(No Model.)

J. G. LEYNER.

ROCK DRILL ENGINE.

No. 604,538. Patented May 24, 1898.

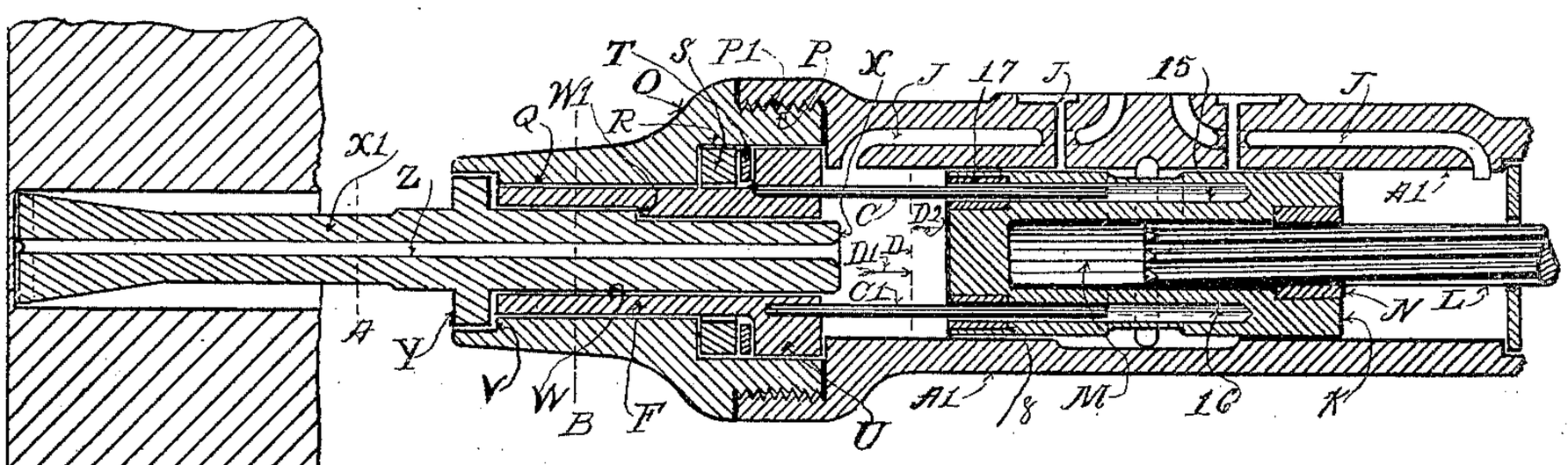

Fig. 1.

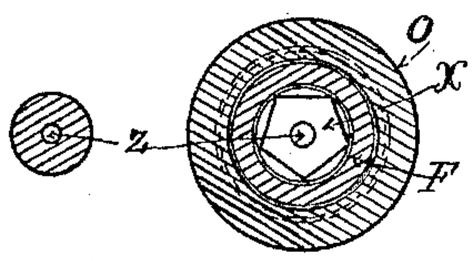

Fig. 2.

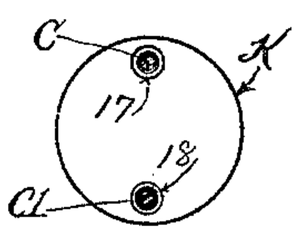

Fig. 3.

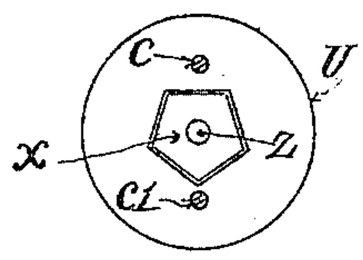

Fig. 4.

Fig. 5.

