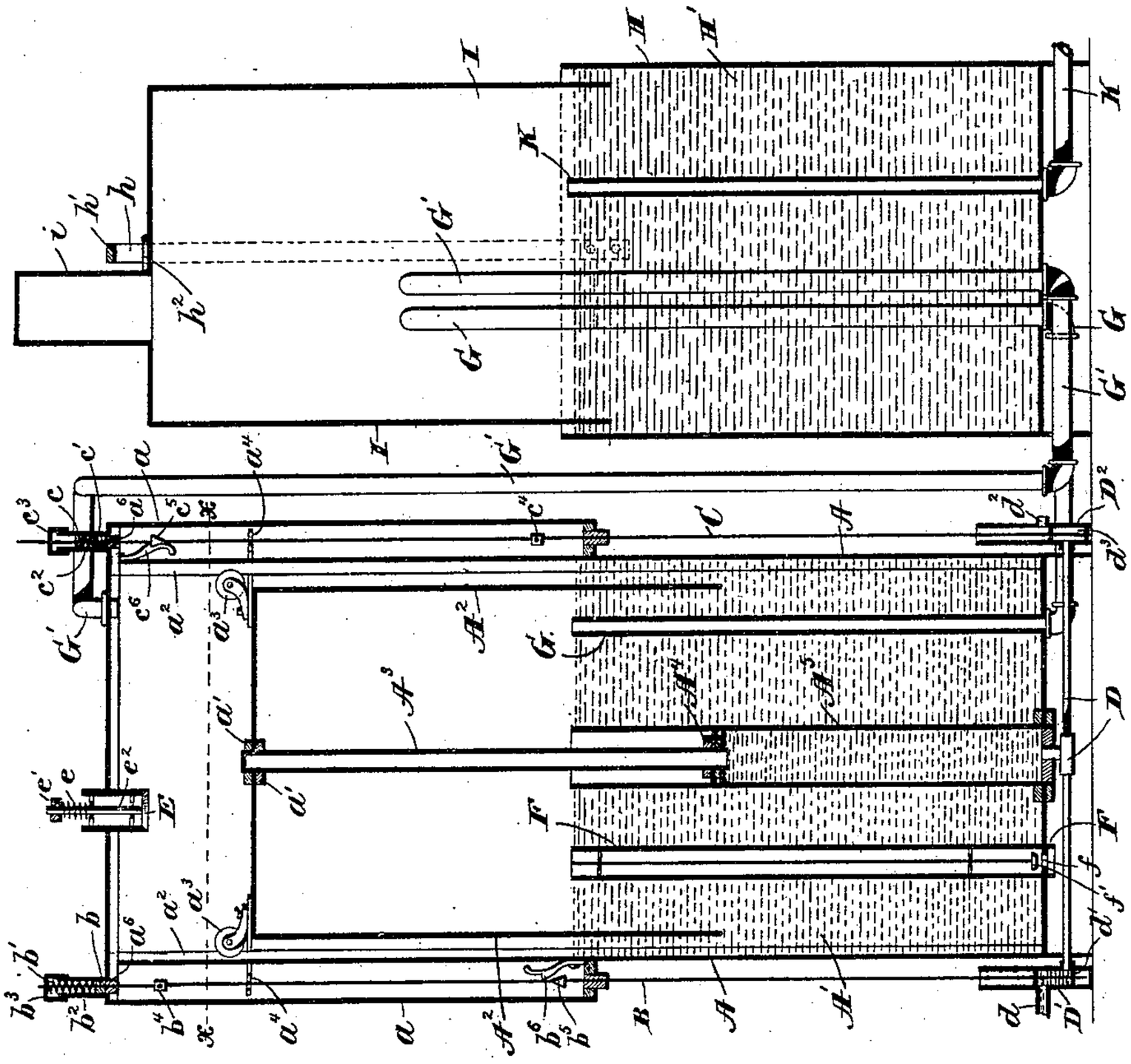
(No Model.) 2 Sheets—Sheet 1.

J. G. HAINES.

AIR COMPRESSOR AND RESERVOIR.

No. 470,934. Patented Mar. 15, 1892.

Fig. 1.



Witnesses:
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(No Model.) 2 Sheets—Sheet 2.

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Fig. 2.

