2 Sheets--Sheet 1.

J. S. BARDEN.

Pumps.

No. 134,626. Patented Jan. 7, 1873.

Fig. 1.

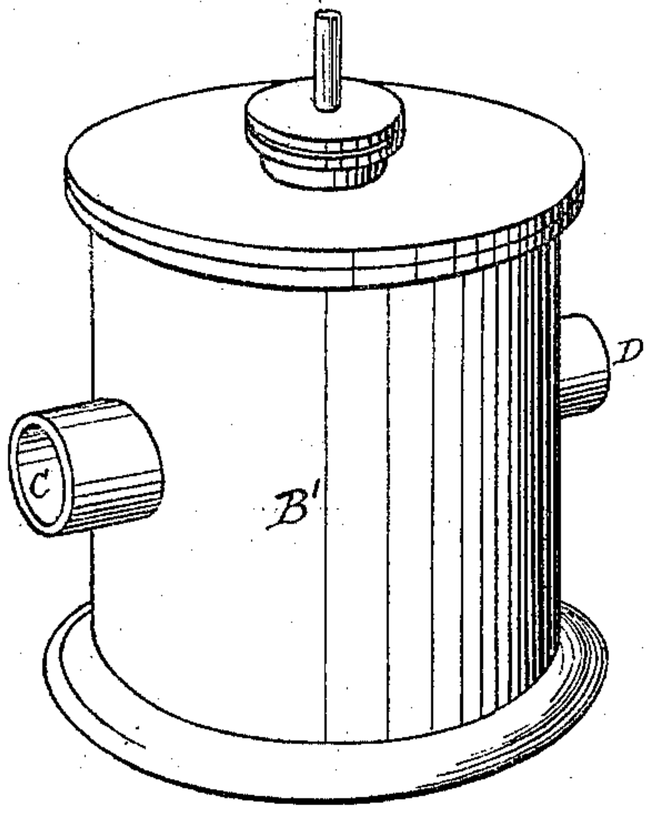


Fig. 2.

