(No Model.) 2 Sheets—Sheet 1.

F. H. MERRILL.

APPARATUS FOR RAISING LIQUIDS.

No. 533,225. Patented Jan. 29, 1895.

Fig. 1

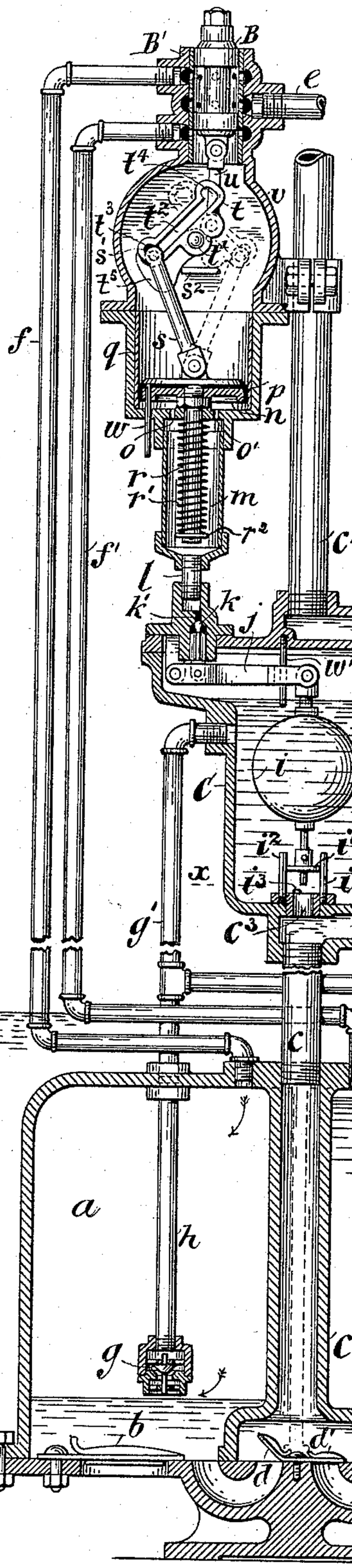

Fig. 2

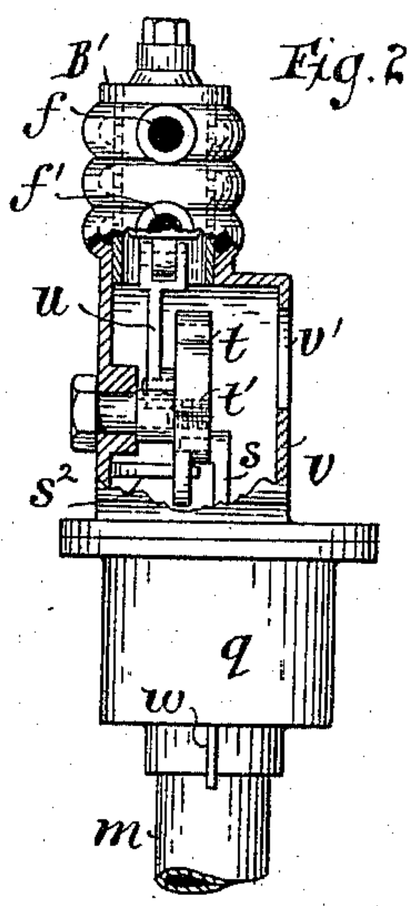

Fig. 3

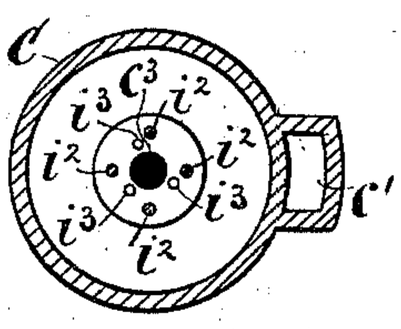

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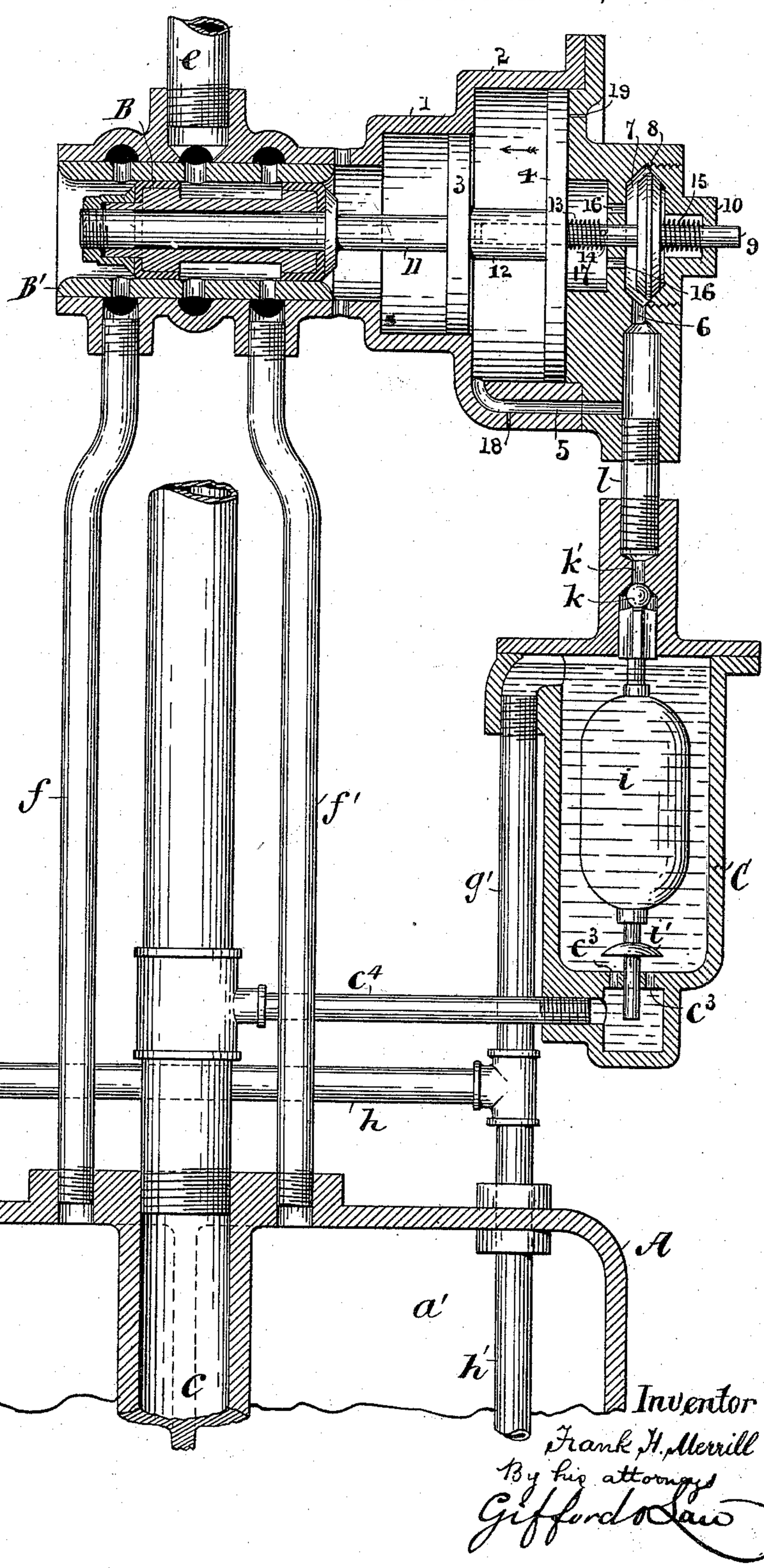
Fig. 4



Witnesses
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Fred'k Kemper.

Inventor
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By his attorneys
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UNITED STATES PATENT OFFICE.

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APPARATUS FOR RAISING LIQUIDS.

SPECIFICATION forming part of Letters Patent No. 533,225, dated January 29, 1895.

Application filed July 13, 1891. Serial No. 399,287. (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 Liquids, of which the following is a specification.

This invention is intended as an improvement upon the liquid raising apparatus described in Letters Patent of the United States No. 403,124, dated May 4, 1889, to A. B. Merrill, and also Letters Patent of the United States No. 403,125, dated May 14, 1889, to myself, and also an application of my own for Letters Patent filed January 15, 1890, Serial No. 337,009.

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 detail partly in section showing another view of the valve actuating mechanism. Fig. 3 is a detail section on the line *x x* of Fig. 1. Fig. 4 is a section of so much of the apparatus as is necessary to explain a modification.

