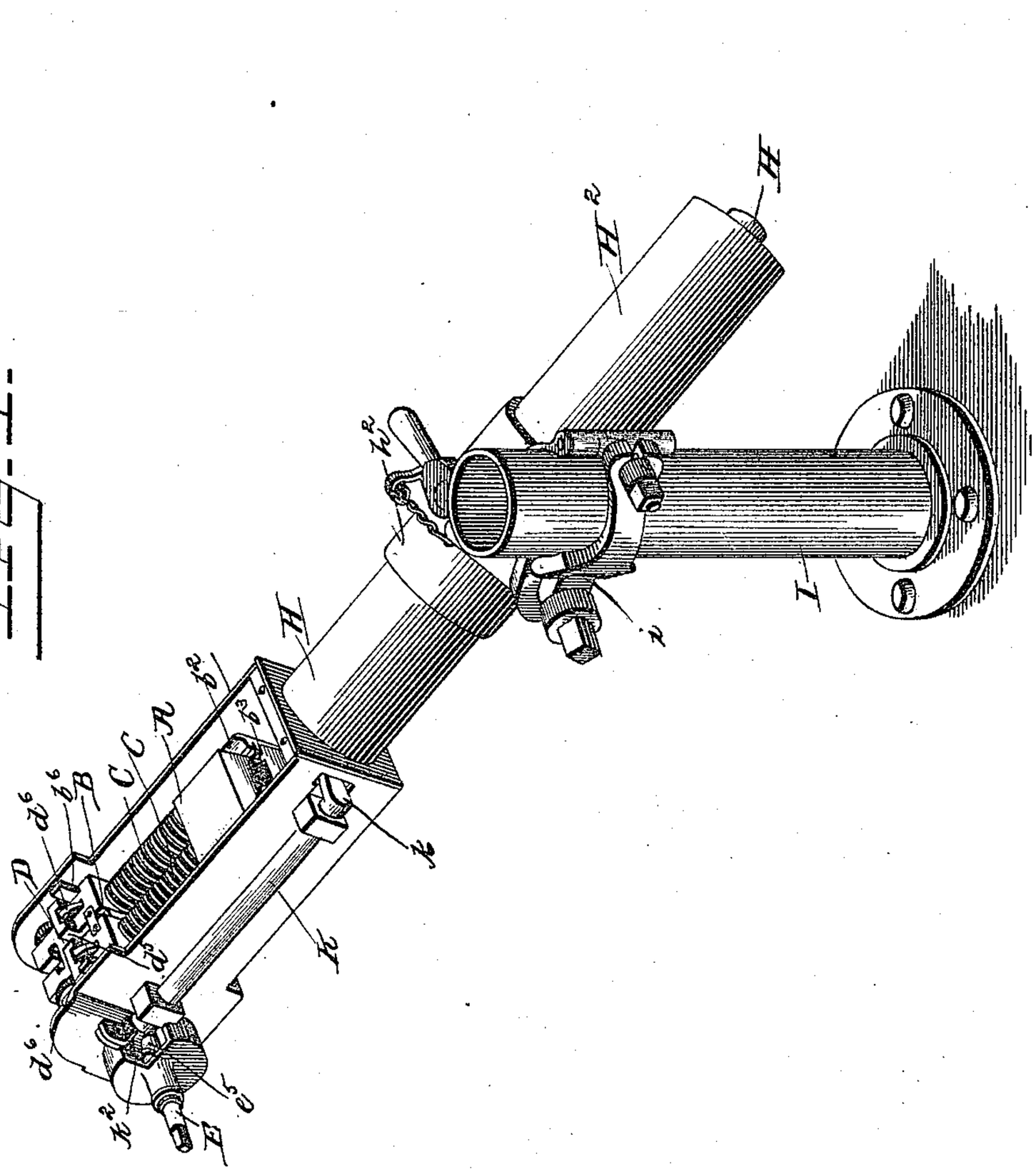
(No Model.) 10 Sheets—Sheet 1.

E. MOREAU.

ROCK DRILLING MACHINE.

No. 440,745. Patented Nov. 18, 1890.

Fig. 1.



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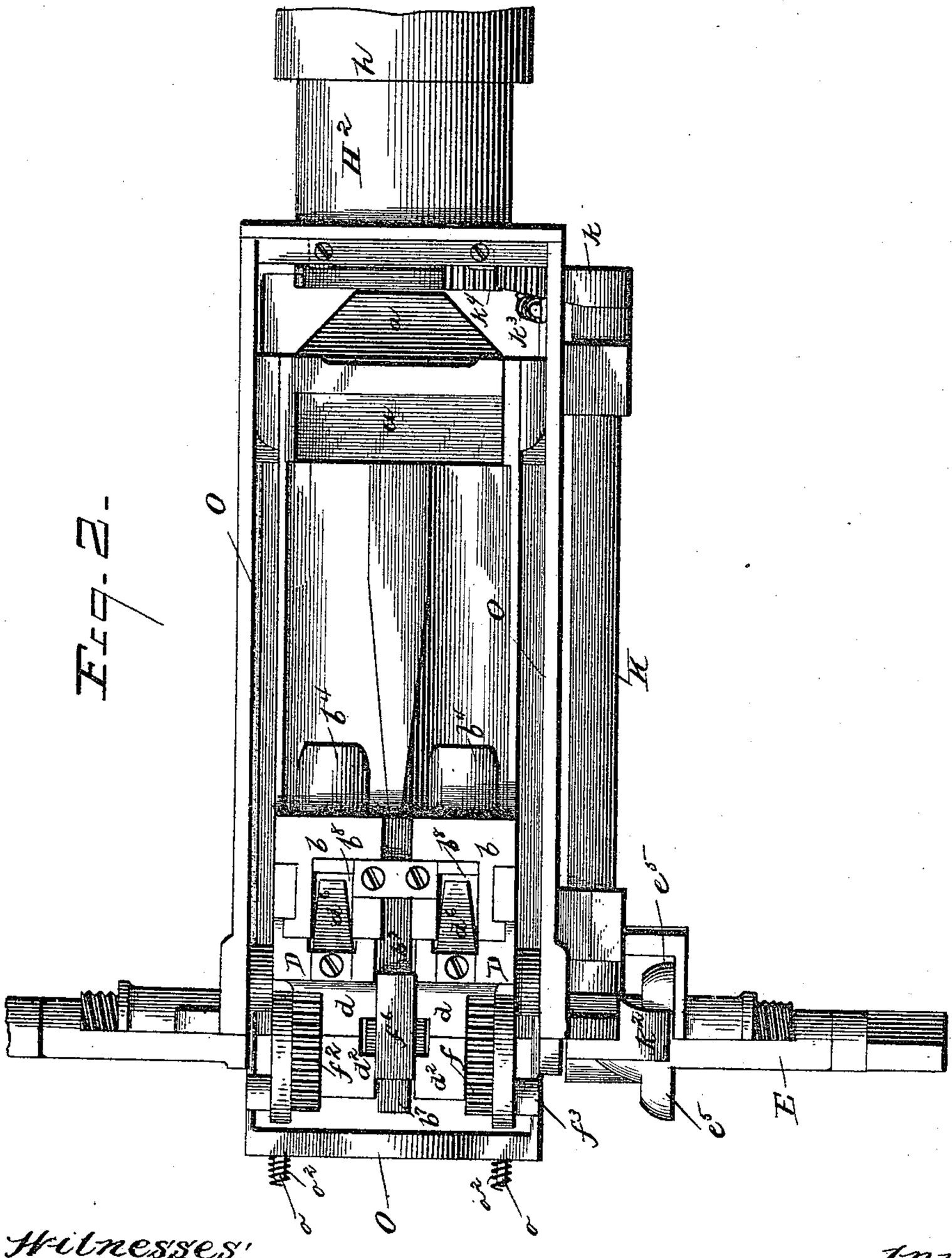
(No Model.) 10 Sheets—Sheet 2.

E. MOREAU.

ROCK DRILLING MACHINE.

No. 440,745. Patented Nov. 18, 1890.



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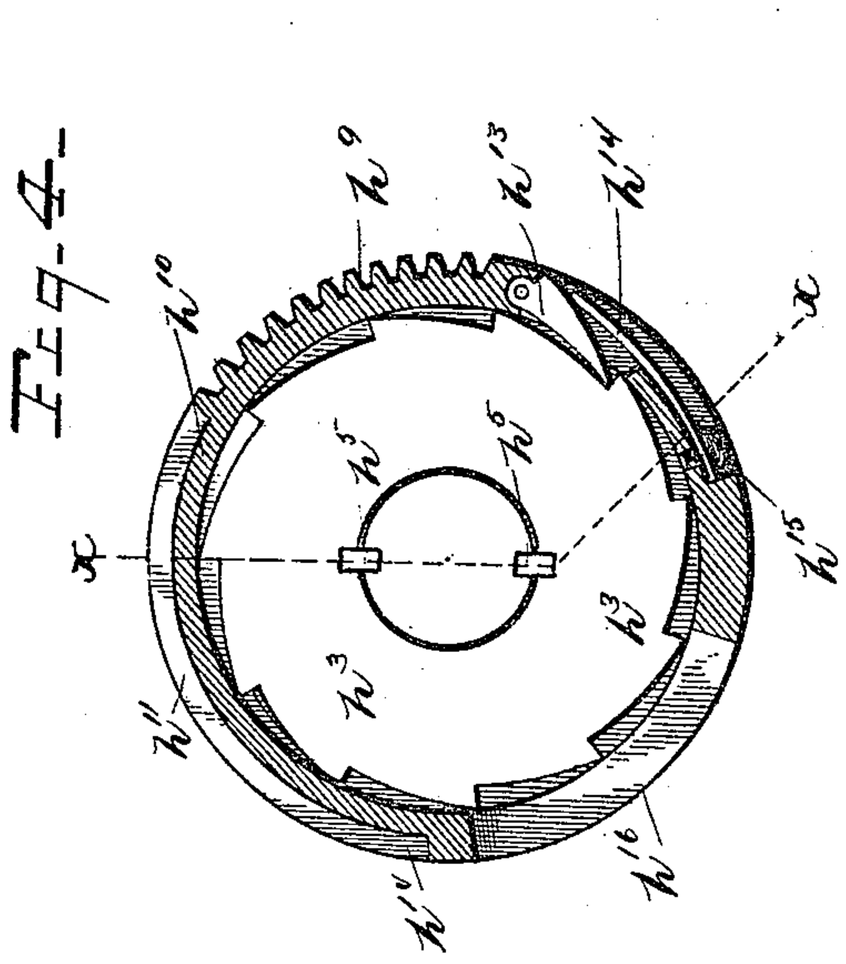
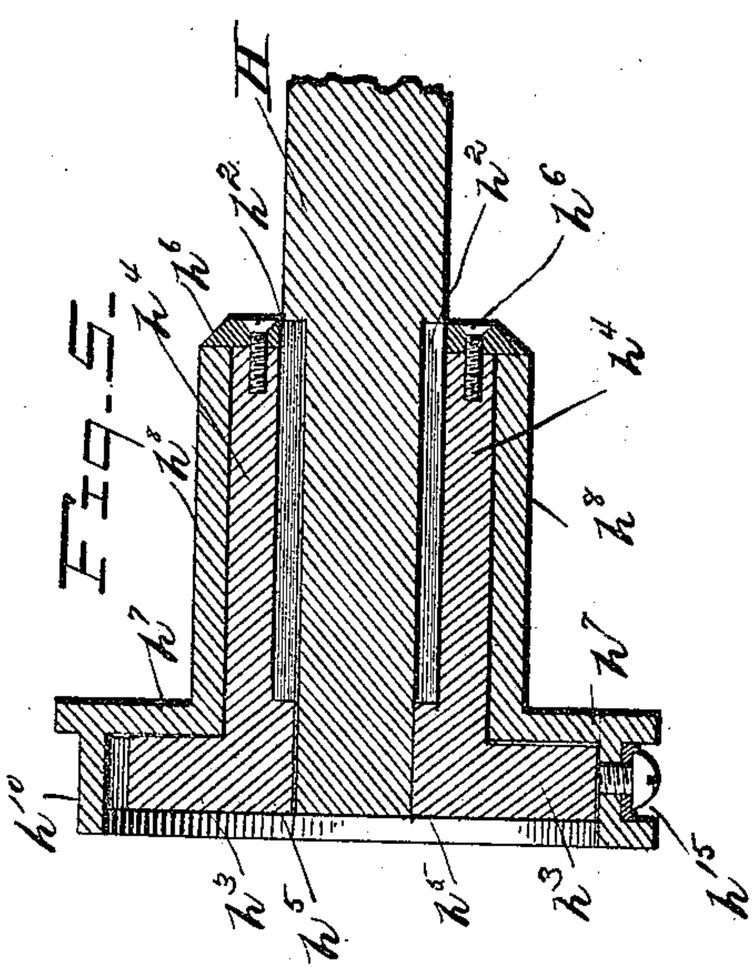
10 Sheets—Sheet 3.

