Aug. 15, 1939. E. G. GARTIN 2,169,637

ROCK DRILL

Original Filed Oct. 21, 1935 3 Sheets-Sheet 1

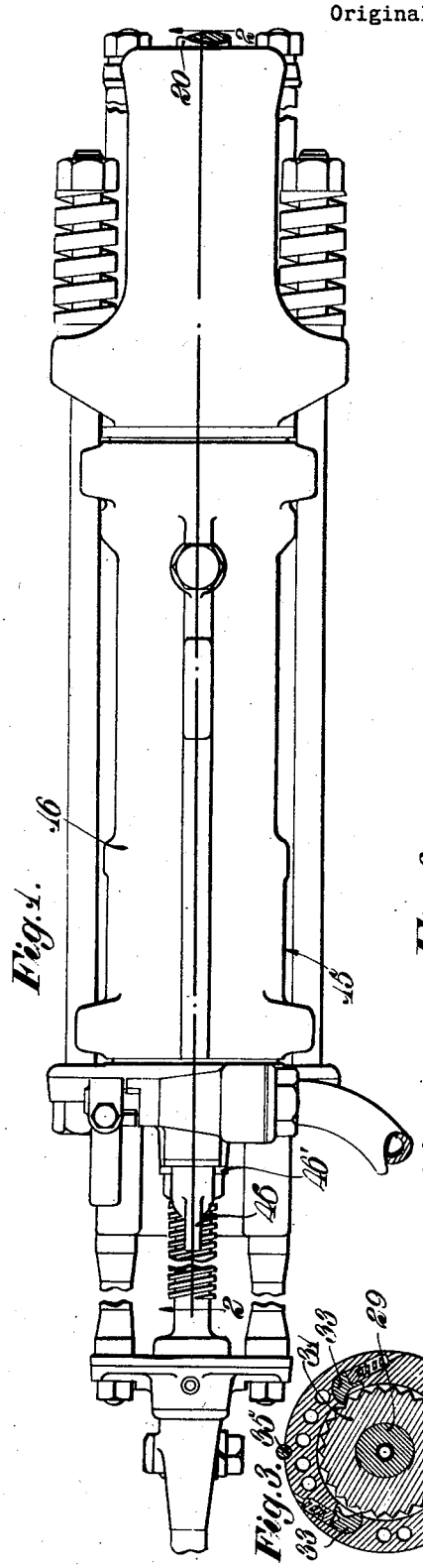


Fig. 1.

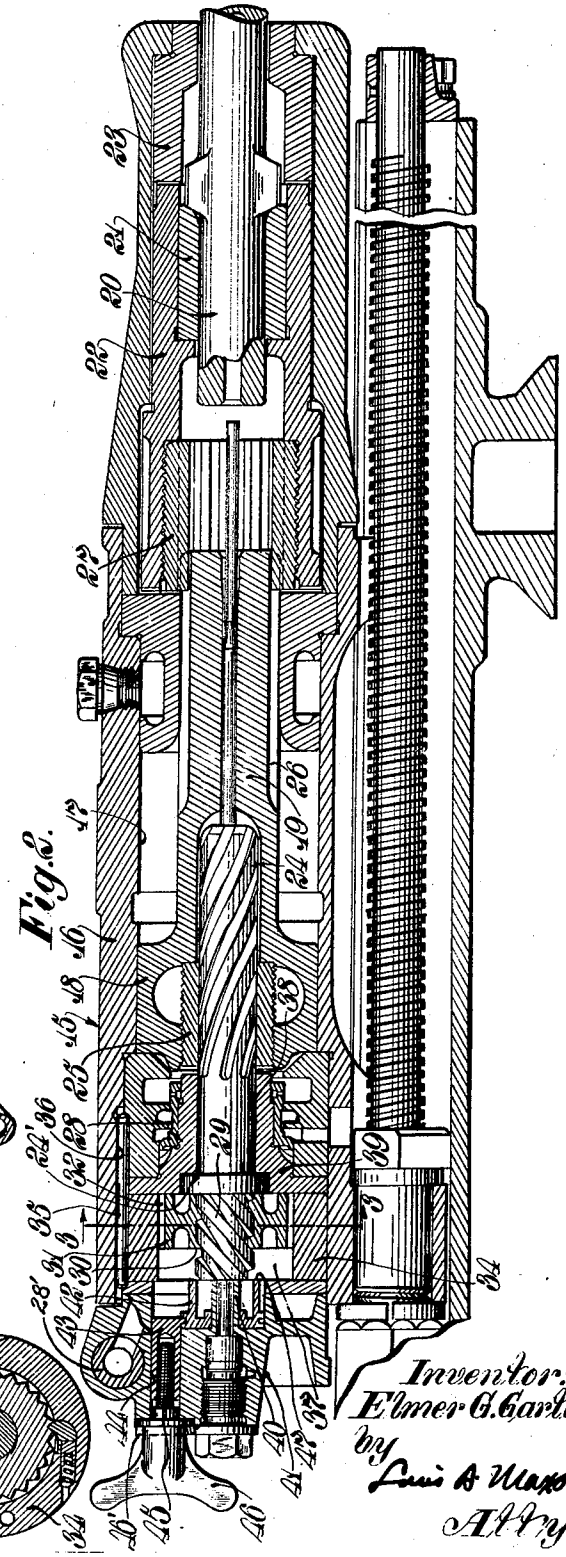


Fig. 2.

Fig. 3.

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Fig.4.

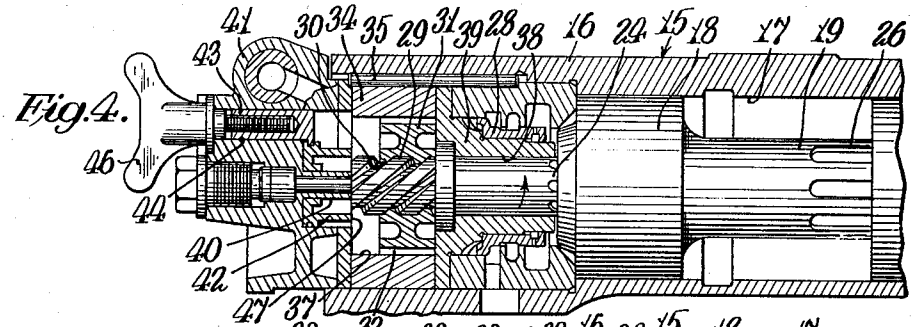


Fig.5.

