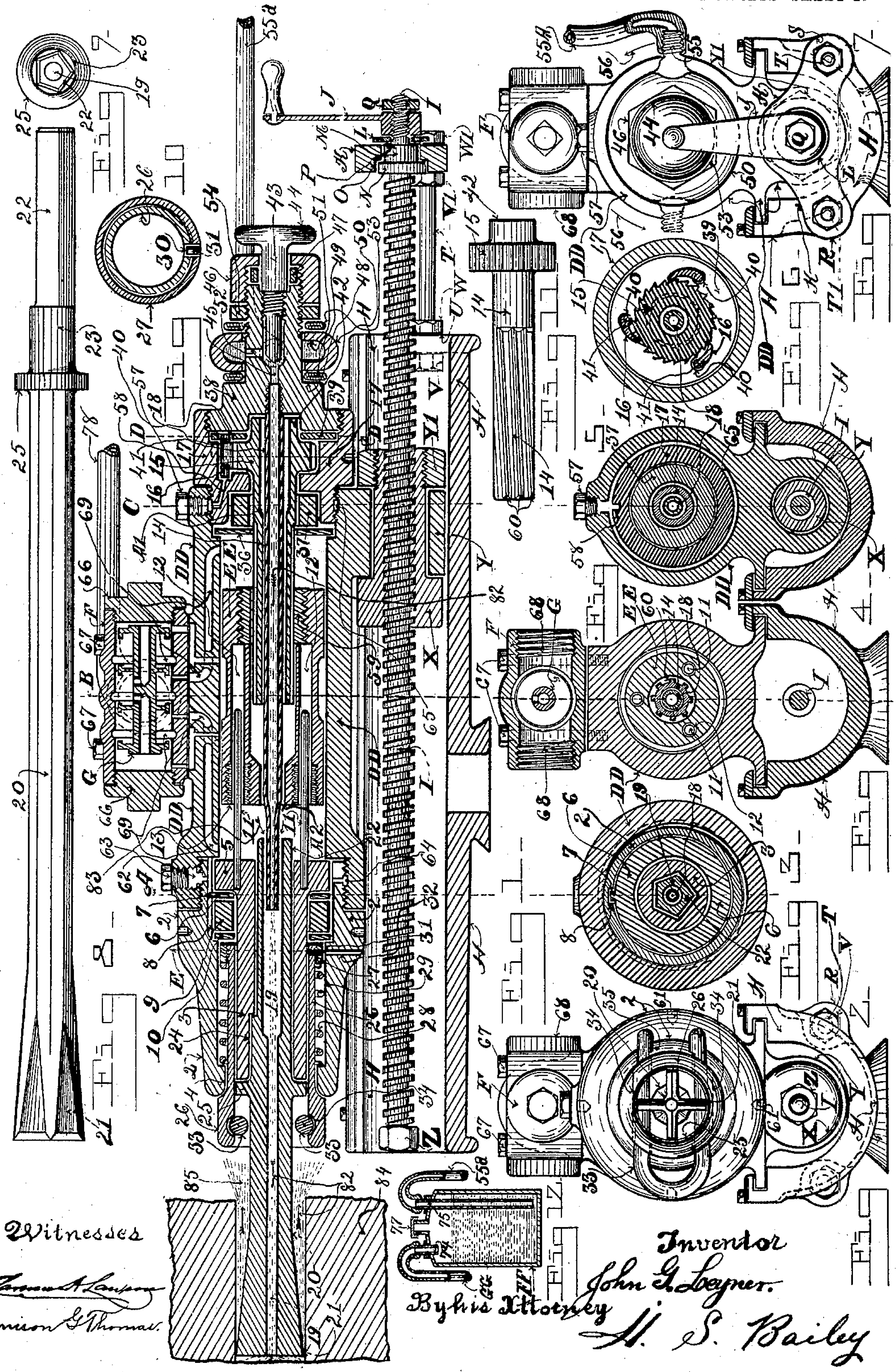
No. 756,972. PATENTED APR. 12, 1904.

J. G. LEYNER.

METHOD OF EJECTING ROCK CUTTINGS FROM HOLES IN ROCK WHILE DRILLING THEM.

APPLICATION FILED JUNE 14, 1898.

NO MODEL. 2 SHEETS—SHEET 1.



Witnesses

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Inventor

John G. Leyner.