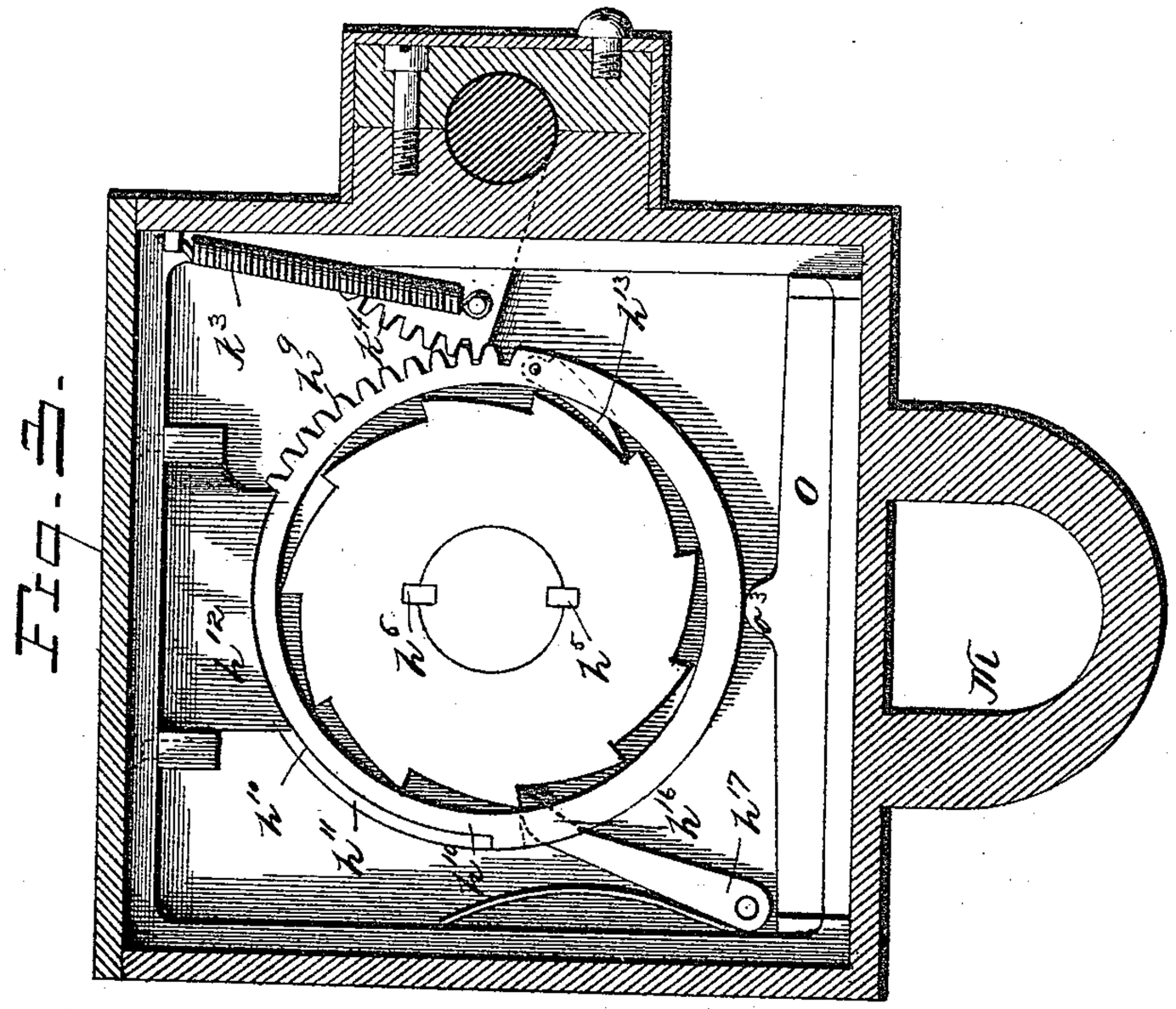
E. MOREAU.

ROCK DRILLING MACHINE.

No. 440,745. Patented Nov. 18, 1890.







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(No Model.) 10 Sheets—Sheet 4.

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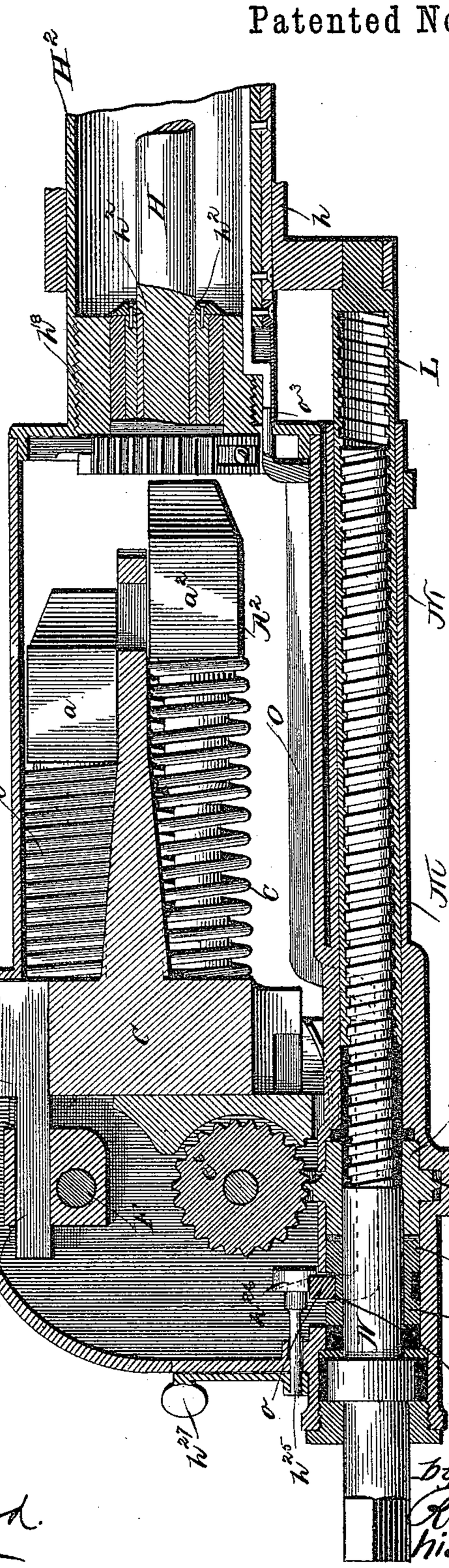
ROCK DRILLING MACHINE.

No. 440,745. Patented Nov. 18, 1890.

Fig. 6.



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ROCK DRILLING MACHINE.

No. 440,745. Patented Nov. 18, 1890.

Fig. 7.

