J. R. MAXWELL.

VALVES FOR STEAM-ENGINES.

No. 180,433. Patented Aug. 1, 1876.

FIG. 2.

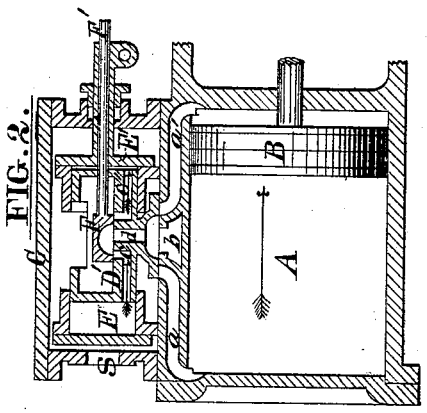


FIG. 1.

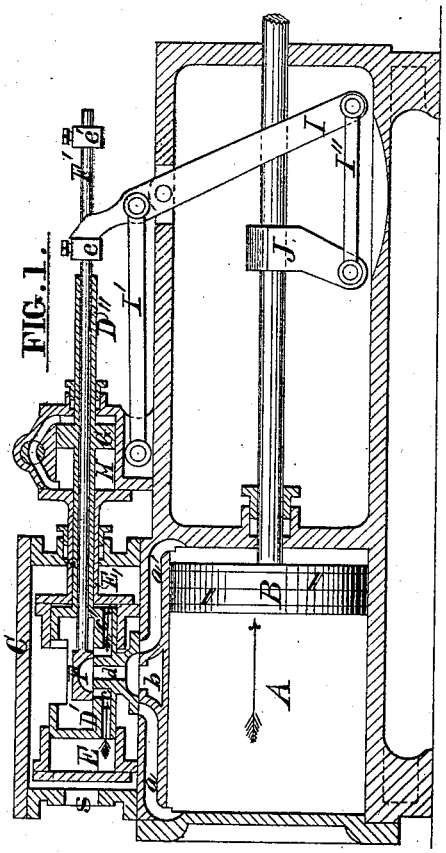


FIG. 3.

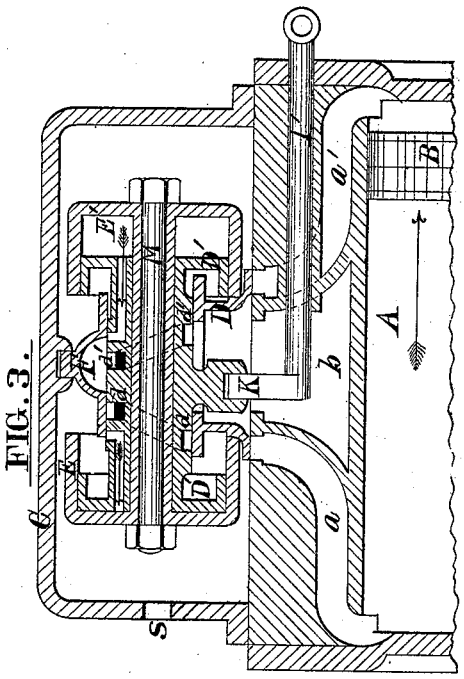
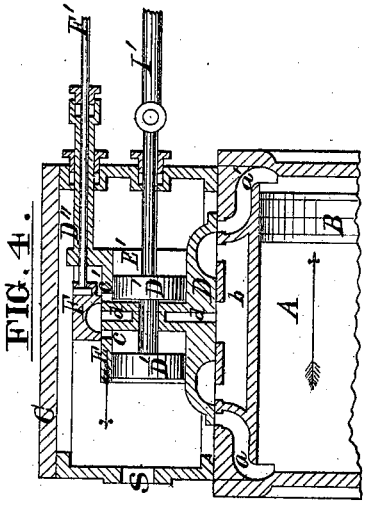


FIG. 4.



Witnesses:
George T. Ress
Robt. C. McKinney

Inventor:
James R. Maxwell

UNITED STATES PATENT OFFICE.

JAMES R. MAXWELL, OF CINCINNATI, OHIO.

IMPROVEMENT IN VALVES FOR STEAM-ENGINES.

Specification forming part of Letters Patent No. **180,433**, dated August 1, 1876; application filed February 12, 1876.

To all whom it may concern:

Be it known that I, JAMES RILEY MAXWELL, of the city of Cincinnati, county of Hamilton, and State of Ohio, have invented certain new and useful Improvements in the Valves of Steam-Engines; and I declare that the following is a full, clear, and exact description thereof, reference being had to the accompanying drawings, which form a part of this specification.

My invention consists of improvements upon the construction and manner of operating the valves of steam-engines, by means of which their action is rendered absolutely positive, and at the same time calculated to render the engine safe under variable loads, varying the distribution of steam to the main cylinder, according to the load against which the piston must work. This is accomplished by actuating the main slide-valve by the combined motions of a valve-moving cylinder and a valve-moving piston, one of which receives motion from the main piston by means of suitable connections, and the other by the direct application of steam. These motions are in opposite directions, the one having a tendency to close the steam-admission port, and the other to open it—the one motion constant, while the other may vary. Hence, the main valve has imparted to it a differential motion, which varies with the variations of load upon the main piston.

