

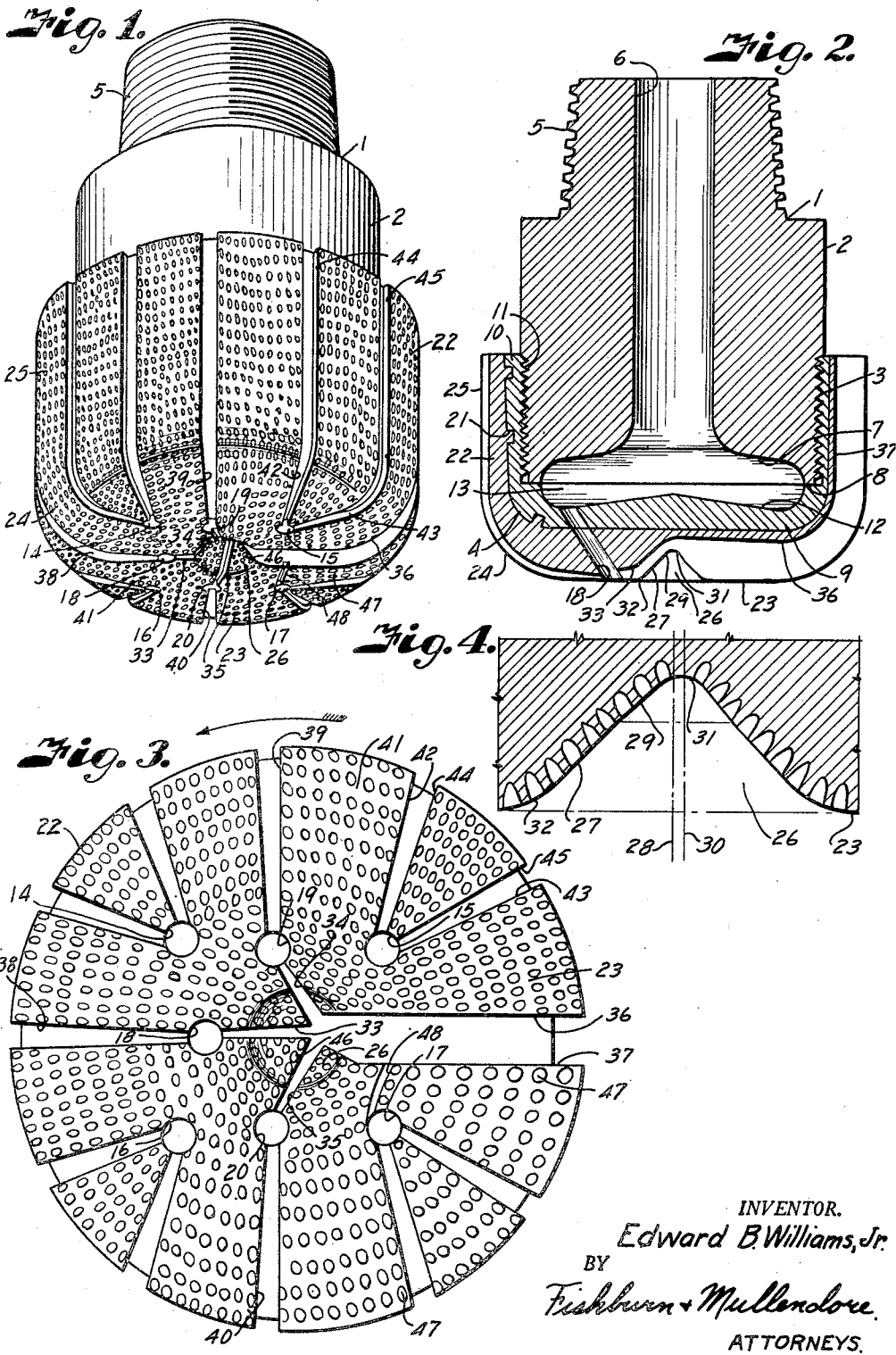
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DRILL BIT

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DRILL BIT

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This invention relates to drill bits for drilling bore holes in earth formations and particularly to a drill bit having drilling and reaming surfaces carrying a plurality of cutting elements such as diamonds, cemented carbides, or similar abrading elements.

The principal objects of the invention are to provide a bit of this character for effecting substantially uniform cutting action across the entire drilling face of the bit; to provide a drilling face shaped to contain a substantially large number of cutting elements in the central area of the bit; to provide for positive flow of drilling fluid across the central area to a low pressure area so as to assure removal of the cuttings from the cutting elements in the central area of the bit; to provide the bit with watercourses having discharge toward the central area of the bit to further assist in removal of the cuttings; and to provide a bit structure to facilitate formation of the watercourses.

It is also objects of the invention to provide the central area of the bit in the form of a cone-like recess having the apical portion offset from the axis of rotation of the bit so that the cutting elements carried therein gyrate about an axis offset from the rotational axis of the bit, thereby providing clearance for facilitating discharge of cuttings from the point of the cone; and to provide one of the sides of the offset portion of the recess with watercourses having outlet to a low pressure area near the opposite side of the recess.