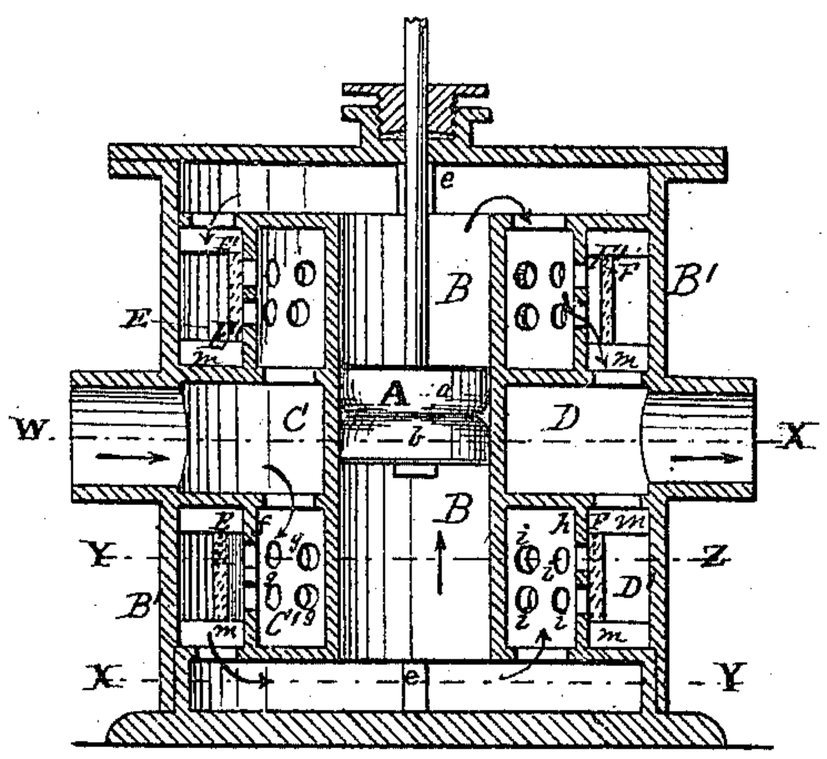


Fig. 3

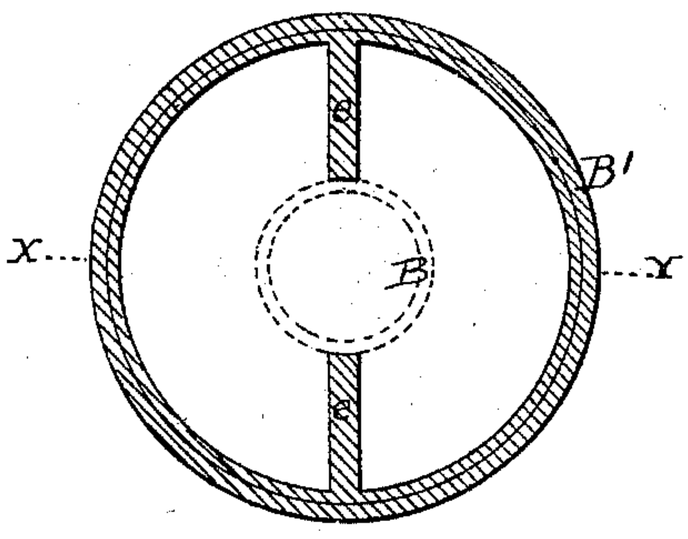


Fig. 4.

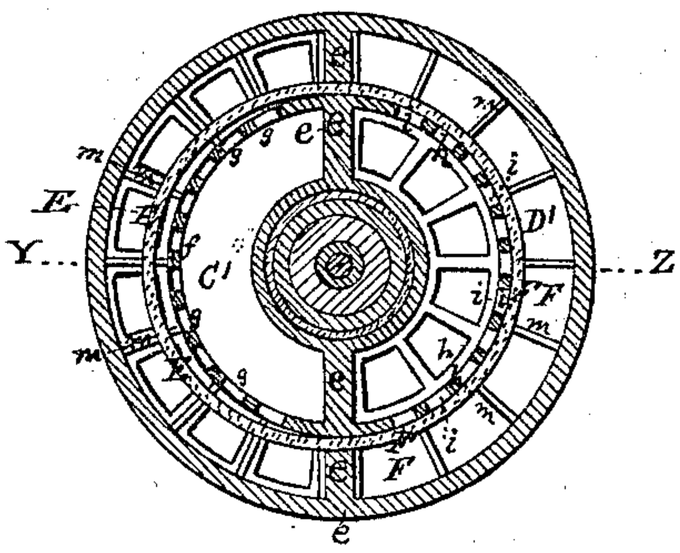


Fig. 6.

