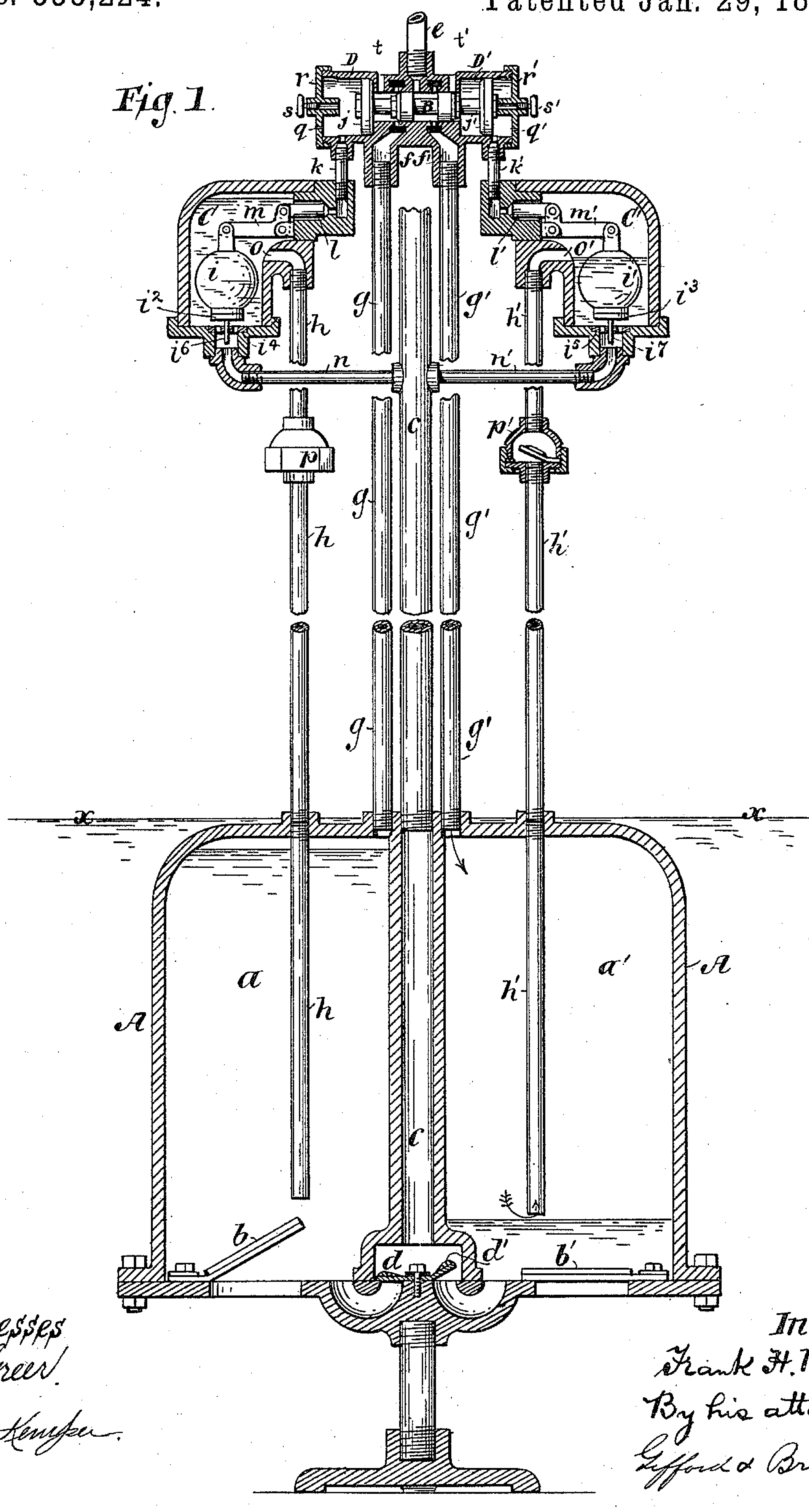
(No Model.) 2 Sheets—Sheet 1.

F. H. MERRILL.

APPARATUS FOR RAISING WATER.

No. 533,224. Patented Jan. 29, 1895.

Fig. 1.



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(No Model.) 2 Sheets—Sheet 2.

