A. J. WEST.

GAS COMPRESSOR AND PUMP.

APPLICATION FILED JULY 12, 1911.

1,052,541.

Patented Feb. 11, 1913.

3 SHEETS—SHEET 1.

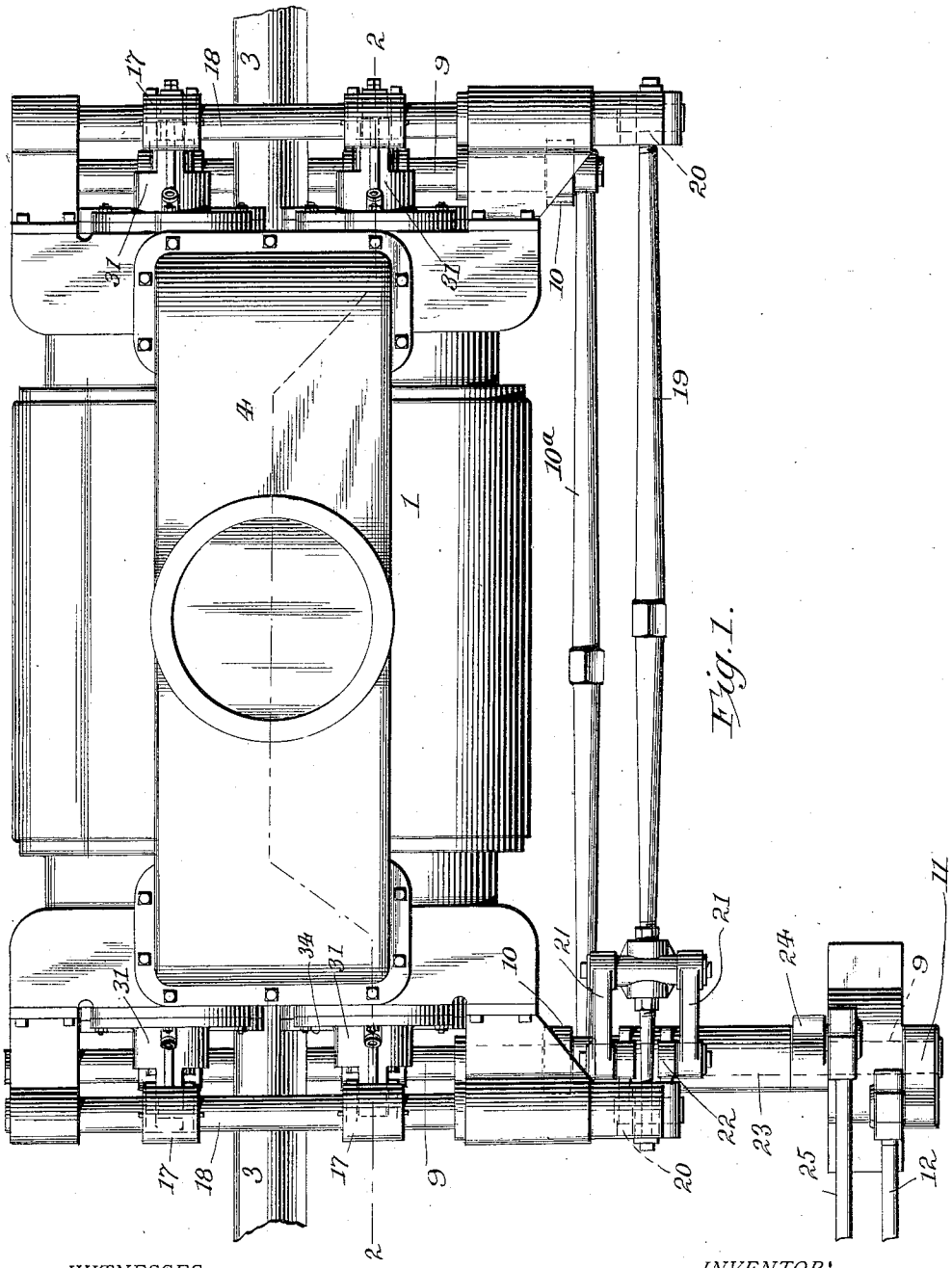

Fig. 1.

