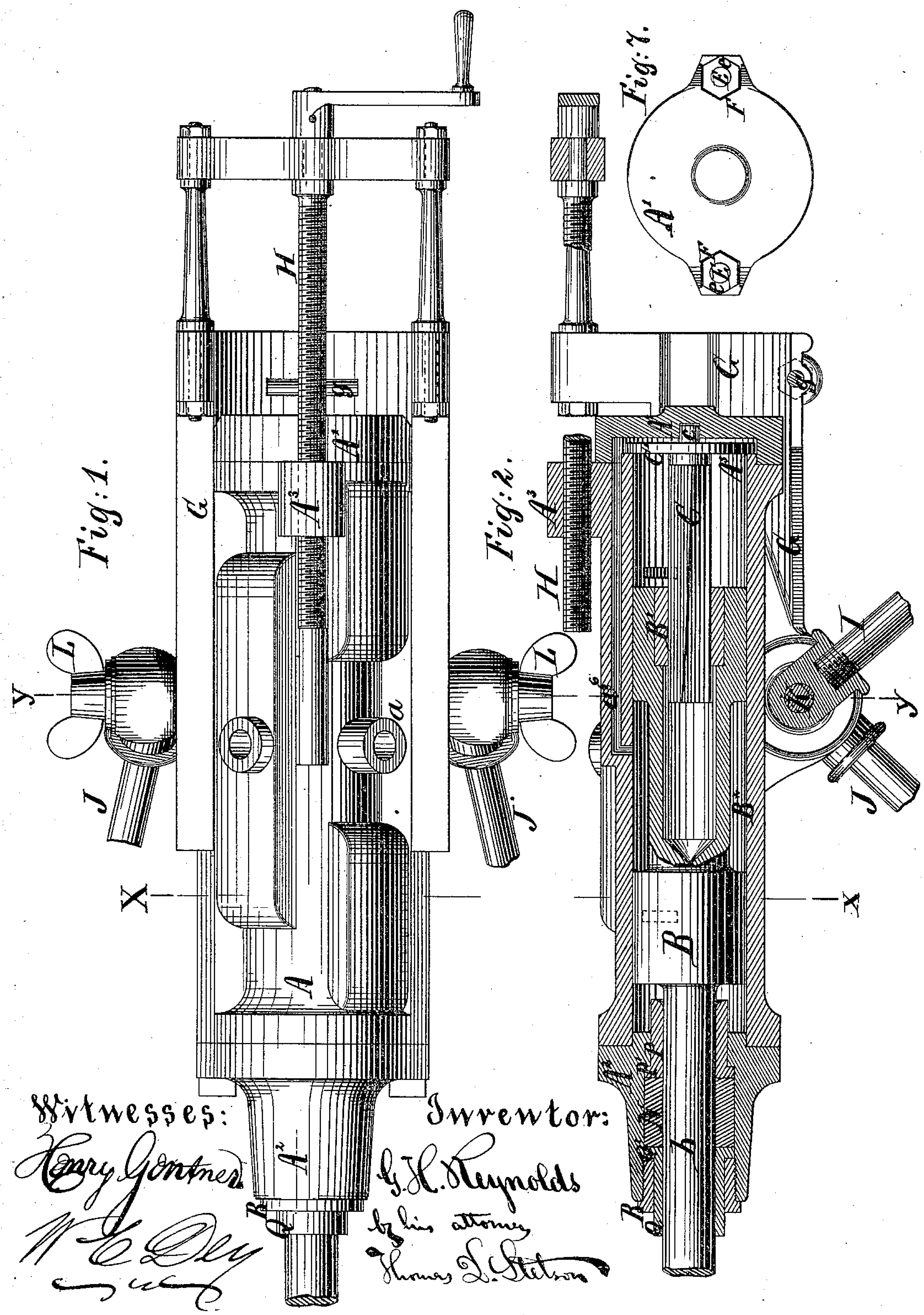
2 Sheets--Sheet 1.

G. H. REYNOLDS.

Rock-Drill.

No. 164,394. Patented June 15, 1875.



