(No Model.)

4 Sheets—Sheet 1.

H. N. MARVIN.

ELECTRIC ROCK DRILL.

No. 368,406. Patented Aug. 16, 1887.

Fig. 1.

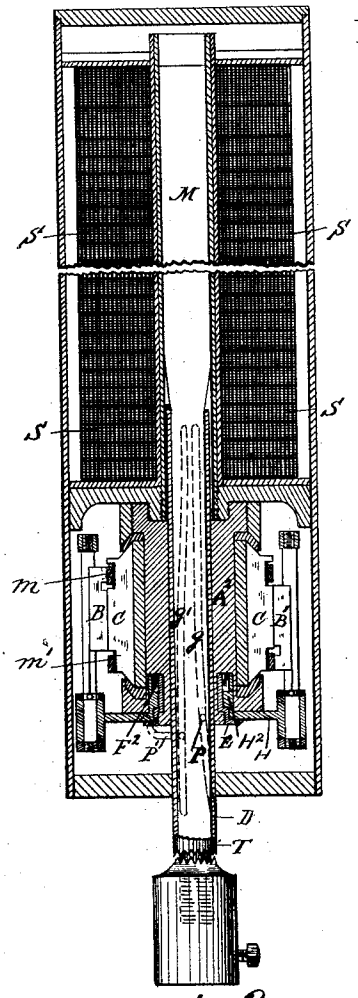


Fig. 3

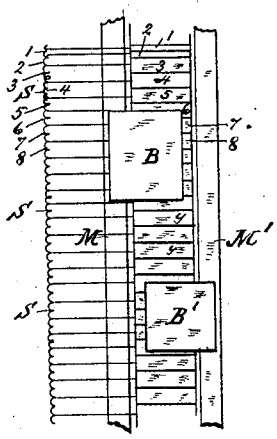
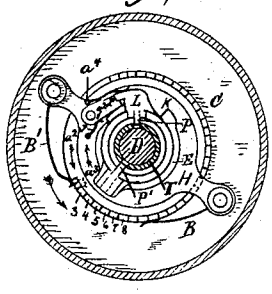


Fig. 2



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(No Model.) 4 Sheets—Sheet 2.

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Fig. 4.

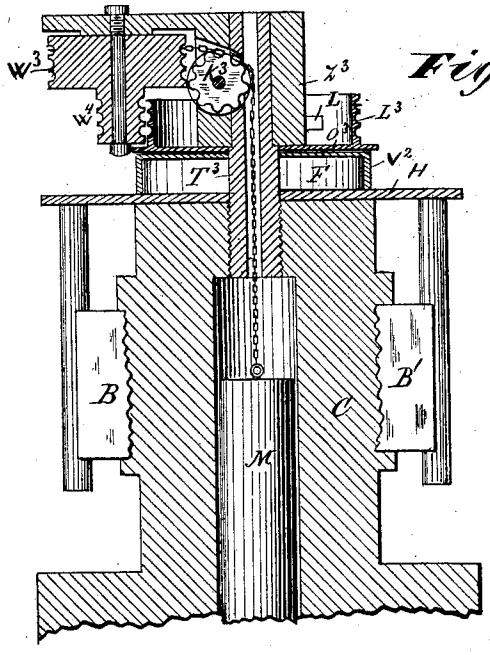

Fig. 5.

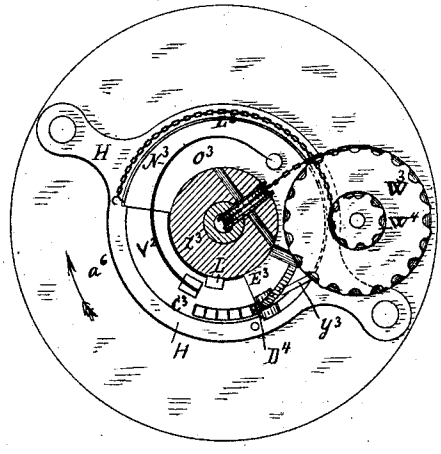

Fig. 6

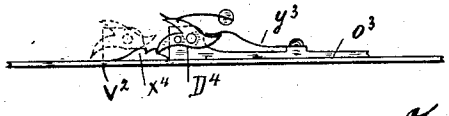

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Fig. 7.

