R. S. TROTT.

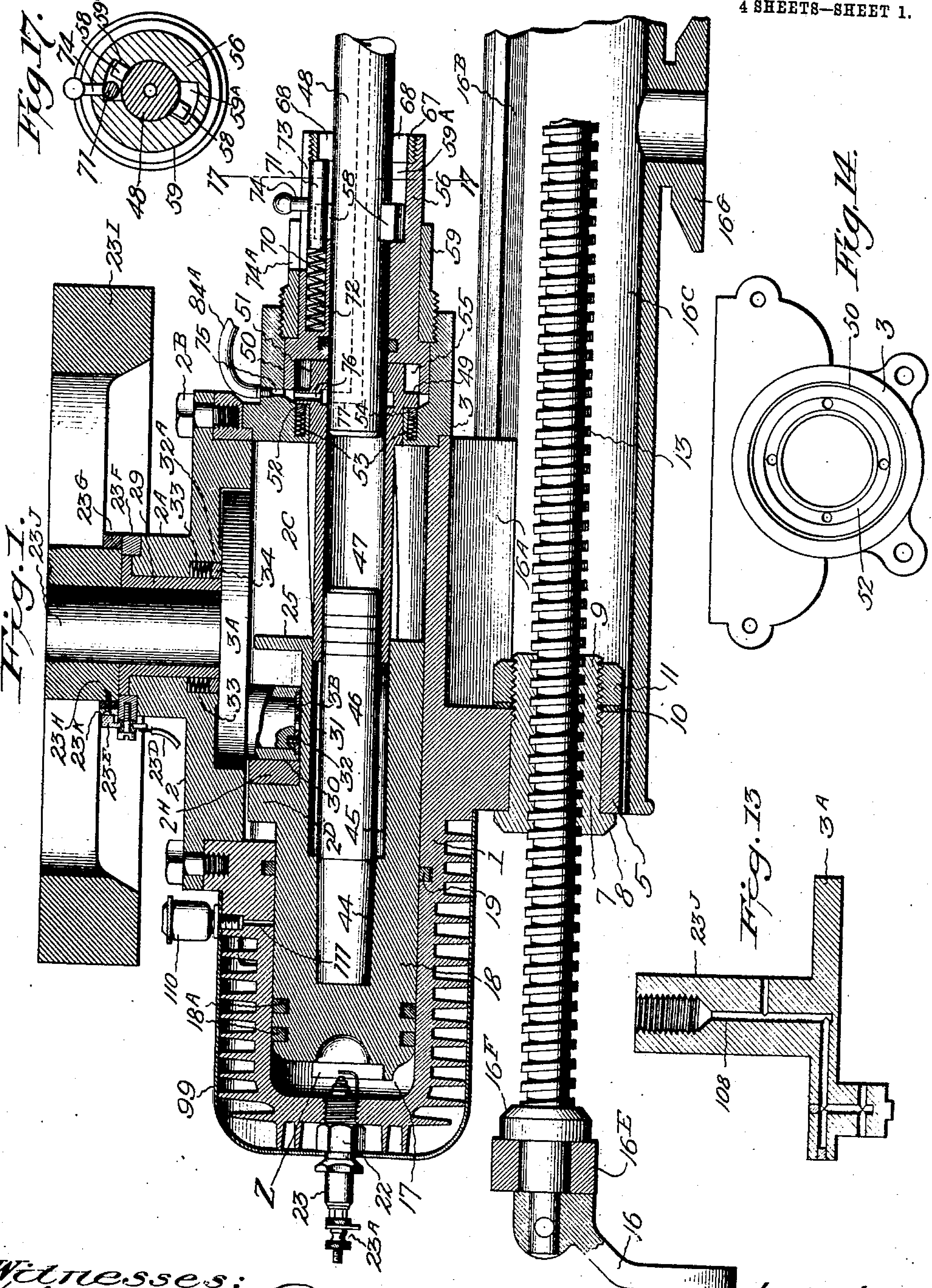
GASOLENE OPERATING ROCK DRILLING ENGINE.

APPLICATION FILED SEPT. 4, 1906.

915,320.

Patented Mar. 16, 1909.

4 SHEETS—SHEET 1.



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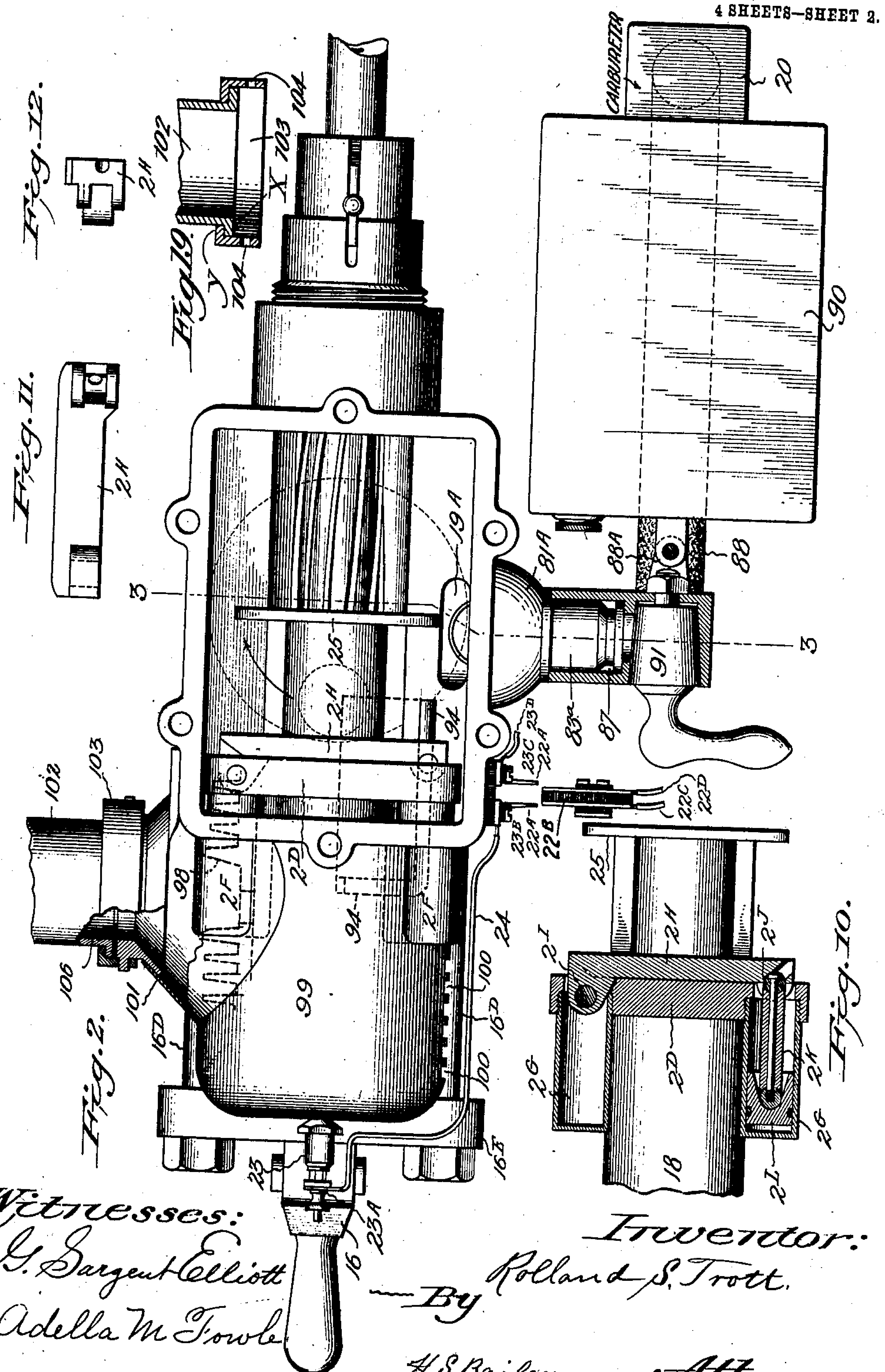

