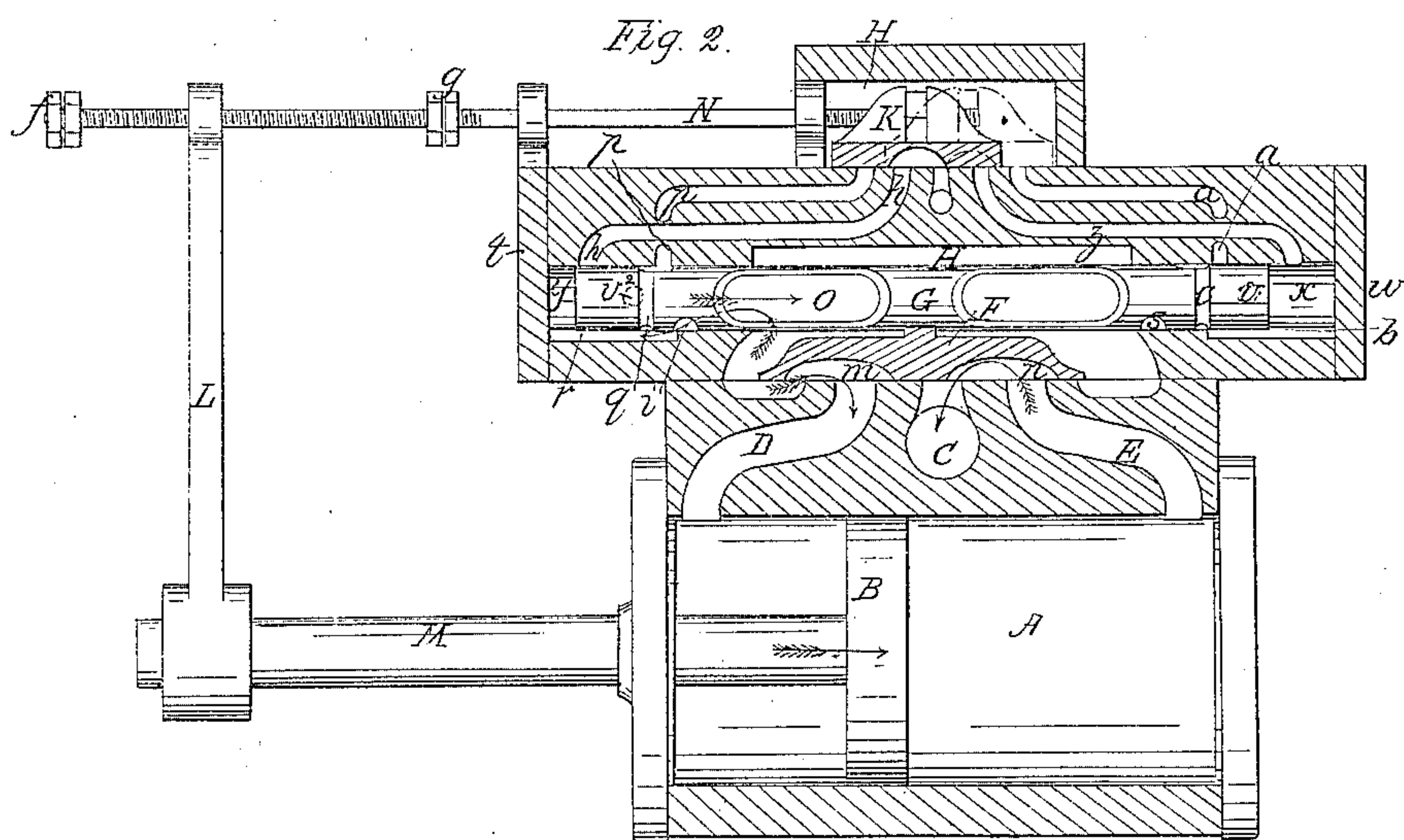
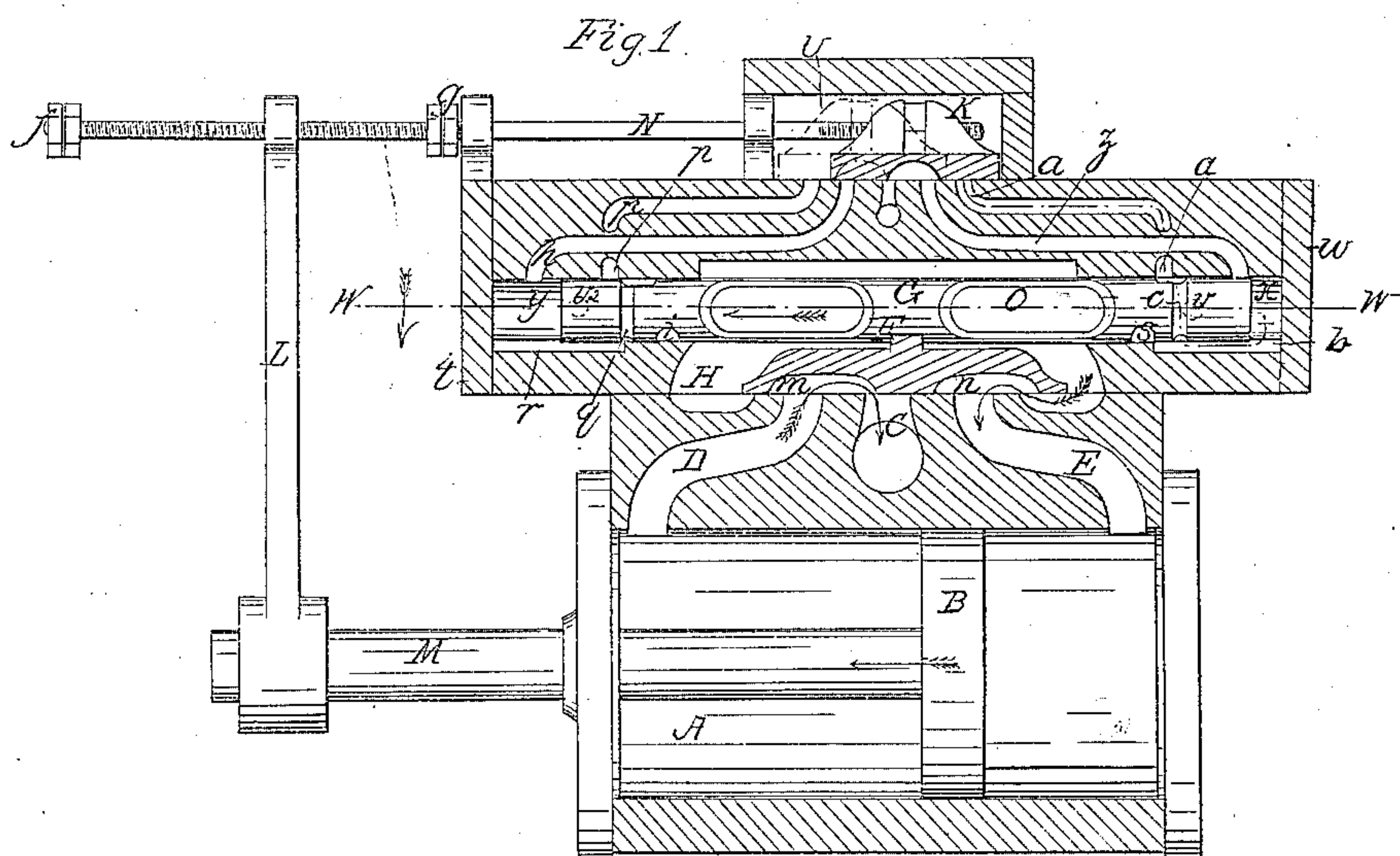
