No. 679,955. Patented Aug. 6, 1901.

Z. W. DAW.

VALVE MECHANISM FOR ENGINES FOR COMPRESSING AIR AND GASES.

(Application filed Jan. 21, 1901.)

(No Model.) 5 Sheets—Sheet 1.

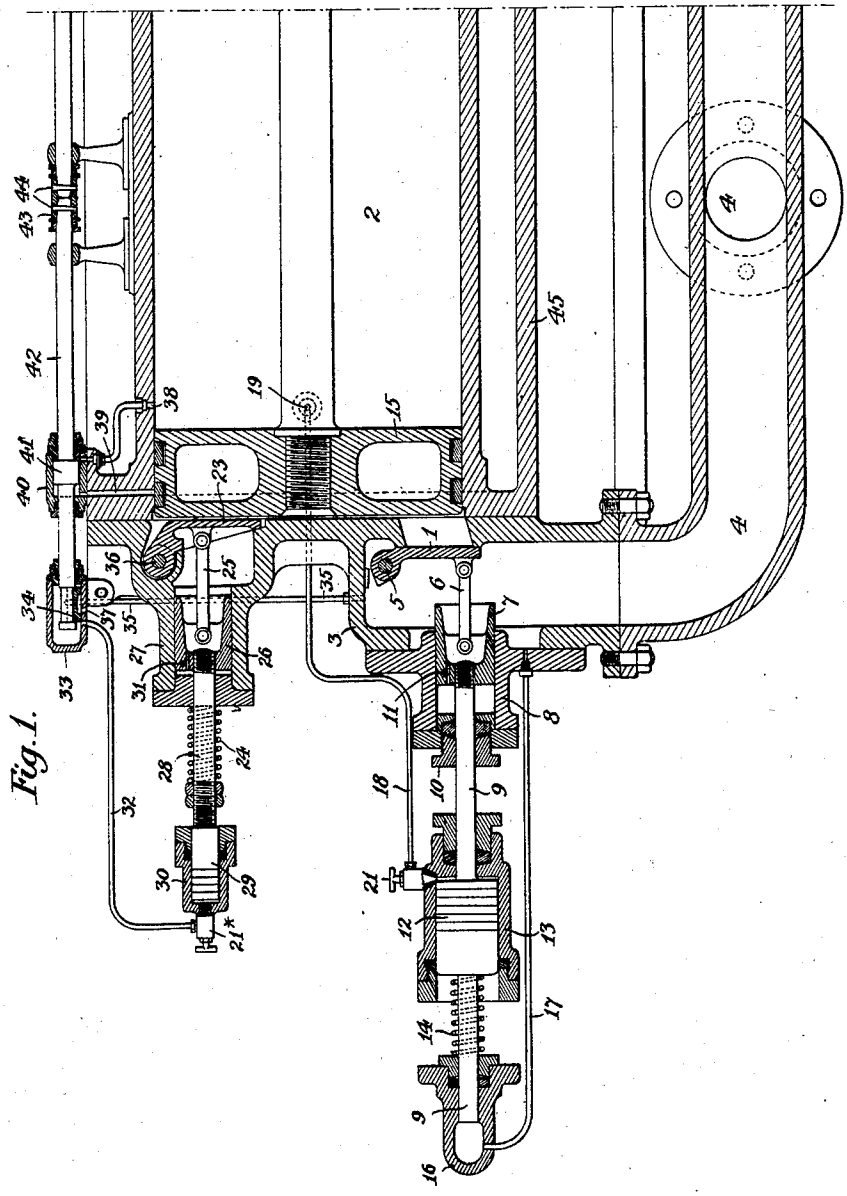

Fig. 1.

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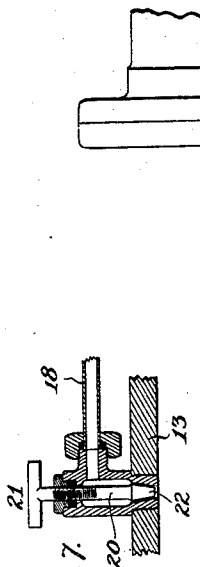

Fig. 7.