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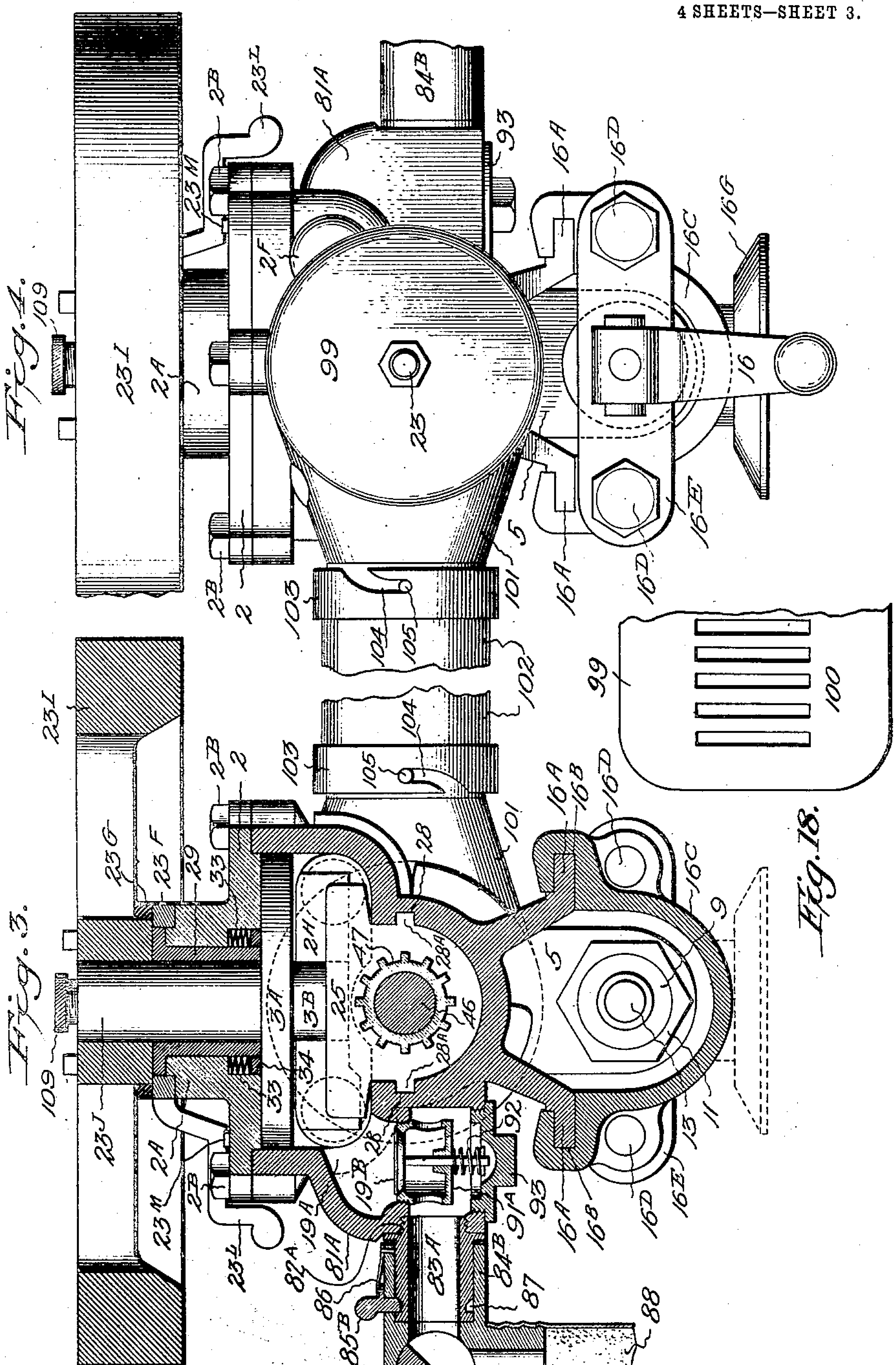

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Fig. 5.

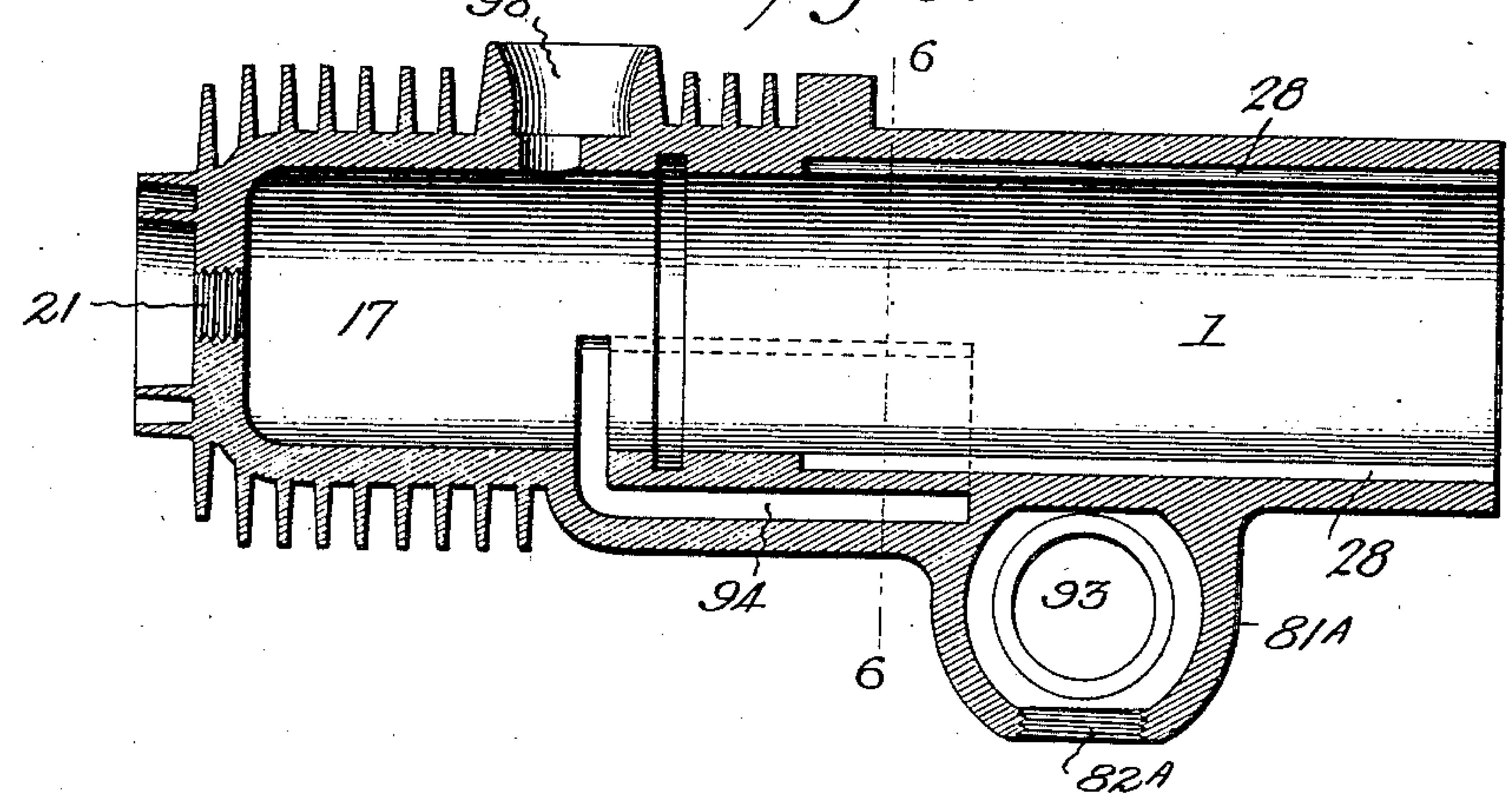


Fig. 6.

