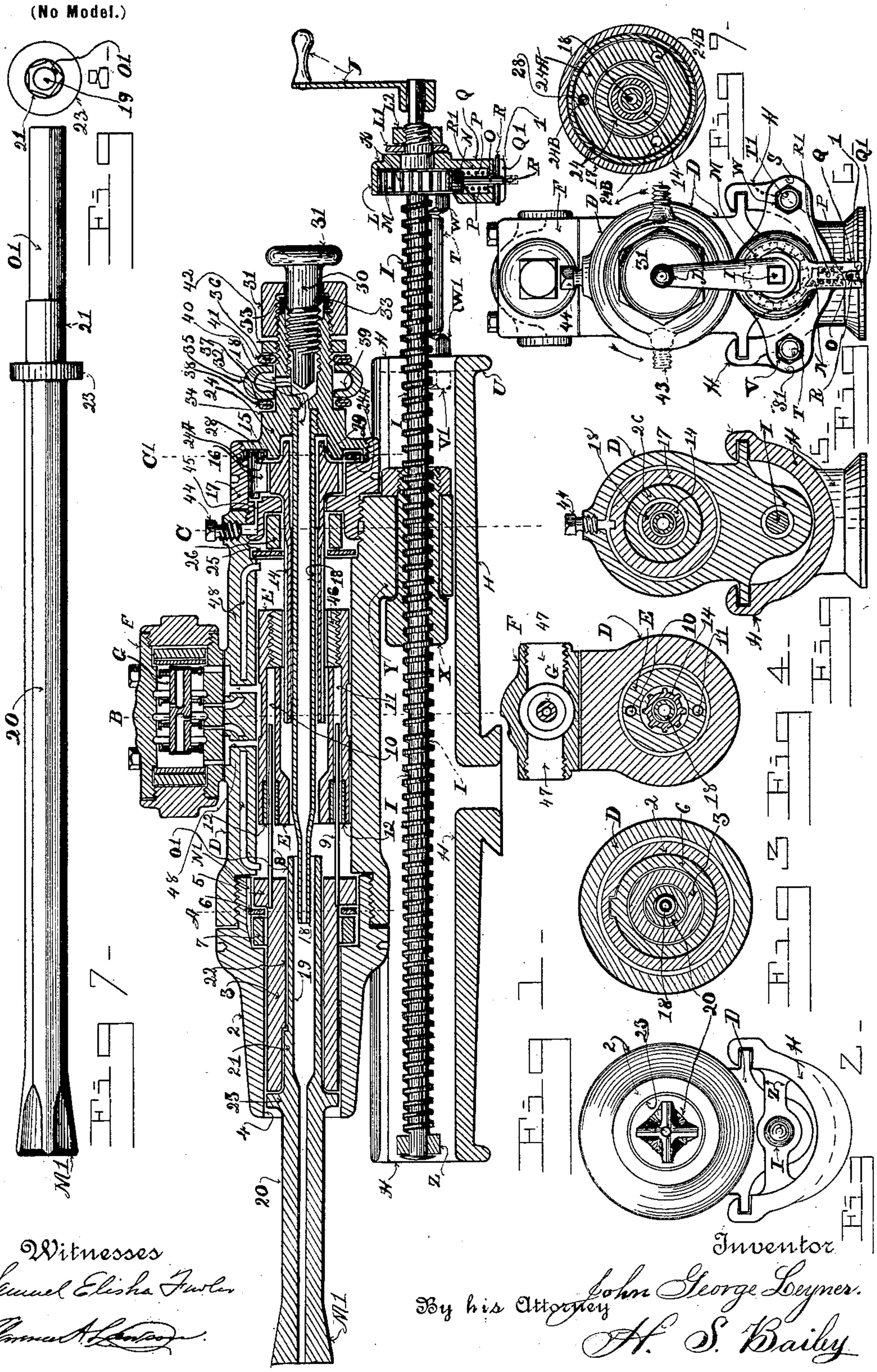
No. 626,761. Patented June 13, 1899.

# J. G. LEYNER.

## ROCK DRILLING ENGINE.

(Application filed Oct. 12, 1897.)