Witnesses:

Henry Gontner

Inventor:

G. H. Reynolds
by his attorney
Thomas D. Stetson

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2 Sheets--Sheet 2.

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Fig: 4.

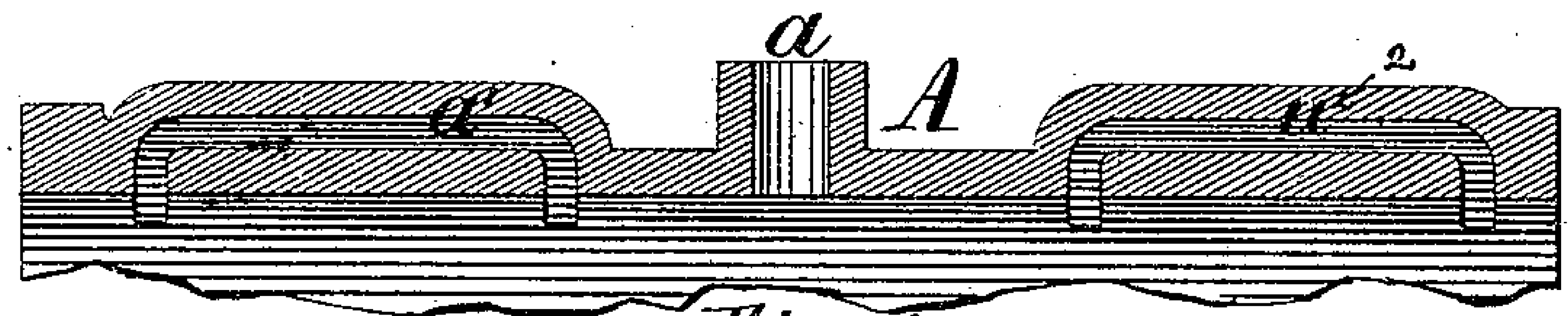


Fig: 5.

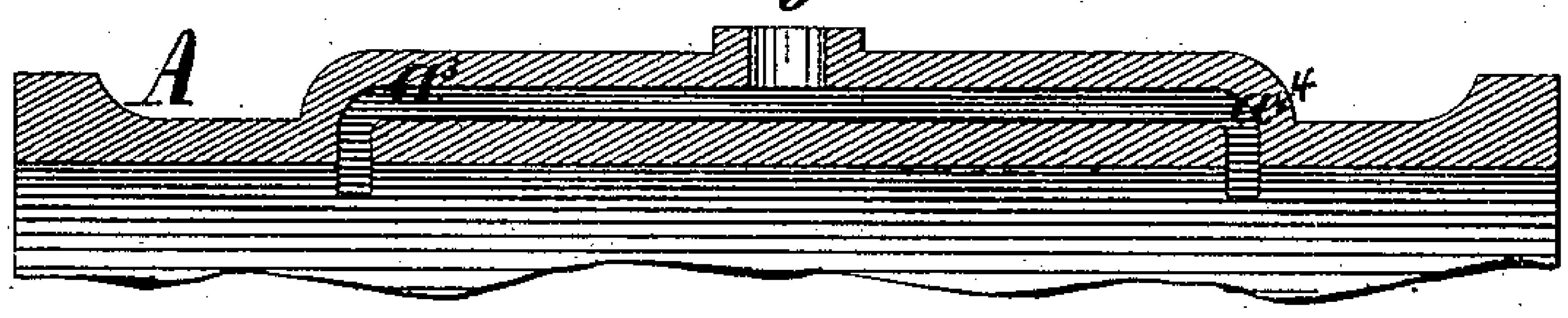


Fig: 3.