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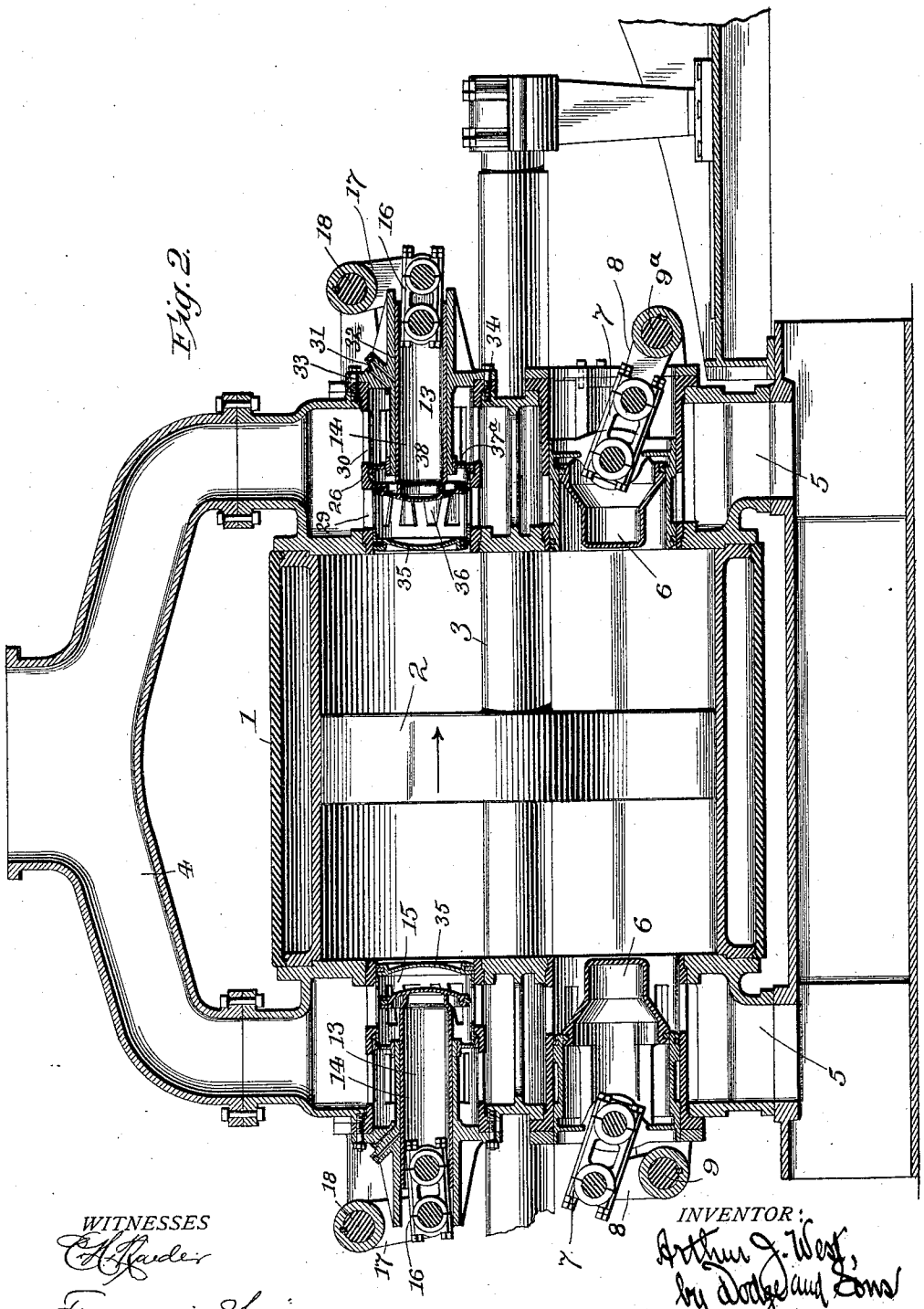
3 SHEETS—SHEET 2.

Fig. 2.