Fig. 2.

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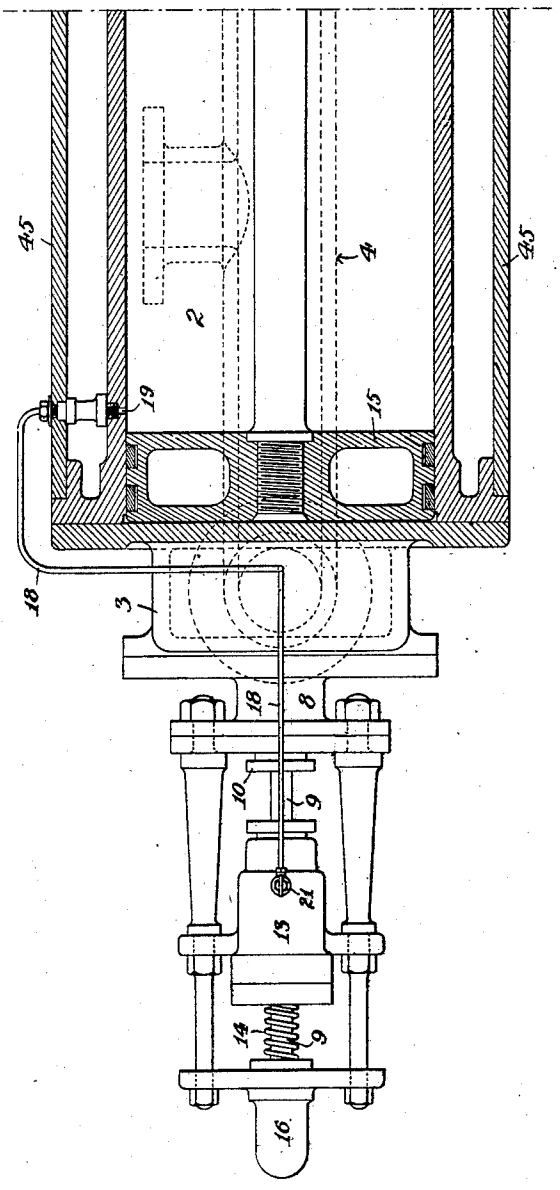
Fig. 3.



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(Application filed Jan. 21, 1901.)

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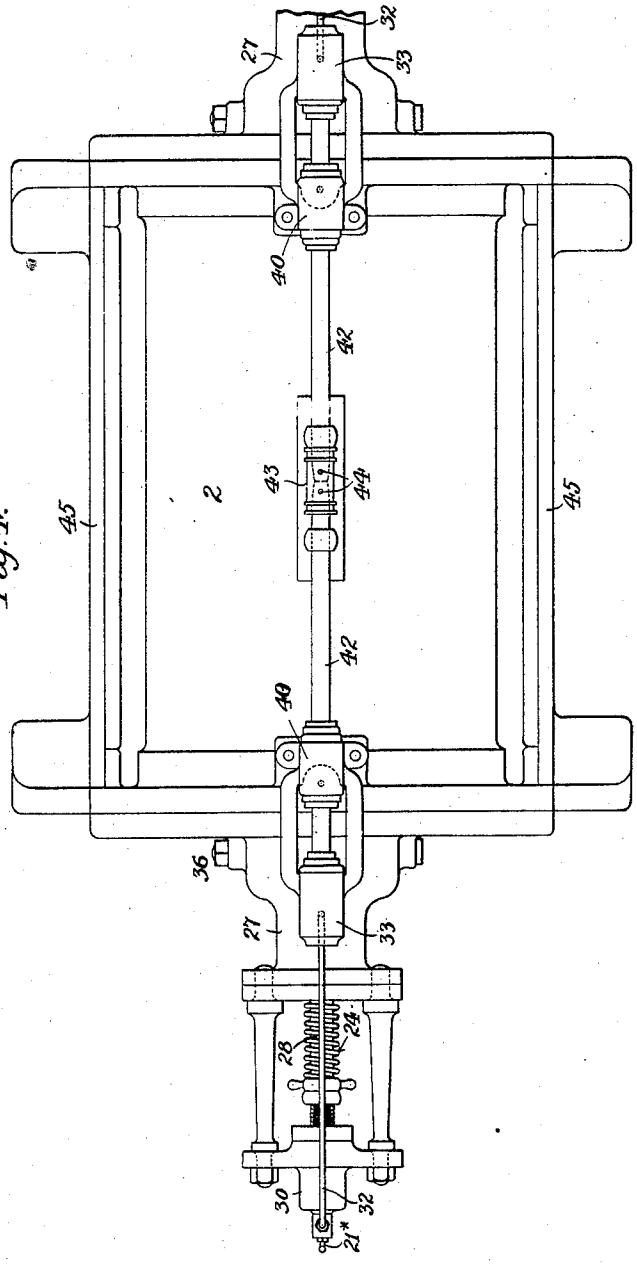
Fig. 4.