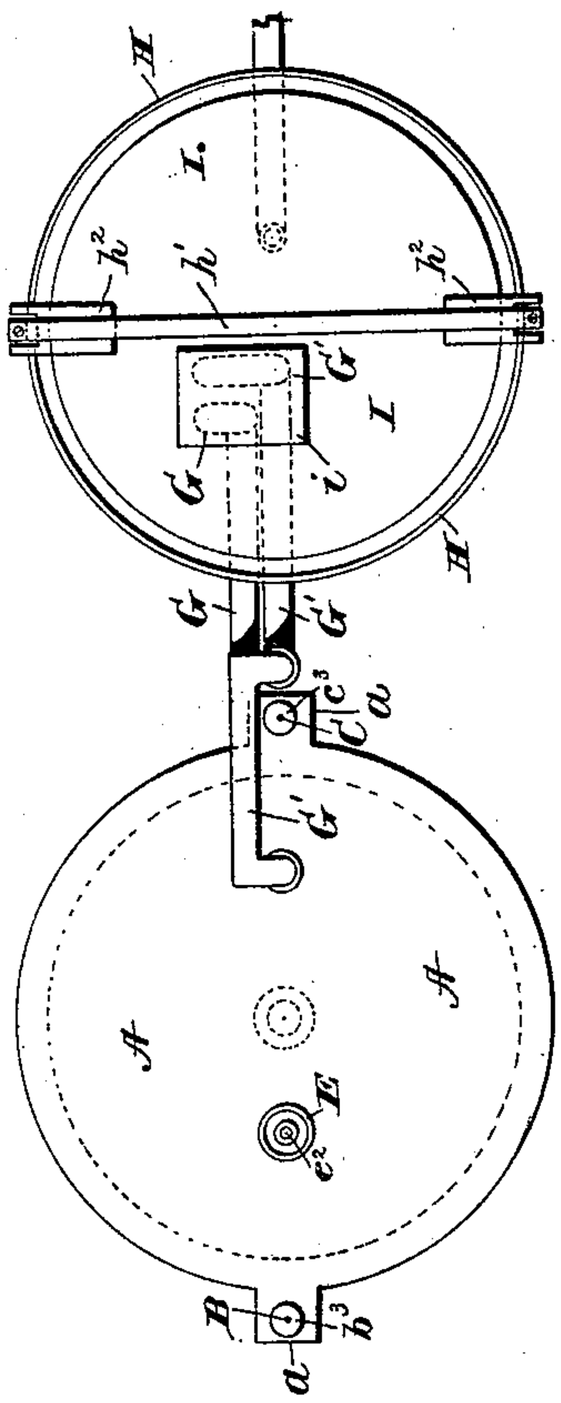
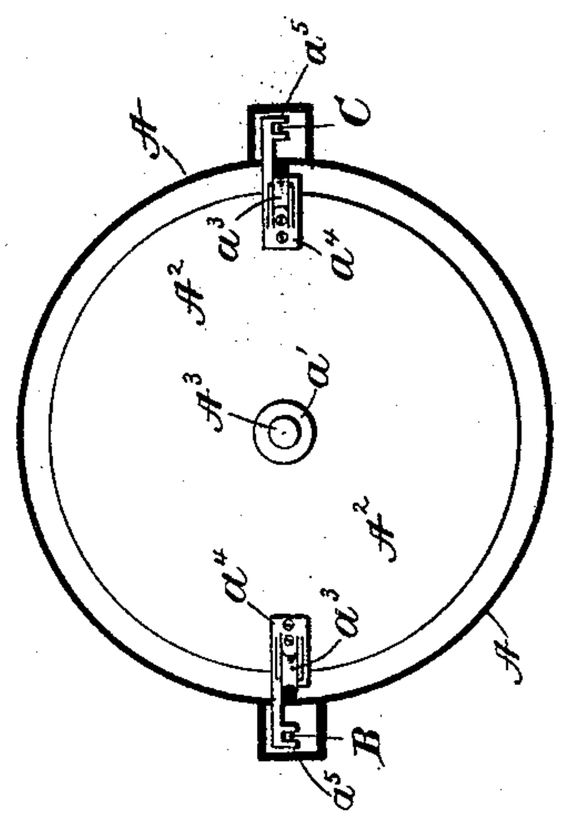


Fig. 3.



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by Pindle and Russell
his attorneys

UNITED STATES PATENT OFFICE.

