(No Model.)

5 Sheets—Sheet 1.

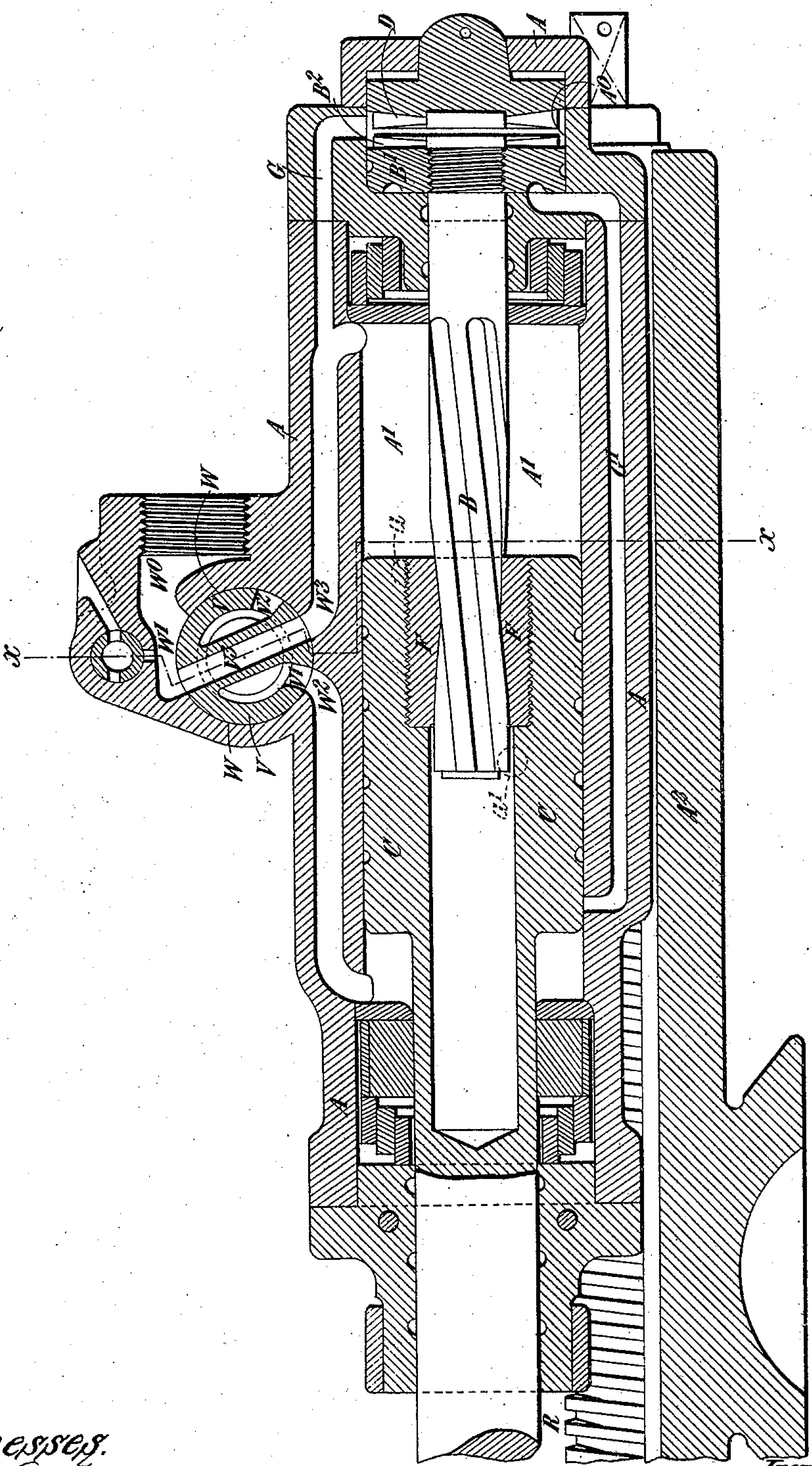
J. McCULLOCH.

ROCK DRILL.

No. 575,970.

Patented Jan. 26, 1897.

Fig. 1.



Witnesses.

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(No Model.)

5 Sheets—Sheet 2.

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No. 575,970.

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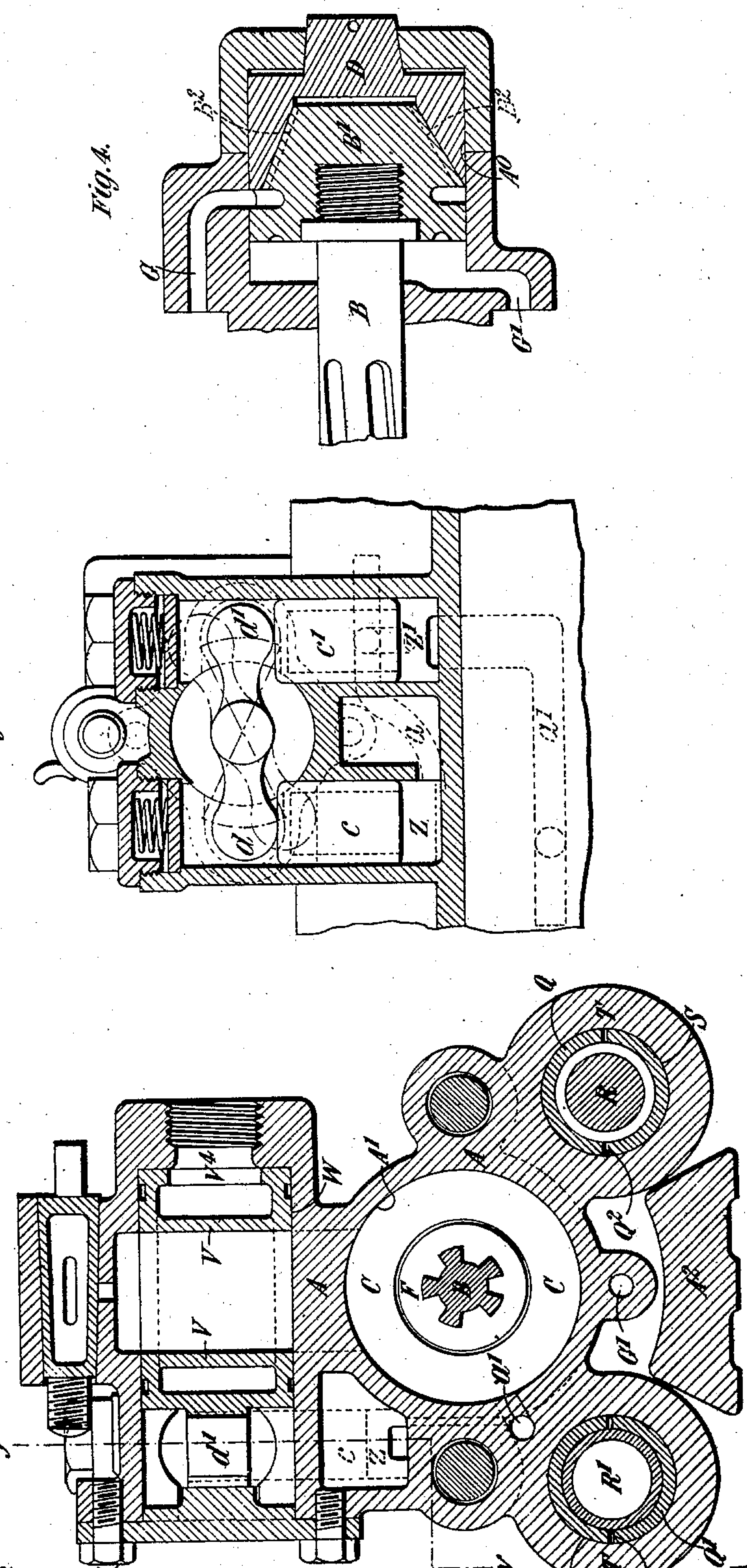

