Oct. 23, 1962 C. F. OSGOOD 3,059,618

REVERSIBLE DUAL ROTATION MECHANISM FOR ROCK DRILLS

Filed Aug. 22, 1960

2 Sheets-Sheet 1

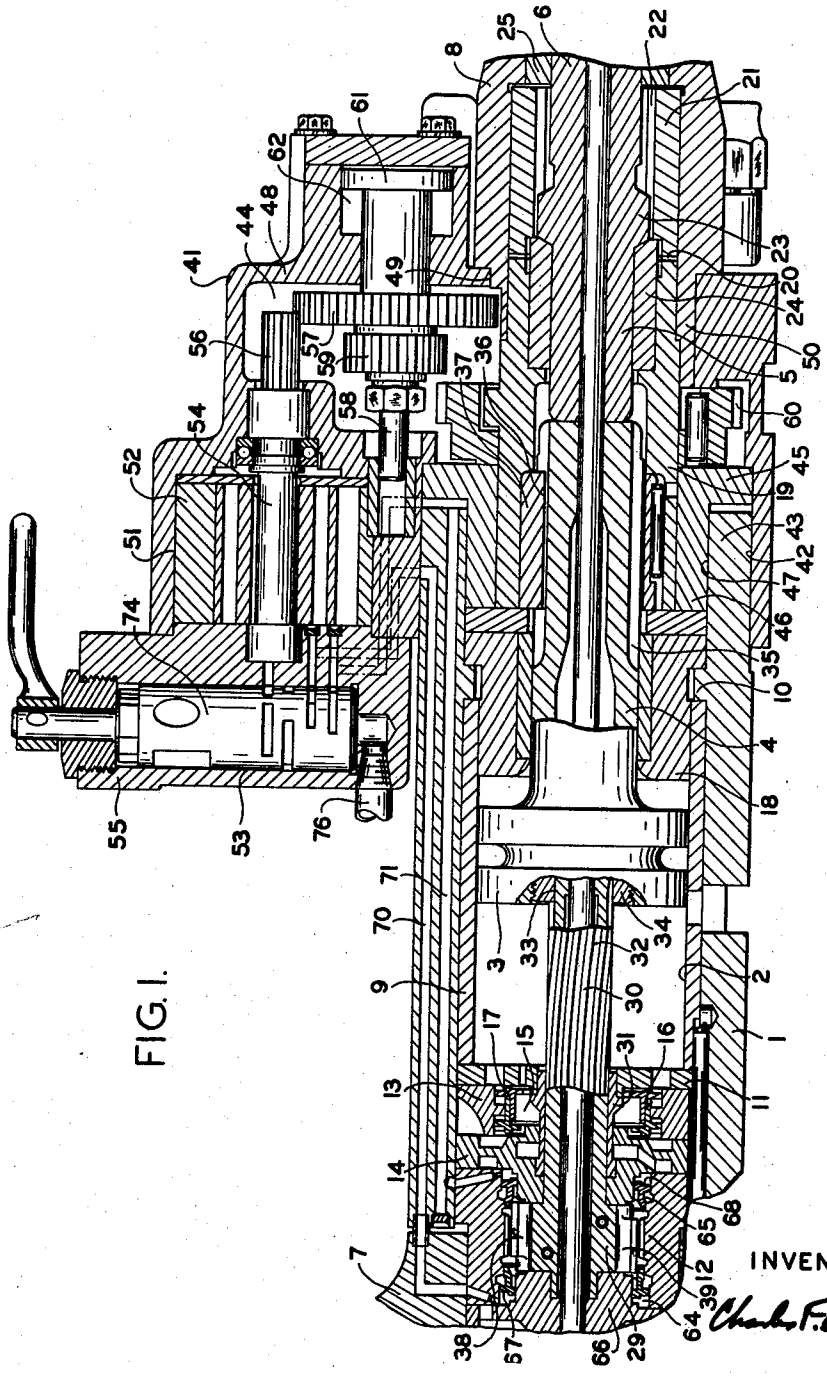


FIG. 1.

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FIG. 2.

