(No Model.)

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ROTARY PUMP.

No. 603,805. Patented May 10, 1898.

Fig. 2.

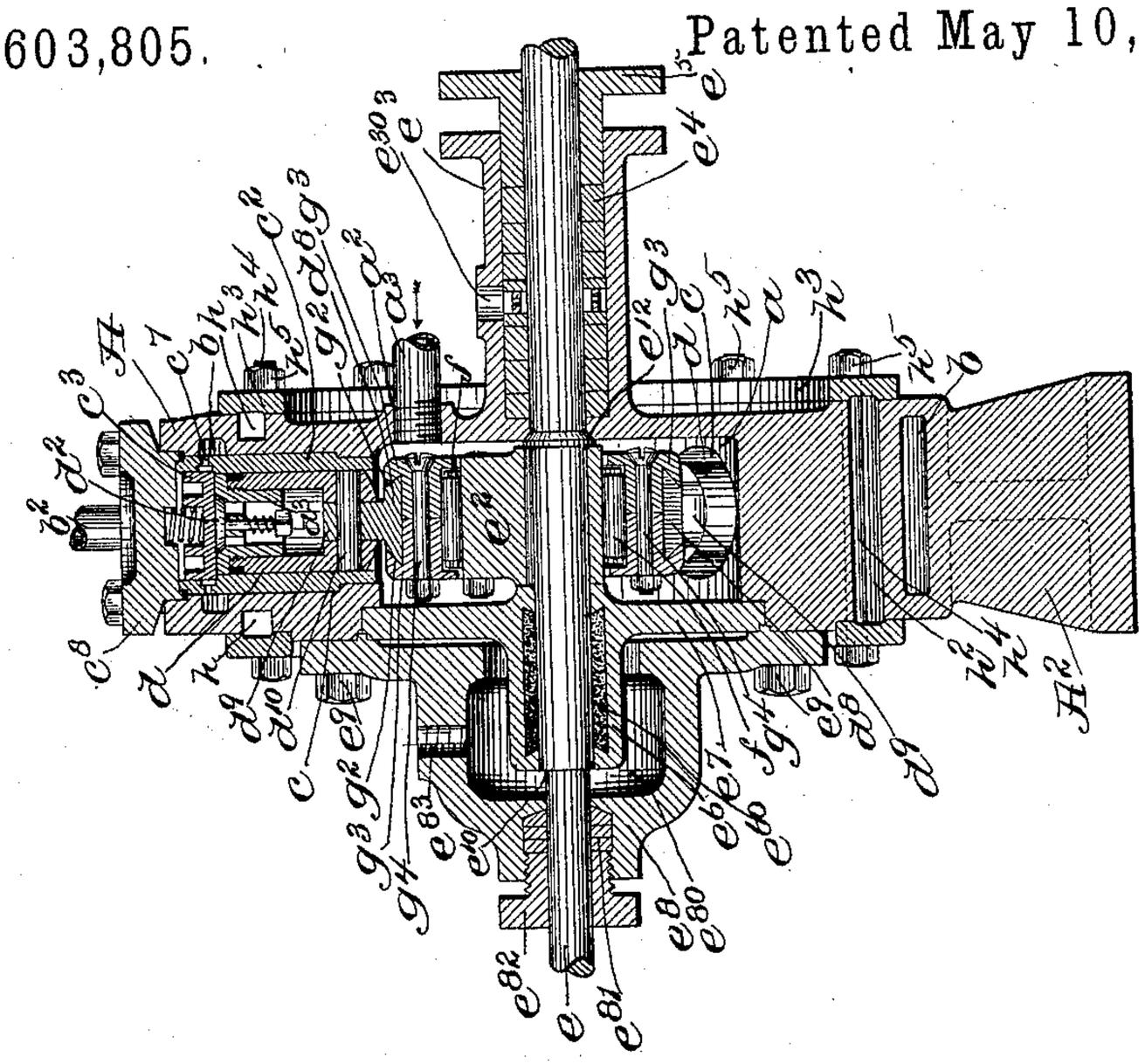

Fig. 1.

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UNITED STATES PATENT OFFICE.

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ROTARY PUMP.

