No. 631,591. Patented Aug. 22, 1899.

H. C. SERGEANT.

COAL CUTTING ENGINE.

(Application filed Nov. 16, 1898.)

(No Model.) 2 Sheets—Sheet 1.

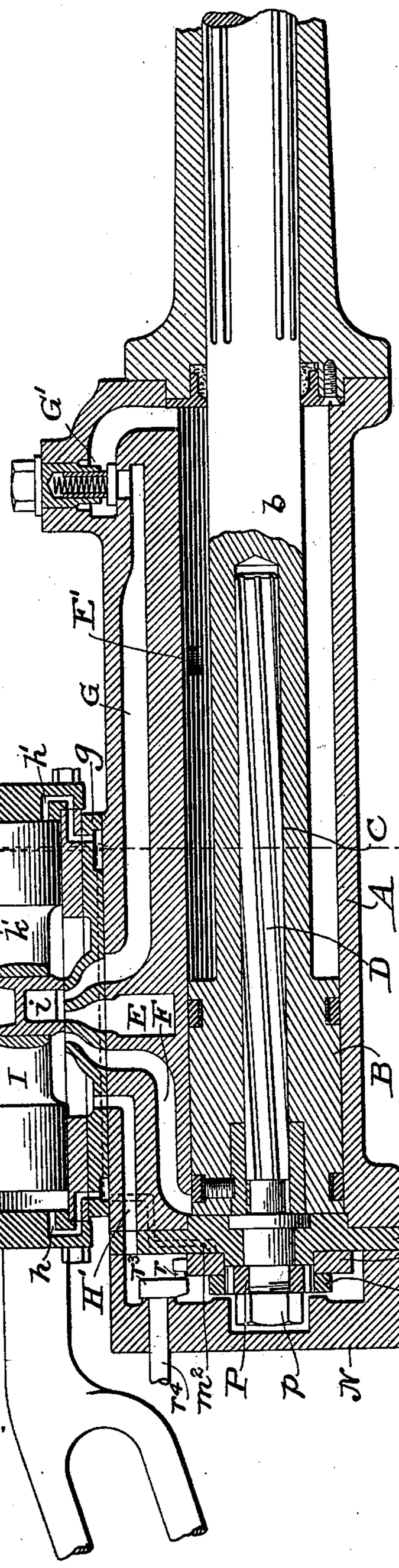

Fig. 1.

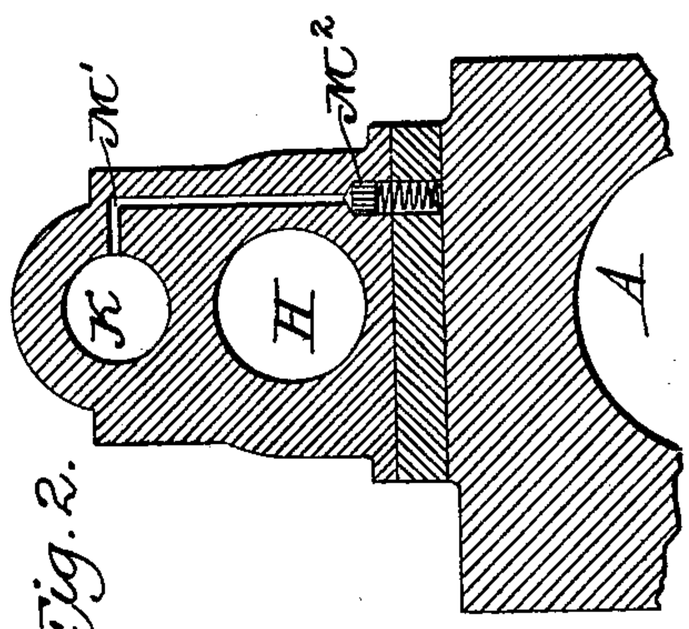

Fig. 2.