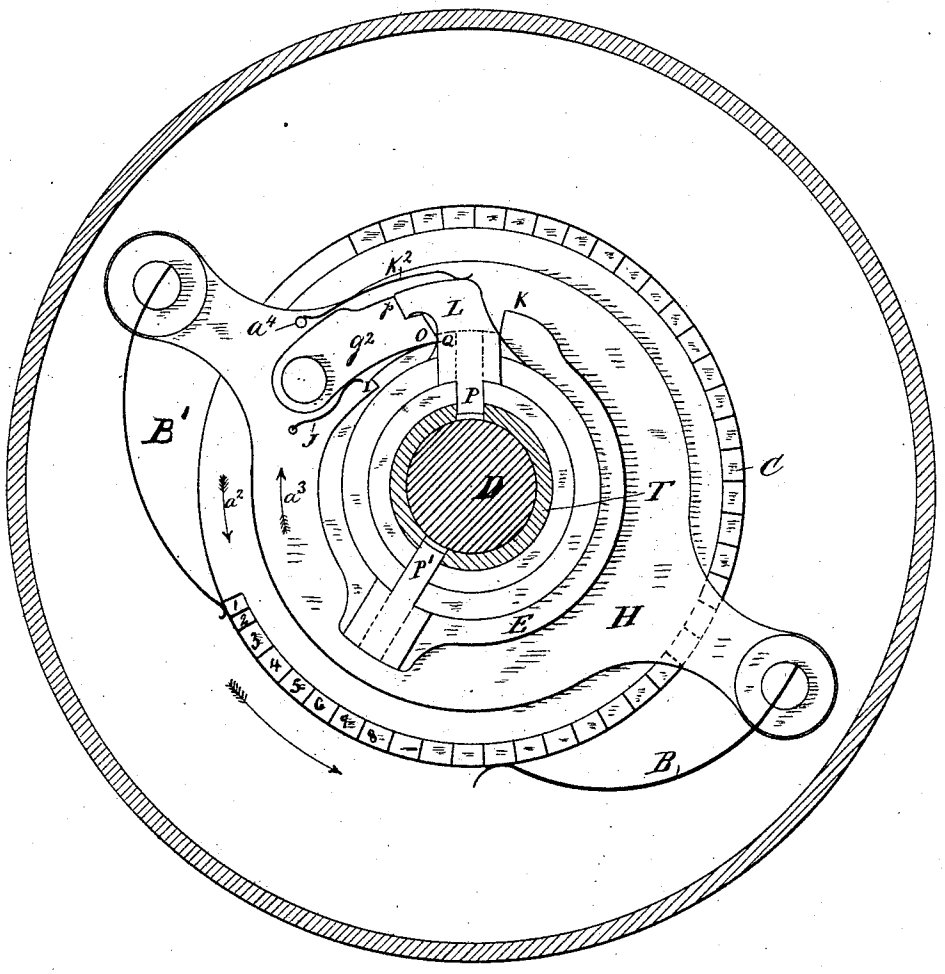

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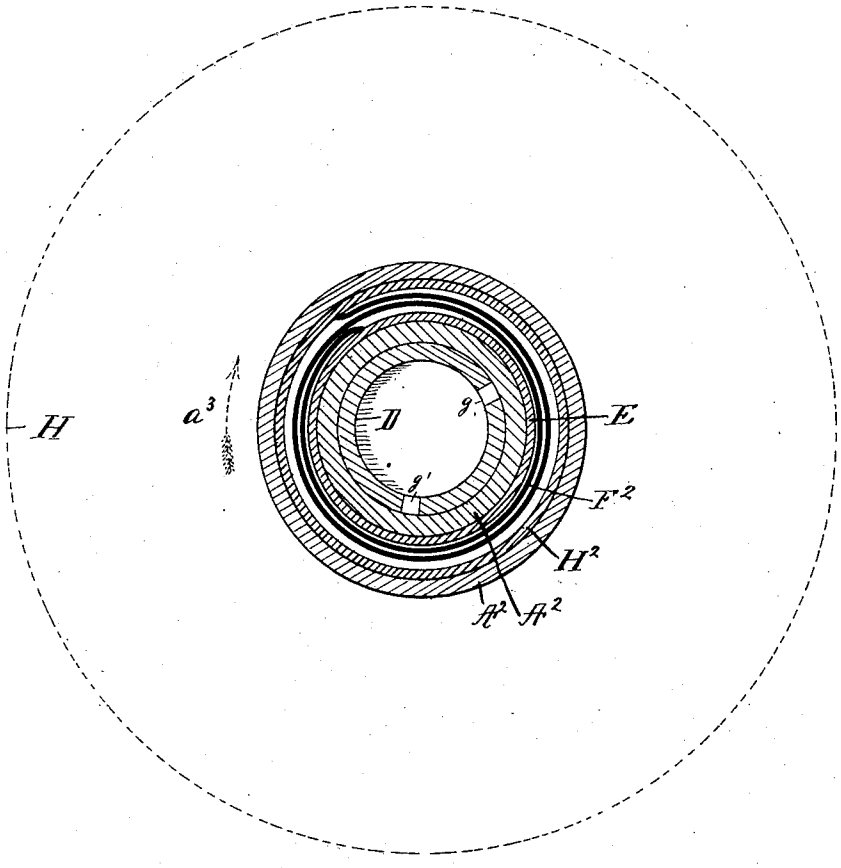
Fig. 8.



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UNITED STATES PATENT OFFICE.

HARRY NORTON MARVIN, OF SYRACUSE, NEW YORK.

ELECTRIC ROCK-DRILL.

SPECIFICATION forming part of Letters Patent No. 368,406, dated August 16, 1887.

Application filed February 1, 1887. Serial No. 226,153. (No model.)

To all whom it may concern:

Be it known that I, HARRY NORTON MARVIN, a citizen of the United States, and a resident of Syracuse, in the county of Onondaga and State of New York, have invented a certain new and useful Electric Rock-Drill, of which the following is a specification.

My invention relates to certain improvements in the commutating devices for that class of electrical apparatus in which a core is reciprocated by the operation of a series of electro-magnetic coils successively thrown into and out of action in proper way to produce a continuous movement of the core first in one and then in the other direction.

My invention is designed more particularly for use in connection with rock-drills, dental hammers, pluggers, and other tools.

In a prior application for patent filed by me June 23, 1886, I have described an instrument in which a reciprocating core and series of coils are employed, and in which the commutator is connected with the reciprocating core by means of a spring and other devices suitably constructed and arranged to permit the core to continue its movement in an upward direction after the commutator comes to rest, thus bringing the core above the set of coils in action and in proper position with relation to the same to be drawn downward, or in the opposite direction. The construction is also such that when the core comes to rest at the completion of its downward movement the spring connecting the core and commutator will automatically shift the commutator with relation to the core, and in an upward direction, so as to change the current to a set of coils in a higher plane, or in a plane such that the mean attractive effect will be to raise the core. The upward movement is then continued, by reason of the fact that the commutator in its changed relation to the core is moved upward thereby, shifting the current continuously in the coils.

My present invention consists in certain novel combinations of devices for effecting the desired movements of the commutator, and, further, in devices whereby the proper rotation of the drill-tool may be effected.

In my prior application I have described a method of cushioning or checking the movement of the core, which consists in compelling it to pass through a magnetic field produced by a coil or coils. In my prior application a retarding influence is produced by the same set of coils which are effective in drawing up the core at the end of its stroke, though it is not inconsistent with my invention, as therein described, to employ a separate set of coils.