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(Application filed Jan. 21, 1901.)

(No Model.) 5 Sheets—Sheet 5.

Fig. 5.

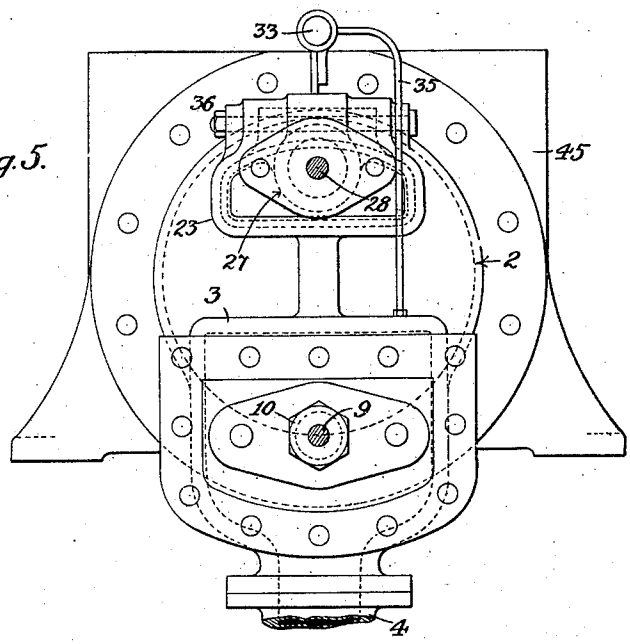
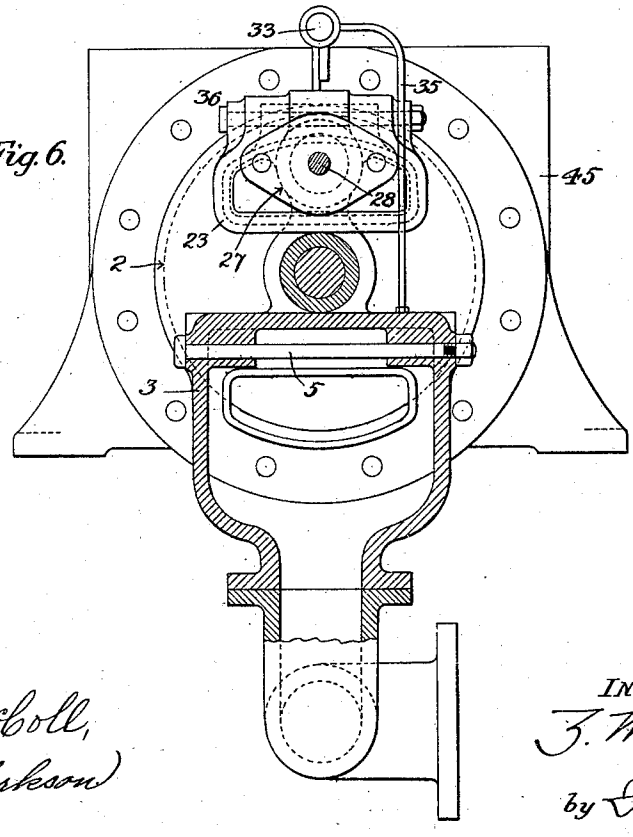


Fig. 6.



