L. J. Knowles,

Operating Steam Slide Valves.

No. 36,656. Patented Oct. 14, 1862.

Fig. 1.

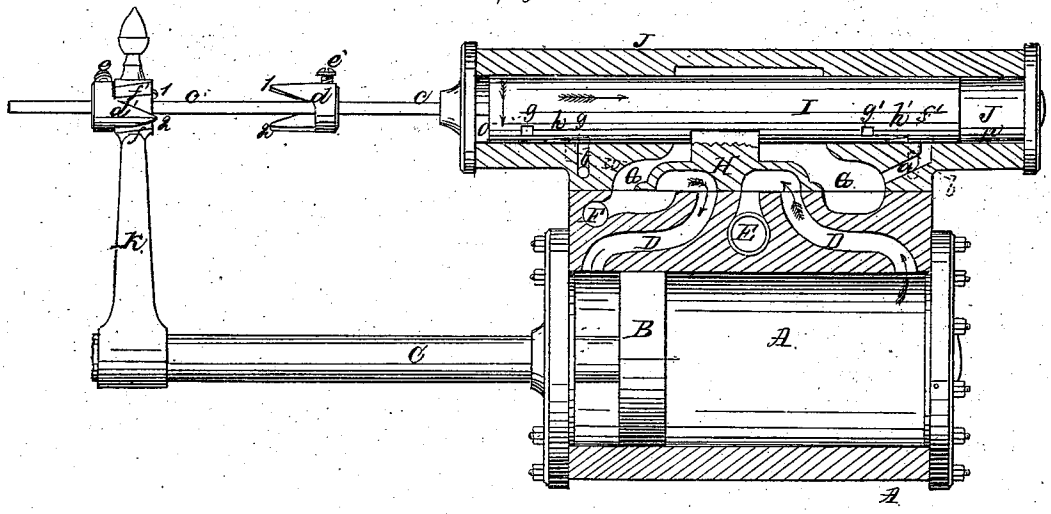


Fig. 2.

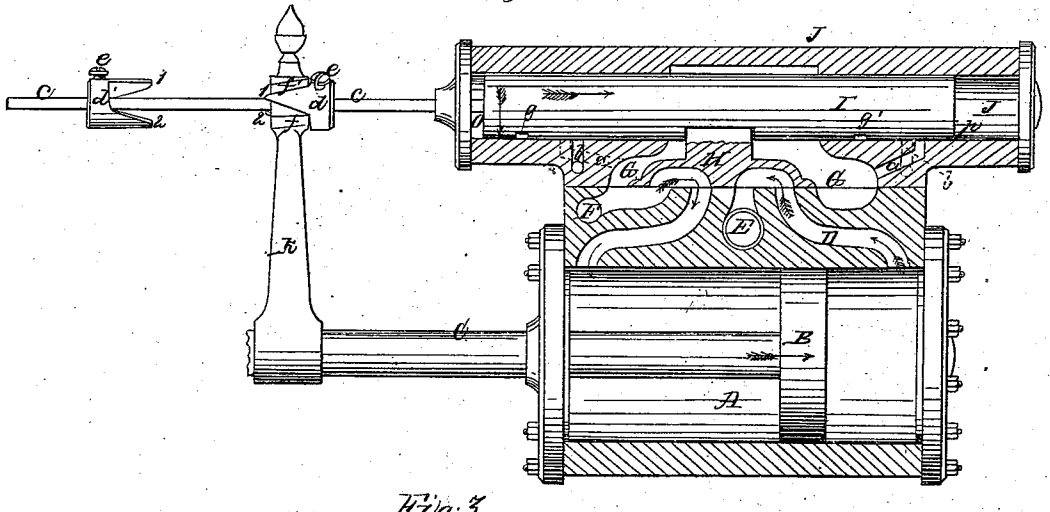
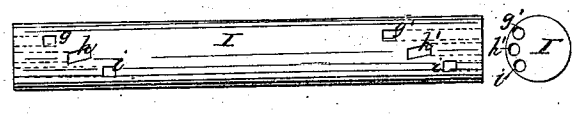


Fig. 3.



