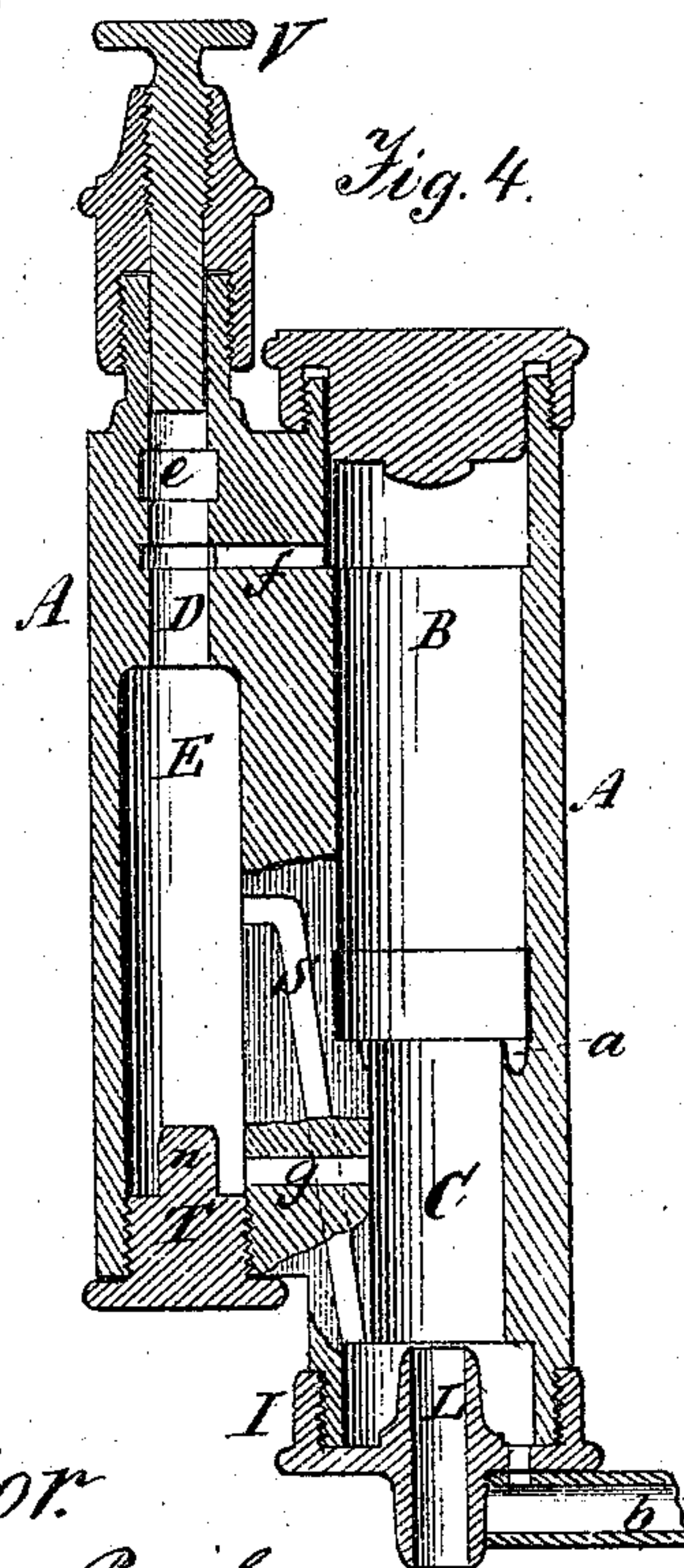