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UNITED STATES PATENT OFFICE.

ZACHARIAS WILLIAMS DAW, OF LONDON, ENGLAND.

VALVE MECHANISM FOR ENGINES FOR COMPRESSING AIR OR GASES.

SPECIFICATION forming part of Letters Patent No. 679,955, dated August 6, 1901.

Application filed January 21, 1901. Serial No. 44,160. (No model.)

To all whom it may concern:

Be it known that I, ZACHARIAS WILLIAMS DAW, a subject of the Queen of Great Britain, residing at Mansion House Chambers, 11 Queen Victoria street, London, England, have invented new and useful Improvements in or Relating to Valve Mechanism Especially Suitable for Engines for Compressing Air and Gases, (for which I have made application for Letters Patent in Great Britain, No. 11,762, dated June 28, 1900,) of which the following is a specification.

This invention relates to improvements in the mechanism of the valves of the cylinders of air compressing or blowing engines and is applicable to double-acting as well as single-acting engines.

The objects of the invention are to effect an economy of power and increase the efficiency of the engine and to prevent the violent closing and also the vibrating or chattering of the valves.

When the engine is a double-acting one, a duplicate set of inlet and delivery valves is provided, one at each end of the compressing-cylinder in which the piston works and which cylinder is closed at both ends, while in applying the invention to a single-acting engine the cylinder is open at one end and the inlet and delivery valves are fitted to the cover of the closed end only.

In the accompanying drawings, Figure 1 is a longitudinal section through one end of a double-acting air compressor or blower constructed in accordance with my invention. Fig. 2 is a similar section through the other end thereof and shows a portion of the motor by which the compressing-piston is actuated. Fig. 3 is a horizontal section through part of the compression-cylinder with the mechanism connected to the delivery-valve in plan. Fig. 4 is a plan view of the compression-cylinder and mechanism connected with the inlet-valve. Fig. 5 is an elevation of one end of the compressor or blower. Fig. 6 is a similar view of the opposite end thereof, but shows the casing of the delivery-valve (which latter is removed) in section. Fig. 7 is a detail view of a regulator employed, as hereinafter described, for controlling the passage by which air enters or leaves certain parts of the apparatus.

I will now proceed to describe the construction and arrangement of the valve mechanism in the compressing-cylinder which regulates the inlet and delivery on one stroke of the piston, it being understood that (as will be seen by reference to Figs. 1 and 2) the opposite end (when same is employed) is identical and operates to regulate the inlet and delivery on the other stroke of such piston.

Taking first the delivery-valve 1, this is arranged to open outward in relation to the cylinder 2 and is inclosed in a casing 3 in open communication through pipe 4 with the receiver, the pressure in which consequently is always exerted on the back of such valve. This valve, which is pivoted at 5, is connected by a link 6 to a piston 7, working in a small cylinder 8, the inner end of which opens into the casing 3, inclosing the valve 1, such piston being mounted on a spindle 9, extending backward and working through a stuffing-box 10 in the cover of such cylinder 8. The pressure in the receiver is consequently exerted on the inner end of this piston 7, through which a small aperture 11 is made, so as to permit the compressed air to also pass to the rear of the piston. Upon the valve 1 opening when the pressure in the compression-cylinder 2 reaches that in the receiver the air behind the small piston 7 will have to pass gradually from the rear of same through the small aperture 11 therein, thereby causing this piston to act as a dash-pot or buffer and prevent the jarring of the mechanism and too-violent opening of the valve 1. The spindle 9, passing through the stuffing-box 10, carries a second piston 12, working in a cylinder 13, for the purpose hereinafter described, and the continuation of the spindle from this second piston is surrounded by a spring 14, tending to close the valve 1, which it does when the compression-piston 15 has completed its stroke. The rear end of the spindle 9 also works in a cylinder 16, which is permanently open to the receiver through a small pipe, as shown at 17, the pressure on which therefore constantly acts upon same, and so compensates for the difference in the pressure exerted, respectively, on the inner and rear faces of the small piston 7, carried by the inner end of such spindle 9, such difference in pressure being due to the diameter