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Fig. 2

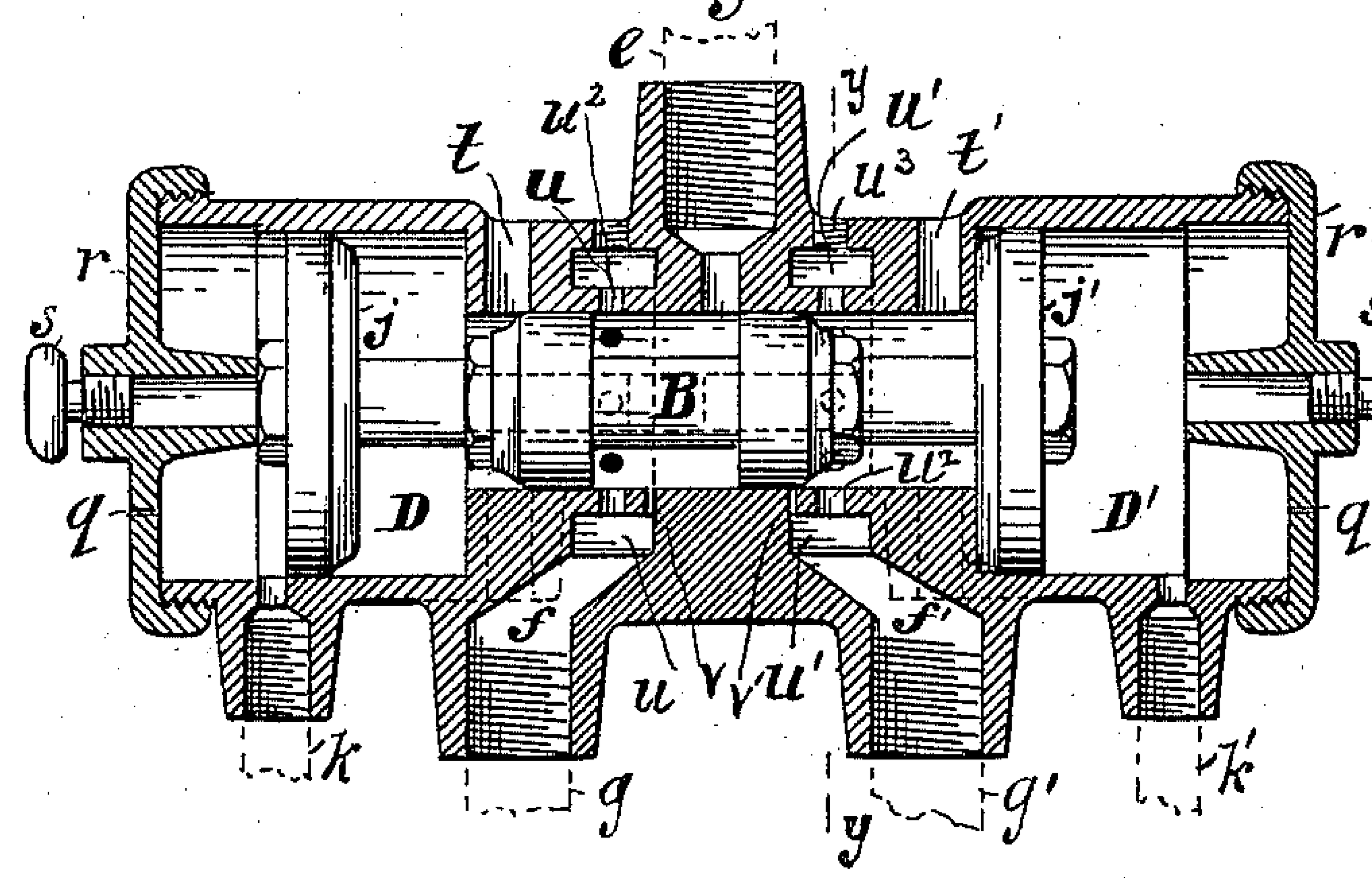


Fig. 3

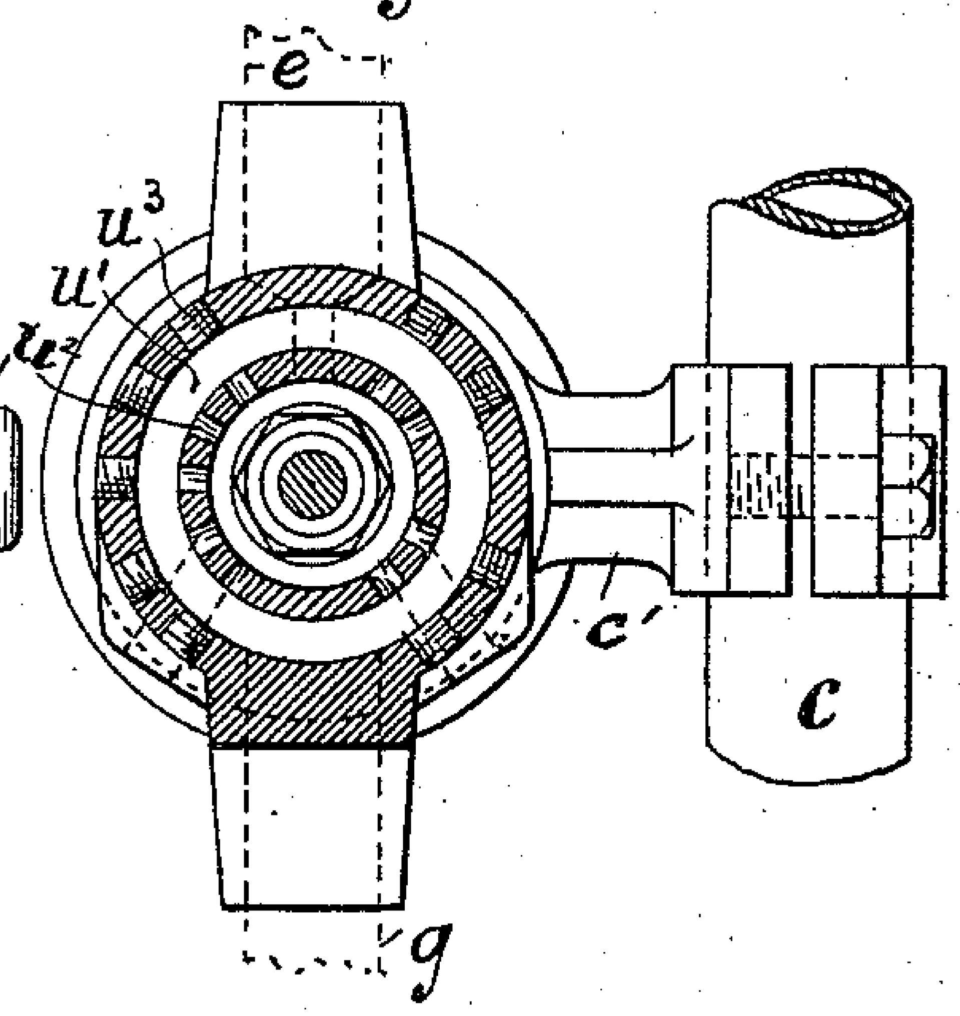