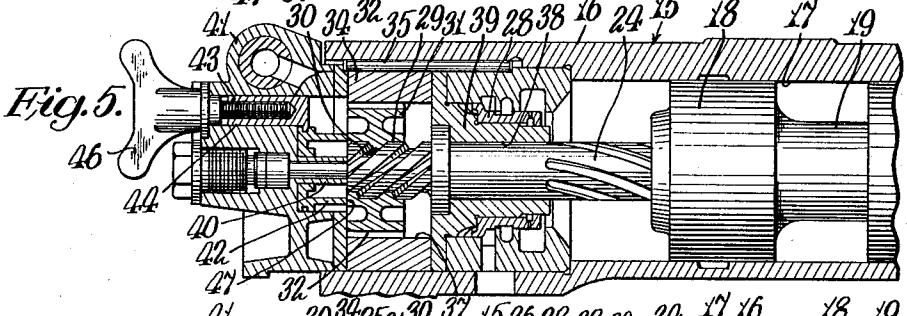


Fig.6.

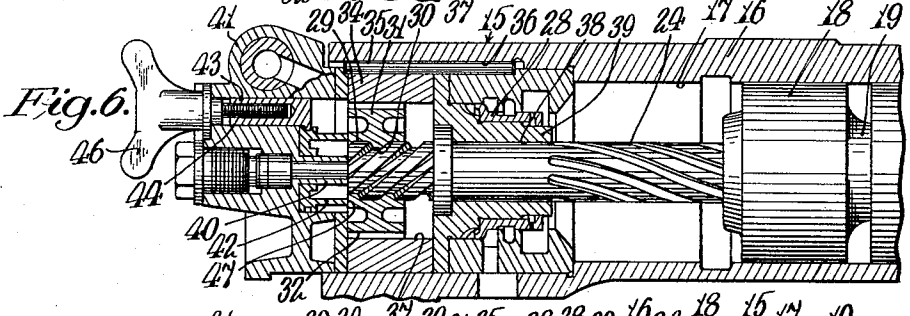


Fig.7.

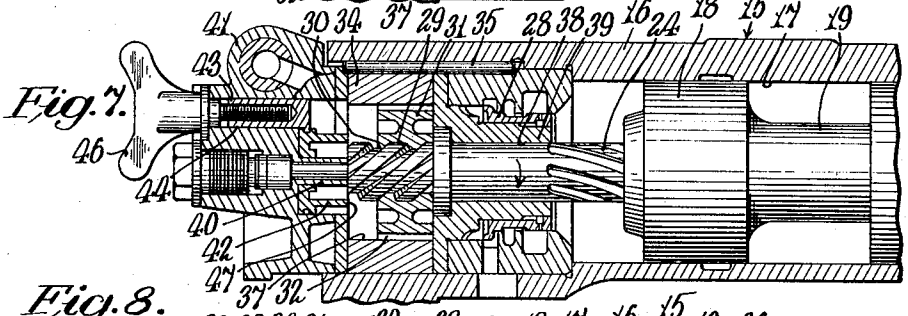
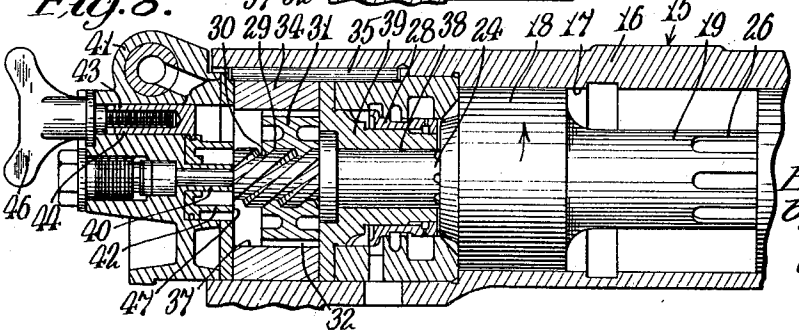


Fig.8.



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Fig. 9.

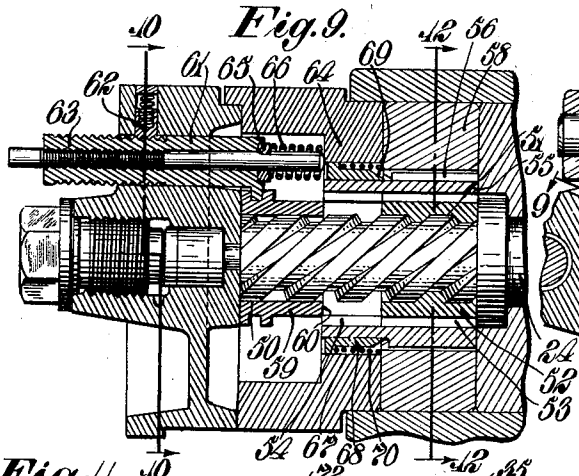


Fig. 10.

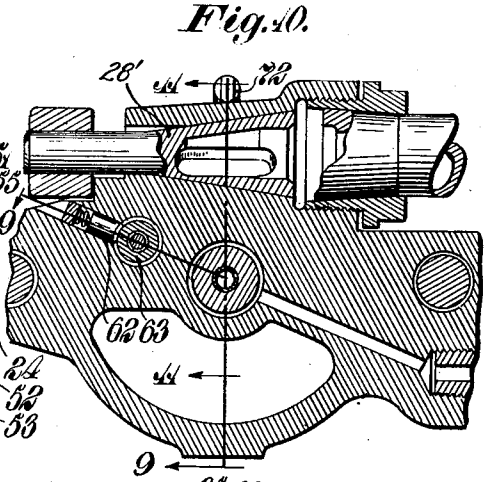


Fig. 11.