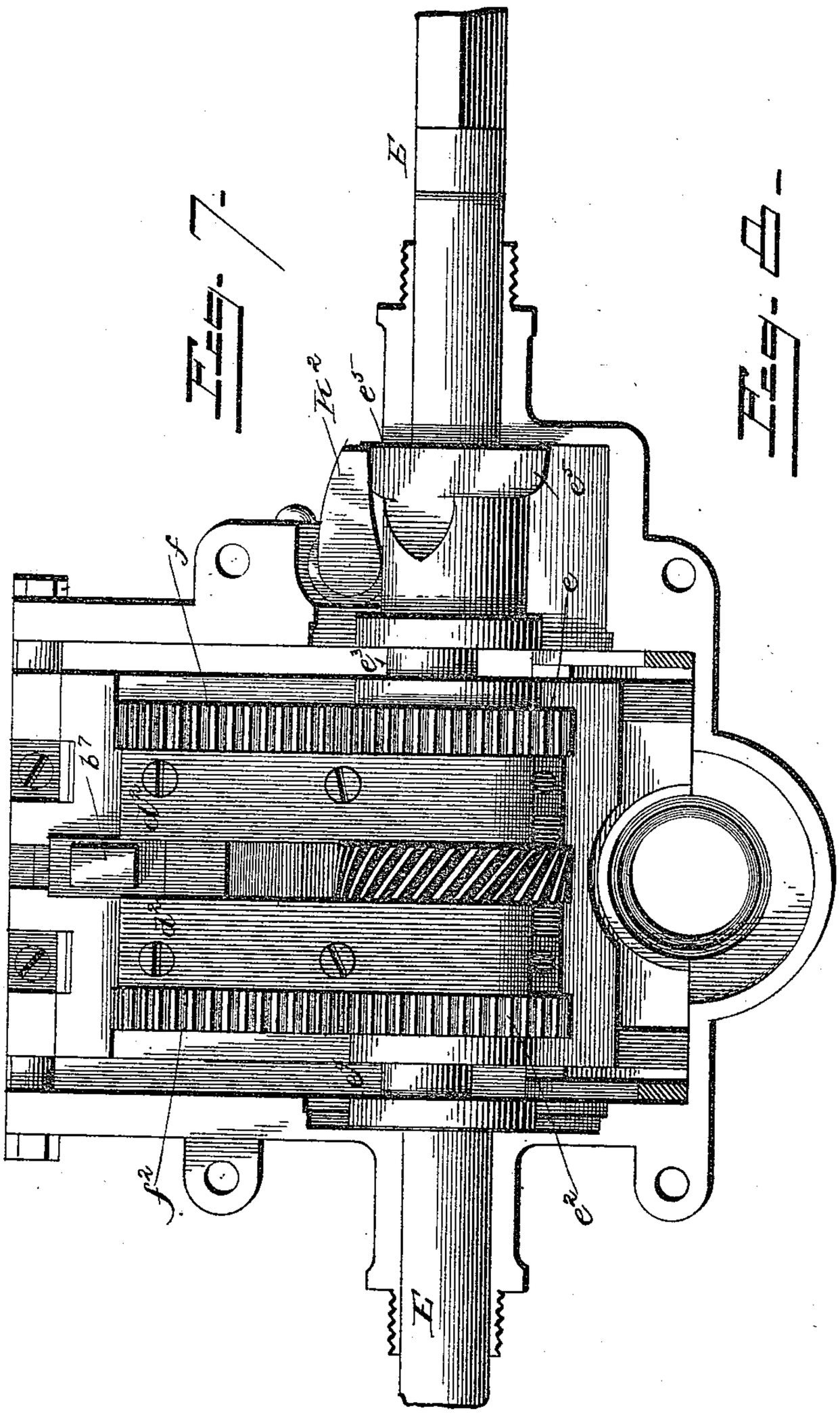
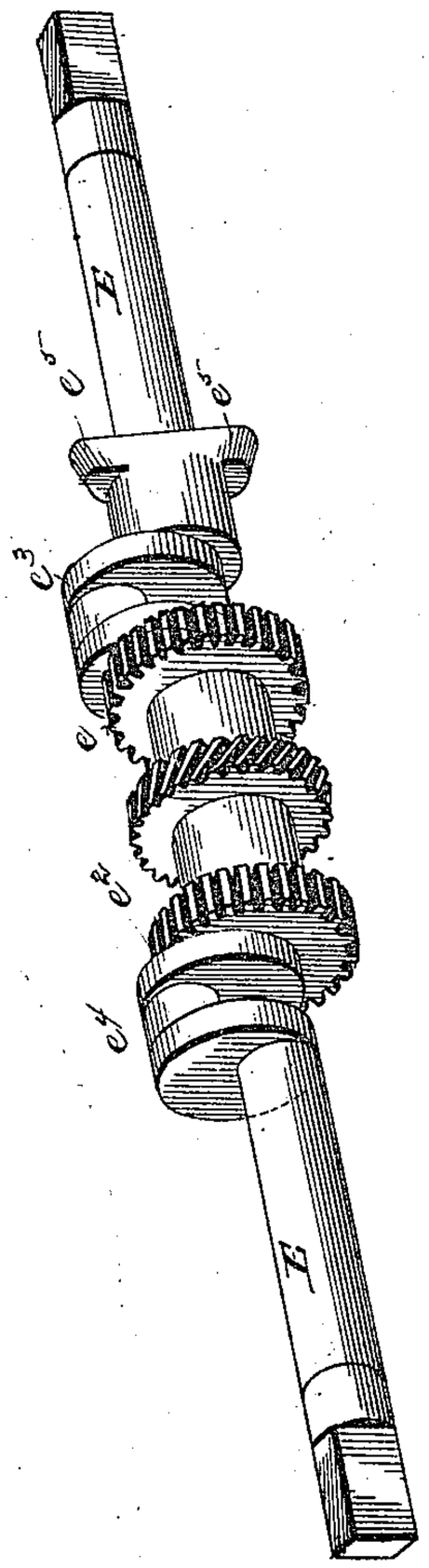


Fig. 8.



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ROCK DRILLING MACHINE.

No. 440,745. Patented Nov. 18, 1890.

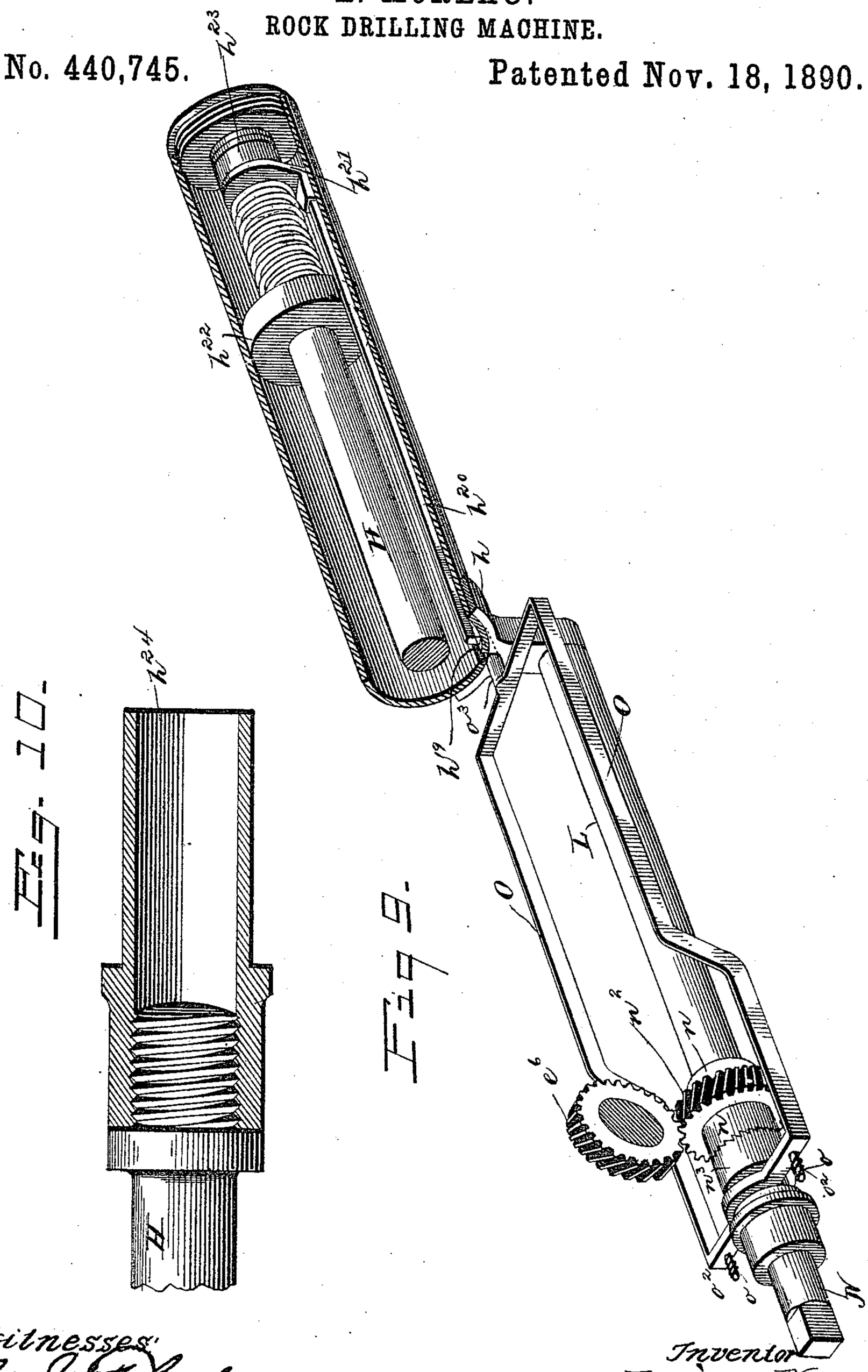

FIG. 9.

FIG. 10.

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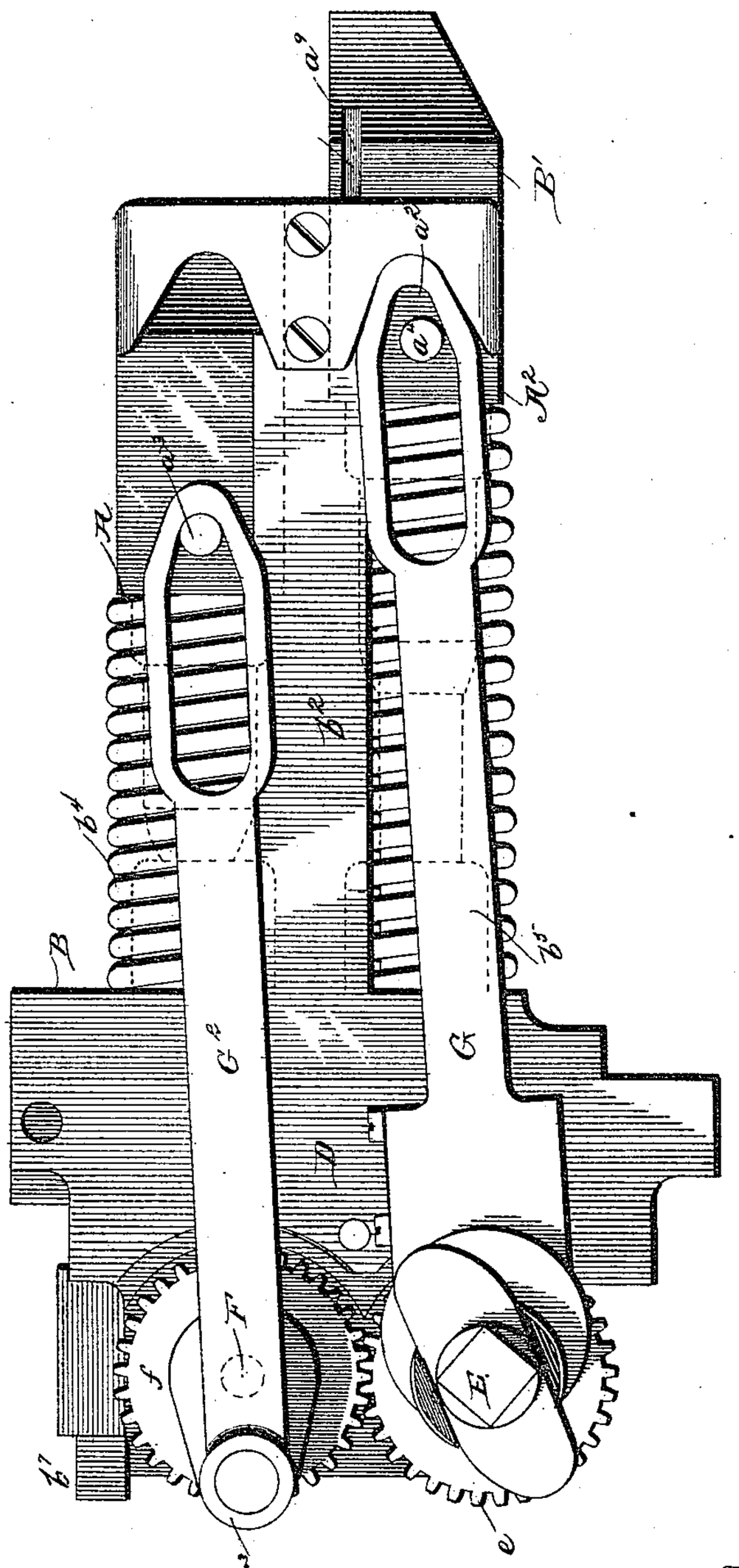
ROCK DRILLING MACHINE.

