2 Sheets--Sheet 1.

E. EDWARDS.

Rock-Drilling Engines.

No. 157,805. Patented Dec. 15, 1874.

Fig. 1

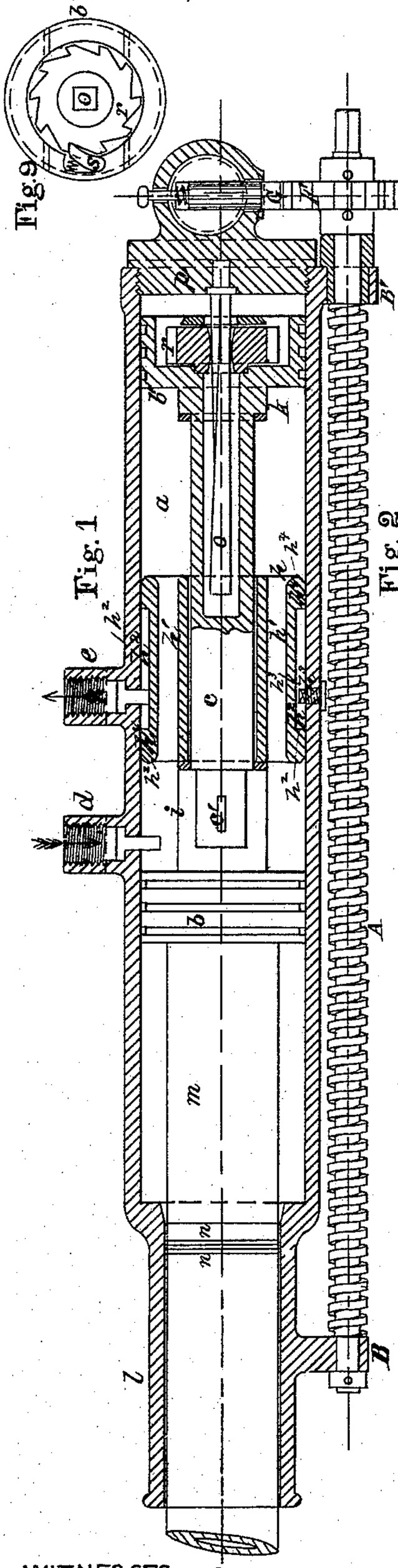

Fig. 2

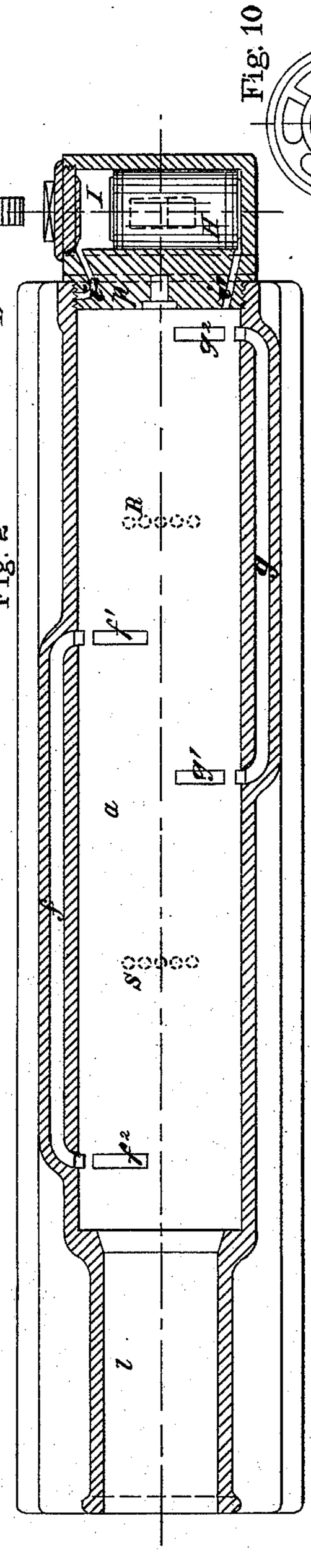

Fig. 3

