No. 632.658. Patented Sept. 5, 1899.

G. W. PICKETT.

ELECTRIC ROCK DRILL.

Application filed Oct. 4, 1898.

(No Model.) 7 Sheets—Sheet 1.

FIG 1

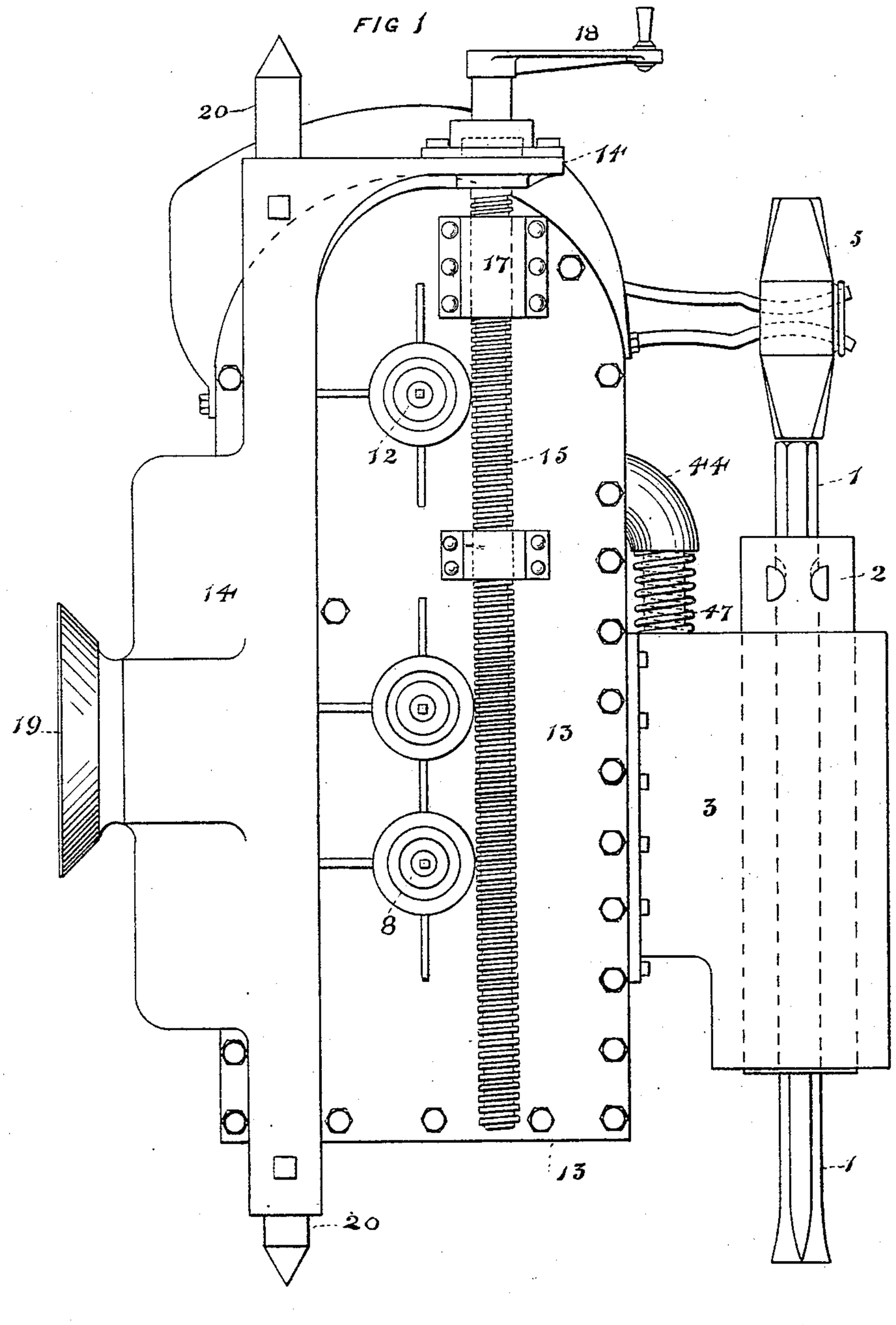

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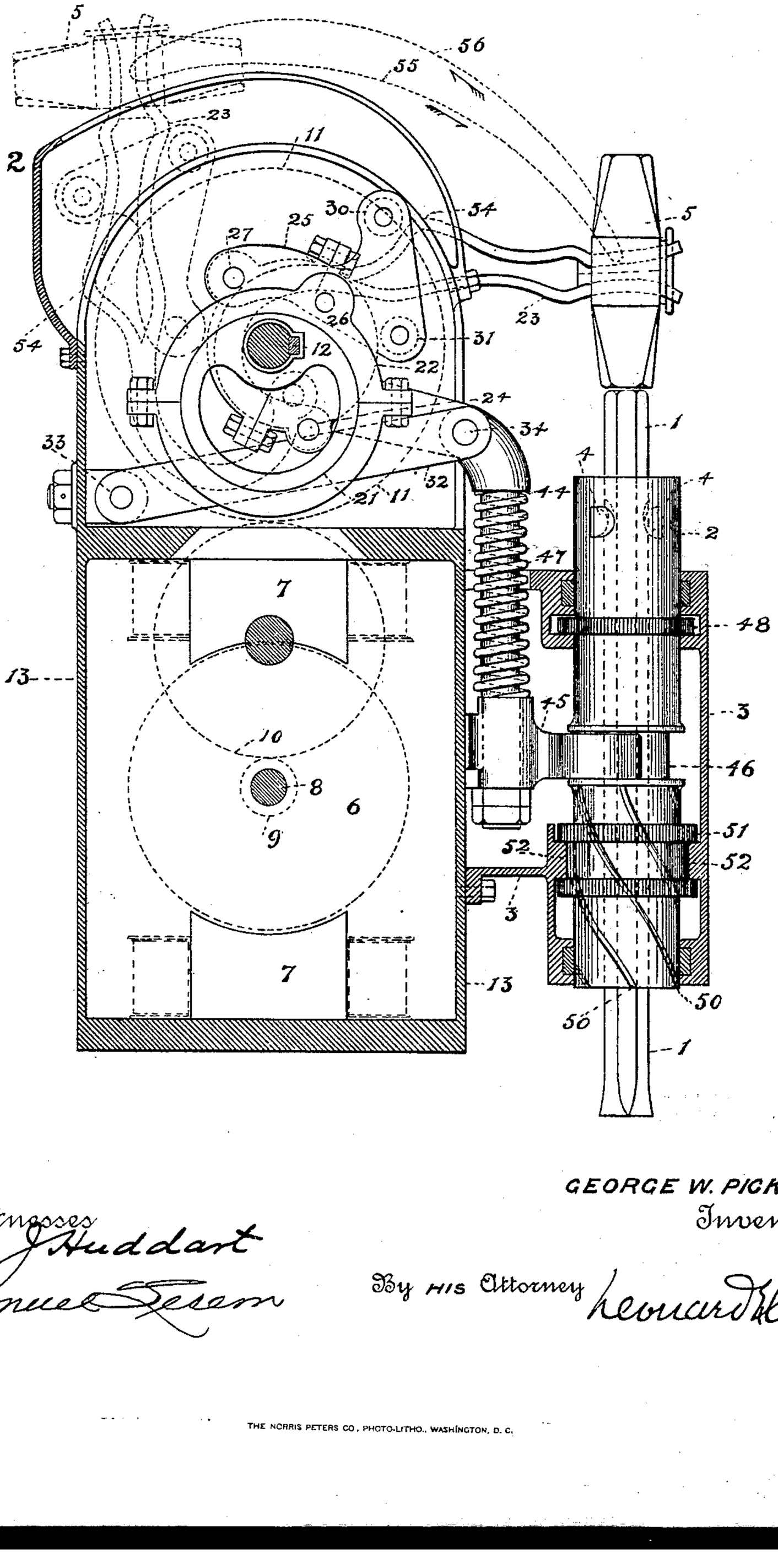
FIG 2