No. 440,745. Patented Nov. 18, 1890.

Fig. 11.



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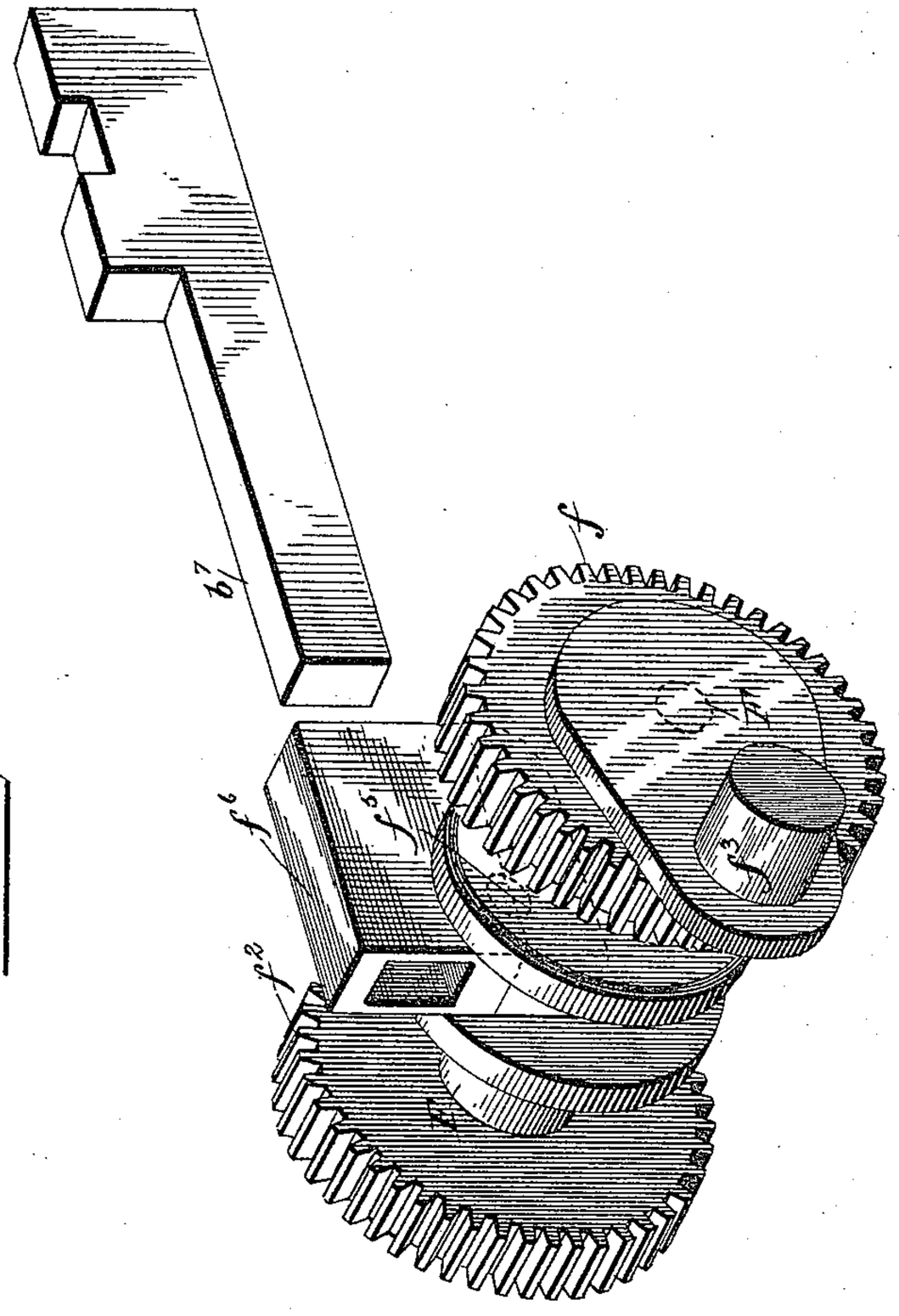
ROCK DRILLING MACHINE.

No. 440,745. Patented Nov. 18, 1890.

Fig. 12.



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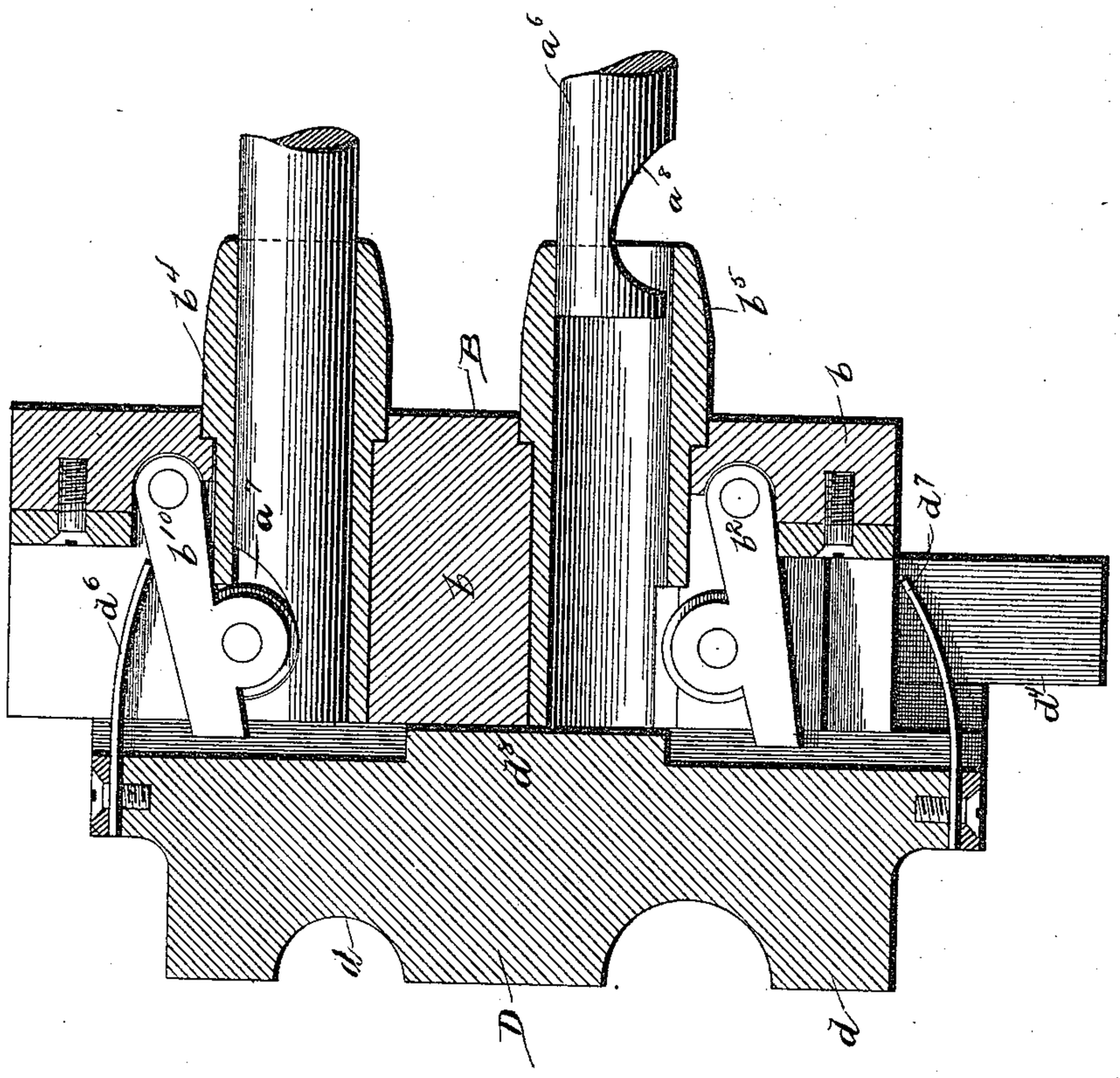
(No Model.) 10 Sheets—Sheet 9.

E. MOREAU.

ROCK DRILLING MACHINE.

No. 440,745. Patented Nov. 18, 1890.

FIG. 13.



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(No Model.) 10 Sheets—Sheet 10.

E. MOREAU.

ROCK DRILLING MACHINE.

No. 440,745. Patented Nov. 18, 1890.

Fig. 13.