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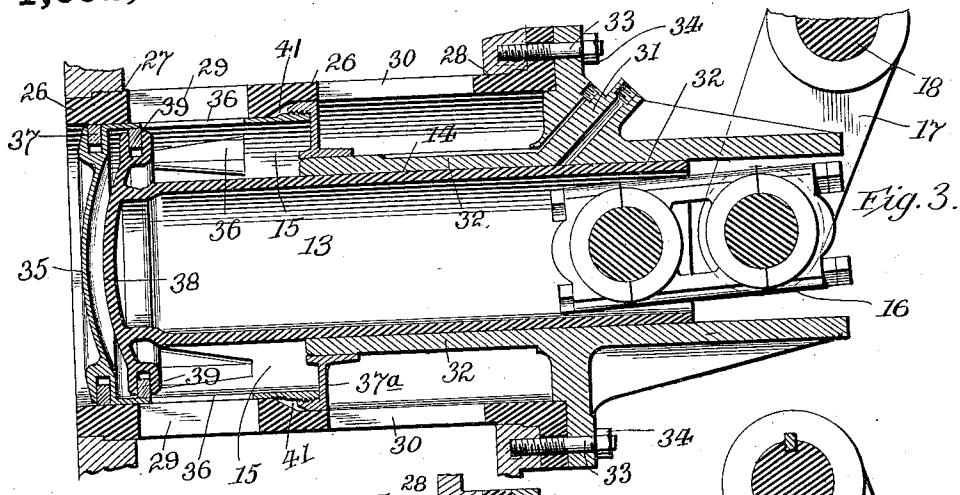

Fig. 3.

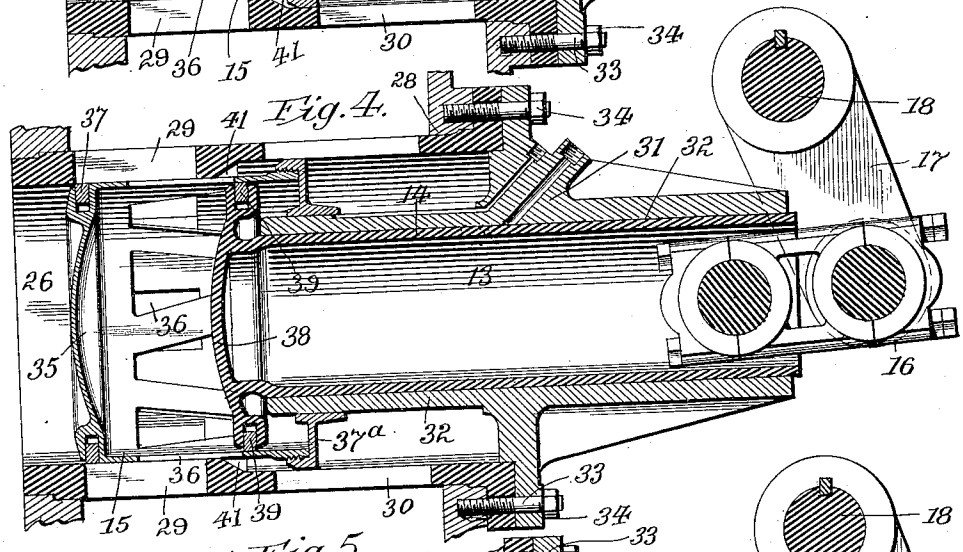

Fig. 4.

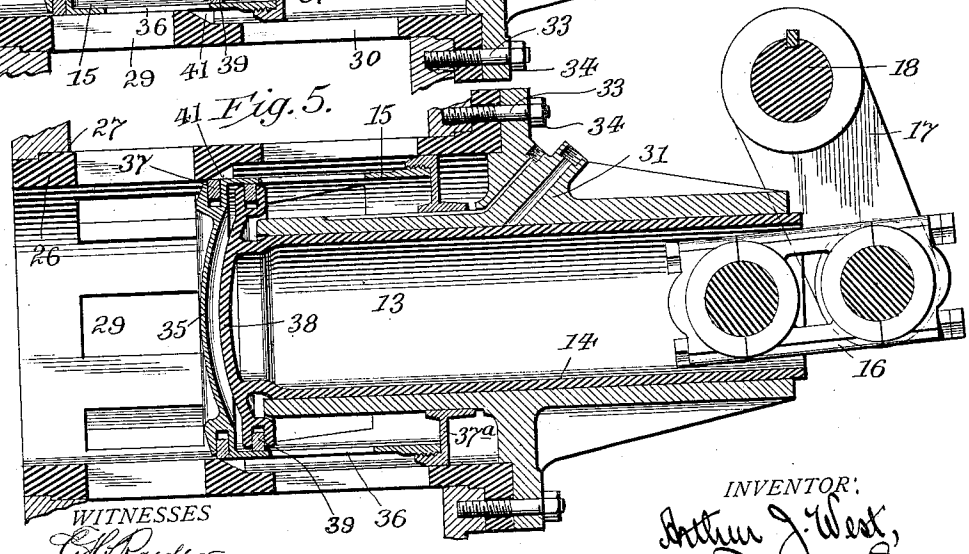

Fig. 5.