In accomplishing these and other objects of the invention I have provided improved structure, the preferred form of which is illustrated in the accompanying drawings wherein:

Fig. 1 is a perspective view of a drill bit constructed in accordance with the present invention.

Fig. 2 is a diametric section through the bit.

Fig. 3 is a plan view of the drilling faces of the bit particularly illustrating the watercourses through which the cuttings are removed.

Fig. 4 is an enlarged fragmentary section through the central area of the bit particularly illustrating the cone-like recess and the offset apical portion thereof.

Referring more in detail to the drawings:

1 designates a drill bit constructed in accordance with the present invention and which includes a substantially cylindrical body member 2 having external threads 3 at one end for attachment of a cap member 4. The opposite end of the body 2 has an exteriorly threaded neck 5 of reduced diameter for attachment of the bit to a

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drill pipe (not shown). The body member of the bit is provided with an axial bore 6 terminating at the lower end in a relatively shallow recess 7 having its outer circumference extending substantially close to the periphery of the end face 8 of the body member 2. The cap member 4 is formed of material similar to that forming the body of the bit and has a head 9 extending across the end face 8 and provided with an annular flange 10 having internal threads 11 for engaging the threads 3 of the body member 2. The inner face of the head 9 has a recess 12 cooperating with the recess 7 to form a closed chamber 13 for distributing drilling fluid to a plurality of ports 14, 15, 16 and 17. The head 2 also has a plurality of ports 18, 19 and 20 opening from the outer marginal portions of the chamber 13 and directed inwardly toward the axis of the bit.

The end of the head and flange 10 of the cap are provided on the exterior faces thereof with a plurality of recesses 21 for anchoring matrix material 22 which embeds cutting elements later described and forms a drilling face 23 having a rounded marginal portion 24 merging into a cylindrical reaming face 25 encircling the flange of the cap member as best shown in Fig. 2. The matrix is formed of a relatively hard, tough material such as bronze or similar metal alloy or a plastic capable of being formed on the cap and having the property of retaining the cutting elements. The matrix material is of suitable thickness to provide the necessary strength, embed the cutting elements, accommodate a central conical recess 26, and the various watercourses for directing the drilling fluid and for carrying off the cuttings as later described. The recess 26 has a conical face 27 coaxial with the axis designated 28 of the bit and an apical portion 29 offset from the axis of the bit on an axis indicated by the line 30, Fig. 4. The terminal of the apical portion is rounded as indicated at 31 and the marginal surface of the conical portion 27 rounds as indicated at 32 into the end face of the bit.

The ports 18, 19 and 20 are continued through the matrix material and emerge through the drilling face 23 adjacent the circumference of the conical recess on one diametrical side thereof. The port 18 connects with a channel-like watercourse 33 formed in one side of the conical recess and extending across the apical portion thereof.

The ports 19 and 20 connect with similar watercourses 34 and 35 joining with the watercourse 33 on the opposite side of the apical portion of the recess and with a relatively larger channel-

shaped watercourse 36 that extends in a radial direction across the drilling face and joins with a vertical watercourse 37 that is formed in one side of the reaming face of the bit. The watercourse 36 is of substantially larger capacity than the combined capacity of the watercourses 33, 34 and 35 so that there is an appreciable pressure drop across the conical recess to assure movement of the drilling fluid at substantial velocity therethrough for carrying away the cuttings. Also connected with the ports 18, 19 and 20 are radial watercourses 38, 39 and 40 which, together with the watercourse 36 divide the drilling face of the bit into substantially quadrant-shaped cutting areas 41. The inlet to the watercourses 38, 39 and 40 are of less size than the inlets to the watercourses 33, 34 and 35 so that the radial watercourses will not bleed off pressure from the watercourses 33, 34 and 35. The cutting areas 41 are also supplied with drilling fluid through the ports 14, 15, 16 and 17, which ports are connected with diverging watercourses 42 and 43. The watercourses 38, 39, 40, 42 and 43 connect with vertical watercourses 44 and 45 extending upwardly in the reaming face of the bit. The conical or central area of the bit is provided along the advancing sides of the watercourses 33, 34 and 35 with rows of cutting elements 46 embedded within the matrix material and backed by similar elements carried in arcuate rows about the face of the conical recess.

The substantially quadrant-shaped cutting areas also have similar cutting elements 47 embedded in the matrix material between the watercourses with the cutting elements in one arcuate series offset from the immediately preceding and succeeding series of the adjacent segmental areas so as to provide substantially uniform cutting area across the face of the bit. To provide movement of drilling fluid on the forward side of the port 17, the port is connected with the low pressure watercourse 36 by a watercourse 48.