of the spindle. The rear end of the spindle 9 can also be arranged when desired to act as a buffer on its backward movement to further prevent the too-violent opening of the valve 1. The second piston 12, above referred to, works in a cylinder 13, open at its rear end and communicating at its closed end through pipe 18 with the compression-cylinder 2 at a a point 19 near the rear end of the latter, so that as the compression-piston 15 makes its effective stroke air will be forced from the compression-cylinder 2 into the small cylinder 13, acting on the piston 12 and filling the space between the closed end of the cylinder 13 and the piston 12 when the delivery-valve 1 has been opened. The area of this piston 12 is calculated so that the pressure thereon will compensate for or approximately balance the difference in the pressures on the two opposite sides of the delivery-valve 1 up to the time when the latter begins to open, and thus avoids any great difference of pressure in the compression-cylinder 2 above that in the receiver. Further, this piston 12 after the delivery-valve 1 has been opened serves to keep such valve 1 open until the compressed air from the compression-cylinder 2 has been expelled, when on the compression-piston 15 completing its stroke such compression-piston will have passed the opening 19 in its cylinder 2, which communicates with the small cylinder 13, so that the air behind the piston 12, working in the latter, is allowed to pass back into the compression-cylinder 2, behind the compression-piston 15, thereby releasing the delivery-valve 1 and allowing of its being closed by the spring 14. The communication 18 between these two cylinders 2 and 13 is small, and, further, the size of the opening of such communication into the small cylinder 13 is capable of adjustment so as to regulate at will the backward travel of the air into the compression-cylinder 2, and thereby prevent the too-violent closing of the valve 1. Any suitable means may be employed for regulating the size of such opening, one arrangement being illustrated in Fig. 7, where, as will be seen, the stem 20 of a screw-down valve 21 is provided at its lower end with a conical plug 22, entering a correspondingly-shaped seat in the valve-casing and which seat opens into the cylinder 13. As before stated, the delivery-valve 1 at the other end of the compression-cylinder 2 (when the engine is double-acting, as illustrated in the drawings) is similarly constructed and arranged and operates in a similar way during the other stroke of the compression-piston 15.

Turning now to the inlet-valve 23, this valve is pivoted at 36 and opens inward, its weight and the pressure within the compression-cylinder 2 during the compression-stroke, and also a spring 24, tending to close same. This valve is connected by a link 25 to a piston 26, working in a small cylinder 27, communicating at both ends with the atmosphere, and a spindle 28, projecting backward from this piston 26, carries another piston 29, working in a cylinder 30, while the spring 24, surrounding the spindle 28, tends to close the valve 23. Air can enter behind the piston 26, above referred to, through a small orifice 31, and as the inlet-valve closes after having opened to admit air to the compression-cylinder 2 such air behind the small piston 26 has to be gradually forced out through this orifice, and so causes said piston to act as a dash-pot or buffer against the action of the spring 24 and the weight of the valve 23 and any pressure acting thereon tending to close it, thus preventing the inlet-valve's closing violently. The outer end of cylinder 30, in which the piston 29 on the spindle 28 works, has a small passage or pipe 32 communicating with a valve-chest 33, in which works a slide or other suitable valve 34 and which chest is placed in permanent communication with the air-receiver by means of pipe 35. When the inlet-valve 23 is open, the slide-valve 34 puts the communication 32 between the chest 33 and the cylinder 30, in which the second piston 29 on the spindle 28 works, open to the communication 35 between the former and the receiver, so that the pressure in the latter consequently acts upon the end of such second piston 29 on the spindle, while when the inlet-valve 23 closes the slide-valve 34 puts the communication 32 between such chest 33 and cylinder 30 open to exhaust to the atmosphere through opening 37, so that the backward movement of the spindle 28, as the inlet-valve 23 closes, forces the air behind the second piston 29 on same out through the small orifice, the size of which can be adjusted by any suitable means—such as a valve 21*, as previously described in connection with the delivery-valve 1 and as illustrated in detail in Fig. 7—so as to regulate the exit of such air. This second piston 29 on the spindle 28 thus further acts as a dash-pot or buffer. When the pressure is on the rear of the second piston 29, it serves to overcome the action of the spring 24 thereon and the weight of the valve 23, so as to maintain the latter in its open position after it has been opened and during the full length of the backward or suction stroke of the compression-piston 15.

