C. H. SHAW.

WATER FEED, DUST LAYING, ROCK DRILLING ENGINE.

APPLICATION FILED SEPT. 19, 1904.

922,526.

Patented May 25, 1909.

3 SHEETS—SHEET 1.

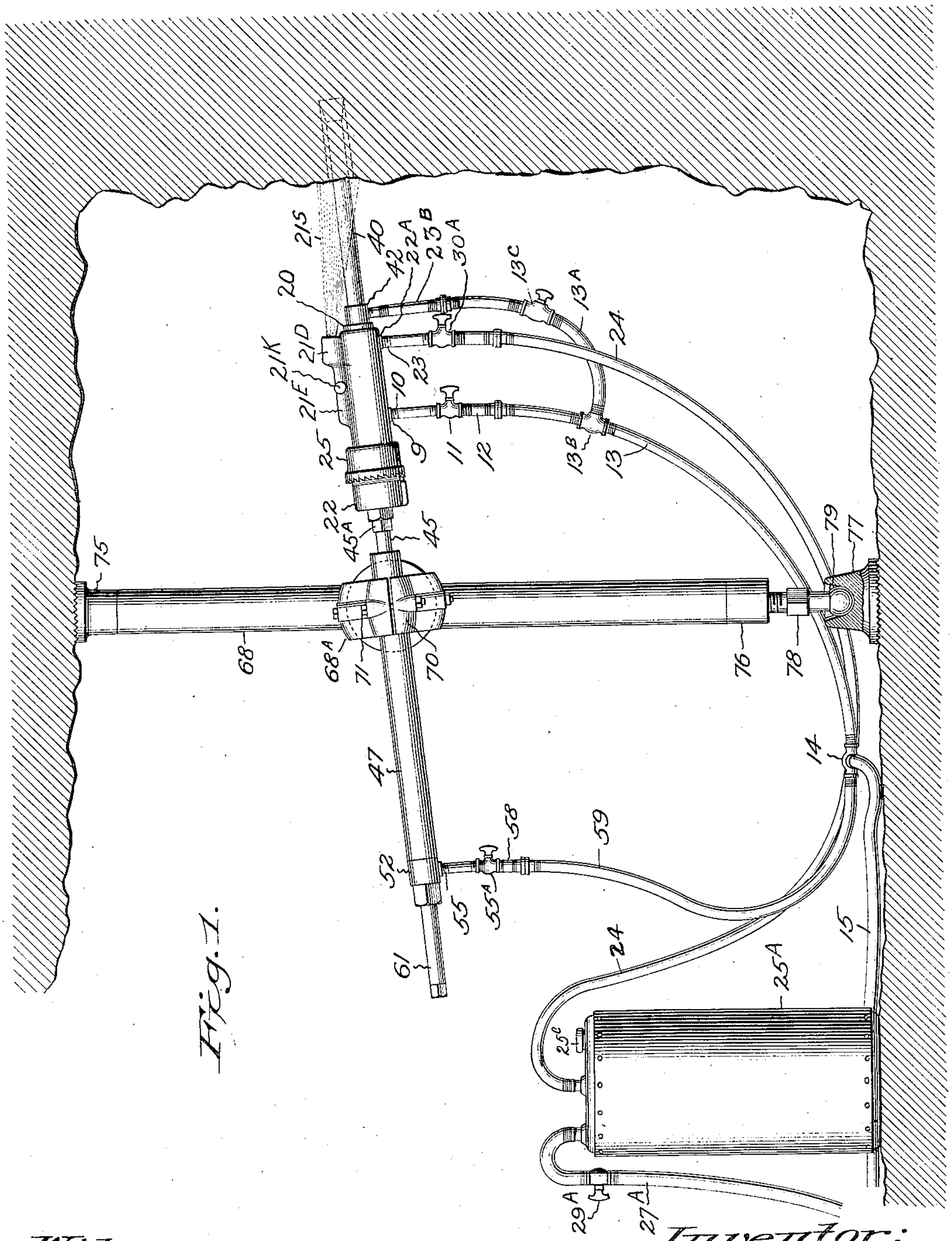

Fig. 1.

Witnesses:
G. Sargent Elliott.
Bessie Thompson

Inventor:
Charles H. Shaw.
By H. S. Bailey. Attorney.

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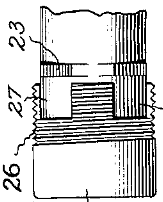

Fig. 5.

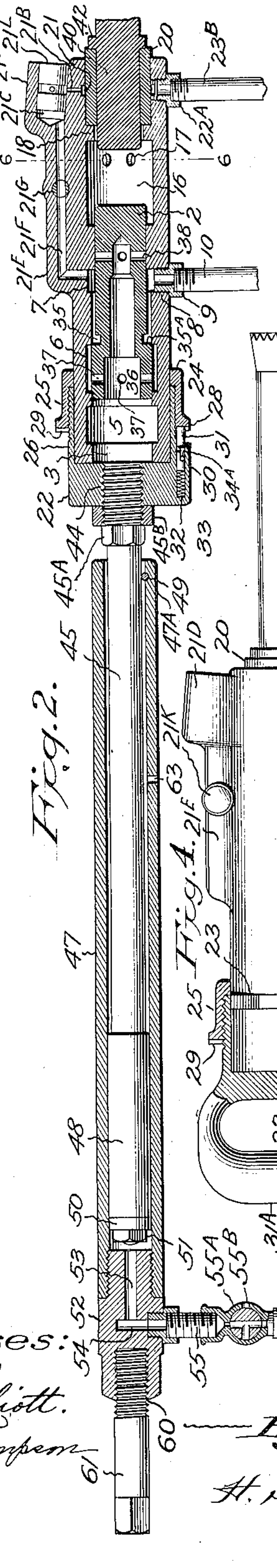

Fig. 2.

