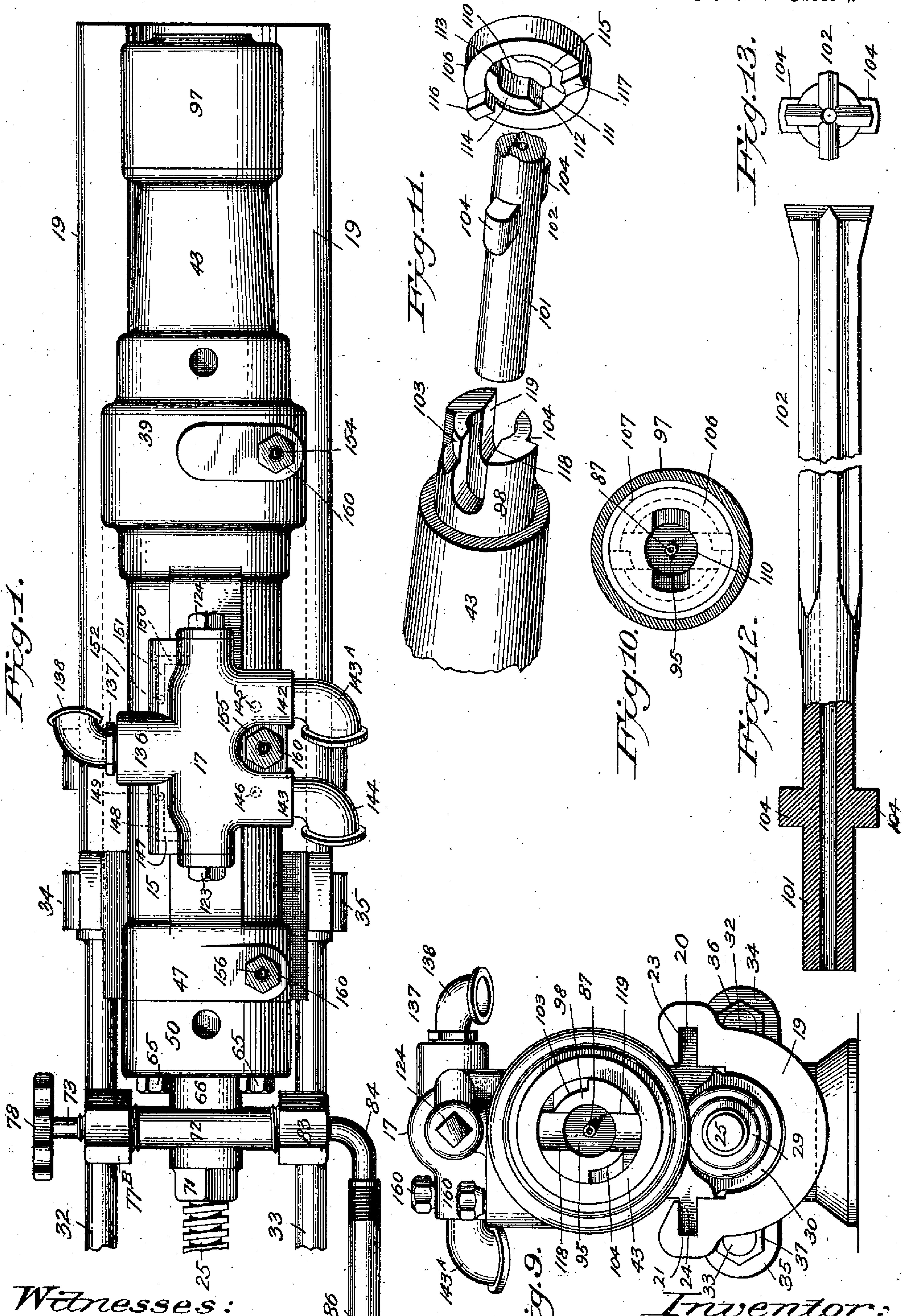
No. 709,022. Patented Sept. 16, 1902.

J. G. LEYNER.

ROCK DRILLING ENGINE.

(Application filed July 18, 1901.)

(No Model.) 3 Sheets—Sheet 1.



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THE NORRIS PETERS CO., PHOTO-LITHO., WASHINGTON, D. C.

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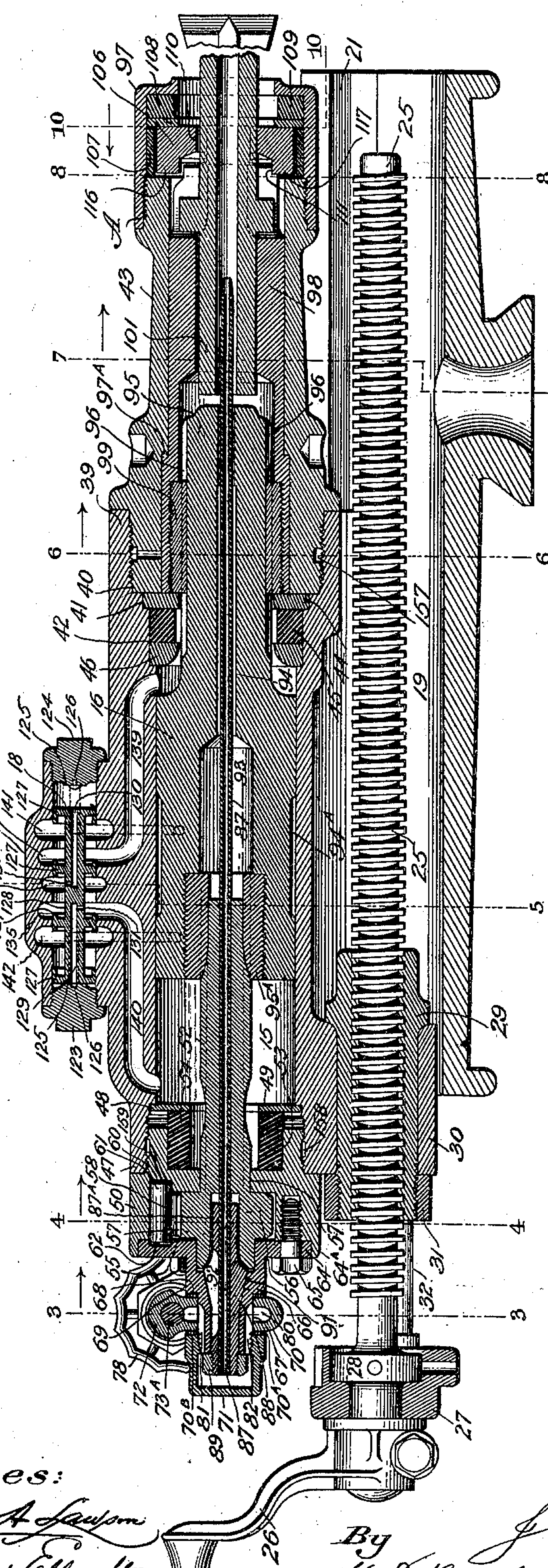

Fig. 2.