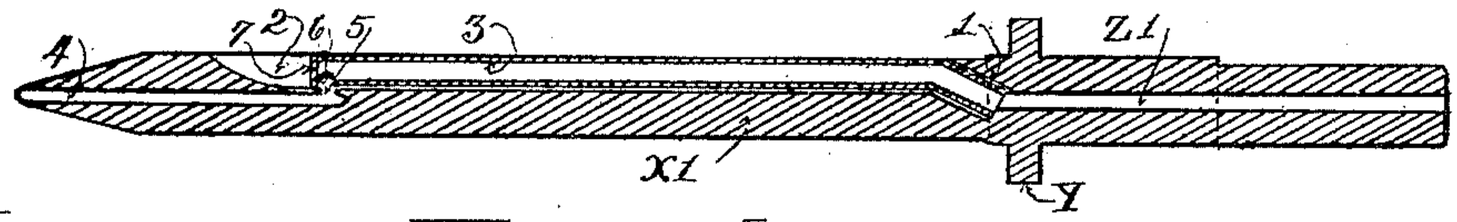

Fig. 6.

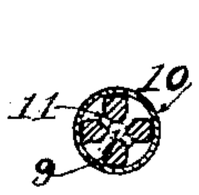

Fig. 7.

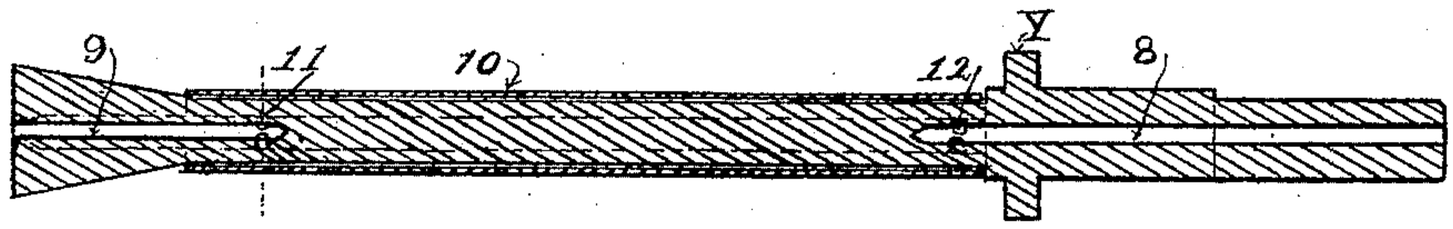

Fig. 8.

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UNITED STATES PATENT OFFICE.

JOHN GEORGE LEYNER, OF DENVER, COLORADO.

ROCK-DRILL ENGINE.

SPECIFICATION forming part of Letters Patent No. 604,538, dated May 24, 1898.

Application filed April 26, 1897. Serial No. 633,955. (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 rock-drilling engines; and the objects of my invention are, first, to provide an air or steam drilling-engine in which a portion of the expansive fluid is conveyed from the cylinder to the cutting end of the drill-bit and when the drilling-engine is drilling in rock is adapted to eject the rock-cuttings from the bottom of the hole; second, to provide a drill-bit that is held loosely by the front cylinder-head and can consequently be inserted into and withdrawn from the front cylinder-head at will and that is adapted to be intermittently rotated step by step therein by the reciprocating and intermittent rotary movement of the piston; third, to provide a drilling-bit for air or steam rock-drilling engines having an air or steam conveying conduit throughout its length and adapted to convey a portion of the expansive fluid from the cylinder to its cutting-point; fourth, to provide a drilling-engine in which the drill-bit rests loosely and is free to rotate in the cylinder-head and at the same time is held in a fixed position relative to the piston, which is adapted to impinge against its inner end. I attain these objects by the mechanism illustrated in the accompanying drawings, in which—

