O. A. ROED.

APPARATUS FOR ELEVATING WATER.

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Fig. 1.

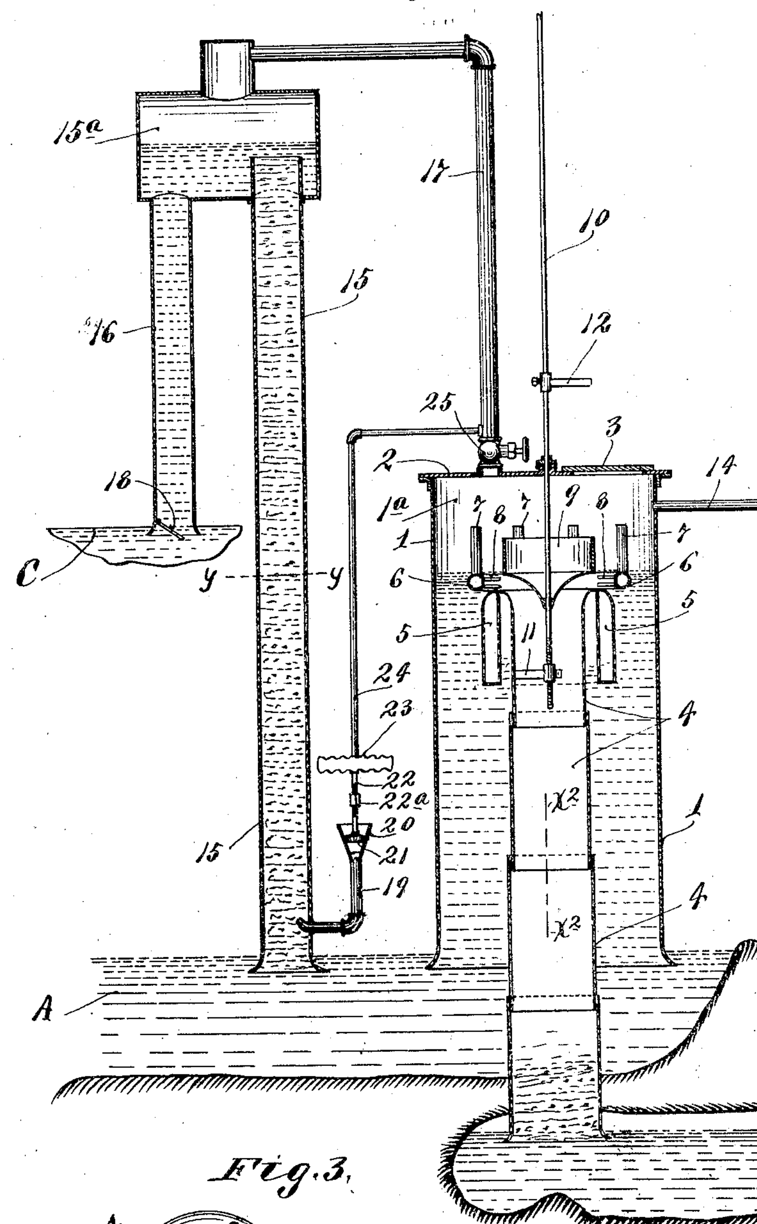


Fig. 2

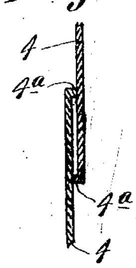
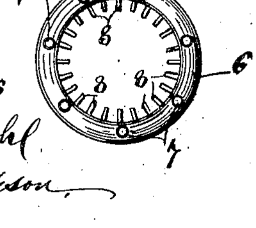


Fig. 3.



Witnesses
A. H. Opsahl
L. L. Simpson

Inventor.
Olaf A. Roed
By his Attorneys
Williamson & Merchant

UNITED STATES PATENT OFFICE.

OLAF A. ROED, OF MINNEAPOLIS, MINNESOTA.

APPARATUS FOR ELEVATING WATER.

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To all whom it may concern:

Be it known that I, OLAF A. ROED, a citizen of the United States, residing at Minneapolis, in the county of Hennepin and State of Minnesota, have invented certain new and useful Improvements in Apparatus for Elevating Water; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

My invention has for its object to provide an apparatus which will utilize the force of the running stream or power developed by the flow of water from a normal or relatively high elevation to the lower elevation; and which, while highly efficient for the purposes had in view, may be maintained at very small running cost.