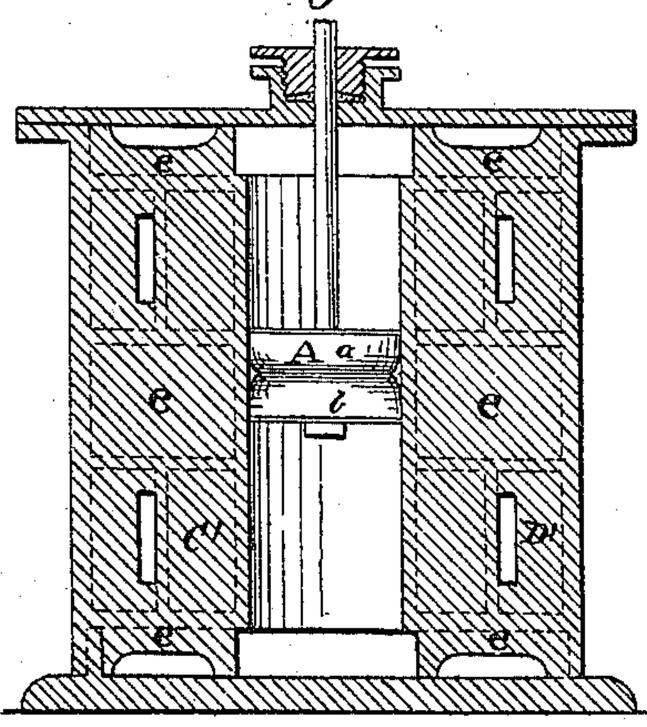
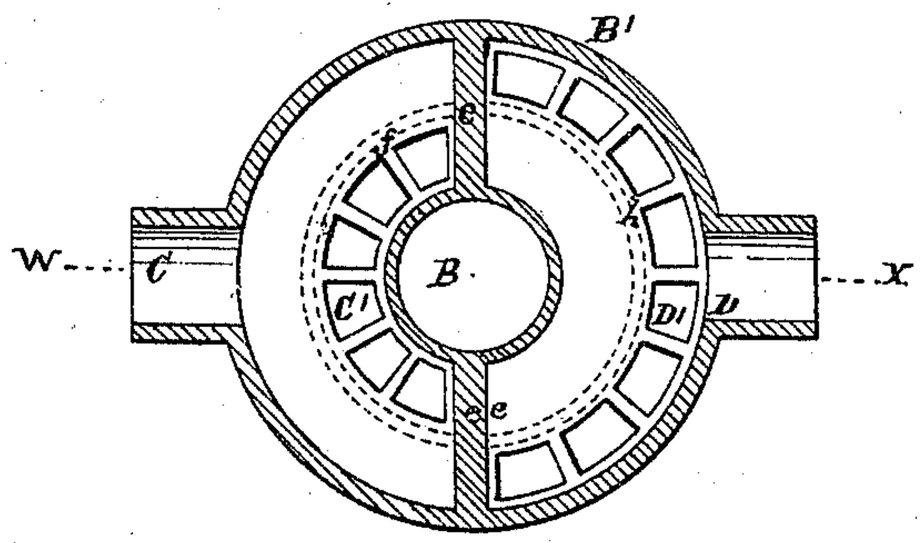


Fig. 5.



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2 Sheets--Sheet 2.

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Pumps.

No. 134,626. Patented Jan. 7, 1873.

Fig. 7.

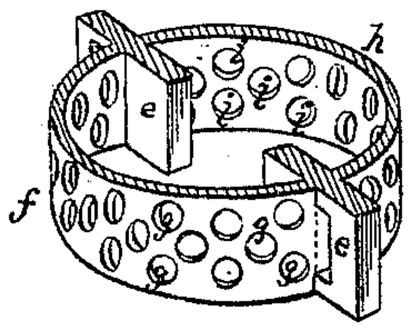


Fig. 9.

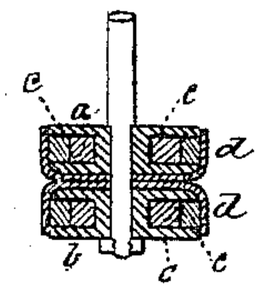


Fig. 8.