Figure 1 represents a central longitudinal sectional view of such parts of an air rock-drilling engine as are necessary to illustrate my invention. This view also shows the drilling-bit extending into a drilled hole in a fragment of a breast of rock. Fig. 2 represents a section of the drill-bit on line A of Fig. 1; Fig. 3, a section through the front cylinder-head on line B of Fig. 1, showing the drill-bit in end elevation; Fig. 4, an end elevation of the piston-head and section of the rods C and C′ on line D of Fig. 1, looking toward the piston-head in the direction of the arrow D′; Fig. 5, a section of Fig. 6; Fig. 6, a sectional elevation of a drill-bit, showing a modification of Fig. 1; Fig. 7, a section of Fig. 8; Fig. 8, a sectional view of a drill-bit made from ribbed steel and adapted to convey the expansive fluid from its shank end to its cutting-point; and Fig. 9, an end elevation of the sleeve F of the front cylinder-head and of the inner end of the drill and section of the rods C and C′ on line D of Fig. 1, looking in the direction of the arrow D^2.

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

Referring to Fig. 1, A′ designates the cylinder of a rock-drilling engine, the back end and back cylinder-head, the pawl and ratchet, and the head of the rifle-bar being broken away.

J designates the air-inlet ports.

K designates the piston, and L the rifle-bar. The rifle-bar extends into a clear hole M in the piston through a nut N, which is rifled or threaded to the rifles or threads of the rifle-bar.

O designates the front cylinder-head. It is an integral cylindrical cylinder-head—that is, it is not divided into two halves, as is customary. It is provided with a threaded end P, which screws into a threaded counterbore P′ in the end of the cylinder. The front head O contains an axially-bored hole Q, which is counterbored at each end. The inner counterbore R is larger in diameter than the bore of the cylinder of the drill. In this counterbore I place a rubber buffer-ring S, which rests against the bottom of the counterbore, and also a steel buffer-ring T, which rests against the rubber buffer-ring. A sleeve F rests loosely and rotatably in the bore of the cylinder-head, and a collar portion U projects into the counterbore and rests loosely between the steel ring and the bottom of the counterbore P′ in the end of the cylinder. The sleeve extends from the inner end of the cylinder-head to the bottom of the counterbore V in the front edge of the cylinder-head. Through the axial center of the sleeve a hole W is made, which from the front end of the sleeve is round for a portion of the length of

the sleeve, or to the point W′, and from the point W′ to the inner end of the sleeve is a pentagon polygon in form, as shown in Figs. 3 and 9. In this partly-round and partly-pentagon-shaped hole rests loosely the inner or striking end X of the drill-bit X′. This striking end is of pentagon shape, and its pentagon end is made a little longer than the same shaped portion of the sleeve in order to allow the drill to extend into the cylinder a short distance beyond the end of the sleeve. This pentagon-shaped end of the drill-bit and the similar-shaped hole in the sleeve key the drill-bit and sleeve together, so that when the sleeve is moved rotatively the drill-bit will move with it. That portion of the drill-bit adjacent to the pentagon end is preferably made round and fits in the round part of the hole in the sleeve. A collar Y is formed on the drill-bit in a position to rest in the bottom of the counterbore V when the drill-bit is in its normal position.