By his Attorney

H. S. Bailey

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

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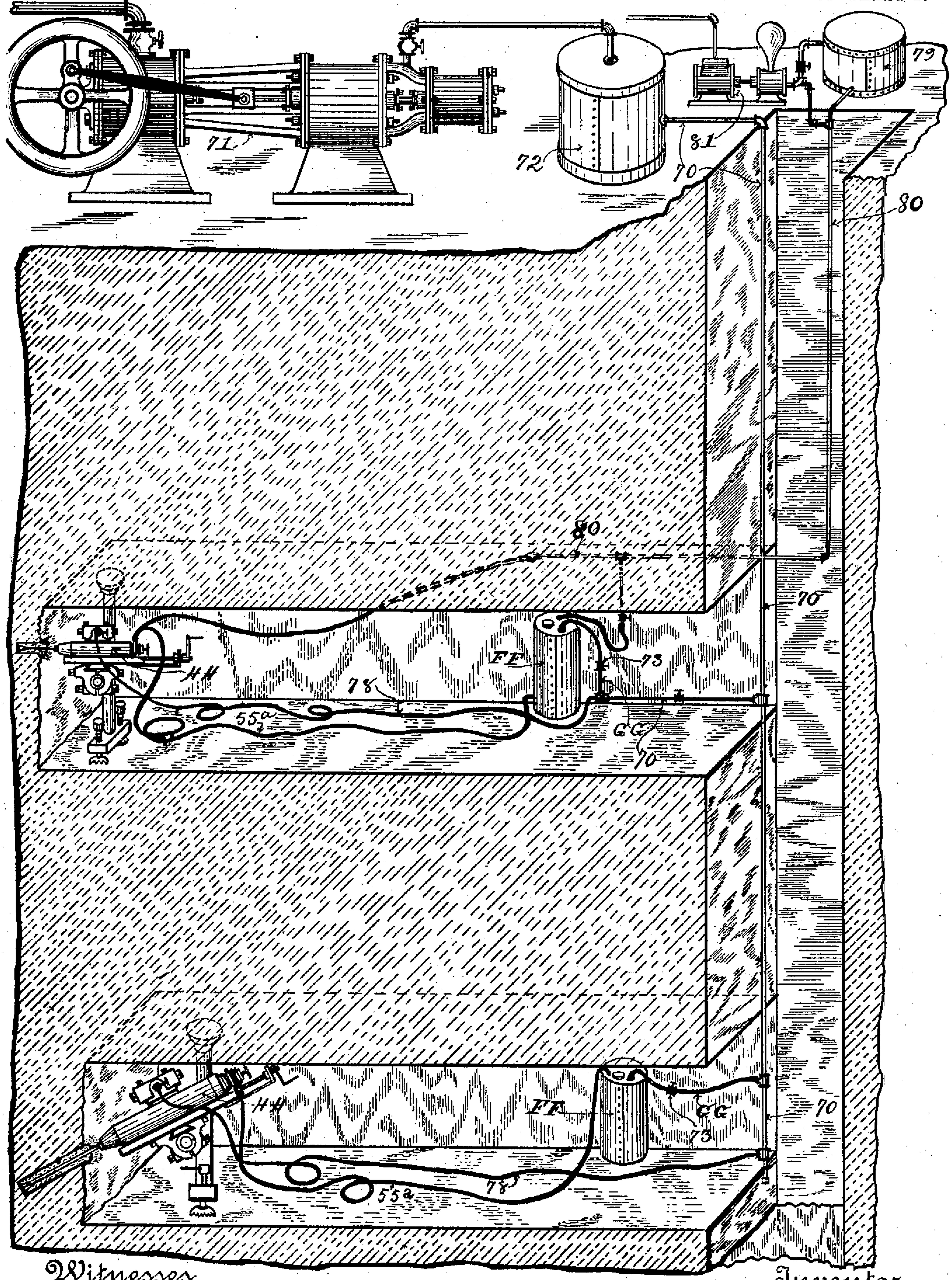

Fig. 13.

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UNITED STATES PATENT OFFICE.

JOHN GEORGE LEYNER, OF DENVER, COLORADO.

METHOD OF EJECTING ROCK-CUTTINGS FROM HOLES IN ROCK WHILE DRILLING THEM.

SPECIFICATION forming part of Letters Patent No. 756,972, dated April 12, 1904.

Application filed June 14, 1898. Serial No. 683,399. (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 a certain new and useful Method of Ejecting Rock-Cuttings from Holes in Rock While Drilling Them; 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.