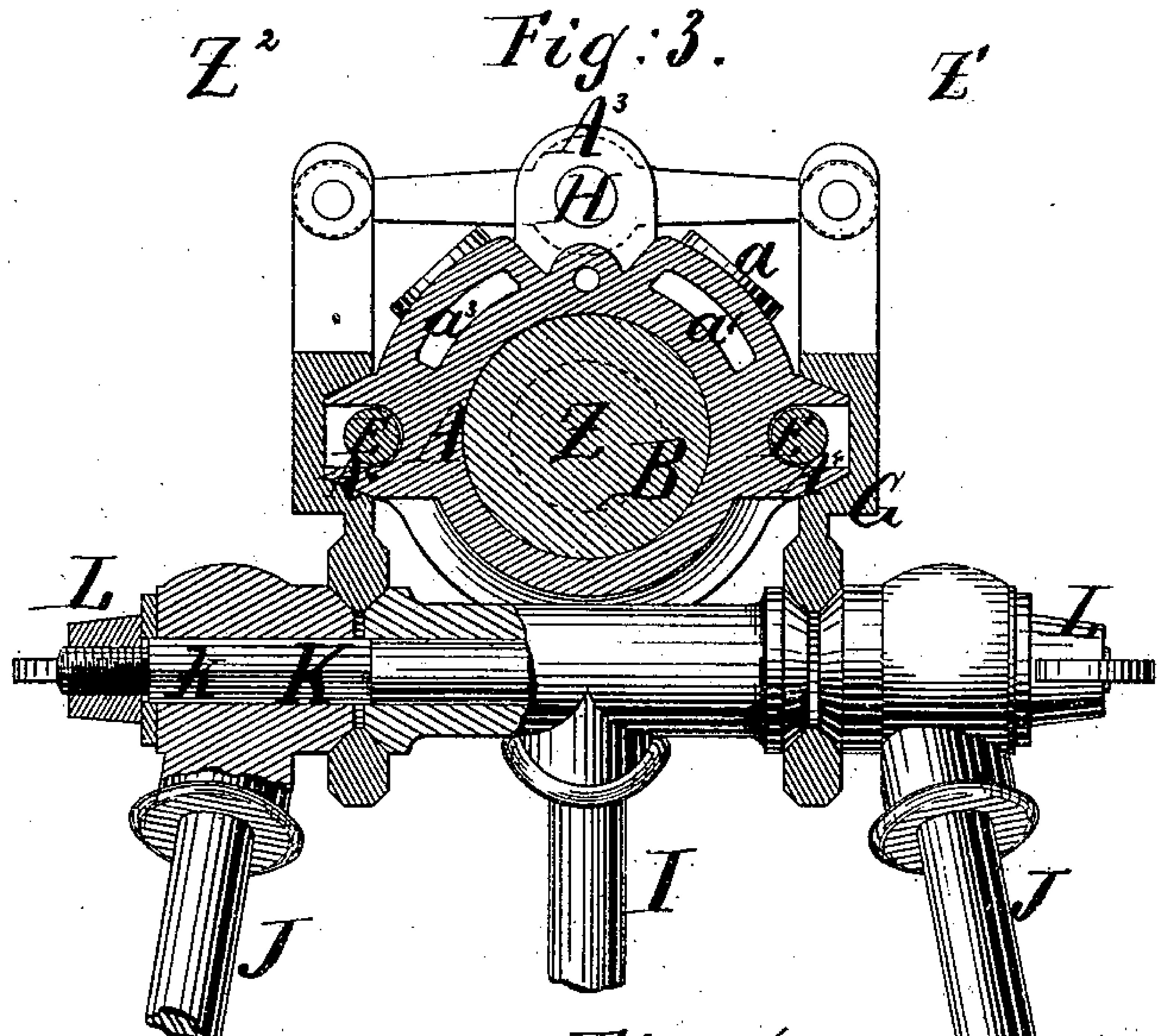