The body of the drill-bit may be of any desired form of cross-section, and its striking end may be of any desired polygonal form. The drill shown in Figs. 1 and 6 is round, as shown in their respective cross-sections 2 and 5, but may be of hexagon or any other polygonal form, if preferred. In Figs. 7 and 8 I illustrate a drill made of the commonly-used four-ribbed or cross drill steel. In order to convey the expansive fluid from the cylinder to the cutting-point of these two forms of drill-bits, I employ different methods. In Fig. 1 I provide the drill-bit with a hole Z, extending axially through the entire length of it, thus making a direct passage for the expansive fluid from the cylinder to the cutting edge of the drill-bit. In Figs. 5 and 6 I show a modification of this arrangement. A hole Z′ is bored into the shank end of the drill-bit to just beyond the collar Y, from which point a hole 1 is drilled at an angle through the side of the shank to meet it. From the entrance of this hole a slot 2 is milled along the shank of the drill to within a few inches of its point. In this slot I secure a tube 3 by solder or other suitable means. Axially into the cutting end of the drill-bit I drill a hole 4 to beyond the end of the tube and then drill a hole 5 through the bottom of the slot into it and also a hole 6 in the tube and arrange the tube in the slot, so that the hole 6 will register with the hole 5. I close the lower end of the tube by a plug 7 or in any suitable manner; but the upper end is open and is bent to fit into and is soldered into the inclined hole. A continuous passage is thus formed through the holes in the ends and through the tube for the expansive fluid. When the form of drill-steel shown in Figs. 7 and 8 is used for the drills, I drill a hole 8 into the shank end beyond the collar and also a hole 9 into its cutting end for a short distance, and before the cutting-point is forged on the bar of steel I place a piece of tubing 10 on the drill-bit that will fit it snugly and solder it to it at the ends and use solder enough to close the ends between the ribs of the drill-bit. I also drill holes 11 and 12 from the bottom of this space between the ribs into the holes in the ends, thus making a continuous passage through the holes in the ends of the drill-bit and the spaces between one, or two, or all of the ribs, as shown in the cross-section in Fig. 7. The shanks of the drill-bits in Figs. 6 and 8 are the same as that of Fig. 1 and fit in the sleeve of the cylinder-head in the same manner. As the drills rest loosely in the sleeve, they will naturally fall out if the drilling-engine is tipped to point them downward; but when drilling down holes a muzzle is used which clamps to them and to the end of the cylinder-head. I do not show this muzzle, as it does not form any part of my improvements. The drill-bit will remain in the sleeve when drilling up holes, and the collar prevents it from moving backward too far into the cylinder, while when drilling rock the drilling-engine is fed to keep the cutting-point of the drill normal against the rock. At diametrically opposite points in the collar portion of the sleeve I secure rigidly two or more rods C and C′, arranging them at equal distances apart from the center. These rods extend to and enter apertures 15 and 16 in the piston-head. These apertures are larger than the rods and form a clear space for them to move in when the piston is reciprocated in the cylinder. At the entrance of these apertures I place brass bushings 17 and 18, which while they fit the rods loosely form bearings for them.

The operation is as follows: The expansive fluid entering through the ports J reciprocates the piston back and forth in the cylinder on the rifle-bar, which is locked against rotative movement in one direction by a ratchet-wheel and pawl mechanism, (not shown,) but the rifle-bar and piston are free to turn in the cylinder as they move either forward or back on the rifle-bar, and the piston is compelled to turn a short distance when moving in one direction as it moves on the rifles of the rifle-bar, and the rifle-bar is locked against turning movement in but one direction. Consequently the rifle-bar imparts to the piston-head a step-by-step rotative movement as it is reciprocated in the cylinder, these movements and the ratchet-and-pawl mechanism for turning the piston-head being common to all air drilling-engines. The step-by-step rotative movement of the piston can take place either on the forward or on the backward stroke, according to the arrangement of the ratchet-head of the rifle-bar and the pawls. As the piston in Fig. 1 is connected to the sleeve F of the cylinder-head by the rods C and C′ and the sleeve is keyed or locked to the shank of the drill-bit by the pentagon-shaped hole and the similarly-formed end of the drill-bit which extends through it, this step-by-step turning movement of the piston is imparted to the sleeve and through it to the drill-bit, which

is thus turned progressively in the hole in the rock. The piston as it reciprocates slides on the rods C and C′ and strikes on the end of the drill, and when the drill is in normal position against the rock, as shown in Fig. 1, the drill and rock receive the full force of the blow of the piston. If the drill-point is too far away from the rock, the piston drives the end of the drill into or out of the sleeve and strikes the end of the sleeve, and the steel and rubber buffer-rings take the force of the blow. By this arrangement I am enabled by proper feeding of the engine and bit to keep the drill pressed against the rock just before and at the time the piston strikes it. The recoil of the drill-bit from the blow of the piston will move it back a slight distance from the rock, where it can be easily turned step by step through the medium of the piston, the rifle-bar, the rods, and the sleeve. As the piston is reciprocated very rapidly in the cylinder by the expansive fluid a portion of the fluid which flows into the front end of the cylinder passes through the hole in the drill-bit to its point or to the bottom of the hole being drilled in the rock, and the expansive force of the air or steam blows the rock-cuttings away from the cutting end of the drill-bit and out of the hole, and as a portion of the expansive fluid discharges at the bottom of the hole directly after each blow is struck as long as the drilling continues the drill-bit and the hole are kept free from rock-cuttings.