My present invention consists, further, in a means whereby an auxiliary coil may be brought into action at or near the end of a stroke, so that the core will move through a larger number of coils, and its movement will be to that extent more greatly retarded. I have designed an arrangement of devices whereby said retarding-coil will only be brought into operation when the core has moved to such an extent that the influence of said coil will not be one which will aid materially in continuing the upward movement of the core—that is to say, it is not brought into action until the core has reached such a point that the influence of said coil on the core shall be one to retard its movement or to tend to pull it in a downward direction.

The novel combinations of apparatus and improved constructions forming my present invention will be described in connection with the accompanying drawings, and then more particularly specified in the claims.

Referring to the drawings, Figure 1 is a vertical section of the lower portion of an electro-magnetic rock-drill embodying my invention. Fig. 2 is a plan of the commutator devices, looking upward. Fig. 3 is a diagram of the commutator and coil connections. Fig. 4 is a vertical cross-section of an upper portion of a drill, showing a modified form of apparatus for imparting circular movement to the commutator. Fig. 5 is a plan of the commutator devices shown in Fig. 4. Fig. 6 is a side elevation of a portion of the devices shown in Fig. 4. Fig. 7 is an enlarged view of the devices shown in Fig. 2. Fig. 8 is a cross-sectional plan view through the volute spring and the parts immediately connected therewith.

M indicates the reciprocating core of the apparatus, and S a series of coils adapted to act upon said core. The coils S are preferably made to operate in sets, the current being suc-

cessively shifted into and out of the coils, so as to keep a number of them constantly in action in a position ahead of the core, or where mean attractive influence will be one that shall continue the movement. Thus, for instance, I prefer to arrange the coils so that five of them shall always be in action, and to construct the commutator so that as the sixth coil comes into action the number 1 coil of the set, supposing them to be numbered in succession, will go out of action, and so on through the whole number of coils employed in moving the core from one end of its stroke to the other.

Connected to the core M is the rod D, carrying a chuck for the attachment of the tool. At the lower end of the set of coils S is a circular commutator, through whose axis the rod D passes. The plates of said commutator are indicated by the letter C, and the hub or fixed support for the same by the letter A^2, the latter part being properly secured to the frame. The construction of the commutator herein illustrated is substantially the same as that frequently employed in dynamo-electric machines, the commutator-plates C being assembled in the form of a cylinder, over which the commutator-brushes play in a circular path.

The brushes herein indicated at B B′ are secured to suitable holders, that in turn are carried by a plate, H, sleeved on the tube A^2, as indicated. The coils S are preferably connected in a continuous series, as indicated in Fig. 3, and the terminals of the series are connected to the terminal plates of the series C, the intermediate plates C being connected in succession to the points of junction between the successive coils, as clearly indicated in the diagram.

The brushes B B′ are maintained in connection with a suitable source of electricity by means of hoops or bands *m m′*, of good conducting material, which encircles the cylindrical commutator, as indicated, being suitably insulated from the plates C. Upon the hoops bear the brushes B B′, or brushes suitably connected with the same. The brushes B B′, being insulated from one another, are applied to the commutator-cylinder at such distance apart as to include between them five or any other number of coils, S, which it is desired shall act on the core. As the plate H and the brushes are moved by the core, the current is shifted in an obvious manner; but the same number of coils is maintained always in action, the effect being to cause a progressive movement of a magnetic field in the direction of the axis of the coils.

T indicates a sleeve or tube on the drill-rod D, which sleeve at its lower end has a number of teeth adapted to engage with teeth on the clutch by which the tool is held. The sleeve T has a sufficient end-play to allow the teeth to engage or disengage, as circumstances may determine.

In the sleeve T are formed two slots, *g g′*, which, starting near the lower end of the sleeve, gradually converge until they come quite near together at the upper end. The angular extent of convergence is substantially the same as the play or angular movement which it is desired to give to the brush-holding plate H.

It will be noticed that the slot *g* at its lower portion is inclined, but at its upper portion is substantially parallel with the axis of the tube T, while the slot *g′* at its lower portion is substantially straight or parallel to the axis of the tube, but is at its upper end inclined.