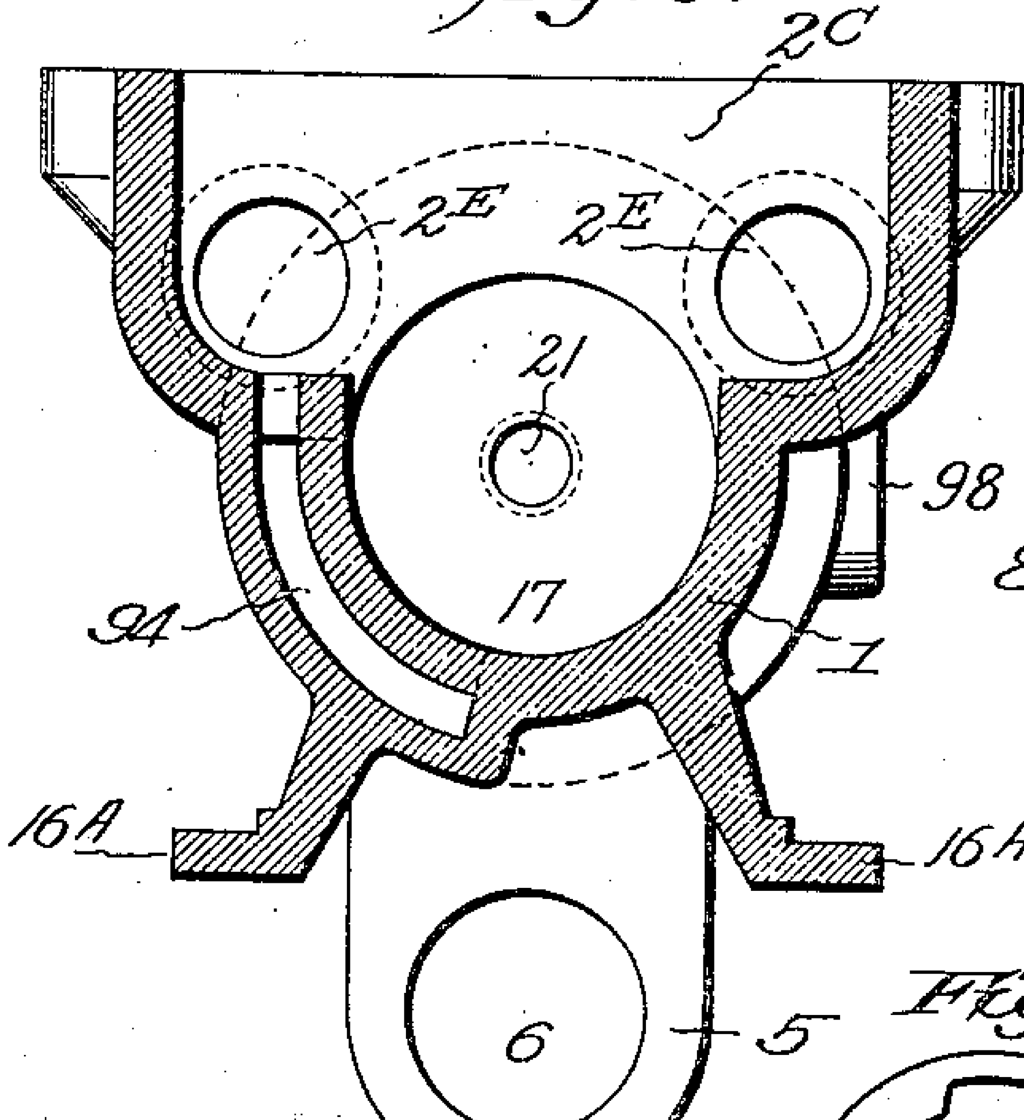


Fig. 7.

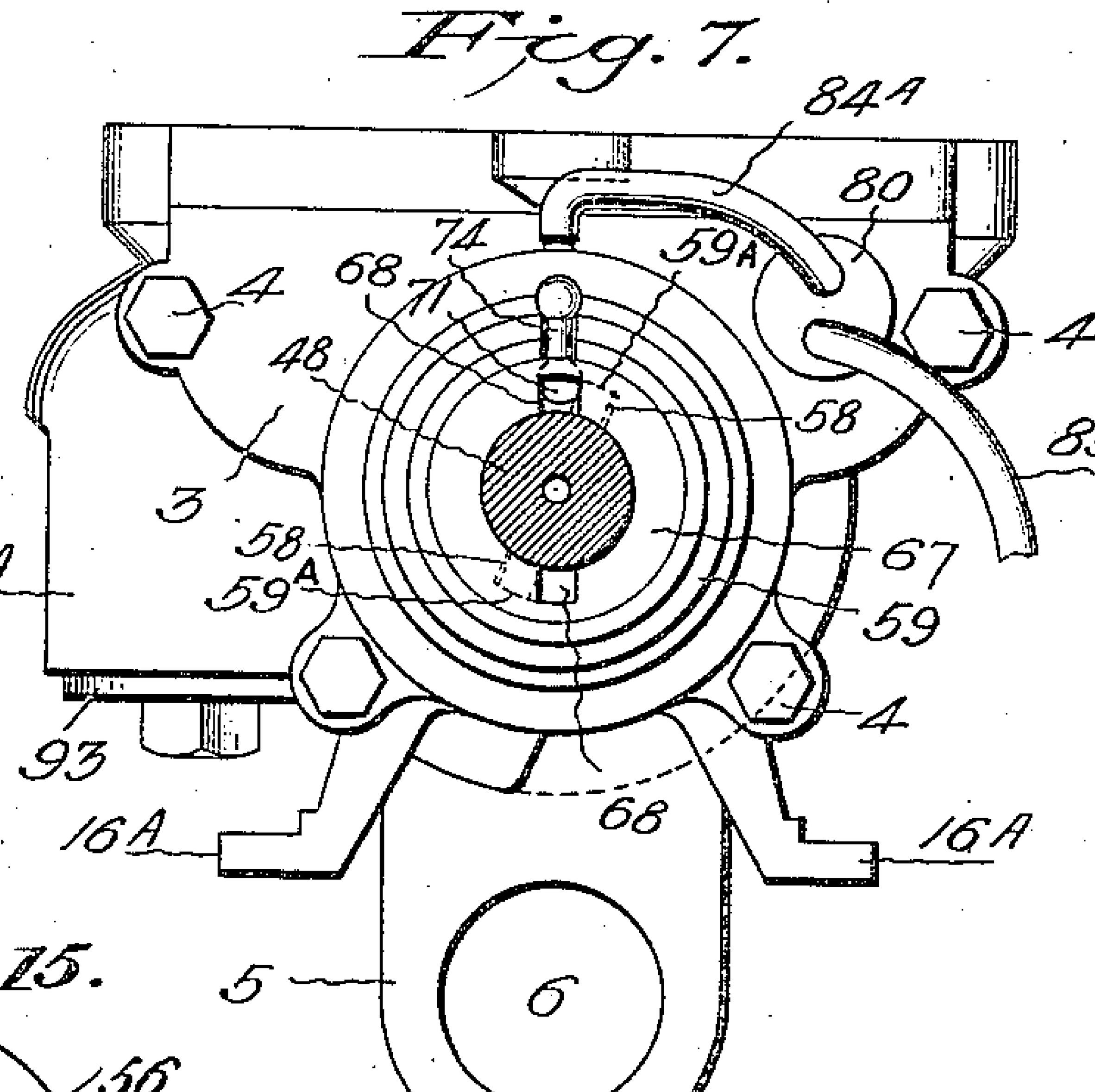


Fig. 15.