Fig. 4.

Fig. 3.

Fig. 2.

Witnesses.
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5 Sheets—Sheet 3.

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Fig. 5.

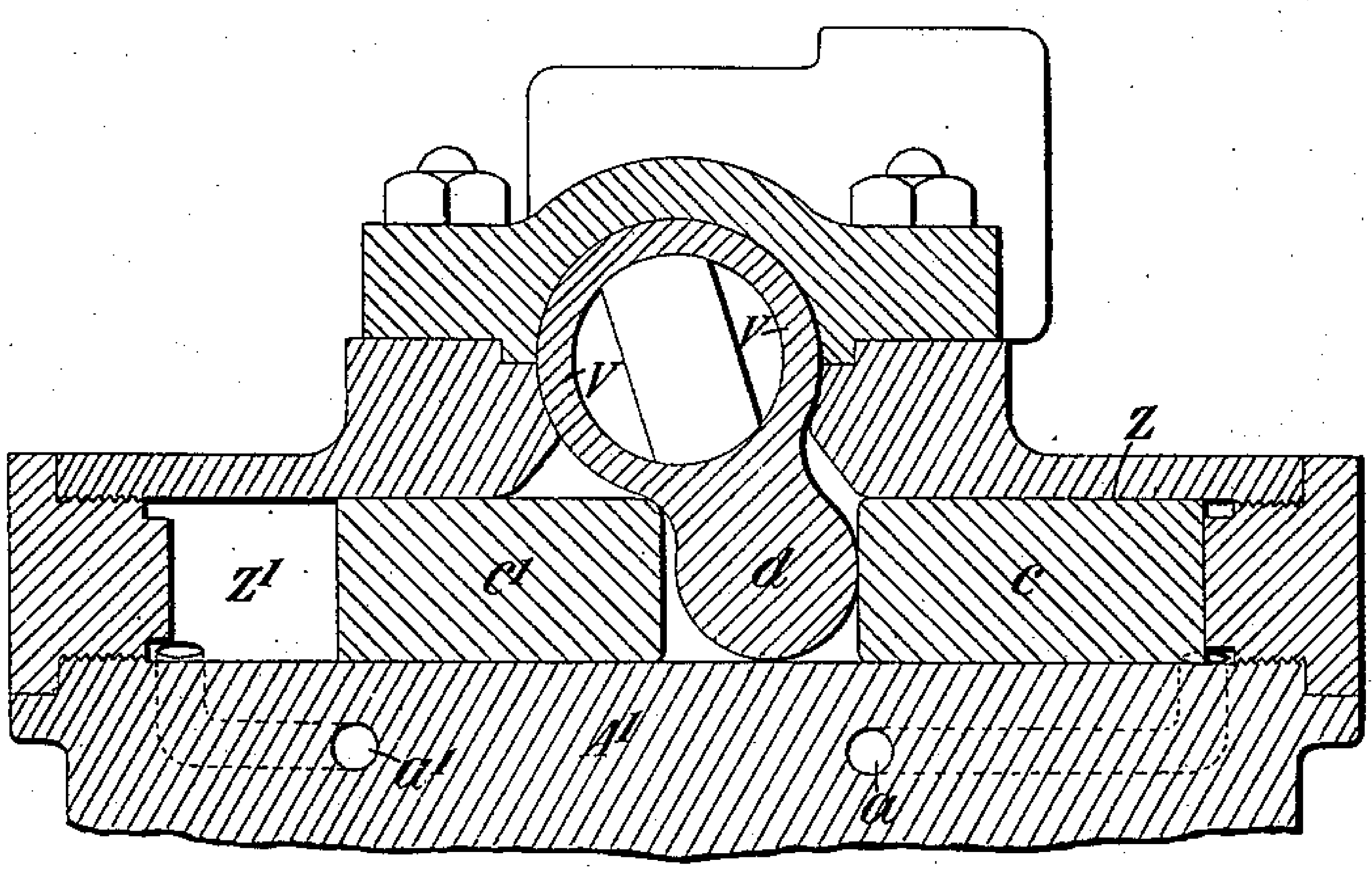
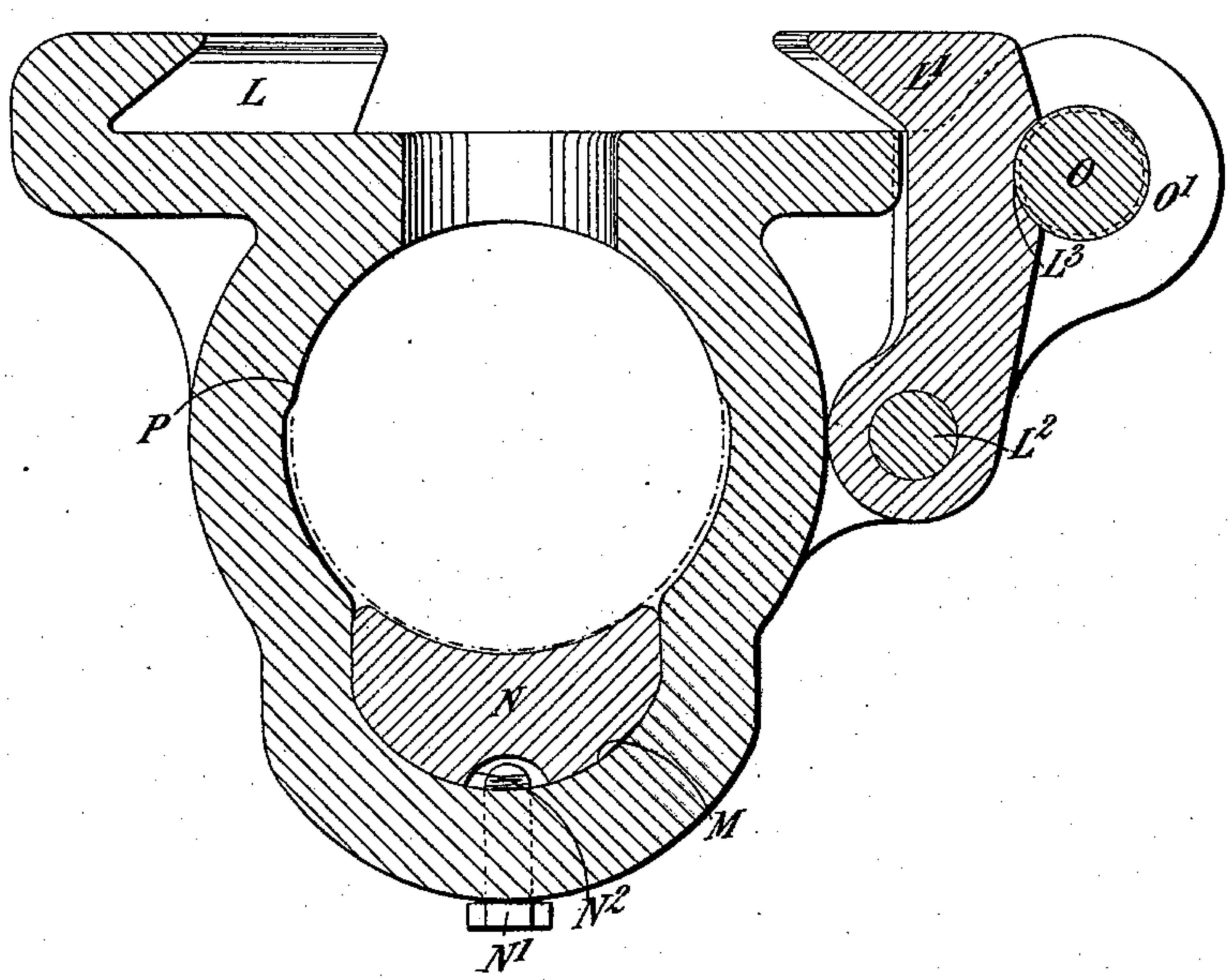