Fig. 4

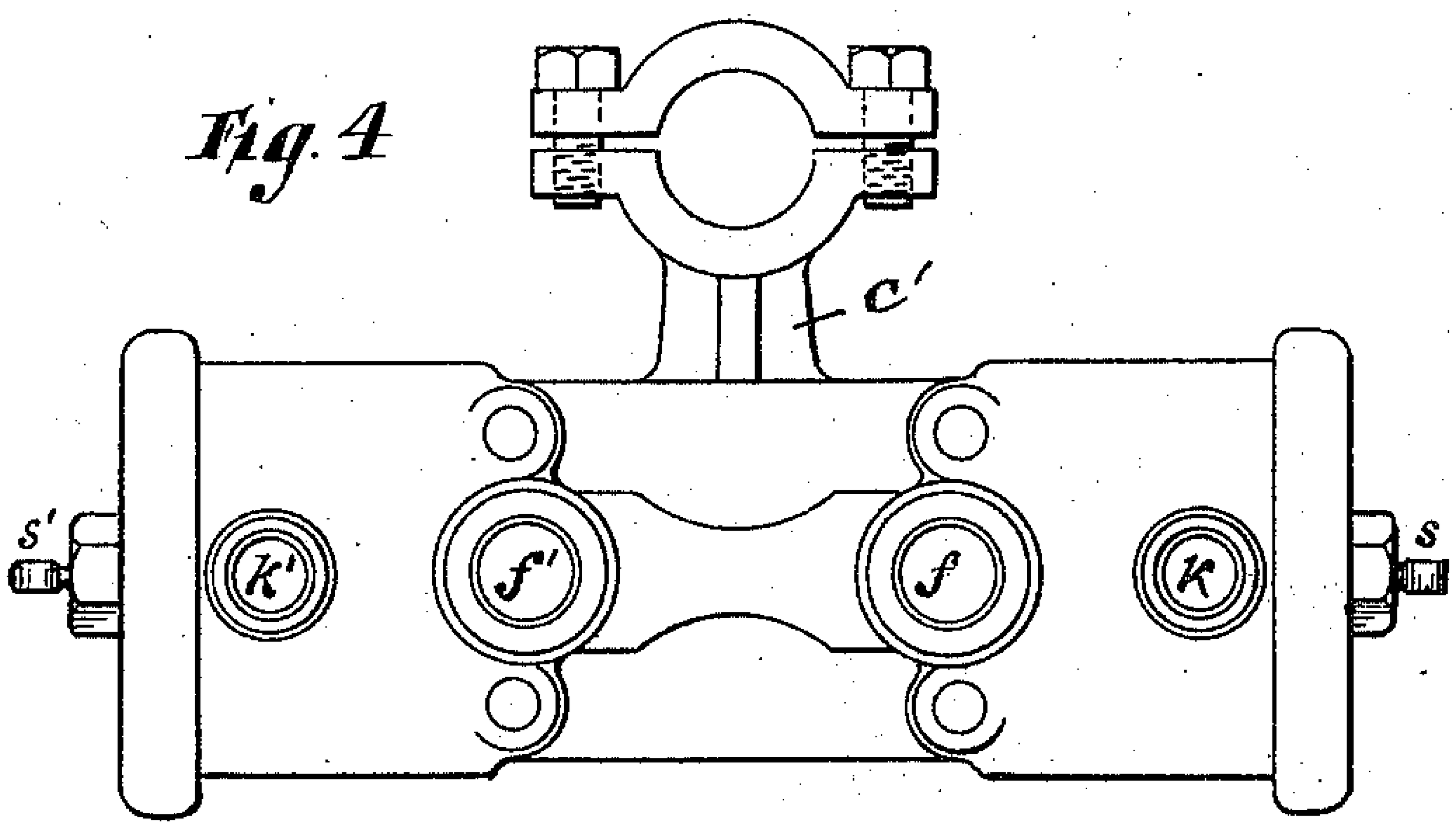


Fig. 5

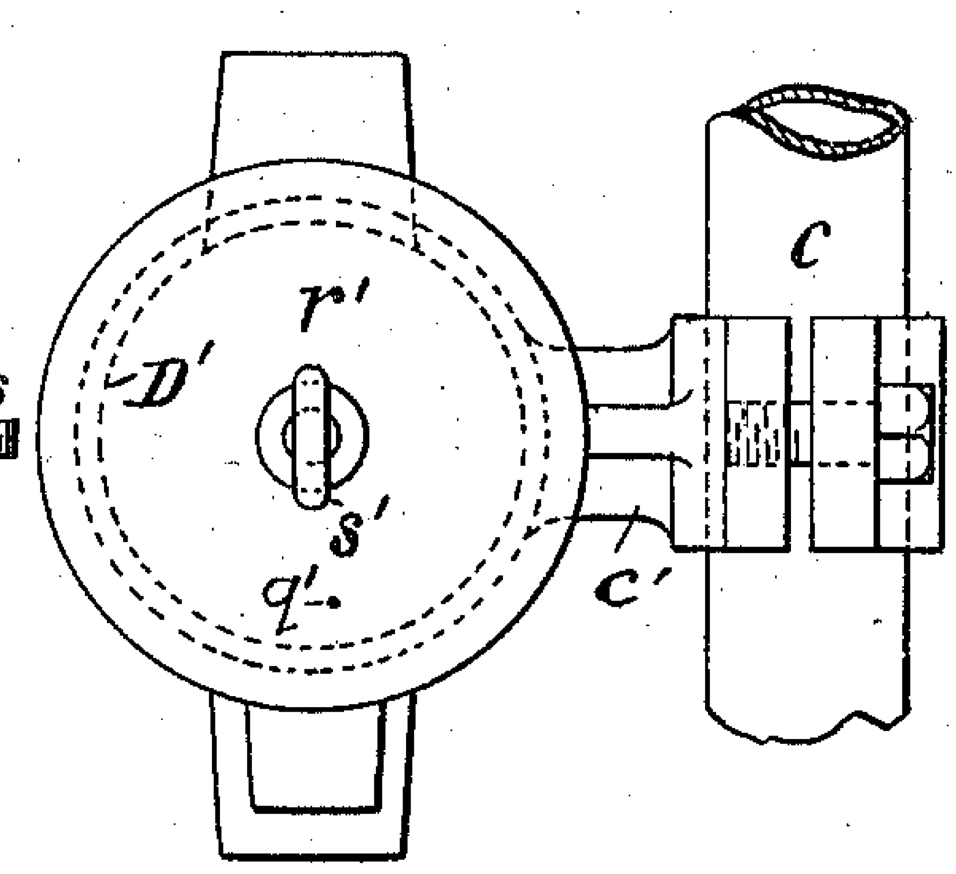
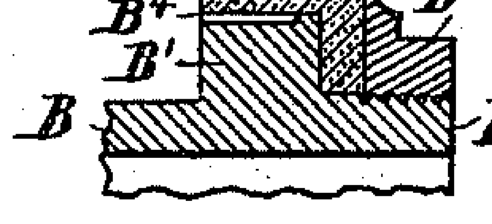


Fig. 6.



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UNITED STATES PATENT OFFICE.

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APPARATUS FOR RAISING WATER.