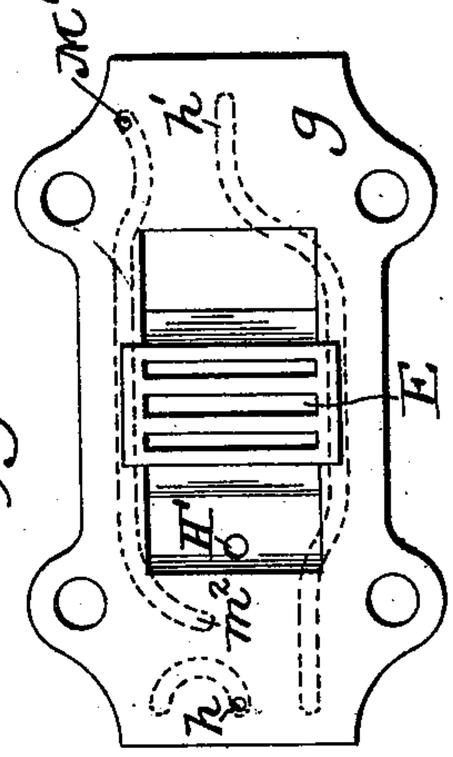

Fig. 3.

WITNESS

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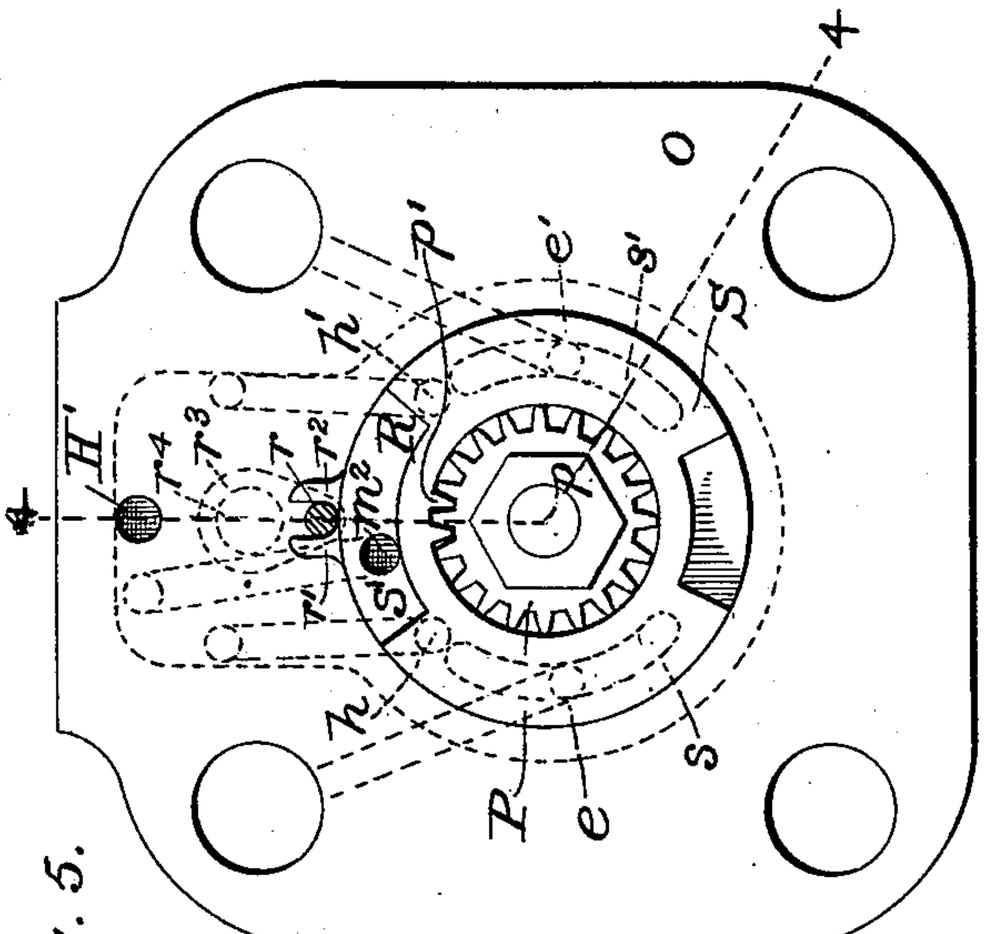

Fig. 5.