Witnesses.
Ebenezer Cole Jr.
Jos. L. Nitschke

Inventor.
Lucius J. Knowles

UNITED STATES PATENT OFFICE.

LUCIUS J. KNOWLES, OF WARREN, MASSACHUSETTS.

IMPROVED APPARATUS FOR OPERATING VALVES OF STEAM-ENGINES.

Specification forming part of Letters Patent No. **36,656**, dated October 14, 1862.

To all whom it may concern:

Be it known that I, LUCIUS J. KNOWLES, of Warren, of the county of Worcester, in the State Massachusetts, have invented a new and useful Improvement in the Method of Operating Valves of Direct-Action Engines; and I do hereby declare that the following is a full and exact description thereof, reference being had to the accompanying drawings, making part of this application.

My invention relates to certain improvements in the valve-motion (or apparatus for operating the valve) of a direct-action engine, and has for its object to insure the proper and requisite motions of the valve through which steam passes to and from the cylinder of the engine, and to render the engine capable of automatically "starting up" with the piston at any point in its stroke.

It is a fact known to those who are familiar with the operation of (double-acting) direct-action engines that if the valve be operated directly by the piston the steam will be cut off when the valve has only made part of its stroke, and the resistance being great against the piston it will cease to move, and some means must be employed to insure the continuance of the valve's motion and the completion of its stroke. Various devices have been suggested and employed for accomplishing this important object, involving different modes of operation, and embracing an auxiliary engine for producing the desired operation of the valves; and on the 4th day of January, 1859, Letters Patent of the United States were granted to me, in which is shown and described a new mode of accomplishing this desirable result by means of a plunger or piston working in a cylinder formed in the steam-chest, which plunger is connected to the slide-valve of the engine, and worked through the medium of an auxiliary slide-valve, which latter is operated by the piston-rod of the engine, in a manner shown and described in said Letters Patent.

My present invention consists in so constructing the plunger or piston (which moves and controls the engine-valve) and combining it with the engine as that it operates as its own valve in the admission and exhaustion of the steam which drives it, as hereinafter more fully explained.

To enable those skilled in the art to make and use my invention, I will proceed to describe its construction and operation, referring by letters to the accompanying drawings, in which—

Figure 1 is a sectional elevation of a double-acting pumping-engine. Fig. 2 is a similar view illustrating a different position of parts, and Fig. 3 embraces detail bottom and end views of the valve-piston.

The same parts are marked in the different figures with the same letter of reference.

A is the cylinder, B the piston, and C the piston-rod, of the engine.

D D are the steam passages or ports, and E the exhaust-port.

J is a box or cylinder bolted to the main casting of the engine, fitted with a piston or plunger, I, and having formed in it the steam-chest G, from which extend the steam-ports *a a*, opening into the interior of cylinder J. The ports *b b* extend from the interior of cylinder J to the main-exhaust pipe, and they, as well as the ports *a a*, communicate at the proper period with the openings *g h i g' h' i'* of piston I, in a manner and for purposes which will be presently explained.

H is the ordinary slide-valve, which is so connected to the piston I as to be moved longitudinally by it.

K is a vertically-arranged arm, secured at its lower end to the piston-rod *c*, and provided at its opposite end with a head, through which the rod *c* of the piston I freely plays, and on which are formed inclined faces *f f'*, which operate upon the cam-faces 1 2 of the tappets or dogs *d d'*, which are secured by set-screws *e* to the rod *c*.

The steam-chest G, it will be seen, is extended farther down than usual at one end, for the accommodation of the steam-induction pipe F, which is connected to the main casting of the cylinder, (same as exhaust-pipe,) instead of being coupled to the box J or "steam-chest," as heretofore.

The arrangement and formation of the openings for inducting and educting steam to and from either end of the piston I will be clearly seen by particular reference to the detail views at Fig. 3, where it will be observed that said openings *g h i g' h' i'* extend out through the ends of said piston.

