

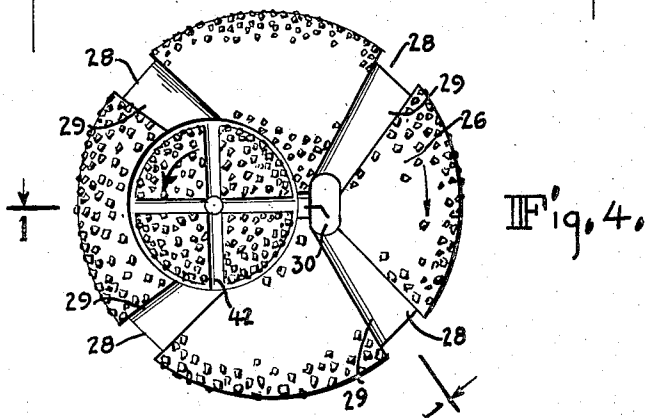
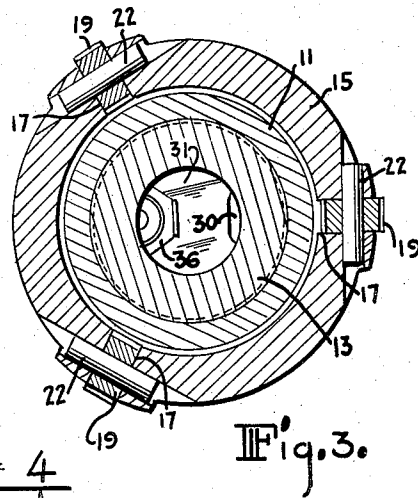
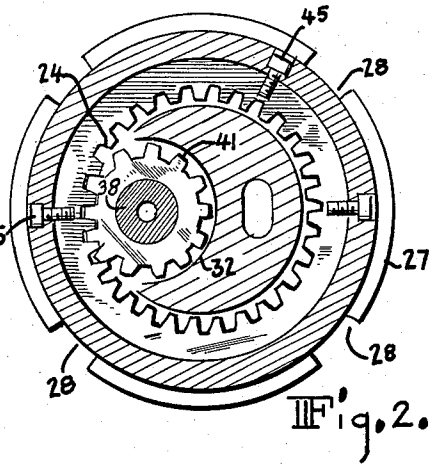
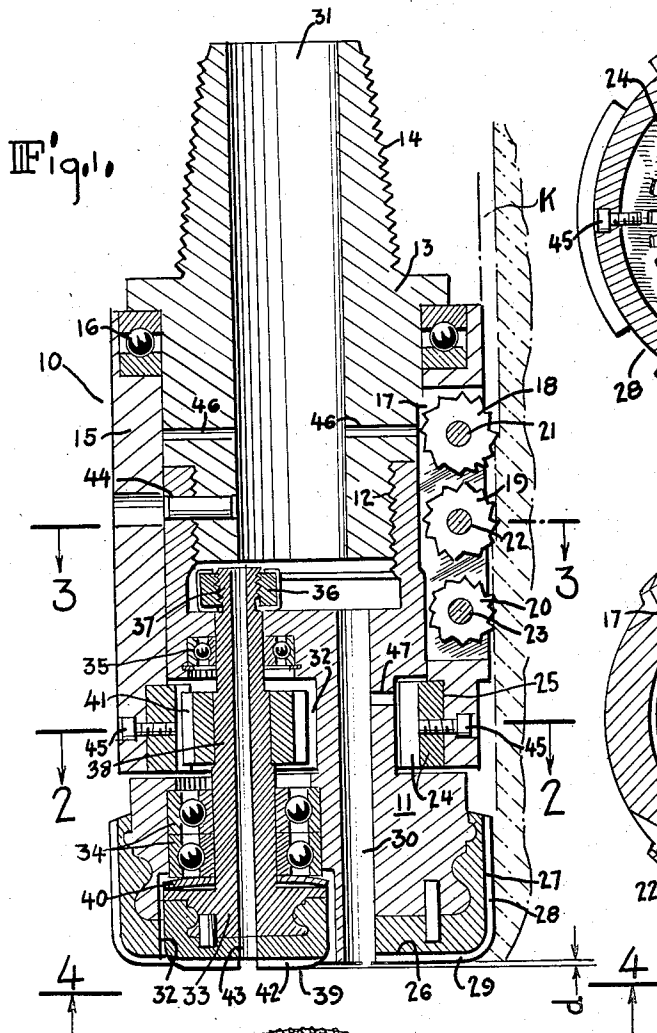
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H. M. CAMERON ET AL