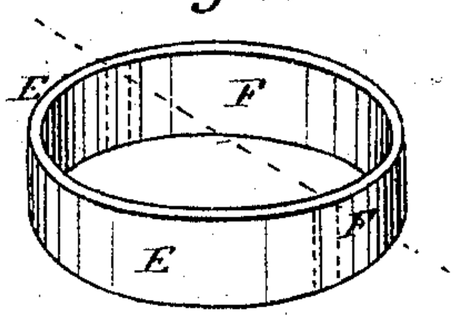
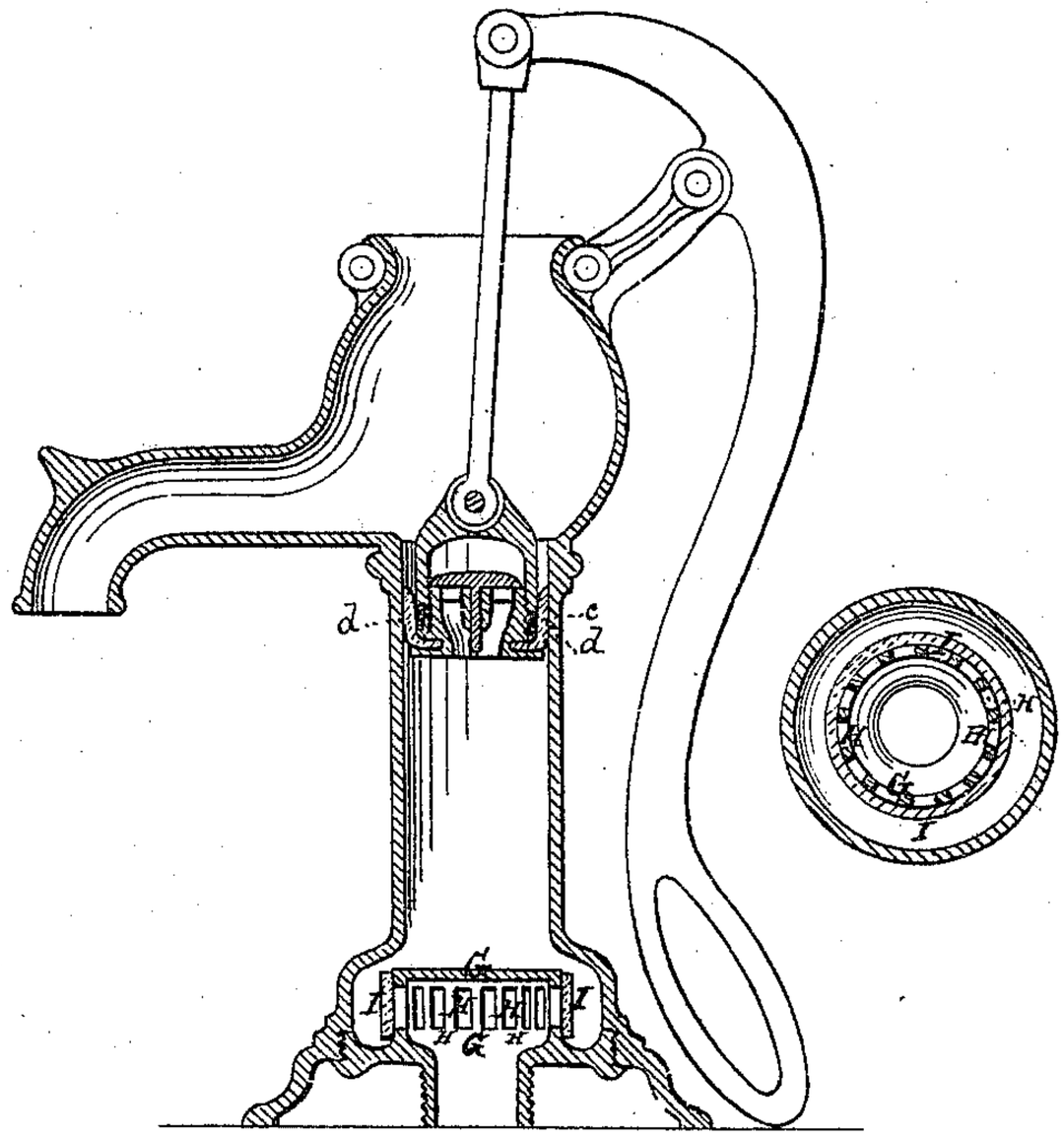


Fig. 10.

Fig. 11.



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UNITED STATES PATENT OFFICE.

JOHN S. BARDEN, OF PROVIDENCE, RHODE ISLAND.

IMPROVEMENT IN PUMPS.

Specification forming part of Letters Patent No. **134,626**, dated January 7, 1873.