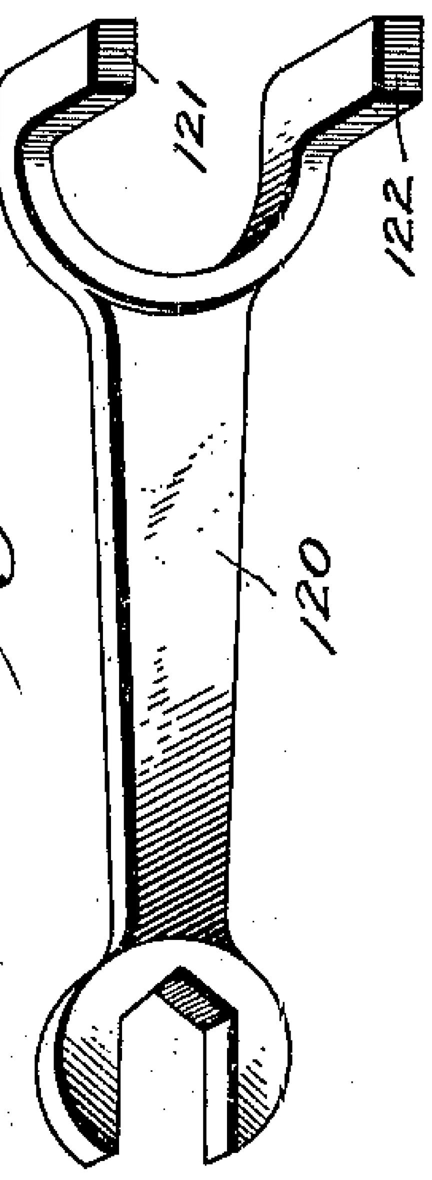

Fig. 15.

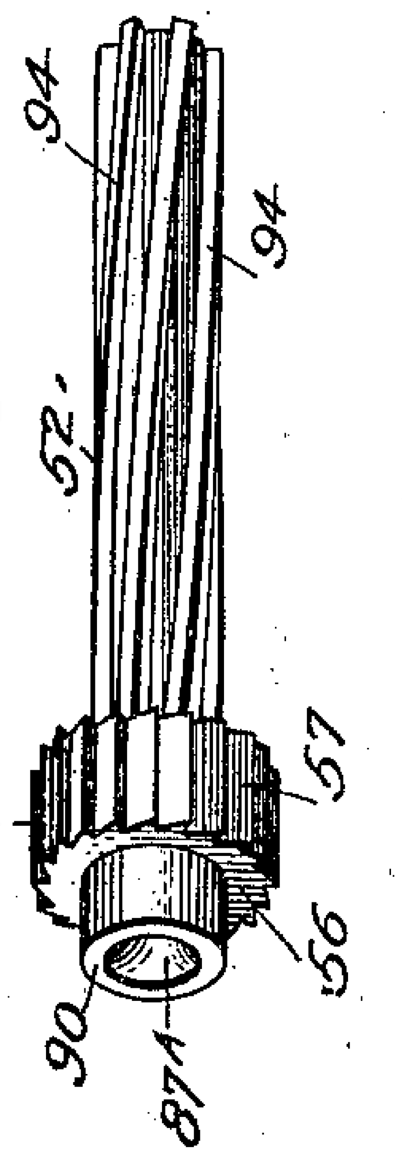

Fig. 14.

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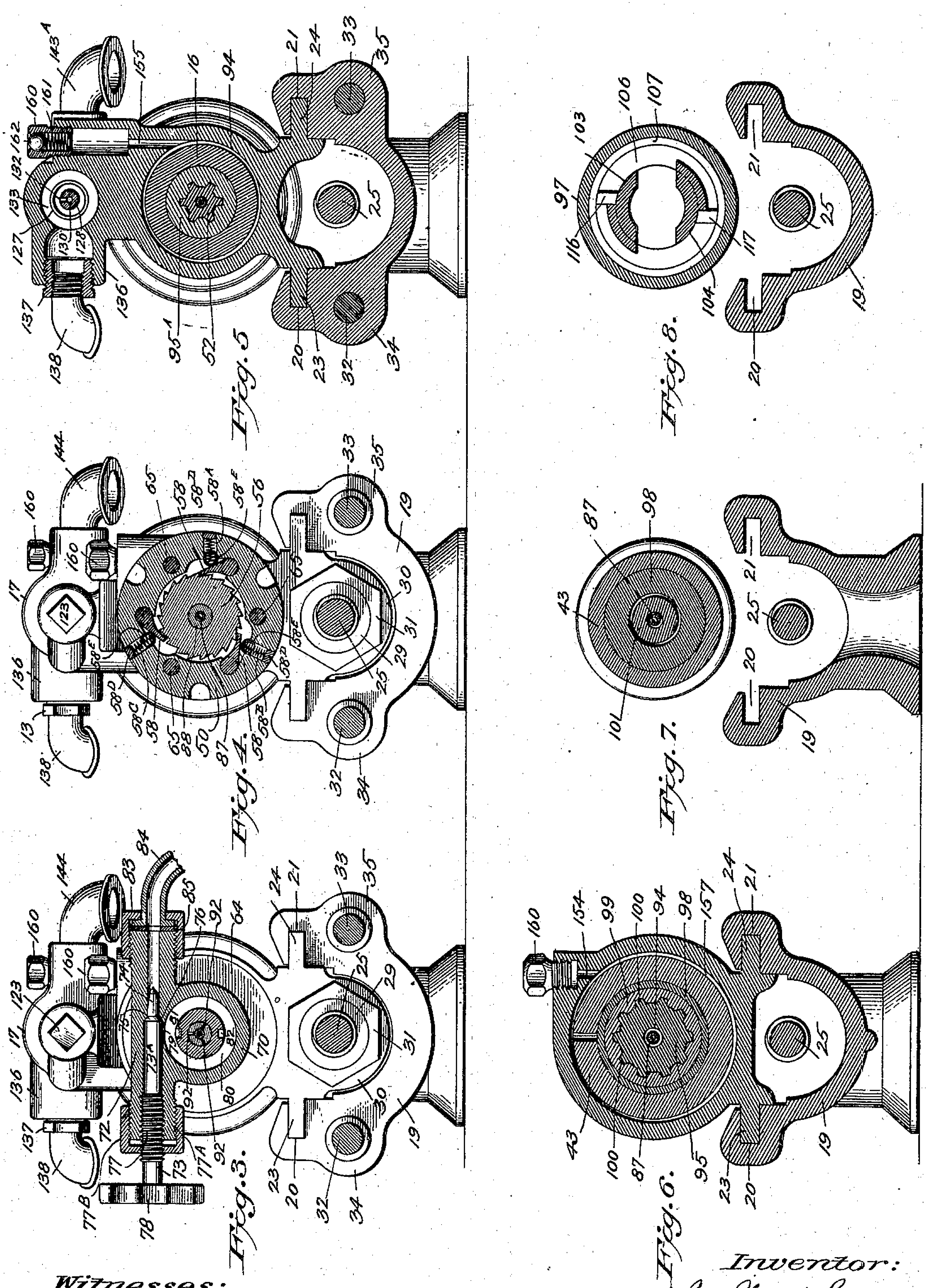
(No Model.) 3 Sheets—Sheet 3.



