Oct. 15, 1957 L. CATALLO 2,809,808

DIAMOND SET CORE BIT

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Fig. 1

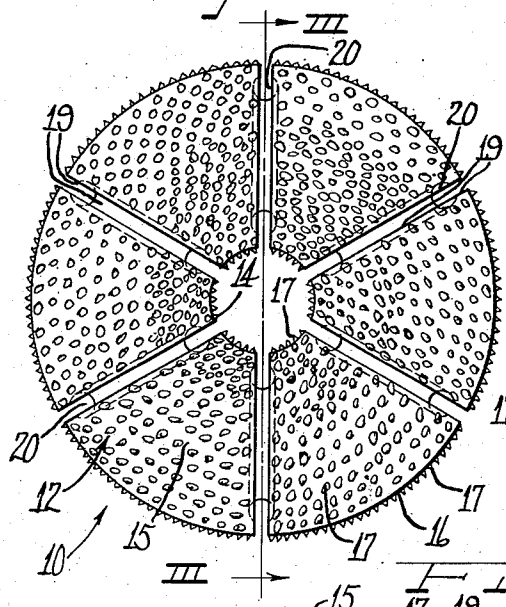


Fig. 2

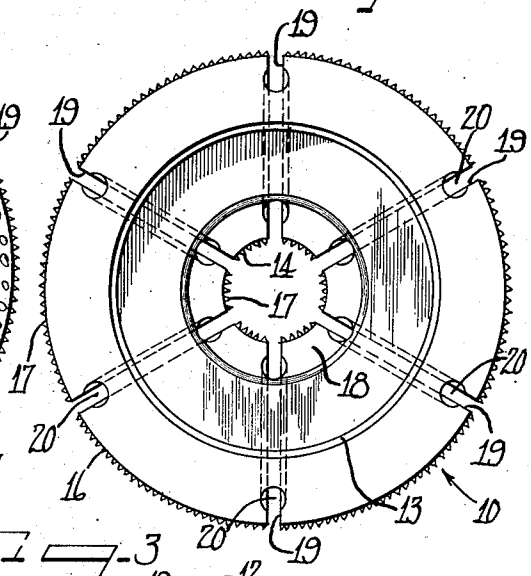
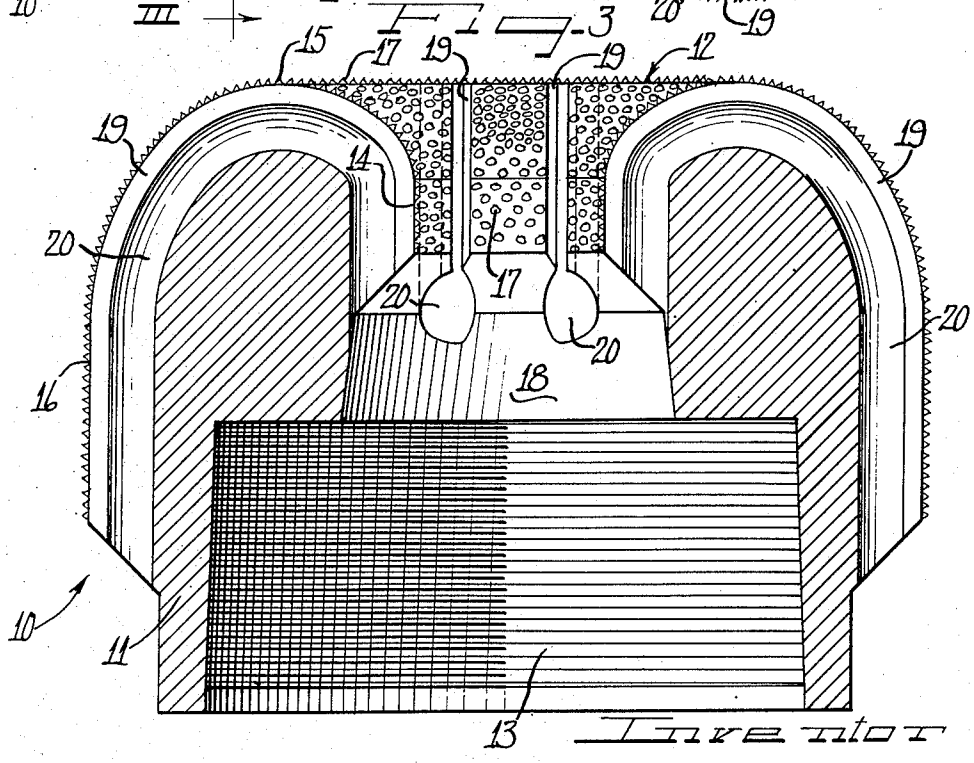


Fig. 3



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DIAMOND SET CORE BIT

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4 Claims. (Cl. 255—72)

The present invention relates to a rotary drill bit, and more particularly to a core-type rotary drill bit having diamonds set in the cutting and reaming faces thereof.