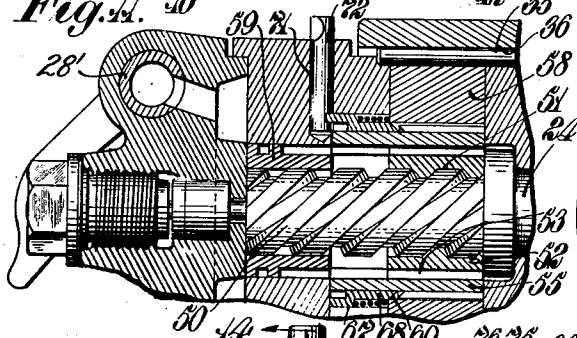


Fig. 12.

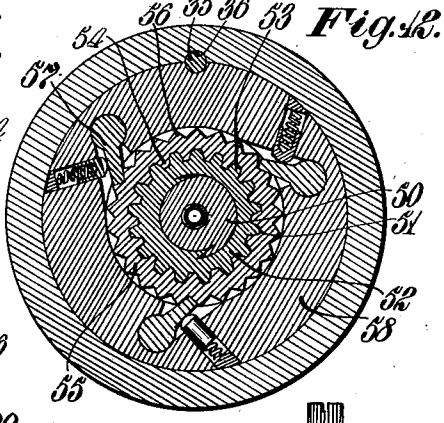


Fig. 13.

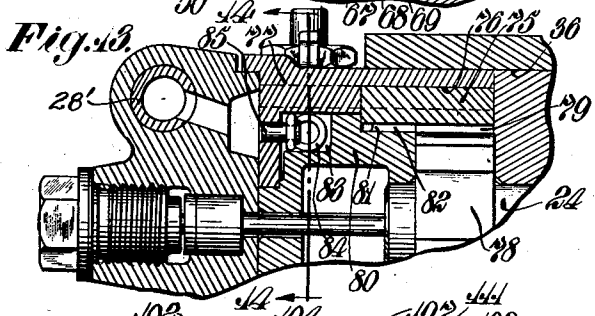


Fig. 14.

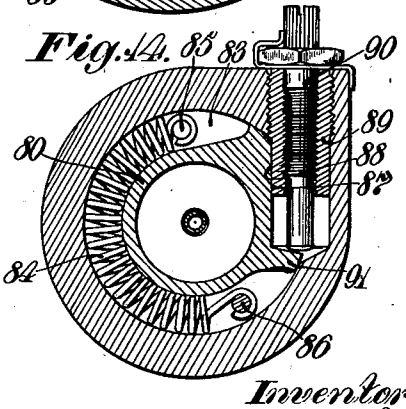
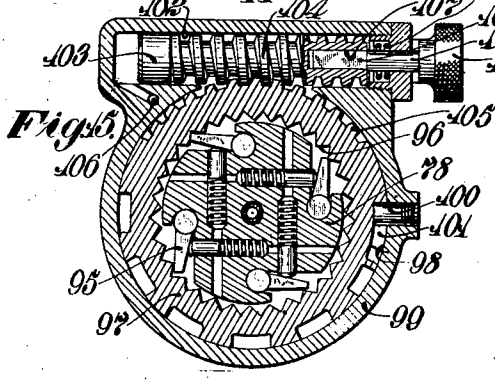


Fig. 15.



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UNITED STATES PATENT OFFICE

2,169,637

ROCK DRILL

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Application October 21, 1935, Serial No. 45,931
Renewed November 4, 1937

29 Claims. (Cl. 121—7)

This invention relates to rock drills, and more particularly has reference to improvements in the drill steel rotation mechanism of a rock drill of the reciprocating piston, hammer type.

An object of this invention is to provide an improved rock drill rotation mechanism. Another object is to provide an improved variable rotation mechanism for the drill steel of a hammer rock drill. Another object is to provide an improved variable rotation device associated with the ratchet and pawl rotation means of a hammer rock drill, whereby the rate of drill steel rotation may be varied to suit different drilling conditions. These and other objects will, however, hereinafter more fully appear.

In the accompanying drawings there are shown for purposes of illustration several forms which the invention may assume in practice.

In these drawings—

Fig. 1 is a plan view of a hammer rock drill equipped with one illustrative form of the improved variable rotation means,

Fig. 2 is a view in longitudinal section, taken substantially on line 2—2 of Fig. 1, parts being omitted to facilitate illustration,

Fig. 3 is a cross sectional view, taken substantially on line 3—3 of Fig. 2,

Figs. 4 to 8, inclusive, are views in longitudinal section respectively showing the movable rotation and motor parts in different positions,

Fig. 9 is a fragmentary view in longitudinal section, taken in the planes of the lines 9—9 of Fig. 10, showing a modified form of construction,

Fig. 10 is a cross sectional view taken substantially on the vertical plane of line 10—10 of Fig. 9,

Fig. 11 is a detail sectional view taken substantially on line 11—11 of Fig. 10,

Fig. 12 is a cross sectional view taken substantially on the plane of the line 12—12 of Fig. 9,

Fig. 13 is a fragmentary view in longitudinal section similar to Fig. 11, showing a further modified form of construction,

Fig. 14 is a detail sectional view taken substantially on line 14—14 of Fig. 13,

Fig. 15 is a view similar to Fig. 14, showing still another modified form of construction.

In the illustrative embodiment of the invention shown in Figs. 1 to 8 inclusive, the preferred form of the improved variable rotation device is embodied in a hammer rock drill, generally designated 15, of the pressure fluid actuated, hammer type. The rock drill is of a conventional design comprising a cylinder 16 having a bore 17 containing a reciprocatory hammer piston 18. The hammer piston has a forwardly projecting striking bar 19 for delivering impact blows to the shank 20 of a usual, lugged rock drill steel loosely supported for reciprocatory movement in a chuck bushing 21 mounted within a rotatable chuck sleeve 22. The chuck sleeve is connected as by clutch teeth to a usual driver member 23 having lugs engageable with the drill steel lugs so that when the chuck sleeve is rotated, the driver member and drill steel are rotated therewith, as is usual in rock drills of the type disclosed. A spirally grooved rifle bar 24 is slidingly interlocked with the spiral lugs of a rifle nut 25 secured within the hammer piston 18. The improved variable rotation device, as will later be described, embodies means whereby the rifle bar 24 is released for free rotation during the forward working stroke of the hammer piston and is held against rotary motion during all or various fractions of the return stroke of the piston. During the return piston stroke the rifle nut, slidingly interlocked with the spiral lugs on the rifle bar, when the rifle bar is held against rotation, imparts a rotary motion to the hammer piston, and this rotary motion is transmitted to the drill steel through straight grooves 26 formed on the exterior of the piston striking bar, slidably interlocked with straight lugs formed on a chuck nut 27 secured within the rotatable chuck sleeve 22. It will thus be seen that as the hammer piston reciprocates within its cylinder, the drill steel is percussively actuated and may be intermittently rotated. The fluid distribution system for conducting the supply of pressure fluid to the motor cylinder to effect reciprocation of the hammer piston and the exhaust of fluid from the motor cylinder is controlled by an automatic fluid-actuated, fluid-distributing valve 28 of a conventional design, and a usual throttle valve 28' on the drill controls the supply of pressure fluid to the distributing valve from any suitable pressure fluid source.