SPECIFICATION forming part of Letters Patent No. 603,805, dated May 10, 1898.

Application filed May 22, 1897. Serial No. 637,710. (No model.)

To all whom it may concern:

Be it known that I, WILLIAM M. WOOD, of Boston, county of Suffolk, and State of Massachusetts, have invented an Improvement in Rotary Pumps, of which the following description, in connection with the accompanying drawings, is a specification, like letters on the drawings representing like parts.

The present invention relates to a rotary pump of that class in which a gang of plungers are caused to reciprocate in suitable chambers or cylinders by the eccentricity of a driving and stationary member and is embodied in a novel construction and arrangement whereby great efficiency is obtained in a machine of small compass, the construction and arrangement of which are such that the machine can be inexpensively constructed.

The pump embodying the invention is mainly intended for use as a gas-compressor in refrigerating systems, although it is equally well adapted for other purposes—such, for example, as compressing air for compressed-air motors, &c.

The machine embodying the invention comprises a frame or casing substantially cylindrical in shape and having a series of radial plunger-chambers surrounding a central bore or opening which is arranged to be substantially gas-tight and constitutes the inlet-chamber of the pump. Each chamber communicates at its outer end through a suitable valve with an annular space formed in the said casing, which constitutes the outlet-chamber, and is provided with outlet-openings adapted to communicate with the receiver for the compressed fluid. Each of the radial plunger-chambers contains a plunger adapted to cooperate with an eccentric, which is mounted on a shaft coaxial with the cylindrical chamber, so that in the rotation of the said shaft the plungers are reciprocated in their respective chambers, each plunger being provided with a valve which is adapted to open as the plunger moves outward with relation to its chamber—*i. e.*, makes its backward stroke toward the middle of the casing—and to close as the plunger moves inward in making its forward or working stroke, so that the gas in the interior of the casing flows into the several plunger-chambers as the respective plungers move out, and is then compressed and forced into the annular outlet-chamber aforesaid during the inward movement of the said plungers. To reduce the friction, the eccentric is surrounded by a loose or floating ring, between which and the eccentric are interposed a number of rollers or similar antifriction devices, and the plungers are caused to coöperate with said ring, each plunger having a shoe connected therewith adapted to be held against the surface of the ring by means of shoulders extending over the same, so that while the said shoes are capable of moving along the surface of the said ring they are held against the said surface as it approaches and recedes from the mouths of the respective chambers in the rotation of the shaft which carries the eccentric. With this construction the ring will not be caused to rotate with the eccentric, while being carried thereby with a revolving movement around the axis of the shaft, and the travel of the shoes along the surface thereof will be only sufficient to compensate for the eccentricity, there being, therefore, a comparatively small amount of friction developed in these parts in the operation of the machine, which consequently is capable of operating at a high speed and compressing to a high degree of pressure.

The invention further relates to certain novel details of construction and arrangement, which will be hereinafter more fully described.

Figure 1 is a transverse vertical section of a pump embodying the invention, and Fig. 2 is a longitudinal vertical section of the same.

The casing A may be formed, as shown, of a single casting, having a standard A^2 formed integral therewith and containing a central opening or inlet-chamber *a*, shown as provided with an inlet-opening a^2, into which is screwed a pipe a^3, leading from the supply of gas or fluid which is to be compressed. Surrounding the said chamber near the outer periphery of the casing is an annular chamber *b*, constituting the outlet-chamber and hav-

ing one or more outlet-pipes b^2, adapted to communicate with the receiver for the compressed gas.

Extending from the chamber a to the chamber b are the plunger chambers or cylinders c, extending radially through the casing A, it being practicable, as shown, to bore the said chambers through from the outer wall of the casing, each chamber then being provided with a bushing c^2, carefully finished, to coöperate with the plunger d, which is movable therein, as will be described. Each of the chambers c therefore affords a communicating passage from the chamber a to the chamber b, the gas passing through an opening in the plunger, controlled by a valve d^2, during the outward movement of said plunger with relation to its chamber, and then during the inward movement thereof being forced into the chamber b through a valve c^3, which closes when the plunger begins its outward stroke, the closing being effected by the pressure in the chamber b, aided, if necessary, by the stress of a spring c^4, with which it is preferably provided.

