No. 675,202. Patented May 28, 1901.

L. DURKEE.

ROCK DRILLING MACHINE.

(Application filed Nov. 30, 1900.)

(No Model.) 3 Sheets—Sheet 1.

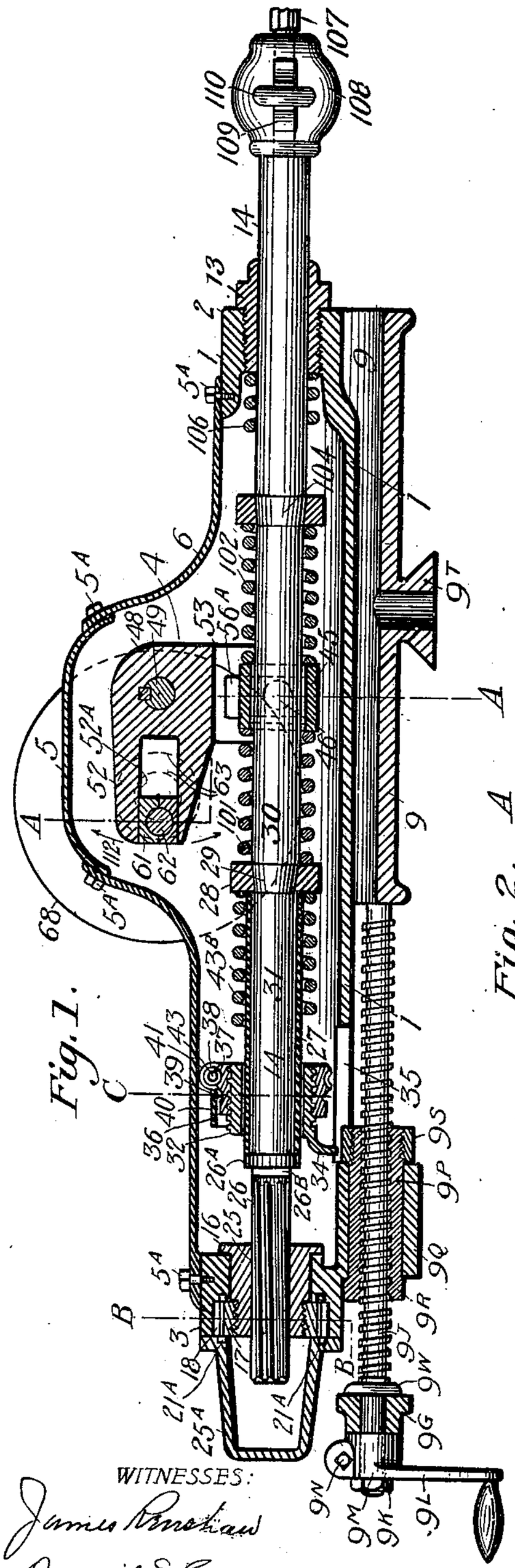

Fig. 1.

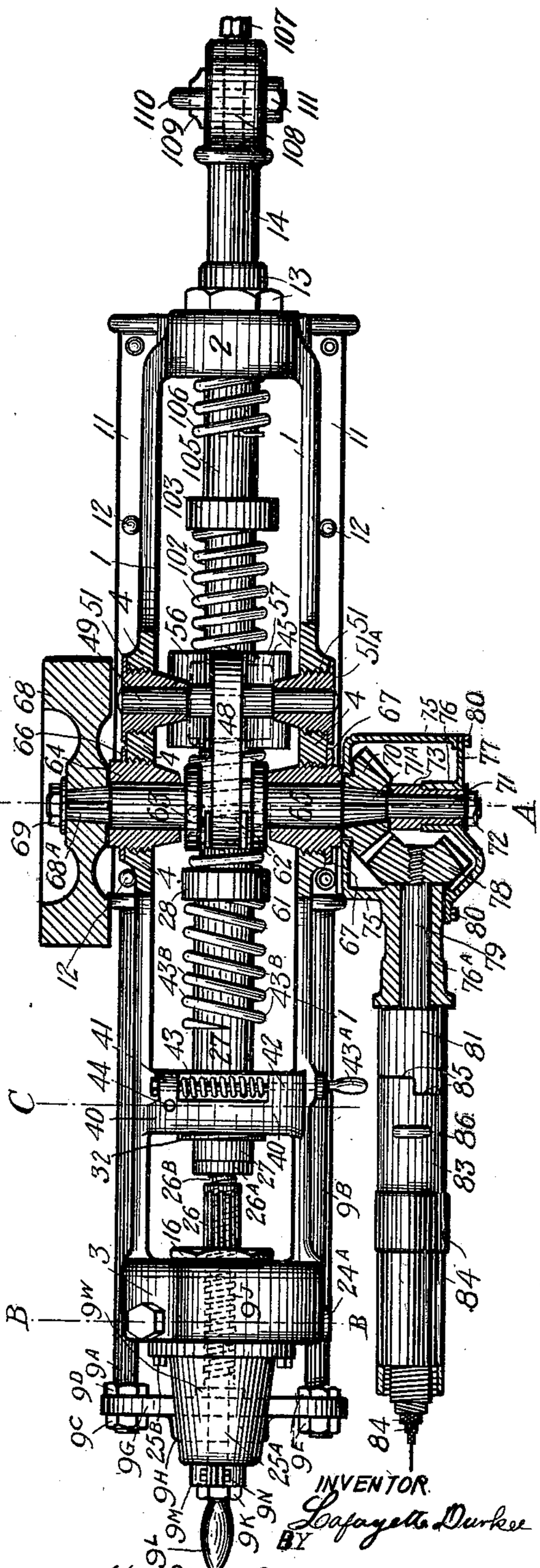

Fig. 2.

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Fig. 3.

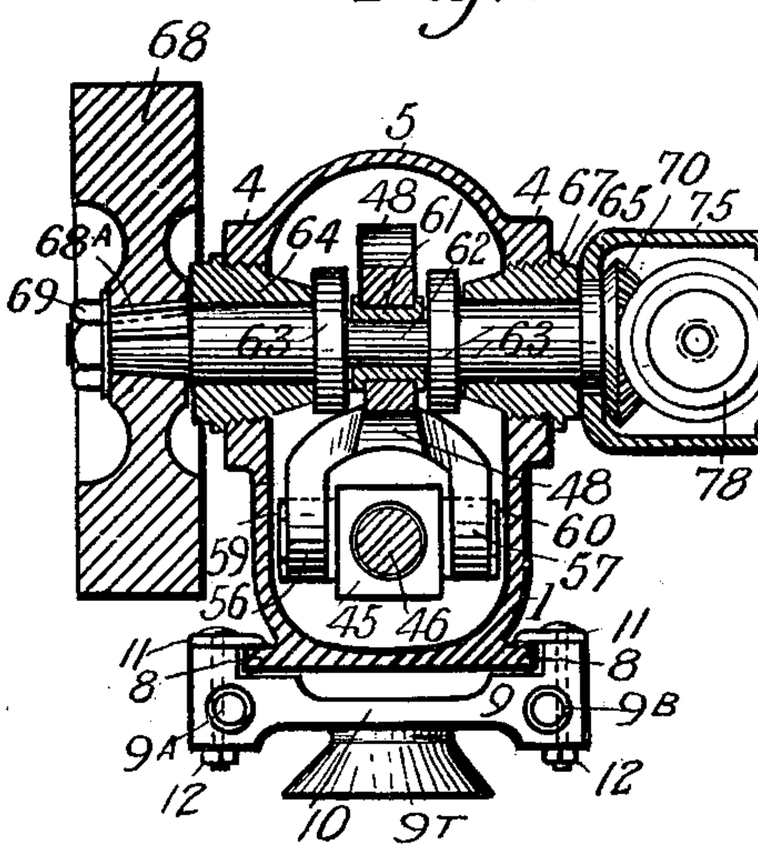
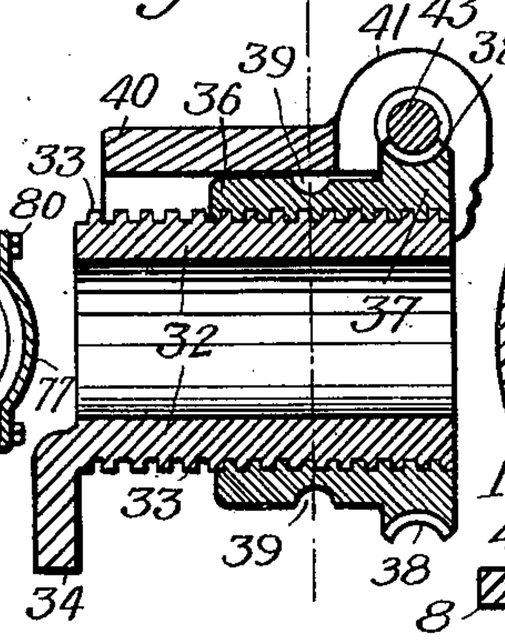