A pin, P, secured to the hub A^2 or other fixed support, takes into the guide-slot *g*, while a pin, P′, secured to a sleeve, E, takes into the slot *g′*. The sleeve E is adapted to rotate on the hub or fixed support A^2, and is connected with a sleeve or support, H^2, carrying plate H, by means of a volute spring, F^2, like a clock-spring, one end of which latter is connected to the sleeve E, or other part carrying pin P′, while the other end is connected to the hub H^2, or other part carrying plate H. The connection is such that if plate H be held stationary and hub or sleeve E be rotated in the direction of the smaller arrow, a^3, Figs. 2 and 8, the spring will be wound up or put under increased tension, so that if the plate H be released or be free to revolve while the sleeve E is stationary the spring will rotate said plate H in the direction of the smaller arrow. The plate H carries a dog or catch, g^2, adapted to engage or be locked to the sleeve E at the notch I. The notch I and the dog g^2 at the point where it engages with the catch are so formed that when once engaged they can only be disengaged by a slight turning of the plate H and dog with relation to the sleeve E in the direction of the arrow a^2, Fig. 2.

A spring, J, serves to throw the dog away from the notch. When this happens, the plate H can be turned by the action of a spring, F^2, and will move independently of the sleeve E and the parts connecting the same with the core M and rod D until arrested by a stop, K, which is carried by sleeve E, which limits the angular movement of the plate H with relation to the sleeve E and core under the action of the spring F^2.

A stop, L, fixed to the hub A or other support, brings the plate H to rest when the sleeve E and the plate H are turned to a sufficient distance in the direction of the smaller arrow, a^3. Under this condition the continued movement of the sleeve E will wind up the spring F^2. The end of the dog g^2 can engage with the stop L at two surfaces or points of engagement disposed one in the rear of the other, as shown. The surface *o* is the first to come into engagement with the stop L; but as the sleeve E turns a notch or depression, Q, on the side of the same finally comes under the end of the dog g^2, and the spring K^2, secured to stop L or other support, forces the dog g^2 inward, disengaging the surface *o* from the stop L, and permitting the dog g^2 and plate H to move for a certain limited distance with the sleeve E until the surface *p* comes against the stop L, when the plate H ceases to move and sleeve E can con-

tinue its movement independently of the dog and plate H, until finally the notch I comes under the dog, and the latter is forced into the notch by the superior stress of the spring K^2. The two parts are thus locked together, and are only disengaged on a movement of plate H in the reverse direction independently of sleeve E, as will be presently explained. A suitable stop-pin, a^4, carried by plate H, limits the outward movement of the dog g^2.

It will be noticed that plate 2 of the commutator-plate C, which is the plate corresponding to the coil numbered 2 of coils S, is of smaller extent than the remaining coils. The effect of this is that when the brushes B B′ rest on plates 2 and 7, for instance, so as to include coils 2 to 6 in circuit, a very slight movement of the plate will bring in coil 1 without throwing out coil 6. The coil 1 forms the retarding-coil, which checks the upward movement of the core M, as will be presently described.