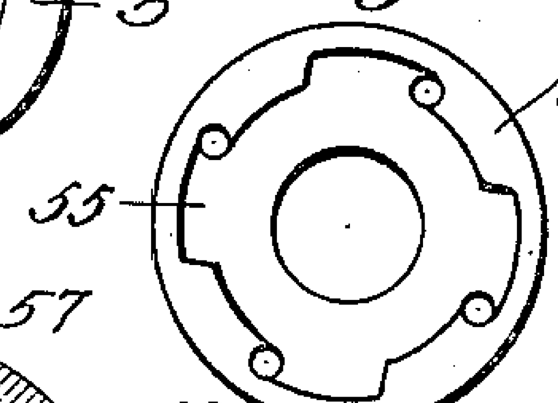


Fig. 8.

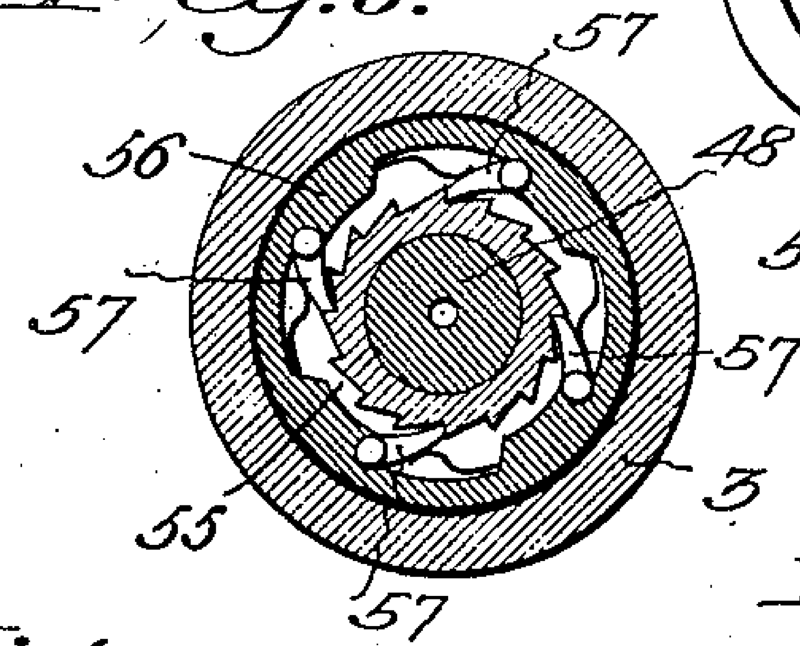


Fig. 9.

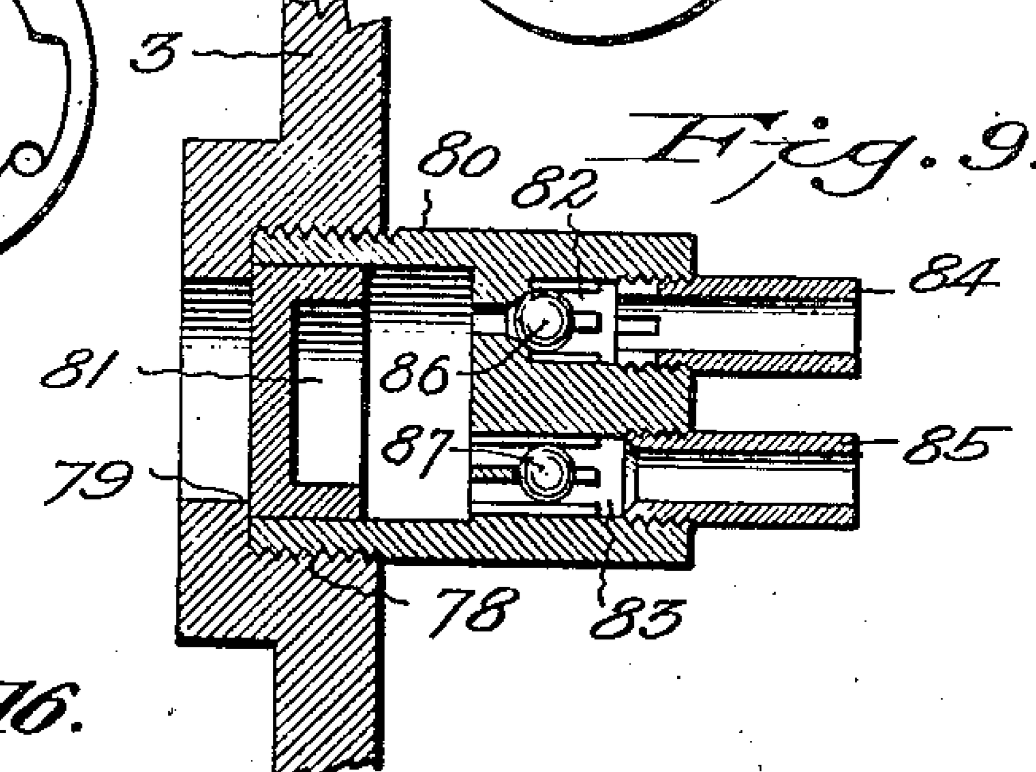
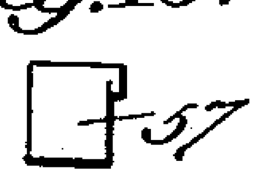


Fig. 16.



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UNITED STATES PATENT OFFICE.

ROLLAND S. TROTT, OF DENVER, COLORADO.

GASOLENE-OPERATING ROCK-DRILLING ENGINE.

No. 915,320. Specification of Letters Patent. Patented March 16, 1909.

Application filed September 4, 1906. Serial No. 333,279.

To all whom it may concern:

Be it known that I, ROLLAND S. TROTT, a citizen of the United States of America, residing in the city and county of Denver and State of Colorado, have invented a new and useful Gasolene-Operating Rock-Drilling Engine, of which the following is a specification.

My invention relates to gasolene operating rock drilling engines, and the object of my invention is: to provide a gasolene operated rock-drilling engine, that is simple, compact, light of weight, and thoroughly practical in its operative features. I attain this object by the mechanism illustrated in the accompanying drawings, in which:

Figure 1, is a vertical, longitudinal, sectional view through the improved rock-drilling engine. Fig. 2, is a plan view thereof, the crank casing or cap being removed. Fig. 3, is a transverse, sectional view taken on the line 3—3 of Fig. 2. Fig. 4, is a rear elevation of the engine. Fig. 5, is a longitudinal, horizontal, sectional view, of the cylinder of the engine. Fig. 6, is a transverse, vertical, section of the same, on the line 6—6 of Fig. 5. Fig. 7, is a front elevation of the engine. Fig. 8, is a vertical sectional view through the pawl and ratchet mechanism of Fig. 1, on a line with the pawls. Fig. 9, is a sectional view of the pump which is operated by the movement of the hammer piston, to force water through the drill bit. Fig. 10, is a plan view of a portion of the hammer piston, showing the piston cushioning mechanism in section. Figs. 11 and 12, are respectively, side and end views of the swinging arm, shown in Fig. 10. Fig. 13, is a sectional view through the crank shaft, disk, and pin, showing the oil passage therein. Fig. 14, is a front elevation of the front cylinder head; Fig. 15, is a front elevaton of the drill holding chuck, showing the recesses in which the pawls are journaled; Fig. 16, is a view of one of the pawls; Fig. 17, is a vertical, sectional view through the drill holding chuck on the dotted lines 17—17 of Fig. 1; Fig. 18, is a view of a portion of the cylinder hood, showing the air inlet passages; and Fig. 19, is a detailed sectional view through the end of the hose nipple and clamping ring.