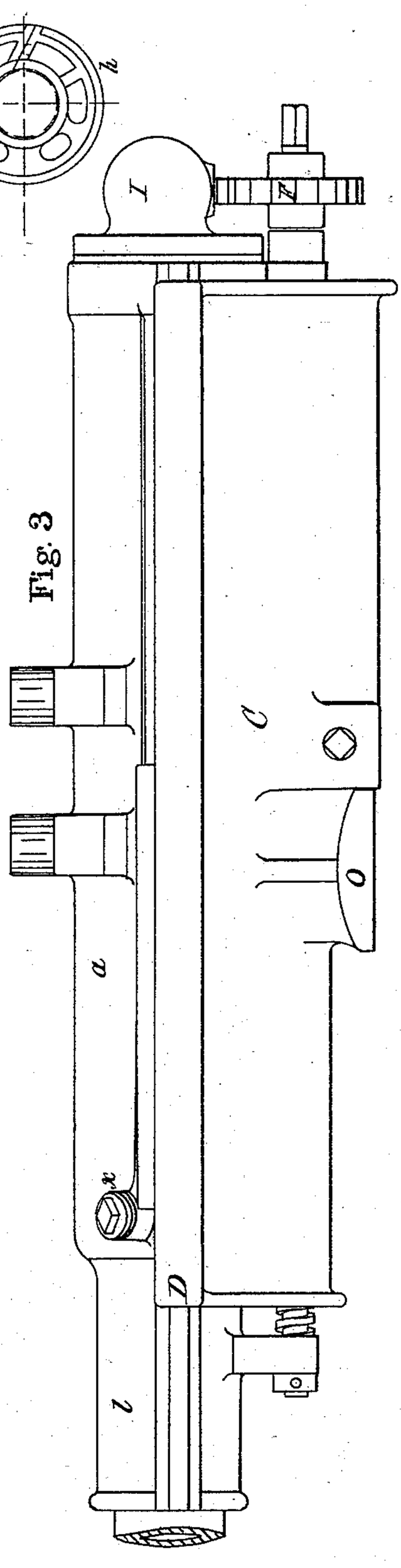

Fig. 10

WITNESSES

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Sidney E. Gayer.

INVENTOR.

Edmund Edwards

2 Sheets--Sheet 2.

E. EDWARDS.

Rock-Drilling Engines.