The valve c^3 is shown as coöperating with an annular valve-seat c^5, formed in the tubular bushing c^2, and just above the said valve-seat an annular space c^6 is formed, said annular space communicating with the chamber b by means of one or more openings c^7, through which the gas is forced into said chamber, it being obvious that the gas can pass through said chamber, around the plunger-chambers, by means of the annular space c^6 aforesaid.

The bushing c^2 is shown as provided with a shoulder c^{20}, coöperating with a corresponding shoulder in the bore in the main casing, and the said bushing is kept in place by means of a bonnet c^8, which is shown as provided with a seat c^9 for the valve-spring c^4, and is secured to the casing by means of bolts or cap-screws c^{10}.

This construction is very simple and has the advantage, moreover, of rendering all parts of the machine easily accessible, it being obvious that if it is desired to get at the interior of any of the chambers it is necessary only to remove the bonnet c^8, when the valve c^3 and bushing c^2 may also be removed, since the bonnet constitutes a fastening device, whereby all the parts are retained after being assembled.

To properly pack the plunger-chamber and prevent the gas from escaping around the bonnet, the bore in the casing is shown as slightly larger at its outer end than along the body of the same, while the upper portion of the bushing is cut away, as shown at c^{12}, thus forming an annular recess at the line of junction between the bore and bushing, in which is laid a ring c^{13} of soft metal, adapted to be engaged on top by a tongue c^{14} along the face of the bonnet c^8, thus constituting a practically gas-tight joint.

The plungers d are shown as consisting of substantially cylindrical shells, having at their inner ends thimbles d^3, adapted to be screwed into the ends thereof and provided with flanges d^4, overlying a packing-ring d^5, supported on a shoulder d^6 at the outside of the plunger. Each of the said thimbles is provided with an opening surrounded by a valve-seat d^7, with which coöperates the valve d^2, above named, the said valve being shown as provided with a stem d^{20}, supported in a bridge-piece d^{21}, and adapted to be seated by means of a spring d^{22}, interposed between said bridge-piece and a nut or enlargement d^{23} at the end of the stem. To produce the reciprocating movement of said plungers, they are adapted to coöperate with an eccentric e^2 on a driving-shaft e, which is mounted in bearings concentric with the axis of the cylinder, so that in the rotation of said shaft the periphery of the eccentric approaches and recedes from the wall of the chamber a.

To connect the plungers d with the periphery of the eccentric which is controlled by the driving-shaft e, each plunger is provided with a shoe d^8, pivotally connected to said plunger, the said shoe being shown as provided with a lug d^9, through which extends a cross-piece d^{10} in the interior of the plunger.

In order to reduce the friction, the shoes d^8, instead of coöperating directly with the eccentric e^2, which would necessitate a constant travel of said eccentric along the surface of the shoes at whatever speed the shaft was operated, are caused to coöperate directly with a floating ring g, surrounding the eccentric e^2, so that the outer periphery of said ring will follow the movement of the periphery of the eccentric, and between the said ring and the eccentric are interposed antifriction devices or rollers f, so that the eccentric can travel within the ring with but slight friction, while the ring, by reason of its non-rotation, has but slight sliding movement with relation to the shoes d^8. To properly coöperate with the shoes d^8, the said ring is shown as provided along its periphery with undercut shoulders g^2, overlying and engaging a portion of the shoes d^8, so that the shoes, while free to travel along the periphery of the ring, are constantly held against the same, whereby each plunger in turn will be forced forward into its cylinder and drawn backward therein as the periphery of the ring approaches and recedes from the wall of the inner chamber. The said ring is shown as comprising two sections g^3, each of which has one of the undercut shoulders g^2 formed therein, so that the two sections can be separated for the insertion of the shoes, and then drawn together, as shown, and secured by the bolts g^4, so that the shoes are retained in position by said shoulders, the ring then practically having an undercut groove along its periphery adapted to retain the shoes.