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

Referring to the drawings, the numeral 1, designates the cylinder casing of my improved drill; 2, the crank shaft casing, and 2^A the hub of the crank shaft casing. This crank shaft casing is secured by cap screws 2^B above an opening, formed in the top of the cylinder casing; and 3, is the front cylinder head, which is bolted to the front end of the cylinder casing by bolts 4. The cylinder shell is provided with a depending lug portion 5, which contains a central aperture 6, in which a sleeve nut 7, is secured, a portion of the nut being turned to fit the aperture of the lug. The nut is provided with a shoulder portion 8, that fits against one side of the lug, and a threaded portion 9, upon which a washer 10 is placed, and a nut 11, is screwed on the sleeve in position to bolt the sleeve to the lug, the nut being arranged to be screwed against the opposite side of the lug from the shoulder. The sleeve 7, is interiorly threaded to receive a feed screw 13, the rear end of which is provided with a crank handle 16, which is removably secured to a reduced shouldered end formed on the screw. The bottom of the cylinder casing is provided with depending slideway lugs 16^A, which move in guideways 16^B, formed in the sides of a supporting shell 16^C. This shell is provided at its rear end with two rods 16^D, which extend rearward substantially parallel to the axis of the cylinder, and at their opposite ends are securely bolted to a cross-bar 16^E, having an aperture centrally positioned between the said bolts, in which the feed screw adjacent to its crank handle portion is rotatably mounted. A collar 16^F is formed on the feed screw, which bears against the inside of the cross-bar, and the crank handle clamping yoke is positioned on the feed screw against the cross-bar on the other side, and acts as a collar for that side, and the feed screw is thus rotatably secured at the cross-bar end of the shell. The bottom of the shell is provided with a depending dove-tail shaped hub 16^G, which is adapted to be clamped to the chuck of a supporting column used to support drills in the shafts, stopes, and tunnels of mines. The drilling engine is fed through the shell by rotating the feed screw, which moves the threaded nut sleeve along as it is rotated.

The cylinder casing is provided with a cylinder bore 17, in which a piston 18 is reciprocally fitted, which is provided adjacent to its rear end with packing rings 18^A. The inner periphery of the cylinder is also provided with a packing ring 19, which is positioned close to the forward end of the explosive portion of the cylinder, and is adapted to prevent the explosive mixture which enters the cylinder and crank chamber and which is drawn into it through the inlet port 19^A and valve 19^B, from the carbureter 20, on the back stroke of the piston, from flowing past the piston into the rear end of the cylinder, as will be explained more fully hereinafter. The rear end of the cylinder casing forms the explosive part of the cylinder, and the peripheral surface of this end of the casing is formed into fluted or ribbed surfaces, or thin projecting circumferential flanges, that form heat radiating surfaces, and a threaded aperture 21 is formed through the axial center of the rear end of the cylinder, which receives a plug 22, and through this plug passes a terminal wire connecting plug 23, to which one end of a cicrùit wire 24, is attached. This plug 23, is made of non-conducting material, and extends into the interior of the cylinder, a wire or rod passing through it, and extending beyond its inner end, and a gap sparking wire is connected at one end to the plug 22, and extends adjacent to the end of the plug 23. A binding post 23^A is formed on the outer end of the plug 23, to which the wire 24, is connected at one end, the opposite end of which extends to one member of a terminal coupling, which is composed of the parts 23^B and 23^C, which are secured to a convenient portion of the casing, and insulated from it and from each other. A wire 23^D extends from the member 23^C of the terminal coupling to a brush 23^E, which is secured to an adjustable ring 23^F, which is rotatably seated in a step formed in the upper end of the hub of the crank casing. From each member of the terminal coupling, extends an arm 22^A, and these arms constitute a clamp, which receives a battery plug 22^B, having wires 22^C and 22^D, which connect with the opposite poles of a battery. This plug is inserted in the clamp to operate the engine, and withdrawn, when it is desired to stop the engine. A non-conductive interrupter ring 23^G, is secured by a screw 23^H, to the hub of a flywheel 23^I, which is mounted on a crank shaft 23^J, that is rotatably journaled in the casing 2, as will be explained hereinafter.

A metal strip 23^K is secured to the interrupter ring 23^G, by the screw 23^H, and the brush 23^E is secured to the adjustable ring 23^E in position to contact with the terminal strip 23^K. The brush is insulated from the ring as shown. A finger lever 23^L is formed on the ring 23^F, and a short notched surface 23^M is formed on the flange of the crank casing, to hold the finger lever; consequently the ring can be turned by the finger lever and the brush set and locked in any position desired, to contact with the metal plate of the hub of the fly wheel to make a spark and consequently an explosion at the spark gap at the desired point of the piston's movement. At each revolution of the fly wheel the metal strip strikes the brush of the binding post and completes an electric circuit from the battery through the wire 22^C and coupling 23^B, and the wire 24 to the plug and spark gap through the casing to the metal strip, and through the brush and the wire 23^D to the coupling 23^C, and through the wire 22^D to the battery. To the lower end of the shaft 23^J is secured a crank disk 3^A, having a depending pin 3^B, the object of which will appear later.

The front end of the piston is provided with a projecting flange plate 25, which projects into a chamber 2^C at the forward end of the cylinder casing and below the crank casing, and an integral bar 2^D is formed on the piston, rear of the flange 25, which fits and moves within the chamber 2^C. This chamber extends laterally beyond each side of the piston chamber, as shown in Figs. 3 and 6, and in its rear end adjacent to the sides of the chamber are cylindrical holes or bores 2^E, which extend through the wall of the chamber and into lugs 2^F, which are formed on the top of the casing. These holes are adapted to receive a pair of thimbles 2^G, which are secured to the rear side of the bar 2^D of the piston, and the holes and thimbles form a cushioning medium for the piston on its rear stroke, as will now be described. The thimbles 2^G are screwed into threaded apertures in the rear side of the bar 2^D, and their rear ends are closed, while their threaded ends are open as shown in Fig. 10. A swinging plate 2^H is secured at one end to the forward side of the bar 2^D. This plate has an apertured lug which extends through an aperture in the bar, and into the end of one of the thimbles 2^G, and is secured by a pin 2^I. The opposite end of this arm has an apertured lug, which extends through an opening in the bar 2^D, concentric with the bore of the other thimble, and to this lug is pivotally secured, by a pin 2^J, one end of an arm 2^K, which extends down into the thimble, and has a piston 2^L, pivoted at its opposite end. As the hammer piston 18, is driven forward by the explosive force of the gas, the fly wheel 23^I, will be turned by contact of plate 2^H, with the crank pin 3^B, and the plate will not swing entirely out, until about the time the pin passes the center, which is just after the piston hammer has struck the drill bit. The piston is then moved rearward by the impetus of the wheel, which causes the crank pin to contact with the swinging plate, which will be thrown back; its piston 2^L compressing the air in the thimble and cushioning the blow of the crank pin, and as the thimbles enter the holes 2^E, the air within will be compressed, and the rear stroke of the piston cushioned.

