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DRILL BIT

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*Fig. 1.*

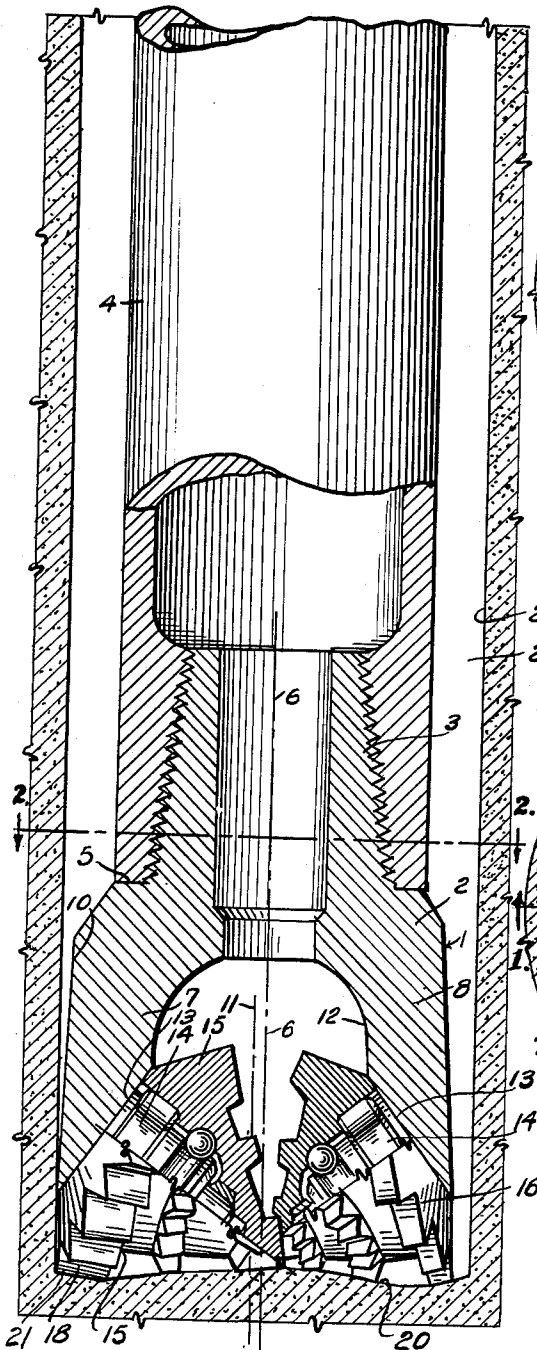


*Fig. 2.*

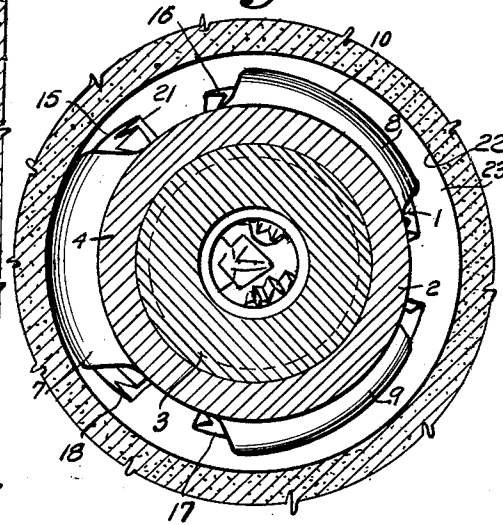
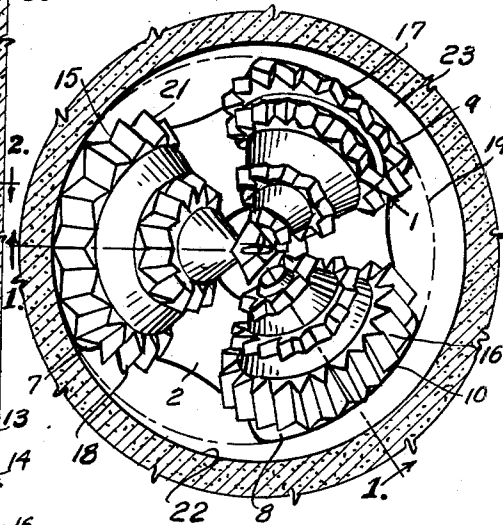


*Fig. 3.*



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## DRILL BIT

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2 Claims. (Cl. 175-376)

This invention relates to drill bits for drilling bore holes into earth formations, and particularly to those of the type having rotating cutters for drilling through the various formations encountered in the drilling of such bore holes.

