

UNITED STATES PATENT OFFICE

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CORE BIT

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6 Claims. (Cl. 255—72)

1

This invention relates to drill bits and particularly to those of the type known as core bits for taking cores of earth formations.

The principal objects of the invention are to provide a core bit having circular series of cutters in association with watercourses to effect efficient and rapid cutting of earth formations; to provide a series of arcuate cutters spaced apart circumferentially to form substantially radial watercourses across the face of the bit and spaced radially to provide circumferential watercourses interconnected with the radial watercourses; to provide watercourses having increasing capacity in the direction of movement of the drilling fluid therethrough so as to compensate for the gradual increase in flow volume due to the progressive addition of cuttings along the length of the watercourses; and to provide progressive offset of the cutters in the respective circular series outwardly from the rotational center of the bit to provide cuts related to the linear travel of the respective cutters and thereby establish substantially uniform cutting action across the face of the bit.

It is also an object of the invention to provide a core bit having a contour and watercourses directed and arranged to facilitate egress of the cuttings and to effect substantially uniform velocity flow of the drilling fluid to thereby prevent centrifugal separation and accumulation of the cuttings in any portion of the watercourses.

In accomplishing these and other objects of the invention hereinafter pointed out, 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 core bit constructed in accordance with the present invention.

Fig. 2 is a diametric section through the bit.

Fig. 3 is an enlarged view of the drilling face of the bit, particularly illustrating the arrangement of the cutters and watercourses.

Fig. 4 is a view showing contour of an enlarged section through the bit.

Referring more in detail to the drawings:

1 designates a core bit constructed in accordance with the present invention and which includes a substantially cylindrical body 2 that is formed of a material to withstand drilling strains and shaped to provide an axial bore 3 to pass a core when the bit is in operation and to pass the drilling fluid from drill pipe (not shown). The upper end of the body is of reduced diameter to form an annular shoulder 4 and provide a threaded portion 5 to connect the bit with a conventional

2

core barrel (also not shown) but which is applied between the lower end of the drill pipe and drill bit as will be well understood by those skilled in core drilling practice.

5 The opposite end of the cylindrical body is also increased in interior diameter and decreased in exterior diameter to provide downwardly facing shoulders 6 and 7 on the respective sides of an annular matrix backing portion 8. The outer end of the portion 8 curves downwardly and outwardly from its inner cylindrical face 9 in gradually increasing curvature as at 10 to merge with the outer cylindrical face 11 which extends to the shoulder 6. The faces 9, 10 and 11 are provided with a plurality of sockets 12 to anchor a matrix material 13 forming the drilling and inner and outer reaming faces of the bit 14, 15 and 16 respectively. The matrix 13 is formed of relatively hard and tough material such as bronze, or other suitable metal alloy or plastic capable of bedding cutting elements therein as later described. The matrix extends outwardly from the shoulders 6 and 7 and projects from the inner and outer diametrical faces of the body 2 a suitable distance to provide a depth of material necessary to accommodate inner and outer vertical watercourses 17 and 18.

The drilling face 14 of the bit substantially conforms with the rounding face of the backing portion 8, that is, the cross section gradually increases in radius from the inner reaming face 15 to the outer reaming face 16 as best shown in Fig. 4. The watercourses 17 and 18 are interconnected across the drilling face by radial watercourses 20 having bottoms following the contour of the drilling face. The watercourses thus described are arranged in circumferentially spaced relation about the periphery of the bit to provide cutting areas 21 therebetween. The cutting areas which extend across the drilling face of the bit have radially spaced circumferential watercourses 22 that connect with the radial watercourses and cooperate therewith to provide arcuate cutters 22 substantially arranged in a plurality of concentric series.

In order to facilitate movement of the drilling fluid through the radial watercourses 20 they increase in capacity from their juncture with the inner vertical watercourses 17 to their juncture with the outer vertical watercourses 18 so as to accommodate freely the cuttings being discharged thereinto from the arcuate watercourses 22. The arcuate watercourses likewise increase in capacity in the direction opposite to the rotational direction of the bit to accommodate the discharge of

3

cuttings into the radial watercourses. The arcuate cutters, therefore, increase in width and depth toward the rotational direction of the bit incidental to the width and depth of the arcuate watercourses. Embedded in the matrix material forming each of the arcuate cutters are a series of cutting elements 24 comprising diamonds or other relatively hard material to cut the formation to be drilled. The cutting elements in each cutter are arranged on the median arcs of the cutters with the rotational axis of the bit as a center whereby all of the cutting elements in each cutter are in cutting alignment with the rotational direction of the bit but the cutters in each cutter of circumferential series are offset radially relatively to the preceding cutters so that the relative offset between adjacent preceding or succeeding cutter establishes the width of the radial cut affected by each cutter.

In order to effect substantially uniform cut across the drilling face of the bit, the offset in the cutters of the circumferential series is such as to compensate for the differential in linear rotational speed incidental to their difference in radii.

Attention is directed to the fact that offsetting of the cutters in each circumferential series gives the effect of a spiral arrangement of the cutters and provides for movement of the cuttings in arcuate paths relatively to the rotational axis of the bit and so that the cuttings are discharged in the flow direction of the drilling fluid moving through the circumferential watercourses.

The reaming faces of the bit have embedded therein a plurality of cutting elements 25 and 26 such as diamonds or the like, the cutting elements being embedded flush with the reaming surfaces so as to protect the diamonds when lowering the drill bit through a bore hole into drilling position.