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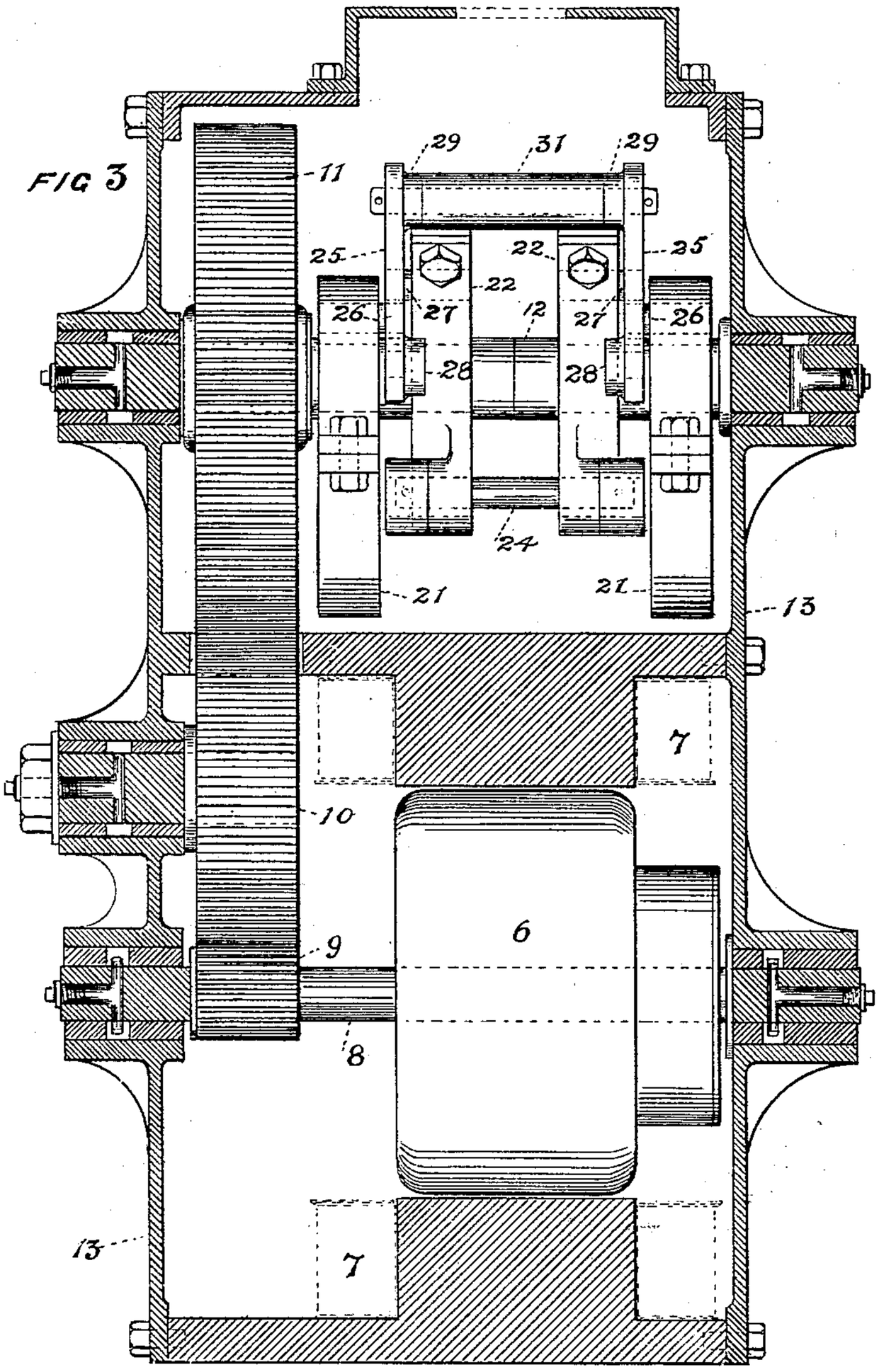
(No Model.) 7 Sheets—Sheet 3.

