(No Model.)

T. O. PERRY.

PNEUMATIC WATER ELEVATOR.

No. 382,727. Patented May 15, 1888.

Fig. 2.

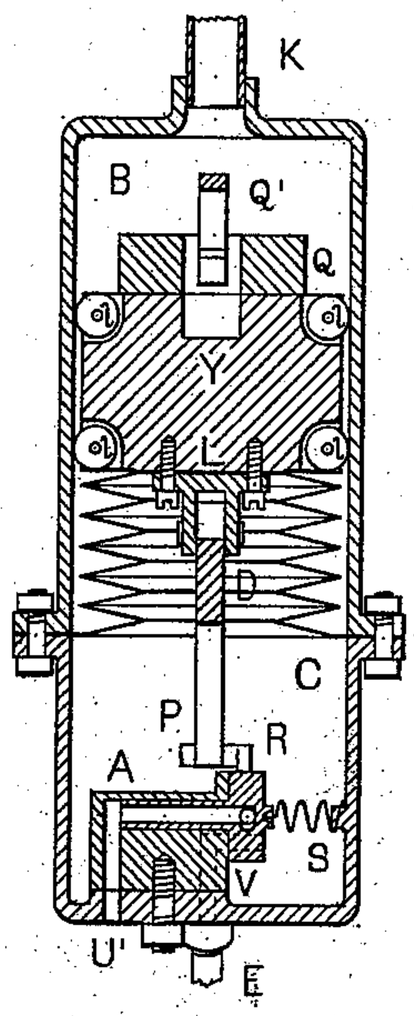


Fig. 1.

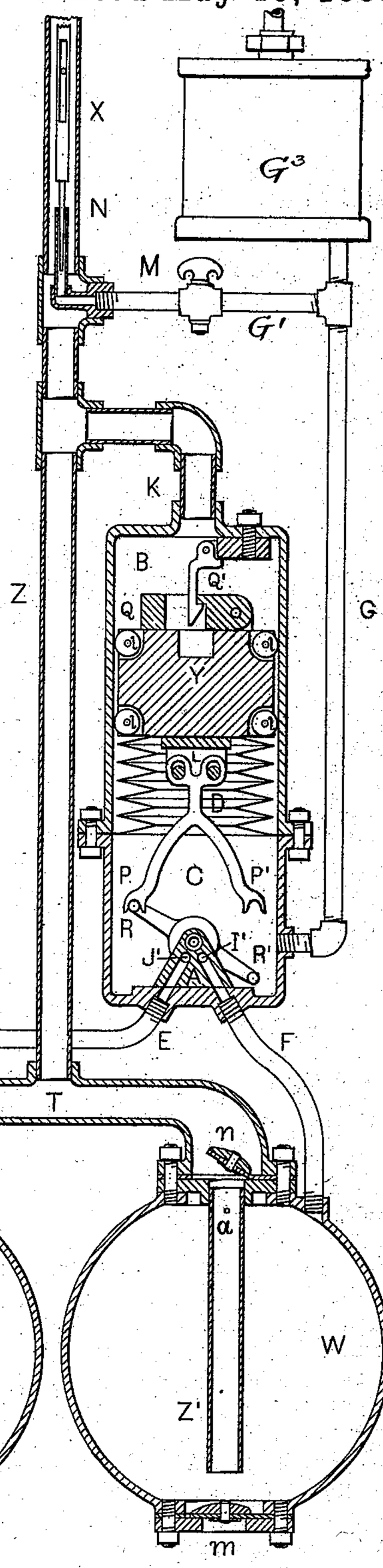


Fig. 3.

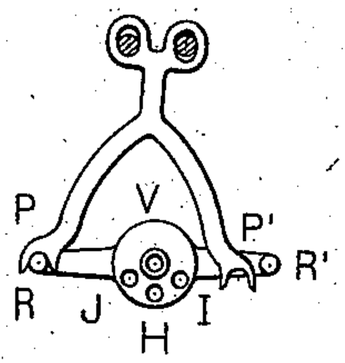


Fig. 4.

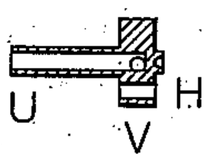
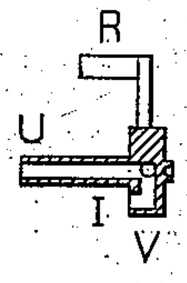


Fig. 5.



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UNITED STATES PATENT OFFICE.

THOMAS O. PERRY, OF TECUMSEH, MICHIGAN.

PNEUMATIC WATER-ELEVATOR.

SPECIFICATION forming part of Letters Patent No. 382,727, dated May 15, 1888.

Application filed October 25, 1886. Serial No. 217,104. (No model.)