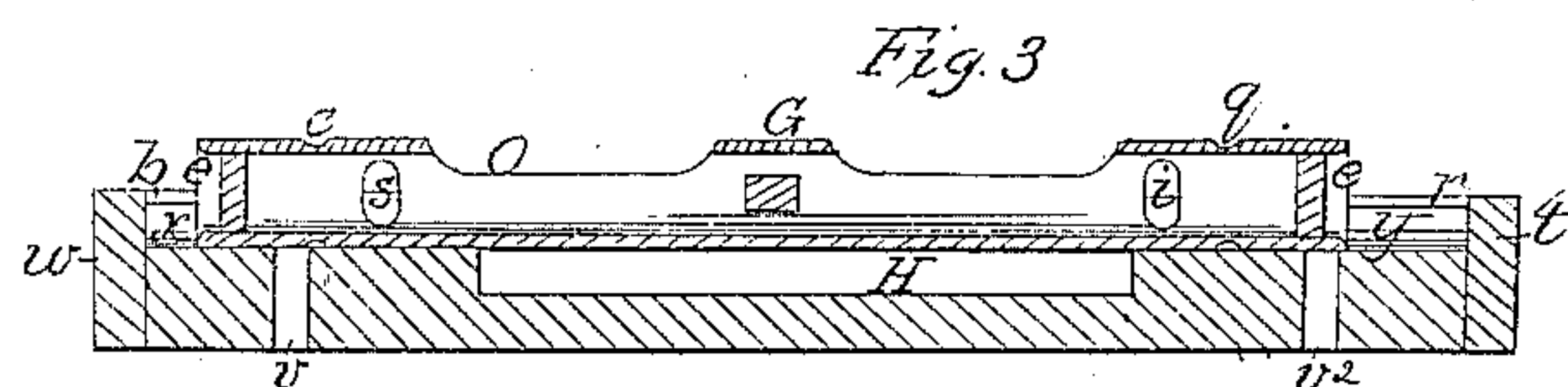