The opposite sides of the inner periphery of the piston's cylinder bore at right angles to the crank shaft's casing, are provided with slide-way recesses 28, and the opposite sides of the piston are provided with projecting lugs 28^A, which are arranged to slide reciprocally in said slide-ways and thus prevent rotation of the piston in its cylindrical bore.

The crank shaft casing includes the flange portion 2, and the hub portion 2^A, and is provided with an axial bore which is provided with an anti-friction metal bushing 29, which is flanged to extend across the greater portion of the hub of the crank casing. The shaft 23^J, which I call the crank shaft, is rotatably mounted in the bushed bore of this crank casing, and extends beyond the outer end of the hub of this casing, and upon its end the fly wheel 23^I is secured. The crank shaft extends to the inner end of this casing, and is provided with the disk 3^A, which rotates in a circular recess formed in the end of this crank shaft casing to receive it. A crank pin 3^B, is secured to the inner face of this crank-disk, and a roller 30, is rotatably secured in any suitable manner to the pin, but preferably by a metal washer 31, and screw 32; the washer being set into a counterbore formed in the other end of the roller, 30 the screw 32 being inserted through the washer and threaded into the end of the crank pin. The crank-pin and roller project into the recess, between the fixed plate 25, and the swinging plate 2^H, and it rotates in contact with the swinging plate. The rearward stroke of the piston compresses the explosive gas in the rear end of its cylinder, and consequently exerts an opposing pressure to the rearward stroke movement of the crank-pin. The piston is provided with an axial bore of two diameters 44 and 45. The smaller bore is tapering, and is adapted to receive the rear end of a drill-bit striking bar 46, which I term the hammer bar, and which is made long enough to project beyond the front end of the piston far enough to enter a spirally fluted or rifled sleeve 47, in which it is closely fitted but reciprocally mounted, and its front end is arranged and adapted to strike the shank of a rock-cutting drill-bit 48, the shank end of which projects loosely in the front end of said rifled sleeve into the reciprocal path of the hammer bar of the piston. This sleeve is rotatably mounted in an axial bore of the front cylinder head, and projects forwardly beyond it a short distance. A collar portion 49, is formed on its front end, which bears against the bottom of a counterbored axial aperture 50, which is of larger diameter than the axial bore, in which the sleeve is rotated, and a circular ratchet toothed terminal end portion 51, extends beyond the collar. The rear end of this sleeve extends loosely into the larger bore 45, of the piston, which reciprocates on it. In the front face of the bottom of the counter-bore of the front cylinder head, opposite to the collar 49, I form a circumferential recess 52, in the bottom of which I form four or more holes extending into the cylinder head, and in each of these holes I place coiled springs 53. These springs bear against a packing ring 54, which is placed in the circumferential recess 52. This packing ring may be of rubber, leather, asbestos, steel, or of any suitable metal, which fits loosely in the entrance of the recess and bears with a resilient pressure against the adjacent face. I employ this packing ring to prevent the escape of the explosive mixture to the atmosphere, through the bearing between the cylinder head and the sleeve and the collar of the sleeve, and thus out through the bearing joints of the hub of the front cylinder head and its members to the atmosphere. In the inner face of the wall of the recess, in which the crank disk is seated, I form a circumferential recess 32^A, in the bottom of which I place expansive coiled springs 33, and in its entrance I place a packing ring 34, of any suitable metal or material, which is adapted to bear against the side of the crank disk and prevent the explosive mixture from escaping out through the crank shaft's bearing to the atmosphere.

The axial bore of the hub of the cylinder head is provided with a sleeve 56, the inner end of which is provided with a large axial recess 55, which allows the inner end of this sleeve 56 to extend and lap over the ratchet toothed end of the rifle bar sleeve and fit rotatably in the main bore of the cylinder head. The recess 55 of the ratchet toothed end is enough larger than the ratchet toothed end of the rifle-bar sleeve to form a space, in which I place ratchet toothed pawls 57, the outer sides of which are provided with trunnions which are pivotally journaled in holes formed in the side walls of the bottom wall of the recess 55, of the sleeve 56. The sleeve 56 extends forward beyond the front end of the hub portion of the front cylinder head, a short distance, and it is confined in the hub of the cylinder head by a collar 59, the outside surface of which is threaded and fits into a threaded counterbore in the end of the axial bore or hub of the cylinder head, which fits loosely over a reduced portion formed on the sleeve, that terminates in a shoulder within the hub of the cylinder head, against which the end of the collar abuts, thus confining the head end of the sleeve 56, in the hub of the cylinder head between the end of this collar and the end of the rifle-bar sleeve. This sleeve 56, I term the drill-chuck, and it contains an axial bore of the same diameter as the axial bore of the rifle sleeve, which bores are made to receive loosely the shank ends of the rock-cutting drill-bit 48, which extends through the drill chuck and into the rifle sleeve a short distance. This rock-cutting drill-bit may be of any type of rock-cutting drill-bits in use. I preferably use a drill-bit with a round shank, and on the shank adjacent to its piston striking end I form on diametrical opposite sides two projecting lugs 58, and the outer end of the drill chuck is provided with oppositely arranged concentric recesses 59ᴬ, which extend into a portion of its length, and are adapted to receive the projecting lugs 58, of the drill-bit, and are enough longer than the thickness of the lugs to allow the lugs to be turned rotatably around the axial center of the drill-bit and bear against the end wall of the recesses. The body of the drill-bit may be round or hexagon or of cross-rib steel, and it may be provided with any kind or character of rock-cutting lips, and it may be solid or hollow, but I preferably use a hollow drill-bit, as shown. The entrance to the recess of the drill-chuck, is interiorly threaded, and a short collar 67, is threaded to screw into it. This collar is provided with an axial bore in which the shank of the drill-bit fits loosely, and on diametrically opposite sides of this collar two radial slots 68, are formed, enough larger than the projecting lugs of the shank to permit these lugs to be pushed easily through them into the recesses 59ᴬ. A hole 70 is formed in the inner end wall of one of the recesses 59ᴬ. which extends into the drill chuck substantially parallel with its longitudinal axis, in which one end of a pin 71, projects for a short distance. This is made long enough to extend across the recess 59ᴬ, and bear at its opposite end against the collar 67, and in the hole 70 I place a coiled expansive spring 72, which is arranged to normally hold the pin under resilient pressure against the collar, and in the shell of the drill-chuck above this pin I form a slot 73, through which the lower end of a finger pin 74, which is arranged to slide loosely in the slot, is extended, and is secured to the pin 71. A slot 74ᴬ is also formed in the end of the collar 59, which registers over and in alinement with the slot in the drill-chuck, to permit the finger pin 74, and the pin 71, to be moved far enough back into the slot 73, and the hole 70, against the spring 72, to permit the lugs of the drill shank to be turned past its outer end against the wall of the recesses, and past the slots in the collar far enough to permit the pin bolt to extend past the lug of the drill-bit and bear against the collar, thus locking one of the lugs of the drill-bit between the spring bolt and the farthest wall of the recess, in which the spring bolt is located, and thus locking the drill-bit to the chuck.