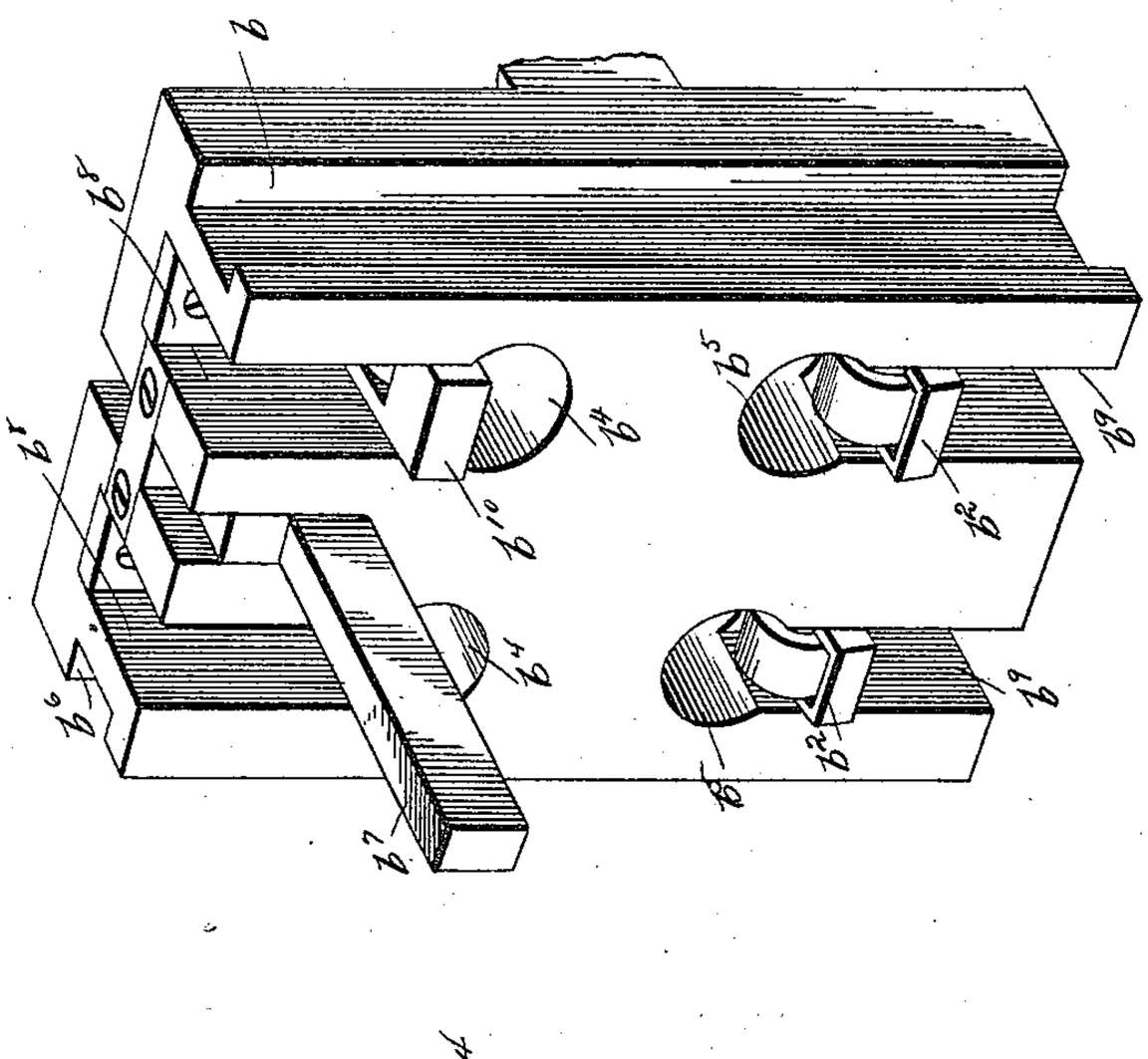
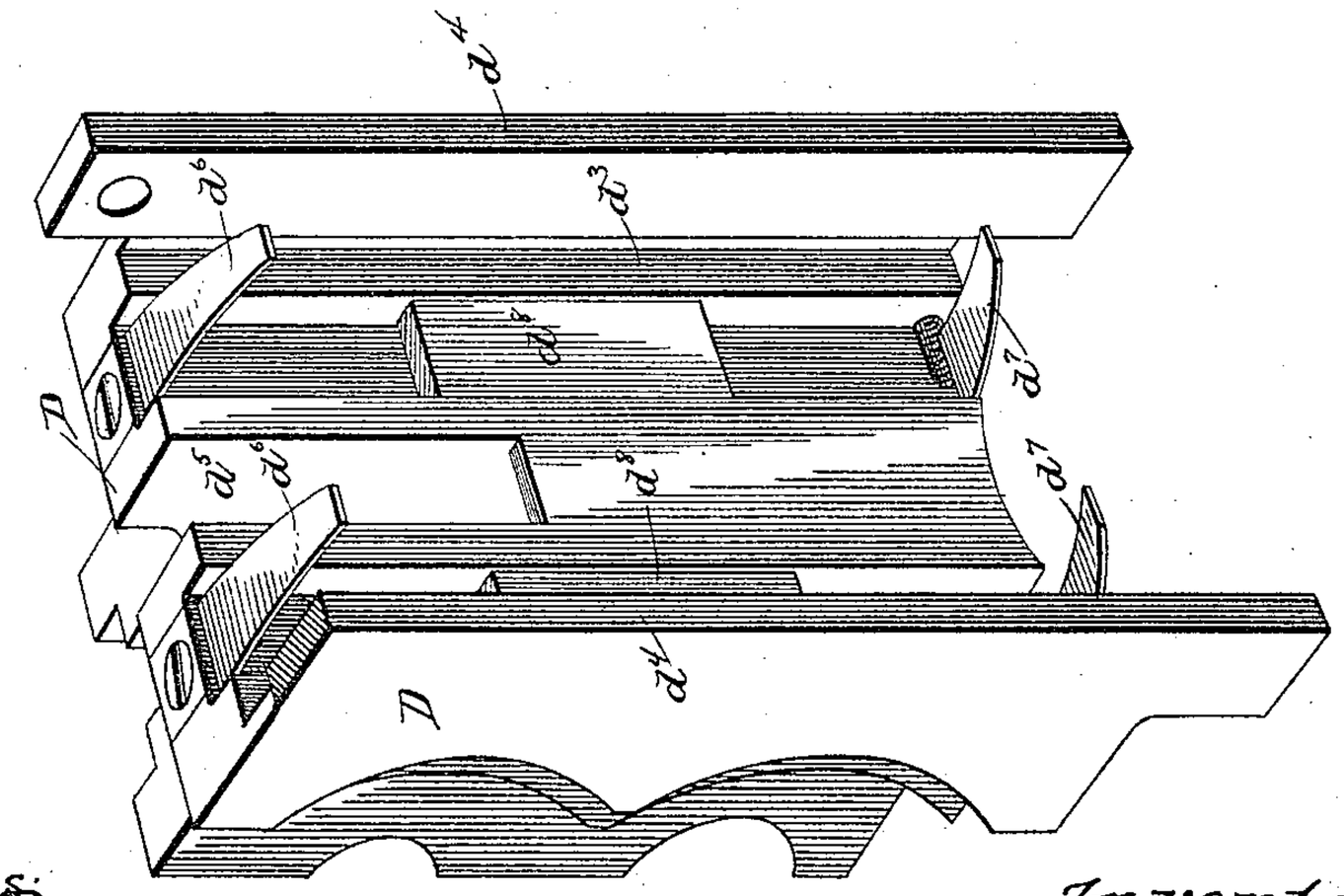


Fig. 14.



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UNITED STATES PATENT OFFICE.

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ROCK-DRILLING MACHINE.

SPECIFICATION forming part of Letters Patent No. 440,745, dated November 18, 1890.

Application filed March 19, 1890. Serial No. 344,473. (No model.)

To all whom it may concern:

Be it known that I, EUGÈNE MOREAU, a citizen of France, residing at Philadelphia, in the county of Philadelphia and State of Pennsylvania, have invented certain new and useful Improvements in Rock-Drilling Machines; and I do hereby 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.

This invention relates to rock-drilling machines, and particularly to that class in which blows are struck upon the drill-tool or a part holding it and in which the drill-tool is rotated between the blows.

The object is to provide a rock-drilling machine which shall be compact, comparatively light, and simple and inexpensive of construction, capable of operation with expenditure of a minimum amount of power, and capable of being rapidly and conveniently manipulated to bring it into any desirable position for use; furthermore, to accomplish the rotation of the tool or part holding the tool in a simple and efficient manner; furthermore, to accomplish forward feed of the machine automatically, and, finally, to accomplish the forward feed automatically, but cause the forward movement to be checked automatically should the advance be proportionately too rapid.

With these objects in view the invention consists in the combination, with a drill and the operating mechanism of a striking device therefor, of means connected with the operating mechanism which will cause a partial rotation of the drill-tool between blows; furthermore, in the combination, with a drill and the operating mechanism of the striking device therefor, of means connected with the operating mechanism acting automatically to accomplish forward feed of the machine, and, finally, in the combination, with a drill and the operating mechanism of a striking device therefor, of means connected with the operating mechanism for accomplishing the forward feed of the machine automatically and for checking the advance automatically when this becomes too rapid.

The striking device, consisting of two hammers adapted to reciprocate in the direction of impact and to be reciprocated to and from the line thereof, is no part of the present application, but forms the subject-matter of another filed of even date herewith, Serial No. 344,472.

The present invention is capable of use with various striking mechanisms.

In the accompanying drawings, forming part of this specification, and in which like letters of reference indicate like parts, Figure 1 is a view in perspective representing a drilling-machine, the drill-shaft being in a tube supported on a standard by collar and sleeve which permit the drill to be tilted up and down and turned or shifted around, and also to be moved longitudinally or to slide, the striking mechanism to which this rock-drilling mechanism is here, for mere illustration of a mode of use, shown attached being in a housing (the cover of which is removed) projecting backward from the tube of the drill, the view showing the end of the drill-shaft, the tube, the sleeve, the standard, and its collar, and also a rock-shaft outside of the housing of the striking mechanism, this rock-shaft having an arm at one end projecting laterally into the housing and toothed at its end, as shown in Figs. 2 and 3, to mesh with a segmental gear loose at the upper part of the drill-shaft, as shown in Figs. 2, 3, 4, and 6, and having a lateral extension at its other end taken under by a cam on the main shaft of the striking mechanism, as seen more fully in Figs. 2 and 7, a boxing over the main shaft being cut away to show the extension from the rock-shaft of the drill and the cam on the shaft of the striking mechanism, the striking device, to which the drill is here applied, having its hammers so arranged in connection with the driving-shaft that upon rotation of the driving-shaft actuating the rock-shaft the drill tool or shaft in which it is fixed will be given a partial rotation between the blows, the striking device here being one with two hammers arranged one above the other, there being seen the upper hammer with two stems and two actuating-springs—one on each stem—part of two portions—a forward projecting portion and a rear or upright portion—of a movable frame in which the hammers are mounted, one of

