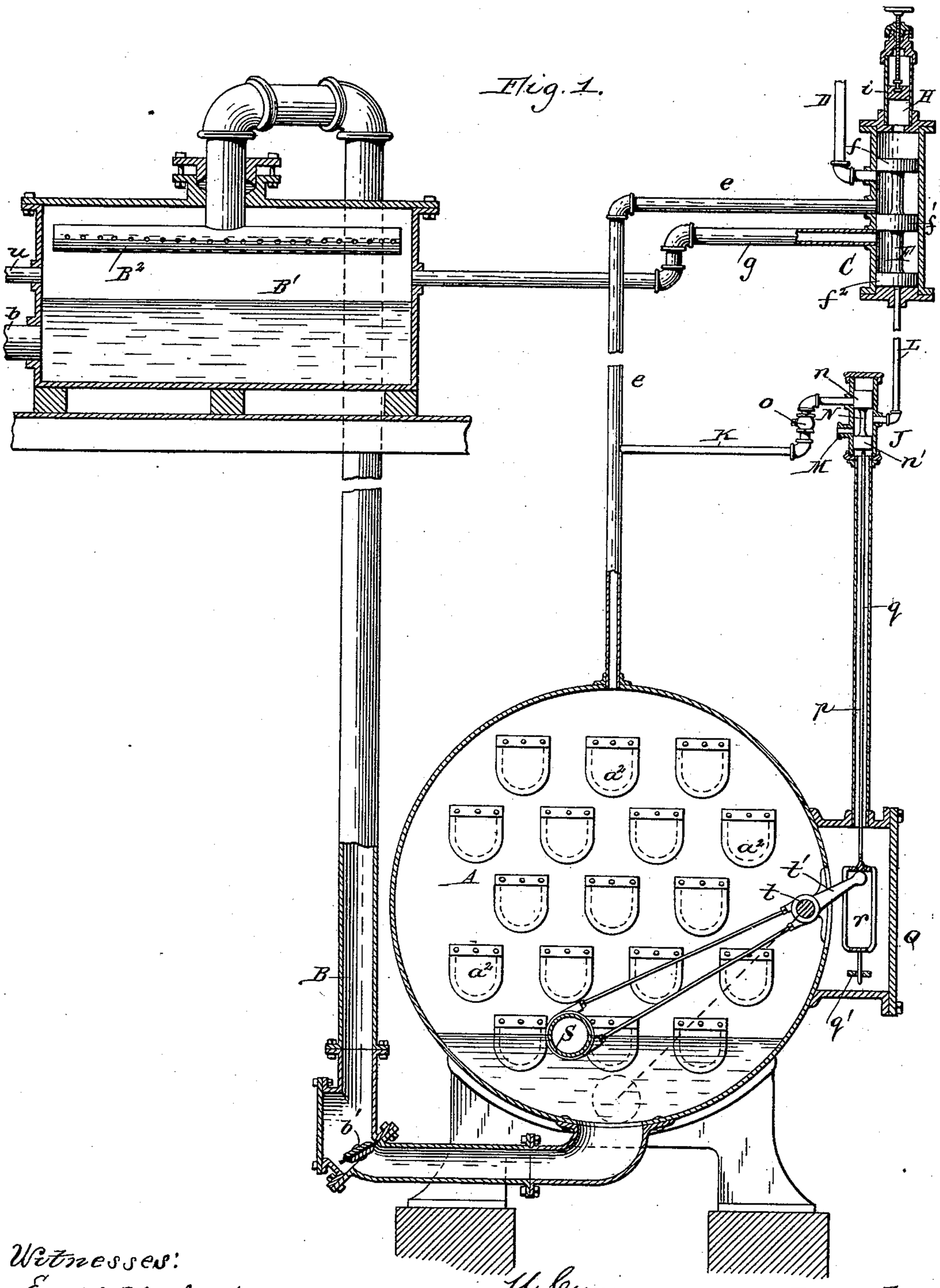
(No Model.) 2 Sheets—Sheet 1.

U. CUMMINGS.

PNEUMATIC PUMP.

No. 465,243. Patented Dec. 15, 1891.

Fig. 1.



Witnesses:
Emil Neuhart
Theo. L. Popp.

U. Cummings Inventor.
By Wilhelm & Bonnell
Attorneys.

(No Model.) 2 Sheets—Sheet 2.

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Fig. 2.