While plain rotary diamond set core-type drill bits are bits of general utility, they enjoy particularly advantageous use in drilling rock or other earth formations such as, for example, in the drilling of earth and rock for oil wells and the like. When so utilized, these drill bits are detachably secured to the leading end of a core barrel which is incorporated as a part of the drilling shaft on the drilling mechanism. Rotation of the shaft about its axis effects rotation of the drill bit which in turn acts in a cutting and abrading manner upon the material against which it is forced by the weight of the shaft above it and, in core bits such as those to which the present invention pertains, the core is cut by the bit and passes through the reaming center of the bit.

Heretofore it has been common practice to pass the core cut by the bit upwardly through the core barrel and remove the same through the hollow shaft. Drilling or cutting in accordance with the methods and techniques in which the core was removed in the manner just described, was relatively slow as compared with many newly devised techniques wherein the drill bit is forced downwardly at substantially greater speeds and is rotated at substantially greater speeds so that the drilling is effected in a substantially reduced time and great savings and economies obtain therefrom.

In accordance with these modern techniques the core of material passing through the drill bit is crushed immediately behind the drill bit by crushing mechanisms carried in the hollow drilling shaft. Such crushing of the core rock has presented several serious difficulties in connection with the use of bits of this type, however, since the former practice left the shaft passage clear for the passage of water or other cooling and cutting fluid to flow therethrough and over the face of the drill bit. When crushing the core immediately above the drill bit, however, it is not readily convenient to remove the core upwardly through the center of the hollow shaft but, instead, the pieces of crushed core flow into the water or other cooling and drilling fluid stream passing to the drilling bit and tend to impede the operation thereof or block the flow of cooling and drilling fluid thereto. Also, the new high-speed techniques and methods operate to cut larger pieces of rock or other earth formations which also tend to block the passage of cooling and cutting fluid through and over the drill bit. It should be understood, of course, that the new high-speed techniques also require greater volumes and pressures of cooling and cutting fluid. From the foregoing it will be seen that even normal flow of water is impeded by the core-crushing and high-speed drilling techniques and that the required increased flow rates and pressures are extremely difficult if not impossible to attain since the large particles from the core and other cuttings tend to block the passages over the face of the drill bit for the water.

It is, therefore, an important object and feature of the present invention to provide a new and improved drill bit of the plain rotary diamond-set core-type wherein these difficulties and problems are obviated. Diamond-set core-type drill bits embodying the principles of the present invention are provided with passageways therethrough to accommodate any large particles of the rock or other earth formation appearing either from the drilling directly or from crushing or breaking up of the core immediately above the drill bit, in addition to being properly provided with flow ways for the water or other liquid coolant and cutting fluid over the diamond-set cutting faces and reaming faces of the bit.

It is, therefore, still another object and feature of the present invention to provide a new and improved drill bit having channels therethrough for the passage of rock or other earth formation particles and flow ways thereover for the cooling and cutting fluid.

Still another object of the present invention is to provide a new and improved diamond-set core-type drill bit having cooling water grooves extending across the reaming and cutting faces thereof and interconnected with flow channels for rock and other earth formation particles.

Still other objects, features and advantages of the present invention will become readily apparent from the following detailed description of the present invention and an embodiment thereof, from the claims, and from the accompanying drawings in which each and every detail shown is fully and completely disclosed as a part of this specification, in which like reference numerals refer to like parts, and in which:

Figure 1 is an end view of a drill bit incorporating the principles of this invention;

Figure 2 is an end view of the opposite end of the bit shown in Figure 1; and

Figure 3 is a full sectional view of the bit of Figure 1 viewed as taken substantially along the line III—III of Figure 1.

As shown on the drawings:

There is illustrated in the drawings a drill bit **10** of the diamond-set core-type. This drill bit is generally of unitary construction and is formed of a metal body **11** which is formed to the shape required for the drill bit. While alternative arrangements for the drill bit body construction may be available, such as that shown in the patent issued to Harry H. Wallace, No. 2,593,229, entitled "Drill Bit," issued April 15, 1952, the solid construction type drill bit body has been illustrated here for simplicity and so as not to cloud the present invention as set out in the specification.

In accordance with the usual form of drill bits of this type, the bit has an enlarged central bore **13** which is threaded to receive a core barrel on the end of a drilling shaft so that the bit may be secured to the drilling shaft.

At the opposite end of the drill bit from the enlarged bore **13**, the head portion **12** of the bit is formed in a toroidal configuration to provide an inner reaming face **14**, an end cutting face **15** which is smoothly arcuate, and an outer peripheral reaming face **16** all of which are abrading or cutting surfaces by reason of having diamonds set therein as indicated generally at **17—17**.