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UNITED STATES PATENT OFFICE.

JOHN GEORGE LEYNER, OF DENVER, COLORADO.

ROCK-DRILLING ENGINE.

SPECIFICATION forming part of Letters Patent No. 709,022, dated September 16, 1902.

Application filed July 18, 1901. Serial No. 68,808. (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 figures of reference marked thereon, which form a part of this specification.

My invention relates to improvements in rock-drilling engines, and pertains to that class of air rock-drilling engines that expel the rock cuttings from the holes they drill by discharging a combined and commingled jet or spray of air and water to the bottoms of holes in rocks while drilling them; and the objects of my invention are, first, to provide a simple, strong, durable, and positive operating drill and a drill capable of drilling the largest and deepest holes required in drilling rock for blasting purposes; second, to provide an improved valve mechanism; third, to produce an improved device for regulating the quantity and pressure of the water that combines and mingles with that portion of the compressed air that discharges in the bottom of a hole while it is being drilled; fourth, to provide an improved device for instantaneously locking and releasing the rock-cutting drill-bit to and from the drilling-engine, and, fifth, to provide an improved hammer-striking piston. I attain these objects by the mechanism illustrated in the accompanying drawings, in which—

Figure 1 is a top plan view of my improved rock-drilling engine with a portion of the feed-screw mechanism broken away. Fig. 2 is a longitudinal central sectional elevation of my improved rock-drilling engine. Fig. 3 is a cross-section through the water-regulating valve of Fig. 2 on line 3. Fig. 4 is a section through the rifle-bar's ratchet-and-pawl mechanism on line 4 of Fig. 2. Fig. 5 is a section through the center of the length of the valve-chest and the drill's cylinder and through the hammer-piston and its rifle-nut and the end of the rifle-bar on line 5 of Fig. 2. Fig. 6 is a section through the rock-cutting drill's bit-turning mechanism on line 6 of Fig. 2. Fig. 7 is a section through the rock-cutting drill's bit-receiving sleeve on line 7 of Fig. 2. Fig. 8 is a section through the rock-cutting drill's bit-locking mechanism on line 8 of Fig. 2. Fig. 9 is the front or drill-bit end elevation of the drilling-engine. Fig. 10 is a section through the rock-cutting drill's bit-locking mechanism on line 10 of Fig. 2. Fig. 11 is a perspective fragmentary view of the drill's bit-locking end of the drill's bit-receiving chuck, the shank of the drill-bit, and the locking-collar. Fig. 12 is a side elevation of the hollow drill-bit, partially in section. Fig. 13 is an end view of the rock-cutting end of the drill-bit. Fig. 14 is a perspective view of the rifle-bar, and Fig. 15 is a perspective view of the rock-cutting drill's bit locking and unlocking wrench.

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

Referring to the drawings, the numeral 15 designates the cylinder; 16, the piston; 17, the steam-chest; 18, the valve; 19, the guide-shell, in which the cylinder is slidably mounted in guideways 20 and 21 by means of a depending portion cast on the bottom of the cylinder, from which extends laterally from each side guides 23 and 24, which are fitted slidably into the guideways of said shell.

The mechanism for feeding the cylinder longitudinally through the shell comprises the screw 25, the operating-handle 26, which is clampably secured to the end of the feed-screw, a cross-head 27, that supports the outer end of the feed-screw, and the washer 28, which is secured to the feed-screw and is seated in a counterbore in the cross-head and coöperates with the crank-handle to revolubly secure the outer end of the feed-screw to the cross-head, and the nut 29, which is threaded to the feed-screw and is fitted in a depending sleeve 30 of the cylinder, to which it is secured by an enlarged shouldered portion at one end, and a nut 31, that is threaded to its opposite end and bears against the adjacent end of said sleeve. The opposite or free end of the feed-screw extends centrally through the pocket of the shell. By turning the crank-handle the feed-screw is rotated in the cross-head and the nut and cylinder are moved along and through the guides of the shell. The cross-head 27 is supported by two rods 32 and 33, that are secured at one end to ears 34 and 35, formed on the opposite sides of the rear end of the shell, to which they are bolted by the nuts 36 and 37. At their opposite ends they are bolted to the ends of the cross-head in a similar manner. The shell is adapted to be adjustably supported at any desired angle and in any position by adjustable columns, sloping bars, or tripods, and for this purpose is provided at its under side at a point preferably nearer to its front end than to its rear end with a depending hub portion 38, the sides of which diverge outward, so that the hub forms the frustum of a cone. This hub is adapted to be clamped to a clamp-ring, which in turn is adjustably secured to horizontal or vertical columns, sloping bars, or to a tripod. I do not illustrate any of these drill-shell-supporting devices, as they are well known in the art of rock-drilling and do not form a part of my present invention.