Having so far alluded to the several parts only as regards their construction and arrange-

ment, I will now explain their operation and advantages. I will suppose steam to be turned on, with the several parts in the position shown in Fig. 1. The piston B will then be driven in the direction indicated by the arrow on it, the steam entering the cylinder A and exhausting from it in the directions indicated by the red arrows. As the arm K moves along with the piston-rod *c*, the inclined faces *f f'* come in contact with the cam-faces 1 2 of the dog *d* and turn it, thereby rotating the piston I on its axis in the direction indicated by the red arrows (on piston) until it assumes the position shown in Fig. 2, by which time the piston B will have moved to the position shown in said Fig. 2. In this position the opening *h'* comes over the exhaust-port *b*, and the steam in space *p* is exhausted through passages *h' b* to the main exhaust E, and at the same time the opening *h* (seen at Fig. 1) comes over opposite to the steam-port *a*, and steam passing through the end of piston I into space *o* drives said piston longitudinally, as indicated by the blue arrow, to shift the slide-valve H, for the admission of steam to the other end of the cylinder for driving the piston B in the opposite direction, in the usual manner. As the piston B travels back, the inclined faces *f f'* operate on the legs or cam-faces 1 2 of the dog *d'*, and turn the piston I back into the first-described position on its axis, as seen in Fig. 1, whereby the opening *h* is brought over the exhaust-port *b*, so as to exhaust the space *o*, and the opening *h'* is brought over the steam-port *a*, so as to admit steam to the space *p* and drive the piston I longitudinally into the position shown at Fig. 1, when the valve H will have been again shifted, and so on. It will be observed that the ports or openings *h* and *h'* are cut obliquely to the axis of the piston I where they come through its periphery. The object of thus shaping the said openings is to have their capacity constantly increase as the piston I slides over the ports *a a*, to insure the propulsion of the piston against any resistance that might occur during its motion. I have described the inclined faces (which are carried by the piston-rod) as coming up against and rotating the dogs *d d'* before the piston B has finished its stroke; but it will be understood that at the instant the said dogs are turned the piston I takes steam, and, moving ahead in the same direction as piston B, has reversed the valve H by the time said piston B has finished its stroke.

The object of the openings *g i* and *g' i'* is to admit and exhaust steam to and from either end of the piston I at proper times to prevent the said piston from carrying the valve H too far in either direction, as it would be likely to do from its momentum or inertia and from the expansion of the steam by which it is driven, and to also avoid any hammering of the piston against the ends of cylinder J; and the operations of this feature of the apparatus may be thus briefly explained: Suppose the piston to be just arriving at the position seen at Fig. 1. Its inertia and expansion of steam in space *p* will tend to keep the piston I in motion; but directly the said piston continues its motion the opening *i* comes opposite to the steam-port *a*, admitting steam to the space *o*, and then the opening *i'* comes over exhaust-port *b*, exhausting steam from the space *p*. As soon as the piston I recedes from this condition of the apparatus, it will open the steam and exhaust ports which brought it up, and between these two limits the piston I is balanced or held. This operation is repeated at the other end of the stroke of the piston. Since this feature of the apparatus is made the subject of Letters Patent previously granted to me, I will not more fully allude to it here.

The object and advantage of putting the steam-induction F down in the main casting of the cylinder A, as before described, is that its attachments may be removed without breaking the steam-connections. The practical benefit of such an arrangement will be apparent to the engineer.

It will be understood that previous to my present invention the piston which moved the valve H had the admission and exhaustion of the steam operating it effected by a valve actuated from the main engine. In the improved apparatus herein described it will be seen that the piston I is made to act as its own valve, as hereinbefore explained.

I propose to make the piston I hollow, to lighten it, leaving sufficient stock to form the ports *g h i g' h' i*.

Having fully described the construction and operation of my improved apparatus for operating the valves of engines, and not wishing to limit myself to the precise construction shown, what I claim as new, and desire to secure by Letters Patent, is—

1. Operating the slide-valve H by means of a piston, I, or its equivalent, which is first brought into a proper position to take steam, substantially as described, by a partial rotary motion derived from the engine, and which is then driven by the steam independently of the engine, substantially in the manner described.

2. The employment of oblique openings or ports *h h'*, in combination with the piston I and the steam-passages of its cylinder, substantially as and for the purpose set forth.

In testimony whereof I have hereunto set my hand and seal this 26th day of July, 1862.

LUCIUS J. KNOWLES. [L. S.]

In presence of—
S. H. SIBLEY,
E. A. KNOWLES.