L. J. Knowles,
Steam Slide Valve.

N^o 22,503.

Patented Jan. 4, 1859.



UNITED STATES PATENT OFFICE.

L. J. KNOWLES, OF WARREN, MASSACHUSETTS.

METHOD OF OPERATING THE VALVES OF PUMPING-ENGINES.

Specification of Letters Patent No. 22,503, dated January 4, 1859.

To all whom it may concern:

Be it known that I, LUCIUS J. KNOWLES, of Warren, in the county of Worcester and State of Massachusetts, have invented an
5 Improved Method of Operating the Valves of Pumping-Engines, of which the following is a full, clear, and exact description, reference being had to the accompanying drawings, making part of this specification,
10 in which—

Figures 1 and 2 are longitudinal sections taken through the steam cylinder, steam chest, and the steam and exhaust passages, the parts B, M, L, N, *f*, *g*, G, and the cylinder heads being shown in elevation; Fig.
15 3 a section upon the line W, W, of Fig. 1.

In pumping engines for feeding steam boilers it is desirable that the valves be so arranged that the engine may start itself
20 automatically whenever steam is admitted to the steam chest and whatever may be the position in which the piston or the valves are left, and my invention has for its object to accomplish this desirable end.

25 To enable others skilled in the art to understand my invention I will proceed to describe the manner in which I have carried it out.

In the said drawings, A, is the steam cylinder, B, the piston, C, the exhaust and D, and E, the steam passages, F, the slide valve which controls the main piston B, and to which is attached a hollow plunger G that slides longitudinally in a cylinder bored for
35 the purpose in the steam chest H.

Attached to the main steam chest H, is an auxiliary steam chest I, in which slides the valve K. This valve is actuated by means of an arm L, attached to the piston rod M, through which passes the rod N attached to the valve. As the piston B, reaches either end of its stroke the arm L, strikes one or other of the adjustable nuts *f*, *g* upon the rod N, and the valve K, is moved as will
45 presently be described.

Steam being admitted to the chests H, and I, and the parts being in the position represented in Fig. 1, the steam passes beneath the valve F, through the port E, to
50 the main cylinder, the other end of which exhausts through the port D, and the piston B is driven in the direction of its arrow. On the piston arriving near the end of its stroke the arm L strikes against the nut *f*,
55 and moves the valve K, into the position seen in red (Fig. 1). Steam from the chest

I, (as seen by the red line in Fig. 1,) now passes through the induction port *a*, the annular passage *c*, around the plunger and the auxiliary passage *b*, to the space *x*, to the
60 right of the plunger, and the space *y*, at the other end of the plunger is exhausted through the passage *h*. The plunger is thus thrown into the position shown in Fig. 2, carrying with it the valve F, so as to open
65 the steam port D, and the exhaust from the opposite end of the cylinder A.