In the operation of the machine it will be seen that the ring being acted upon by the shoes against the pressure of the gas will remain substantially balanced or stationary,

while the shoes will simply travel back and forth along the periphery thereof to a slight extent to compensate for the eccentricity, the friction, therefore, being but slight and nearly all taken up by the antifriction devices. It is possible, however, for the ring to rotate or turn upon its own central axis, so that it may remain without sliding on the shoe of that one of the plungers which at any moment is meeting the greatest resistance or back pressure, and the slight compensating sliding movement thus takes place mainly between the ring and the shoes of the plungers against which the pressure is least.

The shaft *e* is shown as provided with a bearing e^3 in one side of the casing A, the said bearing comprising an opening through the main wall of the said casing and an extension therefrom containing packing material e^4, which surrounds the shaft and is held in position by means of a locking bearing member e^5, fitting the shaft and extending into the extension e^3 against the packing material. The extension e^3 is shown as provided with an oil-hole e^{30} for the purpose of keeping the said shaft lubricated. To further assist in packing the shaft-bearings to prevent the escape of gas from the chamber *a*, the opposite end of said shaft is shown as provided with a suitable bearing or two bearings, the bearing e^6 being shown as formed in a bonnet-piece e^7, adapted to fit the open side of the casing and close the chamber *a*, the said bonnet-piece being held in place by a supplemental bonnet-piece e^8, secured to the wall of the casing A by means of cap-screws e^9. Within the bearing e^6 there is packing material e^{60}, so as to form a substantially gas-tight joint, it being obvious, however, that such gas as may leak through or escape will enter the chamber e^{80}, formed by the bonnet-piece e^8. Where the shaft passes through the said chamber, it is provided with packing material e^{81} and a locking bearing member e^{82}, and the chamber e^{80} is shown as provided with an annular opening e^{83} for oil, it being intended to keep the said chamber substantially full of oil, which will then work in along the shaft to keep the bearings lubricated. As stated, such gas as escapes from the chamber *a* at this end of the shaft will enter the chamber e^{80}, and in order that the pressure of such gas may assist in packing the shaft the end of said shaft which passes through the bearing-piece e^{82} is of smaller diameter than the main portion of the shaft, so that a shoulder e^{10} is formed thereon, it being obvious, therefore, that the gas in the oil-chamber e^{80} will exert an unbalanced pressure on the said shoulder, tending to force the said shaft to the right, Fig. 2. At the opposite end of the said shaft, where it lies adjacent to the body of the casing A, it is shown as provided with an enlargement e^{12}, having an annular beveled surface adapted to coöperate with a countersunk beveled opening in the inner wall of the casing A, it being obvious that the pressure upon the shoulder e^{10} will tend to force the said enlargement closely into contact with the countersunk portions of the openings, so as to effectually close that end of the shaft and prevent leakage of gas at that side.

In the form of pump herein shown the pressure in the chamber *a* is slight during the operation of the pump, it being obvious, however, that when the pump is stopped the pressure will be equalized in the chambers *a* and *b* and will then tend to leak through the shaft-bearings, while the construction above described will tend to prevent loss by leakage. Manifestly, however, the inlet and outlet chambers might be reversed by a proper arrangement of the valves, in which case the chamber *a* would become the high-pressure chamber, and the novel packing means above described are designed with a view to such construction. It may be stated in this connection that while the chambers *a* and *b* have been referred to, respectively, as the inlet and outlet chambers it is not intended to limit the invention in this respect, as it would only involve reversing the valves to reverse the functions of the chambers, without departing in any sense from the construction which embodies the invention.

The construction hereinbefore described of the casing is such that it is a comparatively simple matter to form a water-jacket for cooling the plunger-cylinders, the said water-jacket being obtained, as shown, by forming an annular groove *h* in the outer wall of the casing, at each side thereof, the said grooves being connected across between the plunger-cylinders by means of transverse openings h^2, while the grooves and chambers are closed to form a receiving-chamber for cold water by means of the annular bands h^3, extending along the said grooves in the walls of the cylindrical casing, and are shown as secured in position by means of bolts h^4 and nuts h^5, the said bolts extending across through the transverse openings h^2, as best shown in Fig. 1. The inlet and outlet to this space may be located in any convenient position and are not herein shown, since it is obviously only necessary that the water should be admitted and allowed to flow out before it has absorbed heat enough to become useless.

