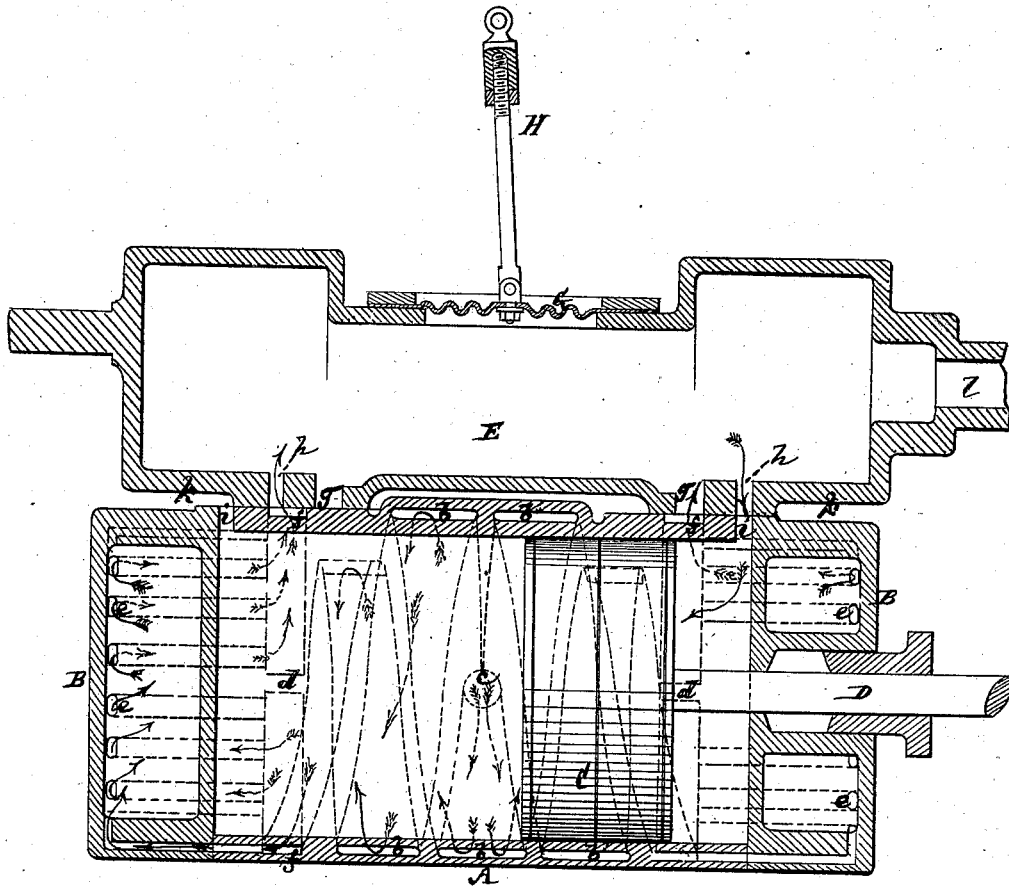


R. HARDIE, J. JAMES & J. G. COOPER.  
Valve for Compressed Air Engines.

No. 203,729.

Patented May 14, 1878.



*Robert Hardie*  
*John James Inventors*  
*James G. Cooper*

*Witnesses*  
*John Becker*  
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# UNITED STATES PATENT OFFICE.

ROBERT HARDIE, OF GOVAN, AND JOHN JAMES, OF EDINBURGH, NORTH BRITAIN, AND JAMES G. COOPER, OF BROOKLYN, ASSIGNORS, BY MESNE ASSIGNMENTS, TO PNEUMATIC TRAMWAY ENGINE COMPANY, OF NEW YORK, N. Y.

## IMPROVEMENT IN VALVES FOR COMPRESSED-AIR ENGINES.

Specification forming part of Letters Patent No. 203,729, dated May 14, 1878; application filed October 17, 1877.

*To all whom it may concern:*

Be it known that we, ROBERT HARDIE, of Govan, in the county of Lanark, North Britain; JOHN JAMES, of Edinburgh, in the county of Mid-Lothian, North Britain, and JAMES G. COOPER, of Brooklyn, in the county of Kings and State of New York, have invented certain new and useful Improvements in Valves for Compressed-Air Engines, also applicable to other engines, of which the following is a description, reference being had to the accompanying drawing, forming part of this specification.