The slide 34 can be actuated mechanically by any suitable means (such as a cam or its equivalent) operated in any convenient manner from any part of the machine. I, however, in the case of a double-acting compressor prefer to employ the following arrangement: Near each end of the compression-cylinder 2 two small openings 38 and 39 are formed, one, 38, being behind the other, 39. These openings at each end communicate, respectively, with the opposite ends of small cylinders 40, within which work pistons 41, carried by a spindle 42, on which the slide-valves 34 (one for the inlet-valve 23 at each end) are mounted. As the compression-piston 15 moves toward the inlet-valve 23 at

one end the air it compresses will be forced through the openings 38 and 39 referred to, and by acting on both sides of the piston 41 in the small cylinder 40 has at first no effect on the slide-valves 34, which remain in the position to which they have been previously moved; but as such compression-piston 15 completes its stroke it will first cut off or close the opening 38, and its further travel will place such opening 38 in communication with the space behind it, in which the air is at reduced pressure, through the inlet-valve 23 of the opposite end of the compression-cylinder 2 being open, when the other side of the piston 41 in the small cylinder 40 being exposed to the full pressure of the air under compression reverses the slide-valves 34. The return movement of the compression-piston 15 will place the openings 39 and 38 referred to in succession in communication with the reduced pressure behind it and at the same time force air through the openings at the other end of the compression-cylinder 2 and cause it to act on the piston 41 in the small cylinder 40 at that end and so reverse the slide-valves 34 again in the manner above described.

It is preferable to form the spindle 42, on which the pistons 41 are carried and by which the simultaneous operation of the slide-valves 34 at both ends of the compression-cylinder 2 is insured, in two parts, which may be secured together by a sleeve 43 and pins 44, as shown clearly in Fig. 1.

It will be readily understood that the movement imparted to the spindle 42 by the means above described instead of being utilized to actuate the slide-valve 34 might be employed in any other suitable manner for the purpose of opening the inlet-valve 23.

In order to avoid overheating of the compression-cylinder 2, I may provide same with a water-jacket 45.

What I claim as my invention, and desire to secure by Letters Patent, is—

1. The combination of a compression-cylinder, a delivery-valve opening outward therefrom and having its rear face exposed to the pressure in the receiver, a cylinder open at its inner end to the pressure in the receiver, a spindle provided with a piston on its inner end adapted to work in said cylinder, means connecting said piston with said valve, a spring for closing said valve, and means for balancing the differences in the pressures on the opposite sides of the delivery-valve up to the time the valve begins to open, to avoid great differences in the compression-cylinder over that in the receiver.

2. The combination of a compression-cylinder, a delivery-valve opening outward therefrom and having its rear face exposed to the pressure in the receiver, a cylinder open at its inner end to the pressure in the receiver, a spindle provided with a piston on its inner end adapted to work in said cylinder, means connecting said piston with said valve, a spring for closing said valve, and a cylinder open at its outer end to the atmosphere, a piston disposed on said spindle, and working in said cylinder, and means for connecting the inner end of said cylinder with the compression-cylinder whereby the differences in the pressures on the opposite sides of said delivery-valve are balanced.