The cylinder 15 is bored out axially to receive the piston 16, which is fitted to reciprocate operatively in it. Each end of the cylinder is counterbored larger in diameter than the diameter of the cylinder. The front end 39 of the cylinder is provided with three counterbored steps 40, 41, and 42. The counterbore 40 is interiorly threaded and the front head 43 is threaded to it. The counterbore 41 forms a step for the steel buffer-ring 44, which is fitted between the shoulder formed by this counterbore and the adjacent end of the cylinder. The counterbore 42 receives the rubber buffer-ring 45 of the cylinder and the cylinder-ring 46 of the front end of the cylinder. The cylinder-ring and the rubber buffer-ring are fitted between the shoulder formed by the counterbore 42 and the steel buffer-ring 44. At the rear end 47 of the cylinder but one counterbore 48 is made. Against the shoulder formed by this counterbore a steel buffer-ring 49 is seated, which I term the "back buffer-plate." The counterbore 48 is interiorly threaded, and the back cylinder-head 50 is threaded to it. The back head is provided with an axial bore 51, in which is revolubly fitted a rifle-bar 52. The inner end of the back cylinder-head is also provided with a counterbore 53, in which is seated a rubber buffer-ring 54, which I term the "back buffer." This back buffer-ring fits between the steel buffer-ring 49 and the shoulder of this counterbore and is held under resilient pressure, which it exerts against the steel buffer-ring and holds it against the shoulder of the larger counterbore by being compressed by the back head when it is screwed onto the the cylinder. The end of the back head is made shorter than the length of the counterbore in order to allow room for the recoil of the steel buffer-ring when it is struck by the hammer-piston. The rear end of the back cylinder-head is also provided with a counterbored chamber 55, in which is rotatably positioned the ratchet-disk 56 of the rifle-bar. The head or disk 56 of the rifle-bar is formed integral with the rifle-bar and consists of a round disk formed on one end of the bar. This disk is seated revolubly in the chamber. Its periphery is provided with ratchet-teeth 57, which are engaged by pawls 58. Three pawls are preferably used, and they are preferably positioned around the periphery of the ratchet-disk at substantially equal distances apart. The pawls are held in engagement with the teeth of the ratchet-disk by the springs 58^A, 58^B, and 58^C, which are positioned in holes formed through the shell of the rear cylinder-head into the pawl-and-ratchet chamber. The springs are confined between a cap 58^D, that is threaded in the holes, and a cup-shaped plunger 58^E, which fits loosely in the holes and bears on the top of the pawls. The springs bear in the cups at their lower ends and hold the plunger in resilient contact against the pawls. The pawls are thus spring-controlled. Pockets are formed in the periphery of the chamber of the back cylinder-head in which these pawls fit loosely, and in the wall of each pocket of the chamber of the back cylinder-head a hole 60 is formed that receives loosely a trunnion 61, that is formed on the adjacent side of each of the pawls. A trunnion 62 is also formed on the opposite side of each pawl from the pawl 60, which fits into recesses 63, which are formed in the supplementary cylinder-head 64. This supplementary cylinder-head fits in a counterbore 64^A, that is formed in the back cylinder-head and is bolted by screw-bolts 65 to the back cylinder-head in a position that will bring the trunnion-recesses 62 in axial alinement with the trunnion-recesses 60 of the back cylinder-head. While the pawls are arranged at substantially equal distances apart, they are positioned relative to the teeth in the ratchet-disk of the rifle-bar, which may contain any number of teeth that is a multiple of the numeral three, so that one pawl will be in bearing contact and a second one will be about a third of a length of a tooth from bearing contact with the shoulders of the teeth it engages, and the third will be about two-thirds of the length of the tooth from the shoulders of the teeth it engages. (See Fig. 3.) This arrangement insures that when a tooth slips by one pawl the next pawl will catch a tooth in one-third the movement or pitch of a tooth, and if two pawls miss their teeth the third will catch a tooth when the rifle-bar has moved rotatively a distance equal to two-thirds the length or pitch of a tooth. This arrangement of the pawls reduces the liability of breakage of the teeth of the disk from the dipping of the pawls, as some one of the pawls are sure to catch a tooth before the rifle-bar slips rotatively under tensional strain far enough to acquire velocity and strain enough to strip the teeth from the disk. The supplementary cylinder-head is provided with a rearward hub portion 66, the outer surface of which is divided into two steps of different diameters, the diameter at the end 57 of the hub being the smallest and forms a shoulder 68 at its junction with the adjacent larger portion 69 of the hub. On the smaller diameter 67 of the hub I fit a ring 70, and on each side of this ring I place copper-covered rubber, leather, or fiber washers 70^A and 70^B. The ring and washers are held against the shoulder by a nut 71, that is threaded to the end of the hub and clamps the ring rigidly but removably against the shoulder 68. The nut is hollow and forms a terminal head over the end of the supplementary cylinder-head. This ring 70 forms an integral part of a tubular member 72, that extends across the upper side of the ring. (See Fig. 3.) The tube is provided with an axial bore of two diameters. In the largest bore a plug-valve 73 is seated. This plug-valve comprises a stem 73^A, that extends into the large bore of the tube and is provided at its ends with a reduced portion 74, that extends into the smaller bore of the tube. A shoulder 75 is formed at the junction of the small end of the stem with the stem which forms the valve, and a shoulder 76 is also formed at the junction of the large bore with the small bore, which forms the valve-seat. The entrance to the tube's valve-seat is internally threaded, and the valve-stem is also provided with an enlarged threaded portion 77, that is threaded to the threaded entrance of the tube. The outside end of this end of the tube contains a thread 77^A, to which is threaded a gland-nut 77^B, that surrounds the valve-stem and forms a stuffing-box gland for the valve-stem at the entrance of the tube. The end of the stem projects beyond the threaded portion, and a hand-wheel 78 is secured to it. By turning the hand-wheel the valve is screwed against or away from its seat. Directly under the large portion of the valve and adjacent to its seat an aperture 79 is formed in the interior bore of the ring, which intersects a circumferential groove 80, formed in the inner periphery of the ring. (See Figs. 2 and 3.) This circumferential groove intersects two grooves 81 and 82, (see Figs. 2 and 3,) which are formed on opposite sides of the end of the hub of the supplementary cylinder-head. These grooves communicate with the hollow space formed by the central bore in the nut 71. The opposite end of the tube is also provided on its outside with a thread, to which is threaded a coupling-nut 83. This union surrounds loosely a curved pipe 84, which is provided at one end with a flange 85, of about the same diameter as the tube 72, that is adapted to be coupled to its end, so that it will swivel or turn the coupling. A flexible washer is placed between the flange of the curved pipe and the end of the tube, and the coupling slips over the flange of the curved pipe and washer against the end of the tube 72. The curved pipe is a short piece, and to its opposite end a hose 86 is attached by any suitable means. The curved pipe allows an air-supply hose to be laid alongside of the drill and over its rear end. The hose 86 leads to a source of water-supply. The water flows through the hose and tube 72 and is admitted to the circumferential groove 80 in the ring by the valve 73 through the aperture 79 and flows along the grooves 81 and 82 to the hood-nut 71, where it enters the water-conveying tube 87, which extends through the axial center of the rifle-bar and piston into the rock-cutting drill-bit. The water-conveying tube 87 is removably attached to a tapering slotted sleeve 88, which is fitted in an axial bore formed in the supplementary cylinder-head and its hub. This axial bore is provided with two diameters and a tapering portion. The smallest diameter of this bore receives loosely the small end of the sleeve 88, which projects beyond it into the interior of the hood-nut 71 and is provided with a thread to which is fitted a nut 89, that screws against the end of the hub of the supplementary cylinder-head. In the largest diameter of the bore of the supplementary cylinder-head is fitted loosely a hub 90, that is formed on the disk 56 of the rifle-bar, and between this counterbore and the small diameter of the bore at the opposite end of the hub of the supplementary cylinder-head a tapering bore is formed The sleeve 87 is round and extends through the supplementary cylinder-head loosely into a counterbore 87^A, formed in the hub of the rifle-bar. The sleeve is provided between its ends with a diverging tapering portion 91, which is adapted to fit tightly into the tapering bore of the supplementary cylinder-head. This sleeve is provided with an axial bore in which the tube 88 fits loosely when the sleeve is not clamped to it. The sleeve is also provided with slots 92, only one of which is shown in the section in Fig. 2, as they are placed equidistant apart around the surface of the sleeve, and the section in Fig. 2 is taken through only one of them. These slots extend through the tapering portion of the sleeve and through the shell of the sleeve into its axial bore. The nut on the end of the sleeve is tightened against the hub of the supplementary cylinder-head to draw the slotted sleeve tighter against the tapering bore in the supplementary cylinder-head, which forces the tapering slotted portion of the sleeve down into the tube 88 and rigidly clamps the sleeve 88 and tube together. The rifle-bar is also provided with an axial bore through which the tube 88 extends loosely. This rifle-bar is a round bar that extends from its ratchet-disk portion loosely into an axial bore 93, formed in the rear end of the hammer-piston, which is also provided with an axial bore 94, through which the water-conveying tube extends. The surface of the rifle-bar is provided with spiral flutes 94, which fit slidably into a spirally-fluted nut 95, that is threadedly secured to the rear end of the piston. The hammer-piston is provided with a circumferential groove 94, which is located centrally of the length of its piston, but a little nearer the rear end than the front end. This groove forms a part of the system of valve-ports of the valve mechanism, as will be explained hereinafter. The piston is preferably fitted to work operatively in the cylinder without piston-rings and is provided with a forwardly-extending ram or hammer portion 95, that projects into the front cylinder-head, the peripheral surface of which is provided with straight flutes 96.