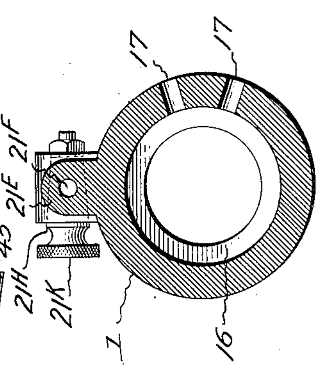

Fig. 3.

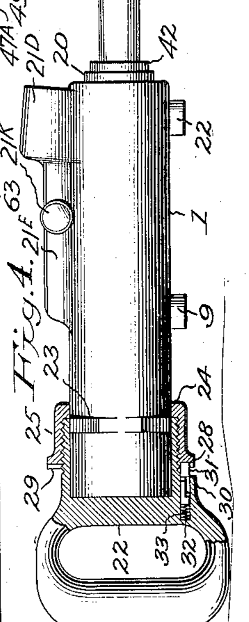

Fig. 4.

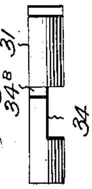

Fig. 6.

Witnesses:

G. Sargent Elliott.

Bessie Thompson

Inventor:

Charles H. Shaw.

By H. S. Bailey. Attorney.

C. H. SHAW.

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3 SHEETS—SHEET 3.

Fig. 7.

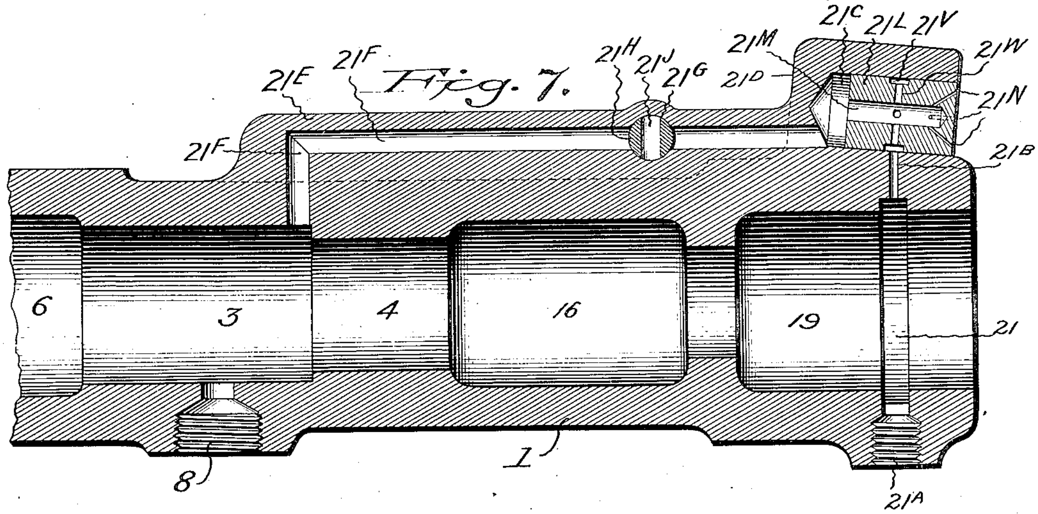


Fig. 8.

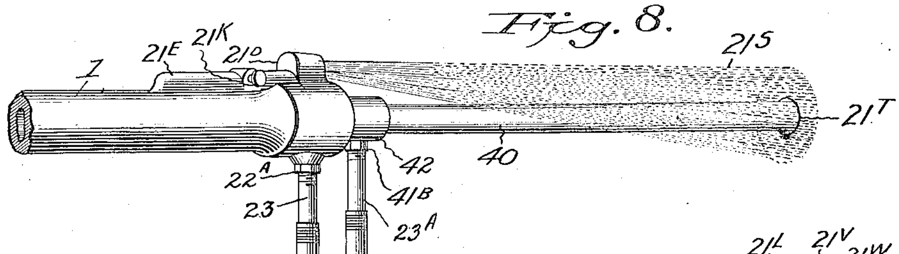


Fig. 10.

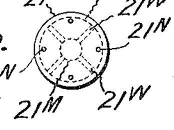
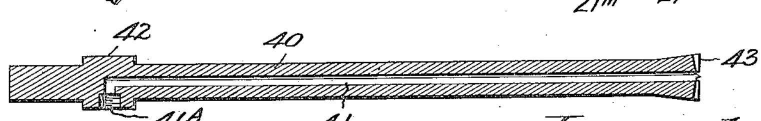


Fig. 9.



Witnesses:
G. Sargent Elliott
Bessie Thompson

Inventor:
Charles H Shaw
By H. S. Bailey.
Attorney.

UNITED STATES PATENT OFFICE.

CHARLES H. SHAW, OF DENVER, COLORADO.

WATER-FEED, DUST-LAYING, ROCK-DRILLING ENGINE.

No. 922,526. Specification of Letters Patent. Patented May 25, 1909.

Application filed September 19, 1904. Serial No. 225,147.