FIG 3



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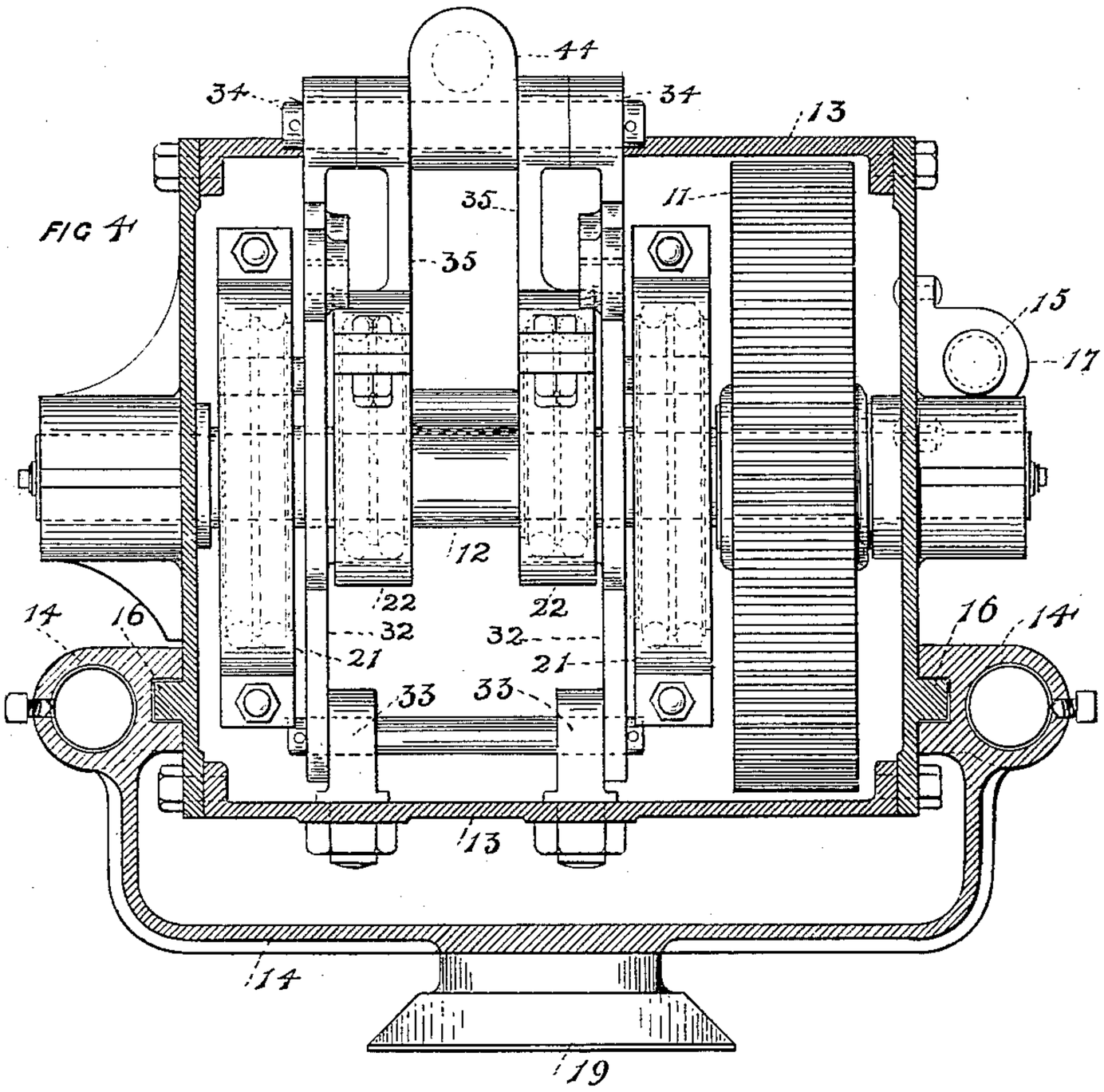
(No Model.) 7 Sheets—Sheet 4.

FIG 4



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7 Sheets—Sheet 5.

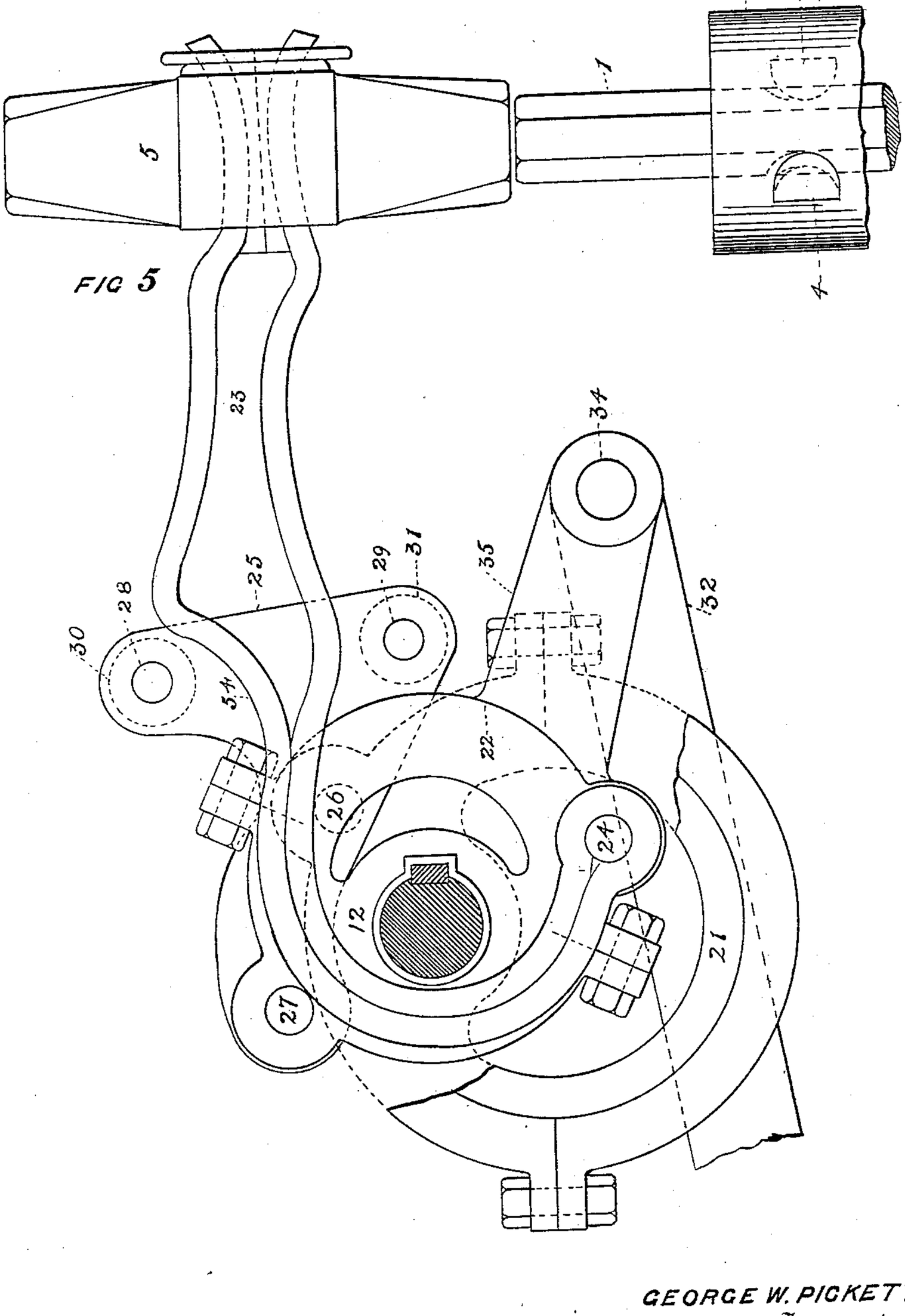

FIG 5

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(No Model.)