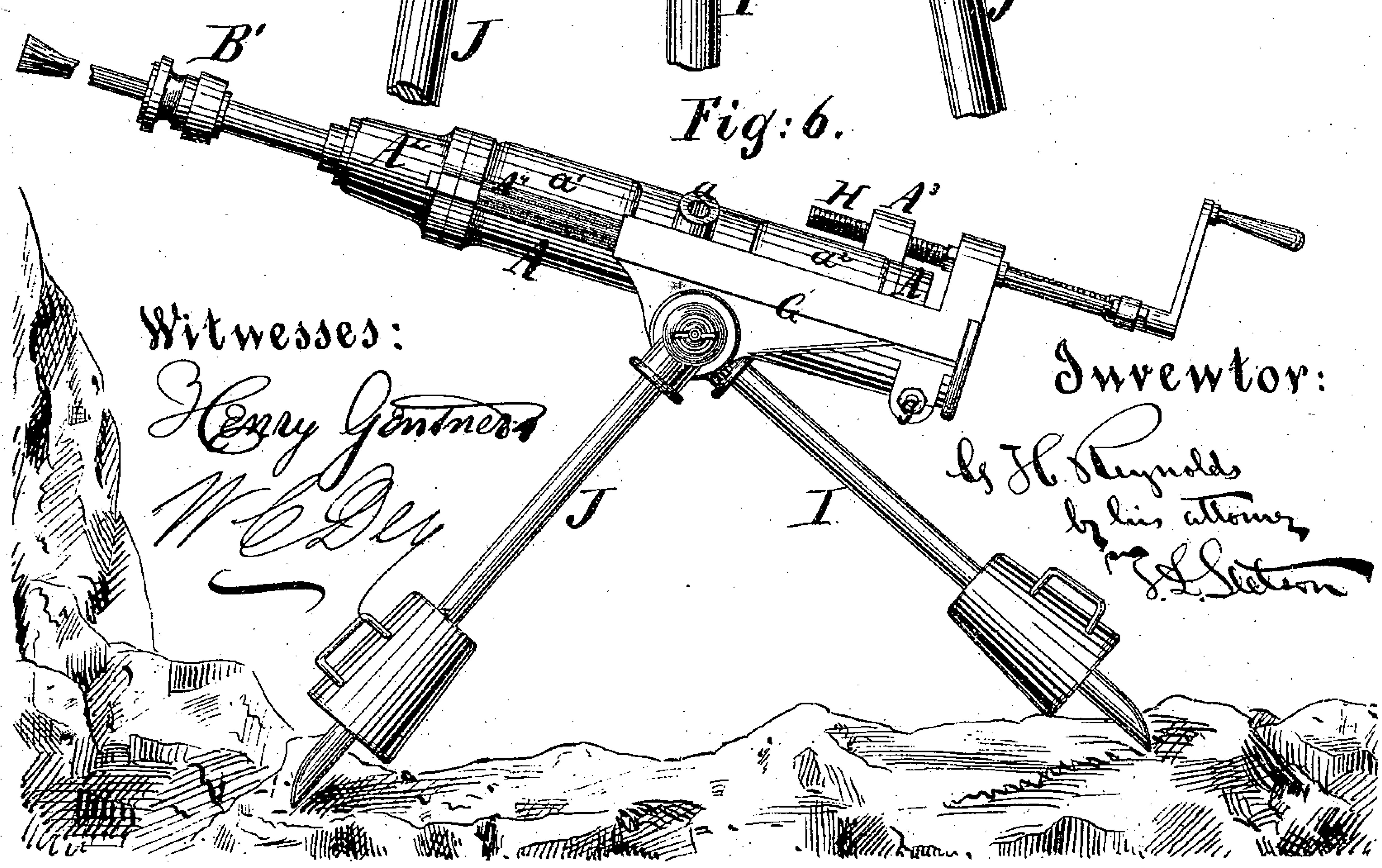


