R. Y. BOVEE.

DUPLEX HYDRAULIC RAM.

APPLICATION FILED MAR. 13, 1909.

1,038,719.

Patented Sept. 17, 1912.

3 SHEETS—SHEET 1.

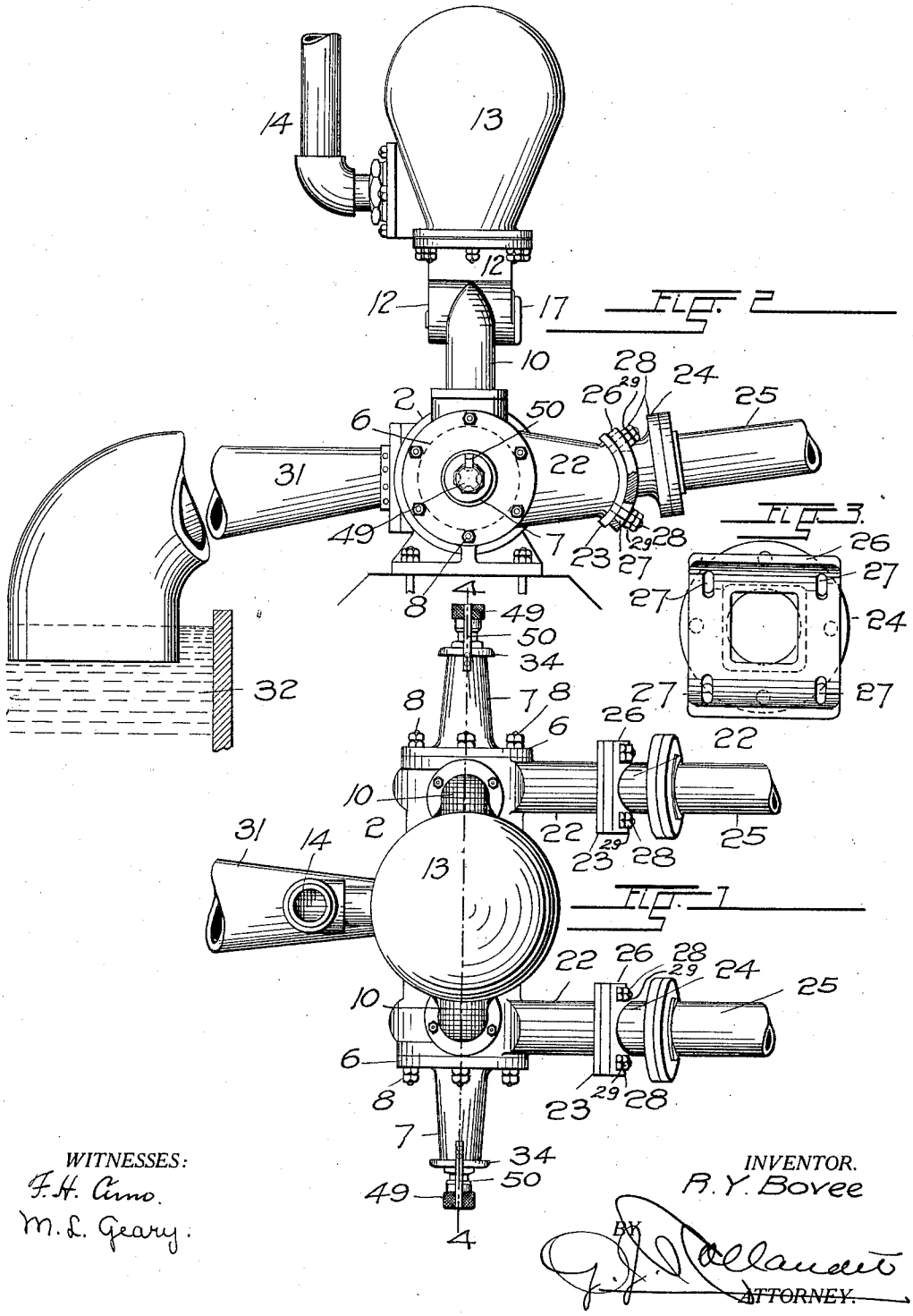

FIG. 2

FIG. 3.