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DRILL BIT WITH DRIVEN AUXILIARY BIT

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INVENTORS
Harry M. Cameron
By Eugene S. Wassel
Kempner & Kempner
ATTORNEYS

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DRILL BIT WITH DRIVEN AUXILIARY BIT

Harry M. Cameron, Oak Park, and Eugene S. Wassel, La Grange, Ill., assignors, by mesne assignments, to American Coldset Corporation, Paterson, N. J., a corporation of New Jersey

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6 Claims. (Cl. 255—301)

This invention relates to rock drill bits and more particularly to diamond drill bits of this character intended to provide a substantial velocity to all of the abrading surfaces with respect to the rock surfaces they are intended to cut as by providing a positively driven auxiliary drill bit within a main drill bit body.

In conventional drill bits, the cutting velocity of each diamond in the drilling surface is directly proportional to the radius at which it is positioned so that at zero radius, normally the axis of the drill, the velocity is also zero and little, if any, cutting occurs.

Objects and features of this invention are the provision of drill bit construction intended to provide substantial cutting velocities to diamonds at all radial positions relative to the axis of the main drill bit.

In an embodiment of the invention as herein contemplated, this is accomplished by incorporating an auxiliary drill bit in the main drill bit body whose cutting surface protrudes slightly from the cutting surface of the main drill bit to compensate for wear and manufacturing tolerances under action of a Belleville or ring spring whose thrust is equivalent to the minimum thrust desired in a single bit of equivalent diameter. This auxiliary bit is keyed to a pinion which engages a ring gear carried by a free sleeve surrounding the main drill bit. A series of star wheels mounted on the sleeve serve to cut keyways into the wall of the hole being drilled and to prevent rotation of the sleeve and also of the ring gear. In consequence, rotation of the main drill body by the drill string causes positive rotation of the pinion and of the auxiliary drill bit in opposite direction to rotation of the main drill body.

Preferably the diameter of the auxiliary drill bit is in excess of the radius of the main drill bit so that diamonds in the auxiliary bit lying at the geometric center of the main drill bit have a positive velocity imparted to them during drilling operations by reason of the positive rotation given to the auxiliary drill bit and also because of the eccentricity of the axis of the latter relative to the main drill bit. Thus drilling of the hole is speeded because positive cutting action of all diamonds occurs.

Additional objects and features of the invention are the provision of combined main and auxiliary drill bits in a unitary structure that is simple in structure, assembly, installation and operation.

Further objects and features of the invention are the provision of appropriate distributing passageways for water to both the main and auxiliary bit surfaces to promote efficient chip removal and heat dissipation and also the provision of additional passageways open to the main water passageway to provide water pressure to counter low pressures of rock laden return mud and substantially preclude chances of serious jamming of the gears by rock particles in this mud.

Other objects and features of this invention will become apparent from the following specification and the accompanying drawings wherein:

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Figure 1 is a longitudinal section of a device embodying the invention taken along line 1—1 of Figure 4;

Figure 2 is a transverse section taken along line 2—2 of Figure 1;

5 Figure 3 is a transverse section taken along line 3—3 of Figure 1; and

Figure 4 is a bottom end elevation of the device.

Referring to the drawing, the reference character 10 generally denotes a rock drilling bit embodying the invention. This bit 10 includes a main bit body 11 which is threadedly engaged at 12 with an attaching shank 13 whose outer end 14 is threaded for conventional attachment to a drill string (not shown).

The bit body 11 and its shank 13 respectively in their upper and lower portions are surrounded by an annular sleeve 15 which freely is rotatable relative to both as on thrust and radial ball bearings 16. Other types of bearings may be used. Longitudinal extending slots or grooves 17 are provided at equi-spaced positions on the periphery of the sleeve 15 and each serves to receive a series of rotatable star wheels 18, 19, 20 respectively supported on the shafts 21, 22 and 23 which transversely span the slots or grooves 17. The star wheels 18, 19 and 20 each project outwardly of the peripheral surface of the sleeve 15 but are of progressively decreasing diameter downwardly for purposes presently to be described.

A ring gear 24 is fixedly supported in a recess 25 provided at one end of the sleeve 15 for purposes presently to be described.

30 Diamond abrading surfaces 26 and 27 of conventional types are provided at the drilling end of main bit body 11. Grooves 28 and 29 in these surfaces communicate with water passageway 30 in the bit body 11. This passageway 30 in turn is in communication with the main 35 water passageway 31 in the shank 13 to provide for flushing out of cut rock particles and for heat dissipation.

