(No Model.) 2 Sheets—Sheet 1.

S. & W. R. LLOYD.

STEAM ACTUATED ROCK DRILL.

No. 481,632. Patented Aug. 30, 1892.

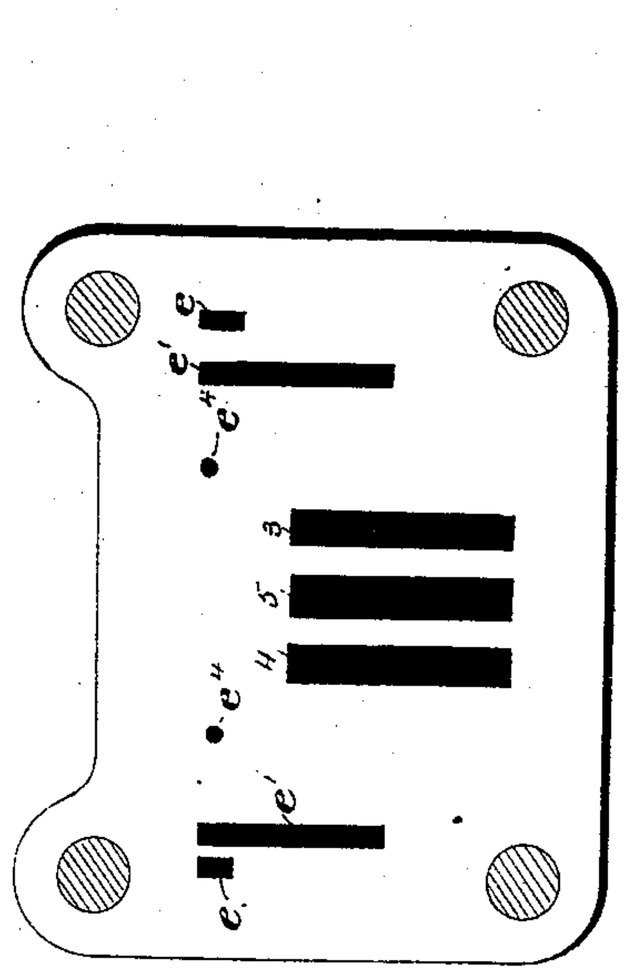

Fig. 3.

Fig. 2.