Fig. 8.



Witnesses.
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5 Sheets—Sheet 4.

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No. 575,970. Patented Jan. 26, 1897.

Fig. 6.

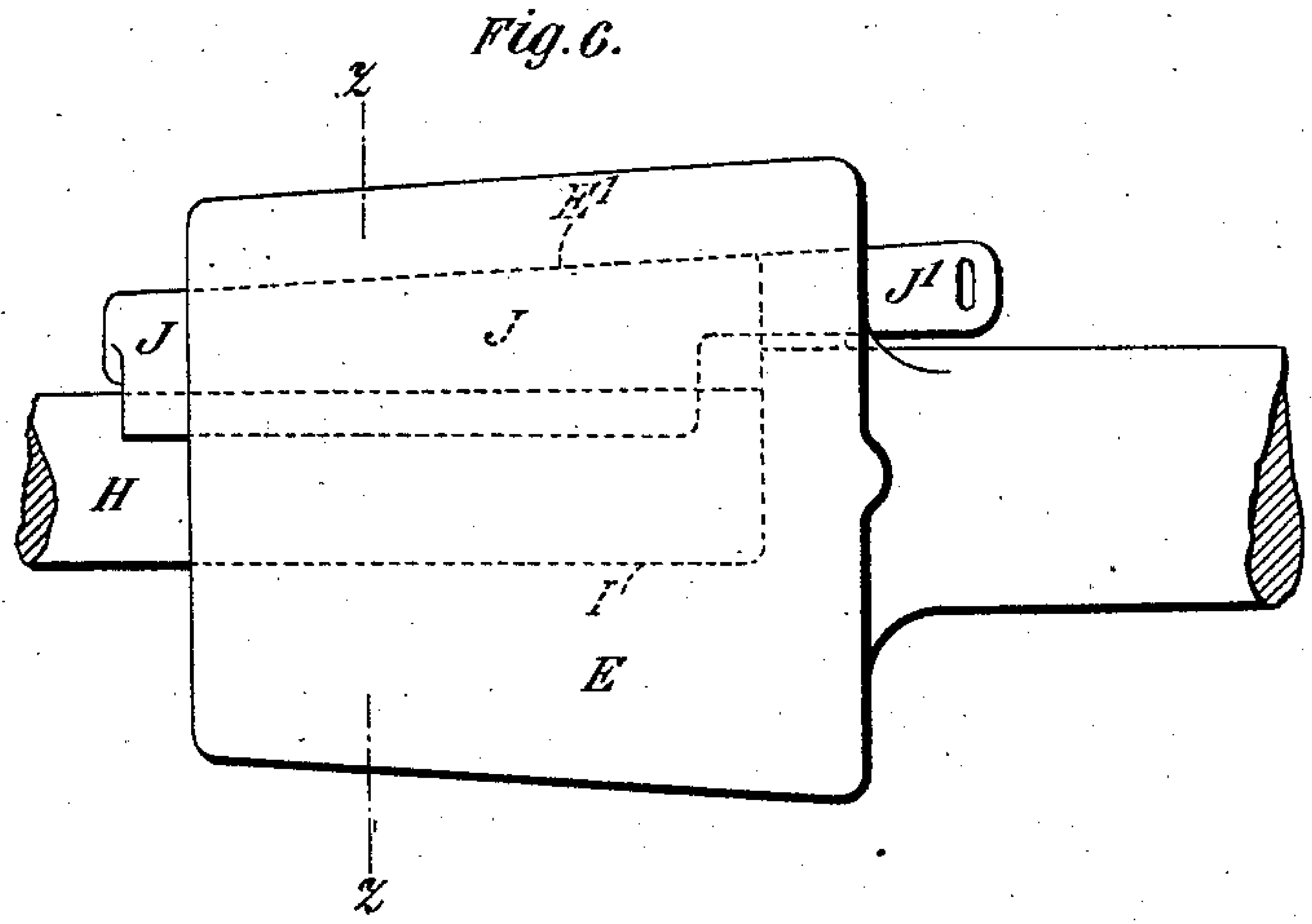


Fig. 7.