To the above ends, the invention consists of the novel devices and combinations of devices hereinafter described and defined in the claims.

Generally stated, my invention consists in the employment of two or more siphons (simple or complex). While, as just indicated, more than two siphons may be employed in this system, the greater number would, nevertheless, include at least two siphons; and, hence, for the purposes of this description, the invention will be hereinafter described as consisting of two siphons, the one designated as a primary siphon and the other designated as a secondary siphon. The so-called primary siphon is arranged to receive water from a normal elevation or supply, such as the forebay of a dam, and to deliver the water to a lower elevation. The so-called secondary siphon has a relatively long receiving leg and is arranged to receive water from a normal elevation or water supply, such as the forebay of a dam, and to deliver the same to a higher elevation. In its lower portion, the relatively long receiving leg of this secondary siphon is provided with an air inlet. Both siphons are provided with vacuum chambers in their summits, and these two vacuum chambers are connected by an air duct. Within the summit or upper portion of the primary siphon is placed an air-suction device, which, under the force of the water running through the said primary siphon, ejects air, and, hence, produces a partial vacuum in the vacuum chamber of the two siphons. The partial vacuum produced in the vacuum chambers or summits of the two siphons will raise the water to a point of overflow in the primary siphon and will raise the water to an equal altitude in the relatively long receiving leg of the secondary siphon. Furthermore, the reduction in the pressure, or the partial vacuum produced in the vacuum chamber or summit of the secondary siphon will cause air to flow through the air inlet of said leg; and air thus introduced into the water in said long receiving leg will flow rapidly upward, thereby decreasing the effective weight of the column of water in said long leg, and thus producing a forced upward flow of the water in said long receiving leg.

One embodiment of my invention is illustrated in the accompanying drawings, wherein like characters indicate like parts throughout the several views.

Referring to the drawings, Figure 1 is a view chiefly in vertical section, but with some parts left in full, showing the said apparatus. Fig. 2 is a detail taken in section on the line x^2 x^2 of Fig. 1; and Fig. 3 is a plan view of the so-called suction air pump which is arranged to work within the primary siphon.

The primary siphon is arranged to receive water from the forebay A of a dam and to discharge the same at a lower elevation B. This primary siphon may take various forms, but it is preferably constructed as shown in the drawings, which construction is as follows: The short or receiving leg of this primary siphon is in the form of an upright shell or cylinder 1, the upper end of which is closed by a head 2 having, as shown, a man-hole normally closed by a man-hole cover 3 detachably but rigidly secured with an air-tight joint by any suitable well-known means. The lower end of this leg 1 is submerged more or less in the water of the forebay A. The long or discharging leg of the said primary siphon is made up of a multiplicity of telescopically connected sections 4 having flanged ends 4^a, shown only in Fig. 2, that prevent the said sections from being drawn completely apart. This long leg 4 is centrally or axially disposed with respect to the leg 1, and the lower section thereof is arranged to discharge at the lower level B. Surrounding the upper section of this telescopic leg 4 and secured thereto is a float, shown as in the form of an annular air can 5, and to the top of this air can, or to the upper end of the upper section of the said leg 1, is secured a tubular ring 6 which has a multiplicity of upwardly extended air inlet tubes 7 and a very much larger number of relatively small inwardly radiating air discharge nipples 8. The head, made up of the ring 6, tubes 7 and nipples 8, constitutes an air suction device or head-piece of the character hitherto employed in hydraulic air compressors. The amount of water overflowing from the leg 1 into the leg 4 may be regulated by an inverted gate 9 shown as secured to an adjusting rod 10. This adjusting rod 10 works through a stuffing box in the head 2, and the lower end thereof has threaded engagement with an arm 11 secured to the interior of the upper section of the siphon leg 4. A hand-piece 12 is adjustably secured to the upwardly extended end portion of the adjusting rod 10. As illustrated, an auxiliary reservoir or vacuum chamber 13 is connected to the vacuum chamber 1^a formed in the summit of the primary siphon, by means of a pipe 14. This auxiliary reservoir 13 in some instances will be desirable, but in other instances will not be required.