7 Sheets—Sheet 6.

FIG 6

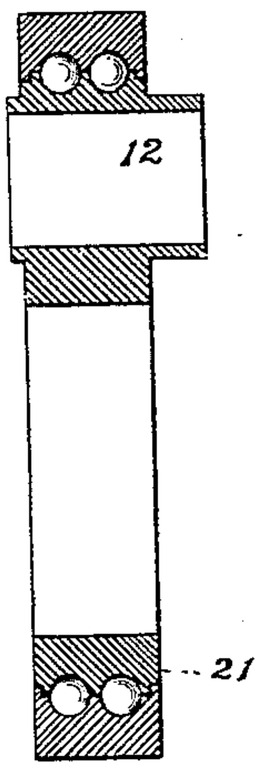


FIG 7

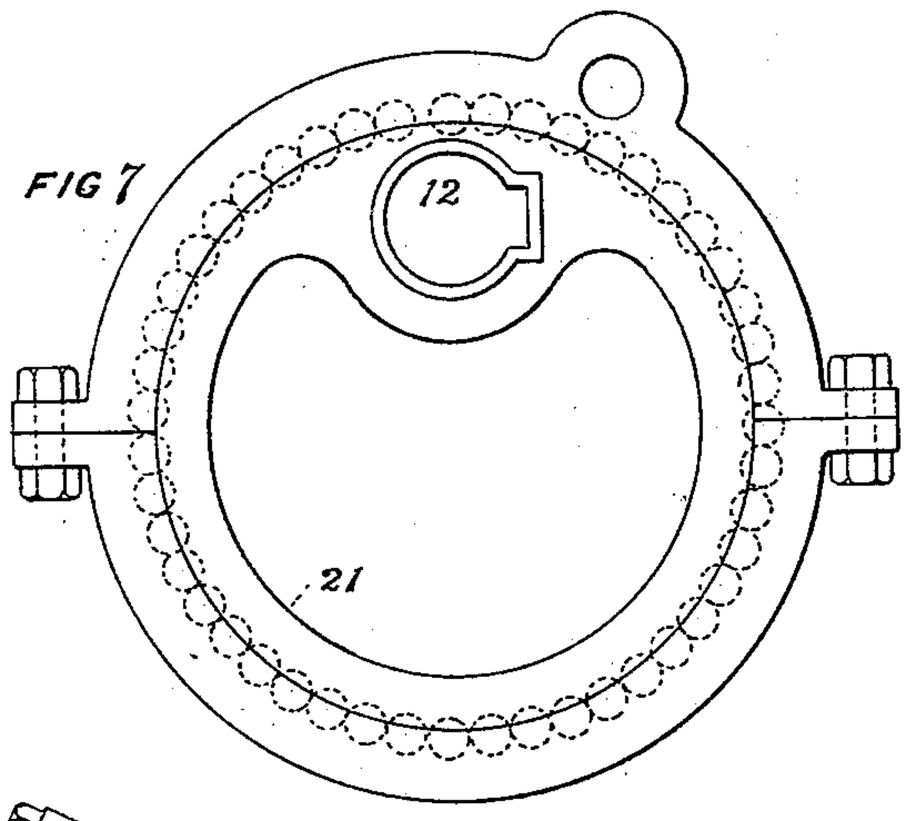


FIG 8

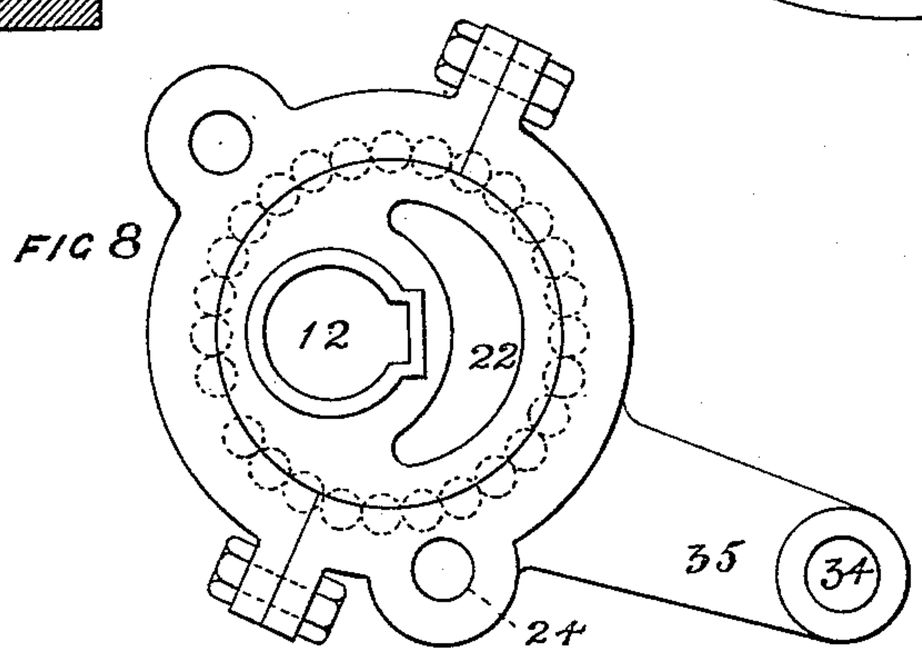


FIG 9

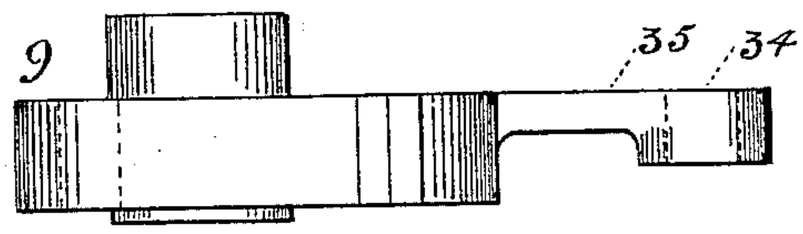


FIG 10

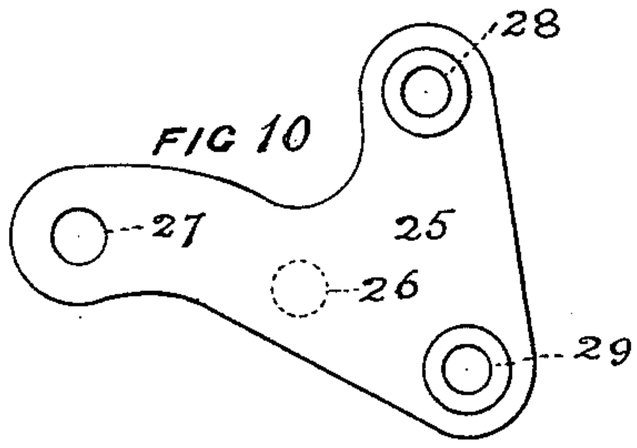
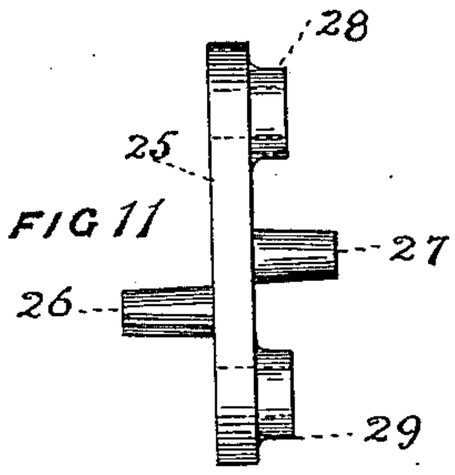