The front cylinder-head 43 projects forward a short distance in the form of a tube, and its free end is provided with a shouldered step portion that is provided with a thread, and cap 97, which is provided with an axial aperture, is threaded to its threaded stepped end. The front cylinder-head is provided with an axial bore of two different diameters, and a shoulder 98 is formed at their junction. The longest diameter of the bore of the cylinder-head is at its cylinder end. In this bore of two diameters I fit a rock-cutting-drill-bit-holding chuck 98, which consists of a round tubular member that is inserted into the front cylinder-head from its cylinder end and extends from its cylinder end to slightly beyond its opposite end. The periphery of this chuck is formed into two diameters, which fit closely but loosely the two diameters of the axial bore of the front cylinder-head. The largest portion of the chuck extends from the cylinder end of the front cylinder-head to the shoulder 97 and is held against axial movement toward the cylinder by the steel washer and against axial movement toward the front end of the drill by the shoulder 97. A threaded counterbore is formed in the large end of the chuck, in which a nut 99 is threadedly secured. This nut is provided with an axial bore that is fluted with straight flutes 100, (see Fig. 6,) which fit slidably and loosely on the flutes of the ram or hammer end of the piston. The chuck is provided with a counterbored axial space in which the extending end of the piston projects and reciprocates through the fluted nut 100, which I term the "chuck-nut," and with a smaller axial bore, which extends through its front end, that is adapted to receive the shank 101 of the rock-cutting drill-bit 102. The drill-bit-receiving end of the chuck is bifurcated diametrically, (see Fig. 11,) and the opposite ends are provided with step portions 103 and 104 of less diameter, that extend circumferentially around each end about one-half of its semicircular periphery. The drill-bit fits loosely in the end of the chuck, and its shank 101 extends into the reciprocal path of the ram of the hammer-piston, which when the drill-bit is in operative position in the chuck strikes against its end at each and every forward stroke it makes in the cylinder. The shank of the drill-bit is provided adjacent to its end with projecting lugs 104, two preferably being used. These are formed diametrically opposite one another and are adapted to fit loosely into the diametrical bifurcation in the adjacent end of the chuck and to bear against the sides of the ends of the chuck. The drill-bit is thus seated in the chuck in such a manner that it can move axially independent of the chuck, but cannot move rotatively except when it is moved by the chuck, which rotates step by step with the piston and carries the drill-bit with it, as will be more fully described hereinafter. The projecting lugs on the shank of the drill-bit are made enough shorter than the length of the bifurcation in the end of the chuck to allow the drill-bit a predetermined axial movement of about three-eighths to five-eighths of an inch, and in order to confine the axial movement of the drill-bit under the varying conditions of the forward feed of the drill-cylinder in the shell and the variable forward movement of the drill-bit under the blows of the piston it is necessary to lock it in the chuck in such a manner that it can move axially about this distance independent of the chuck. For this purpose I employ a chuck-key 106, which is seated in a sleeve-ring 107, that fits loosely in the cap 97. This ring fits between the end of the front cylinder-head and a steel ring 108, and between this steel ring and the bottom of the cap a rubber buffer-ring 109 is placed, which I term the "chuck-buffer." The chuck-key comprises a round narrow ring, which is provided with an axial bore of two diameters 110 and 111. The bore 110 is intersected by diametrically oppositely arranged axial slots 112 and 113, which extend in depth to the surface of the largest axial bore, (see Fig. 14, in which a perspective view of the chuck-key is shown,) thus dividing the smallest diameter of the bore into two oppositely-arranged semicircular lug portions 114 and 115, the axial center of which is provided with the arcs of an axial bore that is adapted to allow the shank of the drill-bit to extend loosely through the ring-key, while the slots permit the lugs on the drill-bit to pass through the ring-key. The side of the ring that faces the chuck bears loosely against the end of the chuck and is provided with two projecting lugs 116 and 117, which are arranged diametrically opposite each other and are adapted and arranged to project loosely over the steps 103 and 104 and to engage the shoulders formed by the junction of these step portions with the larger diameter of the ends of the chuck when the chuck-key ring is turned toward them and to strike against the sides 118 and 119 of the oppositely-arranged ends when turned in the opposite direction. When the chuck-key is turned so that its lugs strike the shoulders formed by the steps 103 and 104, its slots are in line with the slot through the ends of the chuck, and the shank of the drill-bit can be inserted into its operative position with its lugs in the slot of the chuck. The key is then turned until its lugs strike the sides 118 and 119, and its slot will then stand at right angles to the slot in the end of the chuck and to the lugs on the drill-bit, and the drill-bit will then be keyed in the chuck against axial displacement, but will still have an axial movement in the chuck sufficient for operative action. The chuck-key can be turned in either direction instantly with the wrench 120, which is provided at one end with oppositely-arranged right-angled fingers 121 and 122, that are adapted to fit in the slots of the chuck-key ring and turn it in either direction. It is not necessary for the operator to look to see if the key-ring is in line with the slot in the chuck when he wishes to insert a drill-bit. He simply inserts the wrench and turns the key-ring against the stepped shoulders hard enough to turn the chuck a little. This in turn rotates the hammer-piston, and it in turn rotates the rifle-bar and its ratchet-disk, which moves under the pawls, causing them to click as they drop off the ratchet-teeth, which clicking is distinctly heard by the operator, informing him that the key-slot is in line with the chuck-slot. He then withdraws the wrench and inserts the shank of a drill-bit and then again inserts the wrench and turns the key-ring back on in the opposite direction until its lugs contact with the sides of the slots of the chuck, which cannot turn in this direction, as the pawls engage the teeth of the disk of the rifle-bar and prevent rotary movement of either the rifle-bar on the hammer-piston or the chuck in this direction. The drill-bit is provided with an axial hole through it from end to end, and the water-conveying tube 88 is arranged and adapted to project into the hole in the shank end of the drill-bit, as shown, when the drill-bit is in operative position in the chuck.