Fig: 6.



Witnesses:

Henry Gentner

W C Dey

Inventor:

G. H. Reynolds
by his attorney
per S. L. Stetson

UNITED STATES PATENT OFFICE.

GEORGE H. REYNOLDS, OF NEW YORK, N. Y., ASSIGNOR TO HIMSELF, CORNELIUS H. DELAMATER, AND GEORGE H. ROBINSON, OF SAME PLACE.

IMPROVEMENT IN ROCK-DRILLS.

Specification forming part of Letters Patent No. **164,394**, dated June 15, 1875; application filed April 5, 1875.

To all whom it may concern:

Be it known that I, GEORGE H. REYNOLDS, of New York city, in the State of New York, have invented certain Improvements relating to Rock-Drills, of which the following is a specification:

The following is a description of what I consider the best means of carrying out the invention.

The accompanying drawings form a part of this specification.

In practice, holes are required to be drilled in every possible direction; but I will, in describing, speak of the end from which the drill projects as the "lower end" of the cylinder.

In the drawings, Figure 1 is a plan view, and Fig. 2 is a central longitudinal section through the cylinder and its immediate adjuncts. Fig. 3 is a cross-section. The upper part of this figure is a section on the line *x x* in Fig. 2. The lower part is a section on the line *y y* in the same figure. Fig. 4 is a section on the line Z Z^1. Fig. 5 is a section through the metal in the different plane Z Z^2. Fig. 6 is a side elevation, showing the entire machine. Fig. 7 is an end view, showing the upper end of the cylinder, with its provisions for confining the nuts on the through-bolts.

Similar letters of reference indicate like parts in all the figures.

I will indicate the main casting, which forms the cylinder, by the single letter A, distinguishing certain parts thereof by additional marks A, a^1, &c., when necessary. B is a piston, formed with a deep annular recess around its center, as indicated by B*. The piston-rod *b* extends out through a peculiar stuffing-box, which is equipped with elastic material, adapted to serve as a spring in case the piston should tend to move too far in either direction.

The piston is much longer relatively to its diameter than pistons are usually made, and in my experiments has been operated without any packing. The steam is admitted through a passage, *a*, into the annular chamber B*, which forms a belt around the center of the length of the piston, and is always maintained full of steam at the full boiler-pressure, or at such lower pressure as may be caused by a partial closing of a throttle-valve. (Not represented.) When the piston is at exactly mid-stroke the steam is not allowed to flow into or out of the cylinder at all, but in working the piston never rests in this position for a moment. It is flung violently past the central point, and by its own motion admits, cuts off, and exhausts the steam.

In starting, the weight of the piston and its connections holds it at the lower end of the cylinder. To start the machine, the valve should be suddenly opened, admitting the steam at as full pressure as may be. It fills the annular chamber B*, and in this position of the piston also flows around through a port or channel, a^1, and gets below the piston. There being in this position of the parts no pressure above the piston, it is thrown up with all the force that the steam can exert on the lower end. It accumulates a high velocity in its upward motion, and then, having covered or closed the port a^1, it uncovers and opens the port a^2, admitting the live steam from the belt B*, to act on the upper end of the piston, arresting its motion, and at the same time uncovering the port a^3, and allowing the steam from the lower end to exhaust through it. Under these conditions the upward motion of the piston is rapidly checked, and it immediately descends as rapidly as it previously rose. The descending motion again accumulates a sufficient momentum to carry it very forcibly onward, and then closes the upper steam-passage a^2, uncovers the upper exhaust-passage a^4, and admits steam again to the lower end of the cylinder through the port a^1.

Although I use the word steam with reference to the fluid used, it will be understood that it may be compressed air or any other suitable elastic fluid, means being employed to compress the air or evolve carbonic acid or other elastic fluid for the purpose.

This arrangement of the parts renders available some of the expansive action of the steam or other fluid. The working is ordinarily very rapid, amounting under usual conditions to as high as ten or more double strokes per second. When the piston has commenced to rise, and has by its movement cut off the further access of steam to the lower end through the port a^1, the steam already there will act expansively until a subsequent period, when the exhaust-port a^3 is uncovered, and for a little period afterward, until the steam is exhausted. The same conditions occur on the down-stroke. It will be understood that the piston should be fitted as nearly steam-tight as is practicable, and that the recess or hollow belt B* should be made with smooth and accurately-formed boundaries.

The passage *a* may terminate in the cylinder in a plain round hole, the belt B* being always sufficiently capacious to allow a free opening for the steam. The mouths of the several ports a^1 a^2 a^3 a^4, should be extended partially around the cylinder, to allow ample opening for a very active movement of the elastic fluid as the piston is in the act of covering or uncovering the passages.