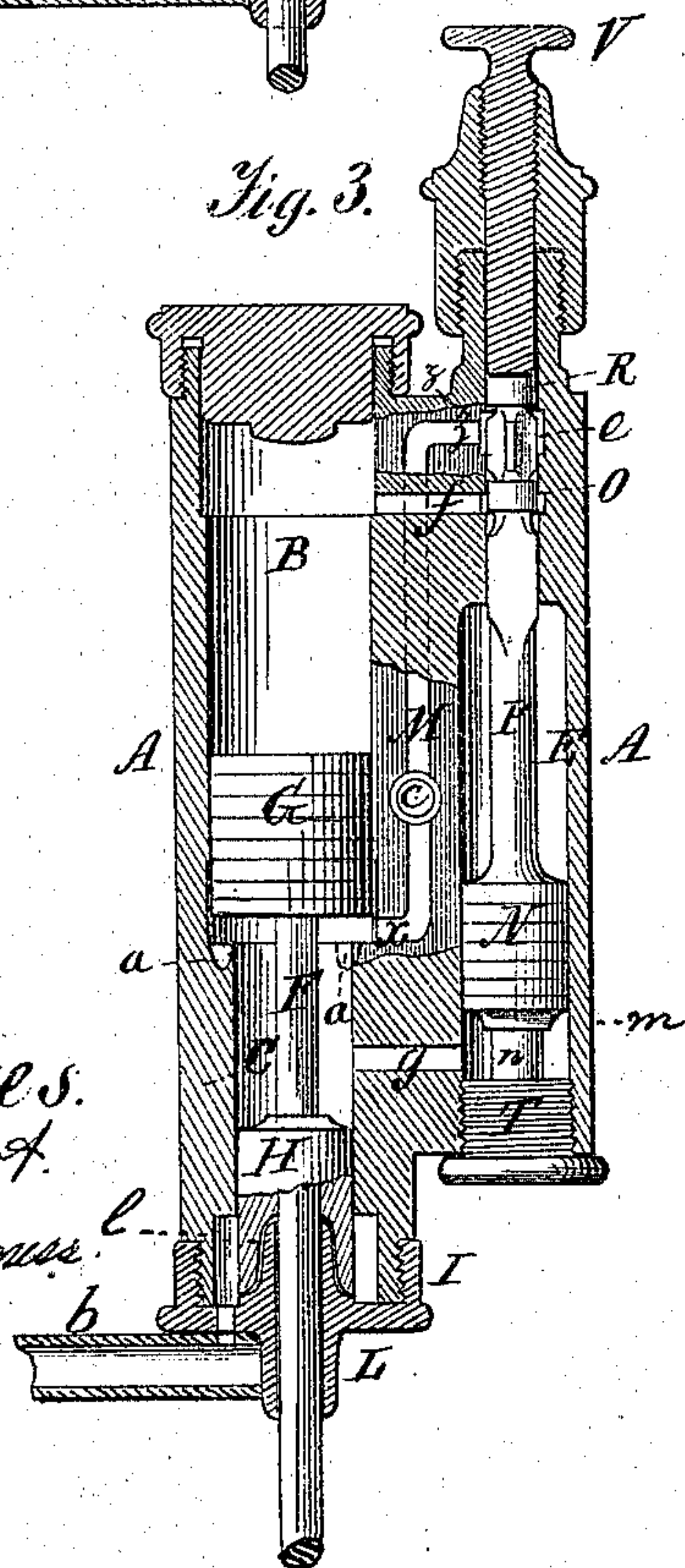
