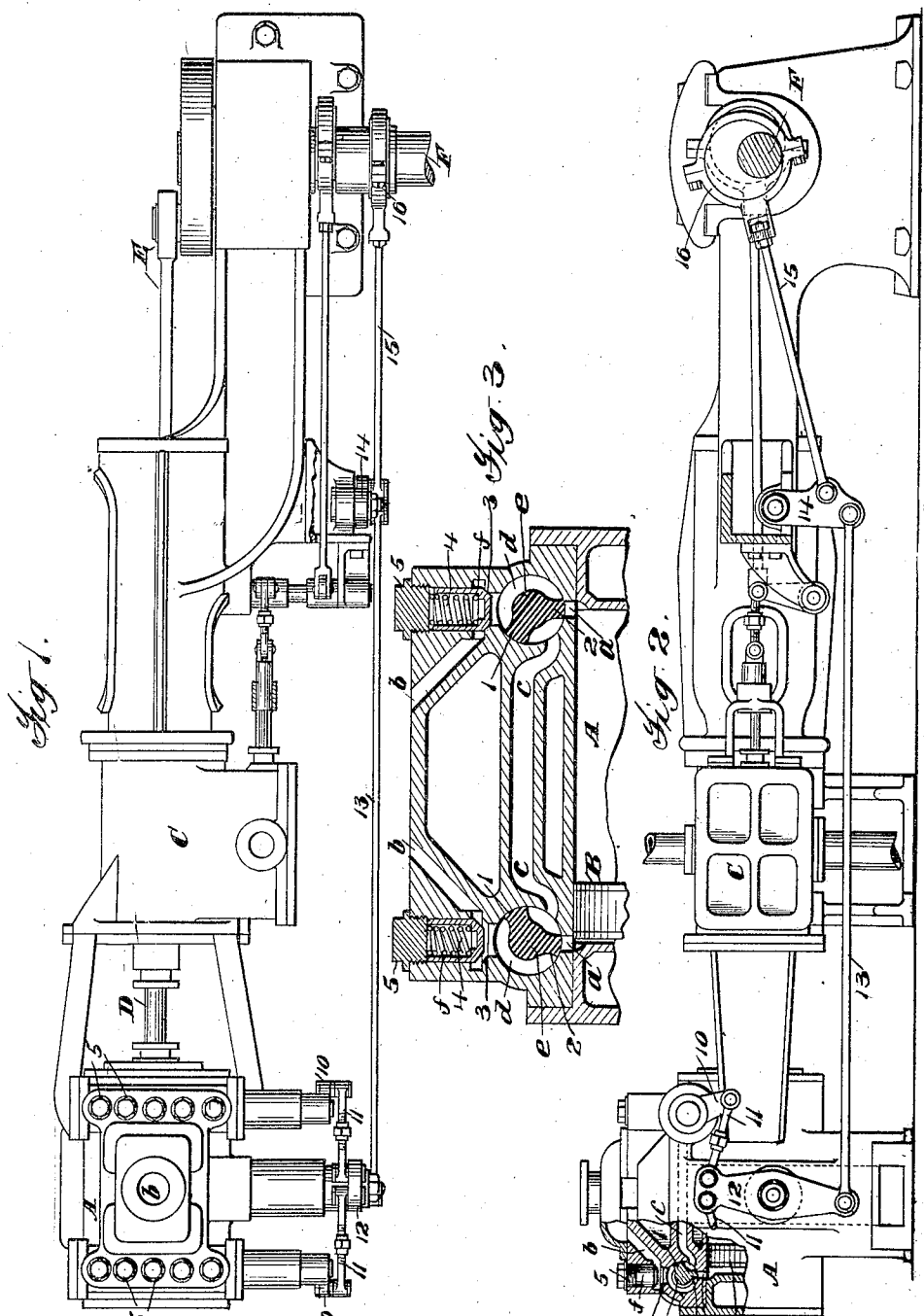


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G. DE LAVAL & G. P. ABORN.  
AIR COMPRESSOR AND THE LIKE.

APPLICATION FILED JULY 15, 1904.



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# UNITED STATES PATENT OFFICE.

GEORGE DE LAVAL, OF CAMBRIDGE, AND GEORGE P. ABORN, OF BOSTON, MASSACHUSETTS, ASSIGNORS TO INTERNATIONAL STEAM PUMP COMPANY, OF NEW YORK, N. Y., A CORPORATION OF NEW JERSEY.

## AIR-COMPRESSOR AND THE LIKE.

No. 845,653.

Specification of Letters Patent

Patented Feb. 23, 1907.

Application filed July 15, 1904. Serial No. 216,682.

*To all whom it may concern:*

Be it known that we, GEORGE DE LAVAL and GEORGE P. ABORN, citizens of the United States, residing at, respectively, Cambridge and Boston, in the respective counties of Middlesex and Suffolk, and State of Massachusetts, have invented certain new and useful improvements in Air-Compressors and the Like, fully described and represented in the following specification and the accompanying drawings, forming a part of the same.

This invention relates to that class of air-compressors and the like in which puppet-valves opened by the discharge-pressure and closed by spring-pressure, which are commonly called "automatic valves," are employed, by which the discharge-passages are closed during the compression-stroke until the cylinder-pressure exceeds the delivery-pressure, the especial object of the invention being to provide an improved construction by which these puppet-valves shall be allowed to close slowly and be cushioned by the air in the discharge-passages during closing, thus avoiding the slamming and consequent wear of the puppet-valves and securing a quiet noiseless operation of the compressor. This result is secured by a novel construction, including mechanically-actuated valves between the puppet-valves and the cylinder, which mechanically-actuated valves are actuated so as to close the discharge-passages just at the end of the compression-stroke and before the closing of the puppet-valves. The puppet-valves thus close against the air included in the discharge-passages between the puppet-valves and mechanically-actuated valves and are thus cushioned, the slow movement of these puppet-valves being permitted by the fact that the discharge-passages having been closed by the mechanically-actuated valves the puppet-valves have the entire return stroke in which to seat themselves.