SPECIFICATION forming part of Letters Patent No. 533,224, dated January 29, 1895.

Application filed January 15, 1890. Renewed July 17, 1894. Serial No. 517,830. (No model.)

To all whom it may concern:

Be it known that I, FRANK H. MERRILL, of Bound Brook, in the State of New Jersey, have invented a new and useful Improvement in Apparatus for Raising Water, of which the following is a specification.

This invention is intended as an improvement upon the water raising apparatus claimed in Letters Patent of the United States, No. 403,124, dated May 14, 1889, to A. B. Merril, and also Letters Patent of the United States, No. 403,125, dated May 14, 1889, to myself.

This invention embodies, among other things, a new principle or mode of operation which is applicable not merely to double acting or continuous pumps but also to single acting or intermittent pumps and which I have applied to both continuous and intermittent pumps in various forms, of which as examples, may be cited in addition to the form shown in this application, those forms shown in my applications numbered as follows: Serial Nos. 408,172, 399,287, and 437,445. This principle or mode of operation may be described as follows: A primary and secondary liquid compartment are connected by a passage. There is a liquid entrance and a gas entrance to the primary compartment. There is a liquid exit and gas exit from the secondary compartment. There is a motor (as a float) arranged to be operated as a liquid is driven out of the secondary compartment and there is means, which may take any one of a variety of forms, by which the motion of the motor is applied to cutting off the pressure of the gas in the primary compartment and opening the gas exit from the secondary compartment. The gas under pressure entering the primary compartment first forces the liquid out of that, then the gas passes from the primary to the secondary compartment through the passage connecting them and forces the liquid out of the secondary compartment until the motor cuts off the supply of gas to the primary compartment and opens the exit for the gas from the secondary compartment when the pressure being removed from both compartments, a new body of liquid is permitted to fill them.

In some of the applications above referred to, the movement of the motor causes the valve, which controls the supply of gas to the primary compartment, to be moved in each direction by the air pressure. In others, it causes the valve to move in each direction by mechanical means and in still others, it causes the valve to move in one direction by the air pressure and in the other direction by mechanical means.

In the accompanying drawings, I have shown in Figure 1 a vertical section through the apparatus, by which its construction may be readily understood. Fig. 2 is a longitudinal section of the main valve on a larger scale. Fig. 3 is a cross section through the line *y y* of Fig. 2. Fig. 4 is an inverted plan view and Fig. 5 an end view of the valve cylinder. Fig. 6 is a detail showing the packing for the valve and the means of securing it.

A is a water receptacle divided into two compartments, *a a'*. In the bottom of each of these compartments is located an opening, closed by the valves *b* and *b'*.

c is the delivery water pipe communicating with the respective compartments by passages, as shown; the passages being controlled respectively by the valves *d d'*.

B is a valve adapted for directing compressed air received from the pipe *e* alternately into the passages *f* and *f'*.

g and *g'* are pipes leading from the passages *f* and *f'* respectively to the chambers *a* and *a'* respectively, so as to deliver the air from the passages *f* and *f'* respectively at the top of the said compartments respectively.

h and *h'* are pipes extending down into the compartments *a* and *a'* to near the bottoms thereof and passing out through the tops of those compartments and upward to other mechanism about to be described. One of the pipes as *h'* extends to a somewhat lower level than the other.

C C' are chambers each adapted to contain a motor to be operated when the entrance of air into the chamber drives the water out. For this purpose, I recommend the use of the floats *i, i'*

D and D' are cylinders each adapted to contain a piston *j* and *j'* respectively. The pistons j and j' are respectively connected with opposite ends of the valve B. The cylinders D and D' are respectively connected with the chambers C and C' by the passages k and k' which are respectively controlled by the valves l and l'. The lever m serves to connect the valve l with the float i so that the raising of the float closes the valve. The lever m' connects the valve l' with the float i' so that the raising of the float closes the valve. n is a pipe leading from the pipe c to the bottom of the chamber C and n' is a pipe leading from the pipe c to the bottom of the chamber C'. The pipes h and h' connect with the chambers C and C' respectively as at o and o'.

p and p' are upwardly operating check valves located respectively in the pipes h and h'.

The water receptacle A is immersed in a body of water to any convenient depth, as for instance, so that the level of the water reaches the line x x. The upper portions of the apparatus being above the level of the water may be elevated to any height desired. The parts shown in Fig. 2 are preferably supported on the pipe c by the bracket c' as shown in Figs. 3, 4 and 5. The cylinders for the valve B and for the pistons j and j' may be made in one continuous casting as shown.