Now referring to the specific structure of the improved variable rotation device, it will be noted that the rearward reduced extremity of the rifle bar 24 is threaded at 29, and these rifle bar threads are threadedly engaged within a threaded opening 30 formed in a ratchet member 31. This ratchet member is of cylindrical form having external ratchet teeth 32 with which spring-pressed pawls 33 cooperate, these pawls being mounted on a pawl carrier 34 secured, as by a dowel pin 35, within a bore 36 formed within the rearward portion of the cylinder 16. The ratchet member 31

is of substantially less width than the width of the pawl carrier and pawls, and the pawl carrier is formed with an internal bore 37 within which the ratchet member 31 is mounted for axial movement. The rifle bar 24 is journaled at 38 within a rear head member 39 likewise secured by the dowel pin within the bore 36, so that the rifle bar is free to rotate under the control of the variable speed device. Longitudinal motion of the rifle bar is, however, prevented by the coaction of the collar 24' thereon with the head member 39, and by coaction between the rear end of the rifle bar and an extension 40 of the rear head block 41. Slidably mounted on the cylindrical extension 40 is an adjustable stop member 42, preferably of cup-shaped form, having a bearing on the projection 40 as shown in Fig. 2. Means is provided for adjusting the stop member 42 axially with respect to the rifle bar and ratchet member 31, comprising an adjusting member 43 slidably guided in a longitudinal bore 44 formed in the head block 41 and threadedly engaged with an adjusting screw 45 having an operating handle 46 held against longitudinal movement by a yoke 46'. The adjusting member 43 is formed with a lateral lug seated within a groove formed in the member 42 so that as the member 43 is moved axially, the member 42 is moved axially therewith. The forward side of the member 42 is provided with an annular abutment surface 47, and upon adjustment of the member 42 the abutment surface 47 may be moved into different positions within the bore 37 and held there, thereby to provide a variable stop for the ratchet member 31 in a manner to be later explained.

The mode of operation of the preferred form of the improved variable rotation mechanism will be clearly apparent from the description given. Let it be assumed that the parts are in the position shown in Fig. 2 with the hammer motor running, the hammer piston reciprocating rapidly within the motor cylinder to deliver impact blows to the shank of the drill steel. At this time (i. e. in the adjusted position of the parts shown in Fig. 2) the stop member 42 is in its rearmost released position. When the hammer piston 18 is in the rearmost position shown in Fig. 4 and is about to move forwardly to effect its working stroke, i. e. to strike a blow on the drill steel shank, the ratchet member 31 is in the position shown, with its forward surface against the rear face of the head member 39. As the hammer piston moves forwardly from the position shown in Fig. 4 to the position shown in Fig. 5, the rifle bar 24 is rotated, due to its splined connection with the spiral lugs on the rifle nut, in the direction of the arrow in Fig. 4, rotating therewith the screw-threaded portion 29, and as a result, due to its threaded engagement with the screw portion 29, the ratchet member 31 will be moved axially rearwardly until it abuts the surface of the stop member 42 (as shown in Fig. 5). During such rearward axial movement of the ratchet member 31, the same is held against rotation in the direction of rifle bar rotation by the frictional engagement of the spring-pressed pawls 33 with the ratchet teeth. As forward movement of the hammer piston continues from the position shown in Fig. 5 to the position in Fig. 6, the ratchet member 31, since it can no longer move rearwardly, rotates in unison with the rifle bar 24 relative to the pawl carrier 34, the spring-pressed pawls slipping over the teeth of the ratchet member 31 at that time. It is accordingly evident that as the hammer piston travels forwardly from the position in Fig. 4 to the position in Fig. 6, its movement is unimpeded, so that the full force of its impact action is delivered to the drill steel shank. Upon the return movement of the hammer position, which starts with the member 31 against the stop member 42, the rifle bar 24, due to its splined connection with the spiral lugs of the rifle nut, is rotated in the opposite direction, as indicated by the arrow in Fig. 7, and the screw portion 29 at that time effects movement of the ratchet member 31 from its initial, rearmost position axially in a forward direction until its forward surface abuts the rear face of the rear head member 39 or, if preferred, the rear of the collar 24', the proportioning of the parts making either result possible. During such forward axial movement of the ratchet member 31, the same is held against rotation in the direction of rifle bar rotation by the pawls 33 engaging the teeth of the ratchet member. As the ratchet member 31, when it attains to the position shown in Fig. 7, can move no farther forwardly, and as the ratchet member is held against rotation in the direction in which the rifle bar has been turning, by the pawls engaging the ratchet teeth thereon, the rifle bar 24 will be locked against further rotation in the same direction. Upon continued rearward movement of the hammer piston from the position in Fig. 7 to the position in Fig. 8, the hammer piston, due to its splined connection with the spiral grooves of the relatively stationary rifle bar, has, therefore, imparted thereto a rotary motion in the direction of the arrow in Fig. 8, and as a result the drill steel is rotated through the straight grooves 26 on the striking bar and the straight lugs on the chuck nut 27. It is accordingly evident that the threaded and axially movable connection between the rifle bar 24 and the ratchet member 31 provides a lost motion connection which permits some idle movement of the rotation mechanism until the rifle bar is locked against rotative movement. When it is desired to vary the rate of drill steel rotation, that is to increase the rate of rotation, the operator may grasp the handle 46 and rotate the adjusting screw 45, thereby to move the stop member 42 axially forwardly to vary the location of its annular abutment surface with respect to the rifle bar so that the amount of rearward movement of the ratchet member 31 during the forward piston stroke may be varied, and as a result the amount of lost motion between the rifle bar and the ratchet member may be correspondingly varied. When the stop member is adjusted into its foremost position in engagement with the rear surface of the ratchet member 31 with the latter abutting the rear face of the rear head member 39, the ratchet member 31 is held against any axial movement within the bore 37 so that the rifle bar 24 is locked against rotary motion during the entire return stroke of the hammer piston, and as a result full rotation is imparted to the drill steel. It is, accordingly, evident that during hard drilling, that is when the drill steel is penetrating a relatively hard material, the rate of drill steel rotation may be decreased, and that during relatively soft drilling, that is when the drill steel is penetrating a relatively soft material, the rate of drill steel rotation may be increased, and by proper adjustment of the stop member 42 any desired rate of drill steel rotation may be attained between fast rotation and slow rotation. If the travel of