To all whom it may concern:

Be it known that I, CHARLES H. SHAW, citizen of the United States of America, residing in the city and county of Denver and State of Colorado, have invented certain new and useful Improvements in Water-Feed, Dust-Laying, 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 water feed dust laying rock drilling engines, and the objects of my invention are: First, to provide a rock drilling engine that will lay the rock dust as it emerges from the holes in rock as they are being drilled. Second, to provide means for delivering a mist of water under pressure against the rock, or around the edge of holes in rock, while drilling them. Third, to provide means for supplying water under pressure to pneumatic hammer rock drills, and for discharging the water from the front end of the pneumatic hammer rock drilling engine in a watery mist or in a plurality of jets or sprays against the surface of rock in tunnels, shafts, stopes and drifts of mines, at or adjacent to or around the edges of holes in rock while drilling them, for the purpose of laying or wetting down the rock dust as it flows from the holes while drilling them. Fourth, to provide means for storing a supply of water and for discharging said supply of water from the drill holding end of pneumatic hammers, and pneumatic hammer rock drilling engines in a circular shower of atomized mist, spray or jets. Fifth, to provide means for introducing either air or water into the rock cutting drill bit, independent of and entirely outside of the cylinder of the rock drilling engine. I attain these objects by the mechanism illustrated in the accompanying drawings, in which:

Figure 1, designates a side view of a pneumatic hammer rock drilling engine and water supply apparatus embodying my invention. Fig. 2 is a vertical longitudinal sectional view of the rock drilling engine shown in Fig. 1; the stopping bar and the clamp shown in Fig. 1, being left out of this view. Fig. 3 is a sectional view on the line 6—6 of Fig. 2. Fig. 4 is a side view partly in section of the rock drilling engine, arranged to be manipulated by hand. Fig. 5 is a detail plan view of the cylinder cap and a portion of the cylinder. Fig. 6 is a side view of the cap locking pin. Fig. 7 is an enlarged fragmentary sectional view of the front end of the cylinder showing the air passage, the water chamber and the mist spraying valve. Fig. 8 is a perspective view of the front end portion of the form of drilling engine illustrated in Figs. 1, 2, and 7, showing the manner in which the water is thrown in a spray or mist around the hole being drilled. Fig. 9 is a sectional view of the drill bit used with this present form of drilling engine. Fig. 10 is a front elevation of the mist or spray making valve.

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

Referring to the drawings: The numeral 1, designates the cylinder of my improved pneumatic hammer dust laying rock drilling engine, and 2, the hammer piston. The cylinder 1, consists of a single integral cylindrical shell, which is provided with an axial bore of two diameters 3, and 4, in which the piston 2, which is also made in two diameters, is reciprocally mounted, the larger diameter of the cylinder is at its rear end and in the inner periphery of the bore of the cylinder close to this end, a circumferential chamber or port 5, is formed. Adjacent to this chamber a second circumferential chamber or port 6, is formed, and at the junction of the larger and smaller diameters of the bore of the cylinder, an annular recess 7, is formed, that forms the air inlet port to the cylinder. A threaded aperture 8, is formed through the shell of the cylinder which receives a reducer 9, the interior of which is threaded to receive one end of a nipple 10, to the opposite end of which a valve 11, is secured. A nipple 12, is secured at one end to the valve and a hose 13, extends to a tee 14, which is connected to a hose 15, that leads to a supply of compressed air. At a short distance from the air inlet port 7, a circumferential exhaust port 16, is formed in the periphery of the bore of the cylinder. This exhaust port is open to the atmosphere through the exhaust apertures 17, which extend radially through the shell of the cylinder. At the end of the exhaust port 16, a narrow partition 18, is formed. Beyond the partition an axial bore 19, of about the same diameter as the exhaust port extends into the cylinder from its front end to the partition 18. In this end bore 19, a drill-holding collet

20, is driven tightly. The partition 18, is also provided with an axial hole a little larger in diameter than the hole in the drill holding collet.

To the rear end of the cylinder of Figs. 1, 2, 3, and 4, I secure a cap or rear cylinder head 22, preferably clamping it to the cylinder in the following manner: On the outer peripheral surface of the cylinder, I form a projecting collar 23, which is formed of four flat square portions and four circular portions, see Fig. 5. The centers of the square portions are flush and even with the circumferential surface of the cylinder, while the end portions of the square and the curved portions of the collar project a short distance above the cylinder and form square shouldered abutments for the introverted end 24, of a nut 25, that is mounted loosely on the cylinder. This nut is of larger diameter than the cylinder and projects forward over the front end of the cylinder from the collar against which its introverted end abuts. The cap 22, is provided with a cylindrical sleeve portion 26, that fits loosely over the end of the cylinder and its end is provided with four recesses 27, that fit over the circumferential portions of the collar, while the four finger ends formed on the end of the sleeve of the cap fit over the flat square portions of the collar, see Fig. 5. The peripheral surface of this collar is threaded and the nut is screwed on to it, thus drawing the cap tightly against the end of the cylinder, while the square portions of the collar and cap prevent the cap from turning. An enlarged collar portion 28 is formed on the free end of the nut, the face of which is provided with a circumferential row of radial ratchet teeth, 29, and on the cap a boss 30 is formed, in which a spring controlled locking pin 31 is placed, one end of which is beveled, and is arranged to project into the ratchet teeth and lock the nut to the cap. This locking pin device comprises a hole 32, formed in the boss, 30, substantially parallel with the axis of the cylinder in the bottom of which a coiled expansive spring 33 is placed. The pin 31 is inserted loosely in the hole against the spring, which is held in resilient engagement with the ratchet teeth by the expansive tension of the spring. A recess 34 is formed in one side of the pin, and a stop pin 34^A is inserted transversely through the boss and recess of the pin and secured the pin 31 in the hole. The pin is arranged to be moved back against the spring away from the ratchet teeth of the nut and locked in that position of disuse by forming a recess 34^B, at the front of the recess 34, and at right angles to it, and it is only necessary when the nut is to be unscrewed from the cap to push the pin back until the recess 34^B, registers opposite the stop pin, and then turn the pin quarter way around and bring the recess 34^B, in contact with the stop pin which will hold it in its retracted or inoperative position.