Figure 1 of the drawings illustrates the arrangement with a cataract attached; and Figs. 2, 3, and 4 show it without the cataract.

To any of these, however, the cataract may readily be attached. I prefer to control the valves by the cataract in the case of large engines, which are subject to great variations of duty, such as pumping-engines for water-works. I do not usually attach it upon smaller engines having a comparatively regular duty.

The drawings are longitudinal sections, showing the arrangement of parts which most clearly illustrate the aforesaid principles. Numerous modifications, some of which will be mentioned in the course of this specification, will suggest themselves, and may be made without in any way altering the principle involved.

In the drawings like parts are indicated by the same letters, and arrows showing the direction of the moving parts and the flow of steam.

A is the main steam-cylinder; B, the main piston, and C the steam-chest. D is the main slide-valve, cast with or otherwise attached to an auxiliary or valve-moving piston, as shown in Figs. 1 and 2, or with an auxiliary or valve-moving cylinder, as shown in Fig. 4; or it may be made independent of either, but abutting against either one, as shown in Fig. 3. E is the valve-moving cylinder, and D′ the valve-moving piston. The former may have motion imparted to it from the main piston by means of suitable connections, and the latter be moved by steam, as shown in Figs. 1 and 2; or the latter may receive motion from the main piston, and the former be steam-moved, as shown in Figs. 3 and 4. F is the auxiliary valve, which admits steam to move the valve-moving cylinder or piston. It may be placed upon the valve-moving piston, Figs. 1, 2, and 3, or upon the valve-moving cylinder, Fig. 4, and operated by tappets *e e′* upon its rod F′, Figs. 1, 2, and 4; or it may be stationary, Fig. 3, and the ports opened by the valve-moving piston moving under it; or the lugs which hold the auxiliary valve may be placed a short distance apart, and the valve allowed to travel with the valve-moving piston, in order that the ports may be opened and closed earlier or later, as necessary; or the auxiliary valve may be dispensed with and the valve-moving cylinder made to perform its functions by moving over suitable ports in the valve-seat.

The cataract-cylinder H, Fig. 1, is attached by a trunk, E′, to either the valve-moving cylinder or piston. In this case, the valve-moving cylinder receiving motion from the main piston, the cataract-cylinder is attached to it, and the cataract-piston G is attached by the tube D″ to the valve-moving piston D′.

The auxiliary valve-rod F′ passes through the tube D″, so that, since it must move with the valve-moving piston, it is not influenced by friction by passing through a stuffing-box in the valve-moving cylinder or steam-chest. When the valve F is carried on the valve-moving cylinder, Fig. 4, its rod F′ passes

through the tube D″, which is attached to the valve-moving cylinder. The lever I is moved, by the main piston, by means of the link I″ and arm J. The other end of the lever is connected, by the link I′, to the cataract-cylinder, and hence the cataract and valve-moving cylinders together have a motion coincident with, but in a direction opposite to, the main piston.

As shown in Fig. 4, the lever may be attached to the valve-moving piston D′, and impart a motion to it coincident with the main piston. Whichever plan is adopted it will be observed that the main valve is cast with, or attached to, the part that is steam-moved.

The lever I is extended, and moves the auxiliary valve F by striking the tappets *e e′* upon its rod F′. These tappets are adjustable, so that the lever will strike them sooner or later, as necessary.

The operation of these various arrangements is essentially the same. I shall, therefore, make the description apply particularly to Fig. 1, and afterward refer to any difference.

The operation is as follows: As shown in the drawing, the main piston has just about reached the end of its stroke to the right. The valve-moving cylinder E, and with it the main valve D, have therefore been moved to the left, cutting off the admission of steam to the main cylinder through the passage *a* on the left. Just before reacing this point the lever I comes in contact with the tappet *e* upon the valve-rod F′, and moves the auxiliary valve F to the left, admitting steam to the right-hand end of the valve-moving cylinder E through the passage *c′*, and exhausting from its left-hand end through the passages *c* and *d* to the main exhaust. The valve-moving piston D′ now moves to the left at the velocity permitted by the flow of liquid in the cataract-cylinder H. The main valve D, being attached to the valve-moving piston D′, is carried with it to the left, and as soon as it begins to uncover the steam-admission port *a′* on the right, the main piston will commence its stroke to the left. The lever I, attached to the main piston-rod, at once begins to move the valve-moving and cataract cylinders, and, consequently, the main slide-valve, in a direction opposite to that in which it is being moved by the auxiliary piston—hence tending to cut off the admission of steam to the main cylinder. Now, if these two motions maintain a constant velocity with relation to each other, (as they will do if the load upon the steam-piston remains the same during its entire stroke,) the position of the main valve will be unchanged, the one motion counteracting the effect of the other. Hence, a constant quantity of steam—just sufficient to perform the work—will be admitted to the main cylinder during the entire stroke of the piston. After the main piston has commenced its stroke, as has been shown, should the load upon it be increased its velocity, and, consequently, that of the valve-moving cylinder, will be retarded, while the valve-moving piston, which moves independently of the main piston, and at a constant velocity, will carry the main valve to the left faster than the valve-moving cylinder can carry it to the right. Hence, the steam-admission port *a′* will be opened wider, admitting a greater quantity of steam to the main cylinder to overcome the increased resistance. On the other hand, should the load be lessened, as might happen, in the case of pumping-engines, from loss of, or failure to take, water, the velocity of the main piston will be accelerated, and, consequently, the valve-moving cylinder will carry the main valve to the right faster than the valve-moving piston will carry it to the left. Hence, the steam-admission port *a′* will be nearly or quite closed. The main piston will then move on slowly to the end, or will come to rest until the valve-moving piston, which continues to advance, has again carried the main valve to the left, opening the port so as to admit steam just sufficient to complete the stroke.