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Fig. 4

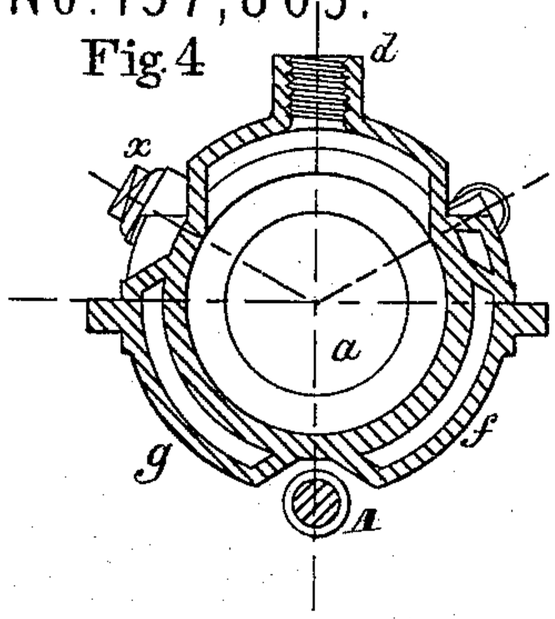

Fig. 5

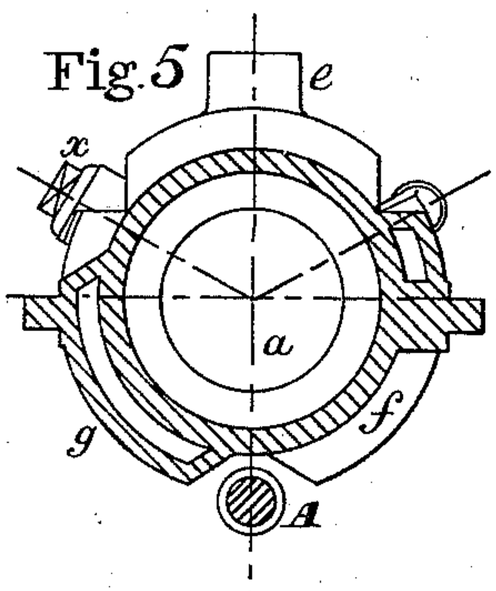

Fig. 6

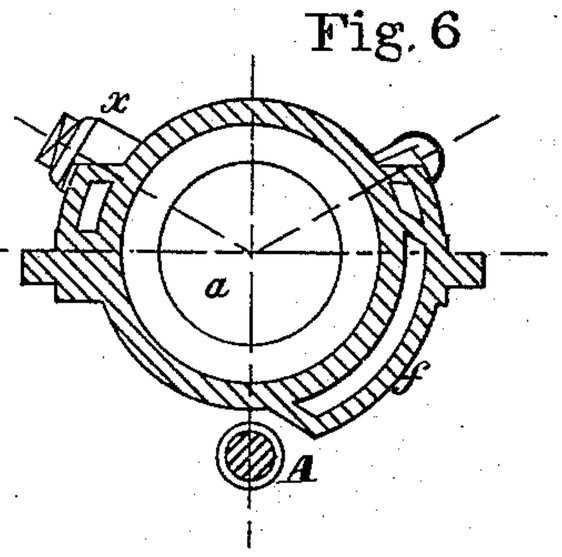

Fig. 7

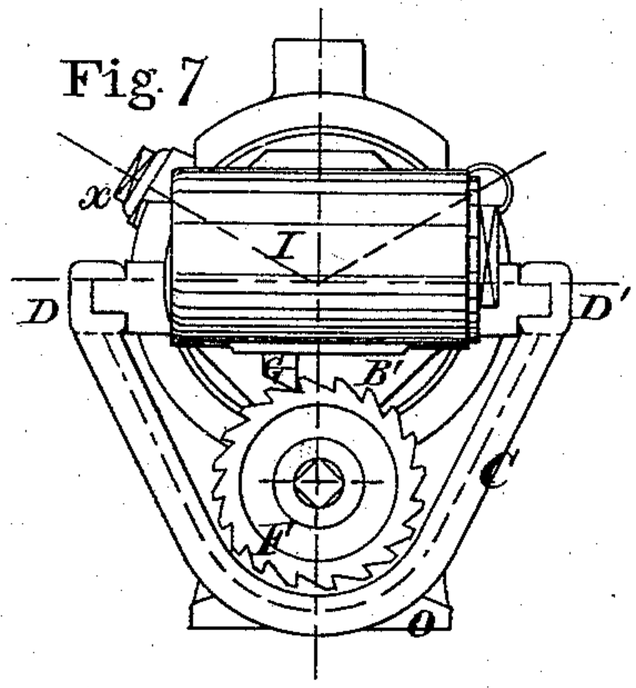

Fig. 16

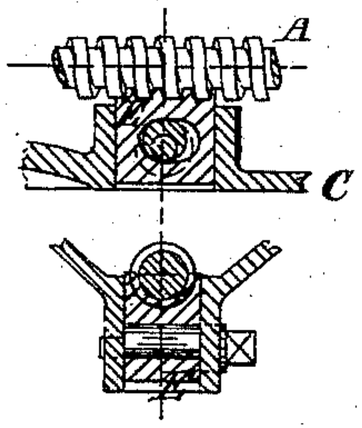

Fig. 8

