(No Model.) 2 Sheets—Sheet 1.

C. J. VAN DEPOELE.

RECIPROCATING ELECTRIC ENGINE.

No. 431,492. Patented July 1, 1890.

Fig. 1.

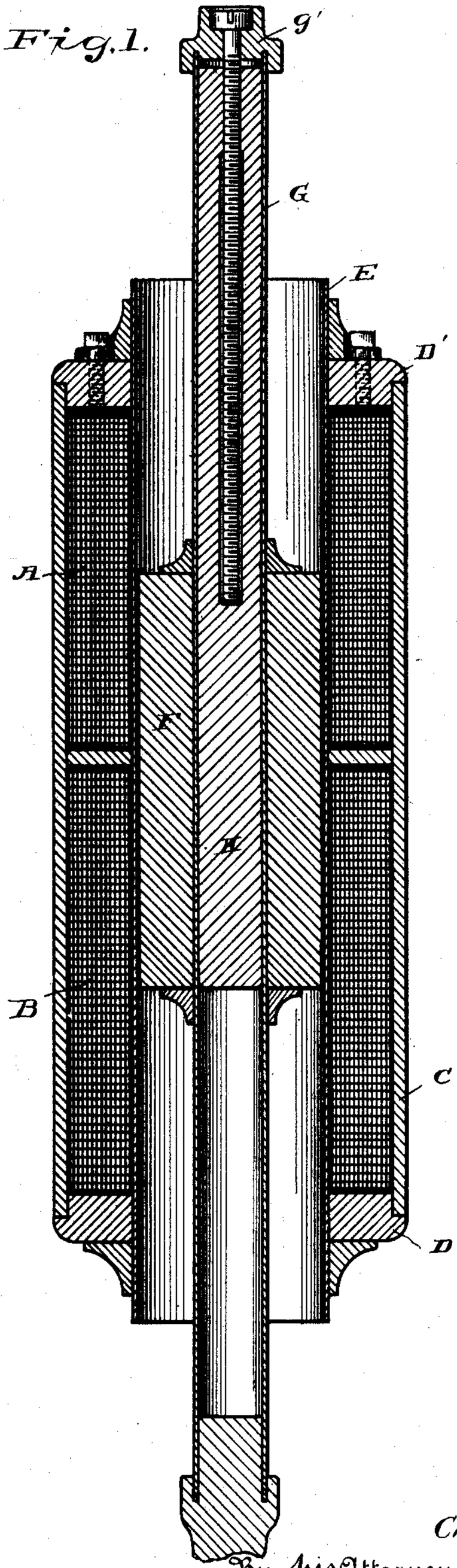


Fig. 3.

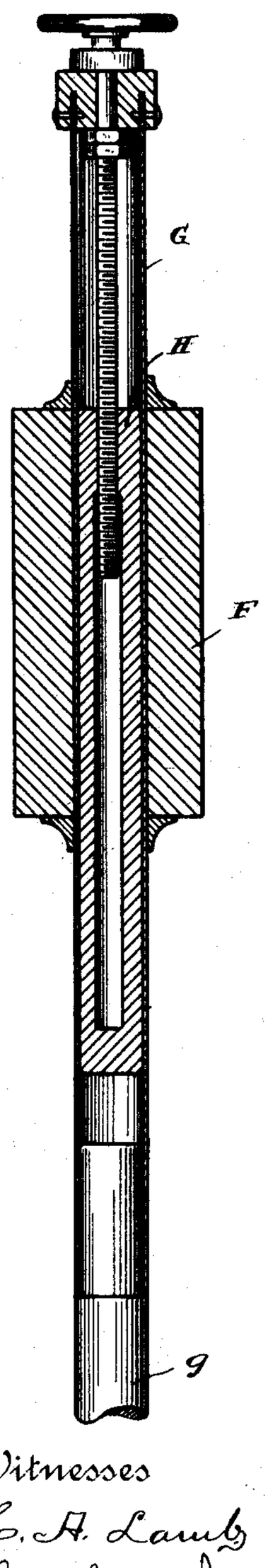
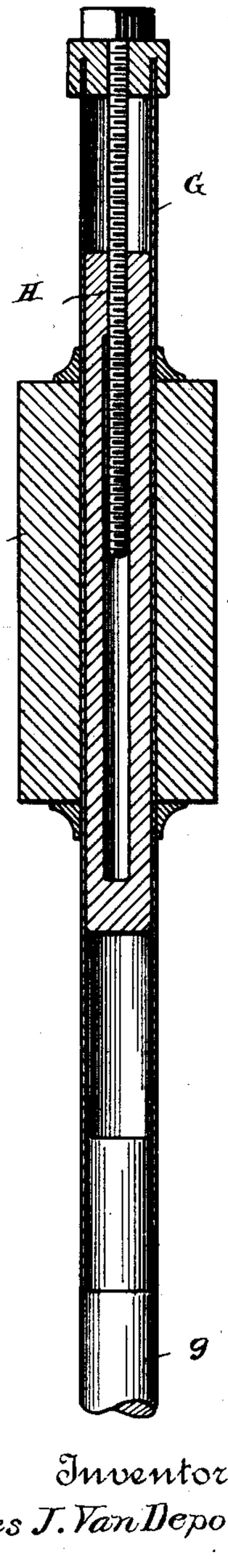