I employ a stream of water for washing the rock-cuttings from the cutting lips of the drill-bit, as holes are being drilled in rock, and preferably lead the water into the drilling engine through an aperture 75, formed in the front cylinder head, which enters the rear end of the bore of the hub of the cylinder-head, and intersects an aperture 76 formed in the collar of the rifle sleeve, to the shank of the drill-bit, in which a transverse aperture 77, is formed into its side that intersects the drill-bit's axial aperture, which extends through it from its rock cutting end to near the end of its shank portion; and in order to secure sufficient pressure on this water to force it through the drill-bit to its rock-cutting lips, I employ the following means: In the cylinder head is a threaded aperture 78, which extends partially through the same, and at the bottom of this aperture an aperture of smaller diameter extends through the cylinder head, a shoulder 79 being formed at the juncture of the two apertures—see Fig. 9. In the aperture 78, is screwed a thimble 80, having a piston 81, which is limited in its rearward movement by the shoulder 79, and in its forward movement by the inclosed end of the thimble. Two holes 82 and 83, extend from the front end of the thimble into the chamber in which the piston 81 is located, and nipples 84 and 85 are screwed into these holes. The hole 82 is formed with a valve seat adjacent to its rear end, beyond which the diameter of the hole is necessarily contracted, and a ball valve 86 moves between the valve seat and the end of the nipple 84. The end of the nipple 85, is formed with a valve seat, and a stop is formed adjacent to the end of the hole 83, which limits the rearward movement of a ball valve 87, which moves between it, and the valve seat in the end of the nipple. A pipe 84ᴬ extends from the nipple 84, to a nipple in the hole 75, of the cylinder head, and a pipe 85ᴬ extends from the nipple 85 to a water supply. Thus the movement of the engine piston oscillates the piston 81, which draws the water in through the pipe 85ᴬ and forces it out through the pipe 84ᴬ to the drill bit.

The cylinder casing is provided with a projecting hub 81ᴬ, in which an inlet aperture 82ᴬ is formed. The entrance to this inlet is threaded, and a nipple 83ᴬ is threaded to it. This nipple is provided with a neck portion, and a sleeve 84ᴮ is rotatably mounted on the nipple 83ᴬ, and a spring catch comprising a finger grasping stem 85ᴮ, to which one end of a spring 86 is attached, the opposite end of which is secured to the sleeve. The finger grasping stem is held by the resilient tension of the spring in a groove 87, formed in the sleeve, which registers over the neck portion of the nipple 83ᴬ, and the stem normally projects into this groove and locks the sleeve to the nipple, while permitting the sleeve to rotate freely on the nipple. This sleeve forms the upper end of a hollow yoke or U-shaped pipe or tube member 88, to the lower end of which a gasolene carbureter 20 is secured.

This carbureter may be of any of the types of carbureters in common use, and it is secured to the bottom of a gasolene tank 90, and is operatively arranged to discharge the explosive gas into the yoke-shaped tube that supports it, from which it flows to the sleeve. This sleeve is provided with a valve 91, which is arranged to control the flow of gas from the carbureter to the inlet port. The gasolene tank is attached to the sleeve by a link 88^{A}, which is pivotally connected between two lugs formed on the side of the sleeve. The connection of the sleeve to the nipple permits rotation of the gasolene tank and carbureter in one direction, and the link connection at one side of the sleeve permits the tank and carbureter to swing in the opposite direction; consequently the gasolene tank and the carbureter are connected to the cylinder by substantially a universal joint, and are free to swing in all directions. The inlet valve is positioned in the inlet aperture of the hub of the cylinder casing, and normally keeps this passage closed, and is preferably arranged therein in the following manner: A thimble 91^{A} is threaded to an annular band portion formed in the inlet aperture, and a valve seat is formed on the side of the ring end of the thimble, and a disk valve 19^{B} is seated against the vale seat. A valve stem projects from this disk valve downward loosely through an aperture formed through the bottom of the thimble, and far enough below it to receive a coiled expansion spring 92, which surrounds the stem, and one end of which bears against the bottom of the thimble, and its opposite end bears against a washer which is secured to the end of the valve stem, and this spring by its expansive force holds the valve disk against the valve seat of the ring portion of the thimble. Below this valve an aperture is formed, in the shell of the hub through which the valve seat thimble is inserted, and a plug 93 is threaded to this aperture. A port 94 extends through the shell of the cylinder from the rear end of the cylinder to the crank disk and piston chamber, and it is positioned in the rear cylinder at a point where it will be only uncovered at about the end of the forward stroke of the piston, and it is positioned in the crank chamber at a point where the forward stroke of the piston will compress the explosive gas, and force it through this port to the rear end of the piston and cylinder, where on the rearward stroke of the piston it is compressed in the rear end of the cylinder.

The cylinder casing is provided with an exhaust outlet aperture 98, which is formed in the shell of the casing opposite to the gas inlet port 94. This exhaust outlet exhausts into a hood 99, which I form around the rear end of the cylinder casing, which may be cast integral therewith or may be secured thereto in any suitable manner. This hood is provided with an aperture in its end, through which the spark plug extends, and it is also provided with an exhaust outlet hub aperture 101, and also with air inlet apertures 100 which are positioned diametrically opposite to the exhaust outlet. The exhaust outlet of the hood is arranged opposite to the gas exhaust aperture 98 of the cylinder, and to the exhaust outlet of the hood, an exhaust hose nipple 102 is attached where it connects to the hood, as it is necessary to frequently detach the hose from the hood in order to reset the drilling engine. The hose nipple is connected to the hub of the hood by being detachably clamped thereto, and is preferably clamped thereto by a clamping collar 103, which is provided with inclined slot recesses 104, on its opposite sides, that hook under projecting lugs 105, formed on the opposite side of the exhaust outlet's hub of the hood. These recesses are inclined to form a wedge surface that bears against the underside of the lugs when the collar is turned to clamp the nipple and hood together. The end of the hose nipple is flanged, as shown at X, and an introverted ring Y is formed on the top edge of the collar that fits over the flange, and the collar, when turned onto the lugs of the hub of the hood, clamps the hose nipple to the hub.

A washer 106 is inserted between the end of the hose nipple, and the hub of the hood, to prevent leakage of the exhaust gas from the nipple and hood. This exhaust hose and nipple are used to convey the exhaust gas from the drilling engine, and from the shaft, tunnel, stope, or other mine working where the drilling engine may be employed. The cool air from the mine workings flows into the hood through the air inlets, and flows around the cylinder and out of the exhaust outlet, and cools the cylinder as well as ventilates the mine workings.

The operation of my improved gasolene operated rock drilling engine, is as follows: In starting the rock-drilling engine, if no gas is in the rear end of the cylinder the piston can be reciprocated once or twice by a suitable starting crank (not shown), fitting the ratchet teeth on the hub of the fly wheel, and turning it, the roller bearing against the starting plate and pushing the piston forward, and as the piston reciprocates on its back stroke forced back by the roller against the swinging plate, it draws by suction a supply of explosive gas from the carbureter through the gas inlet valve into the crank chamber in front of the piston, and on the piston's forward stroke this gas is compressed enough to be forced through the inlet port into the rear end of the cylinder the instant the piston on its forward stroke uncovers the rear end of the port, and in order to prevent the gas from flowing across the cylinder and out of the exhaust port, a deflecting ring or baffle plate Z is secured to the rear end of the piston, which is adapted to deflect the gas and guide it to the rear end of the cylinder the instant the gas inlet port and the exhaust port are open, as the piston only travels a slight distance beyond them, and almost instantly starts back on its rearward stroke, and covers them, and the gas that is forced is made to flow into the rear end of the cylinder by the forward stroke of the piston, and is compressed in the cylinder by the back stroke, and the electric spark apparatus is so timed that the metal contact strip on the hub of the fly-wheel engages the brush of the contact terminal and makes a circuit through the electric wires and the battery herein described, that produces an electric spark at the spark gap within the cylinder at its rear end that ignites and explodes the gas just after the crank-pin has passed its center, thus driving and impinging the piston forward and its hammer bar against the shank end of the drill-bit; and as the piston moves forward it uncovers the exhaust port of the cylinder and the gas exhausts into the hood, and into the exhaust hose, which is directly over the cylinder's exhaust outlet port, from which it flows away from the drilling engine, and out of the mine workings to the atmosphere, and the cold air from the mine workings is sucked into the hood through its air inlets and around the cylinder by the exhaust, and cools the cylinder and ventilates the mine workings. The hood in a large measure stifles and muffles the noise of the explosion and of the exhaust, and it removes the obnoxious fumes from the mine workings and thus prevents annoyance and possible sickness of the operators of the drilling engine, from breathing them.