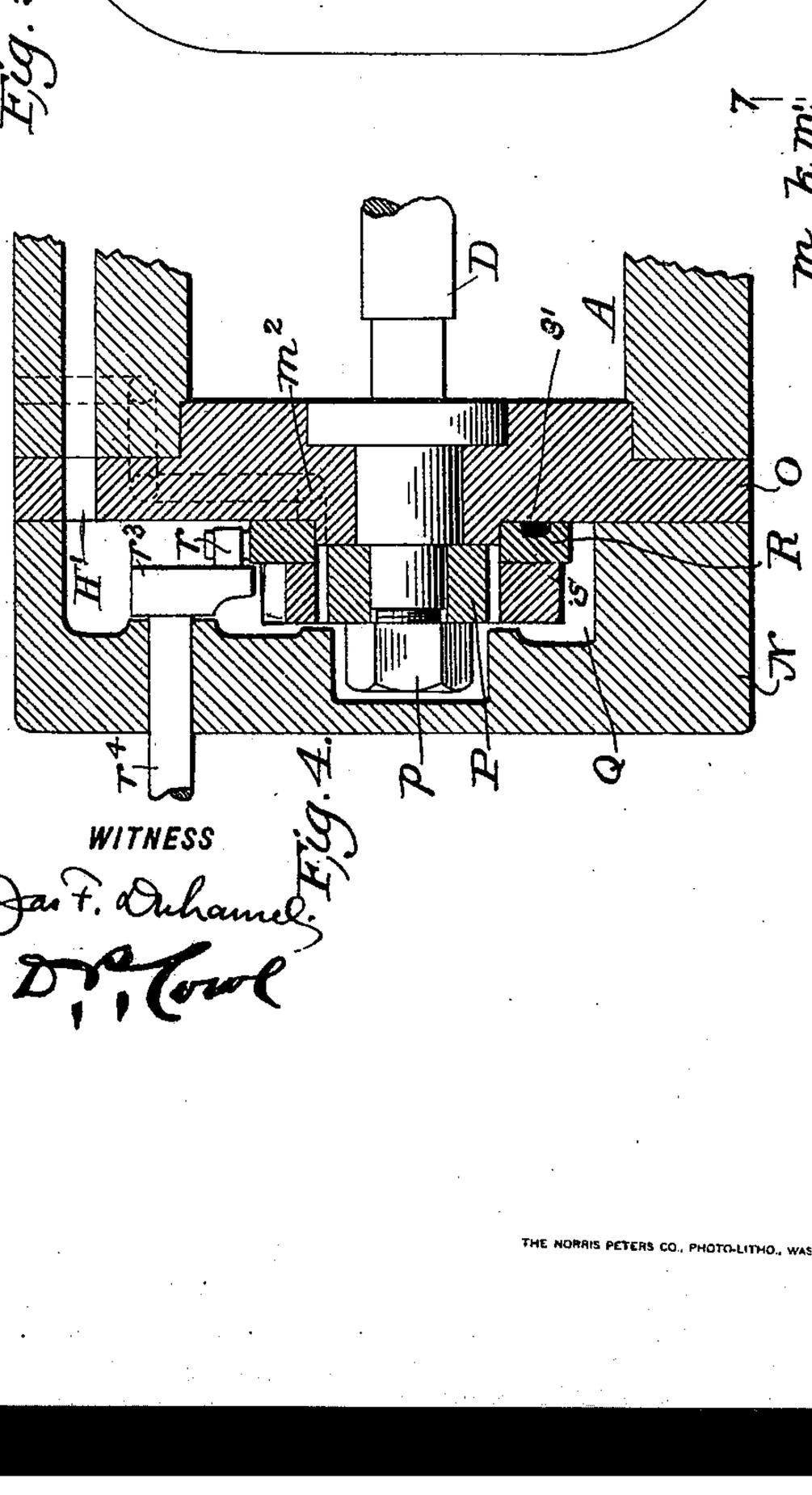

Fig. 4.