Fig. 2.



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(No Model.) 2 Sheets—Sheet 2.

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Fig. 5.

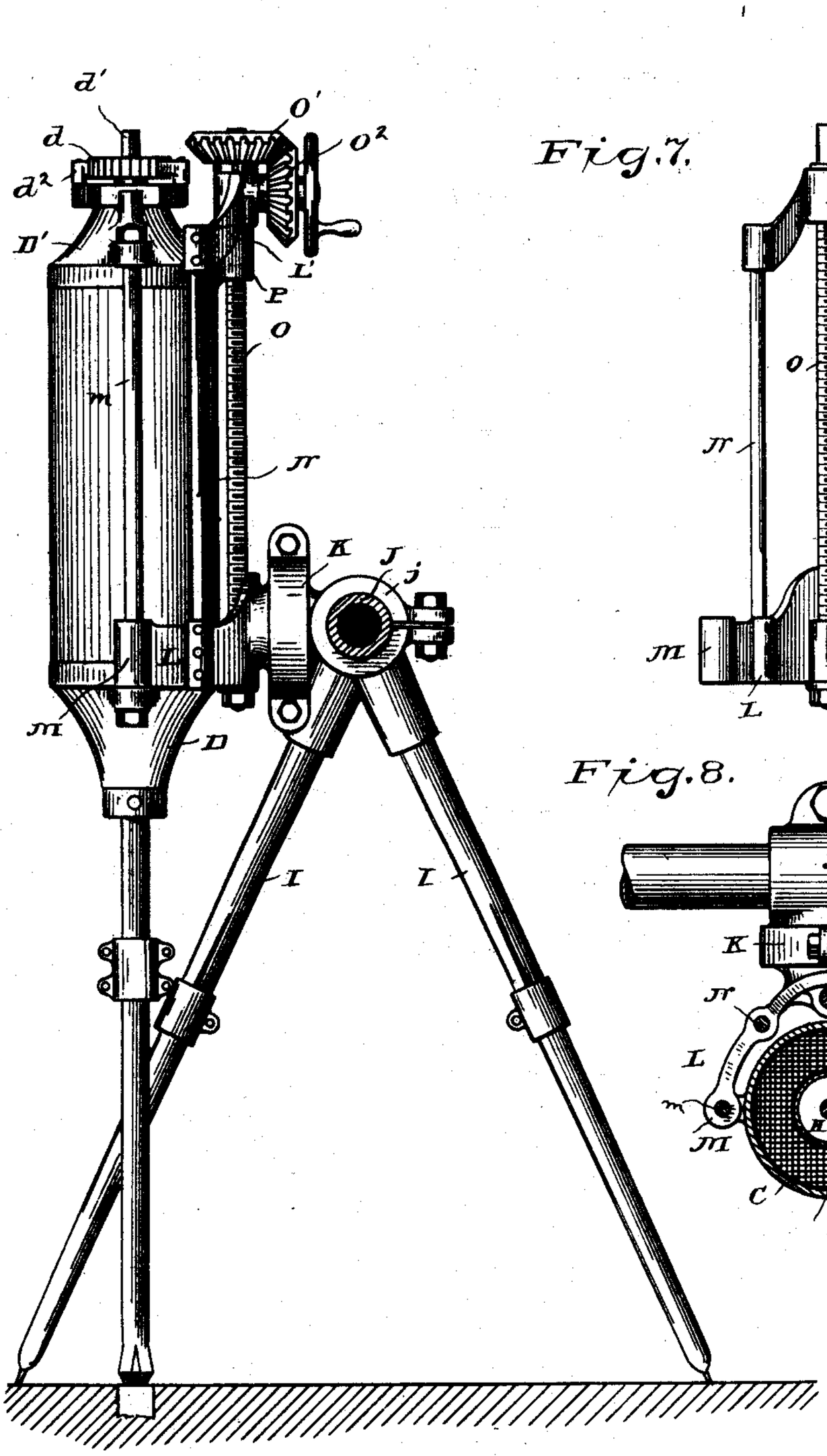


Fig. 6.