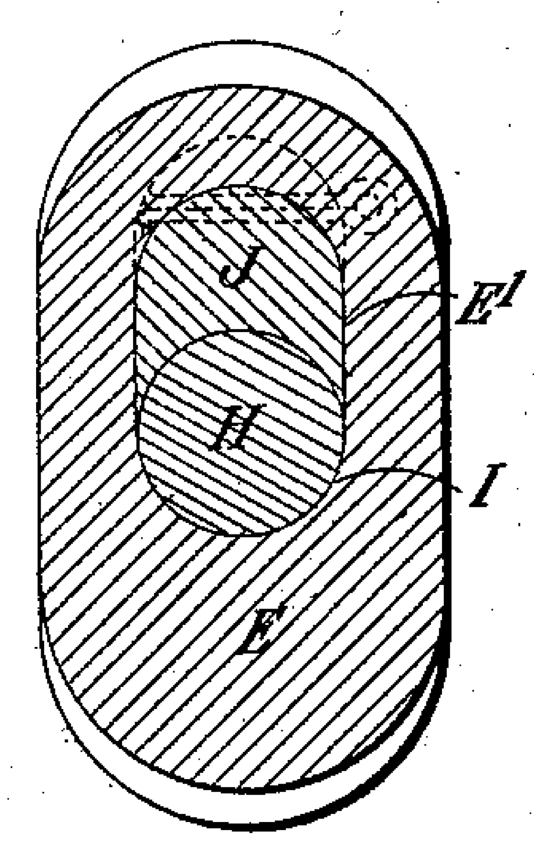
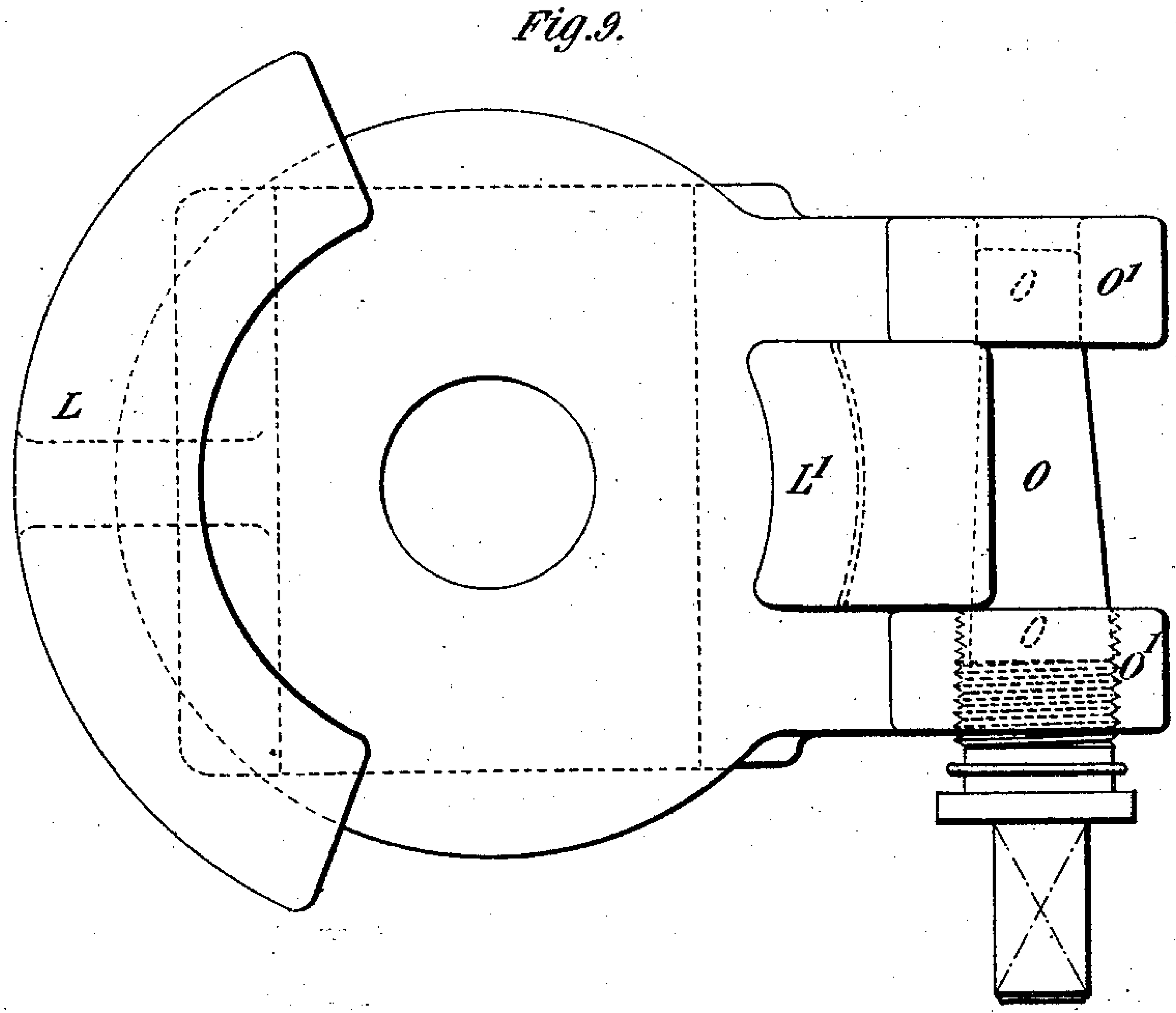


Fig. 9.



Witnesses.
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THE NORRIS PETERS CO., PHOTO-LITHO., WASHINGTON, D. C.

(No Model.) 5 Sheets—Sheet 5.

