L. L. SCOTT.

INTERNAL COMBUSTION ROCK DRILL.

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941,731. Patented Nov. 30, 1909.

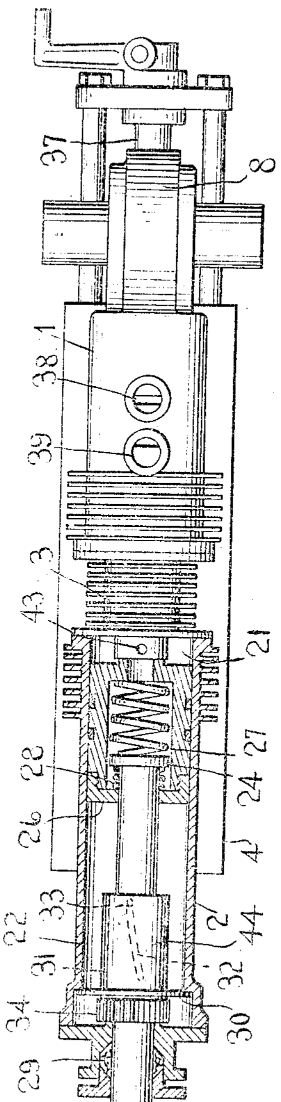

Fig. 1

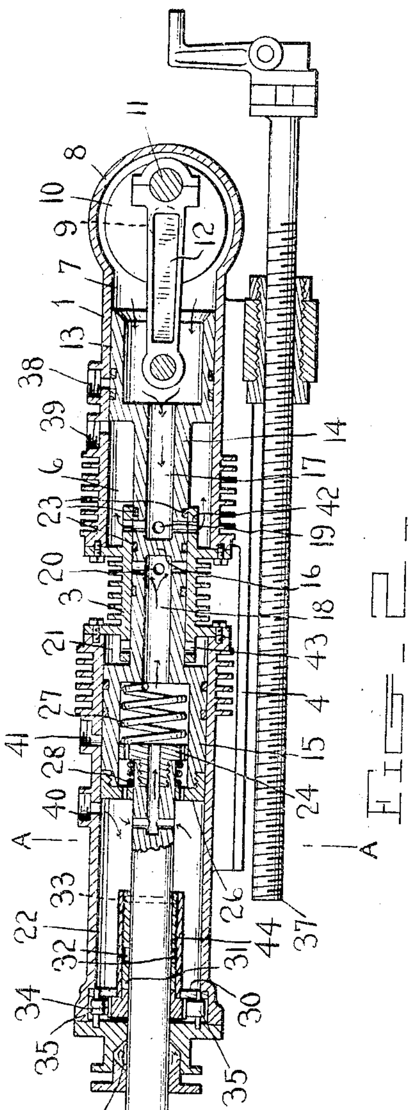

Fig. 2

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INTERNAL-COMBUSTION ROCK-DRILL.

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To all whom it may concern:

Be it known that I, LEWIS L. SCOTT, a citizen of the United States, residing at Joplin, in the county of Jasper, State of Missouri, have invented certain new and useful Improvements in Internal-Combustion Rock-Drills; and I do hereby 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.

This invention has reference to improvements in internal combustion rock-drills.

It has been proposed, as I am aware, to make use of gasolene engines for operating rock-drills, but up to the present time no actually efficient drill of that type has been invented, and it has been found necessary to make use of air as the motive fluid. Air engines, however, are extremely expensive, owing to their enormous consumption of fuel.

In order to render a rock-drill practical, it is absolutely essential that an extreme force be applied at the beginning of each down-stroke, and a force of equal power at the beginning of each up-stroke, the necessity for the application of such force in the latter instance being particularly apparent when a hole of any considerable depth is to be drilled, since the weight of the drill-rod is such that it would otherwise stick or hang in the hole. It is a matter of great importance also that the drill be wholly incased, since the entrance of dirt and grit through the opening in which the piston pin travels into the cylinder would shortly clog the working parts disposed therewithin. Furthermore, it is extremely essential that the apparatus include no valves, gears, cams, or other delicate parts inasmuch as these elements would be injured and damaged to such an extent as to render them absolutely useless after about four blows of the drill-rod against flint-rock. Above all, it is of vital importance that the drill as a whole be light enough to be carried by two men, and sufficiently compact to permit it to be operated in a narrow underground tunnel or shaft.

The object of my invention, therefore, resides in the production of a powerful gasolene rock-drill which shall be possessed of the requisite air and water-tight properties, and of the necessary compactness, strength, and lightness, which shall be extremely simple in its construction and effective in its operation, which shall be completely inclosed, and which shall include no delicate parts such as valves, gears, or the like, which are liable to become injured by such jarring as is not absorbed by the cushioning devices. With these ends in view, I employ a double opposed motor and a drill rod swiveled to the piston, and I locate all of the rotating mechanism inside of the stuffing-box, so as to preclude any posible loss of compression due to the escape of the gases, thus insuring ignition at every stroke.