member 31 be made great enough, complete cessation of drill steel rotation may be secured.

In the modified form of construction shown in Figs. 9 to 12 inclusive, the rifle bar 24 is provided with a rearward threaded extremity 50 threadedly engaged at 51 within a member 52, and the member 52 has straight teeth 53 slidingly interlocked with straight teeth 54 formed on a ratchet member 55. The member 55 is provided with ratchet teeth 56 with which are engageable spring-pressed pawls 57 carried by a stationary pawl carrier 58 secured within the bore 36 of the motor cylinder 16. In this instance, the ratchet member 55 is held against axial movement with respect to the pawl carrier 58 while the member 52 is slidable axially within the ratchet member 55. An adjustable stop member 59, provided with an annular abutment surface 60, is provided for varying the axial movement of the member 52 in a manner similar to the adjustable stop member 42 of the form of the invention above described. The adjustable stop member 59 is provided with a slidable adjusting member 61 having a spring-pressed detent lock 62 for holding the member 61 in its different adjusted positions. Threaded within the member 61 is an adjustable stop screw 63 for varying the amount of inward movement of the adjusting member 61. Surrounding the member 63 and interposed between a surface on the rear head block 64 and a washer 65 engaging the inner surface of the member 61 is a coil spring 66 for normally urging the member 61 into its outermost position. Slidably mounted within a bore 67 formed in a rear head block is a sleeve-like plunger 68 having a front cam surface 69, and this member is normally urged toward its released position by a coil spring 70. Mounted in a bore 71 in the head block is a rotatable cam member 72 having a cam surface engageable with the rear flange of the member 68 for moving the latter axially within its bore. When the member 68 is moved forwardly, the cam surface thereon engages the pawls of the pawl carrier to release th pawls entirely from the teeth of the ratchet member, as will later be described. This form of the variable rotation device operates in a manner similar to that above described except that as the rifle bar 24 rotates, the member 52 is moved axially with respect to the ratchet member 55 while the latter is held against rotation by the engagement of the pawls with the ratchet teeth, and the extent of axial movement of the member 52 is controlled by the abutment surface on the adjustable stop member 59. To effect complete release of the ratchet and pawl mechanism to interrupt entirely drill steel rotation during reciprocation of the hammer piston, the sleeve-like member 68 is moved forwardly by the cam member 72 to release completely the pawls 57 from the ratchet teeth 56 so that the ratchet member 55 is at that time free to oscillate with the rifle bar 24. Otherwise, this form of the invention is similar to that above described. It will be noted that member 52 will abut the collar on the rifle bar when in its forward position.

In Figs. 13, 14 and 15 there are disclosed two modifications of the invention and in these forms of the invention the spiral grooves on the rifle bar are preferably of less inclination than those of the forms of the invention above described, the rifle bars in these latter instances being of the standard type, while those of the forms of the invention above described are of a special type and necessarily having relatively steep spiral grooves in order to obtain the necessary rotation of the screw integral therewith. Therefore, the members 80 and 97 have an arc of rotation substantially less than the arc of rotation of the member 31.

In the modified form of construction shown in Figs. 13 and 14, the ratchet member 75 is rotatably mounted in a bore 76 formed in a head member 77 secured within the bore 36 of the motor cylinder. The rifle bar 24 has formed integral therewith a pawl carrier 78 carrying spring-pressed pawls engageable with the teeth 79 of the ratchet member 75. Rotatably mounted within the member 77 is a rotation-varying member 80 having external teeth 81 interlocked with teeth 82 formed on the ratchet member 75. the members 75 and 80 being interlocked together for rotation with respect to the member 77. As shown in Fig. 14, the member 80 is formed with an arcuate recess 83, and arranged in this recess is a coiled spring 84 having one end connected to a stationary pin 85 fixed to the member 77 and its other end connected to a pin 86 secured to the member 80. The coiled spring 84 normally holds an abutment surface 87 on the member 80 in engagement with an abutment surface 88 formed on an adjustable member 89 threaded within the member 77. Adjustably threaded within the member 89 is a stop screw 90 with which a projecting lug 91 on the member 80 is adapted to abut. When the parts are in the position shown in Figs. 13 and 14, the member 80 and the ratchet member 75 interlocked therewith are held against rotation with respect to the member 77 and at this time the ratchet and pawl mechanism operates in a conventional manner to effect drill steel rotation as the hammer piston reciprocates. When it is desired to vary the rate of drill steel rotation, this may be accomplished by adjusting the screw 90 to move the inner end thereof away from the lug 91, thereby to permit the member 80, together with the ratchet member 75 interlocked therewith, to oscillate more or less with respect to the member 77, so that as the hammer piston moves rearwardly to effect drill steel rotation, the rifle bar 24 rotates with the members 80 and 75 until the lug 91 engages the inner end of the adjusting screw 90, the rifle bar then being held against rotation. The maximum arc of permissible rotation of the member 80 is at least equal to the arc of rotation of the rifle bar during the full return stroke of the hammer piston. Otherwise, this form of the invention is similar to those above described.