The piston and the connected drill require to be turned about the sixteenth of a revolution after each stroke. I have devised means for effecting this without complicated machinery, and without preventing the turning of the drill into any position desired when the machine is stopped.

I effect this by the twisted rod C, of square or star-shaped section, or other section not round. It extends from the upper end of the cylinder down into and nearly through the piston. It fits easily through a nut or close-fitting piece, B′, which is firmly bolted or otherwise secured in the upper end of the piston, and thus plays up and down upon it. The rod C is forged on, or otherwise rigidly fixed to, a stout disk, C′, the plane under face of which matches steam-tight against a corresponding plane annular surface, A^5, at or near the cylinder end. The twisted rod C and head or disk C′ are kept in a central position by means of the extension *c*, which is in the center of the upper face of the disk, and rests in a corresponding hole in the upper head A^1 of the cylinder. A little space between the disk C′ and the adjacent surface of the head A^1 is kept always filled with steam of the same pressure as that which fills the belt B*. There is a free communication with the belt B* by a passage, a^6, cored in the casting. It follows that any variation in the working pressure, by opening or closing the throttle-valve, (not represented,) or by raising or lowering the pressure of the steam, or increasing or diminishing the action of an air-compressor, is felt in the space above the disk C′, which is always filled with steam equal to that in the belt B*, and, consequently, equal to the maximum pressure which alternately acts in the two ends of the cylinder. During the down-stroke of the piston the conditions are very different. During this movement, or the entire first part thereof, the steam is pressing with full working pressure on the under face of the disk C′, and thus balances the pressure thereof. In this condition, when the disk is thus relieved from pressure, it is easily turned. Consequently, during each descent of the piston, the twisted rod C is not held rigidly, but is turned partially around, allowing the drill to descend without turning.

When, on the upstroke, the steam is allowed a free exhaust from the upper end of the cylinder, the pressure of the steam above the disk C′ is unbalanced by the pressure in the exhausted space below it, and the disk is, by the pressure above it, held rigidly on its seat A^5. The twisted rod C′ is, consequently, held stationary during the upstroke of the piston, and it compels the piston to turn about a sixteenth of a revolution. At each reciprocation of the piston, therefore, it is revolved to about the proper amount required to effect the most successful drilling. The seat of the disk C′ may be conical, instead of plane, if preferred.

The absence of any pawls or analogous mechanism to effect this rotation is important, not only in reducing the cost and weight of the apparatus, but also by allowing the drill to be turned freely by hand or otherwise when the action of the piston is stopped.

The construction of the stuffing-box and its appurtenances may be briefly described as follows: A gland, P, fits loosely around the piston-rod *p*, and extends a little distance into the cylinder. Against its flanged or larger end P′ is applied a deep body of packing, N, of a character which is adapted to serve both as a packing to make the piston-rod steam-tight, and as a spring to soften the shock in case the piston moves too far. I have in my experiments used what is known as Tuck's patent packing. A corresponding gland, Q Q′, applies on the outer side of the stuffing-box, with its end Q projecting outward beyond the confining-follower R. When the piston B tends to move too far down, it strikes the gland P P′, and, forcing it downward, compresses the packing N. When the piston tends to move too high, the collar B′, which may be the plane upper end of a stout chuck which confines the drill, strikes the lower gland Q Q′, and, forcing it upward against the packing N, compresses it in the same manner as before. Thus the elastic material N serves as a spring to gently arrest the motion of the piston when it tends to move too far in either direction, and the strain, modified and softened by the intervention of the elastic packing or cushion N, is received entirely on the lower head A^2, forcing it either upward or downward.

The lower head A^2 is confined by long bolts E E, which lie in grooves extending along in each of the wings or longitudinal guides A^4. They take a firm hold of the latter near their upper end. They exert a great compressive force, which the material of the guides A^4 is able to resist. When the piston strikes the gland P P, and thus forces the lower head A^2 downward, the bolts E receive the strain, and transmit it to the flange at the upper end of the cylinder, and the compressive strain is received directly endwise on the guides A^4. These guides, besides thus bearing the compressive strain of the bolts E at ordinary periods, contribute to increase the tensile strength of the cylinder when a rending strain is received from the impact of the piston against the cushion at the bottom of the cylinder. They also fulfill their ordinary function of guiding the cylinder as it is fed up and down in the adjustable frame or cradle G.