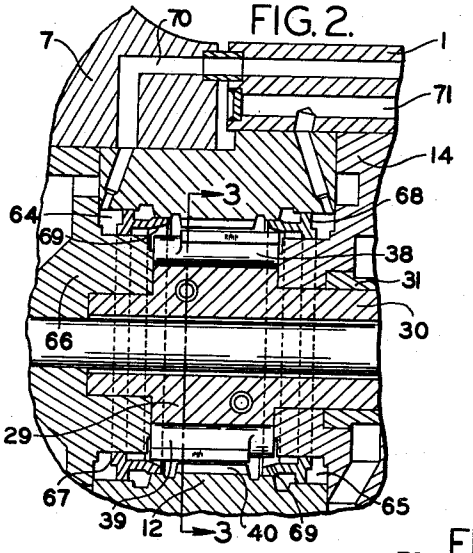


FIG. 3.

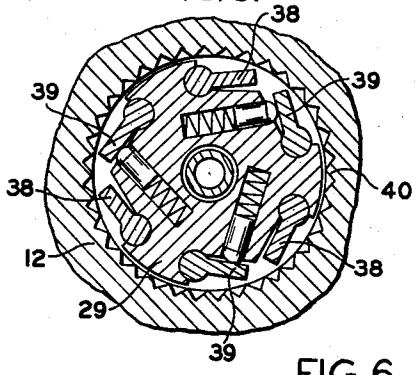


FIG. 4.

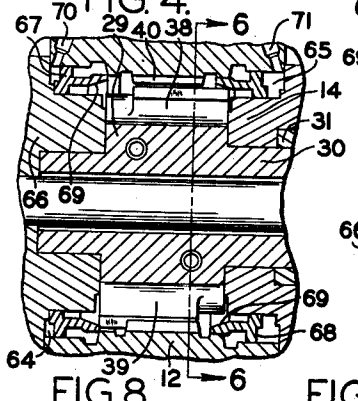


FIG. 5.

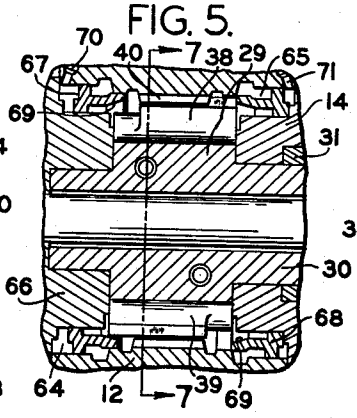


FIG. 6.

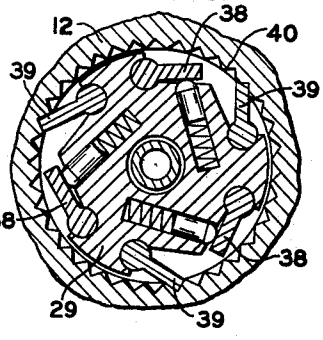


FIG. 8.

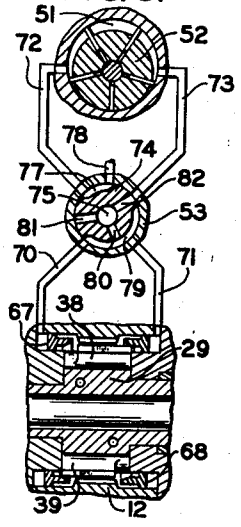


FIG. 9.

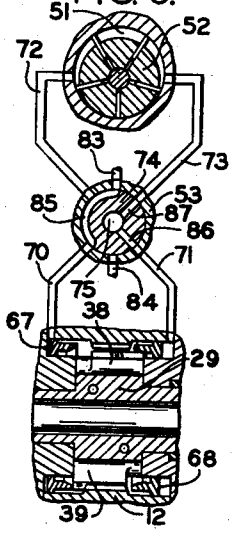


FIG. 10.

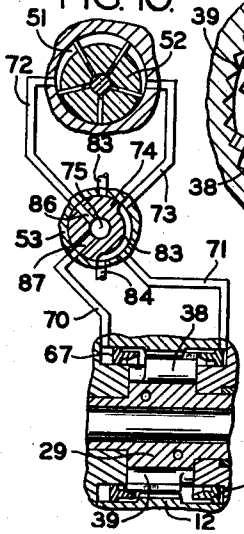
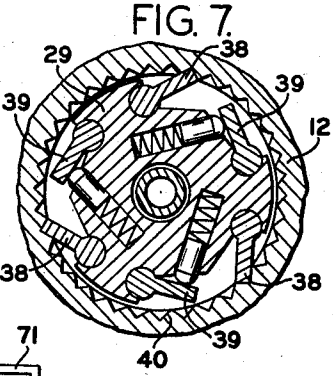


FIG. 7.



