March 13, 1945. E. B. WILLIAMS, JR 2,371,488

CORE BIT

Filed May 6, 1943

Fig. 1.

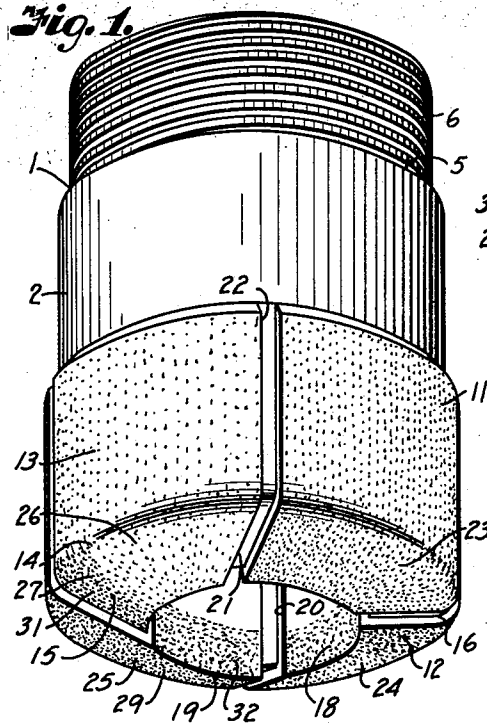


Fig. 2.

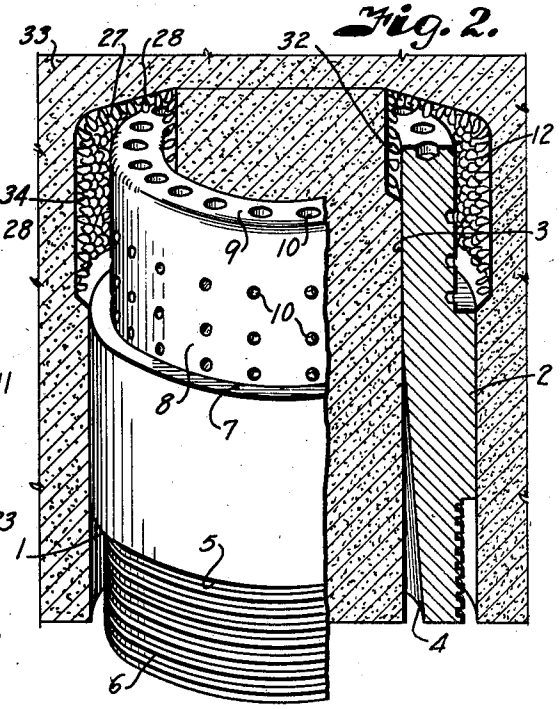


Fig. 3.

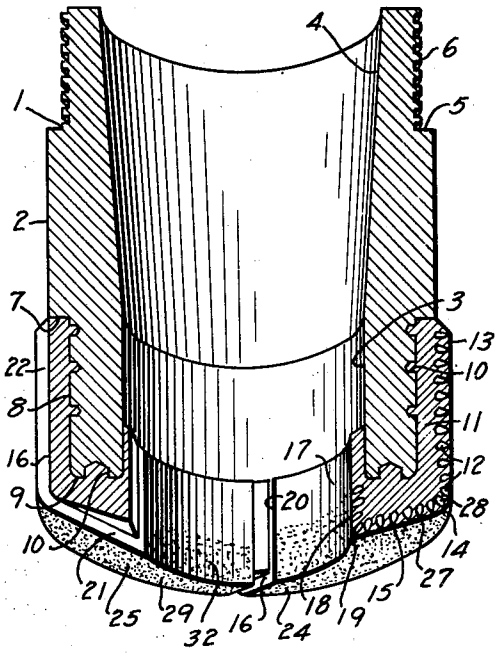


Fig. 4.

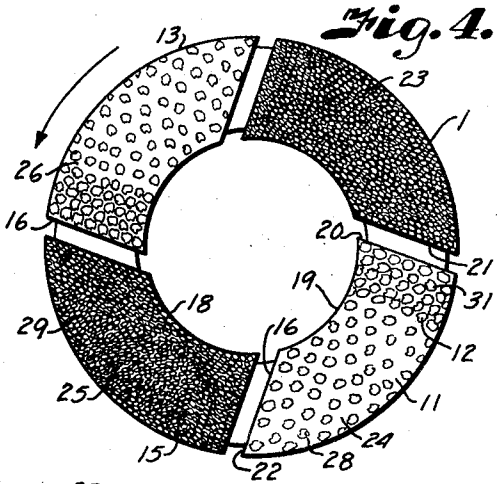
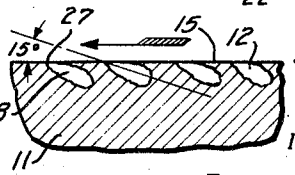


Fig. 5.