FIG. 1

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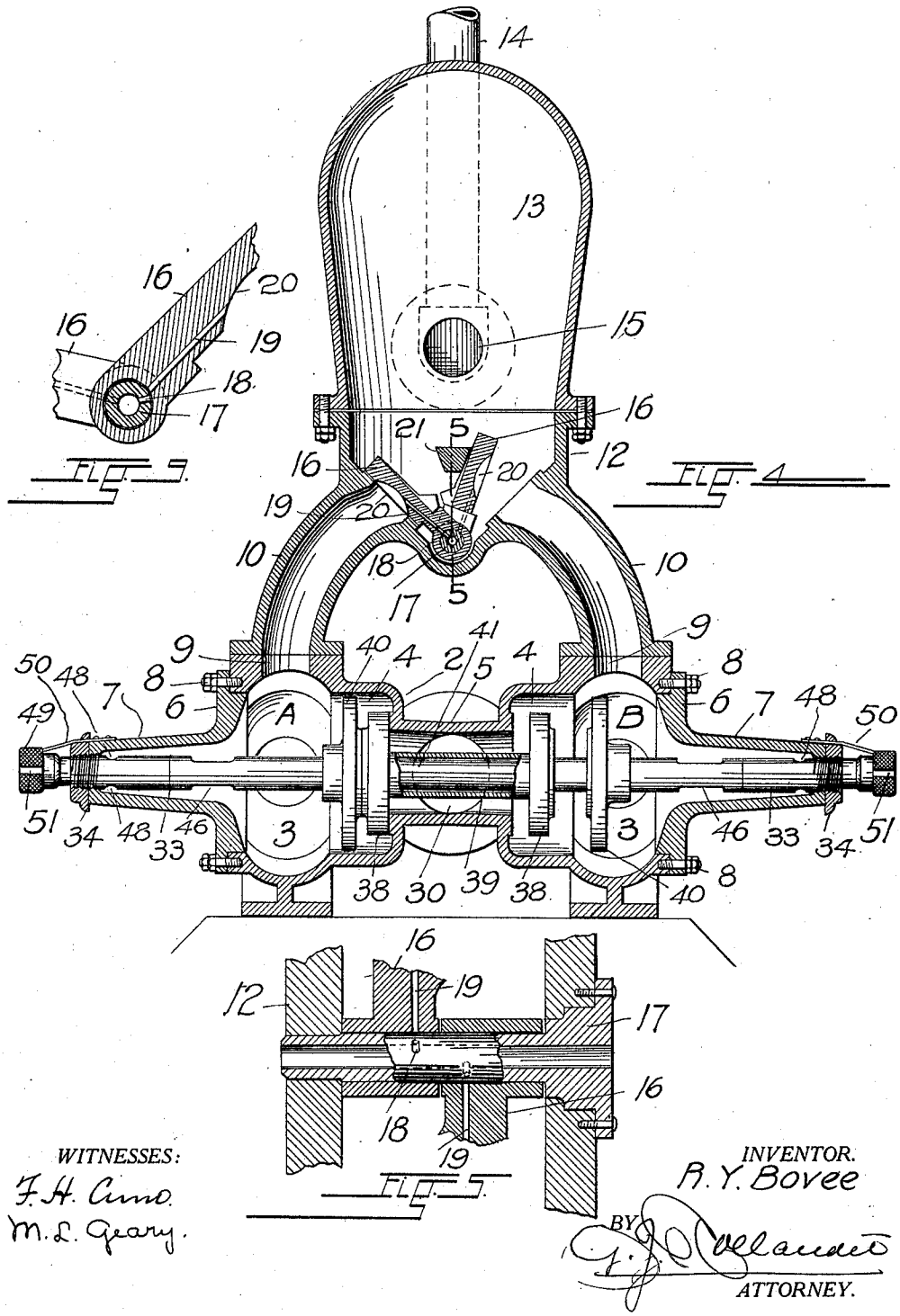

FIG. 1.