The space between the fixed plate 25, and the swinging plate 2^{H}, on the piston, is enough greater than the diameter of the crank-pin and its roller, to permit of a drill-bit striking compensating movement sufficient to permit the piston to travel ahead of the roller crank-pin and strike its blow against the end of the drill-shank before the crank pin reaches its forward center, and as the piston dashes forward it forces and compresses another charge of gas to the rear end of the cylinder. At the time the explosion of the gas takes place, the roller crank-pin which rotates in the direction of the arrow, has passed its rear center on its up-stroke, and when the piston is thrown forward by the explosion of the gas the swinging plate gradually moves out as the crank pin moves away from it, and when the crank pin passes its center on the forward stroke of the piston, it contacts with the swinging plate, and throws the piston rearward, the contact of the crank pin with the plate, and the rearward movement of the piston, being cushioned in the manner previously mentioned, it being understood that the fly-wheel is revolved by the contact of the swinging plate with the crank pin when the explosion takes place, and the momentum of the wheel causes the crank pin to engage the swinging plate, when the pin has passed its center, and throw the piston rearward. The space between the fixed plate 25 and the swinging plate 2^{H} of the piston, is sufficient to allow the hammer bar of the piston to strike the end of the drill-bit at any part of the drill-bit's movement in its chuck; except that should the piston be operated when the drill-bit is not in operative rock-drilling position against a rock, the strokes of the piston are taken by the roller crank-pin, as in an engine running free, and this would also be the case when a drill-bit was not in the chuck. This arrangement prevents the piston striking the front cylinder head, and also from driving the lugs of the drill-bit repeatedly against the end disk of the chuck. The axial movement of the drill-bit in the chuck is sufficient to allow the operator to feed the drilling engine by the feed screw, as fast as the drill cuts into rock, and to allow the drill-bit a feeding movement independent of the feed of the engine, so that the piston can drive it forward into rock should the feed movement of the engine be at times either slower or faster than the drill-bit cuts into rock, but the forward feed movement of the engine should be as near the feed of the drill-bit into the rock under the blows of the piston, as it can be regulated by the operator of the engine. As the piston reciprocates the spiral flutes or its axial bore reciprocate on the spiral rifle ribs of the sleeve, which is rotated on the forward stroke of the piston, but on the backward stroke of the piston the ratchet teeth of the sleeve engage the pawls, and as the piston is held from turning by its guides and guide-ways, the pawls and drill-bit holding chuck, and consequently the drill-bit, are rotated an amount equal to the spiral pitch of the rifled ribs and flutes in the piston rod on the surface of the rifle sleeve. At each backward stroke of the piston, it cushions on the buffer which as above stated, may be a rubber or a pneumatic buffer, or spring steel.

The crank-pin roller and crank shaft, are preferably lubricated by an oil passage 108, which is formed axially through the crank shaft, and then through the crank disk into and out through the side of the crank pin. The entrance to this oil passage may be provided with any suitable oil cup, or may be closed by a plug 109. The piston may be oiled from a grease cup 110, which is threaded to an oil passage 111, which leads through the casing into the hammer piston's cylinder.

While I have illustrated and described the preferred arrangement and construction of my improved gasolene engine, I do not wish to be limited to it, as there are many changes that might be made without departing from the spirit of my invention; and while I have preferably described the piston actuating explosive gas as that of gasolene, my invention contemplates the use of any other explosive gas suitable for this purpose.

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

1. In a gas explosion operated rock-drilling engine, the combination with the cylinder and the piston, of a crank casing connected to said cylinder, a crank shaft rotatably mounted in said casing, a crank-pin on the inner end of said crank shaft, a projecting fixed plate on the front end of the piston, a swinging plate in the rear of said fixed plate and arranged in bearing contact with said crank pin, cushioning means arranged to receive the rearward strokes of the swinging plate, and means for cushioning the rearward stroke of the piston.

2. In a gas explosion rock-drilling engine, the combination with the cylinder, of a piston mounted to reciprocate therein, means for driving said piston on the forward strokes of its reciprocal movements, a fixed plate on the front of said piston, a swinging plate pivotally hinged to said piston in the rear of said fixed plate, a crank shaft journaled in said cylinder, a fly wheel at one end of said crank shaft, and a crank pin at its opposite end, and in rotative bearing contact with said swinging plate.

3. In a gas explosion operated rock-drilling engine, a cylinder, a crank chamber adjacent to said cylinder, apertured lugs at the rear end of said crank chamber, a piston mounted to reciprocate in said cylinder, having thimbles adapted to enter said apertured lugs, and thus cushion the rear stroke of the piston, a swinging plate on said piston cushioned at one end within one of said thimbles, a fixed plate adjacent to the swinging plate, and a fly wheel having a crank pin adapted to move between said fixed and swinging plates.

4. In a gas explosion operated rock-drilling engine, the combination with a cylinder having a crank chamber, and a piston provided with a swinging buffer plate and a fixed plate, of a crank shaft in said crank chamber, a fly-wheel on the outer end of said shaft, a crank disk on the inner end of said crank shaft in said crank chamber, a crank pin secured to said crank disk and extending between said fixed and swinging plates, and means for cushioning the piston on its rear stroke.

5. In a rock-drilling engine of the character described, the combination with a cylinder provided with a reciprocating hammer piston, of a fly wheel, a crank pin connected therewith and adapted to be engaged by the piston on its forward movement to revolve said fly wheel, and adapted to engage said piston through the momentum of the fly wheel, to move the piston rearward, and means for cushioning the contact of the crank pin with the piston, and also the rear stroke of the piston.

6. In a rock-drilling engine of the character described, the combination with a cylinder having cylindrical apertures, closed at one end, of a piston having thimbles, which are adapted to enter said apertures, an outwardly-swinging plate on said piston cushioned at one end in one of said thimbles, a fixed plate on the piston adjacent the swinging plate, a fly wheel and a crank pin connected therewith and adapted to be engaged by the swinging plate, on the forward movement of the piston, to revolve the fly wheel, and to engage the swinging plate through the momentum of the wheel to move the piston rearward.

7. In a rock-drilling engine of the character described, the combination with the cylinder and piston, said piston adapted to be thrown forward by the explosion of a gas, of means for accomplishing the rearward stroke of the piston and of cushioning the said stroke, said means comprising an integral bar on said piston, and thimbles secured to said integral bar, cylindrical air pockets in said cylinder, which said thimbles are adapted to enter, an outwardly swinging plate pivoted at one end to the integral bar, and having a piston adapted to move in the thimble at the opposite end of the bar, a fly wheel, and a crank pin connected therewith and adapted to be engaged by the swinging plate to revolve the fly wheel, as the piston shoots forward, and to engage said swinging plate through the momentum of the fly wheel, to throw the piston rearward.

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

ROLLAND S. TROTT.

Witnesses:
G. S. Elliott,
Adella M. Fowle.