A is a water receptacle divided into two compartments *a* and *a'*. In the bottom of these compartments are located openings 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 pipes *f* and *f'* leading respectively to the chambers *a* and *a'* so as to deliver the compressed air from the valve B at the top of said compartments respectively. *h* and *h'* are pipes extending 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. Within each of these pipes at the bottom, is an upwardly opening valve *g*. A proper level for the surface of the surrounding water in which the apparatus being described is partially submerged, is indicated at *y y*, Fig. 1.

C is a chamber adapted to contain mechanism which may properly be designated either as a motor, a detector or a governor, being operated when the entrance of the compressed air into the chamber C drives the water therein below a certain level. For this purpose, I recommend the use of the float *i*. A pipe *g'* connects the pipes *h* and *h'* with the chamber C near its top. The float *i* is mounted upon a lever *j*, the position of which controls the opening and closing of the compressed air valve *k* in a passage *k'* leading from the chamber C to a passage *l* which communicates in turn with a space *m*, and this in turn with a space *n* through the openings *o* and *o'*. The space *n* is below the piston *p* which reciprocates in the cylinder *q*, being also provided with a stem *r* encircled by a coil spring *r'* in antagonism to which the piston moves upward. The tension of this spring may be adjusted by varying the position of the washer r^2 on the valve stem. The spring *r'* may be omitted in case the weight attached to the piston is sufficient to perform its function and therefore to act as its equivalent. To the piston is pivoted a link *s* which is free to vibrate from the position shown in full lines, Fig. 1, to the position shown in dotted lines and vice versa. The upper end of this link is fitted with a pin *s'* adapted to run from end to end of the slot shown in the oscillating lever *t* which is pivoted, as shown, at *t'*. The slot in the lever *t* which is lettered t^2 is provided at each end with an upward extension t^3 t^4 into which the pin *s'* is thrust by any upward pressure of the link *s* but out of which it is pulled by any downward pressure of the link *s*. A link *u* pivoted respectively to the lever *t* and the valve B compels the latter to respond to the motions of the lever *t*. The lever *t* is surrounded by a casing *v* connecting the cylinder *q* with the valve cylinder B', and this casing may be provided with an opening *v'*.

s^2 is a stationary stop provided for limiting the extent of oscillation of the lever *t* in both directions.

w is a pin attached to the piston *p* and extending downward through an opening in the case *q*. This pin fits loosely in the opening so as to permit the escape of compressed air through the opening around it; the function of the pin being by its motions up and down with the piston, to keep the opening from be-

coming clogged as it would otherwise be likely to do in consequence of its necessarily very small dimensions.

w' is simply a guide-pin for the lever j.

The water escape pipe c is continued through the passage c' around the chamber C to the pipe c^2, and at the bottom of the chamber C it communicates with the interior of that chamber through a passage c^3. The opening to this passage from the chamber C may be nearly closed by the valve i' connected with the float i and moving between guide-pins i^2. When this float is down it is prevented from being completely seated by short studs i^3 which are just long enough to leave a narrow opening between the chamber C and the water passage c'.

In order to describe the mode of operation of this apparatus, I will suppose the parts to be in the position shown in Fig. 1, when compressed air will be entering through the pipe e and will be directed to the pipe f by the valve B. At the same time the interior of the pipe f' will be in communication with the open air through the chamber within the casing v and the opening v' therein. The compressed air passing downward through the pipe f will enter the chamber a and drive the water therefrom into the pipe c and also into the pipe h until the level of the water within the chamber a has been reduced below the bottom of the pipe h whereupon the compressed air will pass through the pipes h and g' into the upper portion of the chamber C. When the operation has reached this point, the compressed air from the pipe f will exert pressure against the water contained in chamber C as well as against that contained in chamber a and will continue to force the water contained in chamber C out into the pipe c' through the opening c^3 so long as the float i remains in the position shown. As soon however, as the water in chamber C has been reduced so low that its buoyancy no longer supports the float i, that float will fall so as to close the valve i' as far as the studs i^3 will admit of and also to open the valve k. Thereupon the compressed air will find an exit from chamber C through passages k', l, m, o, and o' into the space n where it will exert an upward pressure upon the piston sufficient to overcome the spring r' and force the piston upward in the cylinder q; the opening around the pin w being too small to exhaust the air with sufficient rapidity to interfere with this operation. The upward movement of the piston p thrusts the pin s' upward into the slot extension or notch t^3 and continuing, causes the lever t to oscillate from the position shown in full lines to the position shown in dotted lines, Fig. 1. This carries the valve B from the upper end of its stroke to the lower end of its stroke and simultaneously makes connection between the compressed air pipe e and the pipe f' and also between pipe f and the open air.