The parts as thus formed are arranged and organized to operate as follows: Let it be supposed that the parts of the commutator are in the position shown in Fig. 2, the core being nearly but not quite at the end of its stroke upwardly. The arm H and dog g^2 being held by the stop L, the core in completing its movement by momentum will turn the sleeve E sufficiently to bring the notch I under the dog g^2, which latter will be caused to engage with the notch by the force of the spring K^2. The core, having now completed its stroke and being at its upper position, will be in large part above the coils at the upper end of the series. The mean attractive influence of coils 1 2 3, &c., through which the current flows, will tend to draw the core down. As the latter moves down, the sleeve T moves with it and is turned by the engagement of the fixed pin P with the lower end of the groove or guide g, which is inclined at its lower end, as indicated. The sleeve E, being connected with the sleeve by the pin P′ and guide or groove g' therefor, turns and carries with it the arm H, locked thereto by the dog g^2, the effect of which is to throw in a new coil below the set which acts at the beginning of the stroke and to throw out the upper coil of said set. This shifting continues as the core moves, so that there is always below the core a progressing magnetic field, whose influence continues the movement. As the core and sleeve T move down, the straight portion of the slot or guide g is brought to coincidence with the pin P, so that near the lower portion of the stroke the tube does not turn, but the sleeve E and brushes continue to turn, because when the pin P passes into the straight portion of the slot g the pin P′ passes into the inclined or spiral portion of the slot or guide g'. The core and tool are thus moved downward until they suddenly come to rest by contact of the tool with some object. At this instant the arm or plate H, having acquired considerable momentum, continues its movement a slight distance independently of sleeve E, which stops with the tool, and the point of the dog g^2 moves sufficiently in the notch I to permit the spring J to throw the dog out against the stop-pin a^4. The arm or plate H and the sleeve E being now no longer locked together, the spring F^2 draws the arm in a reverse direction until its movement with relation to the sleeve is arrested by the stop K. By this movement of the arm H and connected brushes the current is shifted to a set of coils lying above the set last in action a distance corresponding to the angular shifting of the brushes with relation to the sleeve E. This shifting is made sufficient to raise the magnetic field to a position where its influence will raise the core M. The latter now begins to move upward, and the sleeve T rises with it, the inclined or spiral portion of the slot or guide g' in the latter acting upon the pin P′ so as to turn sleeve E in the direction of the arrow a^3, or in a reverse direction to that in which it moved when the core moved downwardly. The plate H and brushes partake in this movement, the spring F^2 keeping the dog g^2 against the stop K of the sleeve E, and the shifting of the current in the coils now takes place upwardly, producing a shifting magnetic field constantly above the core. The latter therefore continues its upward movement, the latter portion of the movement of the sleeve E and brush being produced by the turning of the sleeve T, through engagement of the pin P with the lower or inclined portion of the groove g, and the simultaneous connection of the sleeve E with T by the pin P′ and straight portion of groove g'. When the brush B′, moving with the core and sleeve E, reaches the plate 2, where the final coil of the series employed in raising the core comes into action, the further movement of the plate H and brushes is temporarily stopped by engagement of the part o of dog g^2 with stop L on the fixed hub A^2, and the core continues its movement by acquired momentum, the sleeve continuing, however, to move with it and to wind up the spring F^2. By the continued movement of the core without shifting of the current in the coils, the core is carried farther into the coils in action, and the influence of the latter in lifting the core gradually decreases. At or about the time that the core begins to reach a neutral position in a magnetic field produced by the coils the movement of the sleeve E with the core independently of the plate H will have brought the notch Q under the toe of the dog g^2, which latter, being pressed inward by spring K^2, will drop into the notch, thus freeing the surface o from stop L and releasing the dog and plate H, so that the latter may move farther with the sleeve E a short distance, or until the surface p of the dog engages with the stop L. This further movement of the plate shifts the brush B′ and brings into circuit the coil 1, whose action on the core is one tending to retard the upward movement of the core. The partial shifting of the plate H in bringing