FIG. 4.

FIG. 5.

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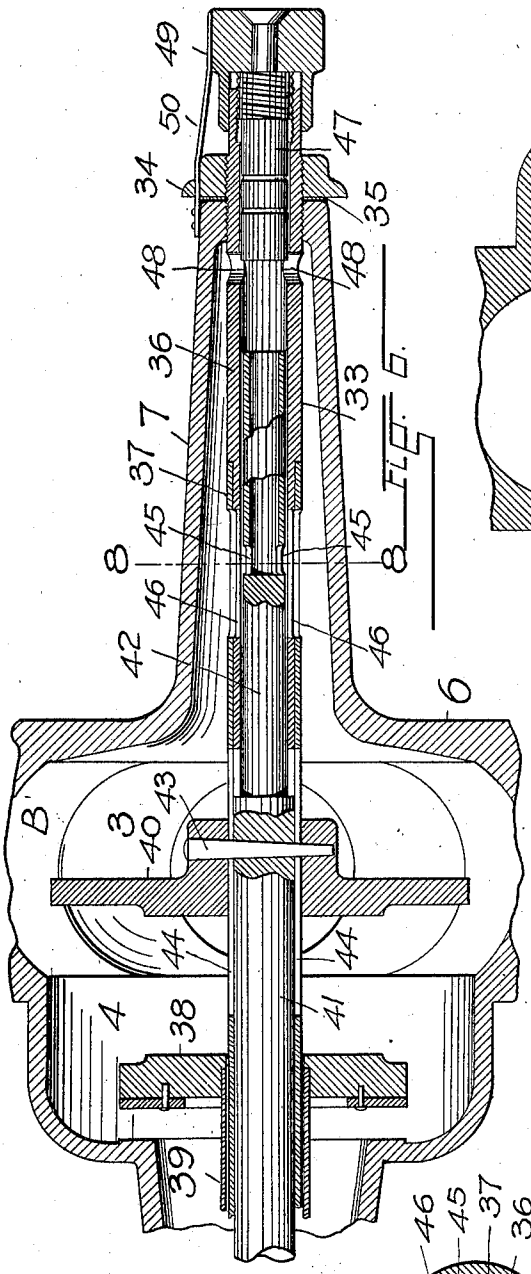

FIG. 6.

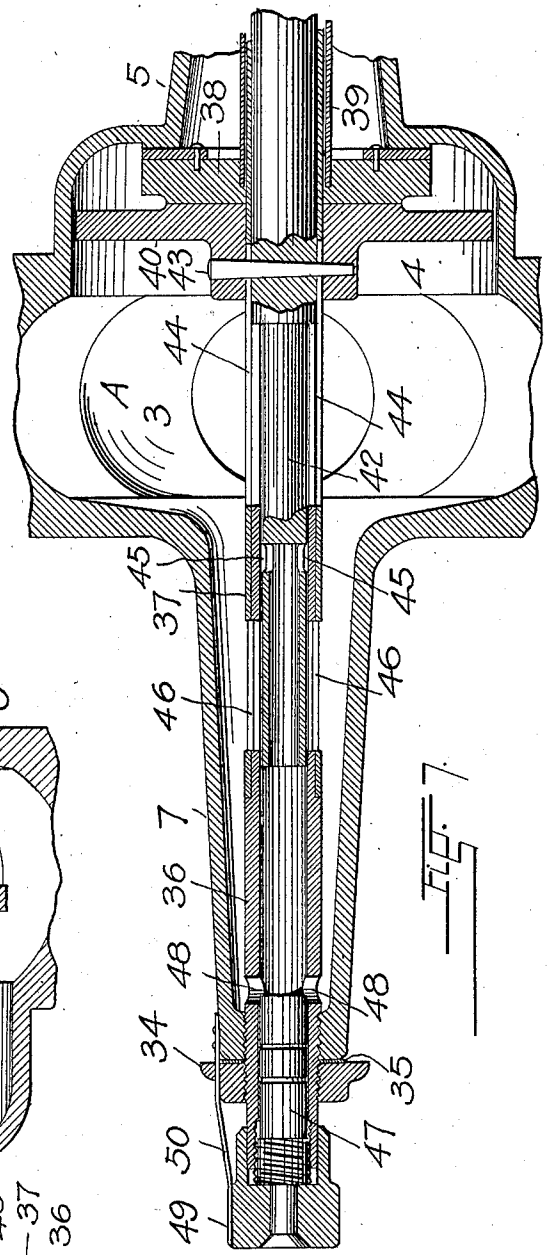

FIG. 7.