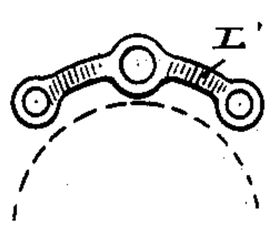


Fig. 7.

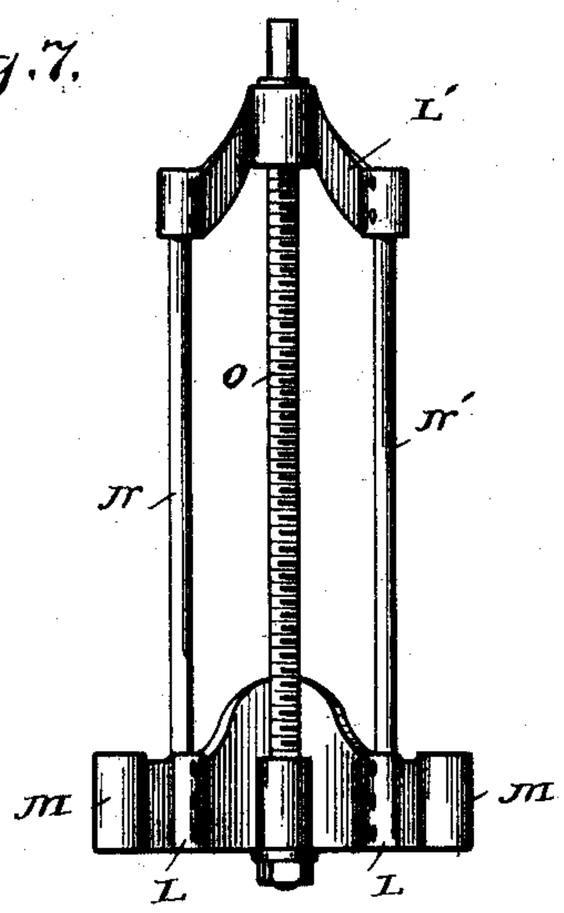
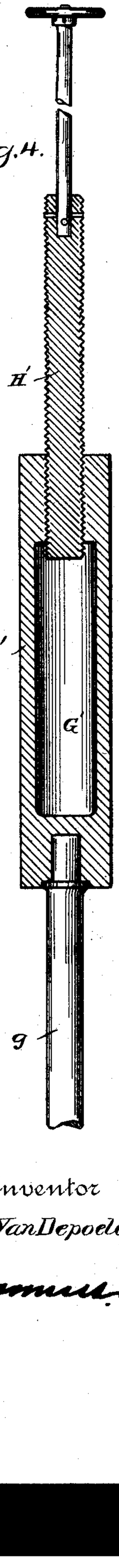


Fig. 8.

Fig. 4.



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UNITED STATES PATENT OFFICE.

CHARLES J. VAN DEPOELE, OF LYNN, MASSACHUSETTS.

RECIPROCATING ELECTRIC ENGINE.

SPECIFICATION forming part of Letters Patent No. 431,492, dated July 1, 1890.

Application filed April 3, 1890. Serial No. 346,395. (No model.)

To all whom it may concern:

Be it known that I, CHARLES J. VAN DEPOELE, a citizen of the United States, residing at Lynn, in the county of Essex and State of Massachusetts, have invented certain new and useful Improvements in Reciprocating Electric Engines, of which the following is a description, reference being had to the accompanying drawings, and to the letters of reference marked thereon.

My invention relates to improvements in electro-magnetic reciprocating engines of the class in which a magnetic plunger is reciprocated through stationary solenoids, the said plunger carrying and operating a tool-holding extension.

It is well understood that in the art of drilling it is, under some circumstances, necessary to increase the length and weight of the tool with the depth of the hole, and it therefore follows that although the relative force of the forward and backward stroke may have been in correct adjustment at first a new adjustment of forces will be required to meet the increase of the weight of the parts to be moved.

An important feature of my invention consists in providing means for increasing the attractive power of the actuating-solenoids in one direction or the other, as may be required. In other words, I shift the magnetic equilibrium of the piston to meet changes in the weight of the parts to be moved and for other purposes, as will appear.