3. The combination of a compression-cylinder, a delivery-valve therefor, a cylinder closed at one end, a spindle connected with said valve and having a piston working in said cylinder, said piston having a passage connecting the cylinder with the receiver, whereby the piston acts as a dash-pot to cushion the opening and closing of said valve, and means connected with said spindle for balancing the differences in pressures on the opposite sides of the delivery-valve.

4. The combination of a compression-cylinder, a delivery-valve therefor, mechanism for closing said valve, and means for balancing the differences in pressures on the opposite sides of the valve up to the time the valve begins to open.

5. The combination of a compression-cylinder, a delivery-valve therefor, a spindle connected to said valve, a spring on said spindle to close said valve, a cylinder having its inner end open to the pressure in the receiver, a piston disposed on said spindle and working in said cylinder, said piston being provided with a small passage to allow the air to pass from one side thereof to the other, a cylinder open at its outer end to the atmosphere and having its inner end in communication with the compression-cylinder, a second piston disposed on said spindle and working in said open-end cylinder, a cylinder having its outer end in communication with the receiver, a piston on the end of said spindle working in said cylinder, and means connecting said cylinder with the receiver.

6. The combination of a compression-cylinder, an inlet-valve therefor, a spindle provided with pistons on its opposite ends, means for connecting said valve to one of said pistons, cylinders disposed at opposite ends of said spindle in which said pistons work, a spring disposed on said spindle between said cylinders and adapted to close said inlet-valve, a valve-chest, means connecting the outer cylinder with said chest, means connecting said chest with the receiver, and means for connecting said cylinder with the receiver or with the atmosphere.

7. The combination of a compression-cylinder, an inlet-valve opening inward to the compression-cylinder, a cylinder open at both ends to the atmosphere, a piston working in said cylinder, means for connecting said piston to said valve, a spindle connected to said piston and provided with a spring for closing said valve, a cylinder disposed at the outer end of said spindle, a piston disposed on the end of said spindle and working in said cylinder, and means for connecting said cylin-

der alternately with the receiver and the atmosphere.

8. The combination of a compression-cylinder, an inlet-valve opening inward to the compression-cylinder, a cylinder open at both ends to the atmosphere, a piston working in said cylinder, means for connecting said piston to said valve, a spindle connected to said piston and provided with a spring for closing said valve, a cylinder disposed at the outer end of said spindle, a piston disposed on the end of said spindle and working in said cylinder, a valve-chest having passages leading to the receiver and to the atmosphere respectively, a valve adapted to uncover said passages alternately, and a pipe connecting said valve-chest with the cylinder disposed on the outer end of the spindle whereby said piston acts as a buffer on the opening and closing of the inlet-valve.

9. The combination of a receiver, a compression-cylinder having an inlet-valve, mechanism for closing said inlet-valve, a valve-chest having passages communicating with the receiver and the atmosphere, a slide-valve mounted on a spindle and working in said valve-chest, said valve being adapted to open communication with the receiver and the atmosphere alternately, a cylinder disposed adjacent to said valve-chest and having passages at its opposite ends communicating with said compression-cylinder, and a piston mounted on said valve-spindle and working in said cylinder the movement of said piston being controlled by the travel of the compression-cylinder piston whereby the slide-valve is actuated.

10. The combination of a compression-cylinder, an inlet-valve therefor, cylinders disposed at opposite ends of said compression-cylinder, each cylinder being connected by two separate passages with the compression-cylinder at points one behind the other, a spindle provided with pistons adapted to work in said cylinders, mechanism for actuating said inlet-valve, and means for transmitting the movement of said spindle to said inlet-valve actuating mechanism for cushioning the opening and closing of the inlet-valve.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

ZACHARIAS WILLIAMS DAW.

Witnesses:

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G. F. WARREN.