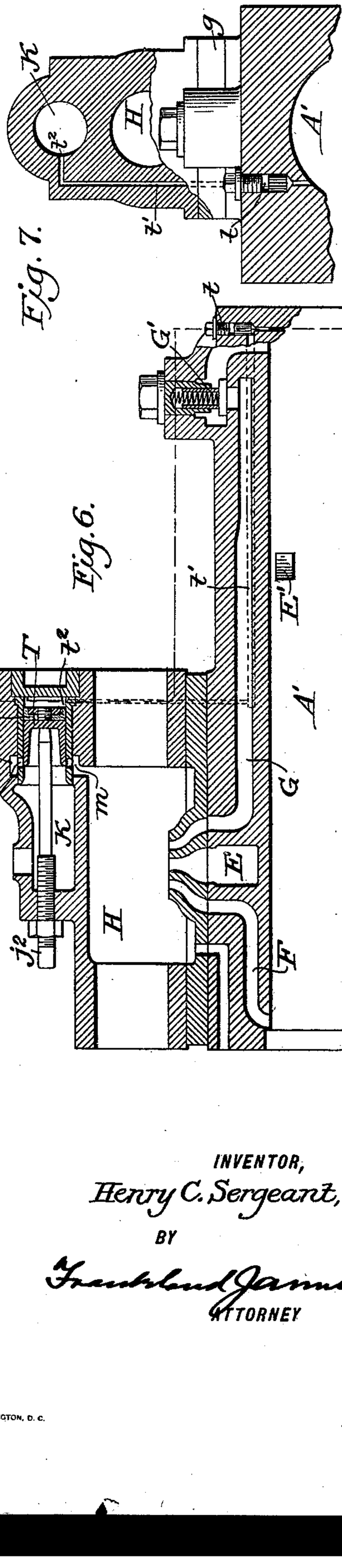

Fig. 7.

Fig. 6.

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COAL-CUTTING ENGINE.

SPECIFICATION forming part of Letters Patent No. 631,591, dated August 22, 1899.

Application filed November 16, 1898. Serial No. 696,614. (No model.)

To all whom it may concern:

Be it known that I, HENRY C. SERGEANT, a citizen of the United States of America, and a resident of the city of Westfield, county of Union, and State of New Jersey, have invented certain new and useful Improvements in Coal-Cutting Engines, of which the following is a specification.

My invention relates to improvements in reciprocating direct-acting engines, and more particularly to the class of machines in which a pick is attached to an extension of the piston and used for undercutting coal, although the invention may be employed wherever applicable.

The invention consists in applying to a coal-cutting or other similar machine a controlling-valve in advance of the main valve by which the motor fluid is distributed to operate the machine and providing means for operating the controlling-valve to reduce the supply of motor fluid, and thereby modify the action of the piston when its movement exceeds that which is necessary to do work.

The invention is illustrated as applied to a coal-cutting machine, but is not confined thereto, and the motor fluid will be hereinafter referred to as "compressed air" or "air," although, of course, steam or other gas under suitable pressure may be used.

In a coal-cutting machine the tool carried at the end of the piston-rod strikes the material operated upon, being moved, guided, and controlled by the operator. During its use the machine is frequently moved while the piston continues to reciprocate, so that at times the tool does not strike anything. Under these conditions there is a tendency to acceleration of speed or racing, accompanied by much jar and vibration of the machine, as well as danger of breakage. The piston also makes a longer stroke than when cutting coal. Therefore when the tool is in the coal the stroke is normal and when out of coal exceeds the normal. By my invention when the stroke exceeds the normal the controlling-valve is operated to partially shut off the air-supply, thereby reducing the number and force of the reciprocations of the piston, until the tool again meets with resistance—is in the coal—when, through reduction of the length of stroke, the governor-valve returns to its normal inactive position and the machine resumes full speed and power.