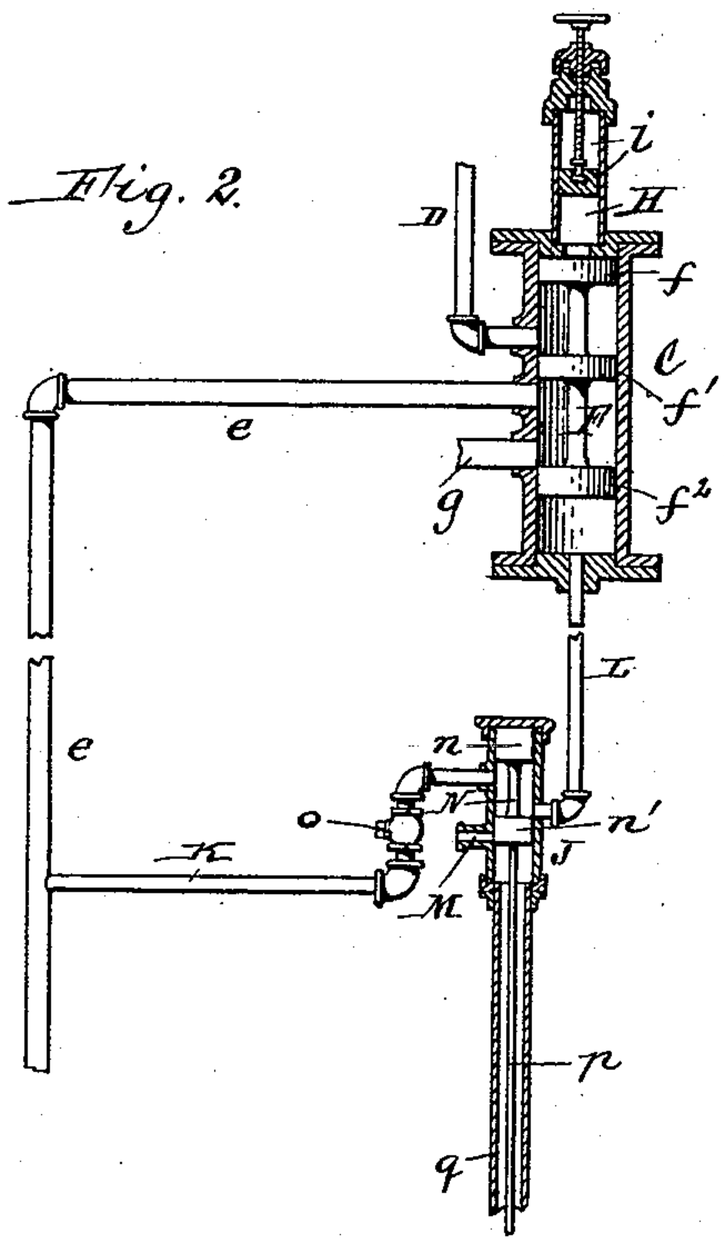
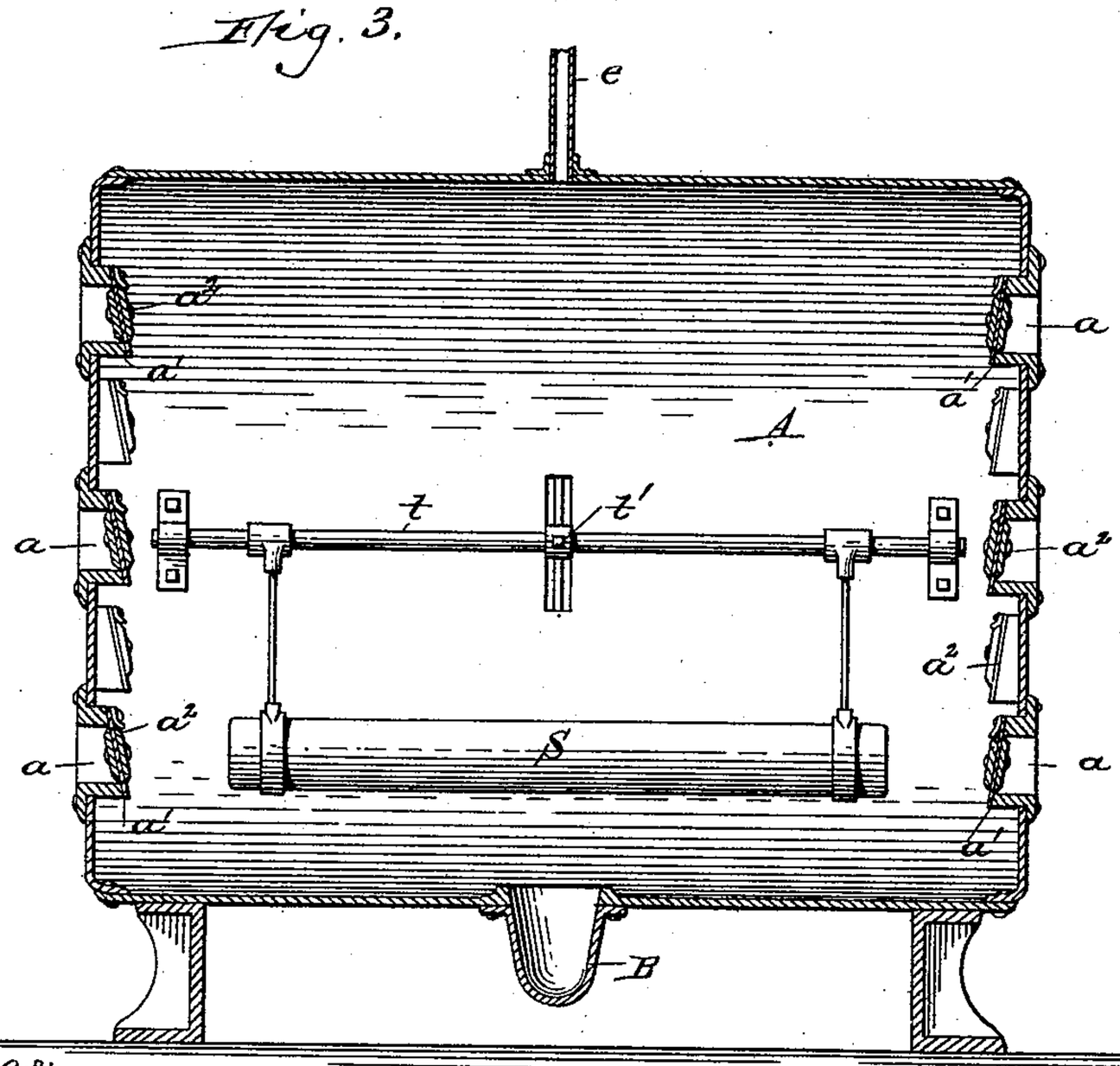