The rock-cuttings are a source of great annoyance in drilling rock, as they clog the drill-bit and strain the turning mechanism of the drill-bit. They also prevent, by packing between the cutting-point of the drill and the rock, the drill cutting as fast as it would if they were removed. The cutting edge of a drill-bit will also wear much longer if the hole is kept free from cuttings.

Most all drilling-engines at present in use are what are called "plunger" drilling-engines. They derive this name from the fact that the drill-bits are removably clamped to an extension of the piston-head called the "plunger," which extends through and beyond the cylinder-head and reciprocates through it and is reciprocated and plunged by the piston and its plunger against the rock, and it is necessary every time the rock-cuttings are removed from the hole being drilled to move the drill out of alinement with the hole in order to insert the tool used to remove them and afterward to reset the drill in line with the hole. By my present invention I am enabled to change the drills very quickly, especially in all horizontal and upwardly-inclined holes, as they simply rest loosely in the sleeves, and for down holes as quickly as in the old method. I am also enabled by providing a drilling-engine in which the drill-bit is adapted to be held against the rock at the time the blow is struck to cut rock faster, to save the cutting edge of the drill-bit, and to get a heavier blow from the piston when the conditions are equal, as the piston works with less friction in the present arrangement than on the plunger principle. I am also enabled by conveying a portion of the expansive fluid at each stroke of the piston to keep the drill-bit and the hole being drilled entirely free from rock-cuttings, and while I have illustrated and described means for expelling the rock-cuttings from the holes being drilled I do not wish to be limited to them, but claim the right to use any and all arrangements by which a portion of the expansive fluid entering the cylinder is conveyed to the point of the drill and to the bottom of the holes being drilled in the rock.

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

1. In a rock-drilling engine, the combination with the cylinder and the piston, of a front cylinder-head comprising an integral, cylindrical member adapted to be threaded to the end of said cylinder, an axial bore through said head, a counterbore at its inner end, a sleeve rotatably seated in said bore, buffer-rings in the bottom of said counterbore and a collar or head portion on said sleeve extending into said counterbore and resting between the buffer-rings and the end of said cylinder, substantially as described.

2. In a rock-drilling engine, the combination with the cylinder, the piston and the cylinder-head, of a rotatable sleeve axially supported in said cylinder-head, having an axial bore, a portion of which is of polygonal cross-section, with a drill-bit loosely supported in said sleeve and having a polygonal-shaped shank adapted to fit the polygonal bore of said sleeve and having its shank extending normally beyond the sleeve into said cylinder of the drill, and having a hole, passage or conduit extending through or along the drill-bit from end to end and adapted to convey a portion of the actuating expansive fluid from the cylinder to the cutting-point of the drill and to the bottom of the hole being drilled, substantially as described.

3. The combination in a rock-drilling engine, of the cylinder, the piston, and the front cylinder-head having an axial bore, a counterbore adjacent to its cylinder end of larger diameter than the bore of said cylinder, a sleeve rotatably seated in said cylinder-head having a collar portion on its inner end extending into said counterbore and of larger diameter than the bore of said cylinder, a rubber buffer-ring and a steel buffer-ring surrounding said sleeve between the collar portion and the bottom of said counterbore and having two or more rods secured at diametrically opposite points in the collar portion, with said piston-head having holes therein adapted to fit freely said rods and adapted to reciprocate on said rods, substantially as described.