Upon reaching the end of this stroke the valve-moving cylinder will have carried the main valve over the steam-admission port *a′*, cutting off the supply of steam. The lever I will strike the tappet *e′*, moving the auxiliary valve F to the right, admitting steam to the left of the valve-moving piston D′. Hence, the main valve will open port *a*, admitting steam to the left end of the main cylinder, and bring *a′* and *b* into communication to exhaust from the right end, thus reversing the stroke of the main piston.

In cases where the valves are not controlled by the cataract, the valve-moving piston or cylinder will move the full extent of its travel as soon as steam is admitted upon one end and exhausted from the other. The main valve will, therefore, be carried entirely off the steam-admission port, admitting the full supply of steam at once. Should the load be increased, it will necessarily retard the velocity of the piston, since the engine is already exerting its full power. Should the load be lessened, however, the same result will occur as has been hereinbefore described.

With the cataract, no arrangement for cushioning the valve-moving cylinder or piston is necessary, the cataract controlling them. Without the cataract, the valve-moving piston or cylinder is cushioned by overrunning the exhaust-ports.

In Fig. 3 two exhaust-ports, *d d′*, one for each end of the valve-moving cylinder, are used. In this case the valve-moving cylinder is steam-moved, and the cushioning is effected by said cylinder carrying a plain portion of the main valve under the port, thus cutting off the exhaust.

The manner of operating the valve-moving piston from the main piston differs somewhat in Fig. 3.

The lever I is attached to the rod I′, which extends into the main exhaust-port *b*, terminating with a finger, K. This finger enters a

fork, extending down from the valve-moving piston D′, and so imparts to the latter the motion of the main piston.

The rod I′ may enter the side of the cylinder, forming a rock-shaft, moving the valve-moving piston by the vibratory motion of the finger K.

The cataract-cylinder may be placed upon either side of the steam-chest, or in any other convenient position.

The valve-moving piston or cylinder may receive an intermittent motion from the main piston, performing essentially the same functions as when the motion is continuous.

Should the main piston attain a very high velocity, and the auxiliary valve fail to act promptly, the valve-moving cylinder or piston and main valve will be carried entirely over the steam-ports, admitting steam to the opposite end of the cylinder in advance of the main piston, and thus effectually prevent its striking the ends of the cylinder.

Having thus fully described the construction and operation of my invention, what I claim as new, and desire to secure by Letters Patent, is—

1. The combination, in a valve-movement, of a cylinder receiving motion coincident with the stroke of the main piston and a steam-moved piston, or the piston may be moved by the main piston, and the cylinder by steam-pressure, whereby the main valve is moved by the main piston to cut off steam, and moved by steam-pressure to open the other port, substantially as shown and described.

2. As a new means of operating the valves of direct-acting engines, the combination of a valve-moving cylinder and piston, moving in opposite directions at the same time, each to the right and left alternately, one at a constant velocity, and the other at a velocity which may vary, actuating the main valve, so that it becomes a regulating and cut-off valve, substantially as shown and described.

3. The combination of the auxiliary valve F, the valve-moving cylinder E, the valve-moving piston D′, the main piston B, and lever I, whereby the main valve is actuated by the combined motions of the main and valve-moving pistons, automatically varying the distribution of steam to the main cylinder according to the load, substantially as shown and described.

4. The combination of the auxiliary valve F, the valve-moving cylinder E, the valve-moving piston D′, the main slide-valve D, and the lever, rod, or rock-shaft and finger I I′ K, when the ports leading to the valve-moving cylinder are opened and closed by the valve-moving piston moving under the auxiliary valve, substantially as shown and described.

5. The movable cataract-cylinder H and piston G, in combination with the valve-moving cylinder and valve-moving piston, arranged to control and regulate the action of the main valve, substantially as shown and described.

JAMES R. MAXWELL.

Witnesses:

ROBT. C. MCKINNEY,

GEORGE T. REISS.