Recesses F, corresponding in form to nuts *e*, are formed in the proper positions in the upper head A^1, and on applying the latter the nuts *e* are firmly locked until the head A^1 is again removed. It will be understood that the head A^1 is secured by bolts, (not represented,) which extend to a sufficient depth into the material of the cylinder A to take a firm hold thereof. The piston never strikes the upper head A^1, because the cushion N at the lower end receives the blow in both directions.

The metal of the cylinder A, adjacent to the bolts E, is properly finished to form guides or slides. These glide in corresponding slides formed in the cradle G, which latter is made in halves, secured together by a bolt, *g*. A feed-screw, H, mounted in a cross-piece properly secured to the cradle G, is tapped through a lug, A^3, formed on the cylinder A, as represented, and allows the latter to be moved forward and backward by turning the feed-screw H, which may be done by hand or by machinery as the work proceeds.

The tripod-legs I J J are supported and adjusted by means of a peculiarly-formed bolt, K, which extends through the cradle G. On the bolt K are two square places, *k*, one of each of which is received in a corresponding square hole in each of the legs J. The third leg I is mounted on a cylindrical portion of the bolt K, and may be adjusted in any required position when the nuts L on the ends of the bolt K are loosened. So, also, the bolt K and the legs J J may be turned in any required position when the nuts are loosened; but the two legs J J cannot be turned independently of each other, by reason of the fact that they are both rigidly set on square portions of the bolt K. The inner faces of the legs J J are made conical, and each fits in a corresponding conical recess in the cradle G. The T-piece or cross-piece at the head or upper end of the leg I is furnished with conical ends, which fit into corresponding recesses in the inner faces of the cradle G. After loosening either or both the nuts L the leg I may be set at any required angle to the legs J, and the entire cradle G and its contents may be inclined in any required position, according to the direction of the hole to be drilled. Then, by tightening the nut or nuts L, the whole is rigidly set in that position, and on admitting the elastic fluid, through the passage *a*, from a strong hose or other conduit, (not represented,) the piston and its attached drill commences to reciprocate rapidly in the proper line, and the attendant, by turning the feed-screw H, drives forward the entire cylinder and its contents, as he finds that the hole is excavated.

All previous devices known to me for adjusting the angle of the drill in relation to the legs, or the position of the legs with regard to each other or to the drill, require the loosening and tightening of two or more separate bolts.

In practice, the changes required are very frequent—almost constant.

It is essential that two of the legs be, by some means, firmly connected together, as it is found not safe to loosen all three of the legs and set the whole entirely at liberty.

My device fulfills all the conditions, and makes the line of direction of the drill and the position of the back leg and of the front pair of legs adjustable within every possible limit, by the slacking of a nut on either end of the single bolt K.

A large proportion of the work is done in tunnels and narrow cuts, where the drill is liable to operate with one side very close to a solid wall of rock, so it is of advantage to be able to liberate from either side.

It will be understood that when the drill is in use massive weights should be mounted upon the legs I J J, and that all the usual accessories may be employed.

I claim as my improvement in rock-drills—

1. The disk C′, resting on the seat a^5 and supporting the twisted rod C, in combination with the reciprocating piston and drill, and with a passage, a^6, leading from the exterior of the disk C′ to a space having a constant pressure of steam, as herein specified.

2. The channeled guides A^4, serving as reenforcing ribs on the cylinder and as guides for the cylinder, in combination with the longitudinal bolts E, as herein specified.

3. In combination with the bolts E, extending from the lower end and taking hold of the flange of the cylinder, the head A^1, formed with recesses adapted to take hold of and confine the nuts *e* on said bolts, as herein specified.

In testimony whereof I have hereunto set my hand this 30th day of March, 1875, in the presence of two subscribing witnesses.

GEO. H. REYNOLDS.

Witnesses:
WM. C. DEY,
M. A. VAN NAMEE.