The preferred embodiment of the invention is illustrated in the accompanying drawings in which corresponding parts or features are designated by the same reference characters throughout both views.

Of the said drawings, Figure 1 is a plan view, partly in section, of the improved drill. Fig. 2 is a vertical longitudinal section therethrough.

Referring more particularly to the drawings, the engine is shown as including upper and lower cylinders 1 and 2 connected by a head 3, the first-mentioned cylinder being formed integral with the base plate 4, to which latter the other cylinder is fastened by any suitable means. The upper cylinder has its interior divided into an explosion chamber 6 and a mixing chamber 7. The chamber 6 is closed by the adjacent wall of the head 3, and the chamber 7 by the crank case 8, said case receiving the journals 9 of the crank shaft which latter includes the crank arms 10 which are connected by the pin 11. This pin is connected through the rod 12 with the upper head 13 of the double-acting piston which reciprocates in the cylinders. The stem 14 which joins the upper head 13 to the lower head 15 has its axial bore divided by a central partition 16 into upper and lower sections 17 and 18 which communicate with the corresponding piston heads. The upper section 17 communicates at times with the explosion chamber 6 through the series of passages 19, said passages being located adjacent the partition 16, while the section 18 communicates through a series of similarly located passages 20 with the explosion chamber 21 of the cylinder 2. Hence the passages 19 form a means of communication between the chambers 6 and 7, and the passages 20 in like manner form a communication between the above-mentioned explosion chamber 21 and the

mixing chamber 22 of the cylinder 2. The central portion of the periphery of the piston stem is formed with a series of parallel circumscribing grooves arranged to receive packing rings 23, for the purpose of preventing any of the explosive charge to pass from the chamber 6 to the chamber 21, or vice versa.

The lower piston head 15 is recessed, and in this recess works a head 24 threaded to the upper end of the drill rod 25, which latter works through an axial opening formed in the cap 26 which is threaded upon the outer end of said piston head and serves to close the recess formed therein. The drill rod is cushioned by means of a pair of springs 27 and 28 which are disposed within the recess formed in the piston head above referred to, the spring 28 being interposed between the cap 26 and the head 24, and the spring 27 between said head 24 and the inner wall of the recess. The spring 27 is sufficiently strong to withstand a powerful blow, and to relieve the intense shock from the main parts of the drill when the drilling tool or bit strikes the rock. The spring 28, which embraces the drill rod, as shown, serves to prevent the head 24 from striking against the cap 26 during the down-stroke of the drill and when the drill bit strikes the rock, and it further serves to prevent such contact which would otherwise result from the inertia of the drill rod on the up-stroke of the drill. The axial opening in the cap has a diameter sufficiently great to permit a free rotation of the drill rod during its up-stroke. The mechanism by means of which this rotation of the drill rod is effected is located within the cylinder 2 whose lower end is closed by a stuffing-box 29. The end in question of the cylinder is enlarged sufficiently to receive a metal disk 30 which is arranged transversely of the cylinder and in spaced relation to the stuffing-box. The disk 30 is formed with an axial opening through which extends a metal sleeve 31 which fits loosely upon the drill rod and is provided at diametrically opposite points with a pair of spiral grooves 32, each groove having projecting thereinto a steel pin 33 which projects laterally from the drill rod and is rigidly secured thereto. The end of the sleeve which bears against the head of the stuffing-box is enlarged, as shown, and has its periphery formed with a series of ratchet teeth 34 which are engaged by a pair of oppositely located pawls 35 whose pins fit in alining openings formed in the disk 30 and in the stuffing-box head. The sleeve 31 is further provided with a cylindrical band 44 which is shrunk thereon, the sleeve being strengthened by the band, as will be apparent. The pawls 35 are normally forced into engagement with the ratchet teeth 34 by means of a pair of suitable leaf springs, said springs bearing against the pawls. Owing to the formation of the spiral grooves, and to the provision of the pins which project into the same, it will be apparent that during each down-stroke of the drill rod the sleeve 31 will be rotated upon the latter, the pawls riding over the ratchet teeth. When, however, the drill rod starts on its up-stroke, the pawls will hold the sleeve against rotation, and the drill rod itself will be rotated owing to the projection of the pins into said grooves.

The two cylinders and the base plate with which they are connected are rendered adjustable by means of a threaded shaft 37 or equivalent device. The cylinder 1 is formed with inlet and outlet ports 38 and 39, and the cylinder 2 with similar ports 40 and 41, while the upper end of the head 3 which projects into the chamber 6 is formed with a series of ports 42, the lower end of said head being provided with a similar series of ports 43. The ports 41 are arranged to register at times with the openings 19, and the ports 42 with the openings 20.

Any suitable mechanism in use on gasolene engines at the present time may be employed for exploding the charges of air and gas introduced into the explosion chambers.