The piston hammer 2, is provided with a circumferential recess 35, in its outside periphery, at the junction of its two diameters, in order to provide a shoulder 35^A, of larger area of surface for the expansive fluid to act on, in moving the piston hammer rearward. The expansive fluid acts against the shoulder in moving the valve rearward as will be explained more fully hereinafter. The piston hammer is also provided with an axial bore 36, of preferably three diameters, which extends into it from its rear end to near its front end. The largest diameter of the axial bore of the valve is at its rear end, and the smallest is at its front end portion. Radially through the shell of the valve from its largest bore a plurality of port holes 37, are formed. I also form a plurality of port holes 38, radially through the shell of the valve into the smallest diameter of its axial bore. I preferably use four port holes at each end of the valve, and position them so that the rear end port holes 37, will register with the circumferential port 6 near its rear end, and the front end port holes 38, will register adjacent to the front edge of the annular inlet port 7 and position the circumferential recess 35 and the shoulder of the largest diameter of the valve at the junction of the two diameters at the front edge of the circumferential port 6, as shown in Fig. 2, in which position of the piston the actuating fluid has been cut off from entrance from the port 7, into the interior of the piston through the port holes 38, and the piston hammer is being moved rearward away from the drill-bit as will be described more fully hereinafter.

In the drill holding collet I fit loosely, when the pneumatic hammer is to be used for drilling holes in rock, the shank of a drill bit 40. This drill bit is preferably made of a round bar of steel and is provided with an axial hole 41, which extends only partially through the drill bit. The hammer striking end is solid and I preferably extend this axial hole to a point about where its hammer striking end or shank enters the drill holding collet; consequently the actuating fluid from the cylinder of the piston hammer cannot and does not enter the drill-bit. The hammer striking end of the drill-bit is preferably made polygonal, and a collar 42 is formed on the round part of the shank adjacent to the hexagon end, and a threaded hole 41^A is formed in the side of the drill-bit into its axial hole. I preferably place this hole 41^A in the collar 42, and to this threaded hole I connect a hardened steel reducing nipple 41^B, which is adapted to receive in its largest diameter one end of a threaded nipple 23^A, the opposite end of which is connected to one end of a piece of hose 13^A that forms a branch of the air supply hose 13. The opposite end of the hose 13^A is connected to a tee 13^B, that is connected in the hose 13.

The hose, 13^A is provided with a valve 13^C as shown. The rock cutting end of the drill bit may be made in any way and may be provided with any number and with any kind of rock cutting lips; I preferably, however, upset the end to form a cutting head. The face of the head of this drill-bit is preferably made at right angles to the axis of the drill shank and is formed into a circular row of tapering saw toothed cutting lips 43, which radiate from the edge of its axial aperture to the periphery of the head of the drill-bit. The hammer striking end of the drill fits loosely in and extends through the hexagon hole of the drill holding collet until its collar strikes against the end of the collet and extends also through the partition 18 a short distance into the reciprocal path of the piston hammer which strikes against it at each forward stroke. When the pneumatic hammer is to be used for stone carving for architectural work and sculpture, suitable chisels must be employed in place of the drill-bit and they may be made with or without axial apertures, as desired.

In the shell of the cylinder close to its front end, and in the counterbore 19, I form a circumferential recess 21. This recess I term a water chamber. This water chamber is closed to the bore of the cylinder and to its exhaust port 16, by the drill-holding collet 20, which is driven tightly into the bore 19. An inlet aperture 21^A, is formed radially through the shell of the cylinder. This aperture is threaded and a hardened steel reducer 22^A is threaded to it, that is adapted to receive in its largest diameter the threaded end of a nipple 23, which is secured to one end of a hose 24, the opposite end of which extends to and is connected to the top portion of a water supply tank 25^A.

In cases where it is not desired to use water in the water chamber, but in the drill-bit only, the hose 24, may be disconnected from the water chamber and connected directly to the drill bit. Compressed air is most generally used in the drill-bit, and is conveyed to it through the branch hose $13,^A$ which is connected to the air hose 13, at one end, and to the drill-bit at its opposite end, as shown. Opposite the aperture 21^A, and opening into the water chamber 21, I form an aperture 21^B, which extends into a nozzle chamber 21^C, that is formed in a projecting lug 21^D, that is formed integral with the front end of the cylinder. This nozzle chamber extends into the lug at an acute horizontal angle to the axis of the cylinder that converges from the rear end of the lug toward the axial center of the cylinder. The degree of this angle is such that if the axis of the cylinder was projected forward, the axis of the inclined nozzle chamber would meet it. A smaller lug 21^E, extends from the rear end of the lug 21^D, along the top of the cylinder to about opposite the air inlet port 7, in Fig. 2, and to about opposite the junction of the bores 3, and 4, of Fig. 7. In Fig. 7, however, the inlet port 7, as shown in Fig. 2, is dispensed with. The cylinder shown in Fig. 7, represents the cylinder of the largest size drilling engine, while the cylinder of Fig. 2, shows the arrangement of the smallest size. The difference is of no consequence, as in Fig. 7, the port 7, of Fig. 2, is dispensed with, and the port 3, of the cylinder in Fig. 7, acts as the air inlet port. From the junction of the bores 3, and 4, of the cylinder in Fig. 7, and from the inlet port 7, in Fig. 2, I extend an air port 21^F, through the lug 21^E, to the nozzle chamber 21^C. In the lug 21^E, I form a tapering valve seat aperture 21^G, at right angles to the port 21^F, and in this valve seat I rotatably secure a tapering plug valve 21^H, which is provided with a port 21^J, that is arranged to register with the port 21^F; the large end of this valve is provided with a finger operating disk 21^K, by which it may be rotated to open or close the port. In the chamber 21^C, I fit a nozzle 21^L. While this nozzle may be secured in this chamber in any desired manner, I preferably fit it to press snugly into it, as it is improbable that it will have to be removed. I form an axial aperture 21^M, in the rear end of this nozzle, that connects with the rear end of the nozzle chamber and with the cylinder port 21^F, which extends into the nozzle to near its front end, and into the front end of the nozzle I drill a plurality of very small holes 21^N, which I arrange in a circle concentric to the axis of the nozzle, and drill them into the nozzle at a converging angle that will discharge the water from around the nozzle in such a manner that at a distance of from a few inches to about, from fifteen to twenty-four inches, it will discharge the jets from the holes as a spray or mist around the drill bit and at short distance from it and from the hole being drilled in the rock, when the rock drilling engine is set at a practical drilling distance from the rock, substantially as shown in Fig. 8, in which 40 designates the drill bit; 21^S, the spray or mist, and 21^T, the outline of a hole being drilled. Two or more holes may be used if desired, but I preferably use four, and arrange them as shown in Fig. 10. I form a circumferential recess 21^V, around the central portion of the nozzle, and position the nozzle in the chamber so that this recess will register with the aperture 21^B; and from the bottom of this recess I drill two holes 21^W, entirely through the nozzle from diametrically opposite sides of it, which intersect the axial aperture 21^M, and form four inlet apertures from the circumferential recess 21^V, into the axial port 21^M.