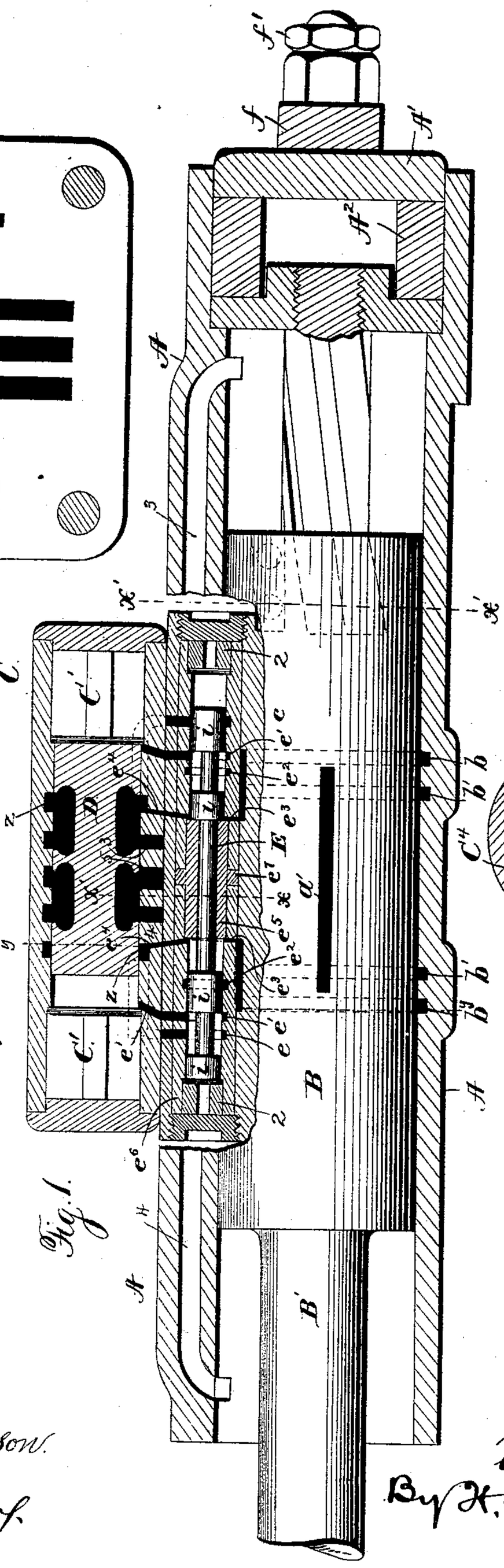

Fig. 1.

Fig. 4.

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(No Model.) 2 Sheets—Sheet 2.

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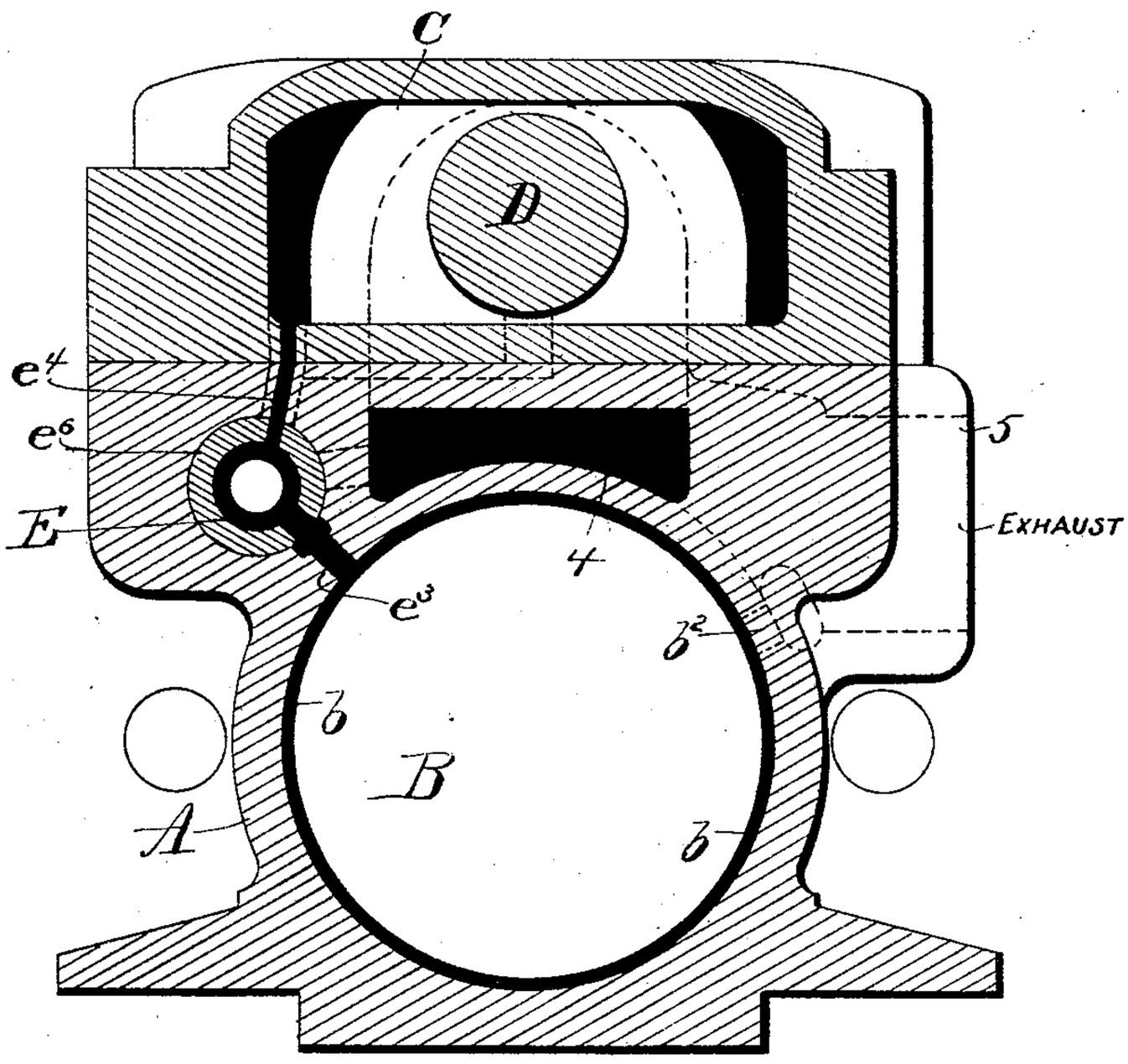
Fig. 5.