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REVERSIBLE DUAL ROTATION MECHANISM FOR ROCK DRILLS

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Filed Aug. 22, 1960, Ser. No. 51,163
15 Claims. (Cl. 121—7)

This invention relates to a rotation mechanism for a drilling tool and more particularly to a reversible dual rotation mechanism for a hammer rock drill whereby the drill steel may be rotated either intermittently in either direction by the hammer piston, or continuously by a reversible independent rotation motor which may supplement or supplant the intermittent rotation during either direction of drill steel rotation.

In hammer rock drills it is becoming a well known practice to employ a reversible ratchet and pawl mechanism operated by the hammer piston for intermittently rotating the drill steel selectively in either of opposite directions, one direction to effect normal intermittent rotation during drilling and the reverse direction to effect breaking of the joints of the sectional drill steel. Also as disclosed in a copending application to J. C. Curtis et al., Serial No. 804,366, filed April 6, 1959, now matured into Patent No. 3,044,448 dated July 17, 1962, owned by the assignee of the present invention, a unidirectional intermittent ratchet and pawl type rotation mechanism operated by the hammer piston is disclosed for intermittently rotating the drill steel as it is percussively actuated and a reversible independent rotation motor may supplement or supplant the intermittent rotation, and whenever the independent motor is reversed the intermittent rotation mechanism is rendered inactive thereby to prevent stalling of the motor and possible breakage of associated parts.

The present invention contemplates improvements over the above known device in that a reversible ratchet and pawl mechanism is so coordinated with the control for the reversible independent rotation motor that whenever the latter is reversed the ratchet and pawl mechanism is concurrently reversed thereby to prevent stalling of the motor and possible damage to the machine. In other words, the reversible ratchet and pawl mechanism is always operated in the same direction as the independent rotation motor irrespective of the direction of the operation of the latter. Also the present invention embodies control means whereby the reversible ratchet and pawl mechanism may be rendered inactive during either direction of operation of the independent rotation motor and vice versa, without the coordinating control.

An object of the present invention is to provide an improved rotation mechanism for the drilling implement of a rock drilling tool. Another object is to provide an improved reversible dual rotation mechanism for the drill steel of a hammer rock drill. Yet another object is to provide a reversible ratchet and pawl mechanism which is operatively associated with an independent reversible rotation motor whereby the latter may supplement the ratchet and pawl mechanism during either direction of operation. A further object is to provide an improved coordinated control means for a reversible dual rotation mechanism whereby whenever the independent rotation motor is reversed the ratchet and pawl mechanism is simultaneously reversed. A still further object is to provide an improved drill steel rotation mechanism wherein an independent rotation motor may supplement or supplant the reversible ratchet and pawl mechanism during either direction of rotation of the drill steel. These and other objects and advantages of the invention will, however, hereinafter more fully appear in the course of the ensuing description.

In the accompanying drawings there is shown for purposes of illustration a preferred form which the invention may assume in practice.

In these drawings:

FIG. 1 is a central longitudinal vertical section through a hammer rock drill in which the preferred form of the invention is embodied, showing both the reversible intermittent piston operated rotation and the reversible independent motor rotation.

FIG. 2 is an enlarged fragmentary section taken on the plane of FIG. 1, showing details of the reversible ratchet and pawl mechanism with both sets of pawls released.

FIG. 3 is a cross section taken on the line 3—3 of FIG. 2.

FIG. 4 is a fragmentary section similar to FIG. 2 showing one set of pawls active and the other set of pawls released, to effect intermittent rotation in one direction.

FIG. 5 is a section like FIG. 4 showing the positions of the pawls reversed to effect intermittent rotation in the reverse direction.

FIG. 6 is a cross section taken on line 6—6 of FIG. 4.

FIG. 7 is a cross section taken on line 7—7 of FIG. 5.

FIGS. 8, 9 and 10 are diagrammatic views, respectively showing the control valve means and pawl control pistons in different operating positions.