JOHN GARDINER HAINES, OF OMAHA, NEBRASKA.

AIR COMPRESSOR AND RESERVOIR.

SPECIFICATION forming part of Letters Patent No. 470,934, dated March 15, 1892.

Application filed March 23, 1891. Serial No. 386,066. (No model.)

To all whom it may concern:

Be it known that I, JOHN GARDINER HAINES, of Omaha, in the county of Douglas, and in the State of Nebraska, have invented certain new and useful Improvements in Air Compressors and Reservoirs; and I do hereby declare that the following is a full, clear, and exact description thereof, reference being had to the accompanying drawings, in which—

Figure 1 shows a vertical section of my apparatus; Fig. 2, a plan view of the same; Fig. 3, a section on line *x x* of Fig. 1.

Letters of like name and kind refer to like parts in each of the figures.

The object of my invention has been to provide an improved air compressor and reservoir for use more particularly with gas-producing apparatus; and to this end it consists in the apparatus and in the parts thereof constructed, arranged, and combined as hereinafter specified.

In the drawings, A designates an upright closed tank, preferably made of galvanized iron and cylindrical in general form. On diametrically-opposite sides it has the two offsets *a a* from its upper part adapted to form upright ways to accommodate the up-and-down travel of certain parts, to be described hereinafter, projecting out beyond the plane of the periphery of the main part of the tank. Within the lower half of the latter is a body A′ of liquid, preferably water, in which is immersed the open lower end of the cylinder A^2, whose closed top is connected with the hollow piston-rod A^3, which is to raise and lower the cylinder. As shown, such rod passes up through the cylinder-top and is fastened thereto by nuts *a′ a′*; but I do not intend to limit myself to such construction. At its upper and lower ends, respectively, the piston-rod is closed and open, so that an air-chamber will be formed within it, for a purpose to be described. On the rod's lower end is a piston-head A^4, which can be of any desired construction and form adapted to fit closely, while being capable of moving up and down easily within the cylinder A^5, attached to and extending upward from the bottom of tank A to a point above the level of the liquid A′.

To guide the cylinder A^2 as it rises and falls within tank A, the latter is provided with upright guides a^2 a^2 opposite the inner sides of offsets *a a*, respectively, which are engaged by the grooved wheels or rollers a^3 a^3, journaled in suitable bearings on the cylinder-top; also, attached to the latter and extending out therefrom into the respective offsets *a a* are the arms a^4 a^4, each one of which has on its end a sidewise-projecting fork a^5, embracing a rod which extends through suitable stuffing-boxes a^6 a^6 at the upper and lower ends of the offset.

The two rods on opposite sides of the tank are lettered B and C, respectively. The former has its upper end above the tank-top provided with a block or fixed washer *b*, which is engaged and pressed downward by a spring *b′*, surrounding the rod within a small cylindrical projection b^2, provided with the screw-cap b^3. On the portion of the rod within the offset *a* is a button b^4, so situated that when the rod has been forced down by its spring it will be struck and carried upward by the corresponding forked arm a^4 as the cylinder A^2 approaches the limit of its upward movement within tank A.

Near the lower end of the part of the rod within the offset is a catch b^5, while on the tank A is a stationary spring-catch b^6, adapted to engage and hold the catch on the rod when the latter has been raised, as above described. The other rod C has on it above the tank-top a head or fixed washer *c*, which is engaged and pressed upward by a spring *c′* within a hollow projection c^2 on the tank-top, provided with a cap c^3, like that on the other corresponding projection b^2.

On the part of the rod which is within the respective offset *a* are the button c^4 and the catch c^5, the former situated so as to be struck and moved down by the corresponding forked arm a^4 as the cylinder A^2 approaches the lower limit of its downward travel, and the latter arranged so as to be engaged and held down by the stationary spring-catch c^6 on the tank when the rod has been moved down, as described, by the fork-arm engaging the button c^4.

Communicating with the lower end of cylinder A^5 is a pipe D, connected at its opposite ends with the valve-chambers D′ and D^2, respectively. The former of these chambers to be connected by port *d* with any suitable source of supply of water under pressure, or

steam, has in it the valve d', attached to rod B and so constructed as to open and close the opening from the valve-chamber into pipe D when the rod occupies its lowest and highest positions, respectively. The other chamber has the outlet-port d^2, which can be connected with any suitable pipe or receptacle to receive the waste water or steam, and the valve d^3, connected with rod C and adapted to open and close such outlet-port as the rod occupies its highest and lowest positions, respectively.