WITNESSES

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UNITED STATES PATENT OFFICE.

ARTHUR J. WEST, OF BETHLEHEM, PENNSYLVANIA.

GAS COMPRESSOR AND PUMP.

1,052,541. Specification of Letters Patent. **Patented Feb. 11, 1913.**

Application filed July 12, 1911. Serial No. 638,133.

To all whom it may concern:

Be it known that I, ARTHUR J. WEST, a citizen of the United States, residing at Bethlehem, in the county of Northampton and State of Pennsylvania, have invented certain new and useful Improvements in Gas Compressors and Pumps, of which the following is a specification.

This invention relates to discharge valves for air compressors, and particularly to valves of the combined mechanically operated and automatic type. In such valves the valve member proper is moved to its closing position either by mechanical contact by a positively operated plunger or by such plunger through the medium of an interposed air cushion. The valve is subsequently released by said plunger so as to be permitted to open when the total outward pressure predominates sufficiently over the inward pressure to overcome the friction and inertia of the valve. These are often great enough to require an undue predomination of such pressure resulting in a deranged valve action and consequent losses of efficiency. In a co-pending application, Serial No. 638,132, filed July 12, 1911, I have described a means for overcoming this defect, such means being dependent upon the use of differential pressure to operate the valve.

By my present improvement I cause the retractile movement of the mechanically operated plunger to exert an elastic pressure upon the valve in an opening direction, near the end of the plunger stroke. This pressure is exerted preferably through an air cushion and is approximately sufficient to overcome the friction and inertia of the valve. The degree of such pressure may be varied by the design of the valve, and may be made sufficient to permit the use of a valve of the piston type having metallic packing rings, instead of the puppet type of valve heretofore used in similar structures. This valve is tighter, smoother in action and may be more perfectly guided, and the possibility of its use in this connection arises from the above described feature of my invention whereby an opening impulse sufficient to counteract friction and inertia is given to the valve, thus producing port openings at the exact time necessary.

There are various other advantages incident to the construction shown and these will appear from the description to be given in connection with the accompanying drawings, illustrating one embodiment of my invention, which however, is susceptible of modification in various respects.

Figure 1 is a plan view of an air pump cylinder showing my improved valve attached; Fig. 2 is a vertical section of the same on the line 2—2 of Fig. 1; and Figs. 3, 4 and 5 are vertical sections through the center of a discharge valve showing it closed, closed but ready to open, and full open, respectively.

In the drawings 1 represents the air cylinder provided with a piston 2 carried on a piston rod 3, and 4 is the discharge or air delivery pipe.

5 are the air inlet ports and 6 the air inlet valves which are here shown arranged in pairs in the opposite ends of the cylinder, these valves being of any suitable type and being actuated through links 7 by the arms 8 upon the rock shafts 9 and 9^a. These rock shafts 9 and 9^a have parallel rocker arms 10 connected together by a connecting rod 10^a. The rock shaft 9 carries an arm 11 connected by an eccentric rod 12 to the usual eccentric, not shown. In this way the valves are actuated in the proper order by the rotation of the eccentric.

13 represents the discharge valve structure which consists of a plunger 14 and a floating valve 15 later to be described in detail. The plunger is actuated through links 16 by the rocking of the arm 17 carried by the rock shaft 18. These rock shafts 18 are linked together to move in unison by a connecting rod 19 connected to rocker arms 20 approximately parallel to each other. Short links 21 connect the rod 19 with an arm 22 on the rocker 23 and this rocker 23 carries an arm 24 connected by a rod 25 to a second eccentric, not shown. The rotation of this eccentric causes actuation of the discharge valves in the proper sequence.

The above enumerated mechanism is described merely to illustrate an actuating mechanism suitable for use with the type of valve now to be described, and is not claimed in the present application. Any

equivalent mechanism might be used, the essential requirement being the operation of the valves at the proper times.