The hammer rock drill in which the present invention is employed may be of a conventional design generally like that disclosed in the J. C. Curtis Patent No. 2,224,861, dated December 17, 1940, also owned by the assignee of the present invention.

The rock drill, as shown in FIG. 1 of the drawings, comprises a motor cylinder 1 having a bore 2 containing a reciprocable hammer piston 3 having a forwardly extending striking bar 4 for delivering impact blows to the shank 5 of a sectional drill steel 6 adapted to carry a usual drilling tool such as rock drill bit, not shown. The motor cylinder has a rear head block or casing head 7 and a front chuck housing 8, and the block and housing are suitably attached to the opposite ends of the motor cylinder. The cylinder bore is formed in a liner sleeve 9 which is held axially forwardly against a shoulder provided by an annular flange 10 on the cylinder, and a rear plate 11 seats against the rear end of the sleeve as shown. Arranged between the head block 7 and the rear plate 11 is a stationary ratchet ring 12 and cooperating front and rear valve box elements 13 and 14 which cooperate to provide a chamber 15 containing cooperating relatively reciprocable dual distributing valves 16 and 17, similar to the valves disclosed in the above mentioned Curtis patent.

The motor cylinder has a front head or buffer ring 18 formed with a front flange engaging the interior cylinder flange 10 and having its rearward portion fitting within the bore of the cylinder sleeve 9, as shown. The piston striking bar 4 extends through and is guided within the bore of the buffer ring 18 and extends within a rotatable chuck sleeve 19 rotatably mounted within the chuck housing 8 and connected as by usual separable clutch teeth 20 to a rotatable driver 21 likewise rotatably mounted within the chuck housing. The driver has interior lugs 22 engaging the usual lugs 23 on the drill steel shank whereby the drill steel may rotate with the chuck sleeve 19 as the drill steel is percussively actuated. The steel shank is guided in a usual bushing 24 fitted within the chuck sleeve. The drill steel is reciprocably and rotatably guided within a front bushing 25 fitted within the front chuck housing.

Now referring to the reversible ratchet and pawl type rotation mechanism it will be noted that for illustrative purposes, the same comprises a rotatable pawl carrier 29

having an integral rifle bar 30 extending axially forwardly through a sleeve 31 providing the internal wall of the valve chamber 15 and through the rear plate 11, and this rifle bar has spiral grooves 32 slidingly interlocked with spiral vanes 33 of a rifle nut 34 secured within the piston head. Formed exteriorly on the piston striking bar 4 are straight longitudinal grooves 35 slidingly interlocked with straight longitudinal vanes 36 of a chuck nut 37 secured within the rearward portion of the rotatable chuck sleeve 19. The pawl carrier 29 carries sets of reversely acting, spring-pressed, pawls 38 and 39 which selectively engage the ratchet teeth 40 of the ratchet ring 12, as shown in FIGS. 6 and 7.

The hammer motor is of the well known pressure fluid actuated type and embodies usual ports and passages alternately controlled by the distributing valves 16 and 17 which are also fluid actuated, for supplying fluid under pressure to the opposite ends of the cylinder bore 2 at the opposite sides of the piston head for effecting reciprocation of the hammer piston 3 thereby to effect delivery of repeated impact blows to the shank of the drill steel, in a well known manner. As the hammer piston 3 moves forwardly to effect its working stroke during normal operation of the drill, i.e., to deliver an impact blow to the drill steel, the spirally grooved rifle bar 30 turns the pawl carrier 29 in a counterclockwise direction as viewed in FIG. 7, causing the pawls 38 to slip over the ratchet teeth 40 so that during the forward piston stroke no rotation is imparted by the hammer piston thereby to permit an unimpeded blow to be delivered to the drill steel. During the reverse stroke of the hammer piston, i.e., during the non-working stroke, the pawls 38 engage the ratchet teeth 40 of the ratchet ring to hold the rifle bar 30 against rotation thereby causing the hammer piston to rotate and such rotation of the hammer piston is transmitted through the straight grooves 35 and the vanes 36 of the chuck nut 37 to the rotatable chuck sleeve 19 and thence to the driver 21 to effect partial rotation of the drill steel in one direction. When reverse rotation is desired, as for example during breaking of the drill steel joints, the pawls 38 are released from the ratchet teeth 40 (FIG. 6) and the pawls 39 are permitted to engage the ratchet teeth so that during the reverse stroke of the hammer piston, i.e., during the non-working stroke, the pawls 39 slip over the ratchet teeth without rotation of the hammer piston. During the forward working stroke of the piston the pawls 39 engage the ratchet teeth to hold the rifle bar 30 against rotation thereby causing the piston to rotate and such rotation of the hammer piston is transmitted through the straight grooves 35 and the vanes 36 of the chuck nut 37 to the rotatable chuck sleeve 19, and thence to the driver 21 to effect partial rotation of the drill steel in the reverse direction. Thus during operation of the drill hammer motor the drill steel may be intermittently rotated selectively in either of opposite directions.