In the accompanying drawings, Figure 1 is a longitudinal sectional elevation of a coal-cutting machine embodying the invention, a portion of the front end being broken away. Fig. 2 is a sectional end elevation on the line 2 2 of Fig. 1, the pistons and valves being omitted. Fig. 3 is a detailed view of the port-plate. Fig. 4 is an enlarged sectional elevation of the back end of the cylinder and its head on line 4 4 of Fig. 5. Fig. 5 is an enlarged end elevation of the center plate. Fig. 6 is a vertical sectional elevation of the cylinder and valve-chests of the engine, showing another arrangement of the governing-valve. Fig. 7 is a vertical sectional end view on the line 7 7, Fig. 6.

In the drawings, Figs. 1 and 7, A is the cylinder of a reciprocating engine.

B is the piston, and *b* the piston-rod, to the outer extremity of which the tool or pick (not shown) is ordinarily attached. The piston-rod and piston are counterbored and rifled, forming a barrel C, into which is fitted the rifle-bar D.

The cylinder A is provided with the usual supply and exhaust passages F G, extending from the main-valve chest H and having an exhaust-port E between them.

I is the main valve, which is reciprocated in the valve-chest H to operate the slide-valve *i*, which is of the usual form and travels over ports connected with passages E F G, which supply and exhaust the compressed air on the opposite ends of the cylinder of the machine.

J is the main supply-pipe which enters an additional chest—the controller-valve chest K—from whence it passes ordinarily through the controlling-valve M into the main-valve chest H to be distributed by the main valve I.

The rear end of the cylinder A is closed by two parts, the back head N and the center plate O, which is between the back head and the open end of the cylinder. These parts are shown on an enlarged scale in Figs. 4 and 5.

The rifle-bar D is rotatably secured at its outer end in the center plate O, through which it projects far enough to carry the pinion P

and the jam-nut *p*. The back head M is formed with an internal cavity or chamber Q of sufficient size to leave space around the mechanism attached to the center plate, so that an equal pressure of air will exist at all points therein.

A number of passages are formed in the center plate O, and these are covered by a removable and renewable flat ring of metal R, the outer surface of which forms the seat for the rotating annular auxiliary valve S. The inner face of the valve S forms a tight working joint against the face of the valve-seat R and has a central opening fitting over the pinion P and is also provided with teeth or projections *p'*, engaging the pinion by which said valve is rotated in accordance with the movement of the rifle-bar in the piston.

H' is a port extending from the main-valve chest, supplying compressed air to the cavity Q at all times when the machine is in operation.

h h' are ports placed symmetrically in the valve-seat R and communicating, respectively, with the opposite ends of the main-valve chest H to reciprocate the main valve I. *e e'* are exhaust-ports therefor.

The auxiliary valve S is formed with two segmental grooves *s s'* at its under side, and the upper part of the periphery of said valve is cut away at S', as indicated.

In the normal operation of the machine the rifle-bar is turned by the reciprocations of the piston and through the pinion imparts rotary movement to the auxiliary valve S, first in one direction and then in the other. During these movements the port *h'* will be uncovered on one side, while the exhaust-groove *s* laps the exhaust-port *e*, and the supply-port *h* on the opposite side exhausting the end of the main-valve chest opposite to that which the port *h'* is supplying, and vice versa with the opposite movement of the piston B, rifle-bar, its piston, and the valve S. The valve seat or ring R is held stationary against the center plate O, as in the operation of the machine it is not required to move; but said ring is capable of adjustment when necessary, being held in position by a crank-pin *r*, which fits between two lugs *r' r²*, extending from the ring R. The crank-pin *r* is attached to crank-arm *r³*, which is secured upon a shank *r⁴*, which extends to the outside of the machine through the back head N.