When the bit is to be used, it is attached to a core barrel and the core barrel is connected with the drill pipe. The assembly is then lowered to the bottom of the bore hole by adding sections of drill pipe. When the bit is in drilling position the drill pipe is rotated by conventional means while drilling fluid is simultaneously circulated downwardly through the drill pipe and through the passageway 3 of the bit for discharge around the core and through the vertical watercourses 17. The drilling fluid on entering the radial watercourses follows the gradually increasing curvature at substantially the same velocity flow so as to avoid settling out of cuttings collected from the circumferential watercourses in the drilling face.

During rotation of the bit, the cutting elements are carried over the bottom of the hole and effect circular cuts corresponding to the relative offset of a preceding cutter, the offsets being proportioned so as to provide uniform cutting action across the entire drilling face. The cuttings removed by the cutting elements pass outwardly into the arcuate watercourses to be carried away by the streams of drilling fluid moving there-through incidental to rotation of the bit. The gradual increase in capacity facilitates discharge of the cuttings so as to prevent any possibility of wedging of the cuttings within any of the respective courses. The arrangement of watercourses thus provides an easy and short flow of the drilling fluid so as to maintain the cutters and flow passageways clean and free of cut material. The bit produces an annular cut in the

4

earth formation with clearance being maintained by the inner and outer reaming faces with the core being formed passing upwardly through the bit into the core barrel.

From the foregoing it is obvious that I have provided an efficient core bit that is kept clean of cuttings and which is capable of cutting relatively hard earth formations at relatively rapid rate.

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

1. A drill bit including a body member having an end drilling face provided with a plurality of radially spaced substantially circumferential passageways interconnected by substantially radial water courses and forming a plurality of annular rows of arcuate cutters having inner and outer eccentric arcuate edges forming sides of the circumferential passageways whereby said passageways increase in capacity between the radial watercourses to accommodate progressive addition of cuttings between the radial watercourses, and said radial watercourses having outwardly diverging sides for increasing capacity from inner ends toward outer ends thereof to accommodate progressive addition of cuttings from the circumferential passageways.

2. A drill bit including a body member having an end drilling face provided with a plurality of radially spaced substantially circumferential passageways interconnected by substantially radial watercourses and forming a plurality of annular rows of arcuate cutters having inner and outer eccentric arcuate edges forming sides of the circumferential passageways whereby said passageways increase in capacity between the radial watercourses to accommodate the progressive addition of cuttings between the radial watercourses said radial watercourses having outwardly diverging sides for increasing capacity from inner ends toward outer ends thereof to accommodate progressive addition of cuttings from the circumferential passageways, and cutting elements embedded in arcuate series within said cutters with the cutting elements in one arcuate cutter offset radially with the cutting elements in a succeeding arcuate cutter in a row of said cutters to effect cuts across the area of the bit when the bit is in use.

3. A drill bit including a body member having an end drilling face provided with a plurality of radially spaced substantially circumferential passageways connected by substantially radial watercourses and forming a plurality of annular rows of arcuate cutters having inner and outer eccentric arcuate edges forming sides of the circumferential passageways whereby said passageways increase in capacity between the radial watercourses to accommodate the progressive addition of cuttings, said radial watercourses having outwardly diverging sides for increasing capacity from inner ends toward outer ends thereof to accommodate progressive addition of cuttings from the circumferential passageways between the radial watercourses for facilitating egress of the cuttings and for maintaining substantially uniform flow velocity of the drilling fluid, thereby preventing centrifugal separation and accumulation of cuttings in the watercourses.

4. A core bit including a substantially tubular body member having an end drilling face and inner and outer reaming faces, said end drilling face being provided with a plurality of radially spaced substantially circumferential passageways eccentric with the axis of said body and inter-

5

connected by radial watercourses increasing in capacity from the inner reaming face toward the outer reaming face, said watercourses forming a plurality of rows of arcuate cutters having inner and outer eccentric arcuate edges forming sides of the circumferential passageways whereby said passageways increase in capacity between the radial watercourses to accommodate the progressive addition of cuttings between the radial watercourses for facilitating egress of the cuttings and for maintaining substantially uniform flow velocity of the drilling fluid, thereby preventing centrifugal separation and accumulation of cuttings in the watercourses.

5. A drill bit including a body member having an end drilling face provided with a plurality of radially spaced substantially circumferential passageways interconnected by substantially radial watercourses and forming a plurality of substantially annular rows of arcuate cutters, said watercourses and passageways having sides diverging in the direction of flow to effect increased flow capacity in the direction of flow for accommodating progressive addition of cuttings, thereby facilitating egress of the cuttings and maintaining substantially uniform flow velocity of the drilling fluid for preventing centrifugal separation and accumulation of cuttings in the watercourses and passageways.

6. A core bit including a tubular body member having an end drilling face and inner and outer reaming faces to maintain diameter of the core

6

and bore hole to be made by the bit, said end face being provided with a plurality of radially spaced substantially circumferential passageways interconnected by substantially radial watercourses forming a plurality of substantially annular rows of arcuate cutters, said inner and outer reaming faces also having watercourses connected with respective ends of the radial watercourses for respectively supplying and discharging a drilling fluid when the bit is in use, the radial watercourses in the end drilling face having sides diverging from the watercourses in the inner reaming faces toward the watercourses in the outer reaming face and said circumferential passageways having diverging sides from one radial watercourse to the next for effecting increased flow capacity in the direction of flow for accommodating progressive addition of cuttings, thereby facilitating egress of the cuttings and maintaining substantially uniform flow velocity of the drilling fluid in said watercourses.

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