Fig. 3.



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Emil Neuhart.
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U. Cummings Inventor.
By Wilhelm Bonn & Attorneys.

UNITED STATES PATENT OFFICE.

URIAH CUMMINGS, OF NEW HAVEN, CONNECTICUT.

PNEUMATIC PUMP.

SPECIFICATION forming part of Letters Patent No. 465,243, dated December 15, 1891.

Application filed November 19, 1890. Serial No. 371,915. (No model.)

To all whom it may concern:

Be it known that I, URIAH CUMMINGS, a citizen of the United States, residing at New Haven, in the county of New Haven and State of Connecticut, have invented new and useful Improvements in Pneumatic Pumps, of which the following is a specification.

This invention relates to pneumatic pumps or water-elevators which are operated by compressed air, and in which the water is allowed to flow into a submerged chamber, from which it is expelled and elevated by the direct pressure of the compressed air upon the liquid in the chamber.

The objects of my invention are to provide a reliable automatic pumping apparatus of this character, having a valve mechanism of simple construction, the principal part of which can be placed above water in a location where access can be conveniently had thereto, and to utilize the waste air for cooling the elevated water.

In the accompanying drawings, Figure 1 is a sectional elevation of my improved pumping apparatus, showing the parts in the position in which compressed air is admitted to the water-chamber and the water is being expelled from the latter. Fig. 2 is a sectional elevation of the valve mechanism, showing the parts in a reversed position, in which the compressed air is cut off from the water-chamber and the water is allowed to enter the same. Fig. 3 is a longitudinal section of the water-chamber.

Like letters of reference refer to like parts in the several figures.

A represents the submerged water-chamber, which consists of a cylindrical shell, constructed, preferably, of wrought iron or steel and provided with heads, which are riveted to the body of the shell.

a represents water-inlet openings, formed in the heads of the chamber and provided at their inner ends with valve-seats *a'*; and a^2 are depending inlet-valves, pivoted within the water-chamber and closing against the valve-seats *a'*.

B is the ascending discharge-pipe of the water-chamber, and B' is a tank or receiver, which receives the elevated water, and from which it is conducted to the place of consumption by a pipe *b*. The water-discharge pipe B enters the tank or receiver through its top and is preferably provided with an elongated perforated nozzle B^2, arranged horizontally in the upper portion of the receiver, whereby the water is delivered into the receiver in the form of a spray. The ascending pipe B is provided with the usual check-valve *b'* for preventing backward flow of the water.