Fig. 5.



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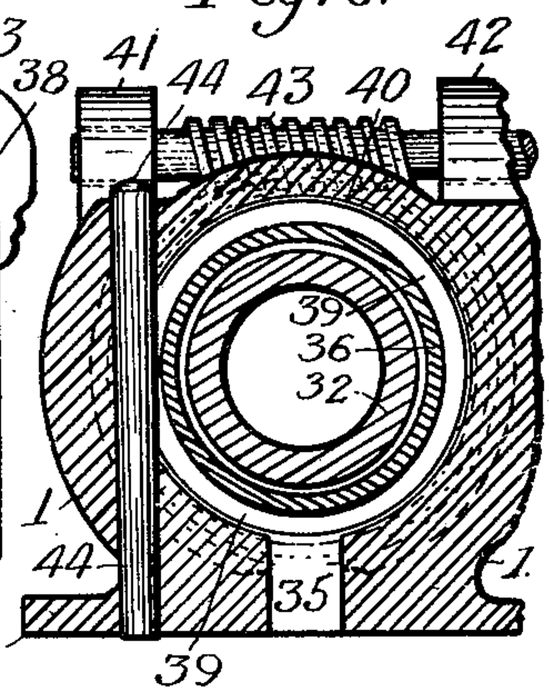
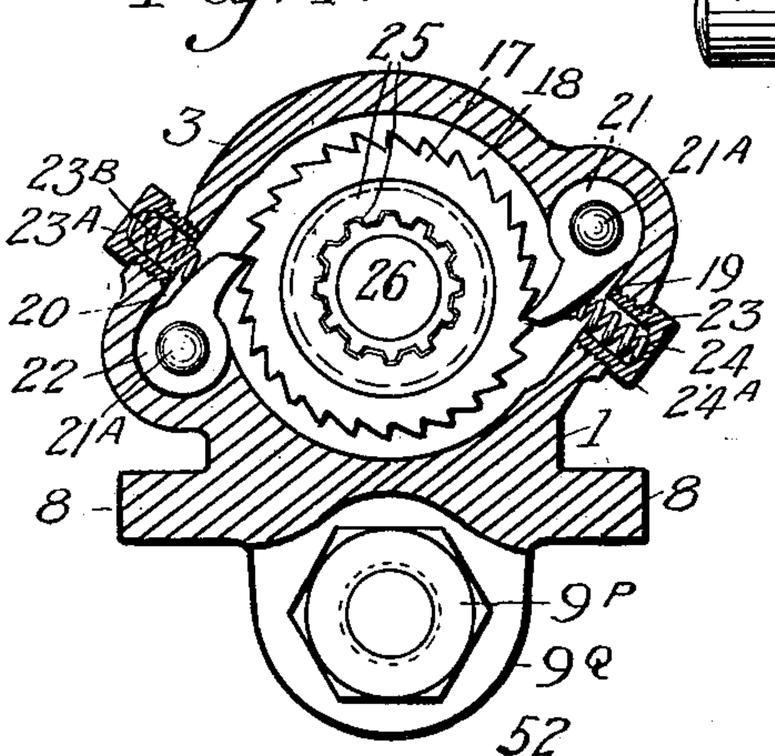


Fig. 4.



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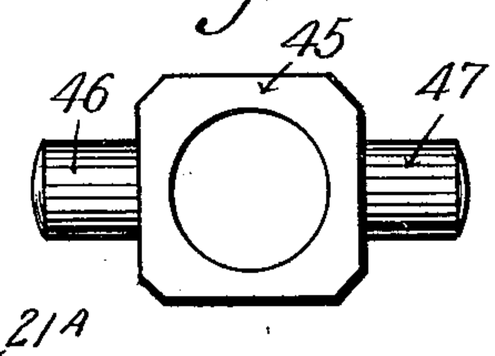


Fig. 8.

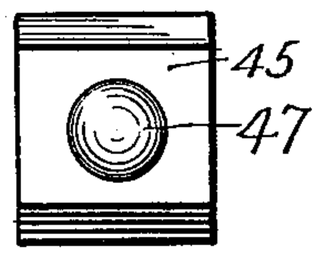


Fig. 9.

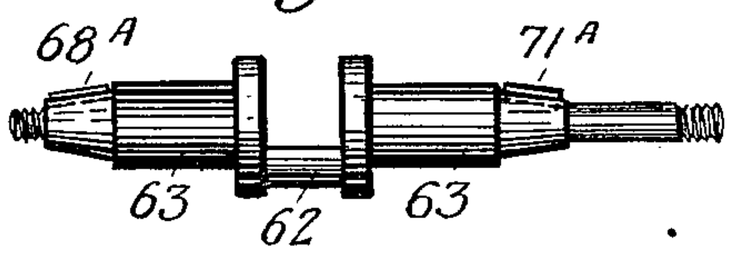


Fig. 10.