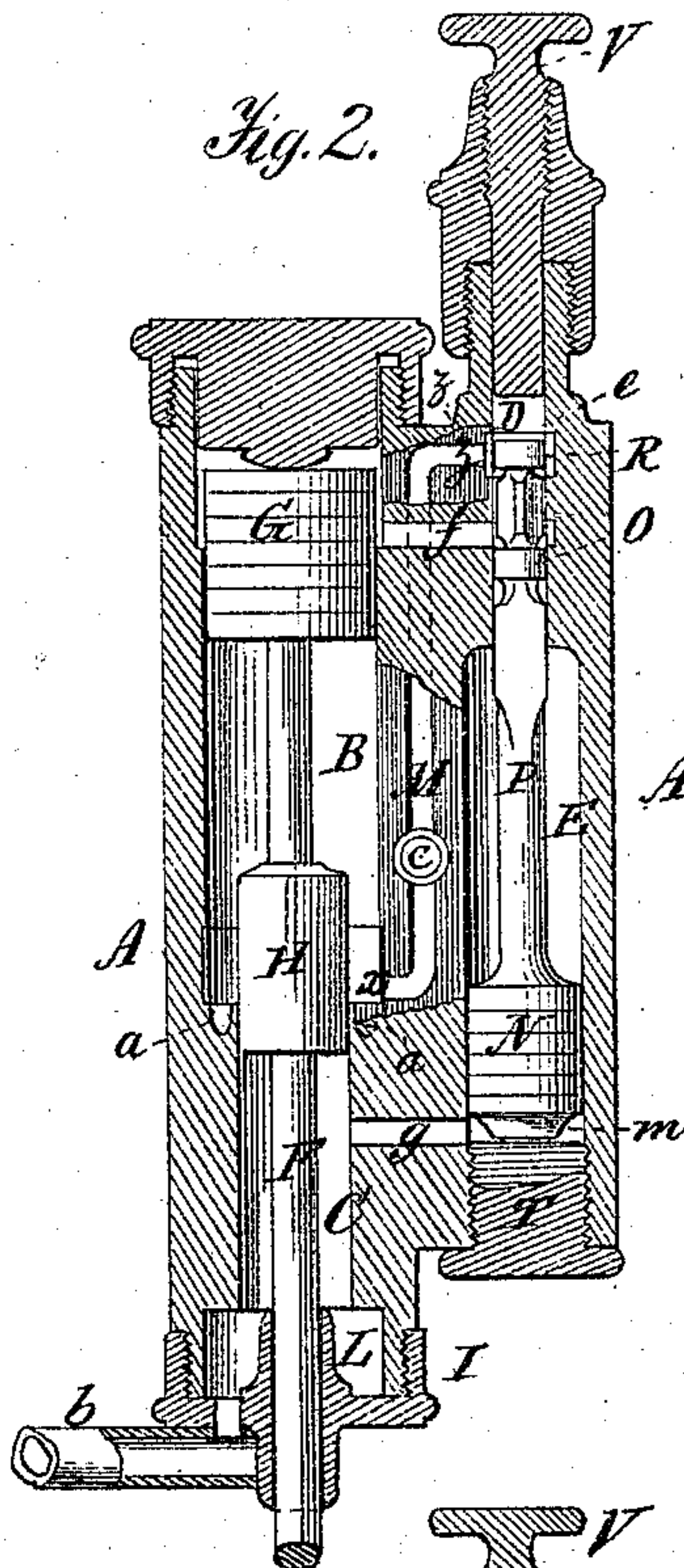