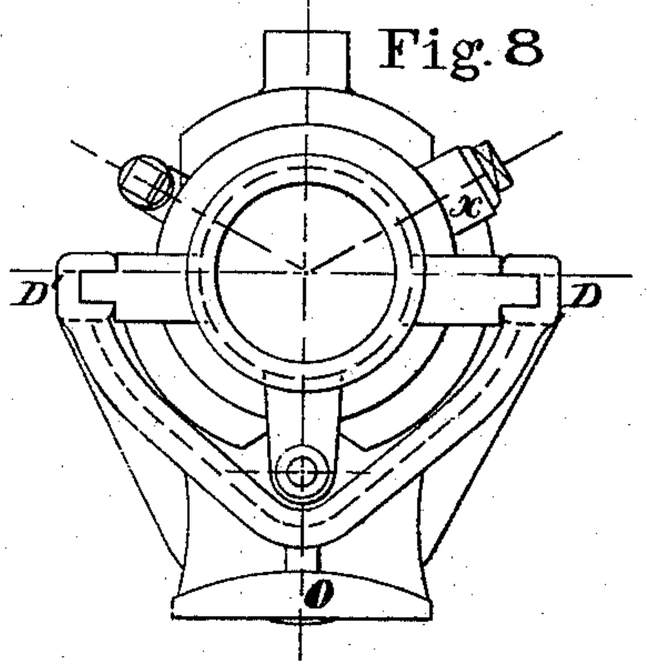

Fig. 11

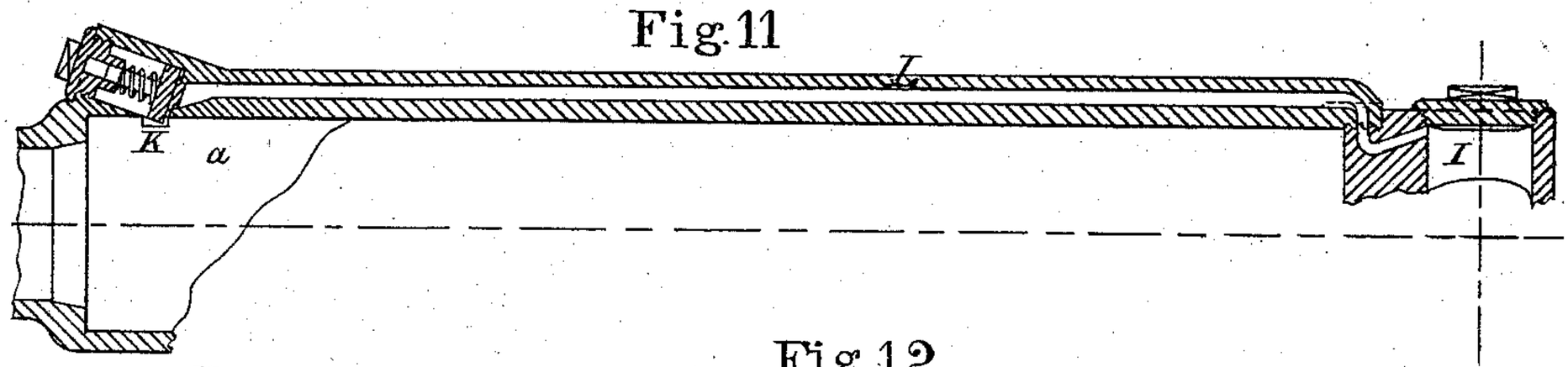

Fig. 12

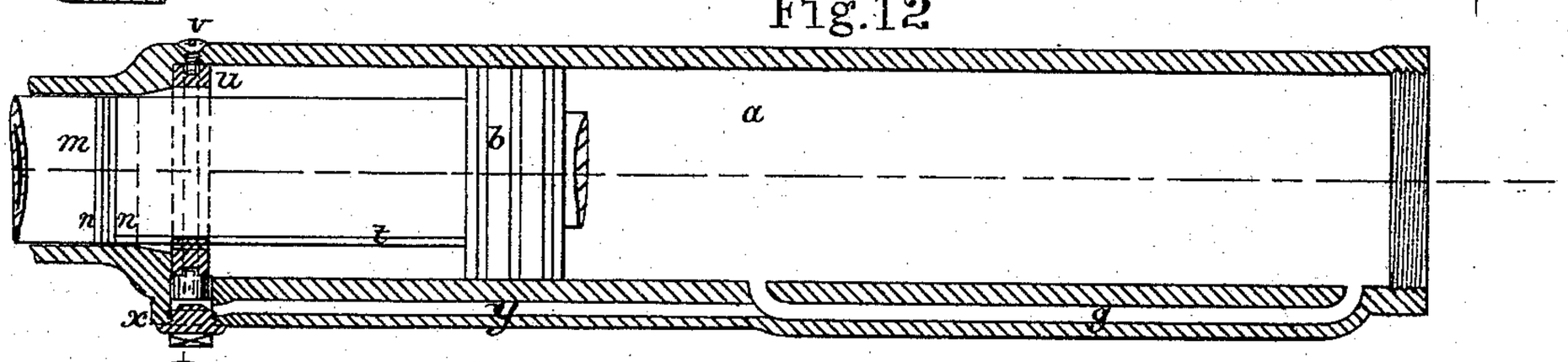

Fig. 13

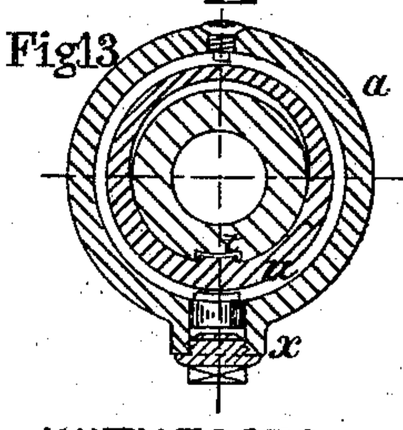

Fig. 14

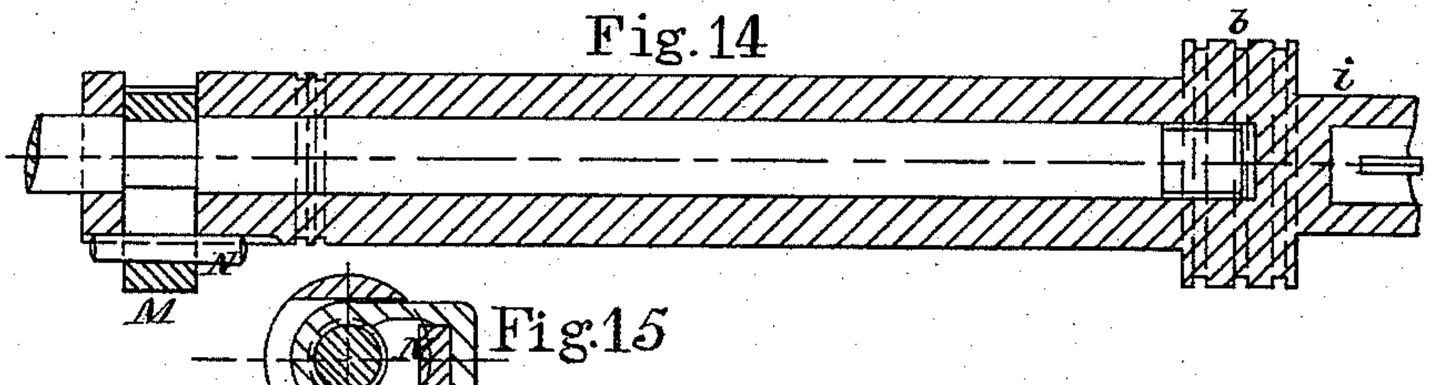

Fig. 15

WITNESSES.

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INVENTOR.

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UNITED STATES PATENT OFFICE.

EDMUND EDWARDS, OF LONDON, ENGLAND.

IMPROVEMENT IN ROCK-DRILLING ENGINES.

Specification forming part of Letters Patent No. **157,805**, dated December 15, 1874; application filed December 5, 1873.