Now referring to the independent motor rotation mechanism for the drill steel it will be noted that attached to the forward portion of the motor cylinder is a housing 41 having a bore 42 for receiving the forward cylindrical portion 43 of the motor cylinder, as shown in FIG. 1. This housing has a gear chamber 44 closed by a rear head member 45 having a rearward sleeve portion 46 fitting within the portion of a front bore 47 in the motor cylinder. The front wall 48 of this gear housing has an opening 49 for receiving the rear sleeve portion 50 of the front check housing 8 and the latter abuts the front face of the housing as shown. Formed in the housing 41 is a motor chamber 51 containing a vane type rotor 52 of a conventional reversible independent rotation motor for the drill steel. It is apparent that various other suitable types for rotation motors may be employed if desired.

A control valve device 53 has a manual operating handle for controlling flow of pressure fluid relative to the reversible rotation motor for controlling the direction of operation thereof. This rotation motor may be used not only in rotating the drill steel during normal drilling but also may be employed in coupling the threaded joints of the sectional drill steel and may be reversed for the purpose of disjointing drill steel sections and during the reverse operation the ratchet and pawl mechanism must be rendered inactive, as later described.

The drive between the independent rotation motor and the rotatable chuck sleeve 19 may assume various forms but herein, for illustrative purposes, the motor rotor 52 is secured to a shaft 54 suitably journaled within the gear housing and a rearward casing 55 for the control valve device. Secured to the shaft 54 is a spur pinion 56 meshing with a spur gear 57 journaled on a shaft 58 which is axially movably mounted in the housing. Rotatable with the gear 57 is a spur gear 59 movable into meshing engagement with teeth of a spur gear 60 mounted on the exterior of the rotatable check sleeve 19. A fluid operated piston 61 contained in a cylinder 62 serves to shift the shaft 58 axially to bring the gear 59 into meshing engagement with the gear 60. This drive gearing is fully disclosed in the Curtis et al application above referred to.

The control means for the reversible ratchet and pawl mechanism comprises annular cylinders 64 and 65 formed by the ratchet ring 12 and the cooperating parts 14 and 66 and these cylinders respectively receive reciprocable annular pistons or actuating rings 67 and 68. Each of these pistons has an internal cam surface 69 and as the piston is moved the cam surface inwardly engages the outer edge portions of the pawls for depressing the latter inwardly to effect release thereof from the ratchet teeth 40, and in FIGS. 2 and 3 both sets of the pawls 38 and 39 are shown out of contact with the ratchet teeth with the intermittent rotation mechanism rendered inactive. Leading from the valve device 53 respectively to the cylinders 64 and 65 at the outer sides of the annular pistons are passages 70 and 71 and the valve device 53 may be positioned to supply pressure fluid through either or both of the passages 70 and 71 to effect the desired positioning of the annualar pistons 67 and 68. The pawl control pistons and cylinders may be similar to those disclosed in the Curtis et al application above referred to.

Passages 72 and 73 lead from the valve device 53 to the opposite sides of the rotor chamber 51 of the reversible vane type rotary motor. The valve device comprises a rotatable valve sleeve 74 having a hollow interior or bore 75 to which pressure fluid may be supplied through a supply connection 76 (FIG. 1) connected to any suitable source of fluid under pressure. The valve sleeve has a circumferential exhaust groove 77 on its outer surface for connecting either of the motor passages 72 and 73 to an exhaust conduit 78. The valve sleeve has a circumferential external supply groove 79 connected to the valve bore 75 by a radial port 80, and spaced from the groove 79 between the ends of the latter and the exhaust groove 77 are radial fluid ports 81 and 82. When the valve is in the position shown in FIG. 8 pressure fluid is supplied to the motor passage 73 and the motor passage 72 is connected to the exhaust conduit 78. Both of the passages 70 and 71 are at this time in communication with the fluid groove 79 so that the pistons 67 and 68 are both positioned inwardly to hold both sets of pawls 38 and 39 released, with the intermittent rotation rendered inactive. By turning the valve clockwise in FIG. 8 the motor passage 73 may be connected to the exhaust conduit 78 by the groove 77 and pressure fluid may be supplied through port 81 to the motor passage 72 to effect reverse operation of the rotary motor. In either valve position shown the fluid groove 79 maintains the pressure fluid supply to the passages 70 and 71.