The secondary siphon, in the construction illustrated in the drawings, is made up of a relatively long receiving leg 15, a relatively short discharge leg 16 and a vacuum chamber 15^a which connects the said two legs 15 and 16. The vacuum chambers 1^a and 15^a of the primary and secondary siphons are connected by a pipe 17 that constitutes an air duct. The discharge leg 16 of said secondary siphon is preferably provided with a check valve 18 that permits free downward flow of the water, but prevents backward flow thereof. The said discharge leg 16 is arranged to deliver water at an elevation, indicated at C. Opening from the atmosphere into the lower portion of the relatively long receiving leg 15 is an air port, shown as in the form of a short pipe 19 having a funnel-shaped upper end 20 adapted to be opened and closed by a valve 21. This valve is connected, by an adjustable stem 22—22^a, to one of the corrugated plates of a steel vacuum box 23, such as used in the aneroid barometer. This vacuum box is connected, by a small pipe 24, to the air pipe 17, so that said box is subject to the same pressure as that in the vacuum chambers of the two siphons. In the air pipe 17, below its junction with the pipe 24, is a valve 25, by means of which the lower portion of the said pipe 17 may be opened and closed. When the apparatus is in action, however, this valve 25 must be open.

Operation: Before starting the apparatus into action, the head-piece will float on the level of the forebay, and the water will run down, carrying with it a certain amount of atmospheric air, say, for instance, 500 cubic feet of free air per minute. As the system is intended for low heads, usually less than 20 feet, the proportion of air to water must be small as compared to that possible in hydraulic air compressors working under high heads. After the head-piece has once been adjusted, the proportion of air to water will be approximately constant. After the manhole is closed by the cover 3 the removal of 500 cubic feet of air per minute will soon lower the pressure in the vacuum chambers 1^a—15^a, and the water-level will rise correspondingly and the head-piece will continue to float on the new water level, with the air tube 7 projecting above the water and with the nipples 8 submerged in the water. This rise we will assume to be 15 feet, so that the pressure in the system, that is, in the vacuum chambers and connections, will be approximately one-half atmosphere, or 7½ pounds per square inch. The water which continues to run over the head-piece in the primary siphon passes downward over the multiplicity of nipples 8 and draws in air through the tubes 7, at the rate of 500 cubic feet per minute, by volume of rarefied air, which volume of air is equal only to 250 cubic feet of free or atmospheric air per minute; and this air is carried downward by the water flowing through the long leg of the primary siphon and is discharged to the atmosphere at the lower end of said leg. Hence, there can be added 250 cubic feet of free air per minute to the system without causing any change in the vacuum, *i. e.*, the pressure in the vacuum chambers and connections. Inasmuch as the secondary siphon is subject to the same vacuum or reduced pressure as the primary siphon, it is evident that all water in the long receiving leg 15 of said secondary siphon will, by its reduced pressure alone, be caused to rise to the level of the water in the primary siphon. By means of the reversely threaded nut 22^a, the valve stem 22 should be so adjusted that the valve 21 will open the air admission or inlet 19 whenever the air pressure in the system is reduced below 7½ pounds, but will move said valve into a position to close said air inlet whenever the air pressure in the system is raised above 7½ pounds. It is, of course, understood that the atmospheric pressure on the exterior of the vacuum box 23 tends to move the valve 21 into an open position, while the pressure within said vacuum box, assisted by gravity of the parts, tends to move said valve into a closed position. Otherwise stated, under the action of the automatic controller 23, the valve 21 admits air to the leg 15 only when the vacuum exceeds the pressure of the head or column of water in the short leg of the primary siphon. The air thus admitted into the leg 15 of the secondary siphon, through the air inlet 19, will rush upward through the said leg at an increasing speed, expanding in its course in accordance with Marriotte's law, and the air bubbles so reduce the specific gravity of the water in the said leg that the atmospheric pressure, acting on the surface of the forebay, instead of supporting the column of pure water to the altitude *y y*, will now support and accelerate upward a column of water and air to the altitude or level of the water in the vacuum chamber 15ª of the said secondary siphon. It will, of course, be understood that the effective weight of the column of water and air in the relatively long receiving leg 15 of the secondary siphon is always less than the effective weight of the solid column of water in the discharge leg 16 of said siphon. An increase of air in the leg 15 will lower the specific gravity of the fluid therein, and, hence, the water will rush upward through the lower end of said leg at a greater velocity; and conversely, a decrease of the supply of water to said leg will increase the specific gravity of the fluid or mixture of air and water in the said leg, and thus decrease the intake of water. It will thus be seen that neither siphon can ever overload itself as to the intake of water; and the system requires no attention, inasmuch as the working of the system is dependent on the supply of air to the receiving leg of the secondary siphon, and this supply of air is regulated by the automatic controller afforded, in the illustration given, by the vacuum box 23.