While I have shown the valve-chambers as cylindrical and the valves as having certain special constructions, I do not intend to limit myself to such arrangement. Any suitable form of valve-chamber and valve can be used instead of what I have shown without departure from my invention. It is, however, desirable to have the two valves constructed, as those illustrated are, so as to be balanced in their action and not liable to be forced in either direction by the pressure from within the respective valve-chambers.

At the top of the tank A, I place an inwardly-opening valve E, which, being normally held closed by spring e, engaging the head or collar e' on its stem e^2, is adapted to open inward easily, so as to let air into the upper part of the tank as the cylinder A^2 descends within the latter.

At the lower end of a pipe or small cylinder F, extending up from the tank-bottom to a point within the cylinder above the level of the liquid A′, is a port f, communicating with the atmosphere. A valve f', opening upward and inward, serves to allow the passage of air up into the pipe and through it to the interior of the cylinder A^2, while preventing any downward and outward flow. A pipe G, whose upper end is situated within the cylinder above the level of the liquid body A′, passes down through the bottom of tank A and runs to the second tank H, while another pipe G′, similarly connected with the latter, is in communication with the upper part of tank A above cylinder A^2.

Within tank H, which can, as shown, be open at its top, is a body H′ of liquid, preferably water, up through which extend the continuations of pipes G G′, which from points well above said body are bent downward, so that their open ends are immersed in the liquid.

The holder I, consisting of a cylinder with closed top and open lower end, is arranged with the latter surrounding pipes G G′, immersed in the body of liquid H′, while its top has a hood or extension i to accommodate the bends in said pipes when the holder is down in its lowest position with its top just above the level of the liquid. Any desired means for guiding the holder as it rises and falls within tank H can be used. As shown in the drawings, the latter is provided with uprights h h, joined at their tops by a cross-bar h', while the top of the holder has pieces h^2 h^2, which, being forked, embrace the uprights or guides; but I do not intend to limit myself to such construction. The bends in pipes G G′, having their ends immersed in the liquid in tank H, are to serve as traps, allowing air to flow into the holder and preventing it from passing back from the latter into the pipes. Instead of these traps I contemplate using any suitable kind of valve to serve the same purpose. For instance, each of the open ends of the pipes might be provided with a valve, which the liquid would tend to keep closed, but which would yield easily to pressure of air from within the respective pipe. Such valves, being closed and sealed by the liquid, would afford certain protection against any backflow of air from the holder through the pipes, whatever the pressure in the holder might be. Extending from a point within the latter and above the level of liquid H′ down through the bottom of tank H is the pipe K, which is to conduct away the air under pressure from the holder to the point at which such air is to be used or into a suitable pipe for leading it where it is wanted.

When my air-compressing apparatus as described is used in connection, as I especially intend it to be, with a carburetor for the purpose of making illuminating or heating gas, the pipe K is to be connected with and discharged into the desired carbureting-chamber.

The operation of my apparatus constructed and arranged as shown and described is as follows: Starting with the cylinder A^2 down in its lowest position, the valves d^3 and d', respectively, closed and open, and the catch c^5 on valve-rod C engaged and held down by spring-catch c^6, the water will flow through valve-chamber D′ and pipe D to cylinder A^5 and will force the piston A^4 upward in the latter, so as to raise the movable cylinder. As the latter rises the air above it within the tank A is compressed and, as the valve E is automatically closed, must flow out through pipe G and into the holder I, from which it is prevented from returning by the described trap in the pipe or the proposed liquid-operated valve, when such is used, instead of the simple bend in the pipe with its end extending down into the body of liquid H′. Meantime, as the top of the cylinder moves away from the top of liquid A′ air passing in to fill the increasing space within the cylinder above the liquid raises the valve f' and flows freely up in pipe F. The water in the cylinder A^5 in forcing the piston and cylinder A^2 upward confines and compresses the air within the hollow piston-rod A^4, so that such air forms a yielding cushion, which will tend to continue the upward movement of the cylinder a short distance after the inflow of water to the cylinder A^5 is cut off by the closing of the valve d'. As the cylinder approaches the limit of its upward movement one of its fork-arms a^4 engages the button or collar b^4, fixed on valve-rod B, and moves the latter upward, so that the valve d' will be closed to shut off the water from pipe D, and the catch b^5 is