To all whom it may concern:

Be it known that I, JOHN S. BARDEN, of the city and county of Providence, in the State of Rhode Island, have invented certain new and useful Improvements in Pumps.

My improvements relate not only to that general class of single and double acting force-pumps in which a plain cylinder-chamber open at both ends is combined with a solid piston and located within an inclosing-chamber which is divided into suitable chambers; but also to the common lifting-pump. My invention consists, partially, in combining with a piston and cylinder a novel "band-valve," which, by its own inherent elasticity, maintains proper relations with its valve-ports, and exercises its valve functions in opening and closing without hammering on its seat and without liability to be rendered inoperative by the introduction between it and its seat of any stony or earthy matter which might possibly enter through the valve-ports. (This novel band-valve constitutes the subject-matter of a separate application, and is therefore not intended to be embraced within these Letters Patent.) Also, in a novel combination, within an inclosing-case, of a piston, an interior piston-chamber, two exterior or surrounding chambers communicating with the interior chamber through suitable valve-ports, and a suitable number of elastic band-valves, which are arranged to guard the valve-ports and permit the pump to draw and force water with ease and steadiness, and wholly without the shock and blow upon the valve-seats, which results from the so-called "water-hammer" usually attendant upon the reversal of the movement of such pistons when rapidly operated; and I do hereby declare that the following specification, taken in connection with the drawing furnished and forming a part of the same, is a clear and true description of pumps embodying the several and combined features of my invention.

Referring to the drawing, Figure 1 represents, in perspective, one of my pumps arranged to operate vertically; Fig. 2 represents, in vertical section, one of my double-acting pumps; Fig. 3 represents, in horizontal section, the pump shown in Fig. 2 on line X Y; Fig. 4 represents, in section, the same on line Y Z of Fig. 2; Fig. 5 represents, in section, the same on line W X; Fig. 6 represents the pump, in vertical section, on a line transverse to that shown in Fig. 2; Fig. 7 represents, in perspective, the walls of the valve-chambers, as if detached from the pump; Fig. 8 represents, in perspective, the elastic band-valve detached; Fig. 9 represents, in longitudinal section, a pump-piston well adapted for use with my pumps; Fig. 10 represents, in perspective, the cup-like leather-surface packing of the piston; and Fig. 11 represents, in section, the interior arrangement of a simple lifting-pump, to which my band-valve is adapted.

A denotes the piston. It is composed in this instance of duplicate parts *a* and *b* of suitable depth or thickness. These parts, each of which is a practically-perfect piston, are both mounted upon the piston-rod consecutively, and secured thereto, near the end, in the usual manner, so that the adjacent faces of the two may be pressed together and bind between them that portion of the packing which is interposed. Each part or piston (see Fig. 9) is provided with a peripherical groove, in which is placed one or two elastic packing-rings, *c*, composed of vulcanized rubber, or of any other suitable material, backed up by any of the well-known kinds of ring-springs adapted to analogous purposes. The surface-packing *d* is cup-shaped, as shown in Fig. 10, and is preferably composed of leather properly prepared as usual for the purpose, although other materials possessing analogous characteristics may be employed with approximate results. The packing *d* may be formed from a flat disk of leather, in molds, or by cutting a disk with a diameter equal to that of the piston, plus its thickness, applying it while wet, and securing it thereto, either between two pistons, as shown, or between one piston and a metallic disk of corresponding diameter. After brief use in the pump the leather disk will assume and retain the desired form. When employed upon a valve-piston an annular disk with an open center may be employed to secure the cup-like packing (also with an open center) to the piston by the aid of rivets or screws. The elastic packing-rings *c*, when in position, constantly force the packing into proper contact with the cylinder. When used in an ordinary lifting-