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Patented Mar. 13, 1945 2,371,488

UNITED STATES PATENT OFFICE

2,371,488

CORE BIT

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Application May 6, 1943, Serial No. 485,823

5 Claims. (Cl. 255—72)

This invention relates to drill bits and particularly those employed on the end of a drilling string to take a core of earth formations; for example, when drilling in the exploration of oil, gas and mineral deposits.

The principal objects of the invention are to provide a drill bit for the efficient and rapid cutting of extremely hard earth formations, to provide a core bit having longer life with less deterioration and disarrangement of the cutting elements, and to provide a core bit constructed in such a manner that the cutting depth of the cutter elements is governed by the character or type of rock drilled by the bit.

Other objects of the invention are to provide a core bit with a conical cutting face forming a relatively sharp inner angular edge circumferentially of the core face of the bit and having an annular marginal edge rounding into a substantially cylindrical reamer face, to provide a core bit with a relatively hard matrix or facing material embedding the cutting elements flush with the cutting points thereof whereby the material is worn down to expose the cutting elements and automatically provide the clearance demanded of the type of rock being drilled, to provide the bit with watercourses dividing the drilling faces into segmental sections or areas, to provide one or more of the segmental sections with relatively large cutting elements closely arranged on the advanced surface of the section and more sparsely arranged on the remaining surface of the section, to provide intermediate segmental sections with smaller and more closely arranged cutting elements whereby the small grooves or scratches started by the smaller cutting elements on one section are cleared away by the larger cutting elements on a succeeding section as the bit is rotated, and to provide a core bit wherein the reaming and drilling faces are of unitary construction to assure a full gauged hole.

It is also an object of the invention to provide a method of applying the cutting elements.

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

Fig. 1 is a perspective view of a core bit embodying the features of the present invention.

Fig. 2 is a perspective view, partly in section, of the body member of the bit and illustrating the steps of applying the matrix and embedding the cutting elements.

Fig. 3 is a vertical perspective section through the bit.

Fig. 4 is a view of the drilling face of the bit.

Fig. 5 is an enlarged fragmentary section through one of the drilling faces of the bit, illustrating the orientation of the cutting elements.

Referring more in detail to the drawing:

1 designates a core bit constructed in accordance with the present invention and which includes a substantially cylindrical sleeve-like body 2 formed of suitable material to withstand drilling strains and is shaped to provide an axial bore 3 extending inwardly from the lower end thereof and terminating in a tapering counterbore 4 to accommodate a conventional core catcher (not shown). The lower portion of the bore 3 forms an entrance for the core into a core barrel (also not shown). The upper end of the body 2 is of reduced diameter to form a shoulder 5 and provide a circumferentially threaded portion 6 to connect the bit with the conventional core barrel. The lower end of the body is also of reduced exterior diameter to provide a downwardly facing annular shoulder 7, a circumferential matrix backing face 8 and a substantially flat end face 9. The faces 8 and 9 are provided with a plurality of sockets 10 to anchor a matrix 11 embedding cutting elements 12 of the bit.

The matrix 11 is formed of a relatively hard and tough material such as bronze or other suitable metal, metal alloy or a plastic capable of being cast and having the property for securely retaining the cutting elements. The material is also selected so that it is capable of wearing to expose the cutting elements embedded therein.

The matrix is shaped to provide a substantially cylindrical outer surface of slightly larger circumference than the shoulder 7 to form a reaming face 13 extending from the shoulder 7 downwardly over the backing face 8 to emerge in a rounding curve 14 in a drilling face 15. The drilling face 15 is conical and tapers at an angle of approximately 15° relatively to a horizontal plane extending through the bit at right angles to the axis of rotation, there being sufficient material between the backing faces of the body and the reaming and drilling faces to embed the cutting elements and to accommodate watercourses or grooves 16. The matrix material also extends upwardly within the bore 3 as indicated at 17, Fig. 3, to provide a core engaging face 18, the matrix being bevelled to join with the surface of the bore. When thus constructed, the inner annular edge 19 of the drilling face forms a relatively sharp edge to assure the desired formation of the core. Each watercourse includes a portion 20 extending downwardly within the face

18, a portion 21 extending angularly across the drilling face 15 and an upwardly extending portion 22 in the reaming face 13 for passage of drilling fluid. The watercourses thus divide the drilling faces of the bit into a plurality of segmental sections. In the illustrated instance there are four in number and designated 23, 24, 25 and 26.