The operation of the apparatus is as follows: At the start, the gravity of the water will cause it to fill both compartments in the receptacle A. If we suppose the valve B to be centered at the start, the main ports of passages f and f' will be closed by the packing of the valve but the supplemental ports v v' are provided at such a distance apart that they will both open into the space between the valve heads and the compressed air will find access to both of them from the pipe e. These supplemental ports v v' are exceedingly narrow so that after the machine commences its regular operation they will not admit sufficient compressed air to substantially modify the action of the other parts. They are, for clearness, only shown in Fig. 2 and are there shown enlarged in comparison with the other parts. The compressed air passing downward through the pipes g and g' will force the water from both compartments upward through the pipe c to any point of delivery desired. As this operation is going on, the water will also be forced through the pipe n into the compartment C and through the pipe n' into the compartment C' and buoy up the floats i and i' and thus close the valves l and l'. This condition of things will continue until the level of the water is forced below the lower end of the pipe h which will be accomplished before the level of the water has reached the lower end of the pipe h'. Then the compressed air will pass through the pipe h into the compartment C and force the water out of the same through the pipe n into the pipe c until there is not sufficient water left in the compartment C to buoy up the float i, when it will drop and open the valve l, thus admitting the compressed air through the pipe k into the cylinder D where it will act upon the piston j and force the valve B to the opposite end of its stroke, as shown in the drawings Fig. 1. Thereupon, the compressed air from the pipe e will be cut off from the passage f, and consequently from the compartment a, and the compressed air already contained in the compartments a and C and the cylinder D and the passages connecting the same, will make its escape into the open air through an exceedingly small opening located at some point as at q. The air in the compartment a and pipe g will pass out into the open air through a passage t in the valve cylinder near the end. The gravity of the water surrounding the receptacle A will now raise the valve b and fill the compartment a. In the meantime, the valve B having been forced to the end of its stroke, shown in the drawings Fig. 1, admits of the passage of the compressed air from the pipe e to the passage f' and into the compartment a' so that the forcing of the water out of that compartment is continued until its level has fallen below the lower end of the pipe h'. At the same time this water which is being forced from the compartment a' upward through the pipe c, will not only pass onward to the main point of delivery, but some of it will be forced through the pipe n into the compartment C, being prevented from passing down the pipe h by the check valve p; and this will continue until sufficient water has entered the compartment C to raise the float i and close the valve l. When the water in the compartment a' has been forced below the lower end of the pipe h' the compressed air will pass upward through that pipe into the compartment C and drive the water out of that compartment into the pipe c until its level has fallen so low as to allow the float i' to drop and open the valve l' whereupon the compressed air will be admitted into the cylinder D' and, acting against the piston j', will force the valve B to the opposite end of its stroke to that shown in the drawings Fig. 1. When this is done, the compressed air in the pipe e will be cut off from the passage f' and be diverted into the passage f and will thereupon, as already described, force the water out of the compartment a through the pipe c to the point of delivery and also into the compartment C' where it will buoy up the float i' and close the valve l', being cut off from passing down the pipe h' by the valve p'. The forcing of the water out of the compartment a will continue as before described until its level falls below the bottom of the pipe h when the compressed air passing through that pipe will force the water out of the compartment C, cause the float i to drop and open the valve l so as to admit the compressed air into the cylinder D and force the valve back again to the position shown in the drawings Fig. 1.

q' is a very small opening corresponding and having the same function as the opening q. These openings q and q' are so small that when the pressure of the air is exerted, they are insufficient to materially decrease the power exerted upon the pistons j and j' respectively; but when the compressed air is cut off, the contained air will gradually escape through these small openings. The air in the compartment a' and pipe g' will escape through a passage t' near the end of the valve chamber.

It will be observed also, that the passages which are closed by the valves l and l' respectively, are of small area, it having been found that the best results are accomplished by this construction.

It will also be observed that the valves p and p' are contained within chambers of considerable area, so that the area of the valve exposed to pressure on top exceeds the area exposed on the bottom and thereby holds the valve down until the water has been driven below the bottom of the pipe h, or h' as the case may be.

The chamber of the valve B and the cylinders D and D' may be contained in a casting closed at each end respectively by the caps r and r'. Holes may be formed in these caps respectively, closed by the plugs s and s', so that in case the valve shall stick, by withdrawing one or both of these plugs, a short rod can be inserted to start the valve in operation without unscrewing either of the caps r and r'.

By the construction described, the water receptacle A and its contents are simplified so that the area of the same may be greatly reduced and there is nothing about it requiring any nicety of adjustment or which will be injured by the sediment contained in the water.

The valves controlling the compressed air and the floats and mechanism connected therewith, are all located in the upper portion of the apparatus where they can be protected from harm and are readily accessible for adjustment or repair.