The valve mechanism of my improved rock-drill may consist of any suitable form or type of valve and any arrangement of inlet or exhaust parts which through the medium of any suitable expansive fluid will automatically operate the valve and hammer-piston; but as illustrated the valve mechanism comprises the valve-chest, which is formed integral with the cylinder. The valve-chest is bored out parallel with the cylinder, and in its opposite ends caps 123 and 124 are threaded, which are provided with wrench-receiving hubs on their outer ends by which they may be screwed into or out of the steam-chest. On their inner ends they are provided with a slight projecting portion 125, of smaller diameter than the bore of the chest, and diametrically across this projection a slot 126 is formed. A valve 18 is fitted to reciprocate in the bore of the steam-chest 17. This valve, as illustrated, comprises a series of four disk members 127, integrally formed on a round axial stem 128. The disks are formed at equal distances apart from end to end of the valve, a disk being placed at each end. Axial apertures 129 and 130 are formed in each end of the valve that extend to close to the center of its length, at which point small holes 131 and 132 are formed through the stem of the valve into each aperture. The valve-chest is provided with a system of ports 133, 134, and 135. The port 133 is the air-entrance port and is positioned in the center of the length of the valve-chest and consists of a circumferential groove in the valve-chest that communicates with the atmosphere through an aperture formed in the hub portion 136, to the interior of which a reducing-nut 137 is threaded, to which is threadedly connected an elbow 138. A hose, which I do not illustrate, may be connected to the elbow at one end and at its opposite end to a supply of compressed air. The ports 134 and 135 are cylinder-ports and also consist of circumferential grooves formed in the periphery of the valve-chest surrounding the valves. The port 134, however, extends in a passage 139 to the front end of the cylinder, and the port 135 extends in a passage 140 to the rear end of the cylinder. The ports 134 and 135 are positioned at equal distances on each side of the entrance-port 133 and in position to be covered by the two central disks of the valve when it is in the center of the chest. Exhaust-ports 141 and 142 comprise circumferential grooves formed in the periphery of the bore of the chest at equal distances from the central inlet-port and beyond the cylinder-ports. These exhaust-ports connect with passages formed in the center of the hubs 142 and 143, that are formed on the opposite side of the chest from the inlet-port hub 136, and they extend to the atmosphere. The entrances to the passages in this hub are threaded, and elbows 143 and 144 are preferably threaded to them. (See Fig. 5.) In addition to these ports there are also two ports 145 and 146, comprising small round holes that extend from the bottom of each exhaust-port passage into the cylinder, (see Figs. 1 and 5,) both of which communicate with the circumferential grooves in the periphery of the piston during the reciprocations of the piston, as will be fully explained hereinafter. There are also in the ends of the chest small zigzag port-holes 147, 148, and 149 and 150, 151, and 152, which are drilled into it from the outside. These ports enter the cylinder in the path of the groove in the piston. These zigzag ports are formed by drilling small holes into the chest to intersect at right angles the holes 148 and 152 and then drilling the vertical holes 149 and 153 into the cylinder in a position that will intersect the holes 148 and 152 and that will also communicate operatively with the circumferential groove in the hammer-piston. The entrance to all these small holes in the shell of the valve-chest is plugged up after they are drilled. This manner of forming these small port-holes is made necessary by the valve-chest being cast integral with the cylinder.

One of the important features of my new drill is in the character of the oil-holes I employ to convey oil to the working parts of the drill. I use three oil-holes 154, 155, and 156. The oil-hole 154 extends into the front head of the cylinder and intersects a circumferential groove 157, that is formed around the end of the drill-chuck, from which oil works into the rifle-flutes of the chuck-nut and ram of the piston-hammer and adjacent parts. The oil-hole 155 is positioned centrally of the valve-chest, but at one side of it, and extends into the cylinder. (See Fig. 5.) The oil-hole 156 extends down through the rear end of the cylinder and intersects a circumferential groove 158, formed in the rear cylinder-head, from which a lateral oil-hole 159 extends to the adjacent trunnion-recess of each of the pawls and from these recesses distributes oil over the rifle-bar's ratchet, teeth, and spiral flutes into the nut in the hammer-piston and to the hub of the rifle-bar. These oil-holes at their entrances into the shell of the cylinder are preferably made of substantially about one-half inch diameter and are interiorly threaded to receive a threaded plug 160, which is provided with a wrench-receiving end, by which they are screwed into and out of the threaded oil-holes. These plugs 160 are provided with an axial bore, in which an expansive spring 161 is inserted and is secured at its lower end to the lower end of the bore in the plug in any suitable manner. The upper end of the spring resiliently bears against a ball 162, preferably a steel ball, which is seated in a circular seat formed at the top of the bore, which is narrowed at the upper end of the bore of the plug which is adapted to receive it. The spring holds the ball against its seat tight enough to prevent dust or dirt from working into the oil-hole, but is easily pressed down into the bore of the plug against the spring with the end of the tube of an oil-can whenever oil is to be supplied to the oil-holes. After withdrawing the oil-can tube the spring will force the ball back to its seat and close the oil-hole.

The operation of my improved rock-drilling engine is as follows: Compressed air is admitted from a source of supply to the central inlet-port 133 and flows through the small holes in the valve's stem, through the valve-stem's axial holes to the ends of the valve and valve-chest, and through the zigzag ports to the cylinder, and around the circumferential groove in the center of the piston, and if the valve is positioned centrally in the valve-chest over the cylinder-inlet ports 134 and 135 it will be balanced by the air, which is of equal pressure on each end; but as the circumferential groove in the hammer-piston is formed at a little to one side of the center of the piston, and preferably toward the rear end, one of the zigzag ports is always sure to be open to the atmosphere through one of the vertical exhaust-ports 145 or 146, no matter what position the hammer-piston occupies in the cylinder, which will relieve one end of the valve of the air-pressure, which will cause the air-pressure on the opposite end to start the valve from its balanced position and move it to the opposite end of the chest, after which it will reciprocate rapidly. Consequently while the valve is a balanced valve it is impossible for it to remain inactive under pressure of air in any position either it or the hammer-piston assumes. The actuating fluid is admitted to the valve-chest 17 by the valve and operates through the medium of the coöperating ports in the valve and chest and cylinder to automatically reciprocate the valve in the chest and the piston in the cylinder in a well-known manner. The piston is turned step by step as it is reciprocated by sliding spirally on the rifle-bar, which is held against turning in one direction by its pawls. The piston as it reciprocates strikes with its hammer or ram on the end of the drill-bit. The drill-bit and drilling-engine should be fed by the operator through the medium of the feed-screw to keep the cutting end of the drill-bit against or close to the rock. The drill and rock receive the full force of the blow of the hammer-piston and its ram. The recoil of the drill-bit from the blow of the piston will move it back a slight distance from the rock, where it is easily turned step by step through the medium of the hammer-piston and its ram and the rifle-bar and the fluted nut in the chuck on the ram of the hammer-piston. The piston when it reciprocates back and forth on the spiral flutes of the rifle-bar turns the rifle-bar and its ratchet-disk in one direction of its reciprocal movement, but is itself turned by the rifle-bar in the opposite direction of its movement, and the piston thus turns the drill-bit holding the chuck through the medium of the fluted nut on the fluted ram of the hammer-piston. At each stroke of the piston a portion of the air that flows through the port 135 and the passage 140 into the front end of the cylinder flows along the straight flutes of the ram portion of the hammer-piston and of the chuck-nut, which are loosely fitted to slide one on the other, and flows into the axial hole in the shank of the drill-bit. Meanwhile a stream of water, which is regulated by the valve 73 as to quantity and pressure, is kept constantly flowing through the tube 88 into the shank of the drill-bit, where the water and air mingle thoroughly together and discharge in a jet or spray, depending on the pressure and volume of both air and water, from the cutting-point of the drill-bit against the bottom of the hole being drilled in puffs, which lays the rock-dust and expels the rock-cuttings from the hole being drilled, thus allowing the drill-bit to constantly work in a clean well-watered hole in the rock.