J. McCULLOCH.

ROCK DRILL.

No. 575,970. Patented Jan. 26, 1897.

Fig. 10.

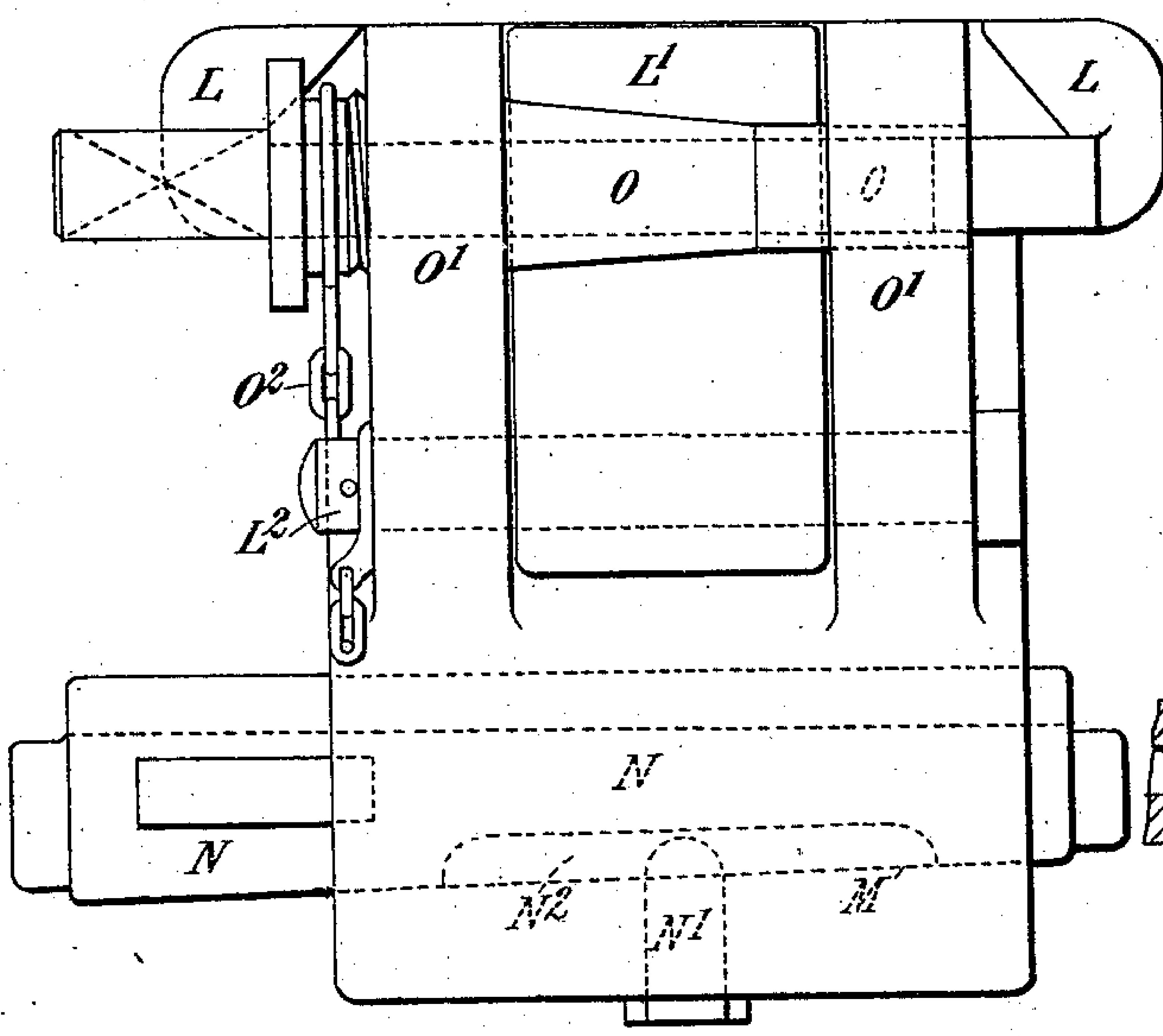


Fig. 12.

