No. 710,935.

Patented Oct. 14, 1902.

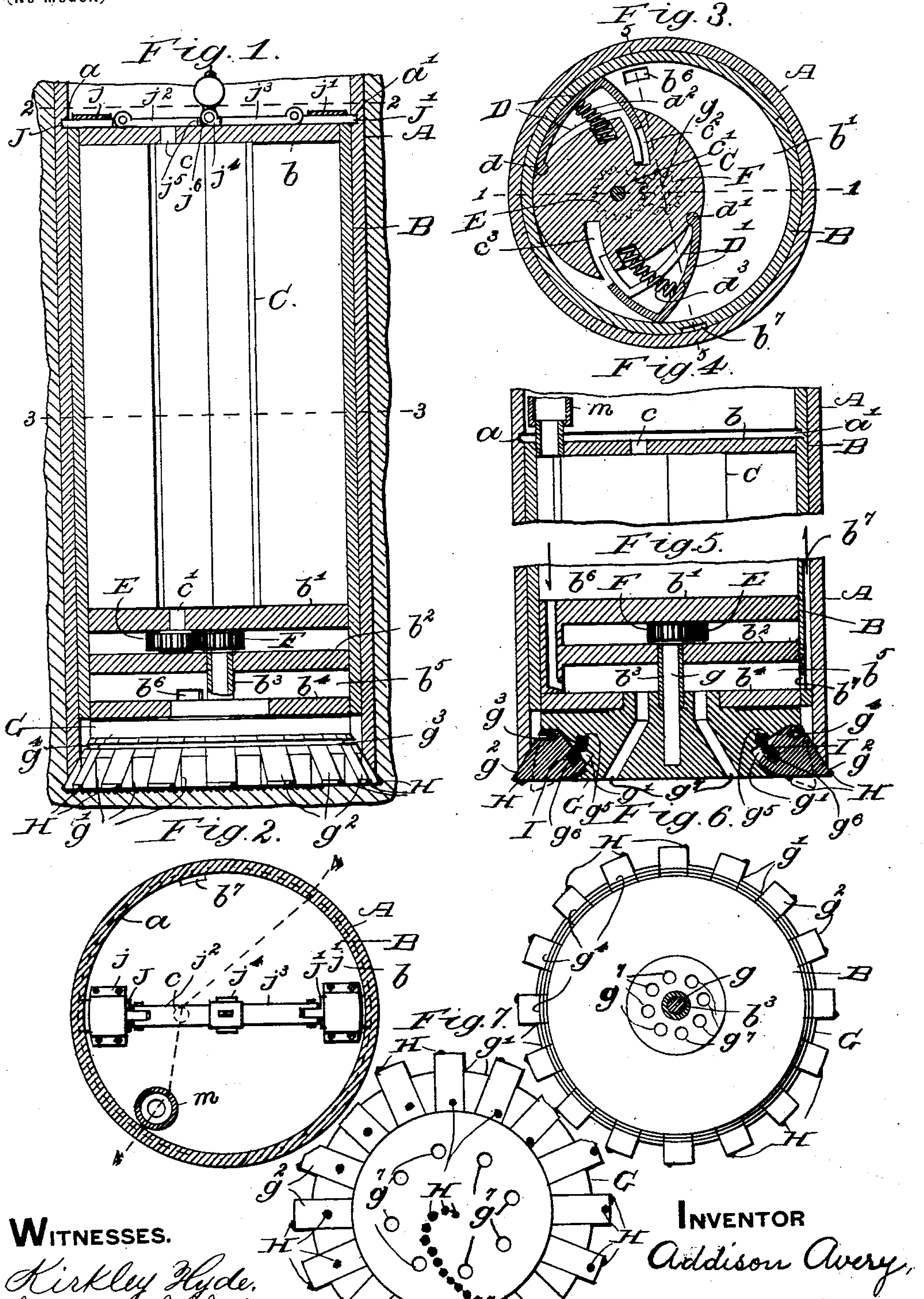
A. AVERY.

ROCK DRILL.

(Application filed Mar. 5, 1901.)

(No Model.)

2 Sheets—Sheet I.



WITNESSES.

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INVENTOR

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His ATTORNEY.