t^5 is a weight cast on the lever t which acts as a counterpoise for the weight of the main valve on the opposite side of the fulcrum. Now however, the conditions existing in the whole apparatus change. The pipe f having communication at its top with the open air, relieves all pressure within the compartment causing valves d and g to close and valve b to open so as to fill the compartment a with water from the supply in which it is immersed. At the same time the pressure of compressed air entering compartment a' through the pipe f' will cause the valve b' to close and the valve d' to open and will cause the water within the compartment a' to be forced into the water exit pipe c and also into pipe h'. This water will pass from the exit pipe c into the pipes c' and c^2 and so on, to the point of delivery; but some of it will also pass through the passage-way c^3 and under some conditions of pressure also through the pipes h' and g' into the chamber C which it will quickly fill so as to raise the float i and close the valve k. Now the compressed air beneath the piston p is cut off from the supply and escapes through the opening around pin w so that the spring r returns the piston to the position shown in Fig. 1 carrying also the pin s' into the position shown in dotted lines in that figure where it is ready upon being again forced upward, to oscillate the lever t back into its first position and shift valve B.

The forcing of the water out of the compartment a' into the water exit pipe c will continue until the level has been reduced below the lower end of the pipe h' when the valve at the lower end thereof corresponding with the valve g will open and the compressed air will flow through the pipes h' and g' into the upper portion of the chamber C. This compressed air will now repeat the operations already described as being performed by the compressed air from chamber a and resulting in the shifting of the valve B back again to the position shown in Fig. 1, whereupon the pressure will be transferred from the pipe f' to the pipe f and the operation first described will be repeated. In this way the pressure of the compressed air will be alternately applied, first in one of the compartments of the chamber and then in the other, so as to force their contents successively through the water exit pipe c; the chamber C and the motor, governor or detector located therein operating to determine for both the compartments of the chamber A when the water therein has been reduced to such a level as to make a change of pressure from one to the other necessary.

I will now describe the modification shown in Fig. 4 which is only claimed in this application in so far as it is generically like the apparatus already described, the details to be claimed in a separate application. This modification has, like the first form, a compressed air supply pipe e, a valve B, pipes f and f' connecting the valve chamber with the compartments a and a' respectively, of chamber A, the pipes h and h' leading from

within the compartments respectively to the pipe g' which communicates with the chamber C near its top. The chamber A is constructed as described and shown in connection with the first form, as are also the lower portions of the pipes h, h' and c. The water escape pipe c connects with the openings c^3 leading into the bottom of the chamber C through a branch pipe c^4. The float i within the chamber C is provided with a valve i to close the opening c^3 and also with a valve k for closing the passage-way k'. The form of construction by which the power of the compressed air entering the passage l is transmitted to the shifting of the valve B is however, different in this modification from that in the form first described, as I will now proceed to show.

Two cylinders 1 and 2 are located in alignment with the cylinder B' of the valve B. The cylinder 2 is larger in diameter than the cylinder 1. Within the cylinder 1 is located a piston 3 and within the cylinder 2, a piston 4. A passage 5 connects passage l with the interior of the cylinder 2 between the two pistons. A passage 6 connects the passage l with the valve chamber 7 within which is located a double conical valve 8. The valve stem 9 is mounted, so as to be capable of reciprocating, at one end in the casting 10 and and at the other end in the piston 4 and its stem 12. Its bearing in the stem 12 is long enough so that it is properly supported at all parts of the stroke of the piston 4. The distance between the valve B and the piston 3 is limited by the stem 11 connecting it with the valve B and the distance between the piston 4 and the piston 3, is fixed by the stem 12 by which they are connected. A coil spring 13 interposed between the piston 4 and a pin 14 in the valve stem 9, exerts a pressure tending to thrust the valve stem 9 in a direction opposite to the arrow. A coil spring 15 interposed between the valve 8 and the casting 10 tends to thrust that valve and its stem 9, in the direction of the arrow.