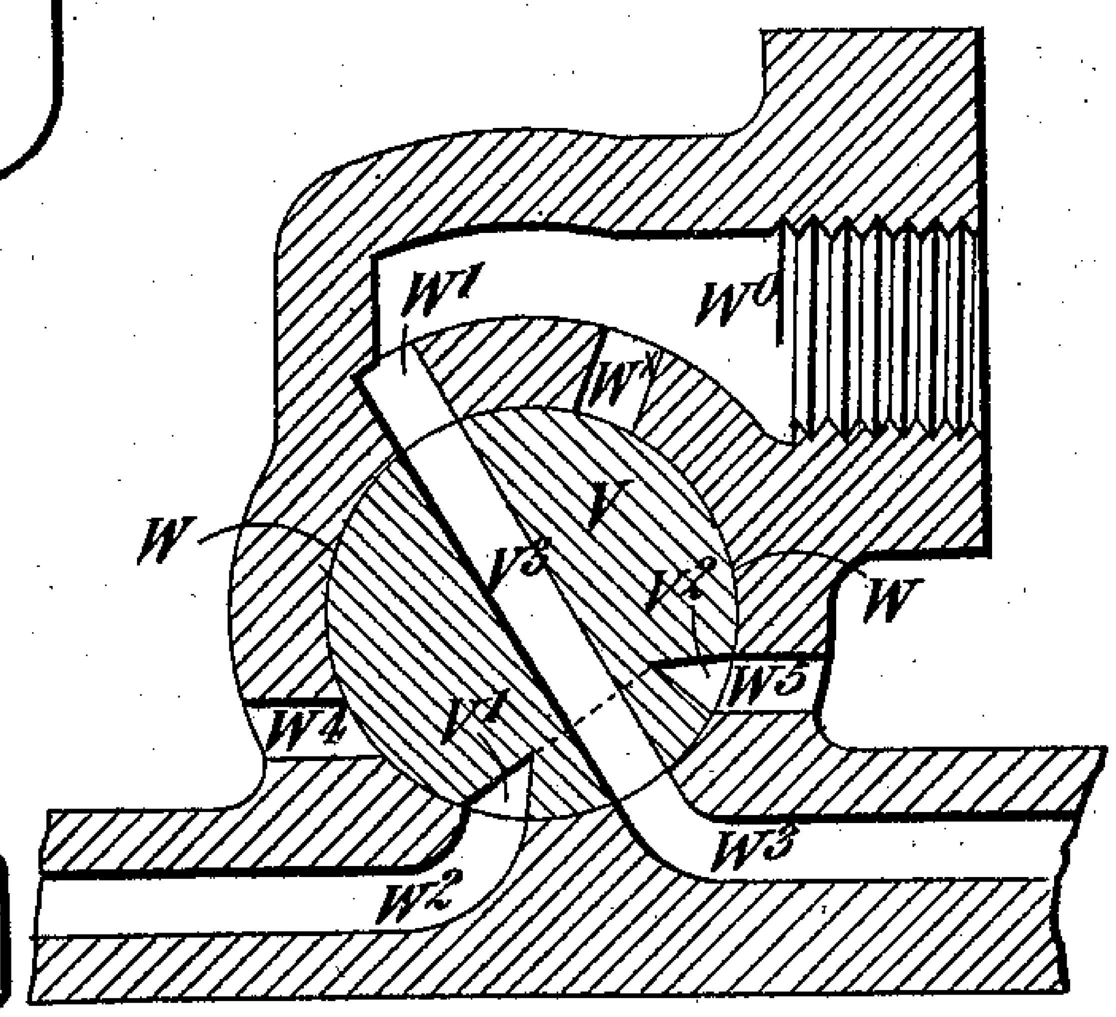
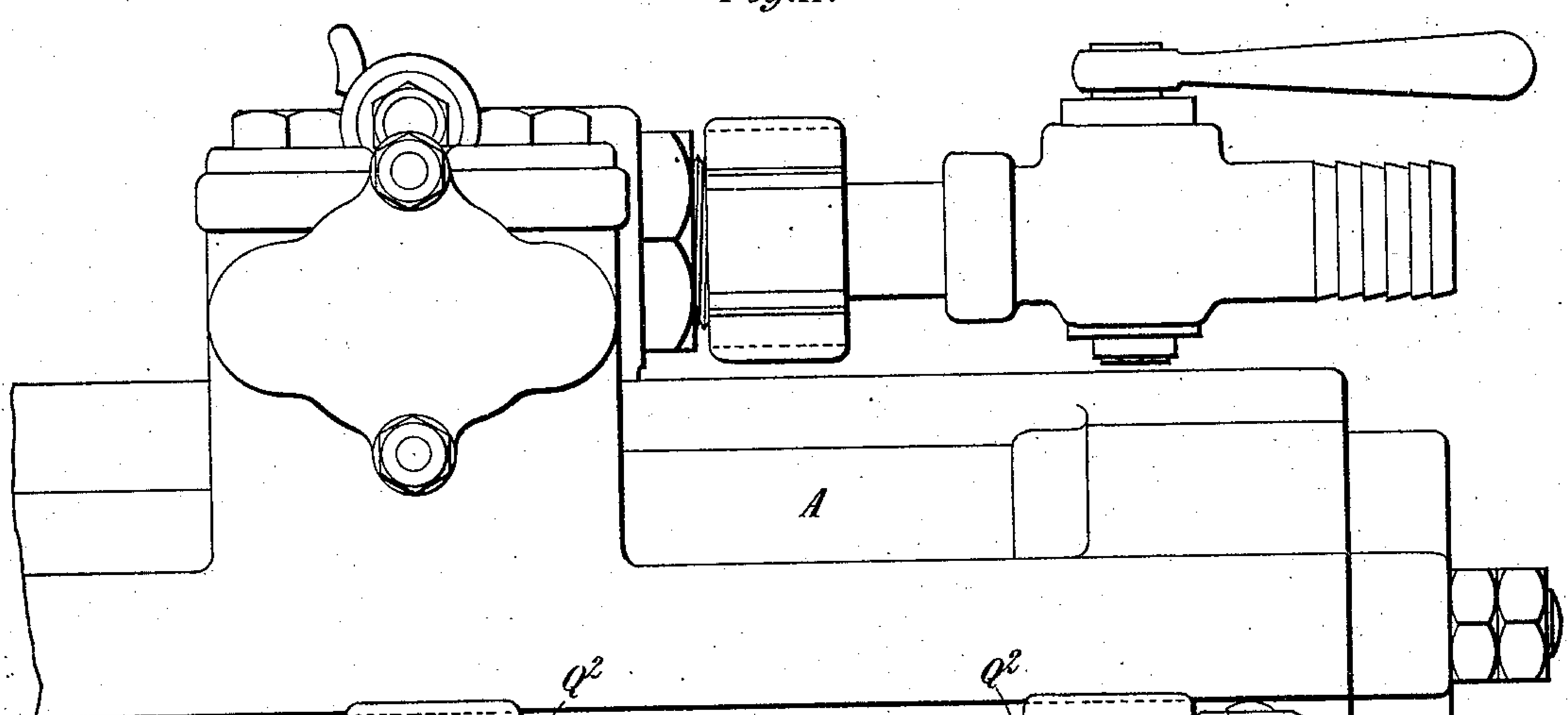


Fig. 11.



Witnesses.
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THE NORRIS PETERS CO., PHOTO-LITHO., WASHINGTON, D. C.

UNITED STATES PATENT OFFICE.

JAMES McCULLOCH, OF WOLVERHAMPTON, ENGLAND.

ROCK-DRILL.

SPECIFICATION forming part of Letters Patent No. 575,970, dated January 26, 1897.

Application filed September 30, 1895. Serial No. 564,185. (No model.) Patented in England September 17, 1894, No. 17,659.

To all whom it may concern:

Be it known that I, JAMES McCULLOCH, engineer, a subject of the Queen of Great Britain, residing at Bella Vista, Wolverhampton, England, have invented certain new and useful Improvements in Rock-Drills, (for which I have obtained a patent in Great Britain, No. 17,659, dated September 17, 1894,) of which the following is a specification, reference being had to the accompanying drawings.

My invention relates to rock-drills, and comprises the improvements hereinafter described.

According to one part of my invention I provide improved means for preventing the rotation of the twist-bar during the backward stroke of the drill. The chief feature of this part of my invention relates to the provision of a twist-bar which can move axially as well as rotate in the drill-casing. It is by the axial movement of the twist-bar that the locking and unlocking of the said bar is effected.

According to other parts of my invention I provide an improved holder for the tool or "bit" and an improved device for easily and readily clamping the drill-casing at any desired angle.