The main bit body 11 is provided with a longitudinally extending recess 32 located eccentrically relative to its axis or center for receiving an auxiliary drill bit body 40 33. This auxiliary bit body 33 is supported within the recess 32 as by the radial and thrust anti-friction ball bearings 34 and 35 and the nut 36 which threadedly engages the inner threaded end 37 of the shaft portion 38 of the auxiliary bit body 33. Other types of bearings 45 may be used. The outer end portions of the body 33 are provided with an abrading surface 39 which is spring loaded axially and maintained slightly protrudent as at the distance d below the lower abrading surface 26 of the main bit body 11 as by a conventional Belleville or 50 ring type spring 40 in order to compensate for bearing and diamond means and manufacturing tolerances.

A gear 41 is keyed to shaft portion 38 of auxiliary bit body 33 and meshes with the sleeve mounted ring gear 24 so that positive drive will be imparted to the gear 41 55 and consequently to auxiliary bit 33 when ring gear 24 is held against rotation during driven rotation of the main bit body 11 as will be presently described.

The abrading surface 39 of auxiliary bit body 32 is grooved at 42. These grooves communicate with a water 60 passageway 43 which in turn is in open communication with main water passageway 31 in the shank 13 for particle flushing and for heat dissipation.

The auxiliary drill bit 33 at its abrading surface 39 overlaps the geometric center of the main bit body so that rotation of the main and auxiliary drill bit bodies 65 will provide a substantial cutting velocity to the abrading surfaces even at the geometric center of the main bit body.

For ease of assembly of the component parts of the main and auxiliary drill bits, the main drill bit body 11 70 and its shank 13 are separate being joined at the threaded joint 12 so that the auxiliary bit body 33 may be secured

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in the main bit body 11 by the nut 36 prior to the threaded joining at 12 of the main bit body 11 and its shank portion 13. Once joined, radial pins 44 serve to prevent unscrewing of the parts at said threaded joint 12. Also the ring gear 24 for assembly is constructed in sections and secured to the sleeve as by bolts or pins 45.

Additional fluid passageways 46 extending radially from the main water passageway 31 into the star wheel containing grooves or recesses 17 and additional fluid passageways 47 extending from fluid passageway 30 to the chamber 32 containing the gears 24 and 41 provide pressurized areas into which rock laden return mud incidental to drilling and which is under low pressure cannot enter. Thus chances of jamming the gears by rock particles is minimized.

In operation, after attachment of shank 13 to the drill string (not shown) when the drill assembly 10 described is lowered into the hole and the drill string is rotated the drill bits cut the hole. As the drill assembly moves down into the hole drilled, the star wheels cut longitudinal keyways K into the hole wall. The progressively increasing diameter upwardly of these star wheels 20, 19 and 18 facilitates the cutting of deep keyways K. Once engaged by the star wheels, these keyways K prevent rotation of the sleeve 15 and consequently of the ring gear 24 which is secured to this sleeve. In consequence the further rotation of the drill string causes driven drilling rotation of the main drill body 11 and forces rotation of gear 41 and rotation of auxiliary drill bit 33 in opposite direction to the direction of rotation of the main drill bit body 11.

Although star wheels have been described as a means for preventing rotation of the sleeve 15, other appropriate means may be utilized. As an alternative solid metal inserts may be carried in the groove their outwardly projecting surfaces being shaped to effect broaching of a keyway in the wall. Other means of preventing rotation of the sleeve 15 while permitting free vertical motion thereof likewise are possible and are contemplated.

An additional feature of note is that the diameter of the auxiliary bit need not exceed the radius of the main drill bit. It is sufficient if its periphery overlaps the center line of the main bit and for this purpose its diameter can have any selected value either less than or in excess of the main bit radius.

While a specific embodiment of the invention has been shown and described, variations in structural detail within the scope of the appended claims are possible and are contemplated. There is no intention therefore of limitation to the exact details shown and described.

What is claimed is:

1. In combination, a main drill bit having an abrading surface, a rotatable auxiliary drill bit having an abrading surface, means for supporting said auxiliary drill bit within said main drill bit whereby its abrading surface will operate generally within the plane of said abrading surface of said main drill bit, a rotatable sleeve carried by said main drill bit, means for rotatably connecting said sleeve to said main drill bit, a ring gear secured to said sleeve, a pinion meshing with said ring gear and keyed to said rotatable auxiliary drill bit, and means extending from said sleeve for engaging the wall of a hole being drilled to prevent rotation of said sleeve and ring gear during drilling rotation of said main drill bit and thereby cause positive rotation of the pinion and of the auxiliary drill bit.