The cutters of drill bits of this type are usually arranged for each cutter to cut the full gauge of the bore hole. Therefore, the overall diameter of the drill bit substantially conforms to the diameter of the bore hole drilled thereby. Consequently, if it is necessary to case the upper portion of the bore hole, further drilling must be carried on with a smaller sized bit, so that the bit can be moved through the casing when running the drilling string into and out of the bore hole, as when changing drill bits. Also, it may be desirable after starting a bore hole to continue drilling of the bore hole with a larger diameter bit and there is not sufficient clearance to run the larger bit through the portion of the bore hole of smaller diameter. Also, in bore holes drilled by a conventional bit the clearance between the bit and wall of the bore hole may be such that the teeth of the cutters may be damaged when running the bit into and out of the bore hole.

It is, therefore, a principal object of the present invention to provide a bit with rotary cutters that may be safely and easily run through a bore hole without damage to the cutters, and which may be run through holes of smaller diameter than the size to be cut by the bit, as when continuing drilling of a larger sized hole to greater depths or when reaming portions of a bore hole.

Another object of the invention is to provide a drill bit with the cutters arranged in a cluster of two or more with the axis of the clusters offset radially from the axis of rotation of the drill pipe, so that the overall diameter is less than the diameter of the bore hole drilled.

In accomplishing these and other objects of the invention as 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 drill bit embodying the features of the present invention and attached to the lower end of a drill pipe when in drilling position.

FIG. 2 is a horizontal cross section on the line 2-2 of FIG. 1, particularly illustrating clearance at sides of the body of the drill bit.

FIG. 3 is a view of the cutting end of the bit particularly illustrating the arrangement of the cutters to cover the entire area of the bore hole when the bit is in use.

Referring more in detail to the drawings:

1 designates a drill bit constructed in accordance with the present invention and particularly adapted for drilling earth formations. The bit 1 includes a body member 2 having an exteriorly threaded pin 3 and which in the illustrated instance is adapted for coaxial attachment to a drill pipe or drill stem 4. The pin 3 is thus concentric with the axis 6 of the drill pipe and forms, with the body member 2, an annular shoulder 5, as shown in FIG. 1. The portion of the body member 2 immediately below the shoulder 5 has depending arms, which in the illustrated instance are three in number and designated 7, 8 and 9, respectively, somewhat similar to a conventional bit. However, in the present instance the outer faces 10 of the arms are formed transversely thereof on arcs about

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a common axis 11 of the body member 2 and which is offset from the rotational axis 6 (FIG. 1) whereby the body member gyrates about the axis 6 when the bit is in use. Or, if desired, the outer face 10 of the arm 7 may be formed about the axis 6 and the outer faces of the arms 8 and 9 may be formed about the offset axis 11. The inner or facing sides 12 of the arms have outwardly diverging end faces 13, and projecting downwardly and inwardly therefrom are spindles 14, each carrying a cutter 15, 16 and 17, respectively, and arranged about the axis 11. In the illustrated instance each cutter is of generally conical shape and has teeth 18 on the conical sides thereof, with the teeth of one cutter having differential spacing and location from the other cutters, whereby the teeth on the cutters each produce an individual cut or chip of the formation when the drill is in use. That is, the teeth of the cutters produce different patterns of cuts, so that the cuts produced by one cutter are out of registry with the cuts produced by the other cutters. The cutters are also of a size and arrangement whereby they are completely contained within a circle 19 (FIG. 3) extending about the offset axis 11 and therefore within the circular limits of the outer faces of the arms. However, when the bit is rotated upon rotation of the drill pipe 4, the cutters gyrate with the body member about the axis 6. The cutter 15 is an outer cutter relative to the axis 6 and produces the full diameter of the bore hole to be drilled, while the other cutters 16 and 17 cooperate therewith to chip or cut away the bottom of the bore hole over which they are caused to revolve, substantially as indicated at 20 (FIG. 1). In other words, all the cutters roll about the axis 6 and are effective, but the base teeth 21 of the cutter 15 make a wider sweep to produce a hole of larger diameter than the overall diameter of the bit as represented by the circle 19 and which will be readily noted by comparing the overall diameter of the bit, represented by the circle 19, FIG. 3, with the inner surface 22 of the bore hole 23 when the bit is rotated about the axis 6. It is thus obvious that the bit, being of less overall diameter than the diameter of the bore hole, may be readily raised and lowered through the bore hole by shifting the drill pipe 4 laterally to bring the axis 11 of the body of the bit into registry with the center line of the bore hole. In this way, a free space is opened up around the entire periphery of the bit, consequently the bit may be readily removed or lowered through a casing or an upper portion of the bore hole that may be of smaller diameter than the diameter to be drilled by the bit.