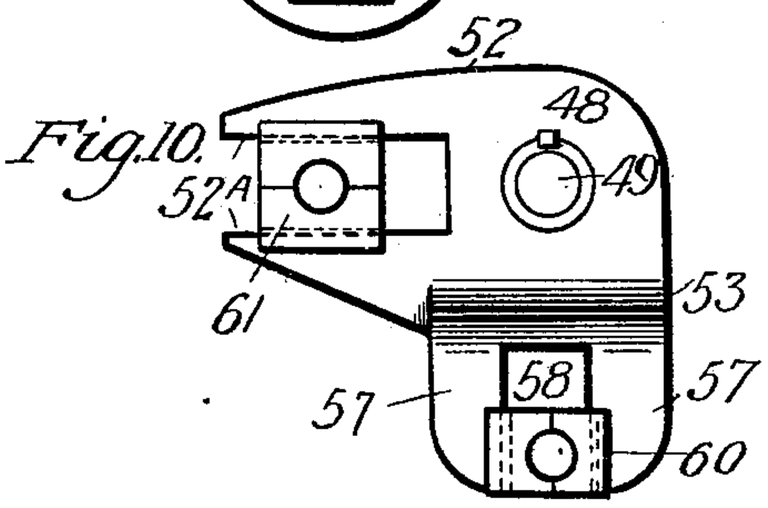
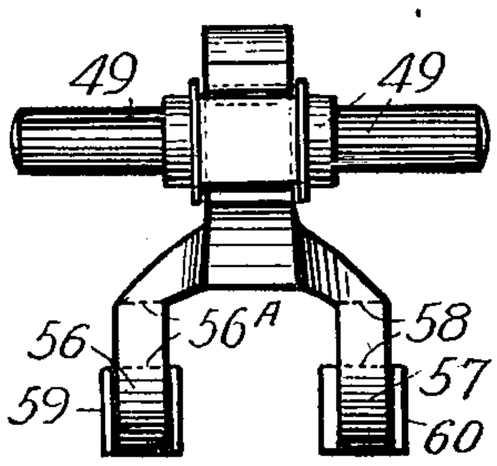


Fig. 11.



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Patented May 28, 1901.

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ROCK DRILLING MACHINE.

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3 Sheets—Sheet 3.

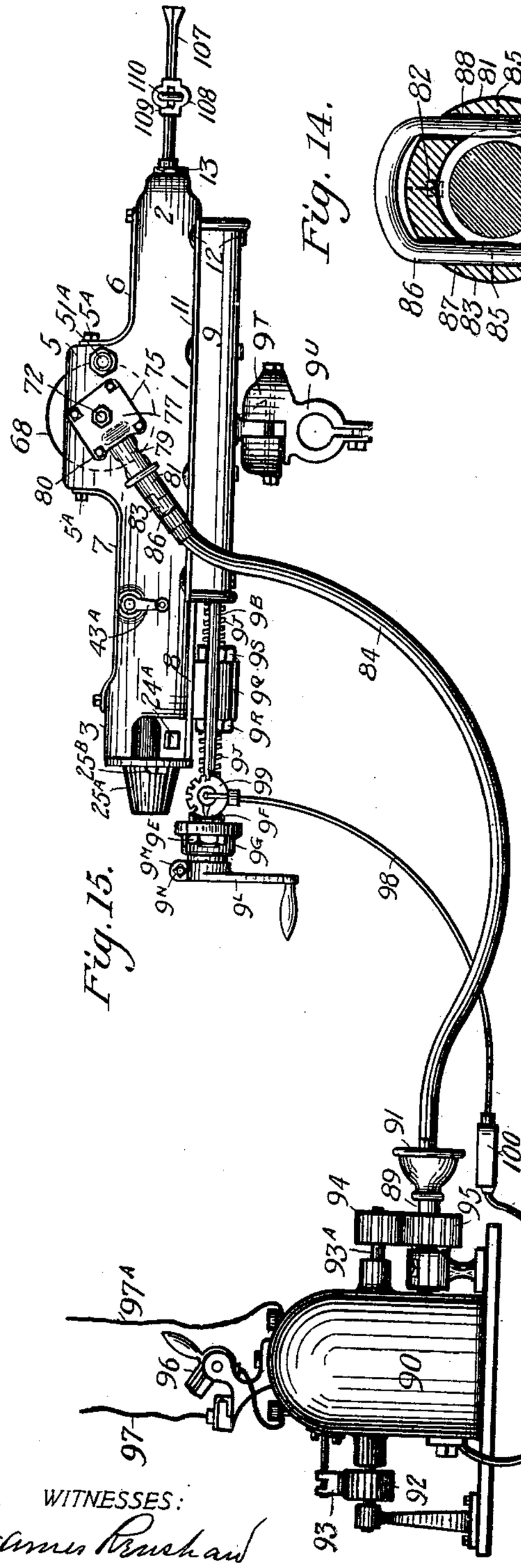

Fig. 15.

Fig. 14.

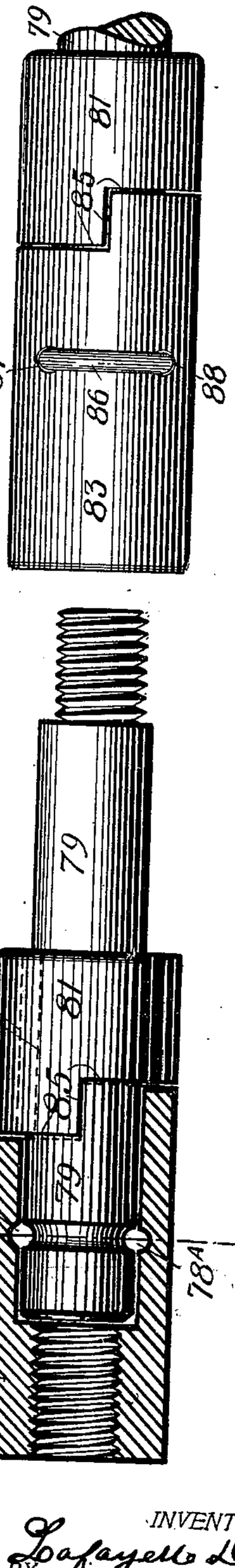

Fig. 13.

Fig. 16.

Fig. 12.

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UNITED STATES PATENT OFFICE.

LAFAYETTE DURKEE, OF DENVER, COLORADO.

ROCK-DRILLING MACHINE.

SPECIFICATION forming part of Letters Patent No. 675,202, dated May 28, 1901.

Application filed November 30, 1900. Serial No. 38,152. (No model.)

To all whom it may concern:

Be it known that I, LAFAYETTE DURKEE, a citizen of the United States of America, residing at Denver, in the county of Arapahoe and State of Colorado, have invented certain new and useful Improvements in Rock-Drilling Machines; and I do declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same, reference being had to the accompanying drawings, and to the figures of reference marked thereon, which form a part of this specification.

My invention relates to improvements in rock-drilling engines; and the objects of my invention are, first, to provide an electrical power-operated rock-drill; second, to provide a rock-drill provided with a reciprocating drill-holder that is actuated by a crank-lever which is operated by mechanism operatively connected to and driven by a motor; third, to provide a rock-drill in which the drill-holder is reciprocated by a two-armed lever, one arm of which is connected to the drill-holder in each direction of its reciprocal movement by a resilient member that directly actuates the drill-holder; fourth, to provide a rock-drill that can be run at a very high speed without its own actuating mechanism interfering with some of its own members, and, fifth, to provide a very simple, inexpensive, and durable rock-drilling engine. I attain these objects by the mechanism illustrated in the accompanying drawings, in which—

Figure 1 is a longitudinal vertical section through the center of my rock-drilling engine. Fig. 2 is a plan view of Fig. 1 with the top cover 6 and 7 removed and the bearings of the crank-shaft and the adjacent portion of the supporting-shell of the drill shown in section. Fig. 3 is a transverse section of Figs. 1 and 2 on line A. Fig. 4 is an enlarged transverse section of Figs. 1 and 2 on line B. Fig. 5 is a sectional view of the adjusting device of the drill-holder with a fragment of the shell on line C of Figs. 1 and 2. Fig. 6 is a fragmentary cross-section of the adjustable abutment through the cylinder of the drill and also a section of Fig. 5 on line D. Fig. 7 is a side elevation of the drill-holder's cross-head. Fig. 8 is an end elevation of Fig. 7. Fig. 9 is a side view of the crank-shaft. Fig. 10 is a side elevation of the bell-crank and its pivotal shaft and its boxes. Fig. 11 is an end view of Fig. 10. Fig. 12 is a side elevation, partially in section, of the coupling that couples the flexible shaft of the electric motor to the driving mechanism of the drill. Fig. 13 is a side elevation shown in Fig. 12 of the coupling. Fig. 14 is a cross-section of Fig. 12 on line E. Fig. 15 is a side elevation of the drill and the flexible shaft and the electric motor and connection.