The object of my invention is to provide a method of automatically ejecting and expelling rock-cuttings from holes in rock while drilling them with drilling-engines that are actuated by an expansive fluid and for laying the rock-dust during the operation of the drill.

My invention consists in discharging into the bottoms of holes in rock while drilling them any suitable liquid, water being preferred, under pressure and a portion of the cylinder's actuating fluid, either as a spray or as a stream or as a jet, and in discharging said water and actuating fluid in a continuous or intermittent stream either singly or combined or commingled together, but more essentially in such a manner that a portion of the actuating fluid of the cylinder at each stroke of the piston coöperates with the water flowing to the bottom of the hole being drilled to forcibly blow out the rock-cuttings made by the drill-bit and at the same time lay the dust.

In the accompanying drawings I have illustrated but one form and arrangement of apparatus for practicing my invention of automatically expelling rock-cuttings from holes in rock while drilling them and for laying the dust. I do not limit my said method to it, as my invention contemplates, broadly, the discharging into the bottoms of holes in rock, while drilling them with drilling-engines, of a portion of the engine's expansive fluid and any suitable liquid, water being preferred, coöperatively combined to blow the rock-cuttings out of the hole while drilling it by the expansive power of the actuating fluid and to lay the rock-dust. 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, a section on the zigzag line D of Fig. 1, showing that part of the auxiliary cylinder-head that is directly above the washer and not the offset portion over the ratchet and showing a section through the ratchet-bar's head and the pawls; Fig. 7, an end elevation of the feed end of the machine; Fig. 8, a side view of the drill-bit; Fig. 9, an end elevation of the striking end of the drill-bit, and Fig. 10 a section on line E through the drill-holding nut and sleeve of the front head of Fig. 1; Fig. 11, a side elevation of the rifle-bar. Fig. 12 is a section through a water-storage tank which is operatively connected to the water-coupling of the drilling-engine by the hose 55^A, and Fig. 13 is a perspective view of a rock-drilling plant applied to a mine and embodying my invention.

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

Referring to Fig. 1, D D designate the cylinder, E 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 United States Patent No. 567,682, of September 15, 1896. The drill-feeding mechanism comprises the screw I, the operating-handle J, the flange K, and a washer L, which bears against a shoulder M, formed on the screw. The screw is provided with a collar N, which projects into a recess O, formed in the flange to receive it. This collar takes the backward thrust of the screw. The round portion P of the screw, between the shoulder and the collar, is made a little wider than the surrounding bearing of the flange, so that the screw can rotate freely in the flange. On the end of the screw beyond the handle I screw a nut Q tightly against the handle. The flange L is provided with two opposite laterally-extending ears R 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 D. This nut is clamped in said lug by a nut Y′. On the opposite end of the screw I thread a nut Z to prevent the nut X and the drilling-engine being fed off from the screw. 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 and around the body of the sleeve I place a steel buffer-ring 6, which is provided with a key portion 7, that fits loosely into a keyway 8 in the cylinder-head to prevent its turning on the sleeve. A rubber buffer-ring 9 is also placed at the side of the steel ring, and a second steel ring 10 is placed on the opposite side of the rubber buffer-ring in the bottom of the counterbore. 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 11 project and extend loosely into holes 12, drilled into the piston. The entrance to these holes is provided with bushings 13, in which the rods fit slidably. In Fig. 4 I illustrate three rods, and in the largest size drilling-engines I would use four. 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 for turning the piston step by step is illustrated in my patent above mentioned and in United States Patent No. 568,089.