While I preferably use compressed air for the actuating fluid of my drill, my invention also contemplates the use of steam or any other suitable actuating fluid.

While I have illustrated the preferred construction of my new rock-cuttings-expelling drill, my invention contemplates the use of any means by which a hammer-piston and a drill-bit can be coöperatively arranged to drill rock by means of any suitable valve and valve-port mechanism and an actuating fluid and by which a portion of the actuating fluid and a supply of water or of a watery fluid is conveyed to the bottoms of holes in rock while drilling them.

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 having a piston-bore and a plurality of counterbores in its front end of different diameters, of a front cylinder-head comprising a tubular member threadedly secured to the largest counterbore of said cylinder, and a steel ring seated in a counterbore against the end of said cylinder-head, a buffer-ring seated in a counterbore against said steel ring, and a steel ring seated in a counterbore against said buffer-ring, substantially as described.

2. In a rock-drilling engine, the combination with the cylinder and the rock-cutting drill-bit of a piston reciprocally mounted therein, provided with a ram extension, having its periphery formed into straight flutes, a front cylinder-head secured to said cylinder, a chuck rotatably secured in said front cylinder, provided with an axial bore, a rifled nut surrounding said ram and secured in the bore of said chuck, and fitting slidably the flutes of the ram of said piston, substantially as described.

3. In a rock-drilling engine the combination with the cylinder, of a valve-chest cast integral with said cylinder, an axial bore in valve-chest, a valve reciprocally mounted in said valve-chest, suitable actuating-fluid inlet and exhaust ports from said valve-chest to said cylinder, coöperatively arranged in operation relative to said valve, a threaded plug secured in each end of said valve-chest, provided with a slight projection on its inner end of less diameter than the bore of said valve-chest, and a slot port diametrically across said slightly-projecting end of said plugs, substantially as described.

4. In a rock-drilling engine the combination of a cylinder having an operative valve mechanism and actuating-fluid inlet and exhaust ports, counterbores in the opposite ends of said cylinder, a front head secured to the front end of said cylinder, a back head secured to the rear end of said cylinder, a steel ring seated in a counterbore at each end of said cylinder's axial bore, a rubber buffer-ring operatively seated between said steel ring and the rear cylinder-head, a rubber buffer-ring seated against said steel ring at the front end of said cylinder, a steel ring seated in a counterbore between said rubber ring and the end of said front cylinder-head and a piston reciprocally mounted in said cylinder between said steel buffer-rings and provided with a ram extension projecting through said steel rings and rubber at the front end of said cylinder into the front cylinder-head, substantially as described.

5. In a rock-drilling engine the combination with the cylinder and the piston, of a tubular-shaped front cylinder-head, secured to one end of said cylinder and extending beyond it, a tubular drill-holding chuck rotatably mounted in said front cylinder-head, a reciprocating piston in said cylinder provided with a hammer extension, a straight fluted surface on the periphery of the end of said piston's hammer extension, a fluted nut secured in said chuck in which said piston's hammer extension fits slidably and a rock-cutting drill-bit having a shank adapted to fit loosely in said chuck and positioned in the reciprocal path of the hammer extension of said piston, and means, including a ring, for securing said drill-bit operatively in said tubular chuck, substantially as described.

6. In a rock-drilling engine, the combination with the cylinder, and the hammer-piston of a tubular-shaped front cylinder-head, secured to said cylinder-head, and extending beyond it, a cap threadedly secured to its outer end having an axial bore, a buffer bearing against the crown of said cap, a steel ring arranged adjacent to said buffer, a drill-bit-holding chuck revolubly mounted in said cylinder-head, and secured therein against longitudinal movement, a rock-cutting drill-bit having a shank provided with projecting lugs, adapted to fit loosely in said cap and in said drill-bit-holding chuck and positioned in the reciprocal path of said hammer-piston, and means including a ring arranged between said chuck and the buffer of said cap for releasably locking said drill-bit in operative striking relation to said hammer-piston in said chuck, substantially as described.

7. In a rock-drilling engine the combination with the cylinder, the hammer-piston and the front and rear cylinder-heads, provided with axial bores, a suitable buffer mechanism in the front and rear end of said cylinder at the ends of the reciprocal movement of said piston, an axial bore in said piston, a spirally-rifled nut in the axial bore of said piston, a chamber in the rear end of said rear cylinder-head, a rifled bar rotatably mounted in said rear cylinder-head having a disk portion extending into said chamber, ratchet-teeth on the periphery of said disk, spring-controlled pawls arranged in said chamber in operative relation to said ratchet-toothed disk, a spirally-rifled bar extending from said ratchet-disk slidably through the said spirally-fluted nut of said hammer-piston, a supplementary cylinder secured to said back cylinder-head, an axial bore in said cylinder-head coöperatingly arranged with said back cylinder-head to operatively support said spring-controlled pawls, substantially as described.

8. In a rock-drilling engine the combination with the cylinder, the front cylinder-head and

the cap on the end of said front cylinder-head, of the piston in said reciprocating cylinder, the drill-chuck rotatably mounted in said front cylinder-head, the rifled nut in said chuck, the fluted hammer or ram of said piston, extending loosely through said fluted nut into said chuck, the bifurcation in the outer end of said chuck, the oppositely-arranged steps in the opposite ends of the bifurcation of said chuck, an axial bore in said chuck, a rock-cutting drill-bit having a shank adapted to fit loosely into said chuck and adapted to extend into the reciprocal path of said piston hammer or ram projecting lugs in said rock-cutting drill-bit's shank, adapted to fit the bifurcation in the end of said chuck and means, including a ring within said cap for operatively securing and interlocking said rock-cutting drill-bit to and from said chuck, means for rotating said drill-bit and means, including a valve-controlled water-conveying tube extending axially through said piston and an axial hole through said drill-bit for conveying a commingled supply of air and water to the cutting end of said drill-bit, substantially as described.

