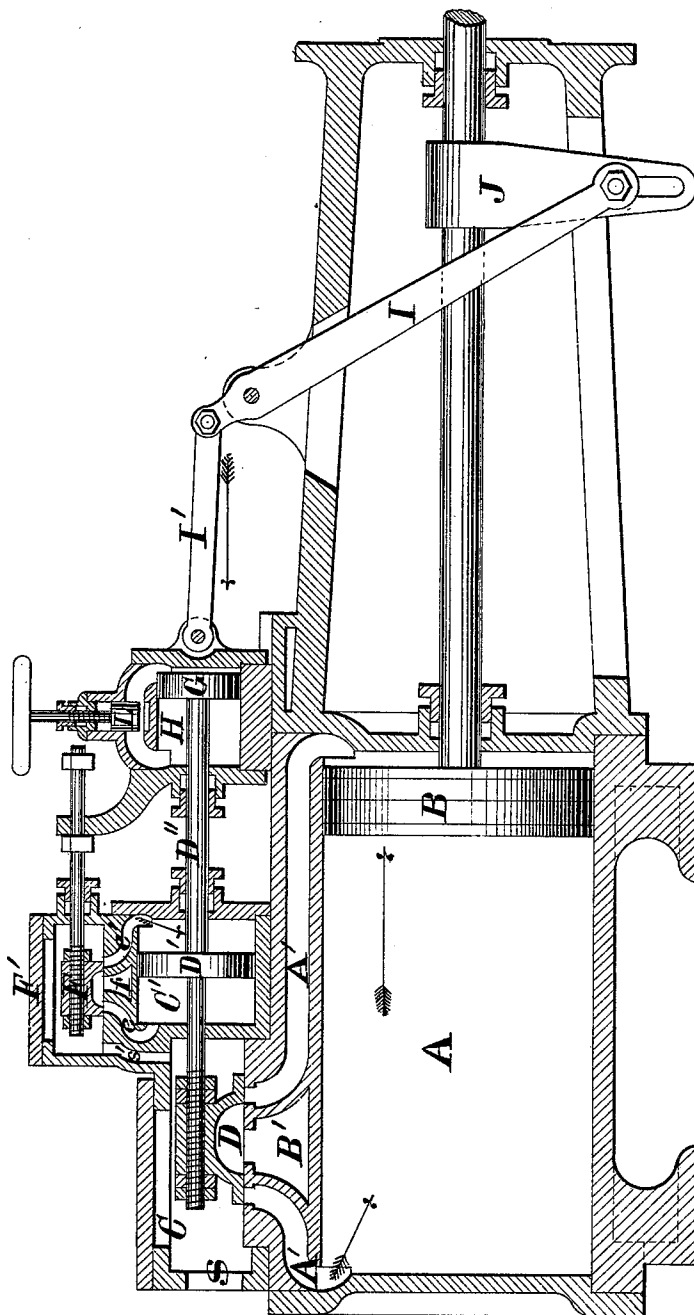


E. COPE & J. R. MAXWELL.  
Valve for Steam-Engines.

No. 202,933.

Patented April 30, 1878.



Witnesses:  
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# UNITED STATES PATENT OFFICE.

EZRA COPE, OF HAMILTON, AND JAMES R. MAXWELL, OF CINCINNATI, OHIO.

## IMPROVEMENT IN VALVES FOR STEAM-ENGINES.

Specification forming part of Letters Patent No. **202,933**, dated April 30, 1878; application filed August 31, 1876.

### *To all whom it may concern:*

Be it known that we, EZRA COPE, of the city of Hamilton, county of Butler, and JAMES R. MAXWELL, of the city of Cincinnati, county of Hamilton, all in the State of Ohio, have invented certain new and useful Improvements in Valves for Steam-Engines; and we 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.

Our invention relates to certain improvements in steam pumping-engines, patented by Robt. Allison, September 29, 1868, numbered 82,475, and reissued August 3, 1869, numbered 3,573, in which the motion of the steam-valves is controlled and regulated by a "cataract."

Our invention consists of an arrangement of parts, in combination with a cataract, whereby the valve motion is rendered more positive, and the engine perfectly safe under variable loads.

The figure of the drawings is a longitudinal section through the cylinder, steam-chest, and valves of our improvement, in which the main piston, by means of a lever, imparts a positive motion to a movable cataract-cylinder, the auxiliary cylinder being stationary and the auxiliary piston steam-moved.