I found that when valve B was placed some distance above compartments a and a' (as in case of bored wells where the water was to be discharged just at top of well, and the distance from chambers C and C' to the place of delivery was small and would require but a slight pressure of air to empty chambers C and C'), the greater pressure required to empty compartments a and a' emptied chambers C and C' so quickly that the compressed air escaped through passages n and n' into water pipe c and found relief at point of delivery of water from pipe c; and that such relief reduced the pressure so that it was not sufficient to move valve B where said valve for any cause required some increased force to move. To overcome this I place leather disks i^2 and i^3 on bottom of floats i and i' which, when said floats drop, will rest upon seats i^4 and i^5 thereby closing passages n and n' and preventing the escape of the compressed air into pipe c. Stems i^6 and i^7 connected with the disks move in guides so as to direct the downward movement and bring the disks properly onto their seats.

In Figs. 2 and 3 I have shown a very desirable way of constructing the air ports from the valve cylinder which may be described as follows: u u' are annular passages in the walls of the valve chamber. Holes u^2 are drilled from the outside radially inward across each of these annular passages and into the valve chamber. The holes in the outer wall are closed by screw plugs u^3. The holes v in the inner walls remain open and the air passes out of the valve cylinder through these and the annular passage u or u' into the passage f or f'. This affords increased area of ports, convenience of construction and the metal remaining between the holes forms bridges by which the packing of the valve is prevented from falling in or catching fast as it moves over the ports.

I do not desire to limit myself to the construction or arrangement of parts shown or even to the use of all the elements shown, since I am aware that the apparatus can be varied in all these respects without departing from the new principles and modes of operation of my invention. For example, I do not limit myself to the float as a detector of the transition from water to air or gas in the supplemental compartments, nor to the means by which the movement of the detecting device causes the movement of the main valve, nor to the employment of a delivery pipe c connecting directly with the primary compartments, since it is evident that even if the valves d d' were kept continuously closed, the apparatus would be operative and all the water would leave the compartments respectively through the pipes h and h'. This division of each port into a series of perforations is especially essential with a valve packed with leather as shown in detail in Fig. 6, where B is the body of the valve, B' a circular flange on the same, B^2 the leather and B^3 the follower nut screw threaded onto the end of the valve. The radial portion of the leather is clamped between the follower nut and the flange and the cylindrical portion of the leather surrounds the flange and bears against the inside of the valve cylinder. Now, the dampening of the leather will cause it to swell, and if the required area of the port were confined to a single opening the leather would fall into the opening when passing over; whereas, when the port is divided up into two or more perforations, each member of the series may be made so small that the leather will pass over smoothly.

B^4 (Fig. 6) is an annular rabbet which is cut around the periphery of the flange extending from the face of the flange receiving the compressed air sufficiently under the leather to enable the compressed air to enter under the leather and force it outward radially. This may be used to make the leather fit more tightly against the interior of the valve cylinder.

I claim—

1. In a liquid raising apparatus in combination, a primary and a secondary liquid compartment, a liquid passage connecting the two, a liquid entrance and gas entrance to said primary compartment, a liquid exit and gas exit from said secondary compartment, a motor operated as the liquid leaves said secondary compartment and means whereby the gas supply is cut off from both said compartments at the same time by the operation of said motor, substantially as described.

2. In a liquid raising apparatus in combination, a primary and a secondary liquid compartment, a passage connecting the two, a liquid entrance and gas entrance to said primary compartment, a liquid exit and gas exit from said secondary compartment, a motor operated as the liquid leaves said secondary compartment, a valve in said gas exit, means whereby said valve is opened by said motor, a valve in said gas entrance and a passage from said gas exit whereby the gas is delivered to close said valve in said gas entrance, substantially as described.

3. In a liquid raising apparatus in combination, a primary and a secondary liquid compartment, a passage connecting the two, a check-valve therein, a liquid entrance and gas entrance to said primary compartment, a liquid exit and gas exit from said secondary compartment, a motor operated as the liquid leaves said secondary compartment and means whereby the gas supply is cut off from both said compartments at the same time by the operation of said motor, substantially as described.

4. In a liquid raising apparatus in combination, a primary and a secondary liquid compartment, a passage connecting the two, a liquid entrance and gas entrance to said primary compartment, a liquid delivery pipe from said primary compartment, a pipe connecting said secondary compartment with said liquid delivery pipe, a gas exit from said secondary compartment, a motor operated as the liquid leaves said secondary compartment and means whereby the gas supply is cut off from both said compartments at the same time by the operation of said motor, substantially as described.