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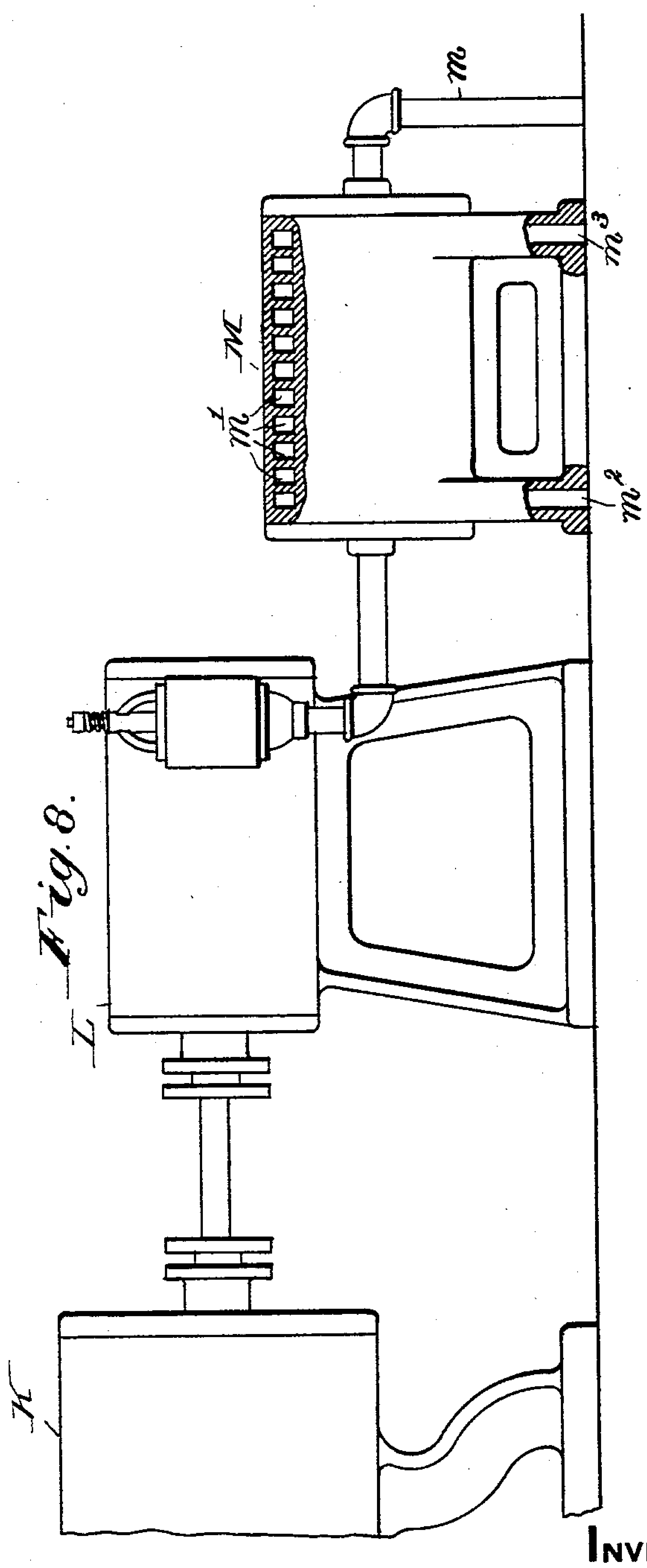

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UNITED STATES PATENT OFFICE.

ADDISON AVERY, OF LOWELL, MASSACHUSETTS.

ROCK-DRILL.

SPECIFICATION forming part of Letters Patent No. 710,935, dated October 14, 1902.

Application filed March 5, 1901. Serial No. 49,925. (No model.)

To all whom it may concern:

Be it known that I, ADDISON AVERY, a citizen of the United States, residing in Lowell, in the county of Middlesex and Commonwealth of Massachusetts, have invented a certain new and useful Improvement in Rock-Drills, of which the following is a specification.

This invention relates to rock-drills. Commonly in such drills a rod or tube carrying the cutter-head revolves with the head, and the friction on the side of the shaft of such rod or tube increases with the depth of the shaft, making it very difficult to revolve the head and increasing the danger of breaking the tube or rod by torsion. In such drills the cutter-head will be pushed aside by the harder masses of rock and will follow the softer streaks, still further increasing the friction on the tube or rod and the danger of breaking and making it impossible to tell exactly where the lower end of the shaft is.