FIG 11



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(No Model.) 7 Sheets—Sheet 7.

FIG 12

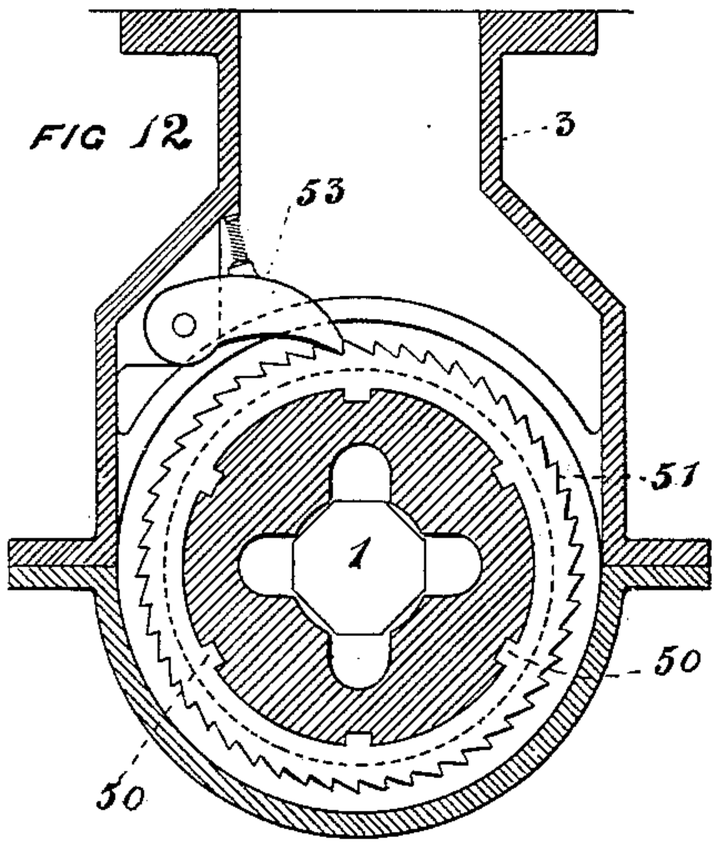


FIG 13

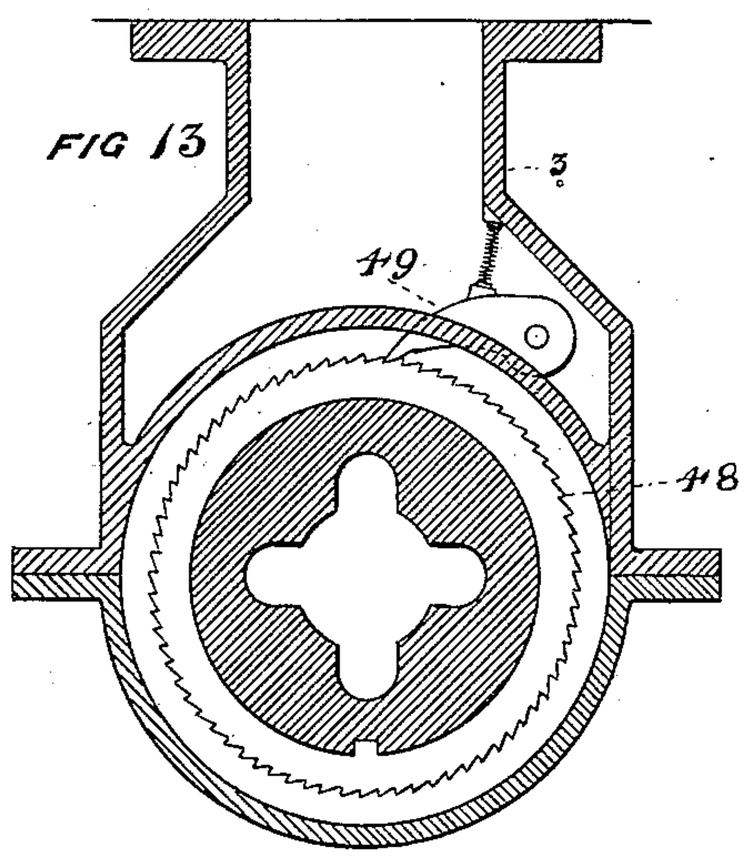


FIG 14

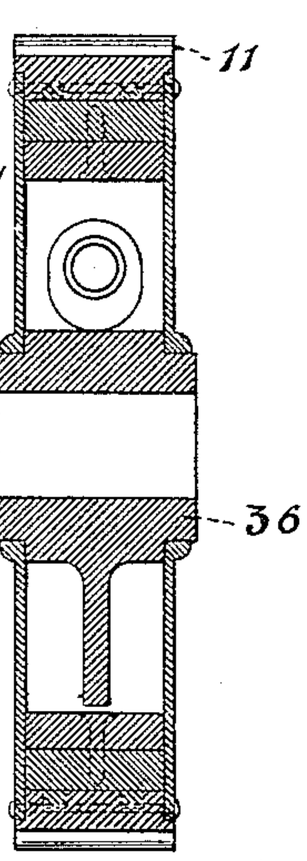
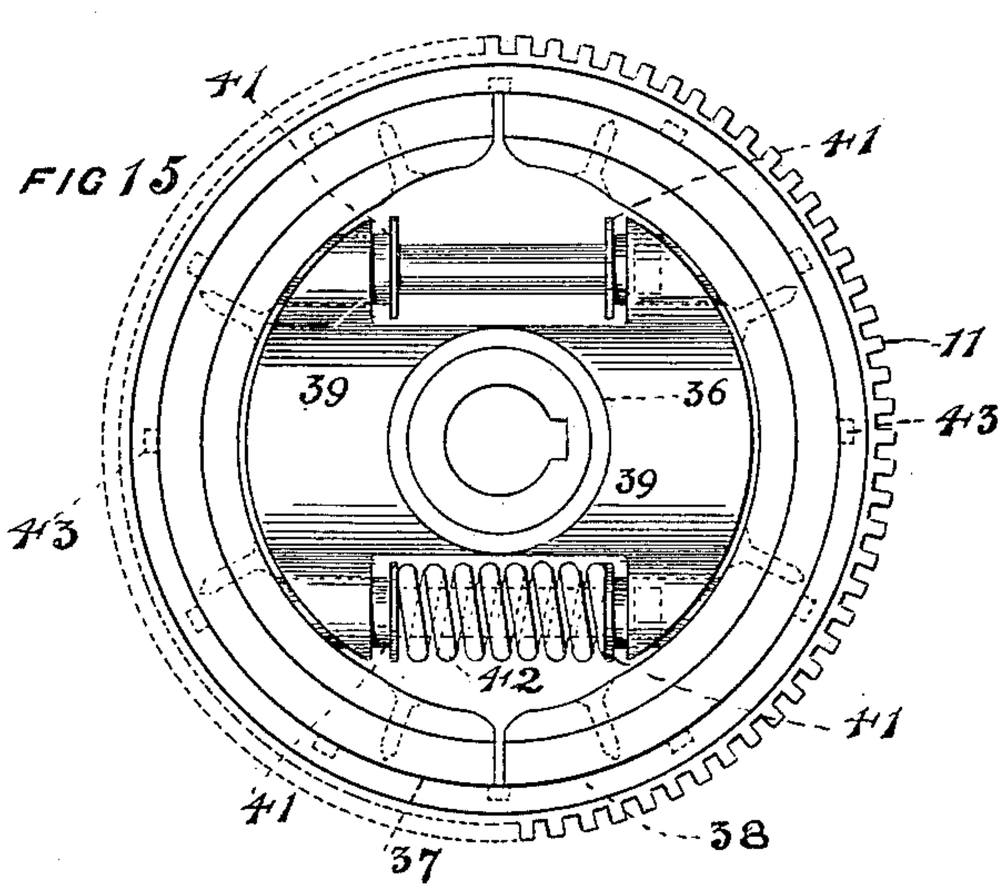


FIG 15



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UNITED STATES PATENT OFFICE.

GEORGE W. PICKETT, OF DENVER, COLORADO, ASSIGNOR TO THE HERCULES ELECTRIC ROCK DRILL COMPANY, OF SAME PLACE.

ELECTRIC ROCK-DRILL.

SPECIFICATION forming part of Letters Patent No. 632,658, dated September 5, 1899.

Application filed October 4, 1898. Serial No. 692,618. (No model.)

To all whom it may concern:

Be it known that I, GEORGE W. PICKETT, of the city of Denver, in the county of Arapahoe and State of Colorado, have invented a new and useful Improvement in Electric Rock-Drills, of which the following is a specification, reference being had to the accompanying drawings, which form a part thereof.

It is the object of my present invention to produce a simple, durable, and efficient apparatus to be operated by electricity for drilling rock; and my invention consists in the combination of devices hereinafter described, and referred to in the claims.

In the drawings, Figure 1 is a side elevation of a drilling apparatus constructed according to my invention, showing the supporting-frame and the casing and the general arrangement of the parts. Fig. 2 is a side elevation, partly in section and with the supporting-frame and part of the casing removed to show the internal working parts. Fig. 3 is a front elevation, looking from the right in Figs. 1 and 2, partly in section and with the frame and part of the casing removed. Fig. 4 is a top view, partly in section. Fig. 5 is an enlarged view of the hammer and its actuating-lever and eccentrics detached from the rest of the apparatus; and Figs. 6 to 15 are detailed views of different parts of the apparatus, as will be more fully explained below.

The same figures of reference designate the same parts in all the drawings.