2. In combination, a main drill bit having an abrading surface, a rotatable auxiliary drill bit, having an abrading surface, bearing means for supporting the auxiliary drill bit within said main drill bit whereby the said abrading surfaces will operate generally within the same plane, a rotatable sleeve carried by said main drill bit, means for rotatably connecting said sleeve to said main drill bit, a ring gear secured to said sleeve, a pinion keyed to said auxiliary drill bit and meshing with said ring gear, star

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wheel means mounted on said sleeve and projecting outwardly of its periphery for engaging the wall of a hole being drilled and cutting a keyway therein, engagement of said star wheels in the keyway preventing rotation of said sleeve and ring gear during drilling rotation of said main drill bit and thereby causing positive rotation of the pinion and auxiliary drill bit in opposite direction to the rotary direction of the main drill bit.

3. In combination, a main drill bit having an abrading surface, a rotatable auxiliary drill bit having an abrading surface, means for supporting said auxiliary drill bit within said main drill bit whereby its abrading surface will operate generally within the plane of said abrading surface of said main drill bit, a rotatable sleeve carried by said main drill bit, means for rotatably connecting said sleeve to said main drill bit, a ring gear secured to said sleeve, a pinion meshing with said ring gear and keyed to said rotatable auxiliary drill bit, means extending from said sleeve for cutting a keyway into the wall of a hole being drilled and to prevent rotation of said sleeve and ring gear during drilling rotation of said main drill bit, thereby causing positive oppositely directed drilling rotation to said auxiliary drill bit, and said bits having passages for distribution of water to their drilling surfaces and the said ring gear for prevention of jamming of said gear and pinion by rock particles in rock laden return mud from the hole.

4. In combination with a rotary drill string, a main drill bit connected to said drill string and having an abrading surface, a free sleeve annularly disposed around said main drill bit, means for rotatably connecting said free sleeve to said main drill bit, a ring gear interior of said free sleeve and attached thereto, a rotatable auxiliary bit having an abrading surface, means for supporting said auxiliary drill bit within said main drill bit whereby its abrading surface operates generally within the plane of said abrading surface of the main drill bit, a pinion attached to said auxiliary drill bit and meshing with said ring gear, spring means between said auxiliary drill bit and said main drill bit for assuring a minimum of positive downward thrust of said auxiliary drill bit, and means extending outwardly of said free sleeve and connected thereto for engaging a wall portion of a hole being drilled to prevent rotation of said free sleeve and said ring gear during drilling rotation of said main drill bit and thereby cause positive rotation of said pinion and of said auxiliary drill bit.

5. In combination with a rotary drill string, a main drill bit connected to said drill string and having an abrading surface, a free sleeve annularly disposed around said main drill bit, means for rotatably connecting said free sleeve to said main drill bit, a ring gear interior of said free sleeve and attached thereto, a rotatable auxiliary bit having an abrading surface, means for supporting said auxiliary drill bit within said main drill bit whereby its abrading surface operates generally within the plane of said abrading surface of the main drill bit, a pinion attached to said auxiliary drill bit and meshing with said ring gear, spring means between said auxiliary drill bit and said main drill bit for assuring a minimum of positive downward thrust of said auxiliary drill bit, and star wheel means mounted on said free sleeve to project outwardly therefrom for engaging a wall portion of a hole being drilled to prevent rotation of said free sleeve and said ring gear during drilling rotation of said main drill bit and thereby cause positive rotation of said pinion and of said auxiliary drill bit.

6. In combination with a rotary drill string, a main drill bit connected to said drill string and having an abrading surface, a free sleeve annularly disposed around said main drill bit, means for rotatably connecting said free sleeve to said main drill bit, a ring gear interior of said free sleeve and attached thereto, a rotatable auxiliary bit having an abrading surface, means for supporting said auxiliary drill bit within said main drill bit whereby its

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abrading surface operates generally within the plane of said abrading surface of the main drill bit, a pinion attached to said auxiliary drill bit and meshing with said ring gear, spring means between said auxiliary drill bit and said main drill bit for assuring a minimum of positive downward thrust of said auxiliary drill bit, and means extending outwardly of said free sleeve and connected thereto for engaging a wall portion of a hole being drilled to prevent rotation of said free sleeve and said ring gear during drilling rotation of said main drill bit and thereby cause positive rotation of said pinion and of said auxiliary

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drill bit, both the said drill bits having passages for distribution of drilling fluid to their said abrading surfaces, and the said main drill bit having passages to said means connected thereto and to said ring gear for distribution of drilling fluid thereto.

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