This invention more particularly relates to valves for locomotive-engines designed to be actuated by compressed air or other elastic fluid, but it is equally applicable to stationary engines which are operated by said fluids.

The invention consists in a hollow main valve of peculiar construction, serving also as a chest or reservoir for the compressed air or other impelling fluids, and having both inlets and outlets in its face, with provision for exhausting directly into the atmosphere, in combination with a supply chamber or jacket around the working-cylinder. Said valve also has combined with it an elastic diaphragm, constructed to form a portion of its back, with means for giving it the necessary tension to resist the lift of the valve from its seat. A valve thus constructed and provided will be found peculiarly advantageous in locomotive-engines operated by compressed air or other fluid.

The accompanying drawing represents a longitudinal sectional elevation of the working-cylinder of a compressed-air engine with a main valve applied thereto, the whole being constructed in accordance with our invention.

A is the working-cylinder of the engine; B B, the heads of said cylinder; C, its piston, and D the piston-rod. The heads B B we propose to make hollow, and to encompass the cylinder A with reversely-arranged spiral channels or ducts *b b*, having a common central inlet, *c*, and, by the addition of longitudinal partitions *d d*, serving to circulate the incoming compressed air or impelling fluid up

and down around the cylinder toward its opposite ends, and ultimately to pass said air into the lower portions of the cylinder-heads, through which it is distributed and supplied, by apertures *e*, to annular or partially annular spaces *f f*, over which the valve E is arranged to work. These spaces *f f* constitute a supply chamber or jacket, in part or in whole, around the working-cylinder, from which the main valve draws its supply of compressed air, and it is with such a jacket, in whatever manner the supply-ducts to it may be arranged, that the valve which is the subject of this invention is combined.

By circulating the compressed air or fluid around the working-cylinder, subject to a special heating of it, if necessary, the efficiency of the engine is increased by doing away with the abstraction of heat from the cylinder, which is incidental to the expansion of the compressed air in the working of the engine.

The valve E is a hollow one, and, in addition to its ordinary function as a valve, serves also as a chest or reservoir for the compressed air or fluid, as it receives the latter from the jacket or supply-chamber *f f* around the cylinder, which it does by means of inlets *g g* in the face of the valve and outlets *h h*, when the latter are brought over the chamber or spaces *f f*, thus keeping up a continuous supply of compressed air to the valve. The outlets *h h* also serve, as the valve is reciprocated or reversed, to pass the air from the interior of the valve to opposite ends of the engine-cylinder alternately, by means of apertures *i i* in the latter. The air is exhausted from opposite ends of the engine-cylinder alternately by receding or cut-away portions *k k* in the face of the valve, at its ends, being brought over the end apertures *i i* of the cylinder, thereby passing the exhaust to the atmosphere direct, and not through the valve.

The stem *l* of the valve may be hollow, to receive through it a rod for working a cut-off valve arranged within the main valve, but not shown here.

To relieve the valve of lift from its seat, as

due to the internal pressure within it against so much of its back area as corresponds with the openings in its face, we construct a portion of the back of the valve of an elastic diaphragm, G, which is preferably corrugated, and which has its tension and flexion to keep the valve down to its seat controlled by a swinging arm, H, arranged to bear on the elastic diaphragm and to move with the valve from the pivot of said swinging arm as a center of motion. This swinging arm may be constructed to admit of its being lengthened or shortened, and so provide for varying its control or hold of the diaphragm G.

We claim—

1. The hollow main valve E, having inlets *g*, outlets *h*, and receding or cut-away portions

*k* in its face, in combination with the engine-cylinder, having a jacket or supply-chamber, *f*, and end inlets *i*, substantially as shown and described.

2. The combination, with the main valve E, having inlets *g* and outlets *h* in its face, of the elastic diaphragm G, constructed to form a portion of the back of the valve, the swinging arm H, and the cylinder A, with its jacket *f* and end inlets *i*, substantially as specified.

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