



# UNITED STATES PATENT OFFICE.

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## IMPROVEMENT IN VALVES FOR STEAM-ENGINES.

Specification forming part of Letters Patent No. 200,855, dated March 5, 1878; application filed July 12, 1877.

*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, and 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 drawing, which forms a part of this specification.

The object of our invention is to so control the distribution of steam to a steam-engine that it will automatically adjust itself to the work to be done, causing the piston to make its strokes in equal times, and rendering the engine absolutely safe under any variation of load to which it may be subjected.

The principle and general arrangement herein involved is covered by the patent to James R. Maxwell, No. 180,433, dated August 1, 1876.

We accomplish the above object by the use of a main valve operated independently of the main engine by an auxiliary piston and cylinder, or by any other means preferred, and by a movable valve-seat connected to the main piston by suitable intervening mechanism, and operated by it, moving under the main valve in a direction tending to cut off steam from the main cylinder. The motion of the main valve may be controlled by a cataract, causing it to make its stroke in either direction in uniform times. In cases where the auxiliary cylinder is placed outside the steam-chest, the auxiliary piston may be moved by water-pressure, and its motion thus controlled without the use of a cataract; or cocks or plugs may be placed in the exhaust from the auxiliary cylinder, and the motion of the valve thus controlled.

The drawing illustrates an arrangement of the parts suitable for practical operation, and of simple and convenient construction. The details may be varied in many particulars by one skilled in the art without departing from the features covered by this specification.

In the drawing, A indicates the steam-cylinder; B, the piston, and C the steam-chest. D is the main valve—a plain slide-valve operated independently of the main engine, in this case by the auxiliary piston D', and sliding upon the movable valve-seat. C' is an

auxiliary cylinder in which the auxiliary piston D' operates. The auxiliary cylinder is cast with or otherwise secured to the movable valve-seat. Together they are operated from the main piston by means of the arm J, lever I, and link I'. Ports *a' a' b'* are formed in the movable seat. The valve-seat may be entirely independent of the auxiliary cylinder, the latter being placed in any other convenient position and the seat connected directly to the main piston. The arrangement shown brings all the parts compactly together, and may be wholly covered by a single steam-chest.

The auxiliary valve F is a double D-valve, united by the rod F''. The valve has no motion of its own, but is carried with the auxiliary cylinder until it is brought into contact with one of the studs F'. The valve will then pause while the auxiliary cylinder moves under it, changing the communication of the ports and reversing the stroke of the auxiliary piston D'. Any other style of valve may be used, and it may be operated by contact of the lever I with tappets on its rod, as shown in the patent of Maxwell before mentioned, or in any other convenient manner.

The operation is as follows: In the drawing the piston is shown at the end of its stroke to the right, having carried the valve-seat under the main valve and cut off steam from the main cylinder. At the same time the auxiliary cylinder is carried under the auxiliary valve F, admitting steam to the right end of the auxiliary cylinder and exhausting from its left end. The auxiliary piston, therefore, moves to the left at the velocity permitted by the flow of liquid in the cataract-cylinder, carrying the main valve with it, opening the port A' on the right, and admitting steam to the right end of the main cylinder. The main piston B then commences its stroke to the left. The main piston, through the lever I, commences to move the movable seat to the left—the same direction in which the main valve is moving. If the load upon the main piston continues uniform, its velocity will be uniform during its entire stroke, and the auxiliary piston will travel just in advance of the movable seat at a constant velocity, controlled by the cataract, admitting an equal supply of steam to the cylinder during the entire travel

of the piston. If the load upon the main piston should be lessened, its velocity would be accelerated; and hence the movable seat, traveling more rapidly than the valve, will be carried under it, nearly or quite cutting off the admission of steam. The piston will then come to rest until the main valve, which continues to travel, again uncovers the port, admitting sufficient steam to carry the main piston to the end of its stroke at its normal velocity. Should the load upon the piston be increased, the velocity of the piston will be retarded, causing the movable seat to advance more slowly than the main valve. Hence the steam-ports will be opened wider, admitting a greater supply of steam to the cylinder. Should the velocity of the piston be greatly accelerated, the movable seat would be carried under the main valve far enough to admit steam in advance of the piston and reverse its stroke.

It will thus be seen that the engine is self-governing; the supply of steam admitted being properly proportioned to the amount of work to be done. By a simple change of mech-

anism the engine may be placed wholly under the control of the engineer, enabling him to regulate the time of the stroke, as well as its velocity and direction.

What we claim as new, and desire to secure by Letters Patent, is—

1. In a steam-engine, the main valve D, operated independently of the main engine, and the movable valve-seat, operated from the main piston by a fixed connection of intermediate mechanism, in combination with the cataract H, by means of which the distribution of steam to the main cylinder is varied according to the work to be done, substantially as described.

2. The auxiliary cylinder C', secured to and moving with the movable valve-seat, in combination with the auxiliary piston D' and the main valve D, constructed and arranged substantially as and for the purpose described.

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J. R. MAXWELL.

Witnesses:

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