(No Model.)



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# UNITED STATES PATENT OFFICE.

JOHN GEORGE LEYNER, OF DENVER, COLORADO.

## ROCK-DRILLING ENGINE.

SPECIFICATION forming part of Letters Patent No. 626,761, dated June 13, 1899.

Application filed October 12, 1897. Serial No. 654,954. (No model.)

*To all whom it may concern:*

Be it known that I, JOHN GEORGE LEYNER, a citizen of the United States of America, residing at Denver, in the county of Arapahoe and State of Colorado, have invented certain new and useful Improvements in Rock-Drilling Engines; and I do 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, reference being had to the accompanying drawings, and to the letters and figures of reference marked thereon, which form a part of this specification.

My invention relates to improvements in air or steam rock-drilling engines adapted to expel rock-cuttings from holes while drilling them; and the objects of my invention are, first, to provide a rock-drilling engine that will discharge against the bottom of a hole while drilling it a jet of the engine's actuating air or steam combined with a stream of water under pressure; second, to provide means for regulating the flow of the water; third, to provide means for conveying the water through the drilling-engine and its drill-bit and through the drill-bit's cutting-point to the bottom of the hole being drilled; fourth, to provide means for uniting the air and water in the shank of the drill-bit; fifth, to provide means for connecting the water-supply to either side of the engine; sixth, to provide an operating rock-drilling engine in which the drill-bit is stationary and is loosely and non-clampably supported by the drilling-engine and is arranged to be instantly withdrawn therefrom or inserted therein at the will of the operator and which is adapted to convey a portion of the piston's actuating fluid from the engine's cylinder, combined with a jet of water, to the bottom of holes while drilling them, and, seventh, to provide a rock-drilling engine adapted to drive the rock-cuttings from holes while drilling them and to lay the rock-dust formed by the drill-bit while cutting or drilling into rock. I attain these objects by the mechanism illustrated in the accompanying drawings, in which—

Figure 1 is a longitudinal section of an air or steam drilling-engine embodying my invention; Fig. 2, an end view of the drill-bit end of the engine; Fig. 3, a section on line A of Fig. 1; Fig. 4, a section on line B of Fig. 1; Fig. 5, a section on line C of Fig. 1; Fig. 6, an end elevation of the feed end of the machine; Fig. 7, a side view of the drill-bit; Fig. 8, an end elevation of the striking end of the drill-bit, and Fig. 9 a section on line C′ of Fig. 1.

Similar letters and numerals of reference refer to similar parts throughout the several views.

Referring to Fig. 1, D designates the cylinder, E the piston, F the steam-chest, G the valve, H the guide-shell in which the cylinder is slidably mounted, and I the feed-screw, of a drilling-engine.

The valve-movement as illustrated is fully described in my Patent No. 567,682, of September 15, 1896.

The drill-feeding mechanism comprises the screw I, the operating-handle J, and the feed-screw-locking mechanism K. This locking mechanism comprises the casing L, which incloses a ratchet-wheel M, which is secured to the screw, and a spring-controlled pawl N, which is provided with a stem O. The pawl and its spring P are mounted in operative engagement with the ratchet-wheel in a depending sleeve portion Q, which forms part of the casing L. The bottom of the sleeve contains a slot Q′, and the end of the stem of the pawl projects into the slot, and a pin R extends transversely through it and is held by the spring P, which surrounds the stem in the chamber R′, against the bottom of the slot and defines the depth of the mesh of the pawl into the teeth of the ratchet-wheel. The casing is held over the ratchet-wheel by the washer L′ and the nut $L^2$. The casing is provided with two opposite laterally-extending ears S and S′, by which it is bolted to the main guide-shell of the drilling-engine by the bolts T and T′. These bolts pass freely through the ears and the flange U of the guide-shell and are secured thereto by nuts V and W and V′ and W′, which are threaded to their ends and which are tightened against the side of the lugs and flange. The feed-screw is threaded through a nut X, which is rigidly supported in a depending lug Y, formed on the bottom of the cylinder D. Its inner end is also journaled in a lug Z, that extends across the end of the guide-shell. The pawl N, which

