharge ports, extending outwardly from the cavity completely through the wall of the body adjacent the upper end of the cavity, said discharge ports tapering from a narrow width at their inner ends to a wider width at their outer ends; and a plurality of alternating chipping cutters and reaming cutters, surrounding the central opening, and projecting downwardly from the working end of the bit, the reaming cutters extending outwardly beyond the chipping cutters and having their cutting edge curved in a circular arc about the longitudinal axis of the bit as a center, and the chipping cutters extending further downwardly than the reaming cutters.

2. In a percussion bit, the combination of: an elongated body, having a central longitudinal cavity terminating in a central opening at the lower working end of the bit and not extending through the upper end of the body; at least one spirally disposed discharge port, extending outwardly from the cavity completely through the wall of the body; and a plurality of downwardly-projecting chipping cutters and reaming cutters surrounding the central opening.

3. In a percussion bit, the combination of: an elongated body, having a central longitudinal cavity open at the working end of the bit and not extending through the upper end of the body; at least one spirally disposed discharge port, extending outwardly from the cavity completely through the wall of the body; and at least one cutter downwardly projecting from the working end of the bit.

4. A bit, in accordance with claim 3, further characterized by the fact that the discharge ports are adjacent the closed upper end of the cavity.

5. A bit, in accordance with claim 3, further characterized by the fact that the discharge ports are elongated longitudinally of the bit body.

6. A bit, in accordance with claim 5, further characterized by the fact that the discharge ports taper from a narrow width at their inner ends to a wider width at their outer ends.

7. A bit, in accordance with claim 3, further characterized by the fact that there are flat surfaces on the exterior of the body above and adjacent to the discharge ports, that the discharge ports are elongated longitudinally of the bit-body, and that the outer openings of the discharge ports extend to said flat surfaces.

8. A bit in accordance with claim 3, further characterized by the fact that there is in the working end of the bit a centrally-located polygonal opening to the longitudinal cavity.

9. A bit in accordance with claim 3, further characterized by the fact that the longitudinal cavity narrows gradually toward its upper end.

10. A percussion bit, having an elongated body containing a central longitudinal cavity terminating in a central opening at the lower working end of the bit, and having at the lower working end a plurality of downwardly projecting chipping cutters and reaming cutters, the chipping cutters extending further downward than the reaming cutters; said bit being further characterized by the fact that the cutting edge of each of the chipping cutters extends outwardly in a substantially radial direction to a point consid-

erably short of the cutting edges of the reaming cutters; whereby the cutting action of the chipping cutters will leave a peripheral shelf at the bottom of the hole being drilled, said shelf being chipped off later by the action of the reaming cutters, said bit further having means extending through the walls thereof, actuable by the descent of the hollow bit to cause the bit to rotate about its longitudinal axis.

11. A bit according to claim 10, further characterized by having a longitudinal cavity, closed at its upper end, and terminating at its lower end in a central opening between the inner ends of the edges of the chipping cutters; and by the fact that the rotation-causing means is turbine acting slots, extending through the walls of the bit from the longitudinal cavity.

12. In a percussion bit, the combination of: a hollow tubular body, open at its lower end and terminating into a solid closed section at its upper end; the upper end of the tubular portion of said body being provided with a plurality of longitudinal slots extending clear through its walls, said slots being spirally disposed and tapered from a narrow area at their inner end to a wide opening at their outer end at the lower extremity of said body, a plurality of reaming cutters, each sloping inwardly upwardly at its inner face and conically bevelled inwardly toward the top of its outer periphery of the body of the bit; a plurality of chipping cutters, each bevelled to provide a sharp cutting edge, said chipping cutters projecting considerably below the reaming cutters, but considerably less far radially outwardly than the reaming cutters.

13. In a percussion bit, the combination of: an elongated body, having a longitudinal cavity open at the lower working end of the bit and closed at its upper end; at least one cutter at the working end of the bit; and turbine acting slots, extending through the walls of the bit from the longitudinal cavity, and actuable by the

descent of the bit to cause the bit to rotate about is longitudinal axis.

14. A percussion bit, having an elongated body containing a central longitudinal cavity terminating in a central opening at the lower working end of the bit and provided with ports in the walls of the body of the bit for the escape of cuttings, and having at the lower working end a plurality of downwardly-projecting chipping cutters and reaming cutters, the chipping cutters extending further downward than the reaming cutters; said bit being further characterized by the fact that the cutting edge of each of the chipping cutters extends, radially, said cutting edges terminating considerably short of the center longitudinal axis of the bit and considerably short of the vertical projections of the cutting edges of the reaming cutters; by the fact that the cavity is large enough in cross section to leave a substantial uncut central core at the center of the bottom of the hole being drilled, but is small enough so that said core will be shattered during drilling by the impact of the cutting edges of the chipping cutters around the core; and by the fact that the cutting edges of the reaming cutters are arcs that are concave inwardly toward the central longitudinal axis of the bit; whereby the chipping cutters will cut an annular groove at the bottom of the hole being drilled, and leave an uncut central core and peripheral shelf.

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