To all whom it may concern:

Be it known that I, THOMAS O. PERRY, a citizen of the United States, residing at Tecumseh, in the county of Lenawee and State of Michigan, have invented a new and useful Pneumatic Water-Elevator, of which the following is a specification.

My invention relates to improvements in pneumatic water-elevators in which water is raised by the pressure of compressed air or other gaseous fluid acting directly on the water previously confined in water-chambers; and the objects of my improvements are, first, to provide automatic mechanism for regulating the alternate admission and escape of compressed air to and from the water-chambers; second, to provide means for reducing the weight of the ascending column of water by introducing a portion of the compressed air to mingle with the water in the discharge-pipe; third, to provide for automatically regulating the proportion of air to water commingling in the water-pipe. I attain these objects by the mechanism illustrated in the accompanying drawings, in which—

Figure 1 is an elevation of the entire apparatus, mostly in section, cutting the valve-seat in front of the air-valve at right angles to its axis in a plane containing the centers of the pipes E and F. Fig. 2 is a sectional view of the interior of the cylinder B C, taken in a vertical plane containing the axis of the air-valve. Fig. 3 is a front view of the air-valve and actuating-pawl detached. Fig. 4 shows a longitudinal section of the air-valve in a plane containing the axis and center of aperture H. Fig. 5 shows a longitudinal section of the air-valve in a plane containing the axis and center of aperture I.

Similar letters refer to similar parts throughout the several views.

W W are two water-chambers supposed to be submerged in water. A discharge-pipe, Z, communicates with both these chambers through a T connecting their tops and branch pipes Z′ Z′, which extend nearly to the bottoms of the water-chambers. Water enters these chambers through the inlet-valves *m m* in their bottoms. The tops of these chambers are connected with the valve-seat A by means of pipes E F, through which compressed air is led into the chambers to drive the water out through the pipes Z′ Z. Check-valves *n n* prevent water from flowing back into the chambers. Air is driven into one chamber at a time until the water is all driven out down to the lower end of pipe Z′, when the air in the chamber must be let off, so that the emptied chamber may refill with water, and at the same time air is let into the other chamber to drive water from that in the same manner as from the first. Thus water is driven from the chambers alternately, and one refills while the other is being emptied.

What I have described so far is common to other pumps of this class. Air is admitted into the chambers W and allowed to escape therefrom by way of the pipes E F and a rotating valve, V. The valve-seat A has two apertures, J′ and I′, in its perpendicular face, which communicate, respectively, with the pipes E and F. The valve V is in the form of a disk, the face of which is ground against the face of the valve-seat, and has a hollow stem, U, inserted in a hole in the valve-seat, within which it may turn freely. In the ground face of the valve V are three openings, H I J, with equal intervals between, and all equidistant from the axis of the valve. The opening H passes directly through the disk; but the openings I J communicate with the hollow stem U, which in turn communicates with the open air through the escape-way U′. The valve V is also provided with opposite arms, terminating in horizontal spurs R R′. The two apertures J′ I′ in the valve-seat are the same distance from the axis of the valve as the openings H I J, and the same distance apart as the openings H J or H I, so that either H J or H I may match and conjoin with J′ I′. The valve-seat A is fastened to the bottom of an inclosing-cylinder, B C, cast in two parts and joined together by means of flanges and bolts. Inside of B C is a heavy plunger, Y, which should be free to rise and fall, and yet should not allow water or air to pass from one end of the cylinder to the other, at least to any great extent. From the under side of plunger Y is suspended a two-footed pawl, P P′, hung on two pins fixed to the plunger and passing loosely through slots in the upper end of the pawl, which slots allow the pawl to have a certain amount of lat-

eral motion, while the two suspending-pins cause the pawl to hang perpendicularly when free. When the valve V is turned so as to bring either the openings J H or H I in conjunction with the apertures J′ I′, the spurs R and R′ stand one elevated and the other depressed, and are perpendicularly beneath the respective feet of the pawl, P and P′, so that a descent of the plunger Y from its upper position will bring one of the feet P P′ in contact with that one of the spurs R R′ which happens to be elevated. The pawl-feet P P′ are notched underneath, so as to cling to the spurs R R′ while descending, and as the pawl descends the foot and spur which are in contact travel in the arc of a circle, swaying the pawl to the right or left, so that the other foot of the pawl misses the other spur, which, in ascending, deviates likewise from a vertical path, but in an opposite direction. The descent of the spurs R R′ may be limited by striking the bottom of the cylinder, or in any convenient way; but whenever the plunger descends to its lowest limit and is again caused to ascend the valve V will be left standing with either the openings J H or H I in conjunction with the apertures J′ I′. After the valve V has been rotated in one direction by the descent of the plunger and pawl, the plunger must both rise and fall in order to rotate the valve in the opposite direction. The object of this will be seen presently. The lateral movement allowed to the pawl permits it while ascending to slip by the elevated spur. Fig. 3 shows the relative positions of the spurs R R′ and pawl-feet P P′ at midway point of descent.