Referring now particularly to Figs. 3, 4 and 5, 26 is a valve cage tightly fitting in the cylinder head at the points 27 and 28 and having ports 29 and 30 in free communication with the air discharge passage 4. A bonnet or cover 31 closes the outer end of the valve cage and is provided with an annular guide-way 32, for the plunger 14 and floating valve 15. This bonnet is held in place by studs 33 threaded in the casting of the cylinder head and passing through the flange of the cage 26 and of the bonnet 31. Thus the removal of the nuts 34 on these studs simultaneously permits the removal of the bonnet and the cage.

The cage 26 is open at its inner end to the cylinder space and sliding within this cage is the floating valve 15 having an imperforate head portion 35. The other end of the floating valve 15 is guided by an annular collar 37ª screwed thereon and fitting closely around the outer side of the guides 32 of the bonnet 31. The sides of the floating valve are provided with ports 36 extending nearly to the ends of the valve, and the extent of these ports determines the degree of cushioning action as will later appear. The floating valve is provided adjacent its head with an annular packing ring 37 making a close joint with the cage 26, and the range of travel of the floating valve is such as to cover or uncover the ports 29 in this cage. Considering the valve as shown in Figs. 3 to 5 it will be observed that when the valve is in its left hand position the discharge passage is closed. When in its right hand position air may pass from the cylinder space through the ports 29 to the discharge passage 4.

The plunger 14 is guided within the guides 32 of the bonnet and is provided with an imperforate head 38 which by means of the metallic packing ring 39 makes a close joint with the interior of the floating valve 15, and the range of movement of the plunger 14 is such that its head 38 over travels the ports 36 in the floating valve 15. The ports 30 are so proportioned as to prevent any cushioning or air resistance to the relative movement of the plunger and the floating valve 15 except near the extreme positions of the plunger.

The operation of the device is as follows:— The eccentrics are so timed that when the piston 2 is at the end of its compressive stroke toward one end of the cylinder the plunger will have moved forward sufficiently to force the floating valve 15 into its closed position as illustrated in Fig. 3. It will be noted that there is no metallic contact between the plunger and floating valve in this action. There is an intervening air cushion between the heads 38 and 35 of the plunger and valve respectively, the depth of this cushion being determined by the distance from the ports 36 to the head 35 as above stated. Toward the end of the succeeding suction stroke the plunger 14 moves outwardly thus releasing the discharge valve, but the pressure in the discharge or delivery pipe penetrating through the ports 36 of the floating valve 15 holds this valve closed against the less pressure within the air cylinder. The plunger 14 continues to move to the right until at the proper time in the compression stroke of the piston it over travels the outer end of the port 36 as indicated in Fig. 4. This results in the creation of an air cushion between the annular portion of the head 38 and the annular collar 37ª carried by the floating valve. Thereafter an opening tendency is exerted on the valve. The degree of this opening tendency may be increased by increasing the distance from each of ports 36 to the annular collar 37ª, and the distance is preferably such that this opening tendency is sufficient to compensate merely for the friction and inertia of floating valve 15. The floating valve 15 thus will remain closed until the pressure within the cylinder equals or predominates over that in the delivery pipe. Then the floating valve 15 moves completely to the right and opens the discharge passage through the ports 29. The floating valve is brought to rest gently by the air cushion formed between the heads 35 and 38 and by the over travel of the annular collar 37ª past the ports 30. The plunger 14 then moves to the left carrying the floating valve with it to close the ports 37. An inspection of Figs. 3, 4 and 5 will show that the valve cage 26 is formed to provide an annular recess or chamber 41 between the walls of the floating valve 15 and the walls of the cage 26. As the floating valve moves toward the closed position, as shown in Fig. 3, a portion of the collar 37ª enters the chamber 41 and the cushioning action of the air confined in this chamber brings the floating valve to rest without slamming, and the pressure of the imprisoned air exerts a certain tendency toward the opening of the vlave. This feature combined with the piston type of valve results in extremely quiet action and is an important element of my invention. This cycle is repeated for each cycle of the pump cylinder.

It is apparent from the above description that I have provided a floating valve which is adequately guided at both ends independent of the plunger which also is adequately guided in fixed ways. The valve joints are formed with piston rings thus securing tightness, and the friction of the valve against opening is overcome mechanically

so that a perfect combination of automatic and positive actuation is secured. The floating valve is never moved through mechanical contact but by means of intermediate air cushions. In this manner all slamming and pounding of the valves is obviated. It will also be noted that the valve is wholly free of springs or the like and may be removed intact for inspection or repair.