Similar figures of reference refer to similar parts throughout the several views.

Referring to the drawings, the numeral 1 designates the supporting-cylinder of the drill. This cylinder comprises a hollow cylindrical member with closed ends 2 and 3. The top is open adjacent to each end, and the central portion 4 is covered by a hood 5, cast integral with the body portion of the cylinder. A cover 6 fits over the opening in the front end of the cylinder and is removably secured to the cylinder by bolts 5^A. A cover 7 is also secured by bolts 7^A over the opening in the rear end of the cylinder.

From the opposite sides of the bottom portion of the cylinder and along the greater portion of its length guideways 8 project laterally. These guideways fit slidably in a supporting-shell 9, that comprises a body portion 10 and the gibs 11, which are arranged and bolted by bolts 12 to the body portion of the shell to form slideways for the guideways of the drill-cylinder. (See Figs. 2, 3, and 4.) Two rods 9^A and 9^B are rigidly secured one on each side of the rear end of the shell. These rods extend to and are rigidly bolted by nuts 9^C and 9^D and 9^E and 9^F to a cross-bar 9^G. On the central portion of the cross-bar a hub 9^H is formed, the center of which is bored out to receive revolubly the end of a feed-screw 9^J. The feed-screw comprises a long threaded rod having a collar 9^W adjacent to one end and a reduced end adjacent to the collar. The collar bears against the inner side of the cross-bar and the reduced end extends freely through and beyond the end of the cross-bar and its extreme end is threaded and provided with a nut 9^K. The feed-screw extends from the cross-bar to close to the end of the shell 9. A crank-handle

9^L, which contains a split clamping-hub 9^M, is mounted on the feed-screw between the nut. This split hub is provided with a bolt 9^N, by which it may be tightly clamped to the feed-screw. The feed-screw is threaded to a nut 9^P, that is supported by a depending lug 9^Q, that forms an integral part of the cylinder of the drill. The lug is bored out to receive the nut, which contains a head portion 9^R at one end. Its opposite end is threaded and provided with a nut 9^S, by which it is rigidly clamped to the lug. As the feed-screw is revolubly mounted in the cross-bar, which is rigidly secured by the side rods 9^A and 9^B to the shell and is also revolubly threaded in the cylinder-nut, when it is turned by its crank-handle the cylinder is fed forward or backward in the slideways of the shell.

On the bottom of the shell a diverging conical hub 9^T is cast. The shell 9 of the drill is supported rigidly in mines to a column and cross-bar, which are not shown in the drawings, as they do not form any part of my invention and are commonly used for supporting rock-drills. The drill is attached to the cross-bar of the column by a clamping-clutch 9^U, which is arranged to be rigidly secured to the conical hub on the bottom of the shell and also to the cross-bar of the supporting-column. A hole is drilled axially through both the ends 3 and 4 of the cylinder. In the front end 2 a nut 13 is threaded. This nut contains an axial bore, in which is loosely supported the front end of the drill-holder 14. This drill-holder comprises a solid bar of metal. It is preferably made of three diameters. The front end is the largest and the rear end is the smallest. The drill-holder extends axially through the cylinder and is supported at its rear end by a bearing which extends across the cylinder near its rear end. This bearing will be more fully described hereinafter. The drill-holder is reciprocably and revolubly mounted in its bearings in the cylinder. In the rear end 3 a nut 16 extends revolubly into the axial hole of the end 3 and is threaded into a ratchet-wheel 17, that fits loosely and revolubly into a counterbore 18, formed in the outer surface of the end 3 concentric with its axial bore. A pawl-holding recess 19 is formed on one side of the center of the outer face of the end 3 of the cylinder, extending from its counterbore into its periphery, and a similar recess 20 is formed on the opposite side. (See Fig. 3.) A pawl 21 is mounted on trunnions 21^A in the recess 19, and a similar pawl 22 is similarly mounted in the recess 20. Both of these pawls are arranged to bear on the ratchet-teeth of the ratchet-wheel 17, and they are also arranged to allow it to turn freely in one direction and to prevent its turning in the opposite direction. A spring 23 bears at one end on the pawl 21 and its opposite end extends into and bears against the bottom of a hole 24, which is formed in a nut 24^A, that is threaded into a hole drilled through the shell of the end 3 into the pawl-recess. The pawl 22 is also provided with a similarly-arranged nut 23^A and spring 23^B, arranged to hold the pawl 22 in operative engagement with the ratchet-wheel 17.

The axial center of the nut 16 contains a bore the inner periphery of which is fluted with spiral flutes 25. A spirally-rifled bar 26 fits slidably in the fluted hole of the nut and is adapted to reciprocate therein. One end of the rifled bar is threaded to the adjacent end of the drill-holder, and it is screwed into the drill-holder against a collar 26^A, that is larger in diameter than the drill-holder and that forms an abutment for one end of a sleeve 27, that fits snugly, but loosely, over the drill-holder. A hood 25^A is secured to the end 3 of the cylinder by bolts 25^B and extends rearward and covers the outer end of the rifle-bar. A flat place 26^B is made in the opposite sides of the rifle-bar close to the collar 26, to which a wrench may be applied to screw or unscrew the rifle-bar to or from the drill-holder. The opposite end of the sleeve 27 extends to an abutment-collar 28, that is provided with a taper bore and fits a short taper portion 29, formed on the drill-holder by making the central portion 30 of the drill-holder larger in diameter than the rear end portion 31. On the sleeve I fit closely, but loosely, a round nut 32, which forms the rear bearing for the drill-holder, which reciprocates freely through it. The periphery of the nut 32 is provided with a thread 33. (See Fig. 5.) The lower central side of this nut is provided with a downward-projecting lug 34, that extends loosely into a slot 35, that is formed in the bottom of the cylinder to receive it. The projection of this lug 34 into the slot 35 prevents the nut from turning on the sleeve. A collar 36 is threaded to the threaded periphery of the nut and contains at its end adjacent to the central portion of the drill-holder and its supporting-cylinder a portion 37 of larger diameter, in which is cut worm-gear teeth 38. A circumferential groove 39 is also cut in the collar. The smaller diameter of the collar fits revolubly inside of a collar 40, cast across the cylinder integral with its sides. The worm-gear portion of the collar projects up on the inside edge of the collar, and at each side of the center of the collar 40, over the worm-gear portion 37, there are lugs 41 and 42, that are cast integral with the collar 40. A worm-pinion screw 43 is revolubly supported in these lugs and meshes with the worm-gear of the collar 36. One end of the worm-pinion screw projects beyond the lug 42, and a crank 43^A (see Figs. 2 and 15) is secured to it. A dowel-pin 44 is extended down through the collar 40 of the cylinder and is positioned to pass freely through the circumferential groove 39 of the collar 36, and thus secures this collar 36 revolubly in the collar 40 of the cylinder, but against lateral movement. Consequently when the crank 43^A is turned by an operator the worm-pinion turns

the worm-gear collar, and as it is secured by the dowel-pin against lateral movement the nut 32 is caused to move axially on the sleeve of the drill-bar in either one direction or the other. This device I call a "combined adjustable abutment." It acts as an adjustable abutment for one end of a buffer-spring 43^B, which I place loosely around the sleeve 27, and also acts as a support for the sleeve and the rear end of the drill-holder. One end of this spring bears against the abutment-collar 28. The spring is shorter than the distance between the adjustable abutment and the abutment-collar. Consequently its opposite end, while it engages intermittently the adjacent face of the adjustable abutment, rests at a short distance from it. Normally the spring rests at about from one-half inch to three inches from the adjustable abutment, depending on the position of the nut 32, which can be moved toward or away from the spring far enough to make this variation. The buffer-spring 43^B cushions the backward or recoil movement of the drill-holder, which in my drill is severe, as will be fully described hereinafter.