I claim—

1. A rotary pump comprising a casing having a closed gas-chamber in the interior thereof and a separate closed gas-chamber also formed in the casing and surrounding the interior chamber, a series of plunger-chambers each one of which extends from one of said closed gas-chambers to the other, a plunger adapted to reciprocate in each plunger-chamber and having a valve adapted to be opened during the movement of said plunger in one direction but not in the other, a valve controlling the communication of each plunger-chamber with one of said gas-chambers, said valve being adapted to be closed when the plunger-valve is open, means for reciprocat-

ing the said plungers, and a gas-inlet to one of said chambers and a gas-outlet from the other, substantially as described.

2. The combination with a casing having an interior closed gas-chamber, provided with an inlet for the gas to be compressed, of an annular gas-chamber in said casing surrounding said closed chamber and adapted to receive and deliver gas after the compression thereof, a series of plunger-chambers extending from said annular gas-chamber to said interior gas-chamber, a plunger adapted to reciprocate in each plunger-chamber, a shaft extending through the interior gas-chamber and having an eccentric mounted thereon, a ring or float surrounding said eccentric, antifriction devices or rollers between said eccentric and said ring, a shoe connected with each plunger and having a portion adapted to be retained in an undercut groove along the outer periphery of said float, a valve in each plunger adapted to be open during the movement of said plunger toward said interior gas-chamber and to be closed during the movement of said plunger in the opposite direction, and a valve interposed between each plunger-chamber and the annular gas-chamber adapted to be opened during the movement of the plunger toward the same and to be closed during the movement of the plunger in the opposite direction, substantially as described.

3. In a rotary pump, the combination with a casing provided with a series of radial plunger-chambers, of a gas-chamber in the interior of said casing, a second gas-chamber formed in the casing, and surrounding the gas-chamber first named, all of the plunger-chambers extending from one gas-chamber to the other and communicating with both, a plunger in each plunger-chamber, and means for reciprocating the same, a gas-inlet to one of said gas-chambers and a gas-outlet from the other, a valve in each plunger adapted to be closed during the movement thereof toward the chamber with the outlet, a valve controlling the communication of each plunger-chamber with the gas-chamber having the outlet, and a water-jacket for the plunger-chambers comprising an annular groove extending along each wall of the casing, transverse passages through the said casing between the plunger-chambers to afford communication between said annular grooves, and a cover or closure for each groove adapted to be secured to the side of the casing over the said groove, substantially as and for the purpose described.

4. In a rotary pump, the combination with a substantially cylindrical casing provided with an interior gas-inlet chamber, of a series of radial openings extending from the outer periphery of said casing to said chamber, a lining or bushing adapted to be inserted into each of said openings and itself constituting a plunger-chamber, an annular valve-seat formed in said bushing, a valve seated thereon, an opening in said bushing above said valve-seat, an annular gas-outlet chamber formed in said casing and having communication with all the plunger-chambers through said openings in the several bushings, an annular channel in the interior of each bushing surrounding the valve, a plunger longitudinally movable in each of said bushings and itself provided with a valve, means for reciprocating said plungers whereby the gas is caused to pass through the same from the interior gas-inlet chamber and to be compressed and forced into the annular gas-outlet chamber aforesaid, and a bonnet adapted to be secured to the outside of the casing at each opening, to close the said openings and maintain the bushing in position, substantially as described.

5. In a rotary pump, the combination with a cylindrical shell having an internal closed gas-chamber and an annular closed gas-chamber surrounding the internal chamber, of radial bores or openings extending from the outside periphery of the casing through the annular chamber to the internal chamber, a bushing for each bore provided with a shoulder, an enlarged mouth for each bore extending from a point adjacent to said shoulder to the outside periphery of the shell, whereby a shoulder is formed in the bore adjacent to that on the bushing, an annular ring of packing material supported upon the said shoulders, a bonnet provided with a tongue adapted to engage said packing material, a plunger longitudinally movable in and fitting the bushing in each bore, said plungers being adapted to be operated by an eccentric mounted on a shaft extending transversely through the said shell, and valves to control the passage of gas through the plunger from one of the gas-chambers to the other, substantially as described.