The tank 25^A, is made of a size that permits it to be easily lifted and carried by one man, and is made small in diameter in order that it will not take up much room and will better fit in niches and at the side of the mine's supporting timbers, and is made long enough to hold several gallons of water. The top of this tank is provided with a capped inlet 25^C. One end of a hose 27^A, is connected to a nipple that is connected to the upper portions of the tank. The opposite end of the hose extends to a supply of compressed air; a suitable valve 29^A, is placed in the hose 27^A, adjacent to the tank to control the air pressure, and a suitable valve 30^A, is placed in the hose 24, to control the flow and pressure of the water to the water chamber in the cylinder.

Where my improved pneumatic hammer dust allaying rock drill is to be held and guided by an operator, when drilling holes in rock in the same manner as pneumatic clipping and calking hammers are held, a handle 31^A, is formed on the cap, as shown in Fig. 4.

My improved dust laying rock drilling engine comprises the pneumatic hammer cylinder and the fluid pressure feed cylinder, which feeds the drill-bit automatically into the rock as fast as it drills into it. The fluid pressure feed cylinder is a part of the pneumatic hammer cylinder and is rigidly connected to it.

In Figs. 1, and 2, a threaded hole is formed in the cap 22, in which I screw one end of a piston rod 45, which is provided with a nut-shaped collar portion 45^A; this collar is formed integral with the piston rod; the piston rod is screwed through a check nut 45^B, until the collar bears against the check nut and the check nut bears tightly against the cap.

The piston rod 45, is a long rod that is provided with a long piston head 48, which is a little larger in diameter than the piston rod, and is fitted slidably in a long cylinder 47, which I term the constant or fluid pressure feed cylinder. I preferably make this feed cylinder long enough to provide a feed movement of about fourteen inches without changing the drill bits, but it can be made to give any desired length of feed movement. The piston feeds outward from the rear end of the cylinder to its front end, and in order to prevent its feeding out of the cylinder, I provide the front end 47^A of the cylinder with a pin 49, which is placed transversely through the end of the cylinder, close to the body of the piston in a position to be struck by the piston head when it reaches the end of its forward feed stroke.

The piston head is provided with a packing ring 50, which preferably consists of a leather washer which is a little larger in diameter than the piston head. This washer is mounted on a reduced threaded stud, formed at the rear terminal end of the piston head, and a hexagon nut 51, which is a little smaller than the piston head is screwed on the stud and tightly against the washer, thus expanding it against the inner periphery of the bore of the cylinder. The rear end of the bore of the feed cylinder is closed by a plug 52, which extends rearward of the cylinder a short distance. This plug is provided with a reduced threaded hub portion that screws into the end of the cylinder which is threaded to receive it. A small axial hole 53, is drilled into the plug from the cylinder end a portion of its length, and a transverse hole 54, is drilled into the surface of the side of the plug to intersect it. These two intersecting holes form the fluid inlet of the constant pressure or feed cylinder. The entrance to the transverse hole 54, is threaded and a nipple 55, is threaded to it. A three way valve 55^A, which I term a pressure relief valve, is threaded to the nipple 55; a second nipple 58, is threaded to the valve, and a hose 59, is secured at one end to the nipple 58, and at its opposite end is secured to a nipple that is secured to the tee 14, which connects with the hose 13. The hose 15, is connected to the tee 14, and leads to a supply of compressed air. The rear end of the plug is formed into a wrench receiving surface, and a threaded hole 60^A, extends axially into its rear end, in which is loosely threaded the threaded end of an adjustable brace-bar 61, the opposite end of which is formed into a wrench receiving surface.

The valve 55^A, is provided with a waste escape aperture 55^B which is arranged in the body of the plug of the valve so that when the valve is closed to the admittance of the actuating fluid to the cylinder, the escape or waste passage is opened, which permits any actuating fluid in the cylinder at the rear of the piston head to instantly escape, see Fig. 2. A waste escape aperture 63, is also formed through the forward end of the cylinder just back of the piston's most forward position in the cylinder, which, when the piston rod has been fed forward to its stop pin or washer, permits the actuating fluid flowing into the cylinder to escape to the atmosphere, thus relieving the piston from the pressure and notifying the attendant that the piston has reached the limit of its feed.

In order to support my improved rock drilling engine in stopes and tunnels of mines, it is necessary that a suitable column be provided. My invention contemplates the use of any operative stoping bar and clamp or chuck. As illustrated, the clamp, in Fig. 1, consists of two parts, one part 70, which is arranged to be clamped to the fluid pressure cylinder by bolts 71, and the other is arranged to be clamped to the stoping bar. This clamp, is arranged to permit the drilling engine to swing in horizontal and vertical planes, and to be set in any desired position. The stoping column 68, comprises a tubular bar, in one end of which a serrated foot piece 75 is secured. In the opposite end of the tubular bar a plug 76 is secured and an extension rod is threaded to it, which is provided with a ball at its outer end. This ball end is secured in a socket foot piece 77, the end of which is serrated. A wrench receiving surface portion 78 is formed on the threaded rod. The ball end of the threaded rod is secured in the socket foot piece by a pin 79, which is inserted transversely through the foot piece just above the ball close to the side of the threaded extension rod.

