2 Sheets—Sheet 1.

W. H. ELLIOT.

Rock-Drilling Engines.

No. 202,638. Patented April 23, 1878.

Fig. 1.

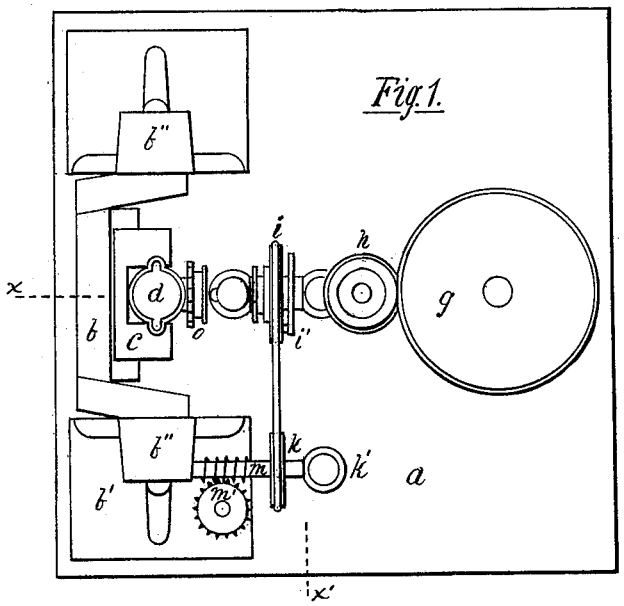

Fig. 3.

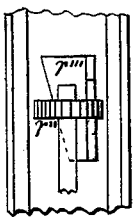

Fig. 4.

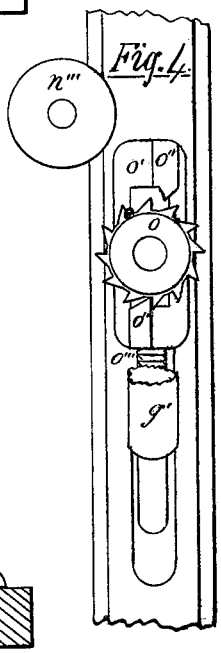

Fig. 5.

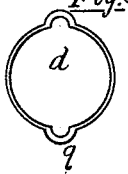

Fig. 6.

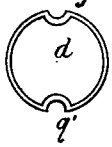

Fig. 2.

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Inventor: Wm. H. Elliot

2 Sheets—Sheet 2.

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Fig. 4.

Fig. 1.

Fig. 2.

Fig. 5.

Fig. 3.

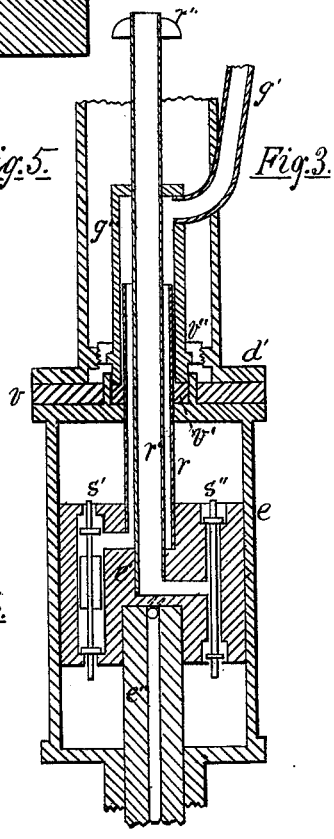
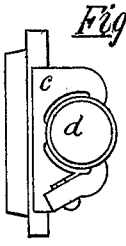


Fig. 7.

Fig. 6.



Witnesses.

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Louis E. Moore.

Inventor.

Wm H Elliot

UNITED STATES PATENT OFFICE.

WILLIAM H. ELLIOT, OF NEW YORK, N. Y.

IMPROVEMENT IN ROCK-DRILLING ENGINES.

Specification forming part of Letters Patent No. **202,638**, dated April 23, 1878; application filed June 16, 1877.

To all whom it may concern:

Be it known that I, WM. H. ELLIOT, of the city and State of New York, have invented a new and Improved Rock-Drilling Engine, of which the following is a specification:

The object and nature of my invention are described as follows:

The object of my invention is to provide a more simple and durable rock-drill, and a more practical method of handling the same, than any now in use; and also to provide means of effectually removing the rock-cuttings from the hole; and the nature of my invention consists in use of certain appliances and methods to further the above object, which are fully set forth in the following specification and claims.

In Sheet 1, Figure 1 is a plan of my improved rock-drilling engine. Fig. 2 is a vertical section of the same at dotted lines x', Fig. 1. Fig. 3 is an elevation of a ratchet and pawl for revolving the drill-tool. Fig. 4 is an elevation of the vertical shaft and the drill-feeding devices. Figs. 5 and 6 are sectional views of a vertical shaft.