5. In a liquid raising apparatus in combination, two primary liquid compartments, two secondary liquid compartments, a passage connecting each of the latter with one of the former, a liquid entrance and gas entrance to each of said primary compartments, a liquid exit and gas exit from each of said secondary compartments, two motors each operated as the liquid leaves one of said secondary compartments and means whereby the gas supply is cut off from one of said secondary compartments and its connected primary compartment at the same time by the operation of said motor, substantially as described.

6. In an apparatus for raising water by the pressure of compressed air or gas alternately in each of two water compartments, the combination with said compartments and the valve directing the compressed air, of two auxiliary compartments, a passage connecting each of said auxiliary compartments with one of the water compartments, passages connecting said auxiliary compartments respectively with a cylinder, a piston whereby the valve is moved, and mechanisms whereby said last named passages are alternately closed substantially as described.

7. The improvement in the means for operating the valve of a compressed air or gas pump in which the movement of said valve is caused by the power of compressed air which consists of an automatic device for controlling the application of compressed air to the movement of the valve having the following elements in combination, viz: a piston, actuating said valve, a cylinder for said piston, a float, a float chamber, a compressed gas passage leading to said cylinder, valve mechanism controlling said passage and operated by the rise and fall of said float, a water compartment, a passage connecting said water compartment with said float chamber, a water exit passage from said float chamber, a supply pipe for compressed air to said water compartment; whereby water is forced from the water compartment into the float chamber and is followed by compressed air, substantially as described.

8. The improvement in the means for operating the valve of a compressed air or gas pump which consists in an automatic valve controlling device having the following elements in combination, viz: a supplemental chamber, passages connected with the same respectively for the entrance of compressed air or gas and the entrance and exit of the water, a cylinder containing a piston for moving the valve, a passage connecting said cylinder with the supplemental chamber, a valve in said passage and a motor operated by the rise and fall of water in the chamber governing said last named valve whereby the same is opened when the entrance of the air into said supplemental chamber drives the water therefrom, substantially as described.

9. In an apparatus for raising water by the pressure of compressed air or gas alternately in each of two water compartments, an automatic valve controlling device having the following elements in combination, viz: a supplemental chamber, a water delivery pipe connected with the water compartment, a compressed air supply pipe disconnected from the supplemental chamber leading to the water compartment, an air passage between the water compartment and the supplemental chamber and a water escape pipe from said sup-

plemental chamber and a motor operated by the rise and fall of the water in said supplemental chamber and means whereby said valve is controlled by the movement of said motor, substantially as described.

10. In an apparatus for raising water by the pressure of compressed air or gas alternately in each of two water compartments, an automatic valve controlling device having the following elements in combination, viz: a supplemental chamber, a water delivery pipe connected with the water compartment, a compressed air supply pipe disconnected from the supplemental chamber leading to the water compartment, an air passage between the water compartment and the supplemental chamber, a water escape pipe from said supplemental chamber, an air escape pipe from said supplemental chamber and a motor operated by the rise and fall of the water in said supplemental chamber and means whereby said valve is controlled by the movement of said motor, substantially as described.

11. In an apparatus for raising water by the pressure of compressed air or gas alternately in each of two water compartments, an automatic valve controlling device having the following elements in combination, viz: a supplemental chamber, a water delivery pipe connected with the water compartment, a compressed air supply pipe disconnected from the supplemental chamber leading to the water compartment, an air passage connecting said water compartment with said supplemental chamber, a water escape passage from said supplemental chamber, an air escape passage from said supplemental chamber and a motor located in said supplemental chamber and provided with valves for controlling the water escape and air escape passages therefrom and means whereby said first named valve is controlled by the movement of said motor, substantially as described.

12. The improvement in the means for operating the valve of a compressed air or gas pump which consists, in combination, of the following elements, viz: a passage leading from below the high water level in the water compartment, a check valve located therein, a passage connected with the water delivery pipe, a motor chamber connected with both of said passages, a motor, a cylinder, a piston therein, a passage between the motor chamber and the cylinder, a valve therein operated by said motor and a vent, substantially as described.

13. The improvement in the means for operating the valve of a compressed air or gas pump which consists, in combination, of the following elements, viz: a piston connected with the valve, a cylinder, a passage connecting said cylinder with the water compartment, a valve in said passage and a motor for operating said valve located outside the water compartment, a chamber containing said motor, a passage connecting said chamber with the water compartment and a water exit passage from said chamber, substantially as described.

14. The improvement in the means for operating the valve of a compressed air or gas pump which consists, in combination, of the following elements, viz: a piston connected with the valve, a cylinder, a passage connecting said cylinder with the water compartment, a valve in said passage, and a motor for operating said valve located above the water level, a chamber containing said motor, a passage connecting said chamber with the water compartment and a water exit passage from said chamber, substantially as described.

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Witnesses:

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