is round, has a long sloping bearing-face and projects only slightly into the teeth of the ratchet-wheel, which are square, as shown in the dotted lines in Fig. 6, and simply catching against their edges locks the screw against turning backward, or what is the same thing against the cylinder's running down or back on the screw when drilling up holes by turning the screw with its weight, but does not when in the position shown prevent its being fed forward. The pawl is reversible, and by lifting the pin out of the slot of the sleeve and resting it across the ends 1, as shown in dotted lines in Fig. 1 and at right angles to the position shown, the pawl is drawn back away from the ratchet-wheel and the screw is free and can be turned in either direction, while if the pin and pawl are reversed end for end the ratchet-wheel and screw are locked against turning to feed the cylinder forward. The object of thus reversing the position of the pawl is to prevent the cylinder's accidentally running down on the screw by turning it with its weight when drilling down holes and the operator has left the operating-lever of the feed-screw and is engaged in setting and adjusting the engine or some of its parts, which, if this precaution was not taken, would result in injury to the operator. The cylinder is provided with a front cylinder-head 2, which is threaded to the end of the cylinder. A sleeve 3 is rotatively mounted in the axial bore 4 of the cylinder-head. At its inner end the sleeve has an enlarged round flange portion 5, which projects and fits loosely into a counterbore in the inner end of the cylinder-head. The flange portion of the sleeve is larger in diameter than the bore of the cylinder, and its inner end bears against the bottom of the counterbore in which the cylinder-head screws. Between the opposite side of the flange and the bottom of the counterbore of the cylinder-head and around the body of the sleeve I place a steel buffer-ring G, which is provided with a key portion that fits loosely into a keyway N′ in the cylinder-head to prevent its turning on the sleeve. A rubber buffer-ring 7 is also placed at the side of the steel ring. These rings are adapted to cushion the blows of the piston that strike against the end of the sleeve, which happens when the engine is running and the drill-bit is not in striking position against rock. From two opposite sides of the flange-head of the sleeve two rods 8 and 9 project and extend loosely into holes 10 and 11, drilled into the piston. The entrance of these holes is provided with bushings 12 and 13, in which the rods fit slidably. The piston reciprocates on these rods, which are rigidly secured to the sleeve, and through the medium of the rifle-bar 14 and its ratchet-head 15, the pawls 16, and these rods the piston rotatively turns the sleeve step by step.

The means illustrated and just described for turning the piston step by step through the medium of the rifle-bar is common to most all air drilling-engines in use and is more fully illustrated in my patent above mentioned and in Patent No. 568,089. The arrangement of the pawls around the ratchet-wheel of Fig. 1 is exactly the same as illustrated in that patent. The sleeve and rods and the turning of them step by step by the piston are also more fully set forth in application, Serial No. 633,955.

The essential object of this invention is to convey a combined jet of commingled compressed air and water from the cylinder and from a source of water-supply through the drill-bit to its cutting-point, to blow out and expel the rock-cuttings from holes while drilling them, and to also lay the dust formed by cutting the rock. The amount of dust made in drilling a hole a few feet deep in dry rock without water in a breast of an average-sized mining-tunnel is sufficient to fill it full, and its presence is practically unbearable to the operators of the drilling-engine, and the use of some medium to lay it in the hole is necessary. Water is used with the common type of drilling-engine by pouring it in a down-hole and by forcing it into up-holes when necessary by any convenient means. In order to expel the rock-cuttings from the holes and at the same time allay the dust with water, it is necessary that they be introduced into the holes in a manner in which they will work together and in which each will perform its special work without neutralizing the effect of the other. Should the air be conducted axially through the drill-bit to the bottom of a hole, as illustrated in Fig. 1 and in the above-mentioned application, and water be forced into the hole around the drill-bit, the air and water would be moving in opposite directions and would meet and the action of both would be defeated. It is therefore necessary to obtain the best results that the air and water should be united into a single substantially integral jet and be delivered at the bottom of the hole through a closed conduit arranged either alongside of the drill-bit or by an axial hole through it, which shall be connected to the actuating fluid of the cylinder and a source of water-supply under suitable pressure. I preferably carry out this feature of my invention in the following manner: Axially through the rifle-bar from end to end I drill a hole and also axially through the striking end of the piston a similar-sized hole. The hole through the rifle-bar is counterbored slightly larger through its ratchet-head end, as this end has a little lateral play in its supporting-socket in the supplementary cylinder-head 17. A hole is also drilled part way into the back cylinder-head from its inner side, which is threaded, and a tube 18 is threadedly secured to it. This tube projects axially through the rifle-bar and piston into a hole 19, drilled axially through the drill-bit 20 from end to end, which is larger in diameter than the end of the tube. The end of the tube is reduced in diameter to adapt it to ex-