In this invention there is no revolving rod or pipe. An outer pipe or case is used to contain the drilling apparatus and to line the shaft. A small rotary engine located in the advancing or front end of the pipe and operated, preferably, by compressed air makes the hole into which the casing is forced by the usual means, said air after passing through the engine and operating the same escaping into the bottom of the shaft and returning in a suitable channel between the engine and the casing to a point above the engine and thence returning to the surface of the ground, bringing with it the rock-dust and cuttings and keeping the cutting-face of the drill-head clear of obstruction. The expansion of the compressed air creates an intense cold, freezing the material in advance of the drill, which works more rapidly upon the frozen rock and is enabled to cut through sand and loose material that would otherwise obstruct the advance of the drill.

The construction of the drill-head, hereinafter described, makes it possible to drill a shaft sufficiently larger than the casing and yet to permit of the drill being removed, when necessary, for any purpose, as for repairs, without removing the casing from the earth and allowing said casing to remain permanently in the ground, if desired, after the boring is completed and preventing water and loose materials from getting into the shaft.

The apparatus herein described is capable of drilling holes in any direction to any distance desired and may be used not only for prospecting purposes, but for laying pipes for gas, water, or other purposes or for forming conduits for underground wires and cables.

The rotary engine and drill-head are carried in the front section of the pipe in such a manner that the drill-head may be fed by advancing said front section, and other sections of pipe may be added to the front section and succeeding sections as may be necessary. In this way the outer pipe or casing serves as a guide and prevents the drill-head from deviating from a straight course, thus enabling a prospector to know the true direction of a mineral deposit reached by the boring. With my construction the friction does not increase sensibly as the depth of the shaft increases while working in the same material.

In the accompanying drawings, Figure 1 is a sectional view of a shaft, lower section of casing, my improved drill and its engine, and means for retaining the same in said lower section on the line 1 1 in Fig. 3; Fig. 2, a plan of my improvement and a horizontal section of the casing on line 2 2 in Fig. 1; Fig. 3, a horizontal section of the casing and engine on the line 3 3 in Fig. 1; Fig. 4, a vertical section on the line 4 4 in Fig. 2; Fig. 5, a vertical section of the engine and drill-head on the line 5 5 in Fig. 3; Fig. 6, a plan of the drill-head; Fig. 7, a plan of the bottom of the drill-head; Fig. 8, a side elevation of the apparatus for compressing the air and forcing it into the engine.

A represents the outer tube or casing, the front section of which should be smooth on its inner face to fit the engine B and of slightly smaller inside diameter than that of the following casing-sections to enable the engine to be drawn up out of the casing easily and quickly. The engine consists of a cylindrical shell B, adapted to fit within the casing A and containing a rotary piston C, having stub-shafts $c\ c'$, one of which is journaled in the head b of said shell and the other of which is journaled in a diaphragm or partition b' parallel with said head b. The axis of the piston C is parallel with the axis of the shell B and eccentric thereto, and the sides of said piston are recessed to receive the swinging buckets D D', pivoted at $d\ d'$ to said piston, said buckets being held in contact with the inner wall of the shell B by springs $d^2\ d^3$ in the usual manner, except that each bucket consists of a pair of folding pieces, the free ends of which are capable of sliding one upon the other to enable them to fold into smaller slots $c^2\ c^3$.

To the lower end of the shaft c' is secured a pinion E, which engages and drives another pinion F, fast on the shaft g of the drill-head G, said pinions being arranged in a dust-proof space between the partition b' and another partition b^2, both of these partitions being parallel with head b of the shell B and the shaft g turning in a sleeve-bearing b^3, which connects the partition b^2 and the front or lower head b^4, passing through the dust-chamber b^5, included between said head b^4 and the partition b^2.

Secured to the shaft g is the drill-head G, arranged in front of or below the head b^4, said drill-head consisting of a circular body having radial slots g', in which are pivoted blocks g^2, carrying abrading-points H, as diamonds, the blocks swinging on a wire or ring g^3, which is laid in grooves g^4 in the upper outer faces of said blocks and in an annular groove in said drill-head.