The apparatus consists of three general parts—a drilling mechanism of the type in which a drill supported in a suitable holder is struck a rapid series of blows by a hammer, an electric motor, and mechanism interposed between the two by means of which the rotation of the armature of the motor actuates the hammer and at the same time retracts and turns the drill after each blow. The general arrangement of the parts is best shown in Figs. 1, 2, and 3, in which I have for convenience shown the apparatus in position for drilling a hole vertically downward. It will of course be understood, however, that it may be adjusted so as to work in any direction.

1 is a drill of the usual construction, supported by a drill-holder 2. The drill-holder is inclosed and held in position by a casing 3, which is firmly secured as a bracket to the main casing of the machine. The drill is loosely supported in the holder and held in position by keys 4 4. The keyways in the drill are made somewhat wider than the keys, so as to permit a certain amount of longitudinal movement of the drill in the holder.

5 is a hammer arranged to strike the head of the drill.

6 is the armature, and 7 7 are the filed magnets of an electric motor, which may be of any of the ordinary types. The armature-shaft 8 of the motor is connected by gear-wheels 9, 10, and 11 to the shaft 12, which actuates the hammer 5 and the mechanism for retracting and turning the drill 1.

The working parts of the apparatus are inclosed in a casing 13, which serves as the main frame of the machine. This casing is in turn supported by a frame or bed-piece 14, upon which it has a longitudinal movement controlled by the screw 15. As is shown in Fig. 4, the two parts are held together by longitudinal splines or rails 16 on the casing 13, working in channels or grooves in the frame 14. The screw 15 is attached to the frame 14 and works in a nut 17, attached to the casing 13, so that by turning the screw by means of the crank 18 the casing 13, and with it the drill 1, may be advanced or retracted by the operator at will. The frame 14 is provided with a lug or trunnion 19 and with adjustable legs 20, so that it may be clamped to a column or fixed directly to the walls of a shaft or tunnel in any desired position in the usual way.