To all whom it may concern:

Be it known that I, EDMUND EDWARDS, of 38 Southampton buildings, London, England, have invented Improvements in Rock-Drilling Engines; and I do hereby declare that the following is a full, clear, and exact description thereof, reference being had to the accompanying drawings making part of this specification, in which—

Figure 1, Sheet 1, is a longitudinal elevation, partly in section, of part of a rock-boring machine. Fig. 2 is a sectional plan of the same, and Fig. 3 a longitudinal elevation of the same. Figs. 4, 5, and 6 are cross-sections, Fig. 7 a back-end view, and Fig. 8 a front-end view, of the same. Fig. 9 is an end view of the parts which cause the rotation of the drill, and Fig. 10 is a cross-section of the valve. Fig. 11 is a longitudinal section of the self-regulating part of the feed apparatus. Fig. 12 is a longitudinal section, and Fig. 13 is an end view, of the apparatus which prevents the drill from rotating while making its stroke. Fig. 14 is a longitudinal section, and Fig. 15 a cross-section, of the attachment of the drill to the piston-rod. Fig. 16 shows the arrangement of the movable nut in which the feed-screw works.

Similar letters of reference indicate corresponding parts in the several figures.

This invention relates to novel improvements in apparatus used for drilling holes in rocks or other hard substances, in which apparatus pistons carrying a drill are made to reciprocate in a cylinder by the pressure of steam, air, or other fluid.

My improvements consist in novel methods of causing the piston to reciprocate, guiding it steadily during its cutting-stroke, and causing it to rotate during its return stroke, and of causing the drill to advance by novel self-acting mechanism, exactly in proportion as the depth of the hole increases.

The following description of my invention will enable others skilled in the art to understand it:

In the annexed drawings, *a* is a cylinder, in which two pistons, *b* and *b′*, work, which are coupled together by inserting the rod *c* of the piston *b′* into a projection, *i*, of the piston *b*, and fastening the parts by a key, *c′*. There is a projection, *k*, similar to the one *i* on the rod *c*, as shown. An inlet-port, *d*, is provided in the cylinder *a*, for admitting steam or other fluid directly into the space between the two pistons, and an outlet-port, *e*, is also provided in the cylinder for the escape of the fluid after it has done its work. There is a passage, *f*, in the cylinder, which forms a communication between the lower end of the cylinder and the space between the pistons, and also a passage, *g*, which forms a communication between the upper end of the cylinder and the steam-space. *h* is a cylindrical hollow valve for regulating the induction and eduction of the fluid. This valve is fitted upon the rod *c* in the cylinder, and between the pistons *b b′*, and is of such length that it opens and closes the ports at the proper times, being caused to perform its movements by the projection *i* or *k* striking its end at the completion of each stroke of the piston. The valve *h* is provided with an annular groove, h^2, at its circumference, which forms a chamber or communicating-passage between the exhaust-opening *e* and the ports *f′* and *g′* alternately, and its stroke is limited by a set-screw, h^3, fixed on the cylinder *a*, which extends into the groove h^2 and prevents the valve, through its bearing-rings h^4, from moving any farther than the proper distance, either backward or forward. The back or forward movement of the valve instantaneously reverses the action of the engine after each stroke without any other valve-gearing whatever.

The valve *h* may be cut at one side, as shown in Fig. 10, so as to be expanded by the pressure of the steam within, and may be made sufficiently strong opposite the cut to prevent such expansion from being too great.

h^1 are longitudinal passages outside the central bore of the valve for the steam to pass through on both sides. The port *e* may be made the inlet-port and the port *d* the outlet-port, and the passages *f* and *g* need not then pass one another longitudinally, as shown. On the lower end of the cylinder *a* is formed the tube *l*, through which works the piston-rod *m*, to which the drill is attached. The tube *l* is bored out, and the piston-rod *m*, or a part of it enlarged for the purpose, is fitted with recesses, in which elastic rings *n n* may

be placed, and the escape of steam is thus prevented without the use of a stuffing-box.