In order to arrest the plunger before it shall be thrown against the head of its cylinder and to prevent the noise and destruction
70 of parts consequent upon such continued hammering, I have devised the following peculiar arrangement of the steam and exhaust passages which govern its motion: On reaching the point which it occupies in Fig.
75 2, it will be observed that it has itself cut off the steam way *a* whereby the further entrance of steam into the space *x*, is prevented and that the exhaust from this space is closed by the valve K. The space *y* at the
80 opposite end of the plunger has by the same motion of the valve K, been exhausted through the passage *h*, and this passage is now cut off by the plunger itself (Fig. 2). So soon as this has taken place steam from
85 the chest H is admitted through the interior of the hollow plunger which is opened at O out at the secondary induction port *i* and by the passage *r*, into the space *y*. The expansive force of the steam in the space *x*, is
90 thus counterbalanced and the motion of the plunger is arrested, the friction of the valve F, upon its seat assisting to retard it and the plunger. Should the valve, when working very rapidly be thrown past this point, be-
95 fore it can strike against its cylinder head *t*, it will have opened an exhaust passage *v*, when the plunger will be returned a short distance or until the exhaust *v*, is cut off. It can not however be thrown sufficiently far
100 back to cut off the port D, or the exhaust through E, for the steam way *a*, being open steam will again be instantly admitted to the space *x*, through the passages *a*, *c*, and *b*, and at the same instant the secondary induc-
105 tion port *i* will be closed, and the plunger will be held stationary, but it is evident that with the parts in the position represented in Fig. 2, the piston cannot be thrown back or made to rebound in the direction of its arrow
110 farther than is sufficient to cut off the port *i*, for the next instant the exhaust through

5 h , as well as the steam way a , c , b , will be
 opened, and that would immediately arrest
 the plunger and prevent its further motion
 in the direction of its arrow; it cannot how-
 ever be made to rebound or return in the
 10 direction contrary to its arrow, for the port
 i will immediately again reach the passage r ,
 and the exhaust through h , as well as the
 steam way a , c , b , will be cut off. All frivo-
 15 lous motion of the plunger is thus pre-
 vented; the friction of the valve F , upon
 its seat as before stated also assists in caus-
 ing the piston to work steadily. On the
 piston again arriving at the right end of the
 20 cylinder the arm L , strikes the nut g and
 returns the valve K , to the position repre-
 sented in red in Fig. 2 when the steam way
 p , q , r , and the exhaust z are opened—and
 the plunger and valve F , are thrown into
 the position represented in Fig. 1. The plun-
 ger being prevented from striking its cylin-
 der head w , by an arrangement of passages
 precisely similar to that described at the
 other end of the steam chest.

25 It will be seen that the valve F and plun-
 ger G must at all times be in one or other of
 the positions represented in Figs. 1 and 2
 and that steam will enter one end or the
 other of the cylinder A , whenever it is ad-
 30 mitted to the steam chests H , and I , and that
 the engine will start automatically whenever
 the steam is thrown on. For were the valve
 K , to be left in a central position so as to
 cover all the passages p , h , z , a the valve G ,
 35 would remain unmoved and when steam was
 again admitted the piston B , would be
 caused to complete its stroke and finish the
 motion of the valve K , and it is evident that
 the valves F and K , can never be left at the
 40 same time in a central position (the only
 position in which the engine would not start
 automatically if steam were admitted) for
 the valve F cannot move until it is actuated
 by steam admitted through the valve K , and
 45 when this valve has once moved sufficiently
 to start the plunger G , it will carry it
 through the whole of its stroke, and if by
 any possibility there should remain in the
 chest I , at the instant that the valve K
 50 moves but a sufficiency of steam to carry the
 plunger to its central position, on the re-
 admission of steam to the chest I , the throw
 of the plunger would be completed and the
 engine would move. Still further however
 55 to diminish the chances of the valve F , from
 being left in the central position above re-
 ferred to the pressure of the steam is taken
 off of it at the instant that it passes its cen-
 tral position by the following device. It
 60 will be observed that the central portion of
 the valve F which rests upon the valve seat
 and covers the exhaust port C , is longer
 than this port itself, and that the chambers
 m , and n , of this valve are so long as to ad-
 65 mit steam at the instant when the valve is at

the middle of its throw to both ends of the
 cylinder A , at once. The valve and plun-
 ger will thus move very freely and easily
 through this central portion of its throw as
 the pressure of the steam is nearly taken off 70
 of it, and if the steam have sufficient force to
 start the plunger when the pressure in the
 chest H , is upon it, it will always be suffi-
 cient to carry it through that portion of its
 stroke where there is much less pressure or 75
 friction upon it. It is evident that this re-
 lieving of the valve from pressure will not
 cause it to bound beyond its limits, for the
 instant it has passed the center of its throw
 the pressure is again returned to it and the 80
 friction between the valve F and its seat
 again assists to render its motion steady as
 before described. This peculiar construction
 of the valve F accomplishes another end of
 importance in engines of this character, as it 85
 prevents the shock upon the piston B , which
 would be occasioned when the work upon the
 engine was light by the simultaneous open-
 ing of the steam and exhaust passages.
 When constructed and arranged as above de- 90
 scribed the valve F , first admits the steam
 to the cylinder and the next instant exhausts
 the opposite end.