In seamy rock I find the use of the adjustable abutment very advantageous, as it enables me to vary and adjust the length of the return stroke of the drill-holder—that is, to shorten the stroke of the drill-holder—so that it will not drive so far forward in the seams and cracks of the rocks; but in good solid rock the adjustable elements of this abutment may be dispensed with, if desired, and a solid abutment used, which I secure by casting the collar 40 solid and bore axially through it, in line with the rifled bore in the rifled nut 16 and also with the front end nut 13, a hole in which the sleeve 27 will fit closely but slidably. The spring 43^B would then strike against the solid collar 40 on the backward movement of the drill-holder.

Upon the central portion of the drill-holder I mount slidably a cross-head 45, which is provided with two trunnions 46 and 47, that project from opposite sides of the cross-head at right angles to the axis of the drill-holder. (See Figs. 7 and 8.) This cross-head is reciprocated on the drill-holder by means of a two-armed lever 48, which is preferably a crank-lever, although any form of lever that is pivoted between its ends will answer. This crank-lever is pivotally supported on a shaft 49, that is journaled in suitable boxes 50 and 51, which are preferably threadedly secured in the sides of the supporting-cylinder. The outside of these boxes is provided with a square or hexagonal wrench-receiving portion 51^A, that enables them to be screwed into the threaded holes in the sides of the cylinder. (See Fig. 15.) The crank-lever is preferably arranged to stand with one of its arms 52 in a substantially horizontal position and with its opposite arm 53 in a substantially depending vertical position, and it is pivoted at the had between the two arms and preferably at a point that will make the depending arm 53 a trifle longer than the horizontal arm 52. The depending arm comprises a yoke-shaped member that straddles the cross-head and terminates in two oppositely-disposed arms 56 and 57, which are arranged at an equal distance apart on each side of the center of the lever. Slots 56^A and 58 extend into each of the ends of the arms 56 and 57 of the yoke-shaped end of the crank-lever opposite one another. In these slots I slidably fit boxes 59 and 60, which are provided with flanged sides that extend over the sides of arms adjacent to the side edges of the slots and prevent the lateral displacement of the boxes from the slots, while at the same time forming guideways in the boxes that permit the boxes to slide reciprocably in the slots. These boxes are bored out through their sides to fit loosely on the trunnions of the cross-head, which is suspended between them. The horizontal arm 52 of the crank-lever also contains a slot 52^A, extending into its end and arranged, preferably, at right angles to the slots in its depending arm. A flanged box 61 is also fitted to slide reciprocally in this slot. This box is bored out to fit revolubly the wrist-pin 62 of the crank-shaft 63 and is divided into two halves horizontally, so that it can be placed around the wrist-pin of the crank-shaft where these parts are assembled together. This crank-shaft 63 is the main or driving shaft of the drill. It is journaled, preferably, in solid boxes 64 and 65, that are threaded on their peripheries similar to the boxes that support the pivotal supporting-shaft of the crank-lever and screw into the threaded holes formed at right angles to the axis of the cylinder of the drill. The outside ends of these boxes are provided with a wrench-receiving square or hexagonal portion 66 and 67, by which they are screwed into the sides of the cylinder. The ends of the crank driving-shaft beyond the bearings is tapered, and these taper portions form a bearing at one end for a fly-wheel 68, which is keyed by a key 68^A and is also secured to the taper portion by a nut 69, that is threaded to the end of the shaft and is arranged to press the fly-wheel on the taper. A bevel-gear 70 is mounted on the opposite taper portion and is keyed to it by a key 70^A. The shaft extends beyond the taper portion on the gear-supporting end in a short reduced portion 71, that is threaded at its end and is provided with a nut 72. The bevel-gear is held tightly on the taper by a sleeve 73, that fits loosely on the reduced portion and is clamped by the nut against the bevel-gear. The sleeve is provided with a reduced portion at its outer end that forms a bearing for a hub 76, which is a part of a cover 77 of a hood 75, that is arranged to surround the bevel-gear. This hood also has a larger hub 76^A cast integral with it, which supports a shaft 79 revolubly, that extends axially through it, to the inner end of which a bevel-gear 78, of preferably the same diameter as the gear 70, is secured, preferably, by thread-

ing the gear to a reduced portion at its end. The bevel-gear 78 is arranged to mesh into the gear 70 and is also inclosed by the hood. This hood is provided with a detachable cover 77 on one side, (see Fig. 15,) that is secured by bolts 80 to the body of the hood. This hood and its cover and the gears are so arranged that they can be quickly and easily taken apart when desired.

The shaft 79 extends through a hub 81 and is secured to it, preferably, by a key 82, (see Figs. 12 and 14,) although it may be made an integral portion of it, if desired. The opposite end of the shaft 79 from that end that carries the bevel-gear projects loosely into a coupling-sleeve 83 and is provided with a circumferential groove 78^{A} adjacent to its end. This coupling-sleeve contains a threaded hole in one end and is threadedly attached to one end of a flexible shaft 84. This coupling-sleeve slips on the free end of the shaft 79 against the face of the adjacent end of the hub 81, and the opposing surfaces of both the coupling and the hub are divided into an equal number of coöperating recessed clutch-teeth 85. (See Figs. 12, 13, 14, and 15.) The coupling is held onto the end of the shaft 79 and coupled to the hub by the spring yoke-pin 86, which is inserted in two holes 87 and 88, drilled through the coupling in positions to intersect opposite sides of the circumferential groove 78^{A} in the shaft, so that both legs of the yoke-pin pass through the groove and lock or pin the coupling to the shaft. I preferably use this form of connection between the flexible shaft and the gear-shaft, as it is very easily and quickly coupled and uncoupled. The opposite end of the flexible shaft is connected by any suitable universal joint to the power-transmitting shaft 89 of an electric motor 90. The universal joint is shielded by a bell 91, that is connected to the power-transmitting shaft of the motor.