pump I prefer that the cup-like edge should project upward. When used with a single-acting force-pump I prefer that the cup-like edge should project in the same direction that the piston will travel in while forcing water. In a double-acting pump the piston should be double, as shown, with the packing *d* projecting in opposite directions. B denotes the piston-cylinder. It is open at both ends, and inclosed by an exterior cylinder, B′, which is divided into two interior subdivisions by means of the vertical partitions *e*, which extend from bottom to top and from the exterior of the piston-cylinder B to the interior of the exterior cylinder B′. One of these main chambers is designated as C, which may properly be termed the induction-chamber, and the other, marked D, as the eduction-chamber. They are respectively connected with the supply and discharge pipes. C′ denotes a chamber which communicates with, and is in fact an extension of, the induction-chamber C. The wall *f* of this chamber is parallel with the piston-cylinder, and describes a half circle, extending from partition *e* on one side around to the partition on the opposite side. The wall *f* is perforated with numerous induction-valve ports, *g*, and its convex surface is in fact the valve-seat of the induction side of the pump. D′ denotes another chamber, which communicates with, and is in fact an extension of, the eduction-chamber. Its wall *h* is provided with numerous eduction-valve ports *i*, and its convex surface is in fact the valve-seat of the eduction side of the pump. The great superficial area of the walls *f* and *h* admits of many valve-ports therein, and any practically desired area of valve-opening can therefore be readily attained.. E and F denote, respectively, the lower band-valves which guard the induction-valve ports *g* and eduction-ports *i*. In this instance the two valves are represented as if made in one piece, in the form of a wide annular band, shown in perspective in Fig. 8. It is composed of elastic vulcanized rubber, so arranged that it will bear with proper force upon the valve-seats, which are merely the outer or convex surfaces of the walls *f* and *h*. This ring encircles these walls, passing through openings in the partitions *e*, as seen in Fig. 6, provided for that purpose, which can be made accessible by means of slots, for instance, extending from the ends of the pump. In Fig. 7 the walls *f* and *h* are represented as if detached entire, and in perspective for the purpose of illustration. Instead of this circular compound valve-band two separate ones can be profitably employed, each of which would be equal to one-half the one shown. When so formed, however, it becomes necessary to secure each end with proper tension, so as to cause the band-valve to press with proper force upon its convex valve-seat.

For a double-acting force-pump the several chambers, valves, &c., are duplicated, as shown in Fig. 2.

The operation of such a pump may be briefly described, as follows: While the piston ascends the valve E, by suction, is opened, and water will be drawn into the lower end of the main piston-cylinder chamber B. Meantime if the piston-cylinder be full of water the piston, as it rises, will force the water in the upper end of the cylinder B, through the ports guarded by the upper valve F′, into the eduction-chamber D. On completing this movement and commencing the descent, the piston, by pressure, would close the lower valve E, guarding the ports *g*, and force the water already drawn in outward through the lower valve F, which guards the ports *i*. Meantime the upper valve E′ will have been opened, and through its ports a charge of water will have been drawn from chamber C, and so on at each stroke of the piston.

In order to secure free ingress and egress of water over and under the edges of the band-valves, certain projected bearings *m* are employed, on which the band-valve may touch, and between which water may freely flow when the valves are distended.

A common lifting-pump is represented in section in Fig. 11, illustrating the combination therewith of an ordinary valve-piston and my novel band-valve. The holding-valve in this instance consists of an upward-projecting annular partition, G, which has vertical sides, perforated with numerous ports H, through which the water is to be drawn into the body of the pump. The annular band-valve I encircles the vertical perforated sides, which constitute, in fact, the valve-seat. When the valve-piston ascends the band-valve is distended, and water drawn into the body of the pump. When the movement ceases, and while the open-valve piston descends, the band-valve prevents the downward passage of the water.

There is seldom much strain on the band-valve, and, as none of the ports need to be of great area, it can be made thin and light. The force requisite to expand or distend the band-valve is so slight, in addition to that necessary for the draft of water, that the difference between the power required for working a pump of this character and one of ordinary construction would be hardly perceptible, all things being otherwise equal.