The essential object of my present invention is to provide a method of blowing out and expelling 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 the tunnel 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 with the engine's actuating fluid and at the same time allay the dust with water or any suitable liquid, 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 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 coöperatively unite and move together, so as to operate as a single stream, and jet or spray 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 any suitable liquid-supply, water being preferred, supplied 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 A′, and also axially through the striking end of the piston a similar-sized hole A^2. 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 preferably reduced in diameter to adapt it to extend 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 comprises a shank of any of the customary forms of drill-steel in use. At one end 21 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 more chisel-edges. The striking end 22 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 23 is preferably turned round, and these two portions at this end are a trifle longer than the length of the sleeve, which is provided with an axial bore 24, 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 25 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 sleeve 3 is surrounded by a collet 26, which also projects into the bore of the cylinder-head. This collet is provided with a thread on its inner end, on which is screwed a nut 27. A coiled expansive spring 28 surrounds the collet and is seated in a counterbore 29, formed on the cylinder-head which is adapted to receive it. The expansive spring resiliently holds the collet in its normal position in the cylinder-head around the rotative sleeve. In order to secure the nut 27 to the collet against unscrewing, I drill a hole 30 through both nut and collet and drive a pin 31 in it, as shown more clearly in Fig. 10. In order to drive this pin out when wishing to take out the collet from the cylinder-head, I provide a hole 32 in the cylinder-head in a position to register over the pin or in line with the pin, in which a smaller pin may be inserted to drive the pin 31 out of the nut and collet. In order to do this, the cylinder-head must be disengaged from the cylinder and the sleeve and drill-bit be first taken out of it. The collet projects forward beyond the face of the cylinder-head far enough to allow a staple-pin 33 to be inserted through its projecting end and straddle the drill-bit at a short distance in front of the collar of the drill-bit. The distance of space between the collar of the drill-bit and the staple-pin should be about a sixteenth of an inch less than the length of the striking end of the drill-bit that projects beyond the end of the sleeve into the cylinder. This clearance between the staple and collar gives the drill-bit a little forward cutting clearance independent of the forward feed of the cylinder, so that when the drill is back against the sleeve, as shown, the drill-bit can cut its way into the rock until its collar strikes the staple without any forward feeding movement of the cylinder. The staple-pin, as shown in Fig. 2, is inserted in holes 34, that are positioned close to opposite sides of the drill-shank and that extend clear through the collet, and the staple-pin projects clear through the collet, and its two prongs extend across and almost touch opposite sides of the shank of the drill-bit and present a rigid abutment to the collar. The cylinder should be fed forward by the feed-screw just fast enough to keep the collar of the drill-bit substantially close to the end of the sleeve or midway between the sleeve and staple-pin and with the cutting-point of the drill-bit firmly pressed by the feed against the rock, as the actuating fluid of the cylinder always moves the drill forward until it bears against the rock and holds it there before the piston strikes it. Consequently when the piston does strike it it is resting against the rock and only cuts into it as far as the blow of the piston drives it into it, which is but a trifle if the rock is normally hard and sound; but if the ground is soft and seamy the drill may be driven so far forward by one blow that its striking end will be driven inside of the sleeve, where the piston cannot strike it, and if it sticks in a seam the air must be shut off and the drill backed and started over. It is to prevent the drill's being driven too far forward and to prevent its sticking in seams that the staple is used. It is not needed and is never used where the rock is hard and sound. Consequently the staple is positioned to give the drill-bit as much forward movement as possible and still keep its striking end projecting into the cylinder far enough to allow the piston to strike it and drive it forward, and when the collar of the drill-bit is against the staple and the drill is struck by the piston the collet is also driven forward, but its expansive spring and staple returns it and the drill-bit back to its normal position, so that the next blow of the piston will strike the end of the drill-bit, which if fed forward carefully, even if driven from the end of the sleeve against the staple at every blow of the piston, will cut a smooth round hole in any kind of bad rock. I form the prongs of the staple either a trifle wider or narrower than the holes are apart, so that it will have to be sprung into them, and its resilient tension when in the holes will assist to hold it in them against displacement; but in order to provide a positive and simple method of securing the staple in the collet I preferably form it with the spread of its prongs narrower than the distance apart of the holes, so that it will have to be sprung apart in order to insert it in them. I then reduce the metal on the inside of each prong to form oppositely-opposing reduced or tapered surfaces, which terminate and form a shoulder 35 on the inside of the prongs, and after the staple is pushed into the holes they spring toward each other after these shoulders pass beyond the lower edge of the holes, and the shoulders overlap the lower edge of the holes, as shown in Fig. 2, and form projecting stops, which effectually lock the staple against accidental displacement from the machine, while at the same time permitting it to be withdrawn from the collet easily by one hand of the operator, for when the staple is pulled by its yoke portion the prongs readily spring apart, as the shoulders are slightly beveled and will easily slide back into the holes. The collet is not attached to the sleeve, but is mounted loosely on it and also fits freely in the cylinder-head and can and does revolve more or less with the sleeve.