tend into the hole through the drill-bit for a short distance and is enough smaller to leave a clear space all around it for the ingress of the actuating fluid from the cylinder into the hole in the drill-shank. The drill-bit is illustrated with a hole of two diameters through it. This is not absolutely necessary. A hole of even diameter will answer the purpose. It is only essential that the end of the tube project loosely into it.

The drill-bit 20 comprises a shank of any of the customary forms of drill-steel in use. At one end M′ it is upset and formed and sharpened into any one of the several cutting-points used for rock-drill bits, as they are made with one, three, or four chisel-edges. The striking end O′ of the shank projects through the sleeve 3 into the cylinder and into the reciprocal path of the piston, which impinges against it at each full stroke. The striking end is formed into a polygon of preferably five sides for several inches from the end. At the termination of the polygonal end a portion 21 is preferably turned round, and these two portions at this end are a trifle larger than the length of the sleeve, which is provided with an axial bore 22, that is formed partially round and partially of a similar polygonal form as the striking end of the drill-shank. The bore of the sleeve is made to fit the polygonal end and round portion of the striking end of the shank with a loose but snug fit. The drill-shank is provided with a collar 23 at the end of said round portion, which bears against the end of the sleeve and defines the inward movement of the shank of the drill-bit into the cylinder. The drill-bit rests loosely and freely in the sleeve and cylinder-head and is not clamped or bolted to them, and consequently is free to be inserted instantly in them or to be withdrawn instantly from them by the operator. The sleeve does not extend quite to the end of the bore of the cylinder-head, a short space being left in which the collar of the drill-bit extends. The rifle-bar, its pawl 16, of which one is shown, and the rear steel buffer-ring 25 and rubber buffer-ring 26 are supported in a supplementary cylinder-head 17, which is threadedly secured in a counterbore in the rear end of the cylinder. This supplementary head contains a chamber, in which the said rubber buffer is seated, and the steel ring is placed at its side and at the bottom of the counterbore in the end of the cylinder. The opposite side of the supplementary cylinder-head is chambered out to hold the ratchet-head of the rifle-bar and the pawls. The detail construction and arrangement of these pawls and rifle-bar are fully shown in Patent No. 568,089, above referred to. The rear cylinder-head 24 has an annular recess, in which is fitted loosely a flat ring $24^{A}$, (see Fig. 9,) in which a hole $24^{B}$ is drilled, into which the trunnion 28 of the pawl extends. Three pawls are used around the ratchet-wheel, as shown in the above-mentioned patent, and one trunnion of each pawl extends into one of the three holes $24^{B}$. (Shown in the ring in Fig. 9.) An axial recess is also formed in the rear cylinder-head around the tube 18 to support the hub 29 of the ratchet-wheel. The ring $24^{A}$ is not used in the cylinder-head of the patent referred to, as the head bolts to the cylinder in that patent, while the rear cylinder-head 24 in Fig. 1 is threaded to a counterbore in the end of the supplementary cylinder, and it is necessary in order to screw it on that the adjacent trunnions of the pawls have a bearing independent of the cylinder-head and one that will remain stationary while the cylinder-head is being screwed into place. The rear cylinder-head comprises a flanged head portion, with a round body portion a trifle longer than its diameter, which is axially bored out from its outer end to form a valve-chamber. This valve-chamber is internally threaded to receive a threaded plug-valve 30, which is provided with a small hand-wheel 31 at its outer end. Its inner end is pointed to form a plug-valve, and the bottom of the valve-chamber is beveled to form a seat for the valve end of the plug. Axially through the valve-seat a hole 32 is drilled from the valve-chamber through the cylinder-head into the water-tube and the plug-valve is adapted to be screwed to and from the valve-seat and to control the passage from the valve-chamber to the water-tube. A gland 31 is mounted on the plug-valve and is threaded to the end of the cylinder-head, and packing 33 is placed in the gland to prevent leakage of water by the valve. A shoulder 34 is formed by a portion that blends from the flange-head, which is larger in diameter than the portion upon which the gland is mounted, and against this shoulder around the cylinder-head is placed a washer 35. The washer illustrated preferably comprises a flat rubber ring 36, covered with copper 37. At the side of the washer 35 I mount to turn freely a coupling 38, which is provided with an annular chamber 39, and through the shell of the cylinder-head a transverse hole 40 is drilled into the valve-chamber and forms a passage from the coupling to it. At the side of the coupling a washer 41 is placed, and a nut 42 is threaded to the cylinder-head at the side of the said washer which is adapted to compress the coupling and washers against the said shoulder and each other and prevent leakage of the water from the coupling. One side of the coupling is provided with a projecting threaded nipple 43, to which a hose may be secured, which should connect the coupling with any suitable supply of water under suitable pressure. By slightly loosening the nut 42 the coupling may be turned on the cylinder-head, so that the hose or pipe of the water-supply may be connected to it or either side of the drilling-engine and can be instantly changed from one side to the other as the position of the drilling-engine requires it. I thread a cap-screw 44 in the end of the

