L. J. Knowles,

Steam Slide Valve.

No. 22,503. Patented Jan. 4, 1859.

Fig. 3

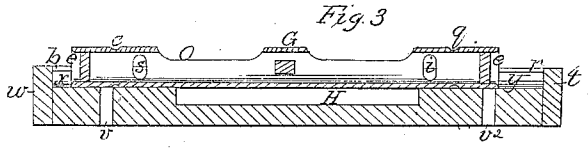


Fig. 1

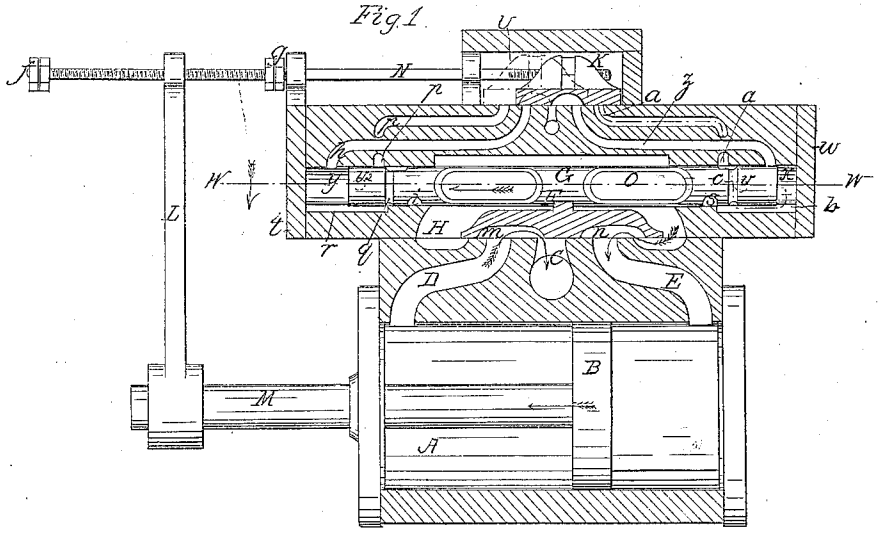
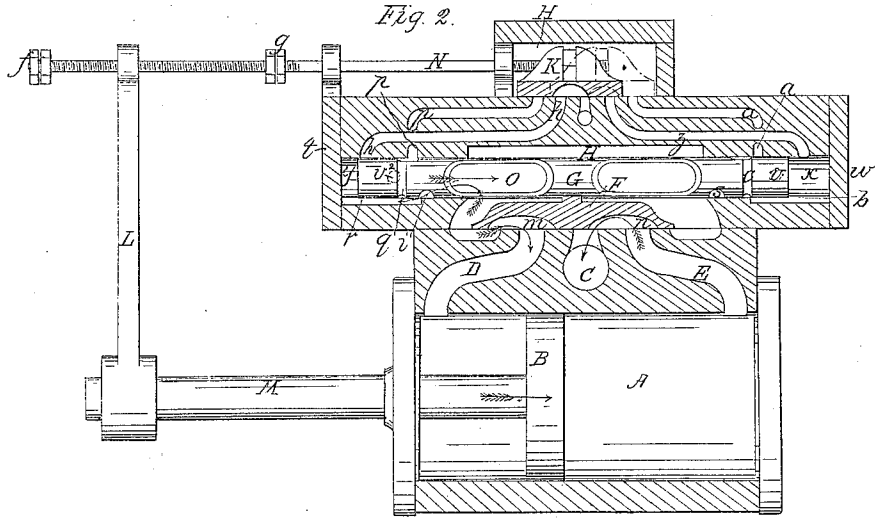


Fig. 2.



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 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, 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. 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 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.

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 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 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 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*, 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 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 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 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. 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 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 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 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, before 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 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 induction 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 farther than is sufficient to cut off the port *i*, for the next instant the exhaust through

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 however be made to rebound or return in the 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 frivolous motion of the plunger is thus prevented; the friction of the valve F, upon its seat as before stated also assists in causing the piston to work steadily. On the piston again arriving at the right end of the cylinder the arm L, strikes the nut g and returns the valve K, to the position represented 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 plunger being prevented from striking its cylinder head w, by an arrangement of passages precisely similar to that described at the other end of the steam chest.

It will be seen that the valve F and plunger 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 admitted 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, 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 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 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 moves but a sufficiency of steam to carry the plunger to its central position, on the readmission of steam to the chest I, the throw of the plunger would be completed and the engine would move. Still further however to diminish the chances of the valve F, from being left in the central position above referred to the pressure of the steam is taken off of it at the instant that it passes its central position by the following device. It 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 admit 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 plunger will thus move very freely and easily through this central portion of its throw as the pressure of the steam is nearly taken off 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 sufficient to carry it through that portion of its stroke where there is much less pressure or friction upon it. It is evident that this relieving 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 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 prevents the shock upon the piston B, which would be occasioned when the work upon the engine was light by the simultaneous opening of the steam and exhaust passages. When constructed and arranged as above described 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 principle of action. For instance it may be composed 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 construction above described is that which I prefer as the plunger may thus be made far lighter than by any other method of construction and consequently will have less momentum when in motion, and be less 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, and y, by the steam each time it enters through the steam ways a and p. To prevent this water from interrupting the motion of the plunger and also to do away with the swapping and hammering occasioned by 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 and exhaust passages which govern the motions of the plunger G, have before been mentioned. It will be observed that the steam ports a and p, as well as the exhausts 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

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.