There are many advantages possessed by my pump over any with which I am acquainted, among which are the following: It can be constructed at less cost than any other pump known to me—for instance, the pump shown in Fig. 2 can be made practically operative with but little machine-work, except the turning out of the piston-cylinder, fitting the piston and rod, and certain screw-bolts for securing the pump-heads to the outer case B′, and connections for induction and eduction. With great variety in the arrangement of the inclosing-case and the several chambers the entire shell can be cast with the several induction and eduction valve-ports; and, if ordinarily smooth and free from positive defects, the convex surfaces of walls *f* and

h will, with good results, receive the band-valves, which, by their general elasticity, will conform to said surfaces, and form therewith a valve-tight joint. It may, no doubt, be preferable to have the convex valve surfaces turned off, but practically-valuable results may certainly be attained without it.

The band-valve involves no hinge-connections, no accurate fitting or grinding, and so long as the inherent elasticity is retained therein its functions will be properly performed. There is but little wear upon the valve-seat except that which results from the passage of water or earthy matter over it. Corrosion will, of course, occur, as in all cases with metallic pumps. It is evident that the wear on the seat or the corrosion will occur with considerable uniformity all over the surface, and therefore that the band-valve will continue, regardless thereof, to operate with nearly as good results as when the pump was new.

Whenever earthy or stony matter in passing the valve is caught between the band-valve and its seat, the thin elastic band closes down about it on all sides, and, by proper contact with the seat at surrounding points adjacent thereto, will still properly act as a valve and release the stone at its next movement.

A double-acting pump, for instance, constructed substantially as shown in Fig. 2, is practically free from all objectionable jar or shock generally known as "water-hammer," at the reversal of the movement of the piston, for the opening and closing of the valves is easily and gradually accomplished. The widest opening of the band-valve from its seat occurs at that point which is midway between the points at which it is secured, and the opening gradually lessens each way to those latter points. Their movement is as prompt as could be desired, and from the fact that at each closing movement the valve is really "water-cushioned," it is practically impossible for the closing movement to be other than easy.

Although I have described my elastic band-valve and the piston in connection with pumps adapted to the lifting and forcing of liquids, it will be readily obvious that they have special value in connection with air or vacuum pumps; and also that the band-valve possesses the desirable characteristics which will enable it to successfully perform the simple service of a check-valve, which will allow gases, air, or liquids to flow through it under a slight pressure or other actuating force, and permit no retrograde movement thereof, as in fact it performs that service only in the lifting-pump herein described.

I am well aware that pumps employing the elastic band-valve can be constructed with the interior arrangement of the piston-cylinder and chambers in an almost endless variety; and I therefore do not confine myself to any of the precise constructions shown. I am also well aware that prior to my invention pumps have been made in which the interior piston-cylinder has been combined with exterior chambers of a similarly general character to those herein described, and that they have been provided with numerous valve-ports, each of which was guarded by a separate spring-valve or others of that character. Also, that flap-valves composed of leather, gum elastic, or similar material have been combined with concave valve-seats; and that said flaps have been secured at each end in such a manner that each flap would "belly" in against the seat when closing the valve, and then "belly" out for the opening. I am also aware that valve-pistons have been made in the form of an inverted hollow cone, and fitted with certain cup-like or conical valves, which, by the weight of the water contained therein during the elevation of the pistons, caused said valves to maintain proper relations with their seats.

I am not aware, however, that prior to my invention one or more pump-valve ports have ever been combined with or guarded by a band-valve, which, while secured at opposite points adjacent to the surface of the valve-seat, would guard said ports by its own inherent elasticity or elastic force.

I therefore claim as new and desire to secure by Letters Patent—

1. The combination, with a piston-pump, of the requisite valve-ports, having a suitable seat or seats, and the elastic band-valve embracing the seat, substantially as and for the purposes specified.

2. The combination of the piston, its cylinder, the inclosing-case divided into induction and eduction chambers, the several induction and eduction valve-ports, and the elastic band-valves E F, substantially as and for the purposes specified.

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