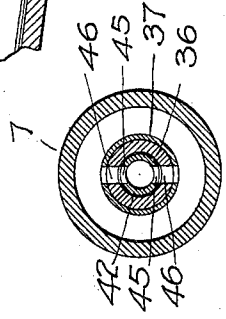

FIG. 8.

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UNITED STATES PATENT OFFICE.

RANSOM Y. BOVEE, OF DENVER, COLORADO, ASSIGNOR TO HYDRO ENGINE, POWER AND IRRIGATION COMPANY, OF DENVER, COLORADO.

DUPLEX HYDRAULIC RAM.

1,038,719. Specification of Letters Patent. **Patented Sept. 17, 1912.**

Application filed March 13, 1909. Serial No. 483,267.

To all whom it may concern:

Be it known that I, RANSOM Y. BOVEE, a citizen of the United States of America, residing at Denver, in the county of Denver and State of Colorado, have invented certain new and useful Improvements in Duplex Hydraulic Rams, of which the following is a specification.

This invention relates to the class of water raising devices, known as hydraulic rams and its object resides in the provision of an automatic machine of the class named in which two motive columns of water operate alternately to raise by the force of their momentums a portion of their own volumes in a common raising main or stand pipe, and which in consequence, combines great capacity with increased power for raising the fluid to a high point of delivery.

Further objects of my invention reside in the provision of an automatically-acting device whereby the moving masses are alternately brought in communication with the stand pipe, in means whereby the action of the said device may be regulated by the operator, and in many other features each of which contributes in rendering the machine more effective than others of its class and which will be fully described in the following description, reference being had to the accompanying drawings in the various views of which like parts are similarly designated and in which—

Figure 1, represents a plan view of the machine, Fig. 2, a side elevation thereof, Fig. 3, an enlarged end view of a union employed in adjustably connecting the drive-pipes to the body portion of the apparatus. Fig. 4, an enlarged sectional view taken along the plane 4—4 Fig. 1, Fig. 5, an enlarged, fragmentary section along the line 5—5, Fig. 4, Figs. 6 and 7, respectively, longitudinal sections of the opposite ports of the valve-mechanism as shown in elevation and to a reduced scale, in Fig. 4, Fig. 8, a transverse section along the line 8—8 Fig. 6, and Fig. 9, a transverse section through the foot-valve axle and adjoining parts.

Referring to the drawings by numerical reference characters, let the numeral 2 designate the body portion of the apparatus which consists of a housing comprising two induction chambers 3, formed at their inner sides with cylindrical throttle chambers 4, which are connected by a hollow cylindrical neck 5. The induction chambers 3 are closed at their outer sides by means of covers 6, which are secured upon the housing by the use of stud bolts 8 and which are formed with outwardly tapering, centrally disposed, open ended sleeves 7 which serve as supports for the valve mechanism included in the apparatus, the construction and operation of which will hereinafter be described. The induction chambers are provided at their upper portions, with outlet-openings 9 which respectively communicate with conduits 10, branching from a valve housing 12 whose externally flanged, open, upper end supports the air chamber 13 which, as in all machines of the class to which the invention pertains, serves to equalize the flow of liquid into the raising main or stand pipe 14 which connects with an opening 15 in the wall of the chamber. The orifices of the two conduits 10, in the valve-housing 12 are normally, closed by foot-valves 16 which are pivotally mounted upon an axially bored axle 17 which is fixedly secured in transverse relation to the housing and projects through openings in its sides. The axle 17 is provided with two transverse ports 18 which extend from its bore to its circumferential surface and which, when the valves are in their normal, closing position, register, respectively, with the orifices of channels 19 in said valves, which open at their opposite ends, within concave depressions 20 in the latter's lower surfaces. A stop 21 in the valve housing serves to prevent excessive inward movement of the two valves. The induction chambers 13 communicate, furthermore, with the orifices of laterally extending inlet conduits 22, which are integral with the housing 2, and are formed at their outer extremities, with arcuate flanges 23. The conduits 22 are connected by means of unions 24, with the inclined drive pipes 25, whose upper ends are in communication with the source from which the water to be raised through the instrumentality of the apparatus, is derived, and said unions have flanges 26 which are curved to correspond with the flanges 23 on the conduits 22. The flanges 26 are provided with parallel slots 27 for the admission of studs 28 which project from the flanges 23, to connect the parts in coöperation with nuts 29, which connections,