In FIGS. 9 and 10 the valve device 53 is shown cut by a different plane although, evidently, if desired, a

separate control valve may be employed to obtain the desired functions. In this sectional plane there are exhaust conduits **83** and **84** and the valve has an external circumferential exhaust groove **85**. Formed in the valve are radial fluid ports **86** and **87** which may connect with the motor passages **72** and **73** and the fluid passages **70** and **71** for the control pistons **67** and **68**. In FIG. 9 the valve is positioned to effect operation of the ratchet and pawl mechanism and the rotary motor both in one direction with passages **70** and **72** vented and passages **71** and **73** connected to the pressure fluid supply. In FIG. 10 the valve is in reversing position, with the passages **71** and **73** vented and passages **70** and **72** connected to the pressure fluid supply to effect reverse operation of both the ratchet and pawl mechanism and the rotary motor. The valve may be turned slightly from its position in either FIG. 9 or FIG. 10 to connect both fluid passages **70** and **72** of the rotary motor to exhaust to interrupt operation of the rotary motor. It must be understood, however, that the passages and ports in the valve shown in FIG. 8 are so arranged and separated to effect the functions as disclosed without bringing the ports and passages shown in FIGS. 9 and 10 into undesired positions, and here separate valves might be provided to obtain the desired results, and it is not wished to limit the present invention to any particular control valve structure.

The reversible intermittent rotation mechanism operated by the hammer piston is used with coupled drill steel sections to provide a convenient and easy method of adding or removing steel sections in a relatively rapid manner. The reverse ratchet and pawl mechanism is efficient, having relatively small pressure fluid consumption, but the more powerful independent rotation motor is always available to assist the intermittent rotation when necessary, and at times the rotation motor may supplant the intermittent rotation. Both the intermittent rotation and the independent motor rotation may be released or interrupted to permit a hammer action on the drill steel for loosening of the joints of the coupled steel sections.

As stated above various types of control valve means may be employed for controlling the reversible ratchet and pawl mechanism and the reversible independent rotation motor, and may embody a common control valve as shown or separate control valves which may be coordinated to obtain the desired sequence of events. The reversible ratchet and pawl mechanism may be released to permit operation of the independent motor rotation and the reversible ratchet and pawl mechanism may function while the independent rotation motor is shut down.

The reversible ratchet and pawl mechanism may be used to rotate the drill steel in either direction in an extremely effective manner and is adequate to serve under most drilling conditions. However, when the drill steel tends to stick or the couplings of the drill steel are difficult to loosen the reversible independent motor may supplement or supplant the reversible ratchet and pawl mechanism. By the provision of the release for the reversible ratchet and pawl mechanism it is possible, as has been made clear above, to use the hammer motor without rotation of the drill steel to aid in loosening a stuck drill steel or a tight joint. By coordinating the control for both rotations any danger of operating the two rotations concurrently in relatively opposite directions is eliminated thus removing the possibility of a stalled motor and breakage of associated parts.

As a result of this invention an improved reversible dual rotation is provided for a hammer rock drill whereby the drill steel may be either intermittently or continuously rotated in either of opposite directions with the continuous rotation either supplementing or supplanting the intermittent rotation. By the provision of a reversible ratchet and pawl mechanism operated by the hammer piston the drill steel may be intermittently rotated in either direction with relatively small consumption of pressure fluid. The independent more powerful and reversible rotation motor may supplement or supplant the reversible ratchet and pawl mechanism but whenever the independent motor is reversed and the ratchet and pawl mechanism is operative the latter is concurrently reversed to prevent stalling and possible damage to the machine. Other advantages of the invention will be clearly apparent to those skilled in the art.