The operation of the engine may be stated as follows: Assuming that a charge of explosive mixture has been drawn into the chamber 7 through the inlet port 38, this charge will be compressed during the back or up-stroke of the piston, while at the same time a vacuum will be formed in the chamber 22. When the piston reaches the limit of its stroke the ports 42 will register with the openings 19, whereupon the compressed charge will be free to pass into the chamber 6. The inlet port 40 in the lower cylinder will likewise be uncovered at this point, thus permitting a charge to be drawn into the chamber 22. As the piston starts on its forward or downward movement the charges in the chambers 22 and 6 will be compressed, the charge in the latter chamber being exploded by means of the sparker above referred to when the piston reaches the limit of such movement, at which point the openings 20 register with the ports 43, thus permitting the charge in the lower cylinder to enter and fill the chamber 21. As the piston again moves upwardly the charge in the last-mentioned chamber, as well as the fresh charge which has been drawn in the chamber 7, are compressed, the charge in the chamber 21 being exploded when the piston reaches the limit of its upward movement. The exhaust gases pass out through the ports 39 and 41, as will be apparent. It will thus be understood that an explosion will take place at the beginning of each down-stroke and at the beginning of each up-

stroke, this being as stated originally absolutely essential in the production of a practical rock-drill, since as much power is required in most instances to lift the drill into position for its down-stroke, as is necessary to effect a proper down-stroke. Where holes are drilled to a considerable depth, as for instance sixteen feet, the drill bit will stick or hang in the hole unless as much power be applied to the drill to raise the same as was applied at the commencement of the down-stroke. Furthermore, it will be apparent that by the employment of a motor consisting of a pair of opposed two-cycle engines, all valves, cams, gears, and other delicate parts are dispensed with, which parts, as originally stated are extremely apt to become injured after about four blows of the drill against the rock. It will also be apparent that by reason of the disposition of the entire rotating mechanism within the mixing chamber of the lower cylinder, all possibility of escape of the gas and consequent loss of compression is obviated, while at the same time the drill rod and the rotating mechanism are not affected by the heat of the explosions. Finally, it will be seen that the entire motor as a whole is incased, and that there is no danger of the working parts of either cylinder becoming clogged with dirt and chippings, or of being exposed to the danger of becoming cut by the chips, since the latter cannot enter the cylinders.

The apparatus as a whole is comparatively light and is exceedingly compact so that it may be used for drilling holes in underground galleries and shafts.

What is claimed is:—

1. A motor drill comprising a pair of opposed two-cycle explosive engines including pistons mutually connected, a crank shaft connected with one piston, a drill rod connected with the other piston, and means for rotating the drill rod, said drill rod projecting from the corresponding engine, and the remaining movable parts of the motor drill being entirely inclosed within the cylinders thereof.

2. A motor drill comprising a pair of opposed two-cycle explosive engines having their pistons mutually connected, the interior of the cylinder of each engine being divided into a mixing chamber and an explosion chamber, said engines being arranged with the explosion chamber ends of their cylinders toward each other, and a drill rod connected with one of said pistons and passing through the mixing chamber of the corresponding cylinder and thence outwardly thereof.

3. A motor drill comprising a pair of opposed two-cycle explosive engines arranged in alinement with each other and having their pistons mutually connected, the interior of the cylinder of each engine being divided into a mixing chamber and an explosion chamber, the explosion chambers of the engines confronting each other, and a drill rod connected with one of said pistons and passing through the mixing chamber of the corresponding cylinder and thence outwardly thereof.

4. A motor drill comprising a pair of opposed explosive engines arranged in alinement with each other and having their pistons mutually connected, the interior of the cylinder of each engine being divided into a mixing chamber and an explosive chamber, the explosion chambers of the engines confronting each other, a drill rod connected with the piston of one engine and extending exteriorly of the cylinder thereof, and means actuated by the reciprocation of the drill rod and located entirely within said cylinder, for intermittently rotating the drill rod.

5. A motor drill comprising a pair of opposed explosive engines arranged in alinement with each other and having their pistons mutually connected, the interior of the cylinder of each engine being divided into a mixing chamber and an explosive chamber, the explosion chambers of the engines confronting each other, a drill rod connected with the piston of one engine and extending exteriorly of the cylinder thereof, and means actuated by the reciprocation of the drill rod and located entirely within the mixing chamber of said cylinder, for intermittently rotating the drill rod.

6. A motor drill comprising a pair of opposed explosive engines including pistons mutually connected, a crank shaft and a drill rod connected with said pistons, and means for rotating the drill rod, said drill rod projecting exteriorly of one of said engines, and the remaining movable parts of the motor drill being entirely inclosed within the cylinders thereof.

7. A valveless motor drill comprising a pair of opposed two-cycle engines arranged in alinement with each other, each engine including a piston, and a drill rod rotatably and yieldably connected with the pistons of both engines and movable thereby alternately in opposite directions.

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

LEWIS L. SCOTT

Witnesses:
SAM. B. CAMPBELL.
ELLEN M. MURPHY.