9. In a rock-drilling engine the combination of the cylinder, the hammer-piston, the front head threadedly secured to said cylinder, and the cap threaded to said front head with the chuck-key and the buffer in the cap, substantially as described.

10. In a rock-drilling engine the combination of the cylinder, the front cylinder-head and the cap, with the hammer-piston reciprocally mounted in said cylinder and the front head, of the drill-holding chuck arranged to be rotated step by step by said piston, the buffer in said cap, the chuck-key ring, and the drill-bit arranged to be releasably secured operatively in said chuck by said chuck-key in the reciprocal path of said hammer-piston, substantially as described.

11. In a rock-drilling engine the combination with the cylinder, the piston, the front cylinder-head, and the cap, of the chuck rotatably mounted in said front cylinder-head, and provided with a centrally-slotted end having its ends on the opposite sides of said slot provided with stepped shoulders, the buffer in said cap, the chuck in its outer end, the key-ring between said chuck and said buffer, having an axial bore provided with oppositely-disposed slots extending from said bore into said ring, and provided with oppositely-arranged projecting lugs in its side facing said chuck, adapted to engage said stepped shoulders when moved in one rotative direction, and to engage the sides of the ends of said slotted end, when moved in the opposite rotative direction, a drill-bit having a shank end provided with projecting lugs adapted to extend loosely through the axial bore and slots of said chuck and key-ring and into the slot in the end of said chuck and means for turning said chuck-key ring to lock said drill-bit in said chuck and to unlock it from said chuck, substantially as described.

12. In a rock-drilling engine, the combination with the cylinder and the rear and front cylinder-heads detachably secured to said cylinder, of a piston provided with a hammer or ram extension reciprocally mounted in said cylinder a drill-bit-holding chuck rotatably mounted in said front head suitable buffer devices operatively arranged between the said front head and chuck and the adjacent terminal stroke of said piston and between the rear cylinder-head and the adjacent terminal stroke of said piston for cushioning the spent strokes of said piston, means including a spirally-rifled bar for rotating said piston step by step in one direction of its reciprocal movement, and means connected with said piston for rotating step by step said drill-bit-holding chuck, substantially as described.

13. In a rock-drilling engine the combination with the cylinder and the piston, of the front head, an axially-perforated cap removably secured to the end of said front cylinder-head, a drill-bit-holding chuck rotatably mounted in said front head, a rock-cutting drill-bit arranged and adapted to be instantly pushed into said chuck, and positioned to be struck by the said piston at each forward stroke of its reciprocal movement, means connected with said chuck and said drill-bit, including a partially-rotating ring, for releasably locking said drill-bit operatively in said chuck, and means connected with said chuck and piston for rotating said drill-bit step by step at substantially each reciprocal stroke of said piston, substantially as described.

14. In a rock-drilling engine the combination with the cylinder and the piston, of the back and supplementing cylinder-heads, the front cylinder-head, the pawl-controlled ratchet-toothed rifle-bar, provided with spiral flutes the water-regulating valve and passages through said supplementing cylinder-head, the water-conveying tube extending from said supplementing cylinder-head axially through said rifle-bar and said piston loosely, a drill-bit-holding chuck rotatably arranged in said front cylinder-head, a rock-cutting drill-bit provided with an axial bore and arranged and adapted to fit slidably in said chuck in a position to be struck by said piston by the forward strokes of said piston's reciprocal movement means, including a ring adapted to be moved rotatably a predetermined distance, for releasably locking said drill-bit to said chuck, and means including said rifle-bar and a rifled nut for rotating said drill-bit step by step at substantially each reciprocal movement of said piston, substantially as described.

15. In a rock-drilling engine the combination with the piston and the cylinder, of the rear cylinder-head and the supplementary cylinder-head, provided with a shouldered bearing, a ring mounted in said bearing, a

copper-covered washer on each side of said ring, a thread at the end of said supplementary cylinder-head, and a hood threadedly arranged to clamp said ring and washers against said shouldered bearing of said head, substantially as described.

16. In a rock-drilling engine the combination with the cylinder and the piston, the rear cylinder-head and a supplementary cylinder-head having a rearward hub projecting, of a ring portion clampably secured to the supplementary cylinder-head, a circumferential groove in the inner periphery of said ring, a water-inlet member, arranged on said ring to intersect said circumferential groove of said ring, and provided with a hose connection at one end, and a valve at the opposite end adapted to control said water-inlet and said circumferential groove of said ring, axial slots in the hub of said supplementary cylinder-head, intersecting the circumferential groove in said ring, and an axial bore in said supplementary cylinder-head provided with a tapering portion a tapering sleeve adapted to fit said taper portion of the axial bore of said head, and extending beyond said head's hub end, a nut threaded to the end of said sleeve, and adapted to bear against said hub's end, an axial bore in said sleeve, a plurality of radial slots in the said tapering sleeve extending through its shell into its axial bore, a water-conveying tube fitting loosely in the bore of said tapering sleeve, and adapted to be clamped to said sleeve by said threaded nut at its end, and a hood secured over the end of the hub of said supplementary cylinder-head, arranged and adapted to form a closed water-passage from said axial groove in said hub to the end of said water-conveying tube, substantially as described.

17. In a rock-drilling engine the combination with the cylinder and the piston, of the rear cylinder-head and the water-inlet ring and tube clampably secured to said supplementary head and provided with a curved hose connection at one end and a water-controlling valve at its opposite end, substantially as described.

18. In a rock-drilling engine, the combination with the cylinder and the piston, the rear and supplementary cylinder-heads, the valve-controlled water-inlet ring the hollow hood on the end of said supplementary cylinder-head and the valve-controlled water-passage through said ring and head to said hood, substantially as described.

19. In a rock-drilling engine the combination with the cylinder and the rear cylinder-heads, of the valve-controlled water-inlet ring, the hollow hood, the axial tapering bore in said supplementary cylinder-head, the tapering split sleeve, provided with an axial bore and the water-conveying tube arranged and adapted to be releasably secured to said sleeve and to said supplementary cylinder-head, substantially as described.

20. In a rock-drilling engine, the combination with the cylinder, the piston and the rear and supplementary cylinder-heads, the piston and the pawl and ratchet rifle-bar mechanism, with a valve-controlled inlet member, secured to said supplementary cylinder-head, a hood at the outer side end of said supplementary cylinder-head, suitable water-passages through said valve-controlled water-inlet member, and supplementary cylinder-head to said hood, a water-conveying pipe projecting loosely through said rifle-bar and piston, and means including a clamping device for releasably securing said tube in operative relation to said water-inlet passages in said supplementary cylinder-heads.

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

JOHN GEORGE LEYNER.

Witnesses:

CLARENCE A. LAWSON,

G. SARGENT ELLIOTT.