A form of the invention will be described and referred to in the appended claims.

In the accompanying drawings, Figure 1 is a longitudinal sectional view of an engine embodying the invention. Figs. 2 and 3 are detail views, also in longitudinal section, showing the magnetic piston and parts directly connected therewith. Fig. 4 is also a detail view in longitudinal section and shows a somewhat different construction of plunger from that shown in Figs. 2 and 3, but embodying the same principle. Fig. 5 is a view in elevation showing a structure embodying the apparatus in working form. Figs. 6, 7, and 8 are detail views of part of the sustaining mechanism.

As shown in said drawings, particularly with reference to Fig. 1, the engine comprises a pair of solenoids A B, which are contained within an envelope or shell C of iron, said shell C being provided at each end with iron heads D D′, which heads concentrate the magnetism toward the plunger or the center, and enveloping said coils form also a strong mechanical protection therefor. Within the solenoid is secured a diamagnetic tube E, within which moves a magnetic plunger F, which is actuated in forward or backward movement by the flow of current in first one and then the other of the solenoids or motor-coils A B.

The plunger F should be about of the size and length calculated to produce the best effects with the shortest stroke and the lightest tool. Then by elongating the iron on one side the stroke will be stronger on the end opposite to the longest extension, so that to strike hard downward or forward the extension must be as shown in Fig. 1, while to secure the strongest rearward or lifting effect the extension must be as shown in Fig. 3.

The description so far given embodies a machine substantially similar to that shown, described, and claimed in my patent, No. 401,231, dated April 9, 1889, and that construction may be employed; but it must be distinctly understood that the present improvements are not limited to that or to any other exact structure—as, for example, as set forth and claimed in a contemporaneous application, the diamagnetic tube E need not be of metal, provided any other non-magnetic substance can be found to withstand the wear of the rapidly-moving plunger, and this whether that substance be of metal or otherwise.

In order to shift the magnetic equilibrium of the piston so as to get a preponderance of force upon either the upward or downward stroke, as desired, or to increase the power of the stroke in one direction, I provide the plunger F with an adjustable part, also of iron, and means for adjusting the movable portion of the plunger to produce the desired change in magnetic equilibrium.

As seen in Figs. 1, 2, and 3, the plunger F is provided with a strong rigid tube G of brass or other magnetic or non-magnetic material, which is passed through an opening in the center of the plunger F and firmly secured therein, extending both above and below, so

that the tool-holding extension *g* may be connected to the lower part of said tube G. Within the tube G is fitted an adjustable auxiliary plunger H, which is adjustable within said tube G, and may be moved forward or backward to increase the magnetic length of the plunger F in either an upward or downward direction, correspondingly affecting the power of the stroke in one direction. As indicated in the said figures, the upper part of the tube G is closed by a cap *g'*, through which extends some form of screw-threaded adjusting device, which projects into said tube and into engagement with the auxiliary plunger H, and by means of which said auxiliary plunger can be raised or lowered, and when positioned can be firmly held in desired relation to the mass of the principal plunger F.

In Fig. 1 the auxiliary plunger H is seen raised to its fullest height and extending above the plunger F.

In Fig. 3 the auxiliary plunger has been lowered as far as may be and will exert its influence in a contrary sense to what is seen in Fig. 1. In Fig. 2, however, the auxiliary plunger is so placed as to balance the magnetic mass between the opposing solenoids. Thus the forward and back strokes are equal in power, since they extend an equal distance beyond each end thereof. Similar results may be secured in many different ways mechanically, one of which is indicated in Fig. 4. In said figure the diamagnetic tube G is entirely dispensed with and the main plunger F' is formed with a cavity G'. The tool-holding extension *g* is in this case of iron or steel and connected directly with the main plunger, and a magnetic extension is provided for in the form of a screw-threaded auxiliary plunger, which is tapped into the upper part of the main plunger and can be screwed down into the cavity G or screwed out to form a projection above said plunger, as in Fig. 1. It will thus be apparent that I can vary the magnetic equilibrium of the plunger without changing the electrical conditions of the motor-coils, and in that way very effectively shift or adjust the motive force to suit changing conditions, and this I claim, broadly, whether it be accomplished precisely as herein set forth or otherwise.

In Fig. 5 I have shown an organized apparatus for sustaining my electro-magnetic reciprocating engine in working position. I represents legs such as are secured at either end of and employed to support a horizontal part J, technically termed a "quarry-bar."