In the modified form of construction shown in Fig. 15, the rifle bar is similar to that of the form of the invention shown in Figs. 13 and 14 and the pawl carrier 78 carries spring-pressed pawls 95 engageable with ratchet teeth 96 formed on a ratchet member 97. This ratchet member is mounted for oscillatory movement within a bore 98 formed in a rear head member 99, and its oscillatory motion is limited by a pin 100 on the member 99 projecting within a slot 101 in the member 97. The extent of the slot 101 is sufficient to permit rotative movement of the member 97 through an arc at least equal to the arc of rotation of the rifle bar. Arranged in a tangential bore 102 formed in the head member 99 is a plunger-like member 103 having screw threads 104 meshed with threads 105 formed on the ratchet member 97. A passage 106, controlled by the throttle valve of the hammer motor, is adapted to supply pressure fluid to the end of

the bore 102 at the left-hand end of the plunger 103 so that this plunger is normally urged toward its right-hand position by the action of pressure fluid thereon. The plunger 103 is formed with a polygonal socket 107 with which is slidably interlocked the polygonal portion 108 of an adjusting member 109. Member 109 is provided with a handle 110 so that the member 109 may be rotated to effect rotation of the plunger 103. A light coil spring 111 constantly holds the member 110 against the end closure of chamber 102 so as to hold it in its adjusted position, the spring 111 acting between a cotter pin secured to the member 110 and the inner surface of the end closure of the chamber 102 in the manner shown. As the plunger is rotated, the threads thereon engaging the threads on the member 97 effect axial adjustment of the plunger with respect to the head member 99, thereby to vary the range of movement of the plunger and the amount of oscillation of the ratchet member 97. When the plunger 103 is moved into a position to abut constantly the left-hand end of the bore 102, the ratchet member 97 is held against oscillation, and, at that time, the ratchet and pawl mechanism operates in a conventional manner to effect drill steel rotation during reciprocation of the hammer piston. When the plunger member is adjusted toward the right in Fig. 15, the ratchet member 97 may be permitted to oscillate, thereby to vary the rate of drill steel rotation in the manner described above in the form of the invention shown in Figs. 13 and 14. Otherwise, this form of the invention is similar to those above described. It will be understood that the area on plunger 103 is insufficient, at the pressure which acts on it, to preclude the limited rotation of member 97 during rearward piston movements.

As a result of this invention it will be noted that an improved rock drill is provided having embodied therein improved variable rotation means, whereby the rate of drill steel rotation may be varied to suit different drilling conditions. It will further be noted that by the provision of the improved speed-varying device associated with the ratchet and pawl mechanism, it is possible to vary the rate of drill steel rotation while the rate of reciprocation of the hammer piston remains substantially constant. It will further be noted that the several improved variable speed devices are of extremely simple and rugged design and may be incorporated in a conventional rock drill with a minimum of change. These and other uses and advantages of the invention will be clearly apparent to those skilled in the art.

While I have in this application specifically described several forms which my invention may assume in practice, it will be understood that these forms of the same are 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 as new and desire to secure by Letters Patent is:

1. In a rock drill, a hammer motor including a cylinder, a piston reciprocable therein, a drill steel arranged in position to receive the impact blows of the piston, drill steel rotation mechanism including means operated by said piston for rotating the drill steel, and adjustable means associated with said drill steel rotation mechanism and cooperating adjusting means for varying and maintaining the rate of drill steel rotation at any speed between a predetermined minimum and a predetermined maximum rotative speed.

2. In a rock drill, a hammer motor including a cylinder, a piston reciprocable therein, a drill steel arranged in position to receive the impact blows of the piston, drill steel rotation mechanism including means operated by said piston for rotating the drill steel, and adjustable means associated with said drill steel rotation mechanism and cooperating adjusting means for varying and maintaining the rate of drill steel rotation at any speed between a predetermined minimum and a predetermined maximum rotative speed independently of any variation in the rate of piston reciprocation.

3. In a rock drill, a hammer motor including a cylinder, a piston reciprocable therein, a drill steel arranged in position to receive the impact blows of the piston, a ratchet and pawl mechanism operated by said piston for rotating the drill steel and including a pawl-carrying member, a ratchet member mounted to turn with respect thereto and having teeth with which the pawls are engageable and a rifle bar slidingly interlocked with the motor piston, and means associated with said ratchet and pawl mechanism for varying the rate of drill steel rotation without varying the load on the rotation mechanism and including rotation varying elements interposed between said rifle bar and said ratchet member.

4. In a rock drill, a hammer motor including a cylinder, a piston reciprocable therein, a drill steel arranged in position to receive the impact blows of the piston, a ratchet and pawl mechanism operated by said piston for rotating the drill steel and including a ratchet member having ratchet teeth, a pawl-carrying member carrying pawls engageable with the ratchet teeth, said members being mounted for relative turning movement, and a rifle bar slidingly interlocked with the motor piston, and adjustable means interposed between said rifle bar and one of said members and cooperating adjusting means for permitting relative rotation between said rifle bar and said member to vary the rate of drill steel rotation without varying the load on the rotation mechanism.

5. In a rock drill, a hammer motor including a cylinder, a piston reciprocable therein, a drill steel arranged in position to receive the impact blows of the piston, a ratchet and pawl mechanism operated by said piston for rotating the drill steel and including a ratchet member having ratchet teeth, a pawl-carrying member carrying pawls engageable with the ratchet teeth, said members being mounted for relative turning movment, and a rifle bar slidingly interlocked with the motor piston, and adjustable means interposed between said rifle bar and one of said members and cooperating adjusting means for permitting relative rotation between said rifle bar and said member to vary the rate of drill steel rotation, said means interposed between said rifle bar and said member including a screw-threaded portion integral with the rifle bar and threads formed on said member and threadedly engaged with said screw-threaded portion.