The rear steel buffer-ring 36 and rubber buffer-ring 37 are supported in a supplementary cylinder-head 17, which is threadedly secured to the cylinder. This supplementary head contains a chamber which holds the ratchet-head of the rifle-bar and the pawls. The supplementary cylinder-head 17 and the rear cylinder-head 38 have formed between them an annular recess, in which is fitted loosely at flat ring 39, (see Fig. 6,) in which I drill three holes 40, which form supporting-bearings for the adjacent trunnion 41 of each pawl. These pawls are used around the ratchet-head of the rifle-bar substantially as shown in Fig. 6 and in the above-mentioned patent to lock the rifle-bar against rotary movement in one direction and coöperatively with the rifle-bar they operate to rotate the piston step by step as it reciprocates in the cylinder. An axial recess is also formed in the rear cylinder-head around the tube 18 to support the hub 42 of the ratchet-wheel. The ring 39 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 38 in Fig. 1 is threaded to the 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 43, which is provided with a small hand-wheel 44 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 45 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 46 is mounted on the plug-valve and is threaded to the end of the cylinder-heads and packing 47 is placed in the gland to prevent the leakage of water by the valve. A shoulder 48 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 I place a washer 49. The washer illustrated preferably comprises a flat rubber ring covered with copper. At the side of the washer 49 I mount to turn freely a coupling 50, which is provided with an annular chamber 51. Through the shell of the cylinder-head a transverse hole 52 is drilled into the valve-chamber and forms a passage from the coupling to it. At the side of the coupling a washer 53 is placed, and a nut 54 is threaded to the cylinder-head at the side of the said washer, which is adapted to be screwed against the washer to compress the coupling and washers against the said shoulder and each other tight enough to prevent leakage of the water from the coupling. One side of the coupling is provided with a projecting threaded nipple 55, to which a hose 55^a is secured. The hose connects the coupling with any suitable supply of any suitable liquid, water being preferred, under pressure enough to give the liquid operative power to eject the rock-cuttings from the holes. By slightly loosening the nut 54 the coupling may be turned on the cylinder-head, as indicated by the arrows 56, so that the hose may be connected to it on either side of the drilling-engine, as required. I thread a cap-screw 57 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 58 from the adjacent recess of the pawl's trunnion to intersect it. These holes form an oil-passage to the pawls and ratchet. The oil placed in them also works along the rifle-bar to the rifle-nut 59, which is screwed in the piston-head. This nut is fluted to slide freely on the flutes 60 of the rifle-bar 14.

61 designates holes drilled into the cylinder-heads to receive a spanner-wrench. In the front cylinder-head I also drill an oil-hole 62 and thread a cap-screw 63 into it. The oil-hole extends to the threaded portion which secures the cylinder and head together, and around the circumference of the head a circumferential groove 64 is cut, which permits the oil to work to the cylinder through the threads and along the head to the joint between the collet and sleeve. A similar groove 65 is cut in the threads of the supplementary cylinder-head 17, which registers with the oil-hole in which the cap-screw 57 is threaded. The valve-chest F has a cylindrical bore, and cylinder-heads 66 are threaded to it. The valve-chest is secured to the cylinder by the cap-screws 67.

My invention contemplates the use of any suitable form or type of valve and any arrangement of valve-ports or exhaust-ports which through the medium of the expansive fluid will automatically operate the valve and piston and also the use of any suitable form or type of mechanism for rotating the piston during its reciprocal movements in the cylinder.

The hose 55[a] leads to a water-supply tank F F, which may be large enough to supply one or several drilling-engines. For convenience, however, in drilling rock in mine-shafts, stopes, and tunnels, and owing to the limited amount of space in such workings, I preferably use an independent tank for each drilling-engine. One of from eighteen to twenty gallons I find of ample capacity, preferably making it a few inches in diameter and of sufficient length for this capacity. Such a tank is easily shifted about and is not in the way. I connect this tank, preferably by a hose G G, to the air-supply piping system 70, which extends from an air-compressor 71 and air receiver or storage tank 72 or may form a part of and extend from any suitable compressed-air-supply system, a suitable pressure-controlling valve 73 being placed to regulate the pressure of air flowing into the tank. In practice I allow the full pressure used to run the drilling-engines to flow unobstructed into the tank on top of the water. I preferably construct these tanks substantially as shown in Fig. 12, in which the top portion is provided with two hose-connecting couplings 74 and 75 of any suitable design, one, 74, for the air-inlet and the other, 75, for the water-outlet. From the water-outlet a tube 76 extends close to the bottom of the tank, and the air forces the water up through the tube and hose to the drilling-engine. The tank is filled partially or nearly full of water through a suitable inlet 77. Where three shifts are working a drill eight hours each in twenty-four, I find that about an ordinary tank full of water to each shift will keep the drill supplied. An air-supply hose 78 is also run from the air-supply system to the drilling-engine.