being rendered adjustable by the slots 27, permit variation of the angle of inclination between the conduits 22 and the respective drive-pipes 25. The inlet conduits 22 expand from their outer ends toward the housing 2, to lessen the friction of the moving mass of water with the walls of the respective conduits and chambers when, during its course toward the conduit 10, it changes its direction.

The neck 5 in the housing 2, which connects the two throttle chambers 4 of the duplex rams, has an opening 30 which connects with the corresponding end of a waste-conduit 31, whose transverse dimensions gradually advance toward its outer or delivery end which during the operation, projects below the surface of a body of water 32.

The valve mechanism, above referred to, comprises a stationary, hollow, cylindrical guide bar 33, which extends axially through the neck 5 and the thereby connected throttle and induction chambers and whose threaded extremities project through the orifices of the tapering sleeves 7 of the covers 6 and are held in place by means of coöperatively threaded nuts 34 which are screwed home against gaskets 35 placed upon the outer surface of said sleeves. The guide-bar 33, is, for convenience in manufacture and assemblage, composed of three parts, *i. e.*, two identical axially bored members 36 and an intermediate tubular member 37 into whose extreme portions the reduced inner extremities of the parts 36 are fitted.

Two circular valves 38 connected by a sleeve 39, which slidably surrounds the central portion of the member 37, are respectively disposed within the two throttle chambers 4 and are adapted to alternately shut off the flow of liquid from the respective chambers, into the interposed neck 5 and the therewith connected waste-pipe 31. The valves are, in practice, operated through the instrumentality of two diskes 40, which concentrically surround the guide bar 33, and which are connected by means of a rod 41, whose middle portion is slidably fitted within the tubular member 37 of the guide-bar 33 and whose extreme portions 42 are circumferentially reduced to occupy the bores of the two end members 36. The connections between the disks 40 and the rod 41 are effected by means of keys 43 which are driven into transverse ways in the rod and therewith registering apertures in hubs formed on the disks, and which project loosely through longitudinal slots 44 in the tubular member 37. The reduced parts 42 of the rod 41 are tubular at their extremities and are provided with ports 45 which connect the interior of said tubular portions at their innermost ends, with their circumferential surface. When one of the disks 40 is at the end of its outward stroke, as is shown in Fig. 6 of the drawings, the ports 45 in the end portion 42 at the corresponding side of the apparatus, communicate with slots 46 in the surrounding portion of the member 36 of the guide bar, while at the opposite side of the apparatus, where the corresponding disk 40 is at the inner end of its stroke (see Fig. 7), the direct communication between the interior of the tubular extremity of the rod 41 and that of the corresponding induction chamber 3, has been discontinued by reason of the ports 45 being moved beyond the slots in the member 36.

Valves 47, longitudinally-movably fitted in the open ends of the end members 36 of the guide bar 33, are adapted to control the flow of fluid through ports 48 which normally connect the interior of the members with that of the respective sleeves 7 in which they are supported. The outer portion of each valve 47 is formed with a screw thread, to coöperate with a corresponding female thread cut in the enlarged outermost portion of the bore of the member 36 while a head 49 is secured upon the extreme end of the valve and partially surrounds the end of said member projecting beyond the nut 34. By turning the valve 47, the operator is enabled to regulate the flow of liquid through the ports 48, and the position of the valve relative to said ports, is denoted by means of a flexible pointer 50, one end of which is secured upon the sleeve 7, while its free extremity occupies one of a series of notches 51 cut equidistantly in the circumferential surface of the head 49.