That is, while the drill bit is of generally cylindrical construction and configuration, the head end **12** thereof has a generally toroidal-shaped surface so that the annular bit has an outer peripheral reaming face **16**, an inner peripheral reaming face **14**, which inner face cuts and defines the core, and a leading cutting face **15**.

The inner reaming face **14** terminates a substantial distance from the axial termination of the enlarged core shaft bore **13** and between these two axial positions in

the bit, the bit body 11 is hollowed with an intermediate diameter bore as at 18 so that the drill bit 10 is axially hollow for the passage of water or other liquid coolant and cutting fluid therethrough. To facilitate flow of the liquid over the cutting and reaming faces (all of which are hereinafter referred to as the abrading face since the entire toroidal face is smoothly curved) radial grooves 19 are provided therein. These grooves 19 extend over the entire abrading face and not only assist in spreading the cooling medium over the face but aid in flushing away the pieces of rock and other earth formation released by the drill bit during the operation thereof.

As explained hereinabove, however, newly developed techniques involving high-speed drill operation and core-crushing or breaking, have a tendency to cause the pieces of rock and earth formation to be relatively large, and frequently too large to pass through the drill bit grooves 19. Under such circumstances they tend to clog the grooves and hamper even normal flow of liquid and seriously impede the high flow rate of the liquid generally required for high speed operation.

In accordance with the principles of the present invention, however, the drill bit body 11 has a plurality of channels 20 formed therein which are larger in cross-section than the grooves 19 and which underlie said grooves. These channels 20 extend from the intermediate bore 18 to the exterior of the drill bit and follow radial paths substantially adjacent to and "concentric" with the toroidal abrading surface of the drill bit 10. While these channels may have any desired cross-sectional configuration, and they have been illustrated here as being substantially circular in cross-sectional configuration since that is a preferred form therefor, it is important that these channels 20 be of sufficient cross-sectional dimensions to pass therethrough any of the rock or earth formation particles dislodged by the drill bit and/or created due to crushing the core created by the toroidal configuration of the abrading face, which core normally extends axially up into the bit and has an outer diameter defined by the minimum radius of the abrading face or, more particularly, the inner reaming face 14.

In addition, in the preferred structure embodying the principles of the present invention the grooves 19 and the channels 20 are in communication with each other throughout their coextensive lengths, so that the drilling fluid is free to distribute itself between said grooves and channels in accordance with the resistance that may be set up in either to fluid flow therethrough. In general, earth and rock particles formed by the cutting action of the diamond-set working face of the bit will be carried away through the grooves 19, while core particles formed by crushing the core within the bore 13 will be flushed out of the bore into the larger channels 20 for flow therealong outwardly and axially upwardly along the drilling shaft.

Under normal operation, the liquid coolant and cutting fluid such as water will be forced downwardly through the bore of the drilling shaft into the drill bit and thence over the abrading face, through the grooves, and through the channels and thereby cool the bit, aid in cutting through the rock formations, etc., and wash the dislodged material and particles away.

In addition to permitting larger particles of rock to pass through the bit and permitting a larger volume of fluid to be utilized thus permitting higher speed operation and accommodating larger bits, drill bits incorporating the principles of this invention permit constructions wherein the inner reaming face 14 may have a larger area or a larger arcuate dimension whereby the bits may be constructed substantially stronger than those heretofore available and others wherein efforts were made to obtain the other advantages of this bit. Also, by providing larger passages for the rock cuttings, damage to the cutting face of the bit is substantially prevented and larger pieces of rock formation may be washed away thereby facilitating more convenient analysis thereof, which is highly important in well logging techniques.

From the foregoing it will be readily observed that there is provided in accordance with this invention a new and improved diamond-set core-type drill bit of which numerous variations and modifications may be effected without departing from the true spirit and scope of the novel concepts and principles of this invention. I, therefore, intend to cover all such modifications and variations as fall within the true spirit and scope of the novel concepts and principles of this invention.

I claim as my invention:

1. In a core bit having a toroidal abrading face and water grooves extending radially outwardly therealong, the improvement which comprises providing channels in the body of said bit of larger cross-section than said grooves following beneath said grooves and in open communication therewith.

2. In a core bit having inner and outer reaming surfaces and an arcuate abrading end face smoothly joining said surfaces, grooves extending coextensively with said surfaces and end face to provide radial water courses and channels in the body of said bit of larger cross-section than said grooves following continuously beneath and opening into said grooves and into the bore of said bit.

3. In a core bit having diamond-set inner and outer reaming faces and an arcuate end face therebetween, grooves extending continuously along said inner reaming face, radially outwardly along said end face and along said outer reaming face, and channels of larger cross-section than said grooves following beneath said grooves in open communication therewith.

4. In a core bit having an enlarged bore and an abrading face providing inner and outer reaming faces and an intermediate cutting end face, grooves extending axially and radially of said bit along said faces and channels of larger cross-section following beneath and in open communication with said grooves and opening into said bore.

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