C is a chamber of the main or primary valve, whereby the flow of air to and from the water-chamber is controlled.

D is the air-supply pipe, which enters the primary-valve chamber, and *e* is the air-pipe, which connects the primary-valve chamber with the water-chamber. The pipe *e* connects with the valve-chamber near the middle, and the pipe D enters the valve-chamber above the pipe *e*.

F represents a piston-valve having three heads *f f' f²*, and arranged in the primary chamber so as to slide therein.

g is the air-exhaust pipe connected with the primary-valve chamber below the air-pipe *e*.

The heads *f f' f²* are so arranged in relation to the air-supply pipe D *e* and exhaust-pipe *g* that when the valve is in the depressed position represented in Fig. 1 communication is established between the air-supply pipe D and the air-pipe *e* and cut off between said pipes and the exhaust-pipe *g*, while when the valve is in the reversed position illustrated in Fig. 2 the air-pipe is placed in communication with the exhaust-pipe *g* and cut off from the supply-pipe D.

H represents a cylindrical air chamber or pocket communicating with the upper end of the primary-valve chamber C. When the primary valve is elevated, the air in the pocket H is compressed, forming an air-cushion or spring, which returns the valve to its depressed position when the air-pressure is removed from the lower end of the valve. An adjustable plunger or piston *i* is arranged in the pocket H for varying the capacity of the pocket and increasing or reducing the tension of the air-spring. It is obvious that any other suitable spring may be substituted for this air-cushion.

J is the chamber of the secondary valve, whereby the movements of the primary valve are controlled.

K is a branch air-pipe connecting the up-

per portion of this chamber with the air-pipe *e*.

L is an air-pipe leading from the central portion of the secondary-valve chamber to the lower end of the primary-valve chamber, and M is an exhaust pipe or opening arranged in the secondary-valve chamber below the air-pipe L and opening into the atmosphere.

N represents the secondary valve formed by a duplex-piston valve having two heads *n n'*, whereby communication is alternately established and interrupted between the branch pipe K and valve-pipe L and between the latter and the exhaust M. The branch pipe K and the valve-pipe L are in communication, and the exhaust is closed when the valve is in the elevated position represented in Fig. 2. The branch pipe is shut off and the valve-pipe is placed in communication with the exhaust when the valve is in the reversed position represented in Fig. 1.

O represents a check-valve arranged in the branch pipe K and opening toward the secondary valve, whereby the air confined in the valve-pipe L and the lower portion of the primary-valve chamber is prevented from escaping into the pipe *e* while the water is filling the chamber A.

p represents the rod or stem of the secondary valve, which extends downwardly through a tube *q*, and is guided at its lower end in a bearing *q'*, secured in a chamber or enlargement Q, arranged on one side of the water-chamber, and with which the lower end of the tube *q* is connected. The valve-rod *p* is provided within the casing Q with a yoke *r*.

S is a float of any suitable construction arranged within the water-chamber A and attached by long arms to a horizontal rock-shaft *t*. The latter is journaled at its ends in bearings secured to the interior of the water-chamber at one side thereof adjacent to the chamber Q, as represented in Fig. 3.

t' is a short actuating-arm mounted upon the rock-shaft *t* and projecting into the chamber Q, in which it engages in the yoke *r*, so as to intermittently move the same and the valve connected therewith in opposite directions as the float rises and falls. The float-arms being long and the yoke-arm being short, the float operates upon the secondary valve with a considerable leverage, whereby the proper movement of the valve is insured. The rod of the secondary valve moves freely through the tube, which connects the secondary-valve casing with the enlargement at the side of the air-chamber. This construction avoids the use of stuffing-boxes around the valve-rod, which would cause the valve-rod to move harder and renders the valve more sensitive.