It will be understood from the foregoing description that the apparatus constitutes a duplex hydraulic ram and to this end is composed of two distinct elements (designated in the drawings by the letters A and B,) adapted to communicate with a common air chamber and stand-pipe and each including an induction chamber and an inclined drive-pipe, while the intermediate portion of the housing and the valve-movement are designed to alternately interrupt the communication between the two elements and the stand-pipe for the purpose of allowing the moving mass of water to regain the energy required to raise a portion of its own volume to a height greater than that of its source.

Supposing that the connected valves 38 and the coöperating driving disks 40 are in the position illustrated in Fig. 4 of the drawings (and to an enlarged scale in Figs. 6 and 7), it will be observed that the induction chamber of the element A is shut off from the neck 5 by reason of the valve 38 engaging its seat around the latter's orifice. The water flowing into the induction chamber through the inclined drive pipe 25, be-

ing impelled by its momentum, is driven through the conduit 10, into the air chamber 13, whence it flows into the stand pipe 14. While this operation takes place in the element A, the water introduced into the induction chamber of the element B is allowed to flow into the neck 5 and thence into the waste pipe 31, by reason of the valve 38 being remote from its seat. The outwardly flaring shape of the waste pipe together with the fact that its outer end is disposed below the surface of a body of water and consequently sealed against the influx of air, aid in accelerating the motion of the water from the induction chamber and through the drive pipe, and while the velocity and consequent energy of the mass flowing through the drive pipe of the element B increases continually, the momentum of the body flowing into the induction chamber of the element A, proportionately decreases. The result is that the pressure upon the valve 38 of the element A, effected by the water flowing into the throttle chamber through the space around the disk 40, gradually decreases while the pressure within the induction chamber of the element B increases. Inasmuch as the pressure of the water upon the disk 40 of the element A is the same at both sides and thus negatives resistance, the continually increasing pressure of the water upon the disk of the element B will, at a certain period in the operation, cause the said disk to move toward the throttle chamber while by reason of their connection the disk in the other element is forced away from the respective valve. When the disk in the element B enters the throttle chamber, the flow of water into the neck 5 is partly shut off and the disk, by reason of the decrease in pressure upon its inner surface, will forcibly engage the valve 38, driving the same against its seat and simultaneously opening the orifice of the neck 5 in the element A. The conditions in the two elements are now reversed and the water introduced into the induction chamber of the element B, will, by its impulse, be driven into the stand-pipe, while that flowing into the induction chamber of the other element passes through the waste-pipe until it acquires the momentum necessary to raise a portion of its volume to a height greater than its source. The water which had entered through the slots 46 and the ports 45, into the tubular end of the disk rod 41 at the side of the apparatus in which the valve 38 was in the open position, will, when said valve is driven to its seat and the ports 45 are consequently closed, present a cushion which effectively prevents the valve at the opposite side of the apparatus from closing prematurely or before the water flowing around said valve, into the waste-pipe, has acquired the desired degree of energy and when said last named valve, impelled by the corresponding disk 40, is moved to its closing position, the water forming the cushion is, by reason of the movement of the rod 41, with said disk, slowly discharged through the ports 48, the velocity of the flow being regulated by means of the valve 47. When the water driven through the pipe 10, enters the valve housing 12, it raises the corresponding foot valve 16, while the valve at the opposite side simultaneously closes the orifice of its respective conduit by reason of the pressure of the liquid within the housing and the decreased pressure in the corresponding induction chamber. When the valve closes, the water descending in the conduit 10, creates a vacuum below the valve, which in the construction shown, is immediately filled by air passing through the bore of the axle 17 and the port 18 into the therewith registering channel 19 and the space below the lower surface of the valve. When the valve subsequently opens, the body of air thus confined, will ascend in the air chamber to replace the amount lost by assimilation with the water flowing into the stand-pipe 14.