My invention further comprises improved means for taking up slack due to the wear of the guides, feed-screws, and nuts of the rock-drill and for lessening the jar given to the operator by the shocks caused by the recoil of the drill.

My invention also has as a further object the construction of an improved valve for controlling the admission and exhaust of the working fluid. An important feature of this part of my invention is the novel means which I employ to actuate the valve by the working fluid in the cylinder.

In order that my invention may be clearly understood, I will now describe the same with reference to the accompanying drawings, in which—

Figure 1 is a longitudinal central section through the drill-casing and parts contained therein. Fig. 2 is a transverse section taken on the line x x of Fig. 1. Fig. 3 is a section on the line y y, Fig. 2. Fig. 4 is a central longitudinal section through the rear end cover of the drill-casing, showing a modification hereinafter described. Fig. 5 is a longitudinal section through the cylinders for operating the valve, showing a modification hereinafter described. Fig. 6 is an elevation of my improved holder for the bit or tool. Fig. 7 is a section on the line z z of Fig. 6. Fig. 8 is a central transverse section of my improved clamp. Fig. 9 is a plan, and Fig. 10 is a side elevation, of the clamp. Fig. 11 is a side elevation of a portion of the drill-casing, showing the device for preventing the wear of the guides. Fig. 12 is a transverse section of a modified form of valve and ports.

A is the drill-casing.

B is the twist-bar.

C is the piston of the drill.

I provide the rear end of the twist-bar with a head B′, having teeth or projections B^2, of any suitable form, secured thereto or formed integrally therewith. The said head works in a chamber A^0, formed in the rear end cover of the drill-casing, and is capable of a limited axial movement in said chamber to lock and unlock the twist-bar. D is a toothed gear so fitted to the said rear end cover of the casing A that it cannot turn. It is adapted to engage with the teeth B^2 when the twist-bar is in its rearmost position. When the teeth B^2 are engaged with the gear D, the twist-bar B cannot rotate in either direction.

At the commencement of the forward stroke of the drill the friction between the twist-bar B and the twist-nut F of the piston C, through which the twist-bar passes, causes the latter to move forward, whereupon the teeth B^2 become disengaged from the gear D and the twist-bar is then free to rotate. During the backward stroke of the drill the twist-bar is moved backward by the friction between it and the twist-nut and its teeth B^2 are caused to reëngage with the stationary gear D, by which means the twist-bar is again locked. The drill will thus be caused to turn during its backward stroke, but will be free to move without turning during its forward stroke.

I sometimes provide that the working fluid in the cylinder A′ shall assist the friction between the twist-nut F and the twist-bar B to disengage the teeth B^2 from and reëngage the same with the stationary toothed gear D. For this purpose I provide suitable passages or channels G G′ in the casing. The channel G communicates with the port leading to the rear end of the cylinder and with the space between the gear D and head B′, and the channel G′ communicates with the cylinder at a point near the forward end thereof and with the chamber A^0 at a point in front of the head B′. During the forward stroke of the drill the working fluid enters the passage G and acts on the rear face of the head B′ of the twist-bar, thus causing the said head and bar to move forward. During the backward stroke of the drill the fluid enters the passage G′ and acts on the front face of the twist-bar head and so causes the bar to move backward. In this manner the twist-bar is locked during the backward stroke of the drill and unlocked during the forward stroke.

I sometimes form the teeth B^2 on a conical-shaped head B′, adapted to engage with a correspondingly conical-shaped gear D, as shown in Fig. 4.

My improved holder E, Figs. 6 and 7, for the tool, drill, or bit is provided with a key-way E′, formed in the side of the socket in which the tool or bit H is held. The said keyway is made of increasing depth from the forward to the rear end, and it is fitted with a corresponding taper-key or wedge J. At the rear end of the key is an extension J′, that projects through an opening in the rear end of the holder. By striking the end of the extension J′ the tool will be wedged tightly in the holder and be thereby very firmly held in position. It can be easily released again by striking the opposite end of the wedge, which projects from the front end of the holder.

Figs. 8, 9, and 10 illustrate my improved clamp for easily and readily fixing a rock-drill to work at the different angles required. It is constructed as follows, that is to say: The clamp, which can slide and rotate on the bar or stand of the rock-drill, is furnished with a fixed jaw L and a movable jaw L′, between which is received the projecting foot A^3, Fig. 1, provided on the cradle A^2 of the rock-drill. A tapered keyway M is formed in the clamp, and a wedge N, sliding in the said keyway, serves for tightening the clamp on the bar. A stud N′, which projects into a slot or groove N^2 in the wedge N, serves to prevent the accidental loss of the wedge.

The hole P that receives the bar of the rock-drill is not truly cylindrical, but about half the area of the hole, and preferably that part in which the keyway for the wedge is located forms part of a cylinder of larger diameter than the remaining portion of the hole, as shown in Fig. 8. The clamp can then be readily applied to and tightened on a bar which is not truly cylindrical and which does not fit the hole P in the clamp. The necessity of having a truly cylindrical bar is thereby avoided. The jaw L′ of the clamp is pivoted at L^2 and is supported by a conical bolt O, which fits an inclined curved recess L^3, formed in the back of the jaw. The ends of the bolt O are parallel or cylindrical and they are received in lugs or ears O′, formed on the body of the clamp. One end of the bolt is screw-threaded and screws into the corresponding lug O′ for the purposes of adjustment. When the bolt is screwed into the clamp, the jaw L′ is pressed tightly against the foot A^3 of the cradle A^2 of the drill, which is thereby firmly secured between the two jaws. By unscrewing the bolt O the foot of the cradle is again released.

O^2 is a chain attached to the bolt to prevent loss of the same.

Figs. 2 and 11 show my improved means for taking up slack due to the wear of guides, feed-screws, and nuts in a rock-drill, and also for lessening or preventing the jar occasioned at the handle of the operating mechanism by the recoil of the drill. According to this part of my improvements I construct the feed-nuts Q, Fig. 2, for the feed-screw R and the bushes Q′ Q′, Figs. 2 and 11, for the guide R′ of a conical shape and split them longitudinally at Q^2. The said nuts Q and the bushes Q′ Q′ are received in corresponding conical recesses S S, formed in projecting parts or lugs T T of the drill-casing. The large ends of the conical bushes and nuts face each other, as indicated with respect to the bushes in Fig. 11. I interpose a spiral spring U between the bushes Q′ Q′ on the guide R′ and a similar spring between the feed-nuts Q, which are on the other side of the casing and not shown in Fig. 11. The spiral springs U operate to deaden or diminish the force of the shock or jar and to automatically take up any slack in the aforesaid nuts and bushes.