cylinder over the supplementary cylinder-head and drill the cap-screw hole into the supplementary head and also drill a second hole 45 from the adjacent recess of the pawl's trunnion to intersect it. These holes form an oil-passage to the pawls and ratchet, while the oil also works along the rifle-bar to the rifle-nut 46 in the piston-head.

The operation of my improved drilling-engine is as follows: Compressed air, which is the most generally used actuating fluid, is admitted to the steam-chest F through the side inlets 47, and the valve G is reciprocated in the chest and admits the actuating fluid alternately to the opposite ends of the cylinder through the ports 48, and the piston is reciprocated by the actuating fluid and is turned step by step by sliding on the rifle-bar, which is held against turning in one direction by its pawls. The step-by-step turning movement of the piston is imparted to the sleeve 3 through the medium of the rods 8 and 9, and the drill-bit is rotated step by step by the sleeve. When the actuating fluid rushes into the front end of the cylinder, it moves the piston backward and also moves the drill forward against the rock if the engine is in operative relation to rock, and it rushes into the shank of the drill-bit and through it to its cutting-point in a puff-like volume.

The water should preferably be under pressure enough to flow to and through the drilling-engine and drill-bit without causing back pressure on the actuating fluid mingling with it. The water-supply pipe or hose is connected to the coupling, and the water flows through it into the valve-chamber and from the valve-chamber into and through the tube into the shank of the drill-bit and mixes and commingles with the actuating fluid of the cylinder as they both flow through the drill-bit together.

It is not necessary that the air should be disseminated through the water. It may even combine with it in the form of independent air-piston-like sections as they both flow along. The water flows in a steady stream; but the size of the stream can be regulated by the plug-valve and can be reduced to a size that when mingled with air will result in a spray which is discharged in puffs from the drill-bit in the bottom of the hole immediately after each blow of the piston against the drill-bit and of the drill-bit against the rock and allays the dust as well as drives the rock-cuttings from the hole.

Some kinds of rock will require more water than a spray would give; but any amount of water can be combined with the air and may be discharged in a steady stream, if necessary, as its volume can be regulated by the plug-valve.

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

1. A rock-drilling engine provided with a drill-bit arranged to project into the cylinder of the drilling-engine and arranged to be operatively struck upon its end by the reciprocal movements of the engine's piston and containing a passage or conduit from said engine's cylinder to or adjacent to said drill-bit's cutting-point and a water passage or tube or conduit and a suitable water-supply through said drilling-engine to said passage in said drill-bit whereby a commingled supply of the cylinder's actuating fluid and water is conveyed from said drilling-engine through said drill-bit to its cutting-point and to the bottom of holes in rock while drilling them, substantially as described.