While any type of electric motor can be used to operate my rock-drill, I preferably use a geared motor, as shown in Fig. 15. This motor 90 comprises a shell that contains the usual magnets and armature, the commutator 92 and brush 93, the armature-shaft 93^{A}, and the gears 94 and 95, that connect the armature-shaft to the power-transmitting shaft 89. A switch 96 is shown attached to the shell, as the motor will have to be moved frequently in the tunnels and stopes and shafts of mines; but it can be attached to any suitable support independent of the motor, if desired. From the switch conductive wires 97 and 97^{A} extend to and form a source of electric-current supply. The motor may be placed at any distance from the drill that a flexible shaft will work, and in order to be able to start and stop the motor from the drill I extend operative conducting-wires in a suitable tube or conduit 98 to a starting and stopping switch 99, which I arrange to be attached to any suitable part of the drill, preferably to one of the supporting-rods of the feed-screw, in which position it is within reach of the operator. This starter consists of any one of the common forms of current-graduating switches in use. A transformer or resistance-box 100 is placed in the conducting-wires between the starter and the magnets of the motor. The wires 97 and 97^{A} are so connected in the motor that the current is conveyed directly from the source of current-supply through the switch 96 to the starter and flows from the starter back to the magnets of the motor. Consequently the switch on the motor controls the current to the starter and the starter controls the current to the motor.

The electric motor and the flexible shaft and the switch and starter individually do not form any part of my invention. My invention, however, contemplates a detachable flexible shaft connected directly to the driving mechanism of the drill and extending to any operative distance from the drill to an electric motor operatively connected to said flexible shaft and coöperating with it to operate the drill and means for controlling the motor directly from the drill.

The motor rotates the flexible shaft, and this shaft rotates the bevel-gear 78, and this gear drives the gear 70, and the crank-driving shaft, the crank or wrist pin 62 of which as it rotates imparts a reciprocal movement to the box 61 in the slot 52^{A} of the horizontal arm 52 of the crank-lever 48. The combined rotative movement of the wrist-pin and the reciprocating movement of its box causes the crank-lever to oscillate on its pivotal shaft 49 in the boxes 50 and 51 and imparts to the end of the horizontal arm 52 of the crank-lever a vertical oscillating movement and to the ends of the arms of the depending end of the crank-lever a horizontal oscillating movement, causing the boxes on the trunnions of the cross-head to slide up and down in the slots of the two arms of the crank-lever and causing the cross-head to be reciprocated on the drill-holder by the depending end of the crank-lever. The cross-head is not, however, attached directly to the drill-holder, but is connected to it by two spiral springs 101 and 102, which are placed loosely around the drill-holder, one on each side of the cross-head. One end of the spring 101 rests against the adjacent side of the cross-head, and the opposite end abuts against the abutment-collar 28. The spring 102 bears at one end against the adjacent side of the cross-head and at its opposite end bears against an abutment-collar 103. This collar 103 is secured to the drill-holder by a taper bearing 104, on which it is fitted tightly. This taper bearing is formed on the drill-holder at the junction of the central portion of the drill-holder with its front end 105, which is made larger in diameter in order to form this taper bearing. Between the abutment-collar 103 and the nut 13 I place around the drill-holder a short buffer-spring 106. This spring is struck by the collar when the

forward blows of the drill-holder and its rock-cutting bit 107 are not in striking relation to rock. The drill-holder extends beyond the end of the cylinder, and at its end a drill-bit-holding chuck 108 is formed, which consists of an enlarged head portion containing an axial hole in its end into which the shank of a drill-bit is inserted. A chamber is cut through one side of the chuck into the axial hole and a clamping-block 109 is inserted in the chamber and rests on the shank of the drill-bit, and a yoke-shaped clamping-staple 110, containing nuts 111, threaded to its ends, is placed over the block and extends freely through the chuck, and the nuts are turned to cause the staple and block to clamp the shank of the drill-bit in its axial hole. This form of drill-bit-holding chuck is in general use on rock-drilling machines.

The operation of the drill-holder under the oscillating and reciprocating movement of the crank-lever and cross-head, which movement is transmitted to them from the motor through the medium of the flexible shaft and the gears and the crank-shaft, as above described, is as follows: The springs 101 and 102 are of preferably the same length and size. They preferably fit a little loose between the collars and the sides of the cross-head. The crank-shaft is rotated in the direction of the arrow 112, so that its crank-pin will move up over toward the front or chuck end of the drill-holder. Consequently when on its downward movement it is at its closest point to the pivotal shaft 49 of the crank-lever and moves the arm 48 of the crank-lever down with a quick sudden movement, as it is close to the pivotal axis of the crank-lever. This throws the depending end and its arms forward toward the front end of the drill with also a quick sudden movement, and throws the cross-head and spring 102 violently against the abutment-collar 103 of the drill-holder, which forces the drill-holder forward with a very quick movement, which enables it to strike a powerful blow, and when the drill-bit is in striking relation to rock the cylinder should be so fed by the feed-screw that the drill-bit will strike the rock at the end of or just before the cross-head and the lower arms of the crank-lever have arrived at the end of their forward stoke. If the cylinder is fed faster than the cutting action of the drill-bit, it will continuously reduce the stroke of the drill-holder until it becomes practically ineffective to cut rock. Consequently the operator should feed the drill only as fast as the drill-bit cuts the rock and keeps the drill-bit moving its full, or nearly its full, stroke. The springs 101 and 102 between the cross-head and the collars of the drill-holder form a resilient or highly-yielding and elastic connection, which drives the drill-holder in both directions of its reciprocal movement and at the same time permits the crank-pin to continue uninterrupted in its rotative movement and the arms of the crank-lever to be moved by the crank-pin their full reciprocal movement, regardless of the exact position of the drill-holder, as these springs compress and extend as occasion requires. Thus if the drill-bit strikes the rock before the crank-pin has made its full downward movement to its lower center and the crank-lever and the cross-head have made their full forward movement the spring 102 will be compressed by the cross-head sufficient for it and the crank-lever to complete their movement. When the crank-pin passes its lower center and moves to its top center, the horizontal arm is moved upward and the depending arm of the crank-lever is moved backward, causing the cross-head to press the spring 101 against the collar 28, which moves the drill-holder back from the rock. When the crank-pin and the crank-lever are running at a high rate of speed—say from five hundred to eight hundred revolutions and reciprocations per minute, which is the usual speed—the drill-holder, which weighs in the ordinary-sized drill from about thirty to forty pounds, strikes a very powerful blow on its forward stroke, and also comes back with great velocity and force, and it is necessary to cushion the return strokes of the drill-holder. This is done by the spring 43^B, which is moved back against the nut 32 of the adjustable abutment by the collar 28 on the drill-holder. This spring 43^B is adapted by means of the adjustable abutment to cushion the back stroke and momentum of the drill-holder just before and as the cross-head reaches the end of its backward stroke, so that the front spring 102 will be almost wholly relieved of severe compression by the drill-holder which it would receive if the spring 43^B was not employed to cushion it. Likewise the front buffer-spring 106 is employed to assist in cushioning the forward momentum of the drill-holder when it is running without striking against rock, in which case the spring 101, assisted by the buffer-spring, receives and cushions the forward movement and momentum of the drill-holder beyond the regular forward stroke of the cross-head and depending arm of the crank-lever. This arrangement of the crank-lever and cross-head and the springs completely counterbalances the weight and momentum of the drill-holder and prevents interference of the parts with one another under high rotative and reciprocal speed. As the drill-holder reciprocates it is also rotated, with its drill-bit, in the cylinder step by step intermittently in order that the drill-bit will cut a round hole in the rock as it is fed into it. The step-by-step rotary motion is imparted by the rifle-bar, which is attached to the rear end of the drill-holder, which also reciprocates through the fluted nut 16, and its spiral flutes turn the nut and the ratchet-wheel a small portion of a revolution at each forward stroke of its reciprocal movement, which is sufficient to move the teeth in

the ratchet-wheel intermittently step by step under and past the holding ends of the spring-controlled pawls, which when the rifle-bar reverses its movement locks the ratchet-wheel against turning backward and holds it stationary, thus causing the rifle-bar and drill-holder to make a partial rotative movement on their return reciprocal stroke equal to the pitch of the spiral flutes of the rifle-bar.