The blocks or point-carriers are preferably nearly triangular in the section in which the axis of the shaft g lies, and the radial slots are of a shape to fit said blocks, the surfaces of said blocks and slots being curved concentrically with the pivot to keep the dust out of said slots as far as possible. The points H in said blocks and others in the body of the drill-head are arranged at different distances from the center of the drill-head, as shown in Fig. 7, in such a manner as to sweep over the entire circle described by the point farthest from said center. The blocks g^2 are thrown outward when the drill-head is revolved by centrifugal force, but I prefer to rely upon the expansive force of springs I, arranged between the back of the radial slots and the adjacent faces of said blocks, which springs are represented as spiral wire springs, the ends of which are retained in place by holes $g^5\ g^6$ in the backs of said slots and the adjacent faces of said blocks, as shown in Fig. 5. In use the outer side faces of the blocks g rest against the advancing end of the casing A, which is shaped like the frustum of a hollow cone to fit said blocks and limit the outward movement of the same. When the engine is drawn up out of the casing, the blocks are crowded by the end of the casing into the positions shown by dotted lines in Fig. 5, near enough to the center of the drill-head to allow said head and blocks to pass up through said casing.

The lower section of the casing is provided on its inner face with slots $a\ a'$ to receive bolts J J', which slide radially in caps $j\ j'$, secured to the top of the upper head b of said engine, and are connected to each other by toggle-levers $j^2\ j^3$, so that by raising the knuckle j^4 of said levers said bolts are drawn out of engagement with said slots and permit the engine to be drawn up out of the casing by a rope or chain attached to said toggle-levers at said knuckle-joint, the upward movement of said knuckle-joint being limited by the projection j^5 on one of said levers striking a stop projection j^6 on the other of said levers. (See Figs. 1 and 2.)

In Fig. 8, K represents an engine-cylinder, L a compressor, and M a tank for holding compressed air, these parts being connected and operated in the usual manner and the compressed air being discharged from the tank M through the pipe m into the shell or engine B, the position of said pipe m where it enters said shell being shown in Figs. 2 and 4, causing the piston to revolve in the direction indicated by the arrow in Fig. 3, and thereby rotating the drill-head by the means above described.

The air is discharged from the shell B through the passage b^6, Figs. 1, 3, and 5, into the dust-chamber b^5, from which said air passes through an opening b^7 between the adjacent faces of the shell B and casing A up past said shell and through said casing to the surface of the ground, carrying with it any dust or cuttings which may be in said chamber. The dust and cuttings made by the drill-head will pass from the face thereof up through dust-passages g^7, formed in said head, partly because the dust accumulating is crowded up through said passages and partly because said dust will be sucked into the dust-chamber by the current of air passing through said chamber.

The tank M is provided with a continuous passage m', which runs from end to end thereof, passing spirally from m^2 to m^3 around the same, through which passage any suitable hot or cold fluid, as steam or cold water, may be driven to warm or freeze the material at the drill-head as may be necessary, the dust-chamber being situated close to the drill-head, as shown in Figs. 1 and 6.

I claim as my invention—

1. The combination of the shaft lining or casing, the compressed-air engine secured in said casing, the drill-head rotated by said engine and having cutting-bits arranged to operate in advance of said casing and to make an opening of greater diameter than said casing, said engine being provided with a dust-chamber into which said engine exhausts and with a passage outward from said dust-chamber between said engine and casing, said drill-head being provided with dust-discharging openings leading from the front thereof into said dust-chamber to allow the dust and

cuttings to be carried from the front of said drill-head back of said engine and out of said casing.

2. The combination of the shaft lining or casing provided with transverse slots on its inner face, the engine arranged to fit said casing and provided with bolts, adapted to enter said slots, means for withdrawing said bolts from said slots and a drill-head, having bits or blocks arranged to cut a hole larger than and in advance of said casing and springs, adapted to throw said bits outward against the front end of said casing, and to yield to allow said bits to pass with said engine and drill-head backward through said casing.

3. The combination of the tank, provided with a passage for a heating or a cooling medium, the engine, containing a chamber, through which said engine exhausts, a drill-head, driven by said engine and arranged in proximity to said chamber, and suitable connections between said tank and said engine, to regulate the temperature of the material operated on by said drill-head.

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

ADDISON AVERY.

Witnesses:
ALBERT M. MOORE,
LEWIS F. LONGMORE.