The operation of my improved pump is as follows: In the position of the parts illustrated in Fig. 1, the primary valve is depressed, and the compressed air passes from the main supply-pipe D into the primary-valve chamber between the heads *f f'* of the valve and thence through the supply-pipe *e* to the water-chamber, where it presses upon the water and forces the latter out of the chamber. The secondary valve is also in its depressed position, so that the valve-pipe L is in communication with the exhaust and the primary valve is held in its depressed position by the air-spring. When the float S reaches the limit of its downward movement by the discharge of the water from the water-chamber, which position of the float is shown by dotted lines in Fig. 1, the short actuating-arm of the float raises the yoke, thereby raising the secondary valve, closing the exhaust of the secondary valve, and establishing communication between the air-pipe *e* and the lower end of the primary-valve chamber. Compressed air now enters the valve-chamber below the primary valve and raises the latter to the reversed position represented in Fig. 2. The supply-pipe D is now shut off from the air-pipe *e* and the latter is placed in communication with the exhaust-pipe *g* of the primary-valve chamber, allowing the air in the water-chamber to escape though said exhaust-pipe and permitting the water to fill the chamber. As the latter becomes filled the float rises, and as soon as the latter reaches the limit of its upward movement the secondary valve is lowered to the position represented in Fig. 1, thereby breaking the communication between the pipes K L, and establishing communication between the pipe L and the exhaust M. The air-pressure being now removed from the lower end of the primary valve, the air-cushion returns the primary valve to the depressed position represented in Fig. 1, thereby reversing the latter and again admitting compressed air to the water-chamber for expelling and elevating the contents thereof. The air underneath the primary valve is exhausted through the pipe L and exhaust M. The air-pressure is maintained in the valve-pipe L by the check-valve O in the branch pipe K, so that the primary valve cannot descend while the chamber A is filling with water. The compressed air which is exhausted from the water-chamber passes through the exhaust-pipe *g* into the tank B', preferably below the spray-nozzle and above the surface of the water in the tank, whereby the water is cooled. The exhaust-air is discharged from the tank through a vent-pipe *u*.

In my improved apparatus the secondary valve, connected by a rod with the float, is arranged near the cylinder, and may be submerged, as it is a single-acting valve and so simple in construction that it is not liable to get out of order. The primary valve, however, can be arranged at a considerable distance from the water-compressing chamber, as it is connected with the secondary valve by a single air-pipe. This pipe can be easily conducted uphill and downhill and around obstructions, and this enables the primary valve to be placed above high water and at such a distance from the bank that freshets will not reach the room in which the primary

valve is located, thereby making this valve readily accessible at all times and placing it under the observation of the attendant, whereby the long delays are avoided which take place when a submerged valve gets out of order.

The action of my improved apparatus is intermittent; but it is obvious that several independent pumps may be arranged side by side and operated to elevate water alternately or successively to produce a constant flow by connecting all of the several discharges with a common discharge-conduit and supplying all the pumps from one supply-pipe. In this manner each apparatus operates independently of the other and is controlled by its own valve mechanism, so that although the several pumps together elevate water constantly, they are unaffected by variations in the air-pressure or in the height of the water.

The exhaust-air from the pipe *g*, being reduced in temperature to nearly the freezing-point as soon as relieved from compression, serves to cool the water in the tank or receiver by being delivered against the water as it enters the tank, thereby considerably reducing the temperature of the water, which is especially desirable in warm weather. By delivering the water into the tank in the form of a spray it is more thoroughly exposed to the cooling action of the incoming exhaust-air, especially when two or more pumps discharge into one receiver, in which case, the haust of air from one pump will coincide with the discharge of water from another pump. The exhaust-air which is ordinarily wasted is thus utilized and the elevated water is thus cooled without extra expense.

I do not wish to claim anything in this application which is claimed in another pending application, filed by me April 26, 1890, Serial No. 349,646.

I claim as my invention—

1. The combination, with the water-chamber provided with a float, of a primary valve whereby the flow of air to and from the water-chamber is controlled, a single-acting secondary valve actuated by the float, a pipe leading from the secondary valve to the primary valve, whereby pressure is applied to the primary valve in one direction, and an air cushion or spring whereby pressure is applied to the primary valve in an opposite direction, substantially as set forth.

2. The combination, with the water-chamber provided with a float, of an air-supply pipe, a primary-valve mechanism connected therewith, an air-pipe connecting the primary-valve mechanism with the water-chamber, a secondary-valve mechanism actuated by the float, a branch pipe connecting the secondary-valve chamber with the air-pipe leading from the primary-valve chamber to the water-chamber, and a check-valve arranged in said branch pipe, substantially as set forth.

3. The combination, with the water-chamber provided with a supply-pipe for compressed air and a receiver into which the water is forced from said chamber, of an exhaust-pipe leading from the water-chamber to said receiver, whereby the exhausted air is delivered into the receiver for cooling the water, substantially as set forth.

4. The combination, with the water-chamber provided with a supply-pipe for compressed air and a receiver, of a water-discharge pipe leading from the water-chamber to the receiver and provided within the receiver with a spray-nozzle, and an air-exhaust pipe leading from the air-chamber to the receiver, whereby the water is caused to fall in a spray through the cold exhausted air in the receiver, substantially as set forth.

Witness my hand this 13th day of November, 1890.

URIAH CUMMINGS.

Witnesses:
FRED C. EARLE,
LILLIAN D. KELSEY.