The rotation of the pistons during their upstroke is caused by the twisted prismatic bar *o*, which passes into an opening in the rod *c*, and is fixed to the cylinder-cover *p*, and upon which works the nut *r*, fitted in the piston *b'*, and held in its place by a cross-plate. The nut *r* has ratchet-teeth formed upon it, as shown in Fig. 9, into which a pawl, *s*, works, and the pistons are thus caused to rotate during their upstroke, but are free to descend without rotation in their downstroke. In order to prevent their rotation during their downstroke I form a straight groove or slot, *t*, on the piston-rod between the lower piston and the recess, at *n n*, as shown in Figs. 12 and 13, which works through the ring *u*, which is formed with a key fitting the groove *t*. The ring *u* can turn around freely, but is prevented from moving endwise by an annular groove around its circumference, into which the screw *v* enters loosely. *x* is a small cylinder formed radially to the cylinder *a*, and containing a piston or plug, which, when pressed down upon the ring *u*, holds the latter firmly in its place, and the outer side of the cylinder *x* communicates, by the passage *y*, with the steam-passage *g*, through which steam is admitted to the upper end of the cylinder *a*. When the pistons are rising the ring *u* revolves with the piston-rod as it rotates; but, when they descend, steam from the other end of the cylinder *a* forces the small piston or plug against the ring *u* and holds it firmly, so that it is almost impossible for the pistons to rotate. A tongue or key upon the plug helps to hold the ring *u* in its place.

In order to feed the cylinder and drill forward as the depth of the hole increases, the screw A is attached to the cylinder *a*, and revolves in bearings B B'. It works in a nut, E, Fig. 16, attached to the cradle C, in which the cylinder *a* is fitted so as to slide backward or forward in the grooves or guides D D'. The nut E can be withdrawn from the screw when desired, so that the cylinder can be readily removed from the cradle, or replaced.

A tangent wheel, the teeth of which fit the screw A, and which can be fixed, when required, may be used instead of the nut E. The screw A is worked by the ratchet-wheel F, Figs. 1 and 7, which is driven by the tooth or pawl G. This pawl is carried by a piston, H, which works in the small cylinder I, attached to the cylinder-cover *p*. One end of the cylinder I communicates with the upper end of cylinder *a*, and its other end communicates with the lower end of the cylinder *a*, and the piston H is thus caused to reciprocate backward and forward simultaneously with the piston *b b'*. The pawl G fits into a recess in the piston H, and is pressed out, by means of a spring, through a slot in the cylinder I, so that, on its back stroke, it passes over the teeth of the ratchet-wheel F without causing the latter to revolve.

In order to prevent the piston H from being moved when the drill has made a cut not sufficiently deep, the valve K, Fig. 11, is fitted at the inner end of the steam-passage L, and prevents the admission of steam to the cylinder I, unless the piston *b* has traveled sufficiently to lift the valve, the edge of which projects into the cylinder for the purpose.

The screw A may be worked by hand by means of a wheel or handle, instead of by the self-acting arrangement described, without departing from the main principle of my invention.

In order to fix the drill to the piston-rod I make the latter hollow, and I fit the ring M, Figs. 14 and 15, round the drill in a slot in the piston-rod, and I tighten the ring M by means of the key N, which is driven between the ring and the outside of the piston-rod.

The drill is shown of smaller diameter where the ring M embraces it, and where the depth of the hole requires it can be drawn out and refixed in a fresh position.

The cradle carrying the cylinder *a* is attached to a tripod or other standard by means of a hollow spherical plate, *o*, Figs. 3, 7, and 8, which may have three bearing-points or projections upon it, and is drawn against a corresponding convex spherical plate by means of a bolt and nut or key, so as to allow a certain amount of universal motion to the cradle and drill.

Where there is sufficient difference between the area of the piston-rod *m* and the piston *b* the steam may constantly be admitted to the lower end of the cylinder, and the motion of the pistons caused by alternately admitting and discharging steam from above the pistons, of which only one need be used, the position of the valve and steam-passages being modified accordingly.