My invention contemplates a supply of water from any source or apparatus flowing to the drilling-engine, and while I preferably use the compressed-air supply for providing pressure to the water and driving it to the drilling-engine any other suitable method of furnishing a supply of water may be employed, and I could also dispense with the small portable independent storage-tank for each drill and instead install one large tank 79 at the surface of a mine or at some convenient place and run a supply-pipe 80 from it to all the drilling-engines used in the mine, keeping sufficient head of water in it to cause the water to flow to any part of the mine by gravity and give it sufficient pressure to maintain a suitable flow and connect it by hose to the drills, or a pump 81 could be connected to and pump directly into the supply-pipe, or the pump could be connected with the tank and a pressure secured in addition to the head of water therein. The use of the compressed-air and small tank makes a much simpler and convenient apparatus.

The operation of my improved rock-drilling engine is as follows: The actuating fluid may be either compressed air or steam or any other suitable expansive fluid. Compressed air, however, is the most exclusively used for running rock-drilling engines. It is compressed by the compressor 71 and is discharged into the air-receiver 72, from which it flows through the pipe-supply system 70 to the drilling-engine H H and to the water-supply tank and keeps a steady supply of water under pressure at the drilling-engine and at the command of the operator. The compressed air or actuating fluid enters the drilling-engine through the hose 78, which is threadedly connected to the ingress-holes 68 of the valve-chest F to the valve G and operates through the medium of the coöperating ports 69 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 slides on the rods 11 and strikes on the end of the drill-bit, and as the drill-bit and drilling-engine are or should be fed by the operator through the medium of the feed-screw I to keep it close enough to the rock so that the expansive fluid will move it against the rock when it enters the front end of the cylinder or should be fed to keep the cutting end of the drill against the rock and its collar 25 at the same time against the sleeve 3. The drill-bit 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, providing the staple-pin is not in place, 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 drilling-engine to keep the drill-bit 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. When the actuating fluid rushes into the front end of the cylinder, it moves the piston backward, 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 in the direction of the arrow 82 into the shank of the drill-bit and combines and mixes and commingles with the actuating fluid of the cylinder, which flows in the direction of the arrows 83 from the cylinder into the drill-bit 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 and preferably is so 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 rush of air into the front end of the cylinder 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. My invention contemplates a controllable supply of water or any suitable liquid, water being preferred, under pressure flowing to the cutting-point of the drill-bit and a coöperating supply of actuating fluid. I preferably use air and water combined together, because where water is used alone it requires a much larger volume of it and makes the work of drilling very wet and nasty, while with air alone the rock-dust fills the tunnels and stopes, and the operators have difficulty in either seeing or breathing; but where both are combined and the water is properly regulated the combined water and air is discharged as a spray, as shown in Fig. 1, where the drill-bit and engine are shown drilling into the rock 84 and the water can be seen discharging from the entrance of the hole in a spray 85, and so little water is required that it does not wet the middle and rear end of the engine and does not in the least annoy the operator.

While I have illustrated and described my preferred apparatus for carrying out my method of expelling rock-cuttings from holes while drilling them, I do not wish to be limited to the construction and arrangement shown, but claim the right to use any and all arrangements by which a portion of a rock-drilling engine's actuating fluid and a supply of water or any suitable liquid or a watery liquid is conveyed to or adjacent to the cutting-point of the rock-cutting-drill bit of any kind, type, or design of rock drilling, cutting, dressing, or rock-channeling engines and to the bottom 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. The herein-described method of expelling rock-cuttings from holes in rock during the process of drilling the holes, which consists in simultaneously supplying to the holes during the drilling operation water and air, both under pressure.

2. The herein-described method of expelling rock-cuttings from holes in rock during the process of drilling the holes, which consists in uniting and commingling compressed water and compressed air and discharging the combined stream under pressure at the drilling-point during the drilling operation.

3. The herein-described method of expelling rock-cuttings from holes in rock during the process of drilling the holes, which consists in commingling with a rock-drilling engine, water under pressure and a portion of the actuating fluid of the engine under pressure, and discharging said commingled fluids under pressure at the drilling-point during the drilling operation.

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

JOHN GEORGE LEYNER.

Witnesses:
CLARENCE A. LAWSON,
HARRISON G. THOMAS.