The controller-valve M is located in the valve-chest K, where it is arranged to move—be reciprocated—under certain conditions within a suitable bushing *m'*. The valve M may assume a variety of forms, but as here shown it is of the piston type and has its front end open toward the chest K. A number of alined slits *n* are formed in the side of the valve M near its open end, said slits corresponding with similar slits *m* in the bushing *m'*. These two sets of slits open into a passage *k*, formed in the wall of the valve-chest K and communicating downward through the opening *k'* into the main valve-chest H, so that in the normal position indicated the supply-air passes from the pipe J through the open end of the valve M, side slits *n m*, and passages *k k'* into the main-valve chest H. The bushing *m'* has a shoulder *n'* at its end, opening into the chest K. The valve M has a partition across its middle portion and is hollow in its rear part and contains a spring *j*, which normally holds said valve in the (normal) position shown, in which the air passes freely therethrough.

From the space containing the spring *j*, which is in the rear of the controlling-valve M although toward the front end of the machine as a whole, extends a passage M', Figs. 1 and 2, and this passage is provided with a check-valve M². The passage M' is continued through the walls of the cylinder and port-plate *g* and through the center plate to port *m²* in the back head N. The port *m²* is located in the valve-seat R in advance of the port *h* and at a point where it is not lapped by the exhaust-groove *s* when the piston is working at its normal stroke. Said port is therefore open or uncovered part of the time; but communication from the cavity or chest Q in the back head with the space in the rear of the controller-valve M is prevented by the check-valve M². When, however, the piston travels farther than the ordinary distance, as is the case when the pick is out of coal, then the traverse of the valve S is increased to such an extent that the exhaust-groove *s* will lap the port *m²* and also the exhaust-port *e* and permit the escape of the balancing air-pressure, which would otherwise exist behind the controller-valve M, whereupon the main air-pressure in the chest K will immediately force said valve backward in the direction to close the openings *n m*, compressing the spring *j*, the valve ultimately coming to rest against an adjustable stop *j'*, secured in the end of the valve-chest, which is set as may be required to produce the desired effect, reducing the supply of air to the main valve and piston. So long as the piston continues to make an abnormally long stroke the exhaust-groove S will continue to exhaust the port *m²* with each movement and the controlling-valve will continue to be held against its stop *j'*, thereby diminishing the air-passages to the valve-chest H and decreasing the speed of the piston and tool. When the tool again strikes the coal, the piston and valve resume their normal length of stroke, the port *m²* will cease to be exhausted, the air-pressure in the rear of the valve M will be restored, and the spring *j* will push the valve M forward against the shoulder *n'* at the front end of the bushing *m'*, opening the airways *n m* to their full capacity and restoring the free passage of the main air-supply to the valve-chest H.

Fig. 3 shows what I have termed a "port-plate" *g*, it being a plate of metal inserted between the valve-chest H and upper side of the cylinder A and is used as a means for

continuing the air-passages to the desired outlets. The groove *h* in the plate *g* communicates with and is a continuation of the port *h* in the valve-seat R, groove *h'* a continuation of the port *h'*, and the groove M' is a continuation of the passage M', extending from the valve-chest K in the rear of the controlling-valve M.

As indicated in Figs. 6 and 7, the controller-valve T is similar in construction to the valve M, already described, except that, as shown, it moves in the opposite direction and that the spring *j* is dispensed with. Instead of having lateral airways or slits the said valve T is shown as slightly shorter than the valve M, and in its forward or normal position, which is toward the front end of the machine, it uncovers the slits *m* in the bushing *m'*, permitting free passage of the main air-supply to the passage *k*, and thence to the main-valve chest H. With this construction the valve T is normally held in its forward position by the pressure of the main air-supply, in which position the air passes freely therethrough to the main-valve chest, from whence it is distributed, as stated.

Near the front end of the passage G is located a check-valve G', which is so arranged that the main air-supply can pass therethrough in the direction to return the piston toward the other end of the cylinder, but which closes automatically to prevent the cylinder from exhausting from that end. A separate exhaust-port E' is provided some little distance away from the front end of the cylinder, and through this the exhaust-air escapes as the piston moves forward on the power-stroke. Ordinarily the piston does not move quite to the front end of the cylinder, and only a slight air-cushion is produced by the air confined by the check-valve G'. When the pick is out of the coal, however, the piston is driven violently forward until stopped by the air-cushion, the pressure of which is greatly increased by such additional forward movement of the piston.