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UNITED STATES PATENT OFFICE.

SETH LLOYD AND WILLIAM R. LLOYD, OF WEST NEW BRIGHTON, NEW YORK.

STEAM-ACTUATED ROCK-DRILL.

SPECIFICATION forming part of Letters Patent No. 481,632, dated August 30, 1892.

Application filed December 9, 1890. Serial No. 374,074. (No model.)

To all whom it may concern:

Be it known that we, SETH LLOYD and WILLIAM R. LLOYD, of West New Brighton, in the county of Richmond and State of New York, have invented certain new and useful Improvements in Steam-Actuated Rock-Drills; and we 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.

Our invention relates to steam-thrown valve and variable-stroke rock-drills and analogous machines that perform their work by a succession of blows. The principal parts comprising such devices are a cylinder, piston, and valve, with ports to operate them. The ports that operate the piston are controlled by the valve, and the ports that operate the valve are controlled by the piston. With previous constructions, said valve-operating ports are so located in the cylinder that the valve will be operated when the piston is at its shortest stroke, which is generally at the middle of the cylinder, the object being to secure a variable stroke, and the effect is to throw the valve before the piston can complete its full stroke, with the following undesirable results: The first half stroke of the valve cuts off the steam, driving the piston at a time when its increasing velocity requires most steam and also cuts off the exhaust, causing the piston to cushion on what steam remains in the cylinder. The last half movement admits steam for the return stroke and also opens the exhaust on the opposite end. In case the valve is retarded sufficiently to travel only one-half its stroke by the time the piston completes its full stroke the exhaust for the return stroke will be restricted, thereby weakening the pull-back, or recovery, and decreasing the speed of the drill. If the valve is not retarded, steam will be admitted in front of the piston before it completes its full stroke, thereby decreasing the force of the blow.

To overcome these defects is the object of our invention, which object we attain by using an auxiliary valve to time the movements of the main valve in such manner that the piston will complete its full stroke before the main valve reverses to admit steam into the cylinder for its return stroke. Said auxiliary valve is adapted to be controlled by the piston, through ports so located in the cylinder that the piston will operate the auxiliary valve when at its shortest stroke, which is preferably in the middle of the cylinder, where a groove in the piston will reciprocate across annular grooves in the cylinder on any stroke, from scarcely more than a vibration to a full stroke. As it will be seen that after said groove in the piston crosses the lower one of said grooves in the cylinder the piston will require an interval of time to complete its full stroke, it is apparent that the auxiliary valve must be constructed and regulated to consume the same time in completing its stroke in order to reverse the main valve, which is adapted to move very quickly at the proper time to admit steam into the cylinder for the return stroke of the piston. To regulate the speed of the auxiliary valve in this manner, the ports e^3 that connect it with the cylinder are restricted in area or cross-section; or the induction e^4 that admits steam to operate it might be restricted. Either way will accomplish the same result, and is equally applicable. In practice a three-inch machine, with a six-inch stroke, working at four hundred strokes a minute under seventy pounds of steam-pressure, will require a one-sixteenth inch port to operate a five-eighth inch auxiliary valve with a half-inch stroke at the proper speed. This auxiliary valve is preferably made with as long stroke and as narrow ports as practical, to admit of closer regulation and to throw the main valve as quickly as possible. It is apparent that as the auxiliary valve must consume a certain time in its travel the longer the travel the quicker it will move and the more quickly it will open the main-valve-operating ports, they being made narrow for the same purpose. The statements thus far relate only to regulating the valve on the down or working stroke. On the return stroke the auxiliary valve is regulated (in the same manner as in the down-stroke) to operate the main valve in time to admit steam into the top end of the cylinder to check the piston before it strikes the top head.