Upon the quarry-bar is placed a longitudinally movable and adjustable clamp *j*. (See Fig. 8.) The clamp *j* is provided with a friction-joint K, claimed in a contemporaneous application, within which is sustained a flanged disk or similar projection extending from and forming part of a yoke L, by which the engine is supported and in which the same is vertically movable. The yoke L is provided at its extremities with vertical guides M, within which move vertical guide-rods *m*, which are secured on opposite sides of the exterior shell or to the heads D D' of the engine. The yoke L also carries two vertical rods N N, which are permanently secured therein, and are united at their upper ends by a second yoke L'. A feed-screw O is sustained at opposite ends in the yokes L L', so that it may be rotated freely therein, but will neither advance nor recede. To the upper portion of the shell of the engine is secured a strong screw-threaded feed-bracket P, which fits upon the feed-screw O, which is in the same vertical plane as are the guide-rods *m*. Consequently rotation of the feed-screw O will, by its action upon the feed-bracket P, raise or lower the engine, as may be desired. A gear-wheel O' is placed upon the upper end of the feed-screw O, and said wheel may be engaged by a second gear-wheel O^2, provided with a hand-crank or other means of operation.

The extension of the plunger F projects upward through the top part of the shell of the engine, and may be rotated step by step by the intermittent magnetism of the upper engine-head D'. To accomplish this, a ratchet *d* is splined onto the upper part of the extension of the piston *d'*. An armature d^2 is mounted also upon said head D' and provided with pawls engaging the ratchet *d*. The movable armature is provided with magnetic pole-pieces, which are in proximity to magnetic extensions of the head D', so that they will be intermittently attracted thereto and then drawn back by a suitable retracting-spring and intermittent rotary motion be thus imparted to the piston, tool-holder, and tool carried thereby.

In a contemporaneous application is shown, described, and claimed a form of piston-rotating mechanism differing only from that hereinbefore described in that it comprises electro-magnetic means for actuating the ratchet. The device shown in Fig. 5 is actuated purely by the magnetism of the cylinder-head D', which particular form will be hereinafter specifically claimed.

Various specific features of the construction hereinbefore described by way of illustration may be altered or changed without in any way departing from the invention.

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

1. In a reciprocating electric engine, a shifting field of force, an iron plunger actuated by said field of force, and means for varying the magnetic relation between the shifting field of force and the plunger.

2. In a reciprocating electric engine, motor-coils, and an iron plunger or magnetic piston movable within the field of force of said coils, said piston being provided with means for varying its magnetic equilibrium with regard to the field of force of the motor-coils.

3. In an electro-magnetic reciprocating en-

gine, the combination, with the motor coil or coils, of a magnetic piston adapted to be reciprocated therein, said piston being provided with an adjustable magnetic extension.

4. In an electro-magnetic reciprocating engine, the combination of a motor coil or coils, a magnetic piston adapted to be reciprocated therein, said piston being provided with a movable magnetic extension, and means for adjusting the extension with respect to the main body of the piston and thereby shifting the magnetic equilibrium, as desired.

5. In an electro-magnetic reciprocating engine, in combination with two or more motor-coils, a magnetic piston adapted to be reciprocated therein by the alternate rise and fall of current in the said coils, and an adjustable magnetic portion connected with said piston whereby a magnetic equilibrium can be shifted, as desired.

6. In an electro-magnetic reciprocating engine, the combination of motor-coils and a magnetic piston adapted to be reciprocated therein, a tool-holder connected with said piston, and a movable magnetic extension or auxiliary piston adapted to be adjusted with relation to the main body of the piston to increase the power of the stroke in either direction, as desired.

7. In an electro-magnetic reciprocating engine, a motor coil or coils, a suitable source of current-producing rising and falling energy therein, a magnetic piston adapted to be reciprocated by said currents within said coil or coils and to operate a moving tool, and means for shifting the magnetic equilibrium of said piston, and thereby causing the force of one movement to preponderate over that of the other, comprising a movable magnetic part forming an extension of the magnetic piston, and a screw-threaded or other adjustable connection extending therefrom to the exterior of the machine.

8. In a reciprocating drilling-engine, the combination, with the motor-coil and an intermittent source of current, of stationary magnetic parts under the influence thereof, mechanism connected to the plunger for rotating the same, and an armature or armatures under the influence of the said magnetic parts for intermittently actuating the plunger-rotating mechanism.

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

CHARLES J. VAN DEPOELE.

Witnesses:

JOHN W. GIBBONEY,

W. J. PLUMSTEAD.