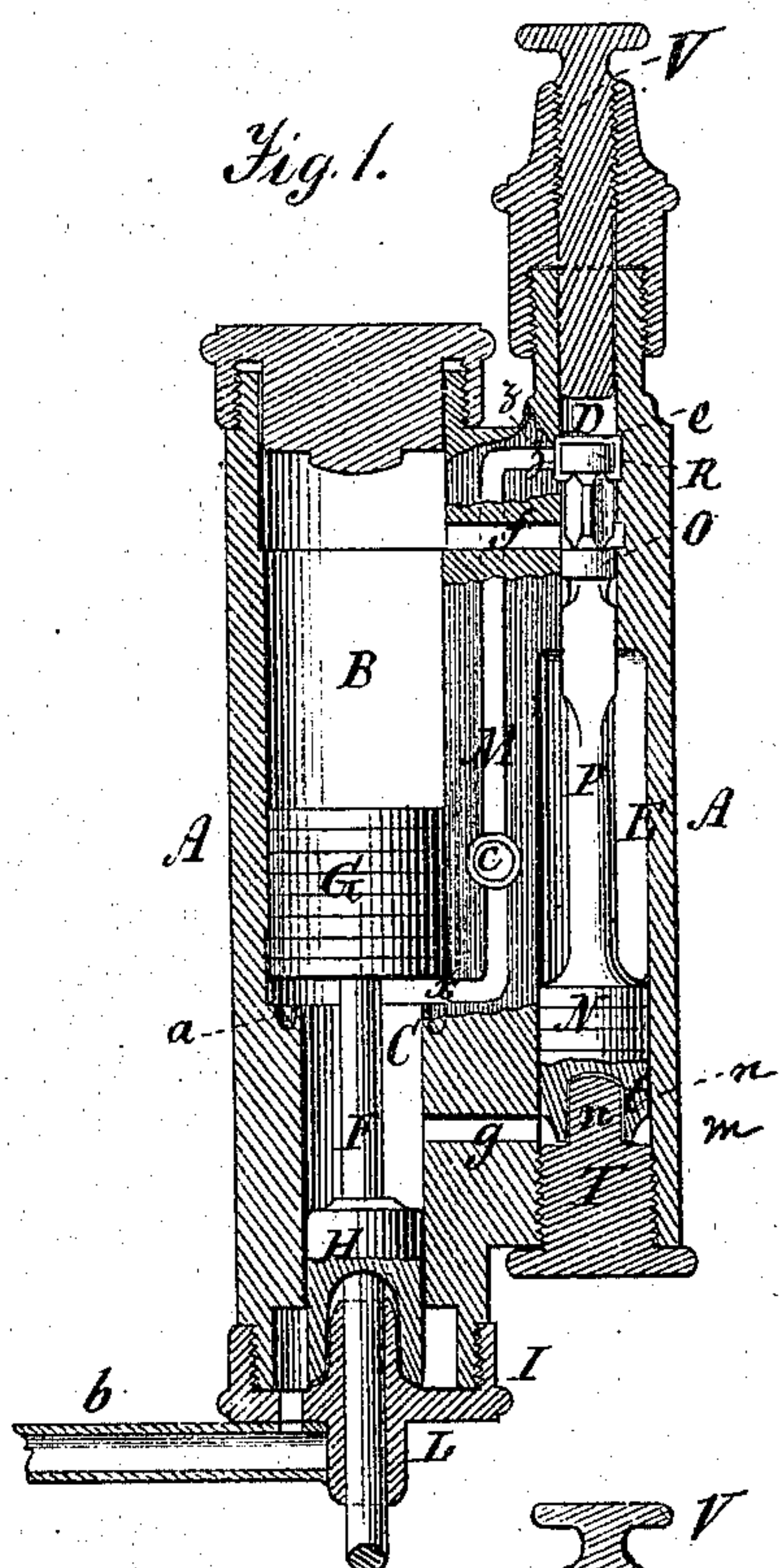