4. The combination with the cylinder and the piston, of the front cylinder-head, the sleeve, the rods, the free holes in the piston

in which the rods extend and a bushing at the entrance of said holes adapted to fit slidably the said rods, substantially as described.

5. The combination with the cylinder and the piston, of the front cylinder-head, the sleeve, the buffer-rings, the rods secured to said sleeve, the holes in said piston-head, the bushings at the entrance of said holes and the drill-bit adapted to be operatively supported by said sleeve and having a passage or conduit from end to end adapted to convey a portion of the actuating expansive fluid from the cylinder to the cutting-point of the drill and to the bottom of the hole being drilled, substantially as described.

6. The combination with the cylinder and the piston, of the front cylinder-head, a sleeve rotatably supported axially therein, a drill-bit operatively supported by said sleeve and means connected with the said piston for rotating or turning said sleeve and drill-bit step by step, substantially as described.

7. The combination with the cylinder, the piston and the front cylinder-head, of a drill-bit adapted to be operatively held and supported loosely in said cylinder-head so as to be withdrawn therefrom and inserted therein instantly at will, and adapted to extend into the reciprocal path of said piston and be impinged by it in its reciprocal movements in the said cylinder and having a passage extending through it, from one end to the other adapted to convey a portion of the actuating expansive fluid used to operate the piston from the front end of the cylinder to the cutting-point of the said drill-bit and means for rotating or turning said drill-bit step by step at each full stroke of said piston, substantially as described.

8. The combination with the cylinder, the piston, the front cylinder-head and the sleeve freely supported by said cylinder-head and having an axial perforation round in cross-section for a portion of its length and of polygon shape for the rest of its length, with a drill-bit having a shank adapted to fit both portions of the hole in said sleeve loosely, and extending through said sleeve into said cylinder into the reciprocal path of said piston, a counterbore in the outer end of said cylinder-head, a collar or projection on said drill-bit normally resting in said counterbore and adapted to define the inward movement and the position of the end of the drill-bit's shank relative to the said piston, means for rotating said drill-bit and sleeve step by step, and an axially-arranged hole extending through said drill-bit from end to end and adapted to convey a portion of the actuating expansive fluid from the cylinder to the cutting-point of said drill-bit, substantially as described.

9. The combination with the cylinder, the piston, the front cylinder-head and the sleeve, of a drill-bit adapted to be operatively supported by said sleeve and having a pentagon-shaped shank and a round portion adjacent to said pentagon end, a collar or projection adjacent to said round portion and an axial perforation through said drill-bit and means for rotating said drill-bit step by step, substantially as described.

10. The combination with the cylinder, the piston, the front cylinder-head and the sleeve, of a drill-bit constructed of ribbed steel and operatively supported by said sleeve and front cylinder-head and having a hole drilled axially into each end of it for a short distance, a tube soldered over its central portion and closed at its ends and perforations extending from the axial holes at each end into the spaces between the ribs of the drill-bit and into the tube, whereby a continuous passage is formed from one end of the drill-bit to the other, as and for the purpose herein set forth and described.

11. The combination with the cylinder, the piston, the front cylinder-head and the sleeve adapted to be operatively supported by said sleeve, of a drill-bit having an axial hole in each end, a hole drilled at an angle from the side of the bit into the axial hole in the shank end of the bit, a slot along the bit from said inclined hole to near the cutting end of the bit and a tube soldered in said slot having one end inserted into said inclined hole and its opposite end closed, a hole leading from each end of the tube into the holes at the end of the bit and means for rotating said bit step by step, substantially as described.

12. The combination with the cylinder, the piston, the front cylinder-head and a sleeve having a polygonal-shaped hole formed axially through its center, of a drill-bit adapted to fit freely in said sleeve and projecting beyond it into the reciprocal part of said piston, a collar on said drill-bit adapted to normally rest in contact with the outer end of said cylinder-head, an axially-formed hole in each end of said drill-bit, and a tube or passage either in or attached to said drill-bit adapted to connect with the holes in its ends, whereby a continuous passage is made throughout the entire length of said drill-bit, substantially as described.