The operation of my improved rock drilling engine is as follows: The drilling engine, by which I mean the coöperating hammer and feed cylinders, the drill bit and water feed mechanism, and their coöperative elements, is operatively mounted on any suitable supporting column, as shown in Fig. 1. The water supply tank is filled with water through the cup 25^C, and should be large enough to hold water enough for one or two or more shifts, and the actuating fluid is conveyed to the tank through the hose 27^A. The actuating fluid is also conveyed to the drilling engine through a hose 15, from a suitable source of supply. The compressed air forces the water from the tank through the hose 24, into the water chamber 21. I preferably use compressed air for the actuating fluid, but steam may be used if desired. When the pneumatic hammer is held in the hands of an operator, the hose 15 and tee 14 and hose 59 are dispensed with and the compressed air simply flows through the hose 13 to the port 7 into the cylinder, and when the fluid pressure cylinder is used with the piston hammer, the compressed air is conveyed from a source of supply through the hose 15 to the tee 14, and through the hose 13 to the piston hammer cylinder and through the hose 59 to the constant pressure feed cylinder the flow being controlled by the valves 11 and 55^A, respectively, placed in the supply pipes close to the piston hammer and feed cylinders. The air enters the port 7 and assuming that the valve is at the forward end of its stroke against the drill-bit, the air strikes the shoulder 35^A of the valve and moves the valve rearward and continues to move it on its back stroke as the front end of the valve is smaller in diameter from the shoulder to its front end than the bore of the cylinder, and forms a circumferential port for the air to the shoulder during the entire rearward stroke of the valve; consequently, the air continuously presses the valve rearward until the shoulder 35^A registers with the port 6, which releases the pressure on the valve as the air flows into the port and through the port holes 37, into the interior of the valve to the rear end of the cylinder and at practically the same time the ports 38 in the front end of the valve register with the inlet port 7, and the air flows into the interior of the valve and flows to the rear end of the cylinder filling the rear end of the cylinder and cushioning the valve at the ends of its rearward stroke and also starts the valve on its forward stroke as the air flows continuously through the valve ports 38, to the rear end of the cylinder and presses against the rear end of the valve and the bottom of its axial bore, and as the volume of air at the rear of the valve is very much greater than the volume of air on the shoulder 35^A, the valve is thrown forward with great force and power against the end of the drill bit. The chamber 5 is formed to provide space for enough air to insure the expansive power necessary to cause the piston hammer to strike the powerful blows required to drill deep holes in rock with long drill-bits. When the valve reaches the end of its forward stroke, the valve ports 38 register with the exhaust port 16, and the air within the valve and at the rear end of the cylinder escapes to the atmosphere through the radial aperture 17. When the valve strikes the drill-bit, the shoulder 35^A and the recess adjacent to it are at the edge of the air inlet port 7, and the valve is instantly started rearward and its reciprocal stroke is repeated.

In most kinds of rock it is preferable to use compressed air to blow out the rock dust and rock cuttings as fast as they are made by the drill-bit in drilling the holes, and to accomplish this I connect the branch air supply hose 13^A to the inlet nipple of the drill-bit, the live air then flows from the air compressor directly to the drill-bit and through the hole in the drill bit that extends partially through it to the bottom of the hole being drilled, and blows the rock dust and rock cuttings out of the hole as fast as the drill makes them. When the rock makes a dry dust, it would, if allowed to flow away from the hole, cover the drill cylinder completely with rock dust; and this dry dust also proves objectionable to the operator of the drilling engine; in fact, miners cannot work long in dry rock dust without being subject to the danger of contracting lung trouble, and in order to effectually allay the dust, I force live air under pressure from the air inlet port of the cylinder which flows to the center port in the nozzle, where it mingles with a supply of water under pressure from the tank and water chamber, which flows through the transverse ports of the nozzle to its center port, where the air atomizes the water, which is then forced out through the four small holes in the nozzle, in jets of atomized spray or mist, which, after the jets leave the discharge apertures in the nozzle, form a complete circular ring of atomized spray or mist which is discharged against the breast of the rock around the drill bit and around the hole being drilled, and I preferably arrange these jet discharging holes so that they will make a circular ring of mist around the hole of from, a few inches to from, about twelve to eighteen inches in diameter, as this mist is so fine and dense that the fine dust, as it flows from the hole can not get through it, and it is drowned and obliterated, while the coarse rock cuttings simply fall to the ground as they are either blown by air or washed by water from the hole being drilled. This fine mist does not in the least interfere with the manipulation of the drilling engine or drill bit, and but a very small amount of air and water is necessary to effectually lay the dust.

The nozzle is set at an angle in the hub that will permit the discharge apertures to throw a circular atomized spray of mist water, a predetermined distance, which is regulated by the length of the feed movement of the fluid pressure cylinder, that is, if the feed travel of the piston of the fluid pressure feed cylinder is fourteen inches, the travel of the piston hammer cylinder and of the drill bit will be fourteen inches also, and the inclination given to the nozzle in its bearing hub, is such that it will discharge a circular ring of atomized spray or mist from the farthest position of this fourteen inches of feed stroke to its nearest point to the face of the rock in which the hole is being drilled, around the drill bit and around the edge of the hole being drilled. This atomized mist encounters the rock dust at either extreme of the feed movement of the drilling engines, as it flows out of the hole and completely drowns and obliterates it. When, however, as in holes where the ground is talcy and is naturally damp enough to form a stiff or sticky mud in the bottom of the hole, and compressed air will not remove it, then the water pressure supply hose 24 can be removed from the water chamber inlet 22, and be connected direct to the inlet 41^A, of the drill bit, and the water flowing under pressure to the cutting point of the drill bit will wash out the stiff or sticky mud as fast as the drill makes it, and will keep the hole clear of it and the drill bit cool. When water under pressure is used in the drill bit, it will not be necessary to use the atomizing spray from the valve. By these arrangements of the water feed, I am enabled to meet any condition of dust or mud or rock cuttings that may be encountered, in a simple and thoroughly practical manner.