The construction of the plunger G may
 be slightly varied without altering its prin- 95
 ciple of action. For instance it may be com-
 posed of two end pistons united into one by
 a rod or other suitable connection, or it may
 be made solid instead of being hollow as
 represented in the drawings, but the con- 100
 struction above described is that which I
 prefer as the plunger may thus be made far
 lighter than by any other method of con-
 struction and consequently will have less
 momentum when in motion, and be less 105
 liable to be thrown too far. Any water of
 condensation in the passages around the
 plunger will be worked out into the chest H ,
 except what may remain in the passages b
 and r , and this is blown into the spaces x , 110
 and y , by the steam each time it enters
 through the steam ways a and p . To pre-
 vent this water from interrupting the mo-
 tion of the plunger and also to do away with
 the swapping and hammering occasioned by 115
 the water, the plunger is recessed or turned
 out as seen at e , in Fig. 3, and the water
 enters this recess each time the plunger
 moves.

The peculiar arrangement of the steam 120
 and exhaust passages which govern the mo-
 tions of the plunger G , have before been
 mentioned. It will be observed that the
 steam ports a and p , as well as the exhausts
 125 h and z , are at times closed by the valve K ,
 and at others by the plunger G , itself in Fig.
 1. The steam way a , is closed by the valve
 K , but it is held in readiness to transmit
 steam to the space x , whenever the valve K ,
 moves. The passage p is open to the steam 130

chest I, but it is closed by the plunger G, and is held in readiness to admit steam to the space y , should the plunger be thrown by rebound or otherwise in the direction of its arrow. In like manner the exhaust z , is open (Fig. 1) so far as regards the valve K, and this was necessary that the space x , might be exhausted when steam was injected at the other end y , but it is equally necessary that it be closed before any steam be admitted at s , to arrest the piston and this is accomplished by the piston itself. To enable me to accomplish these ends and thereby arrest the plunger before it strikes, it is necessary that the exhaust ports z , and h , enter the cylinder at points nearer to the ends of the cylinder than do the steam ports a , and p , and that the latter be employed in conjunction with suitable passages b , c , r , and q , for leading the steam beyond the ends of the plunger, at the same time that the exhaust passages h and z , are nearer to the center of the valve chest I, than the steam ports a , and p . It therefore becomes necessary that the steam and exhaust passages cross each other as seen in the drawings, and enter the cylinder at points so adjusted with respect to the other opening in the valve, that the exhausts z , or h , shall be closed by the plunger, at the instant that steam is admitted at s , or i , and that the steam way p shall be cut off before the plunger can by its motion disclose the secondary exhaust v^2 .

I am aware that steam valves have been operated by means of the exhaust steam as it escapes from the cylinder, but such device will manifestly not answer in an engine that is required to start automatically at any instant when steam is admitted, and whatever may be the position of the main piston

as after a short stop there will be no exhaust steam to actuate the valve. I am also aware that the slide valve of direct action engines has been moved partly by a tappet arm upon the main piston rod, and through the balance of its throw by an auxiliary piston actuated by steam admitted through a secondary valve, which valve was opened by the tappet arm which started the main valve and I therefore lay claim to neither of the above devices but,

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

1. Controlling the motions and positions of the plunger G exclusively by steam admitted from the steam chest, and by suitable exhausts as set forth for the purpose specified.

2. I claim the within described arrangement of the induction ports a , and p , with respect to the exhaust ports z , and h , and with respect to the throw of the plunger G, for the purpose specified.

3. I claim admitting a quantity of steam before the advancing plunger, through the passages s , b , and i , r , for the purpose of arresting its motion as set forth.

4. I claim the secondary exhaust ports v , v^2 , operating as described for the purpose set forth.

5. The peculiar construction of the main valve F, whereby the pressure upon the same is relieved as it passes the center of its throw and the piston is caused to start more gradually as set forth.

LUCIUS J. KNOWLES.

Witnesses:

JOS. F. HITCHCOCK,
DANIEL T. HITCHCOCK.