Like parts are indicated by the same letters, and arrows show 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 valve—in all cases a plain slide-valve. C' is a stationary auxiliary cylinder. D' is an auxiliary piston, operating in the auxiliary cylinder, moved by the direct pressure of steam, and moving the main valve by direct attachment or contact. F is the auxiliary valve, for admitting steam to the auxiliary cylinder to move the auxiliary piston. It may be moved, as shown in the drawings, by the contact of an arm attached to the movable cataract-cylinder, with tappets on its rod, and placed in an auxiliary chest, F; or it may be moved directly by the lever I; or it may be placed in the main chest without motion of its own, being carried upon the auxiliary cylinder until it is brought into contact with one of the studs, F'. The communication of the ports is then established

by the passage of the auxiliary cylinder under the valve.

G is a small piston, working in a cylinder, H, filled with oil, water, or other suitable liquid, and fully described in the patent of Allison, above referred to. The piston is connected by a rod to the auxiliary piston, controlling and regulating its motion, and hence the motion of the main valve.

I and I' are levers and connecting-rods, operated by an arm, J, attached to the main piston-rod, and imparting motion to the auxiliary or cataract cylinders. The main valve is placed in an independent steam-chest, and attached to the auxiliary piston D' by the rod D'', which is also attached to the cataract-piston G. Steam enters the main chest at S, and passes to the auxiliary chest through the passage s'. The auxiliary valve F being moved, as we have shown, admits steam to the auxiliary cylinder C' through the ports e and e', forcing the auxiliary piston, and hence the cataract-piston and main valve, to the right and left alternately.

The cataract-piston maintains this motion at a uniform velocity during the entire travel. By means of the valve L in the passage leading from end to end of the cataract-cylinder, this velocity of the cataract and auxiliary pistons may be varied to suit the circumstances and conditions under which the engine is required to work. The motion thus imparted to the main valve carries it off the steam-admission port, admitting steam to either end of the main cylinder alternately. As soon as the steam-port is opened wide enough to admit sufficient steam, the main piston will commence its stroke, and at once commences to draw the cataract-cylinder H, by means of the lever I, in a direction opposite to its own; hence the cataract-cylinder H and piston G are moving in opposite directions.

The liquid with which the cataract-cylinder is filled being practically incompressible, the motion of cataract-cylinder will act, through the cataract-piston, upon the main valve and auxiliary piston, causing the valve to open or close the steam-admission port, according to the velocity with which the main piston is moving. For instance, if the auxiliary piston has commenced to travel to the left, carrying with it the main valve and cataract-piston, at the ve .

locity permitted by the flow of liquid in the cataract-cylinder, the main steam-port A' will be opened. The main piston then commences its stroke to the left, and, by means of the lever I, will commence to move the cataract-cylinder H to the right. Now, if the velocity of the cataract-cylinder just equals the velocity of the auxiliary and cataract pistons, the former moving to the right as fast as the latter move to the left, as will occur when the main piston maintains a uniform speed, the effect of the one motion upon the valve will be counteracted by the other, and hence the valve will remain stationary, admitting a constant and equal supply of steam to the main cylinder during the entire stroke of its piston.

Should the velocity of the main piston be accelerated, the cataract-cylinder will be forced to the right faster than the auxiliary piston is moving to the left; consequently the latter will be forced to the right, compressing the steam in the auxiliary cylinder, and carrying the main valve to the right, until the admission of steam to the main cylinder is nearly or quite cut off. The main piston will then move on at its normal speed to the end of its stroke, or will come to rest until the auxiliary piston has again carried the valve off the steam-admission port. On the other hand, should the speed of the main piston be re-

tarded, the cataract-cylinder will be moved to the right more slowly than the auxiliary piston is moving to the left; hence the latter will carry the main valve to the left, opening the steam-admission port wider, admitting an additional supply of steam to the main cylinder, to carry the main piston to the end of its stroke at its normal speed. The main valve is thus moved by the combined motions of the main and auxiliary pistons, producing a differential motion of the valve, which varies the distribution of steam to the main cylinder with each variation of load upon the main piston.

Having thus fully described our invention, what we claim as new, and desire to secure by Letters Patent, is—

The combination of movable cataract-cylinder H and piston G, the stationary auxiliary cylinder C' and piston D', and the main valve D, the auxiliary piston moving the main valve in a direction to admit steam to the main cylinder, and the cataract-cylinder H moving it in a direction to cut off steam, whereby the main valve becomes a regulating and cut-off valve, substantially as shown and described.

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Witnesses:

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