In the accompanying drawings, forming part of this specification, the invention is shown as applied in a preferred form to an air-compressor of a well-known type, and this construction will now be described in detail, and the features forming the invention specifically pointed out in the claims.

In the drawings, Figure 1 is a plan view of

one side of a duplex air-compressor containing the invention. Fig. 2 is a side elevation of the same, partly broken away to illustrate the invention. Fig. 3 is a vertical section of a portion of the air-cylinder on the same line as the sectioned part of Fig. 2, but showing the valves in a different position.

Referring now to the drawings, A is the compressor-cylinder, having the piston; B C, the steam-cylinder; D, the piston-rod connecting the steam-piston and compressor-piston; E, the crank-rod, and F the crank-shaft, the compressor shown being of a well-known form, except for the present invention.

Referring now to the parts relating especially to this invention, cylinder A is provided at opposite ends with passages a, which in the construction shown are both inlet and discharge passages, and these passages connect with the delivery b and suction c through valve-chamber d, in which is an oscillating valve e, having two lobes or wings 1 2, and thus adapted to alternately connect the cylinder with the inlet and discharge. The valve-chamber d forms a part of the discharge-passage, and between it and the delivery or receiver passage b are a series of seats 3, on which seat puppet-valves f, five such valves at each end of the cylinder being shown, although it will be understood that any number of such valves may be used. These puppet-valves are shown as of a common type, spring-pressed by internal springs 4, which are adjustable by screw-plugs 5, permitting convenient access to and removal and insertion of the valves.

The oscillating valves e may be actuated by any suitable means, so as to positively close the cylinder-discharge at the end of the compression-stroke and before the closing of the puppet-valves and maintain the cylinder-discharge closed until the puppet-valves close, so as to permit the puppet-valves to close gradually while cushioned by the air below the valves. In the construction shown a common form of valve movement is employed, in which cranks 10 on the valve-stems are connected by adjustable links 11 to a rocker 12, which is operated by link 13, lever 14, and link 15 from eccentric 16 on the crank-shaft F.

The operation of the construction will be

understood from the drawings and above description. In Fig. 2 the piston B is shown as approaching the end of its compression-stroke to the left, in which position the valve *e* at the right-hand end of the cylinder is in position to open the cylinder behind the piston to the suction, and the valve *e* at the left-hand end, or in advance of the piston, is just closing the cylinder to the discharge, and the puppet-valves *f*, which have been opened when the cylinder-pressure during the stroke reached a point above the delivery or receiver pressure, are still open.

In Figs. 3 the part at both ends of the cylinder are shown in their position when the piston B has reached the end of its stroke and is about to reverse, the left-hand end of the cylinder being closed to the discharge by the lobe 2 of the valve *e* and the valves *f* at this end of the cylinder being still open, while at the right hand-end of the cylinder the lobe 2 of the valve *e* has closed the cylinder-port and the valves *f* are closed. On the reversal of the piston B the valve *e* at the left-hand or suction end of the cylinder moves farther to the left, so as to connect the suction *c* with the cylinder through the valve-chamber *d*, while this valve *e* still closes the cylinder to the discharge, and the valve *e* at the right-hand or compression end of the cylinder is moved at the proper time to open the cylinder to the discharge, except as the discharge is closed by the puppet-valves until the pressure in front of the piston exceeds the discharge-pressure and opens the puppet-valves.

It will be understood that the invention is not limited to the special form of valves or air-passages nor to the special means for operating the positive valves shown and above described; but the invention may be embodied in constructions employing other arrangements of the valves and air-passages and other means for operating the mechanically-actuated valves.

The term "mechanically-actuated valves" used in the specification and claims is to be understood as meaning valves that are opened and closed by connections with the compressor or pump shaft or other driven member, so as to be positively opened and

closed at fixed points in the stroke as distinguished from valves that are opened or closed by the pressures of the compressor or pump.

What we claim is—

1. In an air or gas compressor or pump, the combination with the cylinder and its inlet and discharge passages, of spring-closed puppet discharge-valves in the discharge-passages, mechanically-actuated valves between the puppet-valves and the cylinder controlling the discharge-passages, and means for actuating said mechanically-actuated valves to open the discharge-passages at a fixed point and to close the discharge-passages at the end of each compression-stroke and before the closing of the puppet-valves, and maintain the closing of the discharge-passages on the reversal of the piston, whereby a slow-closing movement of the puppet-valves is secured and the puppet-valves are cushioned in closing, substantially as described.

2. In an air or gas compressor or pump, the combination with the cylinder and its inlet and discharge passages, of spring-closed puppet discharge-valves in the discharge-passages, valve-chambers between the puppet-valves and the cylinder, mechanically-actuated oscillating valves between the puppet-valves and the cylinder controlling the inlet and discharge passages, and means for actuating said mechanically-actuated valves to close the discharge-passages at the end of the compression-stroke and before the closing of the puppet-valves and to open the inlet-passages on the reversal of the piston and maintain the closing of the discharge-passages, whereby a slow-closing movement of the puppet-valves is secured and the puppet-valves are cushioned in closing, substantially as described.

In testimony whereof we have hereunto set our hands in the presence of two subscribing witnesses.

GEORGE DE LAVAL.  
GEORGE P. ABORN.

Witnesses:

JOHN J. FINLEY,  
JULIUS MEYERS.