The pressure in the tank and the water pressure can be regulated by the valves in their respective supply hose to throw the jets of water straight to the rock during the full stroke of the feed.

The piston hammer reciprocates very rapidly in the cylinder, striking the drill-bit at each stroke and causing an apparently constant stream of rock dust to flow from the hole being drilled. At the same time that the air is turned into the drill cylinder to start drilling a hole, air is also turned into the constant pressure feed cylinder by opening the valve 55^A, and the air flows through the aperture in the plug to the rear of the piston head and exerts a constant and continuous, even, steady pressure against the piston and feeds the piston head and rod and the hammer cylinder and the drill bit into the rock as fast as it cuts into it, until the piston head reaches the stop pin or cap and washer at the end of the cylinder and passes its air escape aperture, when the pressure is relieved and the feed stops; the valve 55^A is then manipulated to shut off the air from the cylinder and open its air escape aperture which instantly relieves the cylinder of all air and permits the piston to be moved back to the beginning of its feeding stroke and to permit the drilling engine to be adjusted to continue drilling the hole deeper by inserting a longer drill-bit or of moving the drilling engine to start a new hole. When the stoping column and the drilling engine have been set in position to drill a hole, the air is let into the feed cylinder first, and the feed piston moves the drill cylinder forward until the drill-bit bears against the rock. The air is then turned onto the piston hammer cylinder, and the operator takes the nipple 10 in one hand and moves it up and down slowly through an arc of a circle of from five to eight inches and thereby oscillates or rocks the hammer piston cylinder and the drill-bit and the feed cylinder's piston, and continues to rock them as long as the drilling is continued. This rocking motion causes the drill-bit to cut a clean smooth round hole without channeling, clogging or sticking as the fine rock cutting lips of the drill-bit are close together and bear evenly on the bottom of the hole.

My improved rock drilling engine is very light of weight, and small of diameter, the entire weight of a rock drilling engine capable of drilling one inch and an eighth holes from three to eight inches deep in rock, per minute, with a very small amount of air, being but about forty pounds.

While I have described the constant pressure or feed cylinder as being operated by compressed air, my invention contemplates the use of any suitable expansive fluid under pressure, such as steam, or of water, and my invention especially contemplates the use of water as water can be used in place of air or steam in the feed cylinder to maintain a constant feeding pressure on the piston, it being simply necessary to provide an independent hose connection with a suitable water supply under a suitable water pressure to feed the hammer cylinder and drill-bit forward as fast as the drill-bit cuts into rock, and the independent hose could be, if desired, attached directly to the water supply tank 25^A, that is used for supplying the water to lay the dust.

My pneumatic hammer dust laying rock drilling engine is very simple, light of weight, practical and durable and is very easily and quickly handled and manipulated.

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

1. In a dust laying apparatus for rock drilling engines, the combination with a rock drilling engine comprising a feed mechanism, a piston hammer and its cylinder and a drill bit, a drill bit holding collet in said hammer cylinder, and the drill bit operatively supported in said drill holding collet, in operative striking relation to said piston hammer, said cylinder having a water chamber formed therein, comprising a circumferential recess surrounding said drill holding collet, and a water inlet aperture into said chamber, a reducing nipple threaded to said aperture, means for supplying water under pressure to said chamber, means connected with said water chamber for discharging jets or atomized sprays of water from said water chamber and from said cylinder alongside of the drill bit and against the sides of the hole in rock while it is being drilled, said drill bit having an axial hole therein from its rock cutting end, extending partially through it, and a side inlet through the shell of said drill bit into its axial hole, and means connected with said side inlet for conveying a supply of compressed air to the cutting point of said drill bit, and to the bottom of holes in rock while drilling them, substantially as described.

2. In a dust laying apparatus for rock drilling engines, the combination of a rock drilling engine and a drill bit, said drill bit being provided with an axial hole extending partially through it from its rock cutting end and a lateral side inlet through its shell into said axial hole, said engine comprising a cylinder with feed mechanism, a piston hammer reciprocally mounted in said cylinder, a drill holding collet, secured in said cylinder, and the drill-bit operatively supported loosely in said drill holding collet in operative striking relation to said piston hammer, said cylinder having a water chamber therein, a blow out aperture and a water inlet aperture into said chamber, a water supply hose connected to said water chamber, a plug threaded to said blow-out aperture, said cylinder also having water discharge apertures extending from said water chamber, means for discharging jets of water from said water chamber and discharge apertures, alongside of the drill bit and against the sides of the hole in rock, while it is being drilled and means including a hose connected to said inlet aperture of said drill bit for discharging compressed air at the rock cutting point of said drill-bit and in the bottom of holes in rock while drilling them, substantially as described.

3. In a dust laying rock drilling engine, an operative rock drilling engine, having a water receiving chamber, formed in said rock drilling engine, an apertured nozzle connected with said water chamber and means including a valve controlled air discharge passage formed in said engine connected with said water receiving chamber, for discharging sprays of water from said rock drilling engine against the edges of holes in rock while drilling them, substantially as described.

4. In a dust laying rock drilling engine, an operative rock drilling engine, having a water receiving chamber therein, means for connecting said water-receiving chamber with a supply of water under pressure, a discharge passage leading from said water chamber and a mist-making nozzle operatively arranged in said discharge passage and arranged and adapted to throw water sprays in a circular ring around the edges of holes in rock while drilling them, substantially as described.