What I claim and desire to secure by United States Letters Patent is:—

1. In an apparatus of the class named, a raising main, two drive pipes adapted to separately communicate therewith, an interposed waste pipe adapted to connect with either of said drive pipes, a reciprocating valve element constructed to alternately close the communication between the waste pipe and the drive pipes at opposite sides thereof, and means adapted to be actuated independently from the valves by influence of the varying momentums of fluid emitted from the drive pipes, for reversing the position of the said valves.

2. In an apparatus of the class named, a raising main, two drive pipes adapted to separately communicate therewith, an interposed waste pipe adapted to connect with either of said drive pipes, a reciprocating valve-element constructed to alternately close the communication between the waste pipe and the drive pipes at opposite sides thereof, by influence of the varying momentums of fluid emitted from the latter, means for exerting a constantly decreasing pressure upon the closed side of the said element, and means for varying the degree of decrease of said pressure in ratio to a determinate period.

3. In an apparatus of the class named, a raising main, two drive pipes adapted to separately communicate therewith, a waste pipe interposed to connect with either of said drive pipes, coöperative valves adapted to alternately close the connection between the waste pipe and one of the drive pipes while closing that with the opposite one and

an independently operating element adapted to be impelled by the momentum of the body of fluid emitted from the drive pipe in communication with the waste-conduit, and constructed to engage the said valves so as to reverse their position.

4. In an apparatus of the class named, a raising main, two drive pipes adapted to separately communicate therewith, a waste pipe interposed to connect with either of said drive-pipes, coöperative valves adapted to alternately close the connection between the waste pipe and one of the drive pipes while closing that with the opposite one, and an independently operating element adapted to be impelled by the momentum of the body of fluid emitted from the drive pipe in communication with the waste-conduit, and constructed to engage the said valves so as to reverse their position at a degree of velocity disproportionate to that of the said body of fluid.

5. In an apparatus of the class named a housing including two throttle chambers, an interposed waste conduit adapted to connect with either of the said chambers, drive pipes separately in communication with the respective chambers, a valve element constructed to alternately close the connections between the waste-pipe and the chambers at opposite sides thereof, and a driving element adapted to reverse the position of the said valve element by engagement therewith and composed of coöperative members, movable in the said chambers in spaced relation to their walls.

6. In an apparatus of the class named, a raising main, two drive pipes adapted to separately communicate therewith, a waste pipe interposed to connect with either of said drive pipes, coöperative valves adapted to alternately close the connection between the waste pipe and one of the drive pipes while closing that with the opposite one, and an independently operating element adapted to reverse the position of the said valves by engagement therewith and to reduce the area of the connection between the waste pipe and the therewith communicating drive pipe when impelled by the momentum of the body of fluid emitted from the said drive pipe.

7. In an apparatus of the class named, a raising main, two drive pipes adapted to separately communicate therewith, a waste pipe interposed to connect with either of said drive-pipes, coöperative valves adapted to alternately close the connection between the waste pipe and one of the drive pipes while closing that with the opposite one, an independently operating element adapted to reverse the position of the said valves by engagement therewith and to reduce the area of the connection between the waste pipe and the therewith communicating drive pipe when impelled to the momentum of the body of fluid emitted from the said drive pipe, and a means to yieldingly counteract the pressure exerted by the said momentum upon the said element.

8. In an apparatus of the class named, a raising main, two drive pipes adapted to separately communicate therewith, a waste pipe interposed to connect with either of said drive-pipes, coöperative valves adapted to alternately close the connection between the waste pipe and one of the drive pipes while closing that with the opposite one, an independently operating element adapted to reverse the position of the said valves by engagement therewith and to reduce the area of the connection between the waste pipe and the therewith communicating drive pipe when impelled by the momentum of the body of fluid emitted from the said drive pipe, a means to yieldingly counteract the pressure exerted by the said momentum upon the said element and a means for varying the degree of the said counteracting force.