The invention consists in certain novel features of construction and combinations and arrangements of parts, as hereinafter set forth, and pointed out in the claims.

In the accompanying drawings, Figure 1 is a longitudinal sectional view showing the piston and cylinder and ports partly removed to show the auxiliary valve. Fig. 2 is a view on the line x x of Fig. 1. Fig. 3 is a plan view with the valve-chest removed. Fig. 4 is a view on the line x' x', Fig. 1. Fig. 5 is a sectional view on the line y y of Fig. 1.

A represents a cylinder in which a piston B is located and provided with a piston-rod B′, to which the drill-bit is attached. Located on the cylinder A is a valve-chest C, in which a piston-valve D is located, said valve-chest being provided at its ends with buffers C′ to limit the movements of said valve D. The interior wall of the valve-chest C is provided with a series of annular grooves adapted to produce ports 3 4 5, which, in conjunction with the valve D, are adapted to control the ingress and egress of steam to and from the cylinder A.

An auxiliary valve E is located in a valve chamber or casing e^6 between the main valve D and the bore of the cylinder A and at its center is elongated and reduced to receive a ring or sleeve e^5, having a flange e^7, adapted to enter an annular groove in the interior wall of the auxiliary valve-chest e^6. The auxiliary valve E is adapted to receive steam from the space z around the valve D, and is made with pistons i i i i, adapted to open and close the several ports, hereinafter described, to control the ingress and egress of steam to and from the ends of the main valve to operate it, and at the ends of the auxiliary valve-chamber elastic buffers 2. 2 are preferably located.

Located on each side of the central ring e^5 is a set of ports for operating the auxiliary valve. The inlet-port e^4 provides an open passage from the main valve-chest z to the interior of the valve-casing e^6 at the edge of ring e^5. The exhaust-port e^3 passes from the interior of the valve-casing e^6 at the edge of ring e^5 to the outer one of the annular grooves in the cylinder.

The piston B is provided with a longitudinal slot a', and in the cylinder the grooves b b' are arranged in pairs, the upper pair serving to exhaust the top side of the auxiliary valve and the bottom pair serving to exhaust the bottom side. The grooves b connect with the auxiliary valve E and the grooves b' connect with the exhaust 5 through port b^2. (Shown in Fig. 5.) The longitudinal groove a' serves to establish communication between one or the other pair of grooves b b' when the piston B moves toward one or the other extremity of its stroke. Grooves and ports e connect the auxiliary-valve chamber with the main steam-space z and serve to supply the ends of the main valve with steam through ports e', which also serve as eduction-ports when brought into connection with port e^2, which connects with the main exhaust-port 5. In this description by the front or bottom end of the device is meant the end through which the piston-rod protrudes, and the top or back end is the opposite end of the device.

The operation of the apparatus for throwing the piston is as follows: As shown in Fig. I, the parts are in the positions they assume when the piston is on its forward or working stroke. When the longitudinal groove a' crosses the bottom groove b, the lower end of the auxiliary valve E will begin to exhaust through ports e^3 and b^2 and grooves b b' (bottom end) into the main exhaust 5. The upper groove b, being covered by the solid part of the piston B, steam will accumulate on the upper side of the ring e^5 through port e^4 and force the auxiliary valve E to the upper end of its chamber, which movement on the part of the auxiliary valve reverses the main valve by placing the bottom end in connection with the exhaust 5 through the ports e' e^2 and admitting steam to the top end through ports e e'. The parts are then in position for the return stroke, which is the same as the one just described, except that the direction of travel of the valve is reversed.

From the construction and arrangement of parts above described it will be seen that the auxiliary valve is designed and the ports proportioned in a manner to allow an interval of time to elapse between the opening of the auxiliary valve, exhaust-port, and the reversing of the main valve long enough for the piston to complete its full stroke on the forward end. On the return stroke the auxiliary valve is regulated to permit steam to be admitted into the cylinder in time to check the piston and save the back-head from violent shock.

Though in describing our invention we have mentioned steam only as the motive fluid, we do not desire to restrict ourselves thereto, nor do we desire to restrict ourselves to the specific construction of auxiliary valve described.