2. A rock-drilling engine comprising a suitable cylinder, a reciprocative piston, a suitable controlling-valve and suitable feeding mechanism, and drill-bit arranged to project into said cylinder into the reciprocal path of said piston and arranged and adapted to be struck directly on their cylinder-invading ends by the reciprocal movements of said piston, and containing a passage or conduit for the actuating fluid of said rock-drilling engine opening into or communicating with said engine's cylinder and extending through said drill-bits to or adjacent to their cutting-points, a water-conveying tube or conduit and a suitable water-supply connecting with the said passage or conduit in said drill-bits and a combined stream of water and the cylinder's actuating fluid flowing through said drill-bits to their cutting-points and to the bottom of holes while drilling them, whereby a combined stream of commingled actuating fluid and water is forced to the cutting-points of said drill-bits while drilling rock, and the rock-cuttings are thereby rejected, substantially as described.

3. In a drilling-engine, the combination with the cylinder and the piston, of a drill-bit containing an axial hole from end to end and extending into the cylinder and open to the engine's actuating fluid, an axial bore through said piston, and a tube in said bore projecting into the hole in said drill-bit, substantially as described.

4. The combination in a rock-drilling engine of the cylinder, the piston, the cylinder-heads, the sleeve and the hollow drill, with a liquid or water conveying tube through said piston connected with said hollow drill, a passage from said cylinder adapted to allow the cylinder's actuating fluid to flow into said hollow drill whereby a combined stream of liquid and actuating fluid is caused to flow through said drill-bit to the bottoms of holes while drilling them, and means including a valve for controlling the volume and pressure of said liquid and actuating fluid stream, substantially as described.

5. The combination with the cylinder, the piston, the front cylinder-head, the sleeve, and the rods projecting from said sleeve into said piston, with a hollow bit keyed loosely to said sleeve and arranged to be instantly withdrawn from or inserted in said sleeve and provided

with means for defining its operative position in said sleeve and to said cylinder and piston, and with a fixed tube projecting from the rear end of said cylinder freely through said piston and extending into said drill-bit, substantially as described.

6. The combination with the cylinder and the piston of a hollow drill-bit projecting into said cylinder into the reciprocating path of the piston and arranged to convey a portion of the piston's actuating fluid to the bottom of holes while drilling them, of a water-tube projecting into said drill-bit for supplying water under pressure and mingling it with the actuating fluid of said drill-bit and discharging into the bottoms of holes while drilling them in a combined stream of actuating fluid and water, substantially as described.

7. The combination with the cylinder and the piston, of the front, the rear, and the supplementary cylinder-heads, a hollow drill-bit projecting into said cylinder in the path of the piston and a water-inlet tube secured to said rear cylinder-head and projecting through said piston into said drill-bit, substantially as described.

8. The combination with the piston, the drill-bit; the supplementary cylinder-head; the rifle-bar and the rear cylinder-head having a water-inlet tube secured thereto and projecting therefrom loosely through the axial center of said rifle-bar and said piston into the striking end of said drill-bit, substantially as described.

9. The combination with the drill-bit, the piston and the rifle-bar; axial holes through said rifle-bar and piston; a water-inlet tube projecting loosely through said axial holes into said drill-bit adapted to conduct a stream of water under pressure through said tube and drill-bit; and a valve for controlling the flow of said water, substantially as described.

10. The combination in a rock-drilling engine of a piston having an axial bore, a rifle-bar also having an axial bore; a cylinder-head having a tube projecting through said rifle-bar and piston; a water-passage to said tube; a valve adjacent to said tube for controlling said passage; means for mingling said water with a portion of the engine's actuating fluid and means for conducting said actuating fluid and water in a combined stream to the bottom of holes in rock while drilling them, substantially as described.

11. The combination with the hollow drill-bit, of the sleeve; the cylinder; the piston, the rifle-bar; and the rear cylinder-head having a water-inlet tube projecting through said rifle-bar and piston into said drill-bit; and a passage around said tube from said cylinder into said drill-bit; substantially as described.