13. The combination with the cylinder, the piston, the cylinder-head and the sleeve, having a square or polygonal-shaped axially-arranged aperture, with a drill-bit of any form of cross-section, having a square or polygonal-shaped striking end adapted to fit freely the polygonal aperture in said sleeve and arranged to be operatively impinged and intermittently rotated by said piston, a collar or projecting portion adjacent to said drill-point's striking end adapted to normally rest against the outer end of said cylinder-head, and a passage from the striking end of said drill-bit to its cutting-point adapted to convey a portion of the piston's actuating fluid from said cylinder to the cutting-point of said drill-bit and to the bottom of the hole being drilled, substantially as described.

14. In a rock-drill bit, a drill-shank of any merchantable form of cross-section having a

cutting-point of any desired common form, a polygonal-shaped striking end, a collar adjacent to said end and an axial hole from end to end throughout its length, or a closed passage attached to or arranged to form a part of said drill-bit extending from its striking end to its cutting-point, substantially as described.

15. The combination with the cylinder, the piston and the front cylinder-head, of a drill-bit resting freely and loosely and not in any way clampingly secured or fastened to the cylinder-head but operatively supported in a substantially fixed position relative to the reciprocal movements of said piston and arranged and adapted to be struck intermittently and successively by said piston, means for rotating said drill-bit step by step and means for conveying a portion of the piston's actuating fluid from the cylinder to the drill-bit's cutting-point, substantially as described.

16. A rock-cutting drill for rock-drilling engines, comprising a bar of drilled steel of any form of cross-section containing an axial hole through it from end to end and a collar or projection or shoulder adjacent to or at a short distance from its striking end, substantially as described.

17. A rock-drilling engine having a rock-cutting drill loosely positioned and supported in and to the drilling-engine and arranged to be impinged upon one end by a reciprocal movement of the piston, and arranged and adapted to convey a portion of the piston's actuating fluid directly from the cylinder into and through said cutting-drill to its cutting-point and to the bottom of the hole being drilled, whereby said actuating fluid is used to expel the rock-cuttings from the hole being drilled, substantially as described.

18. A rock-drilling engine having a rock-cutting drill loosely positioned and supported in the drilling-engine and arranged to be impinged upon one end by a reciprocal movement of the piston, an axial hole through said rock-cutting drill from end to end arranged and adapted to convey a portion of the piston's actuating fluid directly from the cylinder to its cutting-point to blow out from the hole being drilled the rock-cuttings, and said drill arranged and adapted to be moved by the expansive fluid against the rock after each recoil from the rock, after each blow of the piston, substantially as described.

19. A rock-drilling engine for expelling the rock-cuttings from holes while drilling them, consisting of an operative drilling-engine having rock-cutting drills arranged and adapted to extend into the cylinder of the drilling-engine and to be struck and actuated to cut rock by the reciprocative movements of the piston impinging against its inner end and in which the cutting-drills have an axial hole through them from end to end, and the piston's actuating fluid has at all times, free, direct and unobstructed passage from the cylinder to the cutting-point of the drill and to the atmosphere and to the bottom of the hole being drilled, substantially as described.

20. A rock-drilling engine having a rock-cutting drill arranged to be struck by the reciprocal movements of the piston, and provided with a collar, projection, or shoulder adjacent to its striking end, adapted to form an abutment or rest, against the front part of the drilling-engine and define the cutting-drill's operative position relative to the engine's piston and a passage axially through said cutting-drill arranged to conduct a portion of the piston's actuating fluid directly from the cylinder to the cutting-point of said rock-cutting drill, substantially as described.

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

JOHN GEORGE LEYNER.

Witnesses:

LYMAN E. ANDREWS,

WM. N. HOWDEN.