6. In a rock drill, a hammer motor including a cylinder, a piston reciprocable therein, a drill steel arranged in position to receive the impact blows of the piston, a ratchet and pawl mechanism operated by said piston for rotating the drill steel including a ratchet member having

ratchet teeth, a pawl carrier member carrying pawls engageable with the ratchet teeth, one of said members being mounted for turning movement relative to the other member, and a rifle bar slidingly interlocked with the motor piston, said turnable member mounted for axial movement with respect to the rifle bar, and adjustable means interposed beween said rifle bar and said turnable member and cooperating adjusting means for varying the rate of drill steel rotation including a screw-threaded portion integral with the rifle bar and threads formed on the turnable member and threadedly engaged with said screw-threaded portion, rotation of said screw-threaded portion effecting axial movement of said turnable member.

7. In a rock drill, a hammer motor including a cylinder, a piston reciprocable therein, a drill steel arranged in position to receive the impact blows of the piston, a ratchet and pawl mechanism operated by said piston for rotating the drill steel including a ratchet member having ratchet teeth, a pawl carrier member carrying pawls engageable with the ratchet teeth, one of said members being mounted for turning movement relative to the other member, and a rifle bar slidingly interlocked with the motor piston, said turnable member mounted for axial movement with respect to the rifle bar, and adjustable means interposed between said rifle bar and said turnable member and cooperating adjusting means for varying the rate of drill steel rotation including a screw-threaded portion integral with the rifle bar and threads formed on the turnable member and threadedly engaged with said screw-threaded portion, rotation of said screw-threaded portion effecting axial movement of said turnable member, said adjusting means including stop means for varying the range of axial movement of said turnable member.

8. In a rock drill, a hammer motor for percussively actuating the drill steel and including a cylinder containing a reciprocatory hammer piston for delivering impact blows to the drill steel shank, and drill steel rotation mechanism including means operated by said hammer piston and controllable by the drill operator to render the same effective during different fractions of the piston strokes in one direction, for effecting drill steel rotation at each of a wide range of speeds independently of any variation in the rate of piston reciprocation.

9. In a rock drill, the combination with a hammer motor having a cylinder containing a reciprocable hammer piston and a drill steel arranged in position to receive the impact blows of said hammer piston, of a variable speed drill steel rotation mechanism actuated by said hammer piston and embodying means for effecting variable rotation of the drill steel by said piston during different portions of one piston stroke, said mechanism being entirely released, as regards its rotation effecting function, from piston actuation during the other portions of the piston stroke.

10. In a rock drill, the combination with a hammer motor having a cylinder containing a reciprocable hammer piston and a drill steel arranged in position to receive the impact blows of said hammer piston, of a variable speed drill steel rotation mechanism actuated by said hammer piston and embodying a lost-motion connection and means for varying the extent of the lost motion in said connection so that the drill steel is variably rotated by said piston during different fractions of a piston stroke in one direction, said mechanism being entirely released, as regards its rotation effecting function, from piston actuation during the other fractional portions of the piston stroke.

11. In a rock drill, the combination with a hammer motor having a cylinder containing a reciprocable hammer piston and a drill steel arranged in position to receive the impact blows of said hammer piston, of a variable speed drill steel rotation mechanism operated by said hammer piston and embodying a rotation bar slidingly interlocked with said hammer piston, a ratchet and pawl device, an adjustable mechanism between said rotation bar and said ratchet and pawl device and adjustable at will to cause said ratchet and pawl device to hold said rotation bar stationary during different fractional portions of one piston stroke, said rotation bar when held stationary for different intervals causing varying amounts of rotary motion of the hammer piston, and means for transmitting the rotary motion of the hammer piston to the drill steel.

12. In a rock drill, the combination with a hammer motor having a cylinder containing a reciprocable hammer piston and a drill steel arranged in position to receive the impact blows of said hammer piston, of a variable speed drill steel rotation mechanism operated by the hammer piston and embodying a rotation bar slidingly interlocked with said hammer piston, a screw rotatable with said rotation bar, a nut threadedly engaged with said screw and guided for rectilinear movement, a ratchet formed integral with said nut, pawls engaging said ratchet, means for varying the amount of rectilinear movement of said nut, thereby to vary the intervals when said rotation bar is held stationary by said pawls engaging said ratchet, said rifle bar when held stationary for different intervals effecting a variable rotary motion of said hammer piston, and means for transmitting the rotary motion of the hammer piston to the drill steel.

13. In a rock drill, the combination with a hammer motor having a cylinder containing a reciprocable hammer piston and a drill steel arranged in position to receive the impact blows of said hammer piston, of a variable speed drill steel rotation mechanism operated by said hammer piston and embodying a rifle bar having spiral grooves slidingly interlocked with said hammer piston, a variable holding device connected to said rifle bar for holding the latter against rotation in one direction for varying intervals while permitting the rifle bar to rotate in the opposite direction, said rifle bar when held stationary for different intervals effecting variable rotation of said hammer piston, and means for transmitting the rotary motion of said hammer piston to the drill steel.

14. In a rock drill, the combination with a hammer motor having a cylinder containing a reciprocable hammer piston and a drill steel arranged in position to receive the impact blows of said hammer piston, of a variable speed drill steel rotation mechanism operated by said hammer piston and embodying a rifle bar having spiral grooves slidingly interlocked with said hammer piston, a variable holding device connected to said rifle bar for holding the latter against rotation in one direction for varying intervals while permitting the rifle bar to rotate in the opposite direction, said rifle bar when

held stationary for different intervals effecting variable rotation of said hammer piston, and means for transmitting the rotary motion of said hammer piston to the drill steel, said means for holding said rifle bar against rotation in one direction while permitting the rifle bar to rotate in the opposite direction including a ratchet and pawl device, and said means for varying the intervals during which the ratchet and pawl device holds the rifle bar against rotation including a lost-motion connection between the rifle bar and said ratchet and pawl device.

15. In a rock drill, the combination with a hammer motor having a cylinder containing a reciprocable hammer piston and a drill steel arranged in position to receive the impact blows of said hammer piston, of a variable speed drill steel rotation mechanism operated by said hammer piston and embodying a rifle bar slidingly interlocked with said hammer piston, said rifle bar when held stationary causing the hammer piston to have a rotary motion, means connected to said rifle bar for holding the latter against rotation in one direction for different intervals while permitting rotation of the rifle bar in the opposite direction, and means for transmitting the rotary motion of the piston to the drill steel, said means for holding said rifle bar against rotation in one direction for different intervals including a ratchet and pawl device and means for varying the action of said ratchet and pawl device.