As has already been stated the opening tendency exerted upon the floating valve by the plunger may be varied by varying the design of the ports 36, and although I prefer to so design the valve that it will open automatically when the pressure in the cylinder equals the pressure in the delivery pipe, nevertheless, it is apparent that the valve may be arranged to open at a time when the cylinder pressure is lower than the delivery pipe pressure, in case this should be for any reason desirable.

While I have represented the inlet and outlet valves as both arranged in pairs, I do not mean to restrict myself thereto, and may use a single inlet and a single outlet valve at each end of the compression cylinder. The claims of this case are therefore to be read and understood as wholly unaffected by the number of such valves employed.

Having thus described the invention what I claim is:—

1. The combination of a gas pump cylinder; a discharge pipe therefor; suitable valve actuating mechanism; an inlet valve; a valve cage having ports leading to the discharge pipe; a discharge valve controlling said ports and subject on one side to the pressure in the pump cylinder and on the other to the pressure in the discharge pipe, and a plunger moved by the valve actuating mechanism and adapted to exert elastic pressure upon the discharge valve alternately in opposite directions.

2. The combination of a gas pump cylinder; a discharge pipe therefor; suitable valve actuating mechanism; an inlet valve; a valve cage having ports leading to the discharge pipe; a discharge valve controlling said ports and subject on one side to the pressure in the pump cylinder and on the other to the pressure in the discharge pipe; and a plunger moved by the valve actuating mechanism and adapted to exert pressure through intervening air cushions, upon the discharge valve alternately in opposite directions.

3. The combination of a gas pump cylinder; a discharge pipe therefor; suitable valve actuating means; an inlet valve; a valve cage having ports leading to the discharge pipe; a bonnet therefor, provided with guide ways; a discharge valve controlling the discharge ports and guided by the cage and by the guide ways of the bonnet, said valve being on one side subject to pressure in the pump cylinder and on the other to pressure in the discharge pipe; and a plunger also guided in ways in the bonnet, moved by the valve actuating means and having a head adapted to exert an elastic pressure upon the discharge valve alternately in opposite directions.

4. The combination of a gas pump cylinder; a discharge pipe therefor; suitable valve actuating means; an inlet valve; a valve cage having ports leading to the discharge pipe; a bonnet therefor, provided with guide ways; a discharge valve controlling the discharge ports and guided by the cage and by the guide ways of the bonnet, said valve being on one side subject to pressure in the pump cylinder and on the other to pressure in the discharge pipe; and a piston moved by the valve actuating means and sliding within the discharge valve so as to exert pressure thereon through intervening air cushions, alternately in opposite directions.

5. In a discharge valve for pumps having a delivery passage, the combination of a discharge valve subject to the opposing pressures of air in the pump and in the passage; and means for exerting an auxiliary pneumatic pressure other than the pressure in the pump upon the valve in an opening direction.

6. In a discharge valve for gas pumps having a delivery passage, the combination of a discharge valve subject to the opposing pressures of air in the pump and in the delivery passage; and means for periodically exerting pneumatic pressure upon the valve alternately in an opening and closing direction.

7. In a discharge valve for gas pumps having a working cylinder and a delivery passage, the combination of a discharge valve subject to the opposing pressures in the cylinder and passage respectively, said valve being provided with lateral apertures and air tight ends; and a reciprocating piston moving within the valve and over traveling said lateral apertures, whereby air cushions are formed between the piston and the valve to urge the valve alternately in opposite directions near the extremes of the piston strokes.

8. In a discharge valve for gas pumps having a delivery passage, the combination of a discharge valve of the piston type subject to the opposing pressures of air in the pump and in the delivery passage; and means for alternately exerting pneumatic pressure upon the valve in opening and closing directions.

9. In a discharge valve for gas pumps having a delivery passage, the combination of a discharge valve of the piston type subject to the opposing pressures in the pump and in the delivery passage; a pneumatic

cushioning device adapted to check the closing movement of the valve; and means for periodically exerting pneumatic pressure upon the valve alternately in opening and closing directions.

10. In a discharge valve for gas pumps having a delivery passage, the combination of a discharge valve subject to the opposing pressures in the pump and in the delivery passage; a pneumatic cushioning device adapted to check the closing movement of the valve; and means for periodically exerting pneumatic pressure upon the valve alternately in opening and closing directions.

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

ARTHUR J. WEST.

Witnesses:
B. A. BRENNAN,
J. E. PICKARD.