6. In a rotary pump, the combination with a stationary cylindrical casing provided with a series of radial plunger-chambers, of a closed gas-chamber within said casing and communicating with all of said plunger-chambers, an annular gas-chamber also formed in the casing and surrounding the gas-chamber first named, and also communicating with all of said plunger-chambers, a plunger in each of said plunger-chambers, an eccentric rotatably mounted within said casing, a ring surrounding the said eccentric, the periphery of which ring is adapted to coact directly with the said plungers to produce a reciprocatory movement thereof, antifriction devices interposed between said eccentric and said ring, and valves to control the passage of gas through the said plungers from one of said chambers to the other, substantially as described.

7. In a rotary pump, the combination with the gas-chamber, of gas-compressing devices, an actuating-shaft therefor, a bearing for said shaft in one wall of said chamber having a countersunk or tapered mouth adapted to coöperate with an annular tapered shoul-

der or enlargement on the said shaft, a bearing for the said shaft in the opposite wall of said chamber, an oil-chamber inclosing said bearing and itself provided with a packed supplemental bearing for the said shaft, the sectional area of said shaft where it passes through said supplemental bearing being less than the sectional area thereof at the main bearing, whereby a certain area is subjected to unbalanced pressure of gas which may have escaped into the oil-chamber, said pressure tending to move the said shaft longitudinally and bring the annular shoulder thereof into engagement with the annular mouth of the bearing at the opposite end, substantially as and for the purpose described.

8. The combination with a casing having an interior closed gas-chamber, of an annular gas-chamber formed in said casing and surrounding the said interior chamber, a series of plunger-chambers extending from one of said gas-chambers to the other, a plunger adapted to reciprocate in each plunger-chamber, a shaft extending through the interior gas-chamber and having an eccentric mounted thereon, a ring or float surrounding the said eccentric and adapted to coöperate with the plungers aforesaid to produce the reciprocatory movement thereof, antifriction devices interposed between said eccentric and said ring, a valve in each plunger adapted to be open during the movement of said plunger in one direction and to be closed during the movement thereof in the opposite direction, and a valve interposed between each plunger-chamber and one of the said gas-chambers adapted to be open during the movement of the plunger toward the same and to be closed during the movement of the plunger in the opposite direction, substantially as described.

9. In a rotary pump, the combination with a cylindrical shell having a longitudinal opening through the middle, of an annular closed chamber formed in the said shell and surrounding the said opening, a series of plunger-chambers extending from the said opening to the said annular chamber, a plunger in each plunger-chamber, a valve in each plunger to permit gas to pass in one direction but not in the other, a valve controlling communication between the plunger-chamber and the gas-chamber toward which the plunger moves in its operative stroke, a shaft having an eccentric coöperating with said plungers, the said shaft extending through the opening in the shell, bonnets for the ends of the shell having bearings for the shaft, the said bonnets closing the opening in the shell so that the said opening and bonnets constitute a closed gas-chamber; and gas-passages communicating respectively with said closed gas-chamber and the annular chamber aforesaid, substantially as described.

10. In a rotary pump, a casing having an interior closed gas-inlet chamber, of a gas-outlet chamber surrounding the said inlet-chamber and also formed in the casing, a bore or opening extending from the outside of the casing through the gas-outlet chamber to the gas-inlet chamber, a bushing inserted in said bore, an annular valve-seat in said bushing, an opening in said bushing above said valve-seat to afford communication with the gas-outlet chamber, a valve coöperating with said seat, a bonnet secured to the outside of the casing to hold the said bushing in place, a spring interposed between said bonnet and said valve, a plunger fitting said bushing, the face of said plunger being adapted to engage and lift the said valve, means for reciprocating said plunger, an opening in said plunger controlled by a valve adapted to be open during the movement of said plunger toward the inlet-chamber and closed during the movement thereof toward the outlet-chamber, an inlet to the inlet-chamber and an outlet from the outlet-chamber, substantially as described.

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

WILLIAM M. WOOD.

Witnesses:
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