5. In a dust laying rock drilling engine, an operative rock drilling engine, having a water receiving chamber therein, means for connecting said water-receiving chamber with a supply of water under pressure, a downwardly inclined discharge passage leading from said water chamber, a nozzle seat in said downwardly inclined discharge passage, and a mist-making nozzle operatively arranged in said discharge passage and arranged and adapted to divide said water supply into a plurality of atomized jets and sprays and to discharge said atomized jets and sprays in a circular ring around the edges of holes in rock while drilling them, substantially as described.

6. In a dust laying rock drilling engine, an operative rock drilling engine and a rock cutting drill bit operatively connected thereto, said engine having a water-receiving chamber, means including a passage into the side of and through said drill bit to its cutting point for admitting air under pressure for ejecting rock cuttings from holes in rock while drilling them, and an adjustable valve controlled air discharge passage and a mist making nozzle connected with said water chamber arranged and adapted to discharge a spray of water around the edges of said holes and drown and obliterate the rock dust as it flows from them.

7. In a dust laying rock drilling engine, an

operative rock drilling engine and a rock cutting drill bit operatively connected thereto, said engine having a water-receiving chamber, means including a passage into the side of and through said drill bit to its cutting point, means to supply a fluid under pressure to said passage for ejecting rock cuttings from holes in rock while drilling them, said engine having an adjustable valve controlled air discharge passage provided with a nozzle containing passages that connect with said air passage and with said water chamber, arranged and adapted to discharge jets of water around the edges of said holes and drown and obliterate the rock dust that flows from them.

8. In a dust laying rock drilling engine, an operative rock drilling engine, and a drill bit supported thereby having an axial aperture extending partially through it from its rock cutting end, and means for connecting a supply of fluid under pressure to said drill-bit's axial aperture and for discharging said supply of fluid under pressure at the cutting point of said drill bit and in the bottom of holes in rock while drilling them, said engine having a water-receiving chamber and a combined air and water discharge nozzle arranged and adapted to discharge jets and sprays of water around the edges of holes in rock while drilling them.

9. In a dust laying rock drilling engine, a piston hammer cylinder, provided with a water receiving chamber, means for connecting said water-receiving chamber with a water supply under pressure, a discharge outlet to said water chamber in said cylinder, a lug cast on said cylinder, a nozzle chamber formed in said lug, said cylinder having a discharge aperture from said water chamber to said nozzle chamber, and an air port from the interior of said piston hammer cylinder to said nozzle chamber, and a nozzle in said nozzle chamber, arranged to receive a supply of air and water from said piston hammer cylinder and from said water chamber and arranged to discharge a spray or mist of water around the edges of holes in rock while drilling them, substantially as described.

10. In a dust laying rock drilling engine, the piston hammer cylinder, provided with a water chamber, of a hose connected at one end to said water chamber, and means for connecting said hose at its opposite end to a supply of water under pressure, a hub or lug on said cylinder above said water chamber, a nozzle seat formed in said lug and inclined convergingly to point ahead of said cylinder, said cylinder having a valved air-port extending to said seat, and a nozzle seated in said nozzle seat, and provided with passages connected with said air port and said water chamber, and arranged and adapted to discharge a water mist around holes in rock while they are being drilled, substantially as described.

11. In a dust laying rock drilling engine, the combination of a rock drilling engine, provided with a water receiving chamber, a water-supply pipe operatively connected to said water chamber, a hub or lug on said rock drilling engine, a nozzle seat in said hub or lug, said engine having a discharge passage connecting said nozzle seat with said water receiving chamber, an air port in said rock drilling engine, connected to said nozzle seat, and with means for connecting a supply of compressed air, an adjustable valve in said air port, and a nozzle in said nozzle seat provided with intersecting passages connected with said air port and said water chamber, and arranged and adapted to discharge under air pressure a plurality of jets of atomized spray around the edges of holes in rock while drilling them, substantially as described.

12. In a dust laying rock drilling engine, the combination in a rock drilling engine, said engine having a water chamber, a nozzle chamber in said rock drilling engine, means including a hose for connecting a supply of water under pressure to said water chamber and to said nozzle chamber, and means including a hose for connecting an air supply under pressure to said nozzle chamber and a nozzle in said nozzle chamber arranged and adapted to discharge a spray of water under air pressure against the surface of rock and around the edges of holes in rock while drilling them, substantially as described.

13. In a dust laying rock drilling engine, the combination with the feed mechanism and piston hammer cylinder, and an operative rock cutting drill bit, of a water chamber formed in the drill bit holding end of said piston hammer cylinder, a projecting lug on said cylinder, an inclined aperture formed in said lug, connected to said water chamber, and inclined convergingly toward the plane of said cylinder's axial center, and a nozzle in said inclined aperture provided with an axial port extending partially through it, radial ports extending from said axial port through said nozzle and arranged to connect with said water chamber, obliquely arranged discharge ports in said nozzle arranged to connect with its axial port, and means including an air port for discharging a spray of water from said nozzles' discharge ports under air pressure against the surface of rock and around the edges of holes in rock while drilling them, substantially as described.

14. A dust laying rock drilling engine, comprising a pneumatic hammer cylinder having a rock cutting drill bit operatively connected thereto, a water atomizing device in said pneumatic hammer cylinder, com-

prising an air and water commingling nozzle, means for connecting the nozzle to supplies of air and water under pressure, the axis of the nozzle being arranged at an angle to the axis of the drill as shown and described operatively connected to a supply of air under pressure and to a supply of water under pressure, and arranged and adapted to discharge a mist in a substantially circular ring around said drill bit during its operative feeding rock drilling movement and against the surface of rock around the holes being drilled.

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

CHARLES H. SHAW.

Witnesses:
G. SARGENT ELLIOTT,
BESSIE THOMPSON.