In Sheet 2, Fig. 1 is an elevation of the boiler and engine and a section of the vertical shaft, rock-drill, and their supports at dotted line x, Fig. 1, Sheet 1. Fig. 2 is a vertical section of a rock-drill, showing the means of applying steam to the hole in the rock. Fig. 3 is the same, showing the arrangement of the steam and exhaust valves with their steam-passages. Fig. 4 is a section of a hollow drill-tool finished. Fig. 5 is a side elevation of the feeding devices. Figs. 6 and 7 show a modification of my improved gibways and vertical shaft.

a is the body of the car or engine; a', the boxes; a'', the wheels and axles; b, bed which supports the gibways; b', stands which support the bed b; b'', bearings of the bed b in the stands b'; c, gibway; c', bolt which holds the gibways to the bed b; d, vertical shaft; d', plate on the lower end of the same; d'', block attached to the vertical shaft which supports the feeding devices; e, rock-drill cylinder; e', piston; e'', piston-rod or drill-carrier; g, steam-boiler and furnace; g', steam-passage; g'', steam-chamber; h, steam-engine cylinder; h', piston-rod; h'', bearings of crank-shaft; i i', pulley and clutch; i'', lever for operating the same; k, pulley on worm-shaft m, which is driven by pulley i and belt; k', bearing of worm-shaft m; m', gear which has a tubular connection with cylinder n, and both are supported on stud n'; n'', suspending-rope; n''', pulley over which the rope n'' suspends the vertical shaft and rock-drill; o, toothed wheel and cylinder; o', slide which supports the points o''; o''', spiral spring which raises slide o'; q, ribs raised on the sides of the vertical shaft; q', grooves sunken in the sides of the vertical shaft; r, steam-passage which conducts steam from the chamber g'' to the interior of the piston; r', exhaust-pipe which conducts steam from the interior of the piston through the steam-chamber g'' into the hollow vertical shaft; r'', collar and ratchet on the upper end of the exhaust-pipe. This collar operates the slide o', and it is also cut as a ratchet on its periphery, and is revolved by the pawl r'''; s, valve which closes the passage into the hollow tool-carrier; s', steam-valve in the piston; s'', exhaust-valve in the piston; t, drill-tool; t', chuck for holding the drill-tool; t'', shield to protect the machinery from steam and water; t''', enlarged portion of the drill-tool; u, escape-pipe for condensed steam; v, elastic packing between the drill-cylinder and the vertical shaft; v', packing between the steam-chamber g'' and and cylinder e, through which the steam-pipe r works; v'', screw-ring which forces the steam-chamber down upon the packing v'; x and x', lines of section.

To avoid confusion I have designated the drilling-machine, with its cylinder-piston and valves, as the "rock-drill," and the bar of steel which is fastened to the piston-rod, and is sharpened at its lower end for cutting the rock, as the "drill-tool."

I have shown in this application a rock-drill which is operated by steam. It is obvious, however, that all the devices herein shown which are not peculiar to steam rock-drills will operate with equal facility in connection with any other rock-drill.

I employ on my drilling-engine a double reversible steam-engine, whereby I may reverse the movements of any part of the machinery.

In my improved rock-drilling engine I bolt the rock-drill cylinder firmly upon the lower end

of the vertical shaft, and to prevent the jar from loosening the bolts and otherwise doing injury to the rock-drill and feeding-devices, I put an elastic packing, *v*, between it and the vertical shaft. This combination makes it necessary to feed the vertical shaft and rock-drill down together automatically as the hole deepens; and as these devices are too heavy to be raised quickly and easily by hand when it becomes necessary to lift them up so as to move the engine, I employ two sets of devices for giving them vertical movement, one—automatic—being set in motion by the deepening of the hole, to feed the rock-drills downward, the other—direct-acting—being put in connection with the steam-engine by the rock-drill tender when it becomes necessary to raise or lower the rock-drill and vertical shaft. It is obvious that these two sets of devices must both be connected with and operate one suspending device, whether it be a wire rope, a screw, or any other suitable means, and whether the rock-drill and vertical shaft be raised by connection with the propelling-power or by hand.

In my improved engine the suspending device is a wire rope, one end of which is attached to and wound upon cylinder *n*, and the other end is fastened in like manner to cylinder *o*.