When more than one secondary siphons are employed, all thereof may be arranged to deliver water at the same altitude, or they may be arranged to successively deliver water to higher and higher altitudes.

In many instances the long or discharge leg of the primary siphon would not be made extensible, in which case it will be necessary, in the first instance, to produce a partial vacuum in the summit of said primary siphon in order to start the flow of water through the said siphon. The check valve 18 in the lower end of the discharge leg 16 of the secondary siphon would be required only when putting the system into action.

It will, of course, be understood that the air inlet must enter the long leg of the so-called secondary siphon at a point within the suction effect of the vacuum produced, so that the internal pressure at that point is less than atmospheric.

In this specification and in the claims, the expression "long" and "short" siphon legs has reference only to the vertical extent thereof, and entirely ignores the horizontal extension that may, in many instances, be involved in the siphon legs.

What I claim is:

1. In an apparatus for elevating water, the combination with a primary siphon arranged to deliver water from a normal to a lower elevation, of a secondary siphon arranged to deliver water from a normal to a higher elevation and having an air inlet in the lower portion of its receiving leg, and means actuated by the flow of water through said primary siphon and operating to eject air from the summits of said two siphons, whereby the partial vacuum produced in the summits of said siphons will cause air to enter and flow upward with the water through the receiving leg of said secondary siphon, substantially as described.

2. In an apparatus for elevating water, the combination with a primary siphon arranged to deliver water from a normal to a lower elevation, of a secondary siphon having a relatively long receiving leg and arranged to deliver water from a normal to a higher elevation, the said receiving leg having an air inlet in its lower portion, and means actuated by the flow of water through said primary siphon and operating to eject air from the summits of said two siphons, whereby the partial vacuum produced in the summits of said siphons will cause air to enter and flow upward with the water in the relatively long receiving leg of said secondary siphon, substantially as described.

3. In an apparatus for elevating water, the combination with a primary siphon arranged to deliver water from a normal to a lower elevation, of a secondary siphon having a relatively long receiving leg and arranged to deliver water from a normal to a higher elevation, the said long receiving leg having an air inlet in its lower portion, a valve controlling said air inlet, means actuated by the flow of water through said primary siphon and operating to eject air from the summits of said two siphons, and an automatic controller for said valve actuated by a difference between the atmospheric pressure and the partial vacuum pressure produced in said siphons, substantially as described.

4. In a water elevating apparatus, the combination with a primary siphon arranged to deliver water from a normal to a lower elevation, and having a vacuum chamber in its summit, of a secondary siphon having a vacuum chamber in its summit and having a relatively long receiving leg and arranged to deliver water from a normal to a higher elevation, said long receiving leg having an air inlet in its lower portion, an air conduit connecting the vacuum chambers of said two siphons, and an air suction device located in the summit of said primary siphon and operating to produce partial vacuum in said vacuum chambers and thereby cause air to enter through said air inlet and to pass with the water upward through the receiving leg of said secondary siphon, substantially as described.

5. In a water elevating apparatus, the combination with a primary siphon having a delivery leg extending downward through

its receiving leg and arranged to deliver water from a normal to a lower elevation, said primary siphon having a vacuum chamber in its summit, of a secondary siphon having a vacuum chamber in its summit and having a relatively long receiving leg and arranged to deliver water from a normal to a higher elevation, said long receiving leg having an air inlet in its lower portion, an air conduit connecting the vacuum chamber of said two siphons, an air suction device located in the summit of said primary siphon and operating, under the flow of water through said primary siphon, to produce a partial vacuum in the vacuum chambers of said two siphons, a valve controlling said air inlet, and an automatic controller for said valve, actuated by a difference between the atmospheric pressure and the pressure of the partial vacuum produced in the vacuum chambers of said siphons, substantially as described.

6. In an apparatus for elevating water, the combination with a primary siphon arranged to deliver water from a normal to a lower elevation, of a secondary siphon arranged to deliver water from a normal to a higher elevation and having an air inlet in the lower portion of its receiving leg, a valve for opening and closing said air inlet, means actuated by the flow of water through said primary siphon and operating to eject air from the summits of the said two siphons, and an automatic controller for said air inlet valve actuated by a difference between the atmospheric pressure and the pressure of partial vacuums produced in the summits of said siphons, substantially as described.

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

OLAF A. ROED.

Witnesses:
H. D. KILGORE,
F. D. MERCHANT.