in the coil 1 is not, however, sufficient to throw out the lower one of the coils which was in circuit before the partial shifting took place. No further movement of the plate H with the core as the latter moves upwardly can now take place, because the dog g^2 is held by the stop L, and the movement of the core to its upper limit is completed under the retarding influence of the current in the coil 1, as well as of the current in the coils 2, &c. The movement of the core after engagement of the surface p with stop L simply further winds up the spring F^2 and turns the sleeve E, so as to finally bring the notch I under the dog, when the parts are ready for reverse movement, as already explained. When this occurs, the core or tool will have been finally arrested by a suitable stop, and the core will have attained a position where the action of the coils will tend to pull the core down, producing a new stroke, as already explained. The turning of the drill at each reciprocation is produced by the sleeve T engaging at its lower end with the head of the chuck which holds the tool. This movement of rotation occurs near the upper end of the stroke of the drill, instead of at the lower, owing to the fact that the groove g, with which the fixed pin P engages, is inclined or spiral at its lower end, while its upper end, where the pin engages when the tool is down, is straight. When the core moves down, the sleeve T lags behind, and, being at the upper extreme of its play on the rod, does not engage with the head of the drill-chuck. No movement of rotation of the drill is therefore produced, although the sleeve may be turned so as to turn the sleeve E. Even though it should engage, no movement of rotation would occur when the drill is fully inserted in the drill-hole, because at such time the pin P engages with the straight portion of the slot g'. As the core and rod reverse their movement the sleeve T drops into engagement with the drill rod or chuck, and toward the end of the upward movement the two are rotated together by the engagement of the pin with the spiral portion of the groove g. While the pin is in engagement with the straight portion of the slot g the spiral portion of the other slot, g', engages with pin P', so that the sleeve E is turned through the whole portion of the stroke. By this arrangement of the grooves the same sleeve serves to produce the rotation of the sleeve E through the whole of a stroke and to turn the drill-rod through a portion only of the stroke—to wit, the upper portion, where the drill is to a greater or less extent free from the material. Another means that may be employed for rotating the brushes is shown in Figs. 4, 5, and 6. The core M connects by a chain or cord passing over an idle-wheel, K^3, with a drum, W^3, upon which the cord winds and unwinds. When the core moves down, the cord unwinds and turns the drum, thus causing rotation of a second drum, W^4, that in turn winds up a cord or chain winding in a pulley or drum, L^3, that in turn carries plate O^3, and communicates movement to a box, V^2, carrying plate H, when locked thereto by a dog, D^4, in plate O^3, Fig. 6, which is adapted to engage with a tooth or projection, x^4, in box V^2. When the box is thus turned by the downward movement of the core, it still further winds up a clock-spring contained in the box and under tension at all times. One end of this spring connects to the box and the other to a fixed hub or support.

The plate H carries the commutator-springs.

The plate O^3 is cut away on its top, as indicated in Fig. 4, and a projection, C^3, on the case V^2 is arranged to engage with plate O^3 at E^3, so as to arrest the backward movement of the box V^2 and plate H with relation to the plate O^3 in the same way that the stop K on drum E, Fig. 2, arrests the backward movement of dog g^2 on plate H. A stop, L, on a rigid support, Z^3, is arranged in the path of projection C^3, so as to bring plate H to rest at its limit of movement in one direction when V^2 and O^3 move together under influence of the clock-spring at the time the case moves upward and takes the tension off of the driving cord or chains. A spring, N^3, connected at one end to plate O^3 and at the other to V^2, is normally under tension in a direction such that it will tend to turn drum L^3 in a direction to wind up the cord or chain on the latter. The parts being in the position shown in Fig. 4, the downward movement of the core unwinds the chain from L^3, thus turning O^3 and H through the dog D^4 and winding up the clock-spring. When the drill strikes, the momentum of the plate H and box V^2 unlocks the dog, which is then thrown off by the spring g^3, and the plate V^2 revolves backward under O^3 until arrested by engagement of stop C^3 with O^3 at E^3, thus shifting the current in the coils so as to raise the magnetic field and cause the core to begin to move upward. The plate H, carrying the brushes, and the plate V^2 now move together, under the operation of the clock-spring, and follow the movement of the core as the latter releases the tension on the chains, which are simultaneously wound up by the operation of the clock-spring. When the core nears the end of its movement, the stud C^3 on V^2 strikes L, stopping the movement of plate H, so that the core, now continuing its movement independently of the commutator, shifts its position to a plane above the coils, ready for a new downstroke. The further movement of the plate O^3, necessary after the influence of the clock-spring ceases, through engagement of C^3 with L, is produced by the spring N^3, which turns the plate O^3 until the dog can again engage at x^4. This further movement of the plate O^3 also winds up the final slack in the chain on drum L^3.

What I claim as my invention is—

1. The combination, with the reciprocating core and its series of actuating-coils, of a circular or cylindrical commutator encircling the core or extension therefrom, and a spring-connection between the core and movable portion

of the commutator, whereby the core may move after the commutator comes to rest, and the commutator may be moved independently of the core to reverse the direction of movement of the latter.