As indicated in Figs. 6 and 7, I provide a small check-valve *t* at the extreme forward end of the cylinder A' and also a suitable passage *t'*, extending from said check-valve to the valve-chest K, entering the same at t^2 in advance of the forward position of the valve T. When the pick is out of the coal and the piston makes an additional forward movement by reason of the tool meeting with no resistance, the air in the front end of the cylinder confined by the check-valve G' in its supply-passage becomes so highly compressed as to lift the check-valve *t* when it traverses the passage *t'* and forces the valve T back against its adjustable stop j^2, as indicated in Fig. 6, thereby closing the openings *m* to a greater or less extent and throttling the air-supply, reducing the speed of the piston as much as may be desired.

Upon the tool meeting with the usual resistance of the work and the piston traveling only the normal distance the air confined in the front end of the cylinder A' will not be compressed sufficiently to raise the check-valve. Consequently the valve T will be held in its extreme forward position by the supply-air in the chest K, in which position the openings from the said chest to the main-valve chest H will permit the free passage of said air to operate the machine at full speed. It will be apparent, therefore, that with either construction the operation of the controlling-valve is entirely automatic and that its effect in reducing the flow of the main-supply air to the main valve of the engine will continue so long as the tool is away from the work and the tendency to racing exists, but that when the piston makes its ordinary stroke only said controlling-valves will immediately resume their normal positions and the machine will run at full speed and power.

The invention is not limited to the particular constructions set forth and may be embodied in various forms in accordance with the explanation of its nature and purpose herein given and in connection with the appended claims. I therefore do not limit myself to the exact constructions shown, as they may be modified and changed in many ways without the exercise of invention.

Having described my invention, what I claim is—

1. In a reciprocating engine, the combination with a cylinder having inlet and exhaust ports, a main valve controlling the same, and a piston working in said cylinder, of a normally inactive governing-valve for reducing the speed of the piston, and means for actuating the governing-valve when the piston moves beyond the normal working point and for rendering it inactive when the piston resumes its normal stroke.

2. In a reciprocating engine, the combination with a cylinder having inlet and exhaust ports, a main valve controlling the same and a piston working in said cylinder, of a normally inactive governing-valve for diminishing the main air-supply and means operated by the stroke of the piston for partially closing the governing-valve when the piston moves beyond the normal working point and for opening said governing-valve when the piston resumes its normal stroke.

3. In a reciprocating engine, the combination with a cylinder having inlet and exhaust ports, a main valve controlling the same, and a piston working in said cylinder, of a normally inactive governing-valve for diminishing the main air-supply to the main valve and means operated by the stroke of the piston for operating the governing-valve to diminish the main air-supply when the piston moves beyond the normal working point and for restoring the same when the piston resumes its normal stroke.

4. In a reciprocating engine, the combination with a cylinder having inlet and exhaust ports and passages, a main valve controlling

the same, and a piston reciprocated in said cylinder, of a movable, normally inactive governing-valve controlling the main air-supply, an adjustable stop for determining the active position of said governing-valve and means for moving said governing-valve into position to diminish said main air-supply when the piston moves beyond the normal working point.

5. In a reciprocating engine, the combination with a cylinder having inlet and exhaust ports and passages, a main valve controlling the same and a piston reciprocated in said cylinder, of a movable normally inactive governing-valve for diminishing the main air-supply interposed between said main air-supply and the main valve, an adjustable stop for determining the active position of said governing-valve, and means operated by the stroke of the piston for moving said governing-valve into and holding the same in operative position to diminish said main air-supply when the piston moves beyond the normal working point.

Signed by me, at New York, N. Y., this 14th day of November, 1898.

HENRY C. SERGEANT.

Witnesses:

J. KENNEDY,

FRANKLAND JANNUS.