16, 16 are orifices connecting the valve chamber 7 with the space 17 in front of the piston 4.

The operation is as follows: Starting with the parts in the position shown, when the air has forced the water out of chamber a sufficiently to allow the float to fall, the valve k will open and allow the compressed air to fill passage l. It will pass thence through passage 5 into cylinder 2 and also through passage 6, valve chamber 7 and passages 16 into space 17. The pressure of the air on the two pistons combined in the direction of the arrow, will be greater than its pressure against the piston 4 in the opposite direction, and they will both be forced to the opposite ends of their strokes, carrying the valve B before them. The valve k will now close and the confined compressed air will escape through the very small orifices 18 and 19. As soon as the valve 8 is relieved from the pressure of the air it will be controlled solely by the springs 13 and 15 acting in opposite directions. When piston 4 is at the end of its stroke shown, spring 13 is strong enough to overcome spring 15; but when piston 4 is at the opposite end of its stroke spring 15 will overcome spring 13. At the point of the operation reached by my description, the latter condition prevails, and therefore the valve 8 will move to the opposite end of its stroke from that shown in the drawings. When valve k again opens, the compressed air from passage l will find itself cut off from space 17 by the position of valve 8 and will exert its pressure on pistons 3 and 4 solely from the space between them; but 4 being larger than 3 in area, the pressure in direction opposite to the arrow will prevail and the pistons will be forced back to the position shown, dragging the valve with them. This will bring the force of spring 13 to bear on the valve stem 9 in opposition to spring 15 and therefore, as soon as the compressed air is again cut off by the closing of valve k the valve 8 will be returned by the spring 13 to the position shown.

In the foregoing description, I have in both modifications described the employment of the water exit pipe c and in practice I believe that the presence of this pipe will add materially to the success of the apparatus, and under some conditions will be found to be indispensable. In certain cases however, as where small quantities of water are to be raised and the valve mechanism is comparatively near the water compartments, this water passage c may be dispensed with, the other parts remaining substantially the same. In this case, the water from either compartment, as for instance, the compartment a, will be forced therefrom wholly through the pipes h and g' and the chamber C and the passage c^3 into the delivery pipe c', and the change of condition in the chamber C which serves to operate the float therein will be caused by the compressed air having followed the water up through the pipes h and g' and into the chamber C to such an extent as to force the water within the chamber C below the level which supports the float.

Having now described by way of illustration a form of apparatus suitable for carrying out my invention, I do not desire to be understood as limiting myself thereto since I am aware that many of its elements may be changed in form or arrangement or even eliminated without departing from the principle of my invention.

I claim—

1. In a liquid raising apparatus in combination, two primary liquid compartments provided with inlet liquid and gas passages, a supplementary liquid compartment, a float adapted to be buoyed up by water therein, passages connecting the supplementary compartment with each of the primary liquid compartments, a valve mechanism directing the gas alternately into said primary compartments and means whereby said valve

echanism is controlled by said float, substantially as described.

2. In a liquid raising apparatus in combination, two primary liquid compartments provided with inlet liquid and gas passages, a supplementary liquid compartment, a motor, passages connecting the supplementary compartment with each of the primary liquid compartments, a valve mechanism directing the gas alternately into said primary compartments, mechanism operating upon said valve and adapted to be operated by compressed gas, a passage communicating with said mechanism from the supplementary compartment, a valve controlling said passage and connection between said last valve and said motor, substantially as described.

3. In a liquid raising apparatus in combination two primary liquid compartments provided with inlet liquid and gas passages, a supplementary liquid compartment, a motor, passages connecting the supplementary compartment with each of the primary liquid compartments at or near the bottom thereof, through which liquid passes, other passages connecting each of said primary compartments at or near the bottom with the supplementary compartment at or near the top for the passage of compressed gas, a valve mechanism directing the gas alternately into said primary compartments and means whereby said valve mechanism is controlled by said motor, substantially as described.

4. In a liquid raising apparatus in combination two primary liquid compartments provided with inlet liquid and gas passages, a supplementary liquid compartment, a float adapted to be buoyed up by water therein, passages connecting the supplementary compartment with each of the primary liquid compartments, a check valve in each passage, a valve mechanism directing the gas alternately into said primary compartments and means whereby said valve mechanism is controlled by said float, substantially as described.