12. The combination with the cylinder and the piston, of a hollow drill-bit mounted to be turned step by step by said piston; a water-inlet tube projecting into said drill-bit; and a passage from said cylinder into said drill-bit, substantially as described.

13. The combination with the cylinder, the piston, the cylinder-head and the sleeve, of a hollow drill-bit projecting into said cylinder and adapted to convey a portion of the cylinder's actuating fluid to its cutting-point; of a conduit adapted to convey a stream of water under pressure to said drill-point, a rear cylinder-head; a passage in said cylinder-head for said water, a valve adapted to control the admission and volume of said water, and a water-inlet coupling adapted to connect with a source of water-supply on either side of said cylinder, substantially as described.

14. The combination with the piston having an axial hole, the drill-bit; the rifle-bar having an axial hole and the back cylinder-head carrying a water-inlet tube projecting through the axial bores of said rifle-bar and piston; with a water-inlet coupling rotatably mounted on said cylinder-head; a passage from said coupling to said tube and means including a nut and thread for packing said coupling against leakage, substantially as described.

15. The combination with the piston and the hollow drill-bit, of the back cylinder-head, the water-inlet tube projecting therefrom through said piston and into said drill-bit, a passage through said cylinder-head for the admittance of water under pressure to said tube and drill-bit; a valve, controlling said passage and a suitable packing device for said valve, substantially as described.

16. The combination of the hollow drill-bit, the piston, the rifle-bar; and the back cylinder-head, with a tube projecting loosely through bores in said rifle-bar and piston and with a water-inlet coupling having a hose or pipe connecting nipple, and a passage from said coupling to said tube, substantially as described.

17. The combination with the back cylinder-head, of the rotatable water-coupling mounted thereon, a shoulder or abutment adjacent to said coupling; a washer between said coupling and said shoulder; a second washer on the opposite side of said coupling; and a nut threaded to said cylinder-head adapted to tighten said washers and coupling against said shoulder and thereby pack said cylinder against leakage, substantially as described.

18. The combination of the supplementary cylinder-head, the rear cylinder-head secured thereto, the water-inlet tube; the rifle-bar revoluble on said tube; the piston arranged to reciprocate and turn on said tube and the hollow drill-bit surrounding the discharging end of said tube, substantially as described.

19. The combination with the back cylinder-head, of the water-inlet coupling rotatively mounted thereon, the washers at its sides and the tightening-nut, substantially as described.

20. The combination of the back cylinder-head, the plug-valve threaded thereto and the

gland and packing surrounding said valve and the end of said cylinder-head, substantially as described.

21. The combination with the cylinder, of the piston, the hollow drill-bit, the rifle-bar and the water-inlet tube projecting through said rifle-bar and piston into said drill-bit, with the back cylinder-head, the water-inlet passage therein; the water-inlet coupling and the valve for controlling said water-inlet passage, substantially as described.

22. The combination of the cylinder, the piston, the rifle-bar and the pawls, with the supplementary cylinder-head and back cylinder-head, the pawl-trunnion-supporting ring; a water-inlet tube, a threaded hole in said cylinder and into said supplementary cylinder-head; a cap-screw in said threaded hole and an oil-hole leading from said cap-screw hole to said pawls and rifle-bar, substantially as described.

23. The combination of the cylinder, the supplementary cylinder-head threaded thereto and having an oil-hole therein, a cap in said oil-hole, the pawls, the pawl-trunnion-supporting ring, the rifle-bar supported by said supplementary cylinder-head and an oil-passage from said oil-hole to said pawls and rifle-bar, with the rear cylinder-head and the water-inlet tube, substantially as described.

24. The combination in a rock-drilling engine, of a drilling-engine, a drill-bit for said drilling-engine and means connected with said drill-bit and drilling-engine whereby a combined stream or jet of the engine's actuating fluid and water is discharged steadily or intermittently from the drill-bit into the bottoms of holes in rock while drilling them, substantially as described.

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

JOHN GEORGE LEYNER.

Witnesses:
SAMUEL ELISHA FOWLER,
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