When the bit is in operation, a drilling fluid is circulated through the bore 6 and through the chamber 13 for discharge through the ports 14, 15, 16, 17 and 18, 19, 20. The direction of ports 18, 19 and 20 causes the fluid to be discharged toward the center of the bit and move through the watercourses 33, 34 and 35 into the low pressure watercourse 36 for discharge through the vertical watercourse in the reaming face of the bit. Simultaneously, jets of drilling fluid are discharged through the ports 14, 15, 16 and 17 and through the diverging ports 43 and 42 to carry away the cuttings from the cutting elements in the cutting areas of the drilling surface of the bit.

In order to facilitate movement of the drilling fluid and to accommodate the cuttings, the watercourses preferably increase in capacity in the direction of flow so as to avoid any likelihood of cuttings accumulating and wedging therein.

During rotation of the bit the cutting elements within the conical recess cut away the cone formed therein and the offset apical portion gyrates with respect to the cone so as to provide clearance through which the cuttings are readily discharged into the watercourses 33, 34 and 35 into the larger watercourse 36. The cone point of the formation is thus prevented from wedging into the point of the conical recess and the cutting elements therein are kept clean of the cuttings.

From the foregoing it is obvious that I have

provided a cutter that is capable of rapidly cutting relatively hard formations and wherein all cutting surfaces are adequately supplied with drilling fluid and the watercourses are so arranged that the cuttings are removed from all portions of the bit so that cutting elements throughout the cutting areas are under substantially the same operating conditions thereby assuring substantially uniform cutting of the bit over the entire area of the drilling surface.

What I claim and desire to secure by Letters Patent is:

1. A drill bit including a body member having a recess at one end and a cap member carried by said body member for closing the recess, a matrix material covering the cap member and forming a drilling face and an annular reaming face, said matrix material having a substantially conical recess in the center of the drilling face, cutting elements embedded in sides of the conical recess, said cap having ports connected with said closed recess near the outer marginal portion of said recess and directed inwardly through the drilling face in the direction of the extended axis of the bit and having watercourses connecting the ports with the conical recess for directing drilling fluid across said conical recess when the bit is in operation, said matrix material also having a watercourse on the opposite side of the conical recess to said said ports and of larger capacity than said watercourses for providing a low pressure outlet for the drilling fluid discharged through said ports to assure movement of drilling fluid under high velocity.

2. A drill bit having an end drilling face provided with a substantially conical recess located substantially in the center of said face and cutting elements embedded in the drilling face including the recess, said drilling face having a drilling fluid supply port spaced from one diametrical side of said recess and connected with said recess by a radial channel-like watercourse and said drilling face having a similar watercourse of larger capacity connected with the opposite diametrical side of said recess and opening through the outer circumference of the bit without any connection with the drilling fluid supply port other than through said recess to provide a low pressure outlet from said recess for drilling fluid delivered into said recess through said port and the radial watercourse connected therewith to effect a positive directional flow of drilling fluid and cuttings across said recess and through the low pressure channel-like watercourse.

3. A drill bit having a side reaming face and an end drilling face provided with a substantially conical recess located substantially in the center of said face and cutting elements embedded in the faces including the recess, said end drilling face having a drilling fluid supply port spaced from one diametrical side of said recess and connected with said recess by a radial channel-like watercourse and said drilling face having a similar watercourse of larger capacity connected with the opposite diametrical side of said recess, and extending through the side reaming face in an upwardly extending terminal without any connection with the drilling fluid supply port other than through said recess to provide a low pressure outlet for drilling fluid from said recess in positive directional flow through the low pressure channel-like watercourse.

4. A drill bit having an end drilling face provided with a substantially conical recess located substantially in the center of said face and cut-

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ting elements embedded in the drilling face including the recess, said bit having drilling fluid supply ports spaced from said recess and connected with said recess by a radial channel-like watercourse and said drilling face having a similar watercourse of larger capacity connected with the opposite diametrical side of said recess, but having no connection with the drilling fluid supply ports other than through said recess to provide a low pressure positive directional flow outlet for drilling fluid from recess.

5. A drill bit having an end drilling face provided with a substantially conical recess located substantially in the center of said face and cutting elements embedded in the drilling face including the recess, said bit having drilling fluid supply ports spaced from said recess and connected with said recess by a radial channel-like watercourse and said drilling face having a similar watercourse of larger capacity connected with the opposite diametrical side of said recess, but having no connection with the drilling fluid supply ports other than through said recess to provide a low pressure positive directional flow outlet for drilling fluid from recess, said drilling face also having radial watercourses extending from said ports outwardly to the circumference of said face.

6. A drill bit having a side reaming face and an end drilling face provided with a substantially conical recess located substantially in the center

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of said face and cutting elements embedded in the faces including the recess, said end drilling face having a drilling fluid supply port spaced from one diametrical side of said recess and connected with said recess by a radial channel-like watercourse and said drilling face having a similar watercourse of larger capacity connected with the opposite diametrical side of said recess, and extending through the side reaming face in an upwardly extending terminal without any connection with the drilling fluid supply port other than through said recess to provide a low pressure outlet for drilling fluid from said recess in positive directional flow through the low pressure channel-like watercourse, said end drilling face also having radial watercourses extending outwardly from said ports and upwardly of the reaming face.

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