5. In a liquid raising apparatus in combination two primary liquid compartments provided with inlet liquid and gas passages, a supplementary liquid compartment, a motor, passages connecting the supplementary compartment with each of the primary liquid compartments, a water delivery pipe distinct from said passages connected with said supplementary compartments, a valve mechanism directing the gas alternately into said primary compartments and means whereby said valve mechanism is controlled by said motor, substantially as described.

6. In a liquid raising apparatus in combination two primary liquid compartments provided with inlet liquid and gas passages, a supplementary liquid compartment, a motor, passages connecting the supplementary compartment with each of the primary liquid compartments, a water delivery pipe distinct from said passages connected with both of said primary compartments, a valve mechanism directing the gas alternately into said primary compartments and means whereby said valve mechanism is controlled by said motor, substantially as described.

7. In a liquid raising apparatus in combination two primary liquid compartments provided with inlet liquid and gas passages, a supplementary liquid compartment, a motor, passages connecting the supplementary compartment with each of the primary liquid compartments, a water delivery pipe distinct from said passages connected with all of said compartments, a valve mechanism directing the gas alternately into said primary compartments and means whereby said valve mechanism is controlled by said motor, substantially as described.

8. In a liquid raising apparatus in combination two primary liquid compartments provided with inlet liquid and gas passages, a supplementary liquid compartment, a motor, passages connecting the supplementary compartment with each of the primary liquid compartments, a water delivery pipe, a passage connecting the same with the supplementary chamber, a valve adapted to only partially close said passage, a valve mechanism directing the gas alternately into said primary compartments and means whereby said valve mechanism is controlled by said motor, substantially as described.

9. In a liquid raising apparatus in combination two primary liquid compartments provided with inlet liquid and gas passages, a supplementary liquid compartment provided with an ingress and two egress openings, a motor, passages connecting the ingress opening with each of the primary liquid compartments, valves whereby both of said egress openings are controlled, a valve mechanism directing the gas alternately into said primary compartments and means whereby said egress opening valves are controlled by said motor, substantially as described.

10. In combination with the valve B the following mechanism whereby the same is moved, viz: a tilting lever, a piston adapted to be forced in one direction by compressed air, a spring tending to force the piston in the opposite direction and a connection interposed between the lever and piston and adapted to run from end to end of the lever, substantially as described.

11. In combination with a compressed fluid inclosure containing an exhaust orifice, a pin slightly less in diameter than the orifice extending through said orifice and means whereby said pin is reciprocated, the said pin being as long as or longer than its stroke whereby it is maintained continuously within said orifice as it reciprocates, substantially as described.

12. In a liquid raising apparatus in combination two primary liquid compartments provided with inlet liquid and gas passages, a supplementary liquid compartment, a motor

therein, passages connecting the supplementary compartment with each of the primary liquid compartments, a valve mechanism directing the gas alternately into said primary compartments, a piston mechanism whereby each successive advance of the piston is transmitted to the valve in an opposite direction, a valve controlled by said motor whereby fluid is intermittently admitted against the piston and mechanism whereby the piston is returned when the last named valve is closed, substantially as described.

13. In a liquid raising apparatus in combination, two primary liquid compartments, a secondary liquid compartment, a passage connecting the latter with each of the former, a liquid entrance and a gas entrance to each of said primary compartments, 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 said secondary and one of said primary compartments at the same time by the operation of said motor, substantially as described.

14. In combination, the valve mechanism, the rocker whereby it is operated, the piston and a link interposed between the piston and rocker with the latter of which it makes a running connection extending from one side to the other of the rocker fulcrum, substantially as described.

15. In combination, the valve mechanism, the piston, means interposed between the piston and the valve mechanism whereby the motion of the piston is transmitted to said valve mechanism, means whereby the piston is retracted, a compressed gas supply pipe communicating with said valve mechanism and passages controlled by said valve mechanism leading from the supply pipe to behind the piston whereby the piston is forced forward to operate said valve mechanism by the compressed gas, substantially as described.

16. In combination with the valve mechanism the following mechanism whereby the same is moved, viz: a tilting lever, a piston adapted to be forced in one direction by compressed air, a power device tending to force the piston in the opposite direction and a connection interposed between the tilting lever and the piston and adapted to go from end to end of the lever, substantially as described.

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