two longitudinal tongues or guide-ribs for each hammer on the forward-projecting portion of this frame employed with grooves in the hammers to steady the hammers and hold them in proper position against individual displacement to or from the line of stroke and the place of one of two upright grooves—one at each side of the rear or upright portion of this movable frame—as shown in detail in Fig. 15, to take upon upright guide-bars on a stationary frame or a block having a recess or jaw, as more fully shown in Fig. 14, to receive the movable frame, and provided with upright guide-bars extending inward, upon which the movable frame slides by the grooves in its sides, upper pawl springs to operate in connection with locking-levers or roller-pawls, as shown in Fig. 13, and a cleft in the block from above downward to receive an arm fixed to and projecting backward from the movable frame, as shown in Figs. 6 and 15, into a box on a crank or crank-bend on a second shaft, as shown in Figs. 2, 6, 7, 8, and 12, by which the movable frame is actuated to reciprocate from the crank or crank-bend on the second shaft by means of the box; also, the main shaft, and, finally, a second shaft above the main shaft with gear-wheels. Fig. 2 is a top plan view representing the operation of the means for rotating the drill-shaft and part of the means for accomplishing automatically feed forward of the drill and automatic arrest thereof, the cover of the striking mechanism being off, the stems of the upper hammer and the actuating-springs removed, and the end of the drill-tube broken off, showing part of the tube and its sleeve, the rock-shaft outside of the housing of the striking mechanism, the crank-arm at one end projecting laterally into the housing and toothed at its end meshing with the segmental gear loose at the upper end of the drill-shaft, a spring attached to the crank-arm and the housing to throw the crank-arm and the segmental gear back, as more fully shown in Fig. 3, after it has been moved down by the turning of the rock-shaft from its extension by the cam on the main shaft, and a lateral extension at the other end of the rock-shaft taken under by the cam on the main shaft of the striking mechanism, showing, also, part of a longitudinally-movable connecting-frame, (seen fully in Fig. 9,) through which means actuated from the operating mechanism and acting to accomplish forward feed of the machine are automatically disconnected from or connected with the drill-tool, or are disconnected or connected by hand, the connecting-frame having a pin at the front end set into a well or hole in the drill-casing, as shown fully in Fig. 9, pins at the other end to enter wells or holes in the casing, these pins being surrounded by springs bearing against the connecting-frame and the housing to keep the frame normally pushed forward of the striking mechanism, there appearing the head of one hammer, part of the two portions of the movable frame in which the hammers are mounted, an upper set of tubes set in the upright portion and into which the stems of the hammers slide, the place of the grooves in the rear or upright portion, which grooves take upon upright guide-bars on the stationary frame or block, the top of the stationary frame or block, into a recess of which the upright portion of the movable frame is set, the upright guide-bars extending inward, and upon which the grooves in the stationary frame take, the upper pawl-springs to operate in connection with the locking-levers or roller-pawls, as shown in Fig. 13, the situation of the cleft in the block from above downward, the arm fixed to and projecting backward from the movable frame through this cleft into a box on a crank or crank-bend on a second shaft, as shown in Figs. 6 and 12, by which the movable frame is actuated to reciprocate, gear-wheels and cranks on the second shaft to operate with links to draw back the upper hammer, as shown in Fig. 11, and, finally, the main shaft and studs bracing the stationary frame in the housing. Fig. 3 is a view in elevation looking at and into the housing of the striking mechanism between the end of the forward-projecting portion of the movable frame and the upper end of the drill-shaft, with the housing, the rock-shaft, and a tube at the under part of the housing for containing a feed-screw and an interiorly-screw-threaded tube, as shown in Fig. 6 in section, the view representing in detail the means from the shaft-rock of giving a partial rotation to the drill-shaft between the blows of the hammers, showing the rock-shaft, its crank-arm projecting into the housing, having the spring to throw it up and toothed at its end meshing with the segmental gear, being a number of spur-teeth on the rim of the enlarged end or head of a gear-shell loose upon a ratchet-shell, as seen in Fig. 5, on the upper end of the drill-shaft, this gear-shell having, furthermore, the front part of a portion of its rim or circumference of its head cut away, leaving a flange at the back for a hanger or depending plate to take against to hold the shell against displacement inward, showing, also, the hanger or plate depending from the end of the housing, the flange of the wheel being set behind it, the head or face or wheel of the ratchet-shell, (shown in Fig. 5,) which shell is held upon the upper end of the drill-shaft by short feathers projecting toward the center from the head, taking into long grooves in the drill-shaft, as seen in Fig. 5, causing the ratchet-shell to turn within the shaft, but leaving the shaft free to move longitudinally independently of the ratchet-shell—that is, to slide in it—a ratchet or feed pawl projecting toward the center from the gear-shell head and pushed by a spring, as shown in Fig. 4, taking against a tooth of the ratchet-wheel, and showing, finally, a stop-pawl with its spring, this pawl being pivoted to the cas-

ing and taking through a slot (shown fully in Fig. 4) in the rim of the head of the gear-shell against a tooth of the ratchet-wheel to prevent the ratchet-shell from turning backward. Fig. 4 is a view partly in section and partly in elevation, being a vertical central longitudinal section through the head of the gear-shell, having its ratchet or feed pawl and spring and the ratchet-shell on the end of the drill-shaft in front elevation, showing particularly, the spring to the feed-pawl secured in a countersink on the rim, the slot through which the stop-pawl passes, and the flange. Fig. 5 is a view in vertical and diagonal or angular longitudinal section, taken on the line *x x* of Fig. 4, showing the drill-shaft having surface-grooves into which the splines or feathers of the ratchet-wheel are set for a short distance to hold the wheel on the shaft against turning independently thereof, but leaving the shaft free to slide or be pushed back, showing, furthermore, the ratchet-shell with head and body, the head having the feathers or splines and the body a cleat at its end to take against the body of the gear-shell to hold the ratchet against displacement inward; furthermore, the gear-shell with head and body, the head having the countersink for securement of the feed-pawl spring, the spring being in place, and showing, finally, the flange. Fig. 6 is a view in vertical longitudinal section, taken through the rock-drilling mechanism and through the housing of the striking mechanism attached thereto, the end of the rock-drilling mechanism being broken away, leaving in elevation, segmental of the drill-shaft, the part gear-wheel with depending plate to hold it against displacement inward, the feed-screw for the drill, a rod in the casing of the drill-tool attached at its outer or lower end to the drill-shaft by means of a projection therefrom to be moved longitudinally thereby, as shown in Fig. 9, a part of the front pin from the longitudinally-movable connecting-frame, part of this connecting-frame and a cam-shaft with cam to enable the shaft to be pulled back by hand; furthermore, leaving in elevation of the striking mechanism the hammers to display their shape, their springs, the stem appearing of the lower one, and its tube, (more fully seen in Fig. 13,) the view representing the means for producing forward feed of the machine and parts of the means for automatically arresting the feed in conformity with the work to be performed, showing part of the drill-shaft, its upper end with the grooves, the body of the ratchet-shell with its cleats, the body of the gear-shell, and a sleeve screwed into the end of the housing for sustaining the shaft and shells; furthermore, the tube and its sleeve, an internally-screw-threaded tube fixed thereto, a tube in the lower part of the housing of the striking mechanism which the first tube enters and in which it is free to slide, and a screw-threaded shaft entering the screw-threaded tube, this shaft being free to turn in the housing, but being fixed therein against longitudinal motion, whereby upon turning the shaft in one direction or the other the machine will be advanced or retired on its standard; showing, furthermore, a skew gear-wheel (seen fully in Fig. 9) fixed upon a collar loose upon the screw-shaft in connection with a collar behind it turning with the screw-shaft by means of a spline and groove, but free to move on the shaft longitudinally, as more fully shown in Fig. 9, and also a skew gear-wheel on the main shaft, as more fully seen in Figs. 7, 8, and 9, from which the skew gear-wheel on the loose collar on the screw-shaft is turned, and by which, when it is connected with the spline-collar behind it, as more fully shown in Fig. 9, the shaft will be turned, but which will turn idle when it is not connected with or attached to the spline-collar; showing, also, part of the longitudinally-movable connecting-frame with its front pin projecting through the front of the housing into the tube of the drill, the rear cross-piece of the frame taking into a groove in the spline-collar behind the skew gear-wheel on the screw-shaft, whereby when the frame is moved backward the spline-collar will be moved backward out of engagement with the loose collar or collar of the skew gear-wheel, letting this gear-wheel turn idly on the screw-shaft and the screw-shaft be stopped, stopping the feed, and when the frame is pushed forward by the springs (seen in Fig. 2) the spline-collar will be thrown into engagement with the loose collar on the skew gear-wheel, causing the screw-shaft to be turned therefrom, actuating the feed; showing, also, part of a rod in the casing of the drill-tool, which rod at its upper end abuts against the front pin of the connecting-frame and at its lower or outer end is attached to the drill-shaft by means of a projection therefrom to be moved longitudinally thereby, as shown in Fig. 9, pushing the drill backward against a spring, (not shown, but seen in Fig. 9,) as by excessive resistance, thus stopping the feed automatically; also showing a small shaft with a cam on its inner end taking over the rear cross-piece of the frame and a handle to actuate it, whereby the frame may be pulled back by hand to stop the feed, and showing, also, the segmental gear-wheel with flange, countersink, and pawl-spring screw therein, and the depending plate against the flange holding the wheel against displacement of the striking mechanism, there appearing the upper and lower hammers and one each of their actuating-springs, the upper hammer being drawn back and the lower one extended, having just delivered its blow, a stem of the lower hammer and one of the tubes fixed in the movable frame, into which tubes the stems of the hammers are received and in which they slide, as shown fully in Fig. 13, the movable frame in which the hammers are mounted, its arm in position, and part of one of the recesses for the lock-