While in operation, as the hole deepens, the collar or ratchet *r''* comes in contact with a pin or projection on the under side of slide *o'*, forcing the slide down against the spring *o'''* until the cylinder *o* is allowed to revolve one notch, when the spring again raises the slide so as to catch the next tooth, in the same manner that the feeding of the rock-drill is accomplished in my patent of May 29, 1877. By this means both the vertical shaft and rock-drill are fed down together. When it becomes necessary to raise the rock-drill above the surface, the rock-drill tender starts the steam-engine, and by means of lever *i''* connects the cylinder *n* with the engine, through worm and gear *m* and *m'*, pulley *k*, and pulley and clutch *i i'*, when the vertical shaft and rock-drill can be raised to any required height and lowered again by direct action of steam-power. In this way two sets of devices are made to operate upon one suspending device, so as to give to the rock-drill and vertical shaft together two vertical movements—one automatic and the other by direct action. By thus combining the vertical shaft and rock-drill so that they move together as one piece through the gibway *c*, both for feeding them and elevating them above the surface, I accomplish many valuable objects: I dispense with the sliding joint between the rock-drill and the vertical shaft, (shown in my former patents.) I use the vertical shaft as a weight. I obtain a feed sufficient for the longest drill-tool, and consequently it does not become necessary to change the drill so often.

It may become necessary, in consequence of the great weight of the vertical shaft and rock-drill, to prevent in some manner their too rapid descent in feeding, lest they should thereby injure the feeding devices. This may be done by friction applied either to the vertical shaft or to the cylinder *o*.

My improved rock-drill has all its valves within the cylinder and attached to the piston. It also has its steam and exhaust pipes arranged centrally with the cylinder, their axes being in the axis of the cylinder, both being attached to and moving with the piston.

The steam-pipe *r*, Figs. 2 and 3, Sheet 2, passes into the steam-chamber *g''*. The exhaust-pipe is arranged within the steam pipe, and passes through a packing-box at the top of the steam-chamber *g''*, and opens into the hollow vertical shaft, while the steam-pipe *r* opens into the steam-chamber *g''*.

The steam-valves *s'* in the piston open inward, and the exhaust-valves *s''* open outward, and their operation is as follows: The steam from the boiler passes along passage *g'*, into steam-chamber *g''*, into the steam-pipe *r*, and through it into the piston, and thence past the valve *s'* into the cylinder. The exhaust-steam passes the valves *s''* into exhaust-pipe *r'*, thence into the vertical shaft, where a large portion of it is condensed, and runs out through the waste-pipe *u*. This condensed steam may be conducted through a small rubber hose into the hole in the rock, and, being hot, would readily be reconverted into steam.

The piston, Fig. 3, is represented as descending with live steam above it, and before it reaches the lower limit of its movement the valve-stems come in contact with the lower head of the cylinder, where the lower valve *s'* is opened and the upper one closed, changing the course of the live steam from above to below the piston. At the same time the lower valve *s''* is closed and the upper one opened, shutting off the escape of steam from below the piston and allowing the escape from above when the piston rises. Before the piston reaches the limit of its upward motion the valve-stems come in contact with the upper head of the cylinder, where the operations of the valves just described are reversed, and the piston again descends.

There should be in each end of the cylinder a soft packing, to receive the valve-stems, to prevent their being injured by jarring.

The revolution of the drill-tool is effected by means of the ratchet *r''* on the upper end of the escape-pipe *r'*, which is acted upon during its upward movement by the diagonal pawl *r'''* to revolve it, in the same manner that the drill-tool is shown to be revolved in my patent of June 18, 1867.

To remove the rock-cuttings from the bottom of the hole, I use steam in connection with water. For this purpose I make my drill-carrier and drill-tool hollow, as shown in my patent of May 29, 1877, and I put valve *s*, Fig. 2, Sheet 2, into the piston, which is moved

by coming in contact with the heads of the cylinder in the same manner that valves s' and s'' are moved. Before the piston reaches the lower head of the cylinder the valve-rod s is raised, which allows live steam for an instant to pass down through the drill-carrier and drill-tool into the bottom of the hole in the rock.

When the piston reaches the lower limit of its movement the live steam ceases to flow through the valve s, and as the piston rises the valve is held up by the pressure of live steam on its lower end, which permits exhaust-steam to pass through the drill-tool during its entire upward movement.

When the piston reaches the upward limit of its motion the valve is closed by coming in contact with the upper head of the cylinder. At this moment, the steam-pressure being changed to the upper side of the piston, the valve is held down, and the flow of steam stopped till the valve-rod again strikes the lower head of the cylinder, when the same operation is repeated.

The hole through the piston for the valve-rod is enough larger than that device to allow the steam to pass down around it and into the passage through the drill-carrier; but it is made to fit the lower half of the hole, and has an enlargement on its lower end which prevents the valve from rising too high, and also prevents steam from escaping through the piston.

By boring the hole through the piston for the valve and rod s of one size, and large enough to allow the steam to pass around the rod into the drill-carrier from both ends of the piston, and by placing valves on each end of said rod, with feathers to keep it central, exhaust-steam, or air, if air be used, would pass through the drill-tool both in the upward and downward movement of the piston, and by sinking the valve-seats into the ends of the piston, and shortening the valve-rod, so that the valves will not come in contact with the heads of the cylinder or the packing, then these valves would be operated entirely by pressure, being always closed to the pressure end of the piston, and always open to the exhaust end.