Attention is directed to the shape of the generally convex curvature of the bottom 20 of the hole. This curvature is produced by the shape of the cutters, so that the central portion of the bottom serves as a pilot to assist in the maintenance of a straight hole.

In using the bit, the bit will be connected to the bottom stand of the drill stem and lowered into the bore hole as the upper stands of drill pipe are connected therewith. During these operations the axis 6 of the drill pipe is offset from the axis of the bore hole, so that sufficient clearance is provided around the entire circumference of the bit to lower the bit freely through a small bore hole or a casing, if the upper portion of the hole has been cased. When the bit reaches the bottom of the hole 23, the usual rotating mechanism is connected with the drill stem. Upon starting rotation of the drill stem the cutters 15, 16 and 17 automatically seat over the central crown of the bottom contour and the drilling operation will proceed with the bit rotating about the axis 6 with the base of the cutter 15 rolling in contact with the wall 22 of the bore hole and the base teeth contacting the peripheral portion of the bottom 20 to maintain the desired gauge of the bore hole while the other teeth of the cutter and

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the teeth of the cutters 16 and 17 cooperate in cutting away the bottom 20. When it becomes necessary to pull the drilling string from the bore hole, the drill bit will draw freely through the bore hole and pass through any smaller or cased portion thereof.

It is obvious that the cutters rotate on their spindles to roll in circular paths in substantially the same plane during gyration of the body member. Also, the outer teeth of the cutter 15 are spaced from the axis of rotation 6 a greater radial distance than the corresponding outer teeth of the cutters 16 and 17, for chipping away a path of larger diameter than the other cutters to establish a gauge of the bore hole at the bottom thereof of larger diameter than the overall diameter of the bit, so that the bit may be raised and lowered freely through the bore hole by shifting the drill stem to bring the axis of the body member of the bit into coaxial relation with the axis of the bore hole.

From the foregoing it is obvious that the cutters grouped within the generally circular confines of the offset body portion of the bit, permit cutting of a bore hole of larger diameter, since the cutters gyrate or revolve in rolling action relatively to the rotational axis of the drill pipe. Also, with the arrangement described the bit may be easily withdrawn with ample clearance being provided around the circumference of the bit.

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

1. A rotary drill bit adapted to be rotated by a rotary drill stem for drilling bore holes into earth formations, said drill bit comprising a body member having depending arms spaced from a vertical axis of the body member, a drill stem connection on the body member offset laterally from the axis of the body member on the side opposite one of the depending arms to provide an axis of rotation for the drill bit when the rotary drill stem is connected thereto for effecting gyration of the body member about said rotational axis, spindles extending downwardly and inwardly from said depending arms toward the axis of said body member, and toothed cutters rotatable on the spindles to roll in circular paths in substantially the same plane during gyration of said body member for chipping away the bottom of the bore hole, the cutter associated with said one arm having outer teeth spaced from the axis of rotation a greater radial distance

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than the corresponding outer teeth of the other cutters for chipping a path of larger diameter than the other cutters to establish a gauge of the bore hole at the bottom thereof of larger diameter than the overall diameter of the bit, whereby the bit may be raised and lowered freely through the bore hole by shifting of the drill stem to bring the axis of said body member into coaxial relation with the axis of the bore hole.

2. A rotary drill bit adapted to be rotated by a rotary drill stem for drilling bore holes into earth formations, said drill bit comprising a body member having depending arms spaced apart about a vertical axis, a drill stem connection on the body member offset laterally from the vertical axis of the body member at the side opposite one of the depending arms to provide an axis of rotation for the drill bit when the rotary drill stem is connected thereto for effecting gyration of the body member about said rotational axis, spindles extending downwardly and inwardly from said depending arms toward the axis of said body member, and conical cutters rotatable on the spindles and having teeth extending from the surface thereof to roll in circular paths in substantially the same plane for chipping away the formation, the conical cutter on the spindle of said one arm being an outer cutter with outer teeth thereof spaced from said rotational axis a greater radial distance than the corresponding outer teeth of the other cutters for cutting the bottom of the bore hole to establish the gauge of the bore hole at said bottom of a larger diameter than the overall diameter of the bit, whereby the bit may be raised and lowered freely through the bore hole by shifting of the drill stem to bring the axis of said body member into coaxial relation with the axis of the bore hole.

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