ing-levers or roller-pawls with a lower pawl-spring, as shown fully in Figs. 13 and 15, and, finally, showing the stationary frame or block with the lower part of one of the upright guide-bars, the main shaft, and the second shaft carrying the box, the free end of the arm extending into the box, whereby the movable frame is reciprocated from this second shaft. Fig. 7 is a view in elevation, the end of the housing being removed to display the parts representing the rear of the striking mechanism, with means from the operating mechanism thereof of actuating the feed of the machine and rotating the drill, showing upon the main shaft a skew gear-wheel (seen again in Fig. 8) for meshing with and driving the skew gear-wheel upon the loose collar on the screw-shaft employed to advance or retire the drill on the standard, as seen in Fig. 9; showing, also, the cam on the main shaft and the end of the rock-shaft with its lateral extension, and, finally, the opening in the lower part of the housing for the screw-shaft of the striking mechanism, there appearing part of the stationary frame, being upright strips or pieces confining the shafts at their bearings in the frame, the common main shaft with its gear-wheels for driving the striking mechanism, between which is the skew gear-wheel for actuating the feed, and a second shaft with its gear-wheels, the gear-wheels on the second shaft intermeshing in pairs, the box on the second shaft with the arm from the movable frame projecting through it, and, finally, the sides and bottom of the housing with attachments for the rear plate. Fig. 8 is a view in perspective representing the main driving-shaft with means for actuating the feed of the machine and the rotation of the drill, showing the skew gear-wheel and the cam, there appearing also the gear-wheels for driving the striking mechanism and crank-bends to connect through links with pins on the head of the lower hammer to draw the hammer back against its spring or springs, as fully shown in Fig. 11. Fig. 9 is a view in perspective with a portion of the drill-tube removed to display parts therein and the drill-shaft and tube being cut off outside of or beyond the situation of the shells, representing in detail the means for automatically causing and for automatically arresting the feed of the machine on its standard, showing the tube and its sleeve, the outside of the internally-screw-threaded tube fixed to a bracket on the sleeve, the rear end of the screw-threaded shaft which enters the screw-threaded tube, the skew gear-wheel fixed upon a collar loose upon the screw-shaft, a collar behind it having a groove which takes upon a spline on the screw-shaft, so that it turns with the screw-shaft, but is free to move on the shaft longitudinally, the two collars being provided with teeth on their adjacent edges, forming a clutch, the skew gear-wheel on the main shaft set at an angle to and meshing with its fellow on the screw-shaft, the longitudinally-movable connecting-frame with its front pin projecting through the front of the housing into the tube of the drill and with rear pins provided with springs, the rear cross-piece of the frame taking into a groove in the spline-collar behind the skew gear-wheel on the screw-shaft, whereby when the frame is moved backward the spline-collar will be moved backward out of engagement with the loose collar or collar of the skew gear-wheel on the feed-shaft, letting this gear-wheel turn idly on the feed-shaft and the screw-shaft be stopped, stopping the feed, and when the frame is pushed forward by the springs the spline-collar will be thrown into engagement with the loose collar on the skew gear-wheel, causing the screw-shaft to be turned therefrom, actuating the feed; showing, also, part of the drill-shaft with a projection at its lower end, the rod in the casing of the drill-tool abutting at its upper end against the front pin of the connecting-frame and at its lower or outer end attached to the drill-shaft by means of the projection therefrom to be moved longitudinally thereby, a disk fixed in the tube, but free on the drill-shaft, a spring on the drill-shaft between this disk and the projection, an enlargement or fixed collar on the drill-shaft bearing against the projection, and, finally, an end bearing for the drill-shaft screwed into the tube, pushing the drill backward against the spring, as by excessive resistance, thus stopping the feed automatically. Fig. 10 is a view, partly in elevation and partly in section, showing the end of the drill-shaft with a square socket screwed upon it to receive and hold the drill-tool. Fig. 11 is a view in side elevation, the housing being removed, representing the manner of drawing back the hammers against their springs, showing the hammers with one of the pins on the head of each, and the actuating-springs, the hammer-stems, the tubes, and part of the movable frame being indicated by dotted lines, one of the grooves in the hammers employed with the longitudinal tongues or guide-ribs on the frame to steady the hammers and hold them in proper position against individual displacement to or from the line of stroke, part of the movable frame, part of the stationary frame or the block, the end of the main shaft in full lines, and in dotted line the end of the second shaft; furthermore, the gear-wheels on the shafts, one of the cranks that are on the ends of the second shaft, and (of the links connecting the cranks with the hammer-heads by the pins) the links on this side, the position of the links being such that while the crank on the second shaft is back, having drawn the hammers backward against its spring or springs, to be held by mechanism not seen, but shown in Fig. 13, the crank on the lower shaft will be forward, and vice versa—that is to say, the two shafts being so geared that their cranks will be held, re-

spectively, in positions relatively diametrically opposite, and each link having an opening of sufficient length to permit its hammer to deliver full stroke upon being released, there also appearing in this figure the cam on the main shaft. Fig. 12 is a view in perspective representing in detail the means of moving the arm up and down to reciprocate the movable frame, showing the second shaft with the box (seen in Figs. 2 and 7) on a crank in the length of the shaft and the arm belonging to the movable frame, with a groove and projections for its securement; showing, also, the gear-wheels of the second shaft and a crank for attachment of a link. Fig. 13 is a view in vertical longitudinal section, taken through the fore part of the stationary frame and the rear portion of the movable frame in the line of a stem each for the upper and lower hammers, leaving the stems (broken away toward the hammers) in elevation, as well as locking-levers or roller-pawls, pawl-springs, and a guide-bar, the casing being removed to display the parts, showing a stem of each hammer provided with a notch for receiving a roller of a locking-lever or roller-pawl, part of the movable frame carrying the tubes in which the stems slide, and the locking-levers or roller-pawls, and part of the stationary frame with the pawl-springs, a stop for the locking-levers of roller-pawls to strike to be released from the notches in their respective stems, and an upright guide-bar. Fig. 14 is a view in perspective representing the greater portion of the stationary frame on the block, in a front recess or jaw of which the movable frame carrying the hammers slides, showing the recess or jaw provided with upright guide-bars extending inward for taking into the grooves in the sides of the movable frame, the upper and lower pawl-springs to operate in connection with the locking-levers or roller-pawls, the stops for the locking-levers to strike to release the hammers, the cleft from above downward to receive the arm fixed to and projecting backward from the movable frame through this block into the box on a crank on the second shaft, and depressions at the back of the frame to form portions of the bearings of the main and second shafts; and Fig. 15 is a view in perspective representing the greater portion of the movable frame in which the hammers are mounted, showing the recesses from above downward and from below upward rounded within and holding the back ends of the tubes into which the stems slide, the recesses having the locking-levers or roller-pawls in position, (the locking-levers or roller-pawls being seen in three of these recesses,) and upright grooves at the sides to take upon the guide-bars on the stationary frame and the arm in position in the frame by which the frame is actuated.

In the drawings, H represents the drill-shaft in a tube H^2, supported on a standard I by a sleeve h and collar i, which permit the drill to be moved longitudinally or to slide on the standard and also to be tilted up and down and turned or shifted around. At its upper end the drill-shaft is provided at its surface with longitudinal grooves h^2, and upon this end is a shell which I call the "ratchet-shell," consisting of a head portion h^3, provided circumferentially with ratchet-teeth and a body portion h^4, the shell being secured upon the shaft in such manner as to turn with it, but yet to slide thereon—that is, allow the shaft to be moved longitudinally without moving the shell—the securement being by short feathers or splines h^5, which project from the head portion toward the center into the grooves in the shaft, the feathers filling the grooves in width, but not filling them in length. Upon the end of its body portion the ratchet-shell is provided with a cleat h^6, taking against the end of the body of an outer shell, for a purpose presently to be explained. Surrounding the ratchet-shell and turning loosely thereon is this outer shell, which I call the "gear-shell," having a head portion h^7 and a body portion h^8, the head portion being provided at a part of its circumference with spur-teeth h^9 and being cut away at the front portion at another part h^{10} of its circumference, leaving a flange h^{11} at the back for a hanger or plate h^{12}, depending from the housing of the striking mechanism, to take against to hold the shell against displacement inward. The gear-shell has a feed-pawl h^{13} set through an opening in the rim and projecting toward the center, and this pawl takes against one of the ratchet-teeth on the head of the ratchet-shell, the pawl being held in engagement by a spring h^{14}, set in a countersink h^{15} in the rim. At a portion of the circumference opposite the teeth the rim of the head of the ratchet-shell has an opening or slot h^{16}, through which takes a stop-pawl h^{17} against a ratchet-tooth, the stop-pawl being pivoted to the housing and having a suitable spring. It will now be clear that as the depending plate prevents the gear-wheel from being displaced inward and as the cleat on the body of the ratchet-shell bears against the end of the body of the gear-shell this cleat serves to keep the ratchet-shell also from displacement inward. The upper end of the shaft and the shells are set and turn in a sleeve h^{18}, screwed into the upper end of the tube.

Mounted laterally outside the housing of the striking apparatus is a rock-shaft K, having a crank-arm k projecting into the housing and provided with a spring k^3, fixed at one end to the housing and at the other end to this arm to throw the arm up, the arm having teeth k^4 at its end meshing with a segmental gear, being the spur-teeth h^9 on the rim of the head of the gear-shell. At the other end the rock-shaft has a lateral extension k^2, which is taken under by a cam e^5 on the main shaft E of the machine. It will be obvious that as the main shaft revolves the cam coming under the extension at the rock-

shaft will move this, causing from its arm a partial rotation downward of the gear-shell, by the feed-pawl of which the ratchet-shell will be turned to the extent of one tooth, giving this extent of the turn to the drill-shaft, while as soon as the cam escapes from under the lateral extension of the rock-shaft the spring on the crank-arm will throw the arm up, giving a partial rotation to the gear-shell in the opposite direction, thus bringing its pawl into engagement with a higher tooth, the stop-pawl acting to retain the ratchet-shell in position while the feed-pawl is out of contact with a tooth. The position of the cam upon the drilling-shaft is such with relation to the actuating mechanism of the striking device and its operation so timed with relation to the operation of the hammers that the drill-shaft will be given a partial rotation between the blows of the hammers.

To the sleeve h of the tube H^2, preferably to a bracket projecting from the sleeve, is attached an internally-screw-threaded tube L, and this tube enters and is free to slide in another tube M in the lower part of the housing of the striking mechanism, and entering the other end of the screw-threaded tube through the tube in the housing is a screw-shaft N, free to turn in the housing, but fixed therein, as by a collar abutting against an offset in the tube against longitudinal motion, whereby upon turning the shaft in one direction or the other the machine will be advanced or retired on its standard. This screw-shaft has upon it a loose collar n, provided at its rear with teeth, and formed with or fixed to this loose collar is a skew gear-wheel n^2. Behind the collar n is a second collar n^3, provided at its front end with teeth and arranged to turn with the screw-shaft by means of a spline and groove or the like, but free to move on the shaft longitudinally. Upon the main shaft E is another skew gear-wheel e^6, from which the slanting toothed gear-wheel on the loose collar on the screw-shaft is turned, and by which, when it is connected with the spline-collar behind it by the teeth on both, the shaft will be turned, but which will turn idly when it is not connected with or attached to the spine-collar.