My drill is adapted for drilling the largest and deepest holes required for blasting rock in mines. It is very simple, light, and durable and as the drill-holder is counterbalanced it requires very little power to run it.

While I have illustrated and described the preferred construction and arrangement of my drill, I do not wish to be limited to the construction and arrangement shown, as there are many elements which might be changed and others substituted for them without departing from the spirit of my invention, and while I preferably employ an electric motor for running the drill I do not wish to be limited to its use, as in some mines, quarries, and places it might be cheaper and more advantageous to use a compressed-air or a steam or gasolene motor or engine.

Having described my invention, what I claim as new, and desire to secure by Letters Patent, is—

1. In a rock-drill, the combination with the supporting-cylinder, of a drill-holder loosely mounted in said cylinder, a crank-lever pivotally supported intermediate of its ends to said cylinder, and having one arm arranged in a substantially horizontal position, and its other arm divided into two oppositely-disposed arms arranged to straddle said drill-holder, slots in all the arms of said crank-lever extending from their ends to near said crank-lever's pivotal support, suitable bearing-boxes slidably mounted in said slots, a cross-head slidably mounted on said drill-holder, and having oppositely-projecting trunnions extending pivotally through said boxes, a spiral spring on each side of said cross-head on said drill-holder having one end adjacent to said cross-head, abutment-collars removably secured to said drill-holder on taper bearings arranged to receive the thrust of the opposite end of each of said spiral springs, a crank-shaft rotatably mounted in said cylinder, a crank-pin in said crank-shaft connected to the sliding box of the horizontal arm of said crank-lever, and means including a motor for rotating said crank-shaft whereby said crank-lever and springs are caused to reciprocate said drill-holder and compensate for its weight, substantially as described.

2. The combination with the shell, the cylinder and the feed-screw, of a drill-holder loosely mounted in said cylinder, and provided with two spring-receiving portions adjacent to its central portion, a crank-lever having a pivotal shaft intermediate of its ends, pivotally mounted in suitable bearings in said cylinder, a crank-shaft operatively arranged in said cylinder to oscillate one end of said crank-lever, a cross-head loosely mounted on said drill-holder between said spring portions, a coiled spring loosely mounted on each of said spring-receiving portions of said drill-holder, and arranged to engage with one of their ends the adjacent side of said cross-head, a taper portion on said drill-holder on each side of its central portion, a collar mounted on each one of said tapering portions of said drill-holder, and arranged and adapted to form shoulders or abutments and to receive the thrust of the opposite ends of said springs, and having said springs arranged and adapted to reciprocate said drill-holder, means including a flexible shaft operatively arranged to rotate said crank-shaft, and a motor for operating said flexible shaft, and with a sleeve mounted on the rear end of said drill-holder, means for clamping said sleeve against the adjacent spring abutment-collars, an abutment across said cylinder surrounding said sleeve, a revoluble collar in said abutment, an adjustable abutment threaded to said collar, means including a worm-pinion for moving said adjustable abutment axially of said sleeve, and a spring mounted in said sleeve, between said collar of said drill-holder and said adjustable abutment, of shorter length than the distance between said adjustable abutment and said collar of said drill-holder and arranged to cushion one of the reciprocative movements of said drill-holder, substantially as described.

3. In an electric-power-driven rock-drill, the combination of the cylinder, the shell and the feed-screw, of the drill-holder having two removable abutment-collar projections at its central portion arranged at a short space apart and reciprocably mounted in said cylinder, the right-angled crank-lever pivotally mounted in said cylinder and having its lower end divided into two arms and arranged to straddle said drill-holder, the cross-head slidably mounted on said drill-holder between said abutment-collars and operatively connected to the lower ends of said crank-lever, the springs surrounding said drill-holder on each side of said cross-head and arranged between said abutment-collars and said cross-head, a crank-shaft operatively arranged to oscillate one of the ends of said crank-lever, a flexible shaft operatively connected to said crank-shaft, and an electric motor connected to said flexible shaft, and with a sleeve mounted on said drill-holder and secured against one of said abutment-collar projections an adjustable abutment arranged transversely across said cylinder and surrounding loosely said sleeve and comprising a nut surrounding loosely said sleeve, provided with a thread on its periphery, a collar threaded to said nut, a worm-gear on the periphery of said collar, a worm-pinion arranged in operative engagement with said worm-gear of said col-

lar, and means for rotating said worm-pinion, and with the rifle-bar secured in the end of said drill-holder, the fluted nut operatively mounted on said rifle-bar, the spring-controlled pawls arranged in said cylinder in operative relation to said lock, said fluted nut against rotative movement, and the hood secured to the end of said cylinder and arranged to cover the end of said rifle-bar, substantially as described.

4. In a rock-drill, the combination with the cylinder, of a drill-holder reciprocally mounted in said cylinder, and provided with two removable abutments, a drill-bit-holding chuck on the outer end of said drill-holder, a sleeve loosely surrounding the rear end of said drill-holder and arranged to bear against one of said removable abutments of said drill-holder, a rifle-bar threaded to the rear end of said drill-holder and provided with a collar arranged to confine said sleeve to said drill-holder and a spring-pawl-controlled fluted nut, revolubly mounted in the rear end of said cylinder and on said rifle-bar, substantially as described.

5. In a rock-drill, the combination with the cylinder and the drill-holder provided with two tapering bearings near its central portion, a collar tightly mounted on each of said taper portions, a sleeve surrounding the rear end of said drill-holder and having one end bearing against the adjacent collar, a rifle-bar secured in the end of said drill-holder and provided with a collar arranged to bear against the opposite end of said sleeve, and adapted to clamp said sleeve against said collar, an adjustable support surrounding loosely said sleeve and drill-holder and comprising an integral collar portion cast across said cylinder and containing an axial bore, a collar revolubly mounted in said bore and provided with a circumferential groove, a pin extending through the cylinder-collar and through the circumferential groove in said collar, a worm-gear surrounding said collar, a worm pinion or screw pivotally mounted in said cylinder-collar and meshing into the said worm-gear of said collar, a revoluble crank attached to said pinion-screw, a thread on the inner periphery of said collar, a nut threaded to said collar and loosely mounted on said sleeve and arranged and adapted to be moved axially along said sleeve by said pinion-screw and crank and said worm-gear containing collar, a rifled nut arranged to loosely fit said rifle-bar and a ratchet-wheel and spring-controlled pawl step-by-step rotating mechanism operatively connected to said nut, and arranged to be rotated by said rifle-bar in one direction of its reciprocal movement, and to rotate said rifle-bar and said drill-holder in the opposite direction of its reciprocal movement, substantially as described.