J. BAILEY.
Direct Acting Steam-Engines.

No. 136,806.

Patented March 18, 1873.



Witnesses.

A. Ruppert.

W. H. Rouse.

Inventor.

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by his attys.

Cox and Cox

UNITED STATES PATENT OFFICE.

JOHN BAILEY, OF QUINCY, ILLINOIS, ASSIGNOR OF ONE-HALF HIS RIGHT
TO HENRY BREITENSTEIN, OF SAME PLACE.

IMPROVEMENT IN DIRECT-ACTING STEAM-ENGINES.

Specification forming part of Letters Patent No. 136,806, dated March 18, 1873.

To all whom it may concern:

Be it known that I, JOHN BAILEY, of Quincy, Illinois, have invented certain new and useful Improvements in Direct-Acting Steam-Engines, of which the following is a specification, reference being had to the accompanying drawing.

Nature and Objects of the Invention.

The invention relates to a steam-engine provided with cylinders, two of which are auxiliary to the others, and all so arranged and constructed that by the direct action of the steam or other motive agent the piston-head and the auxiliary piston are elevated, the former being connected with a valve of smaller diameter, which, when the piston reaches its altitude, opens the port connecting the lower part of the lower cylinders through which escapes the steam that has elevated the auxiliary piston, by the elevation of which the steam admitted into the upper auxiliary cylinder is compressed above its head, which is of less diameter than the piston at the lower end of the rod to which it is secured. This compressed steam acting upon the head of the rod forces the same downward, owing to the fact that it operates upon a greater surface, and the peculiar construction of this part of the device, and the arrangement of the cylinders in which it moves as this auxiliary rod descends, being provided with a valve properly located therefor, the port connecting the upper cylinders is opened, whereby steam is admitted from the upper auxiliary cylinder, which, acting upon the head of the piston, and assisted by the pressure of the steam upon the valve connected therewith, forces the piston and piston-rod down, and when its valve passes the port connecting the lower cylinders it opens the same, admitting steam into the lower auxiliary cylinder, which elevates the piston therein, thus operating the valve near its upper end, opening the port connecting the upper and its auxiliary cylinders, affording the steam above the piston-head an escape, and allowing it to be elevated by the action of the steam upon its under surface, as first aforesaid, thus producing a regular reciprocating motion of the piston-rod. The principle of the invention is the operation of pistons against equal pressure by means of excess of

differential surface. The invention further relates to providing a piston with an aperture or pocket which fits loosely over a bumper in the head of the cylinder, the pocket becoming filled with steam or vapor in the operation of the piston. When the pocket therein passes over the bumper the steam is compressed in the pocket, preventing concussion. The invention also relates to providing a piston-rod with a cone serving to strip it of the moisture gathering thereon, and avoid the employment of packing. The invention also relates to providing a cylinder with a movable head arranged to regulate its stroke by limiting the space between the heads of the cylinder and piston, within which the steam is compressed by the action of the latter.

Description of the Accompanying Drawing.

Figure 1 is a longitudinal central section of a device embodying the elements of the invention, showing the pistons, valves, &c., in their initial position, certain parts being broken out to exhibit the delivery-conduit M and the pocket in the piston N. Fig. 2 is a similar view of the same, showing the pistons G and N respectively elevated and depressed. Fig. 3 is a similar view of same with the pistons G and N respectively depressed and elevated. Fig. 4 is a similar view of that part of the device opposite the part shown at Fig. 1, certain parts being broken out to exhibit the escape-conduit S.

General Description.

A, in the accompanying drawing, is a cylinder-casting, in the present instance formed of one piece of material, provided with the cylinders B C D and E. The cylinder B is of greater diameter than the cylinder C, which opens into it at one end, both cylinders being of relatively proper size and having the axes of their bores coincident. The upper and lower parts of the cylinder B are properly recessed, and said cylinder has its lower horizontal face provided with the annular recess *a* to admit steam below the base of the head G should it descend upon the cylinder-head. The piston-rod F operates in the cylinders B and C, and is provided at its upper end with the piston-head G working in the cylinder B, and at a proper distance below with the valve H work-

ing in the cylinder C, the diameter of the piston G being greater than that of the valve H, and both secured rigidly upon the rod F. The extremity of the rod F opposite that to which the head G is attached passes through the cylinder-cap I, and may be secured in any suitable manner to utilize its stroke. The cylinder-cap I is provided with the escape-pipe *b* and the cone L, the axis of the latter coinciding with that of the rod F, which passes through the cone and is guided thereby, and also stripped of any moisture collecting upon it. The cone L also serves to prevent the escape of the steam from the cylinder C, thus obviating the use of packing. The interior of the cap I forms an exhaust space.