The valve *h* need not be cylindrical, but may be sometimes used occupying part only of the cylinder, in end view.

In order to more rapidly discharge the steam or compressed air from above the piston *b*, Fig. 1, at the end of its downward stroke, I sometimes make a port or series of holes (shown in dotted lines at R, Fig. 2) through the cylinder, directly above the piston *b'*, when in its position described, and communicating directly with the exhaust-pipe or the open air. The piston *b'* opens these holes and immediately closes them again upon commencing its return stroke. This arrangement is applicable to all cases in which the space between the two pistons of such engines communicate with the outlet or exhaust, and the annular space round the valve communicates with the inlet-pipe. A similar port or series of holes may be made immediately below the lower piston at the top of its stroke, as shown in dotted lines at S, Fig. 2.

The apparatus described may be used to drive the ram of a pump, connected to the piston-rod or other machinery, instead of a drill.

The operation of my invention begins with

the admission of motive fluid through the opening *d* into the space between the pistons *b* and *b'*. The valve *h* covering the port *f*, the fluid goes into the port g^1, follows the passage *g*, and, through the port g^2, arrives in the cylinder *a* between the cover *p* and the piston *b'*, which latter is thereby moved down. It enters at the same time, through the passage *i'*, into the cylinder I, and, by pushing the piston H forward, gives the feed-screw A' a turn forward. At the same time the motive fluid enters the passage *y*, and presses the plug *x* against the ring *u*, which is thereby made rigid, and guides the piston-rod *m*, and prevents its turning during this stroke. The projection *k* on the piston *b'* comes finally in contact with the hub of the valve *h*, and carries it along until the port g^1 opens into the annular groove h^2 on the valve *h*, and the port *f'* exposed to the motive fluid in the cylinder between the pistons *b* and *b'*, which enters the same, and is conducted by the passage *f* into the lower part of the cylinder *a* below the piston *b*. If the valve K has been opened by the said piston in its descent, the motive fluid enters the passage *z*, and therefrom the cylinder I, and moves the piston H backward, while the motive fluid at the other end is discharged into the cylinder *a*, and from there exhausted through passage *g* and the annular space h^2 on the valve *h* into the exhaust-port *e*. The piston *b* is now driven up and turned by the agency of the twisted bar *o*, the ratchet-wheel P, and the pawl S, turning the ring *u* also, which is released from the pressure of the plug *x* by the exhaustion of the motive liquid from the passage *y* into the passage *g*. Near the end of the upstroke the projection *i* strikes the valve *h*, and pushes it over the port-hole *f'*, exposing the port g^1 to the motive fluid, and the port *f'* to the annular exhaust-chamber h^2. The motive fluid in the passage *z* and the left port of the cylinder I opens the valve K, which has very little elastic pressure, and empties into the cylinder, whence it is carried off by the passage *f* and the exhaust-chamber h^2.

What I claim as my invention, and desire to secure by Letters Patent, is—

1. In a steam boring-machine, the combination of the revolving piston-rod, carrying pistons, and valve-movers, a valve fitted loosely upon the rod between the valve-movers, and the twisted bar for turning the piston-rod, substantially in the manner and for the purpose herein set forth.

2. The feed-screw A, ratchet F, and pawl G, connected to the cylinder as set forth, in combination with the guide, having a movable nut, E, attached to it, substantially as described.

3. The combination of the cylinder *a*, piston-rod, pistons *b b'*, passage *y*, plug *x*, ring *u*, and slot *t*, substantially in the manner and for the purpose described.

4. The combination, with the cylinder I, piston H, piston *b*, and pawl G, of the passage L and regulating-valve K, for the purpose of preventing a too rapid feed forward of the cylinder and drill, substantially as described.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

EDMUND EDWARDS.

Witnesses:

CHARLES JAMES WINTERSGILL,

SIDNEY EVELYN GUYER.