It is apparent, also, that our invention is applicable to all direct-acting engines that perform their work by a succession of blows.

In order to give the drill a rotary as well as a longitudinal or thrusting motion, the mechanism now to be described will be employed. The end of the cylinder A is provided with a steam-tight cap A′ and an elastic buffer A^2, held in place by a cross-bar f and bolts f'. The piston B is provided with an opening or socket, in the walls of which a series of recesses are made for the reception of a number of pawls H, adapted to enter a longitudinal spiral groove in a rod C^2, which is made to fit and slide in the opening or socket in the piston and secured at its outer end to the cylinder-head. The pawls and grooves in the bar C^2 are so placed in relation to each other that when the piston moves down or toward the front head of the cylinder the side of groove C^4 in the bar C^2 will act on the pawl,

force it into its recess, and allow it to slide over the top of the bar and drop into the groove on the other side. On the upstroke, the bottom of bar C^2 acts on the pawl and jams it against the opposite side of its recess, causing the piston to follow the direction of the groove. If the drill strikes in a hole or socket in the rock and will not rotate from any cause, the bar will turn and prevent anything from breaking, the side bolts being adjusted to give the proper amount of friction.

Having fully described our invention, what we claim as new, and desire to secure by Letters Patent, is—

1. In a variable-stroke drill or analogous machine that requires a variable stroke of piston, the combination, with a cylinder, piston, and main valve, of an auxiliary valve constructed and adapted to be operated by the piston at its shortest stroke, substantially as set forth.

2. In a variable-stroke drill or analogous machine that requires a variable stroke of piston, the combination, with a cylinder, piston, and a main valve adapted to move quickly, of an auxiliary valve adapted to be operated by the piston at its shortest stroke and to operate the main valve after consuming in its stroke the time required for the piston to complete its full stroke, substantially as set forth.

3. In a variable-stroke drill or analogous machine in which a variable stroke is required, the combination, with a cylinder, piston, and a main valve, of an auxiliary valve adapted to be operated by the piston at its shortest stroke and supplied with ports connecting it with the main steam-chest and with the interior of the cylinder, one or more of said ports being restricted, substantially as set forth.

4. In a rock-drill or analogous machine, the combination, with a cylinder having an annular groove adapted to connect with the valve and another groove connecting with the exhaust, of a piston having a longitudinal groove which serves to establish communication between the grooves in the cylinder for the purpose of exhausting the valve, substantially as set forth.

5. In a rock-drill, the combination, with a cylinder having annular grooves therein, two of said grooves being in communication with the main exhaust, of a main valve and an auxiliary valve, said auxiliary valve communicating with other grooves in the cylinder, the piston being provided with a slot adapted to connect the exhaust-grooves with the grooves communicating with the auxiliary valve, substantially as set forth.

6. In a variable-stroke rock-drill or analogous machine requiring a variable stroke of piston, the combination, with a cylinder, piston, and main valve constructed to move quickly, of an auxiliary valve adapted to be operated by the piston at its shortest stroke and having its stroke lengthened to admit of close regulation, substantially as set forth.

7. In a rock-drill or analogous machine, the combination of a cylinder, piston, and main valve with an auxiliary valve, the exhaust-port of said auxiliary valve being restricted, as and for the purpose described.

8. In a rock-drill or analogous machine, the combination of a cylinder, piston, and main valve with an auxiliary valve, the inlet-port of said auxiliary valve being restricted, as and for the purpose described.

9. In a variable-stroke rock-drill or analogous machine that requires a variable stroke of piston, the combination, with a cylinder, piston, and a main valve constructed to move very quickly, of an auxiliary valve adapted to be operated by the piston at the shortest stroke and having inlet-ports connecting it with the main valve-chest to supply it with steam, substantially as set forth.

10. In a variable-stroke drill or analogous machine requiring a variable-stroke piston, the combination, with a cylinder, piston, and a main valve constructed to move quickly, of an auxiliary valve adapted to be operated by the piston at its shortest stroke and having exhaust ports placing it in communication with the piston, substantially as set forth.

In testimony whereof we have signed this specification in the presence of two subscribing witnesses.

SETH LLOYD.
WM. R. LLOYD.

Witnesses:
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