As has been stated, the shaft 12 actuates the mechanism by which the hammer 5 is operated. This mechanism is best shown in Fig. 5, and it is also shown in Fig. 2 and to greater or less extent in other drawings. It consists, essentially, of two pairs of eccentrics mounted on the shaft and of actuating-levers operated by the joint action of these eccentrics and imparting a reciprocating movement to a pivoted arm or handle on which the hammer is mounted. One set of these eccentrics and levers is shown in Fig. 5. As will be seen, there are two eccentrics 21 and 22, preferably but not necessarily of unequal size, mounted on the shaft 12 at right angles to

each other. The details of construction of these parts are shown more fully in Figs. 6, 7, 8, and 9. As is shown in these figures, ball-bearings are interposed between the eccentrics and their straps to diminish the friction. The hammer 5 is mounted upon a curved arm or handle 23, which is pivoted at 24 to the strap of the eccentric 22. The arm is preferably curved so as to clear the shaft 12, but it may be made straight, and is preferably made of a steel rod or bar doubled back upon itself and shaped, as shown, for engagement with the rollers carried by the actuating-levers 25. One of these levers detached from the rest of the apparatus is shown in Figs. 10 and 11, and in Fig. 5 it is shown in connection with the eccentrics 21 and 22 and the hammer-arm 23. As will be seen, the lever is triangular in shape and is provided with journals or pins 26 and 27 for pivoting it to the straps of the eccentrics 21 and 22 and with bearings 28 and 29 for the rollers 30 and 31, engaging with the hammer-arm 23. As is shown in Fig. 5, the lever is pivoted at 27 to the strap of the eccentric 22 and at 26 to the strap of the eccentric 21. The strap of the eccentric 22 is restrained from rotary movement by the link 32, (see Fig. 2,) which is pivoted at 33 to the casing and at 34 to the tailpiece or extension 35 of the eccentric-strap, so that the strap has merely an oscillating movement about the center 33.

I have for convenience described the hammer-actuating mechanism as consisting of one set of eccentrics 21 and 22 and one actuating-lever 25, operated by them, and it may be constructed in this way. I prefer, however, to use two sets of eccentrics and two actuating-levers, and this is the construction illustrated in the drawings, as will more clearly appear from Figs. 3 and 4. The corresponding eccentrics 21 and 22 of each set are placed parallel to each other on the shaft 12, and each set is connected in the same manner with an actuating-lever 25. The rollers 30 and 31 are journaled at one end in one of the levers and at the other end in the other. I find that great advantages are secured by this arrangement, as the levers and rollers are kept in sufficiently accurate alinement without any very accurate mechanical fit of the various bearings, and the wear of the parts and the liability to breakage are greatly reduced. In fact, I find that with this construction the machine works more effectively with a certain amount of lost motion in the bearings of the levers and rollers than with the parts accurately fitted. Simple bars may be used in place of the rollers 30 and 31; but I prefer to use the rollers to diminish the friction.

In order to relieve the gearing and the motor from the shocks due to the sudden starting and stopping of the hammer at the end of the stroke, which at high speeds are very severe, I interpose between the gear-wheel 11 and the shaft 12 a friction-clutch which is so adjusted as to work without slip during the greater part of the stroke of the hammer, but to slip or yield somewhat at the times when the hammer is at or near the end of its stroke, and the shocks due to its stopping and starting produce a sudden or violent variation in torque that would put undue strain upon the gearing or the motor. The construction of this device is shown in Figs. 14 and 15. The rim of the gear-wheel 11 is not connected directly to the hub 36, which is keyed to the shaft 12, but is made in a separate piece and surrounds and is carried by the two semicircular pieces 37 and 38. These pieces are connected to the hub 36 through the bar 39 by sliding pins 41, which are pressed outward by springs, of which one is shown at 42. The springs 42 are so adjusted as to produce the required amount of friction between the semicircular pieces 37 and 38 and the interior surface of the rim carrying the gears for transmitting the torque necessary for actuating the hammer properly, but to allow the rim to slip upon such sudden or violent variation in the torque as is caused by the stopping and starting of the hammer. I have found that although it is impracticable to operate the apparatus with a rigid connection of the gearing between the motor and the shaft 12, on account of the frequent breaking of the gears, even when made very heavy, a very small amount of slip during each revolution at the times when the hammer is stopping and starting is sufficient entirely to obviate the difficulty. The springs 42 should therefore be so adjusted as to prevent any considerable amount of slip between the parts. The outer surfaces of the pieces 37 and 38 may be made of any suitable material with reference to uniformity of friction and durability, and the grooves or recesses 43 in the rim may be filled with lead or similar material to secure greater uniformity in the friction between the parts. I have described the friction-clutch as applied between the gear-wheel 11 and the shaft 12; but it is obvious that it may be applied at any other part of the gearing between the armature-shaft and the shaft 12, and it is also obvious that the details of construction of the clutch are not material, so long as the object set forth is accomplished.

I am aware that a friction-clutch has been interposed between an electric motor and a continuously-acting coal-cutter, as described in United States Patent to Sperry, No. 478,141, dated July 5, 1892, for the purpose of acting as a safety device upon any abnormal obstruction to the action of the cutter. My use of the friction-clutch differs from this and requires a different adjustment of the parts in that it is intended and is so constructed and adjusted as to always allow a certain amount of slip at or about the times when the hammer is starting and stopping during the normal operation of the apparatus, and such an adjustment of the clutch as would permit it to

slip only upon the occurrence of an abnormal obstruction to the action of the hammer or reciprocating parts would not accomplish the result which is necessary for the operation of my machine.

In order to prevent the drill from jamming in the hole and to bring its cutting edges into a new position for each stroke, the oscillating movement of the tailpieces 35 of the straps of the eccentrics 22 is utilized to retract and turn the drill 1 after each blow of the hammer, as follows: A retractor-rod 44 is pivoted to the tailpieces at 34 and carries at its lower end a yoke or fork 45, entering a circumferential recess 46 in the drill-holder 2. A spring 47 is interposed between the retractor-rod and the yoke to relieve the working parts from tension when the drill is fed forward by the screw 15. The drill-holder is mounted in the casing 3 so as to have free movement both of rotation and longitudinally, except as restrained by the yoke 45 and the other parts now described. 48 is a ratchet through which the drill-holder moves freely longitudinally, but not rotatively, and 49 is a pawl (see Fig. 13) permitting the ratchet to move only from right to left. The lower end of the drill-holder has a set of spiral grooves 50 cut in its surface, and 51 is a nut carried by lugs 52 on the interior of the casing 3 and having on its interior surface spiral splines or lugs fitted into the grooves 50. The nut 51 has a ratchet on its outer surface, and a pawl 53 prevents it from turning except from left to right, as shown in Fig. 12. When the drill-holder is lifted by the upward movement of the retractor-rod 44, the pawl 49 prevents it from turning backward, and the nut 51 is consequently turned forward, or from left to right, by the action of the grooves 50 on the splines on its inner surface, and when it is lowered by the downward movement of the retractor, the nut being restrained from moving backward by the pawl 53, the drill-holder is rotated from right to left an amount corresponding to the previous rotation of the nut.