Compressed air derived from the compressed-air chamber G^3 is conveyed into the lower part of the cylinder B C through the pipe G, which is supposed to communicate with an air compressor or reservoir containing gaseous fluid under tension. The heavy plunger Y, at first being unsupported, is down; but the compressed air enters one of the chambers W by way of opening H in the valve V, and drives water into the discharge-pipe Z until the "head" of water becomes sufficient to cause the plunger Y to ascend by reason of the tension of air underneath, and as long as the pipe Z is full of water the air-tension keeps the plunger up; but when the surface of the water in the chamber W has been driven down to the lower end of pipe Z′ water will cease to flow from the chamber, and air will then enter the pipe Z′, and, rising in the pipe Z, will displace a portion of the water therein, discharging it at the top, until the column of air and water in the pipe Z becomes so light that the reduced tension of air required to sustain it can no longer support the plunger Y, which then descends and causes the valve V to rotate, as already described. This rotation of the valve V brings the opening H in communication with the other chamber W, from which water is driven as from the first, and the operation is repeated the same as before, the pipe Z first refilling with water, which again becomes in part displaced by air. The rotating of the valve V also brought one of the openings J I into communication with the chamber previously emptied of water, thus letting the air escape from that chamber by way of the hollow stem U and escape-way U′, so that the chamber could refill with water through the valve *m*. Thus whenever one of the chambers W is emptied of water the plunger Y is caused to descend and rotate the valve V, as required, for letting air enter the full chamber and escape from the emptied one in alternate succession. The top of cylinder B C may be open, or it may communicate by means of a pipe, K, with the pipe Z. In the latter case the part of the cylinder above the plunger fills with water, adding its weight to that of the plunger, and this added weight may be further increased by increasing the vertical length of pipe K. Of course the displacing of water by air in the pipe Z above its junction with pipe K will not affect the difference of pressures above and beneath the plunger Y, which is then caused to rise and fall by the relative amounts of water and air in the water pipe beneath its junction with pipe K.

The rapid expansion of the air after it once begins to enter the water-pipe, together with the natural excess of starting friction, is generally sufficient to insure the complete descent of plunger Y after its descent commences; but sometimes an additional retardation at starting is useful. Suspended by a hinge fastened to the top of cylinder B C is a retarding-latch, Q′, which, when the plunger rises, engages a retarding-weight, Q, hinged to the top of plunger Y, so that in descending the weight Q must be lifted from the plunger until, by turning on its hinge, it frees itself from the latch, and then the force accumulated to lift the weight Q suddenly acts to assist in promptly depressing the plunger.

A flexible cylindrical diaphragm, D, made of rubber, leather, or other suitable material, somewhat after the manner of an accordion or bellows, may connect the plunger Y with the inner wall of cylinder B C, so as to prevent the passage of air or water from one side of the diaphragm to the other, and yet allow the plunger to rise and fall freely with very little friction. In this case the plunger need not touch the cylinder directly, but may be guided by rollers *l* to still further reduce friction. In fact, if the diaphragm is used as shown, there should be free passage by the plunger for the water squeezed out of the diaphragm while the plunger descends.

The air which enters the water-pipe in the manner already described increases the efficiency of the apparatus by working expansively and rendering lighter the contents of the pipe Z, and thus enabling water to be raised to a much greater elevation with a given tension of air than would otherwise be possible; but this supply of air to the water-pipe is incidental and limited to what is needed to cause the descent of the plunger Y at intervals.

Without respect to this particular form of water-elevator I have found it advantageous to admit air directly into the discharge-pipe by means of a pipe, G′, connecting the air-supply pipe G directly with the discharge-pipe Z at some point above where it communicates with the interior of the water-chambers W. The pipe G′ terminates inside of the discharge-pipe in a small aperture or nozzle, N, preferably directed upward. Air must not pass so freely through the pipe G as to destroy the direct action of air-pressure in the chambers W, by which water must be raised at least some higher than the nozzle N. The flow of air through the pipe G′ may be retarded by the smallness of its own dimensions, or of its terminal aperture inside the pipe Z, or by a common service-cock, M, by means of which the flow may be regulated. The air issuing from the nozzle N may act somewhat after the manner of an ejector, but not necessarily so. It is the mingling of a certain amount of air with the ascending column of water, thus rendering the contents of the discharge-pipe lighter and rendering a lower tension of air available in raising water to great heights, that constitutes the chief object of this device, for much power is lost in compressing air to a great extent unless power consumed in compression can be recovered by letting the compressed air work expansively. Air may be beneficially admitted to the water-pipe by small perforations *a a* in the pipes Z′, preferably near their tops, so that some portion of the air, acting by direct pressure in the chambers W, may leak into the water-pipe and act indirectly by mingling with the ascending column of water.