Embedded within the matrix with cutting points 27 thereof flush with the drilling surfaces are a plurality of cutting elements 28; for example, black diamonds or the like, having the axis thereof oriented at an angle of about 15° relatively to the surface of the matrix material in the direction of rotation of the bit as best illustrated in Fig. 5. The cutting elements in the reaming face are of a size range of from 3 to 8 per carat. The cutting elements in the drilling faces of the segmental sections are of differential size; for example, those in the sections 23 and 25 are of substantially smaller size and more closely grouped as illustrated at 29, Fig. 4. These cutting elements may be Congo cubes or small bortz of a size ranging from 12 to 25 per carat to produce a large number of relatively fine cuts in the rock formation being drilled. The intermediate sections 24 and 26 have larger cutting elements embedded in the faces thereof, substantially conforming to the cutting elements in the reaming face of the cutter. The cutting elements at the advancing ends of the sections 24 and 26 are more closely spaced as indicated at 31 than the cutting elements at the trailing end of the sections. With this arrangement of cutting elements, the sections having the relatively small closely spaced cutting elements produce a great many grooves or scratches in the formation which are cleared away by the larger cutting elements of the intermediate sections when the bit is in operation. The larger cutting elements also act to gauge penetration of the small cutting elements in that the larger elements will penetrate only slightly due to the larger surface thereof in contact with the rock formation. The core engaging face also has similarly arranged cutting elements 32 to provide clearance around the core.

In forming the bit, the matrix material is cast on the body 2 within a mold 33 which may be formed of sand having a suitable binder and baked to provide the desired stability. The cutting elements are glued in the desired patterns to the faces 34 which form the respective matrix faces, after which the body of the bit is inserted in the mold and the matrix material is poured into the mold so that it fills the space between the body portion of the bit and the surfaces 34. Portions of the material will enter the sockets 10 and will key the matrix material to the body when the material congeals thereon.

When the bit is to be used, it is attached to a core barrel and the core barrel is connected with a drill pipe. The assembly is then lowered to the bottom of the borehole and rotated by the rotary mechanism of the drilling rig. When the bit is rotated, contact of the faces of the matrix with the formation wears the matrix to expose the points of the cutting elements. As the rotation progresses, the points of the smaller cutting elements begin to form scratches in the surface of the rock and the scratches are cleared away by the points of the larger cutting elements to produce an annular cut in the rock formation, clearance being provided for the bit by the inner cutting elements 32 and by the cutting elements on the reaming surface. The core being formed passes upwardly through the bit into the core barrel.

From the foregoing it is obvious that I have provided an efficient core bit capable of cutting extremely hard formations at relatively rapid rates.

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

1. A device of the character described including a body member, a matrix fixed to said body member and having a drilling face provided with watercourses dividing said drilling face into sections, and cutting elements having support within said drilling face of the sections, one section having larger cutting elements than another section, whereby the larger cutting elements control the depths of cuts produced by the smaller cutting elements.

2. A core bit including a body member having an axial bore for passing a core when the bit is in use, a matrix fixed to said body member and having a drilling face circumferentially of said bore, differentially sized cutting elements having bedded support within said drilling face of the matrix and having cutting points oriented at an angle of approximately 15° with respect to the drilling face and in the direction of rotation of the bit, the larger cutting elements being in groups between groups of the smaller of said cutting elements whereby the larger cutting elements control depth of cuts produced by the smaller cutting elements.

3. A rotary bit including a body member, a matrix fixed to said body member and having a drilling face, said matrix having watercourses dividing the drilling face into sections, and cutting elements having embedded support in the drilling face of said sections, the cutting elements of one section being of smaller size than the cutting elements of another of said sections, said larger elements having closer spacing at the end of said section in the direction of bit rotation.

4. A core bit including a substantially cylindrical body having an axial bore for passing a core thereinto when the bit is in use, a matrix fixed to said body and having a drilling face circumferentially of said bore, said matrix having watercourses dividing the drilling face into sections, and cutting elements having bedded support in the drilling face of said sections, the cutting elements of one section being of smaller size than the cutting elements of another section.

5. A core bit including a substantially cylindrical body having an axial bore for passing a core when the bit is in use, a matrix fixed to said body and having a drilling face circumferentially of said bore, said matrix having watercourses dividing the drilling face into sections, and cutting elements having bedded support in the drilling face of said sections, the cutting elements of one section being of smaller size than the cutting elements of another of said sections, said larger elements having closer spacing at the end of said section in the direction of bit rotation.

EDWARD B. WILLIAMS, JR.