9. In an apparatus of the class named, a housing including two induction chambers and an interposed hollow neck whose orifices connect therewith, two drive pipes respectively terminating in said chambers, a waste conduit connected with said neck, a raising main having separate valve controlled connections with said chambers, a guide bar projecting through said neck and said chambers, connected valves, in said chambers slidably mounted on said bar and adapted to alternately close the respective orifices, and an element movable on said bar to actuate said valves when impelled by the momentums of fluid emitted from said drive pipes.

10. In an apparatus of the class named, a housing including two induction chambers, throttle chambers forming part thereof and a neck whose orifices connect with the latter, drive pipes terminating in said induction chambers, a raising main having separate valve controlled connections therewith, a waste-conduit connected with said neck, reciprocating valves connected to alternately close said orifices, and reciprocating connected disks circumferentially spaced from the walls of said throttle chambers and adapted to engage said valves so as to alternately impel them against their respective seats.

11. In an apparatus of the class named, a housing including two induction chambers, throttle chambers forming part thereof and a neck whose orifices connect with the latter, drive pipes terminating in said induction chambers, a raising main having separate, valve controlled connections therewith, a waste-conduit connected with said neck, a guide bar projecting through said neck, and

the various chambers, connected valves slidable upon said bar and adapted to alternately close said orifices, connected disks slidable upon said bar, circumferentially spaced from the walls of the throttle chambers and adapted to alternately engage said valves so as to impel them against their respective seats.

12. In an apparatus of the class named, a housing including two induction chambers and an interposed hollow neck whose orifices respectively connect therewith, drive pipes terminating in said chambers, a raising main having separate valve controlled connections therewith, a waste conduit connected with said neck, a hollow guide bar extending through said neck and chambers, connected valves slidable upon said bar and adapted to alternately close said orifices, a reciprocating rod within said bar and disks secured upon said rod and adapted to engage said valves so as to impel them against their respective seats, said bar having at opposite sides of its center, inlet and exhaust ports, the former of which are disposed at each side so as to be obstructed by the reciprocating rod, at the termination of its stroke toward the opposite end of the bar.

13. In an apparatus of the class named, a housing including two induction chambers and an interposed hollow neck whose orifices respectively connect therewith, drive pipes terminating in said chambers, a raising main having separate valve controlled connections therewith, a waste conduit connected with said neck, a hollow guide bar extending through said neck and chambers, connected valves slidable upon said bar and adapted to alternately close said orifices, a reciprocating rod within said bar, disks secured upon the rod and adapted to engage the valves so as to impel them against their respective seats, said bar having at opposite sides of its center, inlet and exhaust ports, the former of which are disposed at each side so as to be obstructed by the reciprocating rod at the termination of its stroke toward the opposite end of the bar, and valves adapted to regulate the flow of fluid through the exhaust ports.

14. In an apparatus of the class named, a housing including two induction chambers and an interposed hollow neck whose orifices respectively connect therewith, drive pipes terminating in said chambers, a raising main having separate valve controlled connections therewith, a waste conduit connected with said neck, a hollow guide bar extending through said neck and chambers, connected valves slidable upon said bar and adapted to alternately close said orifices, a reciprocating rod within said bar, disks secured upon the rod and adapted to engage the valves so as to impel them against their respective seats, said bar having at opposite sides of its center, inlet and exhaust ports, the former of which are disposed at each side so as to be obstructed by the reciprocating rod at the termination of its stroke toward the opposite end of the bar, valves adapted to be operated from the outside of the casing to regulate the flow of fluid through the respective exhaust ports, and indicative means to denote externally, the position of the valves relative to their ports.

15. In an apparatus of the class named, a drive pipe, an air chamber connected therewith, a foot-valve controlling said connection, an axle upon which said foot-valve is pivotally mounted, having a bore opening in the atmosphere, a raising main terminating in said chamber and a waste pipe arranged to communicate with said drive pipe, said valve having a channel which connects its lower surface with the bore in said axle, when the valve is in its closing position.

In testimony whereof I have affixed my signature in presence of two witnesses.

RANSOM Y. BOVEE.

Witnesses:
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Copies of this patent may be obtained for five cents each, by addressing the "Commissioner of Patents, Washington, D. C."