In the lower part of the housing is a connecting-frame O, capable of limited longitudinal movement, through which frame the screw-shaft is automatically thrown into action to accomplish forward feed of the machine or automatically stopped to discontinue the feed, the rear cross-piece of the connecting-frame taking into a groove n^4 of the spline-collar, so that the spline-collar can be moved longitudinally on the shaft by the frame. Projecting backward from the frame are pins o, which enter suitable holes in the housing, and upon these pins between the housing and the end of the frame are spiral springs o^2, which tend to push the frame forward. As the frame is pushed forward it carries with it the spline-collar, whereupon the teeth upon its front end catch into the teeth at the rear end of the loose collar carrying the skew gear-wheel, forming a clutch, so that when from the slanting toothed gear-wheel on the main shaft the skew gear-wheel and collar on the screw-shaft are turned the spline-collar will be turned, and by it the shaft; but when the frame is pushed backward it carries back with it the spline-collar, whereupon the teeth upon its front end part from engagement with the teeth at the rear end of the loose collar carrying the skew gear-wheel, uncoupling the clutch, so that when from the skew gear-wheel on the main shaft the skew gear-wheel and the collar on the screw-shaft are turned these will turn idly and the shaft will not be turned.

The connecting-frame has at its front end another pin o^3, which projects into the tube of the drill or into a channel h^{19} along the under side thereof. In the lower part of the tube or in the channel is a rod h^{20}, which abuts against the pin of the frame, the other end being attached by means of a collar h^{21}, surrounding it, to the drill-shaft to be moved longitudinally thereby. Fixed in the tube is a disk h^{22}, through which the shaft passes freely, and outside of the collar the shaft has an enlargement h^{23}, which bears against the collar. Between the collar and the disk the shaft is surrounded by a strong coil-spring, and into the end of the tube is screwed an end bearing for the drill-shaft, the drill-shaft having screwed upon its end a square socket h^{24} to receive and hold the drill-tool.

It will be obvious that when the drill is pushed backward against the spring, as by excessive resistance, which would otherwise result in more rapid feed of the machine than penetration of the drill-tool, the rod will push against the front pin of the frame and the frame will uncouple the clutch, thus stopping the feed automatically.

To arrest the feed by hand there is provided a cam-shaft h^{25}, the cam h^{26} of which takes over the rear cross-piece of the connecting-frame. The shaft is provided with a handle h^{27} outside the housing. By turning the handle, bringing the broader part of the cam against the cross-piece of the frame, the frame will be drawn backward and the clutch uncoupled. Upon turning the handle, bringing the narrow part or edge of the cam against the cross-piece of the frame, the frame will be thrown forward by the springs at the rear and the clutch uncoupled.

Of the striking mechanism, to which the drill is here shown applied, A A^2 designate two hammers having enlarged portions or heads a a^2, provided with pins a^3 a^4, and one or more reduced portions each or stems a^5 a^6, provided with outward-facing rounded notches a^7 a^8 near their ends. The hammers are mounted one above the other, but free to slide independently lengthwise in a movable frame B, consisting of two portions—an upright portion b and a forwardly-extending por-

tion b^2—the extension having at the side of each hammer an inwardly-projecting longitudinal tongue or guide-rib b^3, which takes into a corresponding groove a^9 to steady each hammer and hold it in proper position against individual displacement to or from the line of stroke—that is, in the present embodiment, against displacement up or down, as the hammers in this instance are shown one above the other, though they may be side by side—the movable frame having, furthermore, tubes b^4 b^5 fixed in the front face of the main portion b toward the hammers, and which the ends of the stems of the hammers enter free to slide therein. Upon the stems of the hammers are spiral springs C C^2, which abut at one end against the front face of the movable frame over the tubes and at the other against the enlargements or heads of the hammers, these springs being the hammer-actuating springs. The movable frame has grooves b^6 in the sides of the upright portion to permit the frame to be guided in its movement, and has, furthermore, an arm b^7 fixed in it near its top and projecting backward beyond its rear face, by which arm the frame can be moved, and recesses b^8 b^9 in the rear face, respectively from above downward and from below upward, each recess ending in a rounded opening, into which a tube is set, the recesses containing locking levers or pawls b^{10} b^{11} to engage the notches in the stems of the hammers, as shown in Fig. 13, the levers carrying rollers that enter the notches, in order that upon pressure of the levers outward the pawls may readily slip out of engagement with the hammers and release them to be actuated by the springs, and having their free ends projecting beyond the plane of the rear face of the movable frame to be struck and thrown out of engagement with the notches.

Behind the movable frame is the stationary frame or the block D, consisting of a main portion d and upright strips or pieces d^2, confining the shafts at their bearings in the frame, the main portion d having a recess or jaw d^3, into which the movable frame is set, with its grooves upon guide-bars d^4 and with its arm in a cleft d^5. Projecting into the jaw from the top and bottom of the block are springs d^6 d^7, which, being opposite the recess in the movable frame, are in position to act against the locking-levers as required, the locking-levers being thrown out of engagement with their notches in the hammers by striking against stops d^8. Set into the block at the rear and at its lower part is the main shaft E, having spur gear-wheels e e^2 and cranks or crank-bends e^3 e^4, also a cam e^5, and above the main shaft a second shaft F, with spur gear-wheels f f^2, the gear-wheels e and f and e^2 and f^2, respectively, on the two shafts intermeshing, cranks f^3 f^4 at the ends of the shaft, and a crank f^5 between the gear-wheels or intermediate in the length of the shaft, the two shafts being so geared that the cranks or crank-bends on the main shaft and the cranks on the ends of the second shaft will be respectively in position relatively diametrically opposite, and the cranks carrying links G G^2, which turn on them at one end (the rear end) and at the other end take over the pins on the hammer-heads, the cranks on the main shaft bearing the links which take over the pins on the head of the lower hammer and those on the second shaft carrying the links which take over the pins on the head of the upper hammer. It will be obvious that as the main shaft revolves the hammers will be drawn back one after the other by the links. Upon the intermediate crank of the second shaft is journaled a box f^6, into which an arm b^7 passes through the cleft d^5, the box sliding slightly but freely on the arm. It will be obvious that as the second shaft is turned and its intermediate crank or crank-bend revolves with its box the arm will be moved up and down, carrying with it the movable frame, which is in this manner moved up and down, whereby the hammers by it carried will be reciprocated, and there will be a period of rest at the end of each movement up or down before the opposite movement begins, it being clear that the period of rest may be made greater or less by well-known means—for example, greater by having the box larger in vertical diameter than the end of the arm.

As already described, the stems of the hammers are provided near their ends with notches and the movable frame with pawls. Now the intermediate crank on the second shaft is so set that when the upper hammer is drawn back, with its spring or springs compressed to the fullest extent, the movable frame will be at its uppermost limit of motion, bringing the upper pawl or pawls against the upper pawl spring or springs and forcing the pawls into the notch or notches of the upper hammer, retaining it until, upon movement of the frame in its contrary direction, about centrally, the pawl or pawls will strike against the stop on the stationary frame, and, releasing the stem or stems, the upper hammer will be shot forward by the actuating spring or springs to deliver its blow, while when the lower hammer is drawn back, with its spring or springs compressed to the fullest extent, the movable frame will be at its lowermost limit of motion, bringing the lower pawl or pawls against the lower pawl spring or springs and forcing the pawl into the notch or notches of the lower hammer, retaining it until, upon movement of the frame in the contrary direction, about centrally, the pawl or pawls will strike against the projection on the stationary frame, and, releasing the stem or stems, the lower hammer will be shot forward by the actuating spring or springs to deliver its blow. Otherwise stated, the shafts are so geared with each other that they act upon the respective actuating-springs through their cranks and connecting-links alternately, and the box mounted on the shaft is so arranged

with relation to the other moving parts of the machine and its operation is so timed that each hammer, respectively, is at the outward limit of the motion of the frame farthest removed from the drill-tool or part holding the drill-tool when its spring is compressed and the notch in the hammer is entered by its pawl, and it is carried to a point opposite the drill-tool when its locking-lever is moved from the hammer releasing it.

It may be here noted that delivery of a blow takes place at a time when the reciprocatingly-moving frame, having reached its extreme position in one direction or the other, is about to retrace its course—that is, at a moment when it is deprived of motion—having no motion either in one direction or the other. The delivery of the blow being practically instantaneous under the quick action of the springs, it may be said that the movement of the hammer at that time is all in one direction—that is, in the direction of the object to be struck.

The advantage of reciprocation of the operative part to and from the line of direction of its action is, first, that by reciprocation more than one hammer can be employed, instead of having to use a single hammer, thus dividing the labor and consequent wear and tear, and, secondly, that by reciprocation or alternation as distinguished from constant motion onward or succession a period of rest is afforded at the end of each movement—namely, just before return—and just then the striking can be performed.

It will be obvious that the screw device may be employed for causing the striking device to advance or recede by itself.

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

1. In a rock-drilling machine comprising a striking device composed of two hammers reciprocating in the direction of impact and also in a line crossing that of the impact, mechanism for imparting the desired movements to the striking mechanism, a drill-tool, and a rock-shaft connected to the drill-tool or to a part holding a drill-tool and receiving motion from the operating mechanism of the striking device, substantially as described.

2. In a rock-drilling machine comprising a striking device composed of two hammers reciprocating in the direction of impact and also in a line crossing that of impact, mechanism for imparting the desired movements to the striking mechanism, a drill-tool, and a rock-shaft connected to the drill-tool or to a part holding a drill-tool by a ratchet-feed and receiving motion from the operating mechanism of the striking device.

3. In a rock-drilling machine comprising a striking device composed of two hammers reciprocating in the direction of impact and also in a line crossing that of impact, mechanism for imparting the desired movements to the striking device, a standard upon which the machine is mounted, a connection between the standard and the operating mechanism of the striking device, and a screw receiving motion from the operating mechanism and imparting a longitudinal movement to the connection, substantially as described.

4. In a rock-drilling machine comprising a striking device composed of two hammers reciprocating in the direction of impact and also in a line crossing that of impact, mechanism for imparting the desired movements to the striking device, a standard upon which the machine is mounted, a longitudinally-movable connection between the standard and the operating mechanism, and a clutch attaching the connection to the operating mechanism, substantially as described.

5. In a rock-drilling machine comprising a striking device composed of two hammers reciprocating in the direction of impact and also in a line crossing that of impact, mechanism for imparting the desired movements to the striking device, a standard upon which the machine is mounted, a longitudinally-movable connection between the standard and the operating mechanism, a clutch attaching the connection to the operating mechanism, a drill-tool holder having a limited longitudinal movement, and a connection between the tool-holder and the clutch, substantially as described.

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

EUGÈNE MOREAU.

Witnesses:
R. G. DYRENFORTH,
T. B. KEEFER.