The proportion of air to water in the pipe Z may be automatically regulated by means of a long slim float, X, placed inside the water-pipe, and having at its lower end a slender extension reaching down loosely into the nozzle N for some distance, so as to obstruct the flow of air to a greater or less degree, according as the float descends or rises. The slender extension may taper slightly toward its lower end, as shown. The float X may be several feet long, and should be as much lighter than water as economy and circumstances require. If none or too little air mingles with the water, the float rises, thereby letting air flow more freely through the nozzle. If too much air mingles with the water, the float descends, thereby diminishing the flow of air. The amount of air admitted to the water-pipe would thus depend on the specific gravity of the float X. While the air which enters from the water-chambers through the lower ends of pipes Z′ is passing the float X the flow from the nozzle N might be altogether stopped. The float should not be permitted to rise sufficiently to withdraw entirely its slender extension from the nozzle.

What I claim as my invention, and desire to secure by Letters Patent, is—

1. In combination with the water-chamber and its upwardly-extending discharge-pipe, a chamber supplied with compressed air, a pipe leading from such air-chamber into the water-discharge pipe, and a float and a valve operated thereby to control the discharge of air from such air-pipe into the water in the water-discharge pipe, substantially as set forth.

2. In combination with the water-discharge pipe and the air-pipe terminating within the same in a nozzle upwardly extended, a float terminating downwardly in a long and slender tapering extension, which protrudes into the mouth of the air-pipe nozzle to act as a regulating-valve, substantially as set forth.

3. In combination with two water-chambers, a third chamber from which compressed air is supplied to the water-chambers, a valve which controls the supply admitting air to but one chamber at a time, said valve having two arms, by which it is operated, a plunger or piston reciprocating within the compressed-air chamber and provided with suitable arms to engage the valve-arms at its stroke in one direction only, whereby the valve is shifted only once for each full reciprocation of the plunger, substantially as set forth.

4. In combination with an oscillating valve, a plunger which reciprocates toward and from it, a pawl flexibly connected to the plunger, the valve having arms provided with two abutments located at opposite sides of the axis at such distance that only one can be encountered by the pawl at a time, and adapted when thus encountered to engage the pawl laterally, whereby the pawl is deflected laterally as the valve is rotated by it; said pawl being adapted—as by the action of gravity—to resume its original position when it recedes from the abutment, substantially as set forth.

5. In combination with the two water-chambers, the water-pipes communicating with them, respectively, near the bottom, and leading into a common discharge-pipe extending upward and constituting a stand-pipe, air-pipes leading into the water-chambers from a single compressed-air chamber, the valve which admits air from said air-chamber to the water-chambers, respectively, one at a time, a plunger in said chamber adapted to be lifted and upheld therein by the compressed air admitted thereto, and having connections, as the pawl P P′, which engage and actuate the valve when it falls, whereby the compressed air passing into one water-chamber will first expel the water into the stand-pipe, and then follow it thereinto and partially expel it therefrom and lighten the column, and then permit the plunger to fall and shift the valve to admit compressed air to the other water-chamber, substantially as set forth.

6. In combination, substantially as set forth, a water-chamber, and its upwardly-extending discharge-pipe constituting a stand-pipe, the compressed-air chamber, and the air-pipe leading therefrom to the water-chamber,

a valve which controls the escape of air from the air-chamber into the air-pipe, a plunger in the air-chamber actuated upward by compressed air, and connections therefrom, as the pawl P P′, whereby it operates the valve when it falls, and a pipe communicating with the air-chamber above the plunger and with the stand-pipe, whereby the column of water in the stand-pipe above the point of such communication exerts its pressure equally upon both sides of the plunger.

7. In combination with the compressed-air chamber, the vertically-reciprocating plunger therein uplifted by compressed air, the valve which controls the escape of air, and connections, as the pawl P P′, whereby the plunger actuates the valve, the weight hinged to the upper end of the plunger, and a latch connected to the upper end of the chamber and adapted to engage the hinged weight, substantially as and for the purpose set forth.

8. In a pneumatic water-elevator, in combination with the water-chambers and the air-chamber communicating therewith, the eduction-pipes from the water-chambers protruding into them, respectively, and provided with perforations *a*, whereby the compressed air may leak into the water-pipes to charge the water, substantially as and for the purpose set forth.

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Witnesses:
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