The valve H is constructed with a cylindrical opening of suitable dimensions in its lower portions, which opening or pocket *l* fits loosely over the cone L when the valve is depressed. The upper end of the cylinder B is closed in any desired manner. The cylinder B is connected by the channel or conduit M, which receives the steam through the pipe *c* with the cylinder D. This conduit passes upward in any desired manner, and has its lower mouth or vent *x* directly above and in close proximity to the upper surface of the lower cylinder-head of the cylinder B, its upper mouth Z opening at the center of the steam-space *e* near the top of the cylinder D. The cylinder B is also connected with the cylinder D by the steam-port *f*, the latter cylinder being properly recessed opposite the mouth of the port. The lower part of the cylinder C is connected with the cylinder E by the steam-port *g*, both cylinders being properly recessed opposite the mouths of the port. The cylinder E is of greater diameter than the cylinder D, which opens into it at one end, both cylinders being of relatively proper size, and having the axes of their bores coincident. The rod P operates in the cylinders E and D, and is provided at its lower end with the piston N having the pocket *t* in its lower portion. The piston N works in the cylinder E, and has its lower surface provided with the annular bevel or recess *m*, which prevents the piston from stopping the port *g*. The upper extremity of the rod P is provided with the head R, below which and the valve O the rod P is properly reduced to allow a passage of steam between it and the cylinder. The head R works in the cylinder D, and is of the same diameter as the valve O, but of smaller diameter than the piston N, which, with the head R and valve O, is rigidly secured at its center to the rod P, the axis of which coincides with that of the cylinders E and D. The cylinder D is provided with the steam-space *e*, so placed that when the steam is being received through the mouth Z into the cylinder D the head R is situated at, or about at, the center of the space *e*. The cylinder E is connected with the exhaust-space in the cap I at the base of the cylinder C by the escape-pipe S, and has its head provided with the bumper T, so placed and constructed as to en-

ter closely the pocket *t* in the base of the piston N. The movable head V of the cylinder D consists of a piece of material fitting closely in the bore of the cylinder, and is provided with a packed screw or any other suitable appliance, by means of which it may be elevated or depressed.

Operation.

The device being in the initial position shown at Fig. 1, steam is admitted through the pipe *c* into the conduit M, whence it issues into the cylinder D through the mouth Z, and into the cylinder B through the mouth *x*. In the latter cylinder it acts directly upon the upper surface of the valve H and the lower surface of the piston-head G; the latter area being the larger, the rod F and its connections are elevated. Simultaneously with its passage into the cylinder B the steam passes through the port *g* into the cylinder E, acting upon the lower surface of the piston N. Synchronously with the foregoing the steam passes from the mouth Z into the steam-space *e* in the cylinder D, acting upon the upper surface of the valve O and the lower surface of the head R; but as the area of surface exposed to the upward action of the steam is greater than that exposed to its downward pressure, the rod P and its connections are elevated, the diameter of the valve O being less than the combined diameters of the head R and piston N. The operation of elevating the rod P continues until the valve H passes the mouth of the port *g*, through which the steam below and sustaining the piston N passes into the cylinder C below the valve H, escaping thence into the exhaust-space in the cap I and out of the pipe *b*, leaving the cylinder E empty below the piston N. Now, the steam admitted into the cylinder D through the mouth Z has, by the elevation of the head R, been compressed in the cylinder between the head R and the movable cylinder-head V. This steam now acts, and, from the fact that the steam acting in all directions presses equally upon the under surface of the head R and the upper surface of the valve O, there results an equilibrium of pressure, which is overcome by the excess of pressure exerted upon the greater area of the upper surface of the head R, whereby the rod P and its connections are forced downward; such steam as issues from the mouth Z while the rod is descending, and enters the cylinders D and E, escaping through the conduit S. Thus the rod P and its connections descend without interruption. When, in the descent of the rod P, the valve O passes the mouth of the port *f*, it prevents the steam admitted through the mouth Z from passing down the cylinder D, and, as a consequence, it pours through the port *f* into and about the recess in the upper part of the cylinder B, acts upon the upper surface of the piston-head G, forcing it and the rod F downward—this for the reason that the steam acts upon the lower surface of the head G to force the rod upward, while it acts upon the upper surface of the same, and also