6. In a rock-drill, the combination with the cylinder and the shell, of a drill-holder mounted for reciprocation in said cylinder, a crank-lever pivotally supported in said cylinder, a crank-shaft arranged to oscillate one arm of said crank-lever, a pair of oppositely-disposed arms at the opposite end of said crank-lever arranged to straddle said drill-holder, a cross-head slidably mounted on said drill-holder and operatively connected to the two arms of said crank-lever, taper bearings on said drill-holder on each side of said cross-head, a collar fitted tightly on each taper bearing, a spring on each side of said cross-head surrounding said drill-holder and bearing between said collars and the opposite sides of said cross-head, a sleeve loosely mounted on the end of said drill-rod and arranged to bear against the adjacent collar and means for clamping said sleeve against said collar whereby said collar is held from accidental displacement from its taper bearing, substantially as described.

7. In a rock-drill, the combination with the cylinder, the shell and the feed-screw of a drill-holder comprising a bar having three straight portions of three different diameters in its length, a taper portion at the junction of each two straight sections, collars having a taper bore fitted tightly on the taper portion, a sleeve fitting freely on the smaller end of said drill-holder, a rifle-bar threaded to the rear end of said drill-holder and arranged to clamp said sleeve against said collar, and a drill-bit-holding chuck on the opposite end of said drill-holder, substantially as described.

8. In a rock-drill, the combination with the cylinder, of a drill-holder mounted for reciprocation in said cylinder having two taper bearings at its central portion placed at a short distance apart, collars removably fitted to said taper bearings, a sleeve on the rear end of said drill-holder secured against the adjacent collar, two spiral springs fitted loosely around said drill-holder between said collars, a cross-head slidably mounted on said drill-holder between said springs, a right-angled crank-lever pivotally supported in said cylinder having one arm operatively arranged and connected to said cross-head and adapted to reciprocate said cross-head a crank-shaft journaled in said cylinder and provided with a crank-pin operatively connected to the opposite arm of said crank-lever and arranged and adapted to oscillate said arm, and said crank-lever on said crank-lever's pivotal support, a pair of bevel-gears operatively connected to the one end of said crank-shaft, a flexible shaft detachably connected to said bevel-gears and a motor operatively attached to said flexible shaft to rotate said flexible shaft and crank-shaft, substantially as described.

9. In a rock-drill, the combination with the cylinder having solid ends, a nut threaded centrally to its front end, a nut revolubly mounted in axial alinement with the first-named nut in its rear end, a fluted bore in the axial center of the rear nut, an axial bore in the center of the nut in its front end, a drill-

holder having a drill-bit-holding chuck at its outer end slidably and revolubly mounted in the axial bore of the nut at the front end of said cylinder, a rifled bar secured to the rear end of said drill-holder and having its flutes fitted to reciprocate in the axial bore of said fluted nut at the rear end of said cylinder, a counterbored chamber in the rear end of said cylinder, a ratchet-wheel secured to one end of said fluted nut in said chamber, spring-controlled pawls operatively supported and arranged in said cylinder in bearing contact with the teeth of said ratchet-wheel, a hood secured to the rear end of said cylinder adapted to cover said ratchet-wheel and the end of said rifle-bar, a collar on said rifle-bar, a collar on said drill-holder, a sleeve secured on the end of said drill-holder between said rifled bar and the said collar on said drill-holder, a spring mounted on said sleeve and an abutment in said cylinder surrounding said sleeve loosely having an axially-adjustable portion arranged to receive the compression thrust of said spring, substantially as described.

10. In a rock-drill, the combination with the cylinder, of a drill-holder mounted for reciprocation therein having two taper bearings at its central portion a short distance apart, two collars removably secured to said taper bearings, a cross-head slidably mounted on said drill-holder between said collars, a coiled spring on said drill-holder between one side of said cross-head and one of said collars, a similar coiled spring on said drill-holder between the opposite side of said cross-head and the other of said collars, and a sleeve on the inner end of said drill-holder clampably secured to hold said collar on its taper bearing against accidental displacement, an adjustable support and abutment surrounding said sleeve and drill-holder comprising a surrounding portion of said cylinder, a collar revolubly mounted in an axial bore in said surrounding cylinder portion concentric with the axis of said drill-holder and secured against lateral movement, a nut surrounding said sleeve and threaded in said collar, a worm-gear on said collar, a worm-pinion in mesh with said worm-gear and arranged in operative relation to said collar, a spiral spring surrounding said sleeve loosely between one end of said nut of said adjustable abutment and the adjacent collar on said drill-holder of shorter length than the distance between said collar and said adjustable abutment, a crank-lever pivotally secured in said cylinder intermediate of its ends operatively connected at one end to said cross-head and means including a crank-shaft operatively connected to the opposite end of said crank-lever to oscillate the ends of said crank-lever and through the medium of said cross-head and springs to reciprocate said drill-holder, substantially as described.

11. In a rock-drill, the combination with the cylinder, the shell and the feed-screw, of the drill-holder mounted for reciprocation in said cylinder, the rifle-bar at the rear end of said drill-holder, the ratchet-wheel and spring-controlled pawl step-by-step drill-holder-rotating mechanism operatively connected to said rifle-bar, the taper bearings on said drill-holder, the collars mounted on said taper bearings, the sleeve on the rear end of said drill-holder and arranged to hold said rear collar on its taper bearing against accidental displacement, the combined support and abutment extending transversely across said cylinder adjacent to the rear end of said drill-holder and the spiral buffer-spring arranged around said sleeve between said collar and said abutment, substantially as described.

12. In a rock-drill, the combination with the cylinder and the drill-holder, the cross-head, the springs surrounding said drill-bar and in engagement with said cross-head, the abutments on said drill-holder for the opposite ends of said springs, the crank-lever operatively connected to said cross-head and the crank-shaft operatively connected to said crank-lever and having taper bearings adjacent to its ends provided with a keyway and key, a fly-wheel secured to one of said taper bearings, a bevel-gear secured to the opposite taper bearing, an end portion on said crank-shaft extending beyond said bevel-gear and its taper bearing, a collar loosely mounted on said end portion and a nut threaded on the end of said extension and arranged to clamp said collar against said bevel-gear, substantially as described.

13. In a rock-drill the combination with the cylinder, the supporting-shell and the feed-screw, the drill-holder mounted for reciprocation therein, the crank-lever pivotally mounted in said cylinder intermediate of its ends and the cross-head slidably mounted on said drill-holder, and pivotally connected to said crank-lever, the spring mounted on said drill-holder and arranged to engage the opposite sides of said cross-head, and the abutment-collars arranged to receive the opposite ends of said springs, the rifle-bar and spring-pawl-rotating mechanism at the end of said drill-holder, the tapering bearings on said drill-holder, the collars mounted on said taper bearings, the sleeve secured to said drill-holder between said rifle-bar and the adjacent collar, the abutment surrounding said sleeve and the spring mounted on said sleeve between one of said collars and said abutment and of shorter length than the distance between said collar and said abutment, of the crank-shaft revolubly supported in said cylinder and operatively connected to said crank-lever, the beveled gears operatively supported and connected to one end of said crank-shaft, the detachable clutch-coupling comprising the opposing clutch-hub and sleeve, the sup-

porting-shaft, the circumferential groove and the yoke-shaped spring-pin operatively arranged and connected together, the flexible shaft connected to the sleeve of said coupling and the motor operatively arranged and connected to said flexible shaft, substantially as described.

In testimony whereof I affix my signature in presence of two witnesses.

LAFAYETTE DURKEE.

Witnesses:
JAMES RENSHAW,
DAVID LA SALLE.