In carrying into practice that part of my invention which relates to an improved valve for controlling the admission and the exhaust of the working fluid to the cylinder A′ of the drill I construct the valve V, Figs. 1 and 2, of cylindrical form, and I arrange it to work in a cylindrical chamber W, formed in the drill-casing A. The axis of said chamber is preferably perpendicular to the direction of motion of the piston C.

The chamber W forming the valve-seat is in the construction shown in Figs. 1 and 2 provided with three openings or ports W′ W^2 W^3 in the wall thereof. The port W′ communicates with the fluid-chest W^0. The other two ports W^2 W^3 communicate by passages one to one end and the other to the other end of the working cylinder A′. The valve V is provided with exhaust-ports V′ V^2, that communicate with a common outlet V^4, and it is also provided with an admission port or passage V^3. The ports are so arranged that in one position of the valve, as shown in the drawings, Fig. 1, a communication is opened between the port W^3, leading to one end of the cylinder A′, and the fluid-chest W^0 through the passage V^3 in the valve, while the port W^2, leading to the other end of the cylinder, is open to the exhaust through the port V′ in the valve. In another position of the valve the fluid-chest W^0 is in communication with that end of the cylinder which was before open to exhaust and the opposite end of the cylinder is open to exhaust.

It is obvious that the exhaust from the cylinders Z Z′ takes place simultaneously with that from the two ends of the working cylinder A′.

In a modification shown in Fig. 12 the valve chamber or seat has six openings or ports in the side thereof. Two of the said ports—viz., W′ and W*—communicate directly with the fluid-chest W^0, the two ports W^2 and W^3 communicate with the opposite ends of the working cylinder A′, as before, and the two remaining ports W^4 and W^5 are exhaust-ports. The valve is provided with ports V′, V^2, and V^3, of which V′ and V^2 are in communication with one another. The passages are so arranged that in one position of the valve, as shown, a communication is opened between the port W^3, leading to one end of the cylinder A′, and the fluid-supply port V^3, while the port W^2, leading to the other end of the cylinder, is open to the exhaust-port W^5 through the ports V′ V^2 in the valve. In another position of the valve the port W^3, which was formerly opened to the supply-port V^3, is then opened to the second exhaust-port W^4, and the port W^2, which was in communication with the exhaust-port W^5, is open to the supply-port V^3. Hence when the motive fluid is being admitted to one end of the cylinder the other end of the cylinder is in communication with the exhaust. On the valve being turned to its second position the working fluid is admitted to the opposite end of the cylinder and the first-named end is opened to the exhaust.

For working the valve I provide small cylinders Z Z′, Fig. 3, having pistons *c c′* working therein and also having ports or passages *a a′*, which communicate with the working cylinder A′. The valve is provided with wings or arms *d d′*, that project above the pistons *c c′* and that are operated by said pistons when the latter move up and down. When the piston C in the working cylinder A′ approaches the end of its forward stroke, it uncovers the passage *a* and allows the working fluid to enter the cylinder Z and act on the small piston *c* therein. The said piston *c* is thereby raised and caused to act on the arm *d* of the valve and thus turn the valve. When the piston C in its backward stroke uncovers the other passage *a′*, (the passage *a* being then closed,) the piston *c′* of the cylinder Z′ is raised and caused in the same manner to turn the valve V in the opposite direction. The ends of the passages *a a′* indicated by dotted lines in Fig. 1 are really in front of the plane of section.

I sometimes provide only one arm or wing *d* on the valve, as shown in Fig. 5, and I then place the two cylinders Z Z′ on opposite sides of the said arm, so that the pistons *c c′* of the cylinders Z Z′ may act alternately on the said arm, but in opposite directions.

I may employ more than two cylinders such as Z Z′.

The arms or projections are secured or made solid with the valve in such a manner that the valve will be balanced and will only alter its position when positively operated. Such a balanced valve will work equally well in any position and angle at which a rock-drill may be required to be worked.

My improved valve is not subject to much or uneven wear, since it has a rotary reciprocating motion in place of a sliding reciprocating motion. Moreover, the valve may be easily constructed of such a design as will enable a drill to be made short and light, which are attributes of especial advantage in rock-drills.

What I claim is—

1. In a rock-drill, the combination with the casing, and the drill-spindle, of a twist-bar capable of a rotary and a limited axial movement in the casing, a toothed gear fixed on the rear end of said twist-bar, and a non-rotatable, stationary gear D supported in the casing and adapted to lock the twist-bar when the latter is pushed backward, and to become disengaged therefrom when said twist-bar is pushed forward or outward, substantially as described.

2. In a rock-drill, a tool-holder consisting of a head E furnished with a taper-keyway E′ smallest at the forward end, and a wedge or key J which projects from the head at the forward end and has a prolongation J′ at the rear end projecting through an opening in the rear end of the head, substantially as described.

3. In a rock-drill, the combination with the casing and cradle, of a clamp having a keyway M in the opening P for the drill-bar, the key N, the fixed jaw L, the movable jaw L′ having in its back the recess L^3, and the bolt O working in the lugs O′ to support and adjust said movable jaw between which and the fixed jaw is received the foot of the cradle, substantially as described.

4. In a rock-drill, the means for taking up slack due to the wear of the feed-screws, guides and bushes, and for preventing jar at the handle of the operating mechanism, said means consisting of split conical feed-nuts Q for the feed-screw and bushes for the guides, received in conical lugs formed on the drill-casing and having their large ends facing each other, and a spiral spring interposed between said large ends substantially as described.

5. In a rock-drill, a balanced circular valve V adapted to oscillate in a valve-chamber without gland or bushing about an axis at right angles to the axis of the working cylinder, wings or arms integral with the valve, pistons *c*, *c′* adapted to control the said arms

but not connected thereto, cylinders Z, Z′ in which the pistons work, and ports or passages forming communications between the said cylinders Z, Z′ and the working cylinder A′, said ports being opened and closed alternately by the movements of the main piston C, substantially as described.

In testimony whereof I have hereunto set my hand this 5th day of September, 1895.

JAMES McCULLOCH.

Witnesses:
SIMON ROBERTS,
WILLIAM G. COOPER.