2. The combination, with the reciprocating core and its actuating-coils connected in continuous series, of a circular series of commutator-plates mounted at the end of the actuating-coils, and commutator-brushes mounted on an arm which is connected with the core through a spring and is adapted to reciprocate in the arc of a circle over the commutator-plates.

3. The combination, with a reciprocating magnetic core, of an actuating coil or coils, a supplemental coil for checking the movement of said core, and means for completing the circuit of said core as the core nears the end of its stroke, as and for the purpose described.

4. The combination, with the core, of a series of actuating-coils and a commutator whose terminal contacts connected to the terminal coils of the series are of reduced extent, as described, so that as the core nears the end of its stroke a number of coils in action will be increased.

5. The combination, with the movable magnetic core and the commutator connected therewith through devices permitting a limited movement of the core independently of the commutator, a stop for arresting the movement of the commutator when the core and commutator have moved together to a predetermined extent, and means for disengaging the commutator after the core has moved independently thereof to a certain extent, so as to permit the two to move together still farther in the same direction until the commutator is finally arrested.

6. The combination, with the core and its actuating-coils, of a retarding-coil and a commutator for bringing said retarding-coil into circuit after the core has moved to a predetermined distance under the operation of the final set of actuating-coils, as and for the purpose described.

7. The combination, with the core, of a series of coils through which the core is adapted to move, and a series of commutator-plates, the terminal one of which is connected to the terminal of the series of coils, while the remaining plates are connected in series to the junctions of the coils, the terminal plate of the series being of reduced extent, as described, so that the final movement of the commutator-brushes will throw into circuit the final coil without throwing out the coil at the opposite end of the set in action.

8. The combination, with the drill-rod, of the tube or sleeve having a rod or guideway straight at its upper and inclined at its lower end and a fixed pin or stud engaging with said guide, as and for the purpose described.

9. The combination, with the drill-rod, of the tube or sleeve having a slot or guideway, *g'*, a sleeve carrying a pin or stud engaging with said groove, and a commutator-brush-supporting plate mounted concentrically with the second sleeve and connected therewith by a spring, as and for the purpose described.

10. The combination, with the reciprocating core and its set of actuating-coils, of a circular commutator, a dog or catch for temporarily locking the movable part of the commutator to a part which revolves under the operation of the core, a spring for moving the commutator independently of the core when the latter stops and the parts are disengaged by momentum, and means for throwing the locking devices into engagement when, through movement of the core independently of the commutator, parts are brought into opposition.

11. The combination, with the reciprocating drill-tool, of the sleeve or tube having inclined slot or guide, a sleeve or collar carrying a pin or stud engaging with said guide, a second sleeve or collar carrying a plate or support for the commutator-brushes, and a converting volute spring, as and for the purpose described.

12. The combination, with the drill-rod, of the tube having two slots or guideways, a fixed pin engaging with one guide, a pin carried by a movable support and engaging with the other guide, a brush-carrying plate or support for a circular commutator, and a dog or catch for connecting said supports, as and for the purpose described.

13. The combination, with the drill-rod, of a tube or sleeve, two grooves or guides, each having a straight and an inclined portion, the straight portion of one guide being opposite the incline portion of the other, a fixed pin or stud engaging with one guide, and a circular commutator operated by a pin or stud engaging with the other guide, as and for the purpose described.

14. The combination, with the sleeve or support adapted to rotate in a plane transverse to the line of movement of the core and tool, of a plate or support, H, carrying the brushes for a circular commutator, a catch or dog upon one support adapted to engage with the other support, and a spring constantly tending to throw the dog out of engagement, as and for the purpose described.

Signed at Syracuse, in the county of Onondaga and State of New York, this 29th day of January, A. D. 1887.

HARRY NORTON MARVIN.

Witnesses:

FRANK J. SHARER,

GEORGE J. DONOVAN.