After the drill-tool has been raised to steam-heat, or above that temperature, the drill-tender pours a little water into the hole around it. This, as soon as it reaches the bottom, is converted into steam, which, with the help of the exhaust-steam, rushes out of the hole, bringing with it all the rock, mud, and cuttings.

The steam-boiler and furnace g serve as an apparatus for preparing hot vapor or steam, which is afterward conducted to the bottom of the hole in the rock by means before described. This not only saves all the time that is consumed in withdrawing the drill-tool for the purpose of using the sand-pump; but the hole is kept free of all obstruction to the action of the drill, so that the drilling advances faster in deep holes than in shallow ones. In this way I utilize a large portion of the exhaust or dead steam or air which has ceased to act upon the piston to propel it, and would otherwise be discharged through the eduction-passage on its way to the open air, but which, when directed through the drill-tool, acts not only by its heat, but by its little remaining expansive force to expel the débris from the drill-hole.

The valve s can be applied with equal facility to any rock-drill piston and drill-carrier, as it operates independently of the other valves.

In my improved rock-drill, or in any other rock-drill which has an exhaust-passage in the piston, a continuous blast of exhaust-steam without a valve for the purpose could be conducted into the bottom of the hole in the rock by simply making an opening from the exhaust-steam passage into the opening through the drill-carrier, as shown by dotted lines, Fig. 3. Sheet 2; but I prefer the method I have described, as the little jet of live steam is sure to drive out any mud that may collect in the lower end of the drill-tool.

To prevent the mud and water from being thrown upon the rock-drill, I place a shield, t'', around the top of the drill-tool, which effectually protects the machinery.

Figs. 5 and 6, Sheet 1, represent sections of a hollow vertical shaft of suitable shape. Ribs may be raised on it, as shown in Fig. 5, or a groove sunk in it, as shown in Fig. 6; but the form that I prefer to all others is shown in Figs. 6 and 7, Sheet 2, especially when used with the improved gibways shown in Fig. 6. In this case the tube is round as it leaves the manufacturer, and the gibways made to fit it. It has the advantage of being very much cheaper; and in case the rock-drill at the lower end is constructed to swing upon a horizontal axis, as rock-drills usually are, this round vertical shaft may be turned in the gibways upon its own axis, and so bring the rock-drill to any point of compass.

For all purposes of conveying steam from the boiler to the bottom of the hole in the rock, the passage g', steam-chamber g'', steam-pipe r, and the steam-spaces within the cylinder may be described as a convenient steam-passage from the boiler to the hollow drill-carrier or hollow drill-tool. The steam may be conveyed between these points by a separate passage; but it is most convenient to employ these several steam-spaces as a steam-passage for the purpose described.

Hot air or hot vapor of any kind may be used instead of steam; but steam is the most convenient and the least expensive.

Having described my invention, what I desire to have secured to me by Letters Patent of the United States is—

1. In combination with a rock-drill and vertical shaft rigidly fastened together, and adjustable vertically in ways c, the device, as described, for lowering and elevating the shaft

and drill by means of the propelling-power, and independent means for feeding and operating the drill, as shown and described.

2. A vertical shaft and rock-drill, suspended, substantially as described, by a suspending device, through which positive vertical movement is given to said vertical shaft and rock-drill by connection with the propelling-power to raise and lower the same, and through which automatic movement is given to the same by the devices *o*, *o'*, and *o''* to feed the same downward as the hole deepens, substantially as specified.

3. The combination, with a rock-drill cylinder which discharges its exhaust or dead steam or air through an eduction-passage, with which it is provided, to the open air, of valve *s*, through which a portion of said dead steam is admitted to the hollow drill-carrier and hollow drill-tool, whereby it is utilized, substantially as and for the purpose specified.

4. In a rock-drilling machine having the vertical shaft and cylinder rigidly fastened together, the combination of the induction and eduction pipes, arranged, as shown, in relation to each other and to the vertical shaft and cylinder, with the piston *e'* and drill-carrier *e''*, so that the induction and eduction pipes, piston, and carrier reciprocate and rotate together as one piece, substantially as set forth.

5. In a rock-drilling machine having the vertical shaft and cylinder rigidly fastened together, the combination of the induction and eduction pipes and piston, arranged as shown, with the fixed chamber *g''* within the vertical shaft, and connection *g'*, so that the induction and eduction pipes can reciprocate and rotate together within the chamber *g''*, as and for the purpose set forth.

6. The combination of the elastic packing *v* with the vertical shaft and the rock-drill cylinder, substantially as and for the purpose specified.

In testimony that I claim the foregoing I hereunto set my hand this 14th day of June, 1877.

WM. H. ELLIOT.

Witnesses:
D. LEWIS,
LOUIS E. MOORE.