While there is in this application specifically described one preferred form which the invention may assume in practice, it will be understood that this form is shown for purposes of illustration and that the invention may be modified and embodied in various other forms without departing from its spirit or the scope of the appended claims.

What I claim is:

1. In a tool rotation mechanism, reversible means for intermittently rotating the tool in either of opposite directions, independent reversible motor means for rotating the tool in either of opposite directions to supplement or supplant said intermittent means, and means for automatically reversing said intermittent means whenever said independent motor means is reversed.

2. In a rock drill, a cylinder containing a reciprocable hammer piston for percussively actuating a drill steel, a reversible intermittent mechanism operated by said piston for intermittently rotating the drill steel in either of opposite directions, and an independent rotation motor for supplementing or supplanting said intermittent rotation during normal intermittent rotation.

3. A rock drill as set forth in claim 2 wherein said independent rotation may supplement said intermittent rotation in either direction.

4. In a rock drill, a cylinder containing a reciprocable hammer piston for percussively actuating a drill steel, a reversible intermittent ratchet and pawl mechanism operated by said piston for intermittently rotating the drill steel in either of opposite directions, a reversible independent motor for continuously rotating the drill steel in either direction, and control means for coordinating said intermittent rotation mechanism with said independent motor so that whenever the latter is reversed the ratchet and pawl mechanism is simultaneously automatically reversed.

5. A rock drill as set forth in claim 4 wherein said control means includes means for rendering said reversible ratchet and pawl mechanism inactive during operation of said independent rotation motor.

6. In a rock drill, a cylinder containing a reciprocable hammer piston for percussively actuating a drill steel, an intermittent reversible rotation mechanism operated by said piston for intermittently rotating the drill steel in one direction during normal drilling or in the opposite direction, and an independent rotation motor for supplementing said intermittent mechanism in one direction.

7. A rock drill as set forth in claim 6 wherein said independent rotation motor may supplement said intermittent rotation mechanism during either direction of operation thereof.

8. A rock drill as set forth in claim 6 wherein control means is provided for effecting automatic reversal of said intermittent rotation mechanism upon reversal of said independent rotation motor.

9. A rock drill as set forth in claim 6 wherein control means is provided whereby said independent motor may supplant said reversible intermittent rotation mechanism during either direction of drill steel rotation.

10. A drilling tool having a drilling implement, a reciprocatory motor for rotating the drilling implement in one direction during drilling and in the reverse direction, a separate reversible rotary motor for aiding said reciprocatory motor in rotating the drilling implement, and means for automatically reversing the direction of rotation effected by said reciprocatory motor whenever said rotary motor is reversed.

11. A drilling tool having a drilling implement, a reciprocatory motor for selectively rotating the drilling implement in either of opposite directions, and a separate rotary motor for aiding said reciprocatory motor during rotation of the drilling implement in one direction.

12. A drilling mechanism comprising a motor for actuating a drilling implement to effect drilling, reversible intermittent rotation mechanism for intermittently rotation mechanism for intermittently rotating the drilling implement selectively in either of opposite directions, and means for superimposing a superior rotation force on said rotative mechanism during one direction of intermittent rotation of the drilling implement.

13. In a rock drill, an impact motor having a reciprocating piston for percussively actuating a drilling implement, a reversible ratchet and pawl mechanism connected to said piston for rotating the drilling implement selectively in either of opposite directions, and means for superimposing a superior rotative force on said ratchet and pawl mechanism during operation of said mechanism in one direction.

14. In a drill, means for rotating a drilling implement selectively in either of opposite directions, and means embodied in the drill for superimposing a superior rotative force on said rotating means during rotation of the drilling implement in one direction.

15. In a drill, means for rotating a drilling implement selectively in either of opposite directions, and means embodied in the drill for superimposing a superior rotative force on said rotating means during rotation of the drilling implement in either direction.

References Cited in the file of this patent

UNITED STATES PATENTS

1,176,443	Haeseler	Mar. 21, 1916
1,384,661	Guiley	July 12, 1921
1,390,834	Stage	Sept. 13, 1921
1,409,703	Gilman	Mar. 14, 1922
1,456,234	Hansen	May 22, 1923
2,051,053	Morris	Aug. 18, 1936