The operation of the apparatus will be understood from the foregoing description of its construction. When the current is supplied to the electric motor, its armature is rotated at substantially uniform speed in the same direction, and the shaft 12 is driven by it through the gearing connecting them. The eccentrics 21 and 22, being set at an angle with each other on the shaft and being of unequal throw, impart an oscillating movement to the levers 25, which are pivoted to their straps. This movement is produced by the conjoint action of the two pairs of eccentrics and is at certain parts of their revolution due to their combined action in the same direction and at other parts of the revolution to their differential action. The parts are so arranged as to give the levers a gradually-accelerated motion on the forward stroke, especially toward the end of it, which gives the hammer a very efficient stroke, such as is required for enabling it to strike a sharp and effective blow on the head of the drill. This is aided by the curve 54 in the upper member of the hammer-arm 23, against which the actuating-roller 30 bears. This curve also facilitates the clearance of the roller from the hammer-arm after the blow is struck, so as to prevent the arm from striking the roller violently on the rebound. As will be seen, the two rollers 30 and 31 are adjusted so as to provide for a certain amount of lost motion between them and the hammer-arm, so as to leave the hammer free to swing by its own momentum for a short distance at each end of the stroke, and especially at the forward end. This greatly relieves the levers and eccentrics from the shocks that would otherwise be imparted to them by the inertia of the hammer. In Fig. 2 I have shown by dotted lines at the left the position of the parts at the end of the back stroke and by full lines at the right their position at the completion of the forward stroke. Since the hammer-arm 23 does not swing about a fixed center, but about a pivot on the strap of the eccentric 22, the hammer does not follow the same path on its forward and return stroke, and the dotted line 55 indicates its path on the forward stroke and the dotted line 56 its path on the return stroke. It is obvious that the hammer-actuating apparatus may be applied with advantage to reciprocating the drill and its holder instead of a hammer striking the head of the drill; but I prefer the type of drilling mechanism shown as more efficient and more readily managed.

When the apparatus is in use, the frame or bed-piece 14 is firmly clamped to a column by the trunnion 19 or fixed directly to the walls of the working by means of the adjustable legs 20, with the drill turned in the direction in which it is desired to drill the hole, and the drill is advanced by means of the screw 15 until its point is in contact with the rock. Current is then admitted to the motor, and the hammer 5 is reciprocated rapidly and strikes a sharp blow on the head of the drill at each stroke, and as the hammer is drawn back for each stroke the drill is retracted and rotated part of a revolution, so as to bring its cutting edge into a new position in the hole. As the rock is cut away, the drill is advanced by the operator by means of the feed-screw 15, and the spring 47 keeps its point firmly in contact with the rock at the time when the hammer strikes the head of the drill. It is obvious that a switch for stopping and starting the motor and a rheostat or any of the common devices for controlling the speed of electric motors may be placed in a position convenient to the hand of the operator, so that he may stop and start the drill and control its speed at will.

This apparatus is cheap to construct, since accuracy of mechanical fit is not necessary for most of the working parts, and they may

be made of simple castings. It is easily managed and not liable to get out of order and may be readily repaired by any ordinary workman when it does get out of order by the use of duplicate parts. It is also highly efficient in operation. I have found that it will do a given amount of work in cutting rock with a much smaller amount of power than the ordinary compressed-air drill.

What I claim as new, and desire to secure by Letters Patent, is—

1. In a rock-drilling apparatus, the combination of drilling mechanism having a reciprocating movement of its rock-cutting parts, an electric motor having a rotary movement of its armature in one direction, and gearing connecting the armature-shaft of the motor with the drilling mechanism and provided with a friction-clutch adjusted so as to transmit the power of the motor to the drilling mechanism but to slip or yield at or about the times when the movement of the reciprocating parts is reversed, substantially as described.

2. In a rock-drilling apparatus the combination of a drill supported in a holder and having longitudinal movement therein, a reciprocating hammer arranged to strike the head of the drill, mechanism for reciprocating the hammer, an electric motor, and connecting-gearing between the motor and the hammer-operating mechanism provided with a friction-clutch adjusted so as to transmit the power of the motor to the hammer-operating mechanism but to slip or yield at or about the times when the movement of the reciprocating hammer is reversed, substantially as described.

3. In a rock-drilling apparatus, the combination of a drill supported by a holder in which it is capable of longitudinal movement, a reciprocating hammer arranged to strike the head of the drill, mechanism for reciprocating the hammer consisting essentially of two eccentrics set at right angles to each other on the same shaft and having their straps pivoted to an actuating-lever which imparts a reciprocating movement to a pivoted arm carrying the hammer, an electric motor, and gearing connecting the armature-shaft of the motor with the shaft carrying the eccentrics, substantially as described.

4. In a rock-drilling apparatus, the combination of a drill supported in a holder in which it is capable of longitudinal movement, a reciprocating hammer arranged to strike the head of the drill, mechanism for reciprocating the hammer consisting essentially of two pairs of eccentrics set at right angles to each other on the same shaft with two actuating-levers, each pivoted to the straps of two eccentrics (one of each pair) and carrying rollers or bars between their outer ends which actuate a pivoted arm carrying the hammer, an electric motor and gearing connecting the armature-shaft of the motor with the eccentric-shaft, substantially as described.

5. In a rock-drilling apparatus, a drill supported in a holder so as to be capable of longitudinal movement therein, a reciprocating hammer for striking the head of the drill, a shaft driven by power, two eccentrics mounted on the shaft at an angle to each other, an arm pivoted at one end to the strap of one of the eccentrics and carrying the hammer at its other end, and a lever actuating the hammer-arm and pivoted to the straps of both eccentrics so as to receive an oscillating movement from the conjoint action, substantially as described.

6. In a rock-drilling apparatus of the type described, in which the drill is operated by blows of a hammer, the combination of a shaft, two pairs of eccentrics mounted on the shaft with those of each pair parallel to each other but at an angle to the other pair, two actuating-levers each of which is pivoted to the straps of two eccentrics (one of each pair), a pivoted arm carrying the hammer, and rollers engaging with the hammer-arm and carried by the outer ends of the two actuating-levers, substantially as described.

7. In a rock-drilling apparatus of the type described in which the drill is operated by blows of a hammer, the combination of a shaft, two pairs of eccentrics mounted on the shaft with those of each pair parallel to each other but at an angle to the other pair, two actuating-levers each of which is pivoted to the straps of two eccentrics (one of each pair), an arm carrying the hammer and pivoted to the straps of one pair of eccentrics, and rollers engaging with the hammer-arm and carried by the outer ends of the two actuating-levers, substantially as described.

8. The combination of the eccentrics 21 and 22 mounted at an angle to each other on the shaft 12, the actuating-lever 25 pivoted to the straps of the eccentrics, the hammer-arm 23 having the curve 54 and the rollers 30 and 31 carried by the lever 25 and engaging with the hammer-arm, substantially as described.

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