16. In a rock drill, the combination with a hammer motor having a cylinder containing a reciprocable hammer piston and a drill steel arranged in position to receive the impact blows of said hammer piston, of a variable speed drill steel rotation mechanism operated by said hammer piston and embodying a rifle bar slidingly interlocked with said hammer piston, said rifle bar when held stationary causing the hammer piston to have a rotary motion, means connected to said rifle bar for holding the latter against rotation in one direction for different intervals while permitting rotation of the rifle bar in the opposite direction, and means for transmitting the rotary motion of the piston to the drill steel, said means for holding said rifle bar against rotation in one direction for different intervals including a ratchet and pawl device and means for varying the action of said ratchet and pawl device, said last mentioned means including a screw rotatable with the rifle bar and a nut threadedly engaging said screw and guided for rectilinear movement, said nut connected to an element of said ratchet and pawl device, and means for varying the amount of rectilinear movement of said nut.

17. In a rock drill, the combination with a hammer motor having a cylinder containing a reciprocable hammer piston and a drill steel arranged in position to receive the impact blows of said hammer piston, of a variable speed drill steel rotation mechanism operated by said hammer piston and embodying a rotation bar slidingly interlocked with said hammer piston, said rotation bar when held against rotation in one direction effecting rotary motion of said hammer piston and said hammer piston, when said rotation bar is permitted to rotate in the opposite direction, effecting rotation of said rotation bar, means operatively connected to said rotation bar for varying the time intervals when said rotation bar is held stationary, thereby to vary the amount of piston rotation, and means for transmitting the rotary motion of the piston to the drill steel.

18. In a rock drill, the combination with a hammer motor having a cylinder containing a reciprocable hammer piston and a drill steel arranged in position to receive the impact blows of said hammer piston, of a variable speed drill steel rotation mechanism operated by said hammer piston and embodying a rotation bar slidingly interlocked with said hammer piston, said rotation bar when held against rotation in one direction effecting rotary motion of said hammer piston and said hammer piston when said rotation bar is permitted to rotate in the opposite direction effecting rotation of said rotation bar, means operatively connected to said rotation bar for varying the time intervals when said rotation bar is held stationary, thereby to vary the amount of piston rotation, and means for transmitting the rotary motion of the piston to the drill steel, said means for varying the time intervals when said rotation bar is held stationary embodying means rotatable with said rotation bar for transforming the rotary motion of the rotation bar to a reciprocatory motion and means for varying the extent of said reciprocatory motion.

19. In a rock drill, in combination, a hammer motor having a cylinder containing a reciprocable hammer piston, a chuck for supporting a steel for actuation by said piston, and rotation means operatively connected to said hammer piston and operated thereby for rotating said chuck during different predetermined portions of the cycle of piston movement.

20. In a rock drill, in combination, a hammer motor comprising a cylinder containing a reciprocable hammer piston, a chuck for supporting a steel for actuation by said piston, a rotatable rifle bar engaging said piston, an interengaging connection betwen said piston and said chuck, and means for locking said rifle bar against rotation during selectively different portions of the passes of the hammer piston in one direction.

21. In combination, a drilling motor cylinder, a piston reciprocable therein, fluid distributing means, and rotation means including a rifle bar and means for selectively locking the latter throughout certain passes of said piston or during different portions of the passes of the piston in one direction.

22. In combination, a drilling motor cylinder, a piston reciprocable therein, fluid distribution means, and rotation means including a rifle bar and means for selectively locking the latter throughout certain passes of said piston or during different portions of the latter parts of the passes of the piston in one direction.

23. In combination, a drilling motor cylinder, a piston reciprocable therein, fluid distribution means, and rotation means including a rifle bar and means for selectively precluding locking of said rifle bar, or locking the latter throughout certain passes of said piston, or during different portions of the passes of the piston in one direction, at will.

24. In combination, a drilling motor including a cylinder having a piston reciprocable therein, a rifle bar operatively connected with said piston, a chuck connected to said piston for rotation thereby, ratchet and pawl mechanism associated with said rifle bar, and means for rendering said ratchet and pawl mechanism ineffective to control rifle bar movement for different predeter-

mined portions of the cycle of piston movement.

25. In combination, a drilling motor including a cylinder, a piston reciprocable therein, a drill steel actuated by said piston, and drill steel rotation mechanism including coacting elements effective upon piston motion in one direction to effect piston rotation if one of said elements be held against rotation, and means for holding said element against rotation for different predetermined portions of such piston movements.

26. In combination, a drilling motor including a cylinder, a drill-actuating piston in said cylinder, and means for effecting rotation of said piston to effect rotation of a drill actuated thereby including a rifle bar so connected with said piston that relative longitudinal movement between said piston and bar requires relative rotation between them, and means for effecting rotation of said rifle bar relative to said piston during different predetermined portions of like piston strokes including an element automatically connected in non-rotative relation to the rifle bar for different selected predetermined portions of such piston strokes.

27. In combination, a drilling motor including a cylinder, a drill-actuating piston in said cylinder, and means for effecting rotation of said piston to effect rotation of a drill actuated thereby including a rifle bar so connected with said piston that relative longitudinal movement between said piston and bar requires relative rotation between them, and means for effecting rotation of said rifle bar relative to said piston during different predetermined portions of like piston strokes including an element automatically connected in non-rotative relation to the rifle bar continuously or for various definite portions, selectable at will, of the latter parts of the opposite piston strokes.

28. In combination, a drilling motor including a cylinder, a drill actuating piston, and means for effecting rotation of said piston to effect rotation of a drill actuated by said piston including adjustable rotation-controlling means independent of the resistance to rotation afforded by the work and adjustable to provide and maintain selectively different rates of drill rotation.

29. In combination, a drilling motor including a cylinder, a drill actuating piston and means for effecting rotation of a drill actuated by said piston including an element reciprocable, when free to move, in synchronism with said piston, and when held against rotation adapted to effect drill rotation, and means for variably, predeterminedly, limiting the reciprocation of said member or holding it against reciprocation.

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