upon the upper surface of the valve H, to force the rod downward; hence, as there is an excess of area, equal to the said surface of the valve H, subjected to a downward pressure, that prevails and the rod F descends. When in the said descent of the rod F the valve H passes the mouth of the port *g* steam is admitted through the same, elevating the piston N and rod P, whereby the valve O is forced to a position just above the recess opposite the mouth of the port *f*, thus preventing an entrance of steam from the steam-space *e*, and at the same time affording an exit for the steam in the upper part of the cylinder B, which passes through the port *f*, thence down the cylinder D, between it and rod P, into the cylinder E, finally escaping through the escape-pipe S; then the steam acting as first aforesaid elevates the piston-head G, and the above-specified operations are repeated and continued so long as steam is admitted through the pipe *c*. In the descent of the piston N a certain amount of steam and vapor is caught in the pocket *t* in the base thereof, which steam and vapor are compressed between the top of the pocket and the bumper T as the piston descends, thus preventing a concussion of these parts, while the steam compressed by the elevation of the heads G and R subserves a similar purpose as to those parts, the constant pressure of steam upon the lower surface of the head G preventing its striking its cylinder-head.

It is obvious from the foregoing that the rod F will rise and descend regularly, while the rod P will have an irregular intermittent movement, rising and descending with every elevation and descent of the rod F. It is also obvious that the stroke of the rod P may be lengthened or shortened, and accordingly quickened or slackened, by respectively elevating or depressing the movable cylinder-head V, operated by the screw W, as this respectively increases or diminishes the space between it and the head R, within which the steam is compressed when the latter passes above the steam-space *e*.

It is obvious that the space formed by the cylinders B C, and that formed by the cylinders D E, may be in close relation, as in the present instance, or may be formed so as to be placed a distance apart; also that the cylinders D E, with their accompanying devices, may be attached to and operate the rods F of several cylinders B C.

The escape-pipe S may lead directly through the wall of the cylinder E, or be arranged in any other suitable manner, so as to afford an escape for the steam passing into the cylinder E from the cylinder D.

It is further evident that the same devices, herein specified, will operate with equal facility in a horizontal position, the term vertical

and terms co-relative therewith having been adopted herein only to facilitate description.

Claims.

1. The cylinders D and E, provided with the adjustable cylinder-head V, in combination with the rod P, piston N, and head R, substantially as shown and described.
2. The cone L, valve H, provided with the pocket *l*, in combination with the piston-rod F and cylinder C, substantially as shown and described.
3. The cylinder B, provided with the annular groove *a*, in combination with the piston-head G and conduit M, substantially as shown and described.
4. The cylinders B and C, in combination with the rod F, piston G, and valve H, substantially as shown and described.
5. The piston-rod P, having its surface so reduced as to allow a passage of steam between the head R and valve O, and below the latter, arranged relatively to the cylinder D, conduit M, and port *f*, substantially as shown and described.
6. The piston-head N, provided with the annular recess *m*, in combination with the port *g* and bumper T, substantially as shown and described.
7. The loose valve, consisting of the piston N, with pocket *t*, rod P, valve O, and head R, in combination with the head V and bumper T, and arranged in the cylinders E D, provided with the ports *f* and *g*, conduit M, and escape-pipe S, substantially as shown and described.
8. The arrangement of the conduit M and escape-pipe S and ports *g* and *f*, in relation to the several cylinders, substantially as shown and described.
9. The combination of the cylinders B C with the cylinders D E, arranged substantially as shown and described.
10. The rod F, provided with the valve H and piston G, in combination with the rod P, provided with the piston N and valve O, and the several cylinders, the conduit M, escape-pipe S, and ports *g* and *f*, substantially as shown and described.
11. The cylinder D, provided with the space *e*, and arranged relatively to the head R, valve O, ports *f* and *g*, substantially as shown and described.

In testimony that I claim the foregoing improvements in direct-acting steam-engines, as above described, I have hereunto set my hand and seal this 11th day of November, 1872.

JOHN BAILEY. [L. S.]

Witnesses:

HARRY COX,
THOS. T. WOODRUFF.