carried up into position to be engaged and held up by the respective spring-catch b^6. Without the air-chamber in the hollow piston-rod containing air compressed by the water from the cylinder A^5 the moving cylinder would stop rising as soon as the inlet-valve is closed, and consequently could not be used conveniently for causing the opening of the exhaust-valve d^3, while with such chamber there will, on account of the elasticity of the air inclosed therein, be a short upward motion of the rising cylinder after the inlet-valve is closed, as described. The catch c^6, which engages and holds up catch c^5, and the exhaust-valve rod, to which the latter catch is attached, is situated so that it will be engaged by the respective fork-arm a^4 and caused to release catch c^5 during said extra motion of the cylinder A^2 after the closing of the inlet-valve. The spiral spring engaging the head or collar on the outlet-valve rod will then draw the latter upward, so as to quickly open the exhaust-valve to its full capacity. As the water runs out of cylinder A^5 the piston therein and the moving cylinder A^2 will descend at once. The latter, sinking down into the body of liquid A′, will force the air within its upper portion out through pipe G, from which it passes into the holder through the trap shown and described or past the liquid-operated valve, which can be used instead of the trap for preventing any backflow of air from the holder through the pipe. As the cylinder A^2 approaches the limit of its downward movement its forked arm A^4 on the side toward rod C engages the button or collar c^4 and forces said rod down, so as to close the outlet-valve and bring the catch c^5 into position to be engaged and held down by spring-catch c^6. The body of air inclosed within the hollow piston allows a short continuation of the downward movement of the cylinder A^2 after the outlet-valve is closed, which, because of the incompressibility of water, could not be secured without the air-chamber. This extra movement is taken advantage of to make certain of the opening of the inlet-valve only after the outlet one has been fully closed, the spring-catch b^6 being so situated as to be struck and tripped by the respective arm a^4 during such movement. The rod B, being then released, is thrown down quickly by its spiral spring, so as to fully open the inlet-valve attached to its lower end, as shown and described. As the cylinder A^2 descends air is drawn into the upper part of tank A, previously occupied by the cylinder. The valve E opens easily to admit the influx of air, but closes immediately to prevent its egress, as indicated hereinbefore, when the cylinder begins to rise again. The inlet and outlet valves are now open and closed, respectively, as in the first position of the parts of the apparatus above described. The cylinder A^2 will then be forced upward again, driving the air out of the upper part of tank A through pipe G′ and drawing another supply into its own interior above the body of liquid A′ through pipe F. With the construction described the cylinder A^2 will continue to rise and fall, alternately forcing air from within itself and the upper part of the tank into the holder I. The latter is thus given a substantially continuous supply of air under pressure, which will raise it up within the tank H, as shown in the drawings. The weight of the holder, which tends to sink down into the liquid in said tank, will then cause the air to be forced out through pipe K, from which it passes to the point at which it is to be used or into a suitable conduit or main for conducting it wherever desired.

While I have, in describing the operation of my apparatus, set forth water under pressure as used to raise the piston A^4 to lift the movable cylinder A^2, I desire it to be understood that I contemplate using instead for the same purpose steam, air, or other fluid under pressure, which can be delivered from any suitable source of supply to the inlet-port *d* of valve-chamber D′. Where air or steam is used the air-chamber in the piston-rod is not a necessity, as it is where water is employed to lift the piston, and can be dispensed with, if desired.

My apparatus constructed as shown and described is cheap, simple, and not liable to get out of order and in action is entirely automatic, requiring only a supply of water under pressure to the port *d*. There is in it no complicated machinery and no working part which requires watching or is likely to become worn, so as to be inoperative after continued use.

Having thus described my invention, what I claim is—

1. In combination with the closed tank containing a body of liquid, the movable cylinder within the tank, having the upper closed end and the open lower end immersed in the liquid, inlets for admitting air to the upper part of the tank and the interior of the cylinder, respectively, valves for such inlets to allow inward but prevent outward flow of air through them, suitable eduction-pipes leading from the upper part of the tank and the interior of the cylinder above the liquid, and means for raising and lowering the cylinder within the tank, substantially as and for the purpose specified.

2. In combination with the closed tank containing a body of liquid, the movable cylinder within the tank, having the closed top and the open lower end immersed in the liquid, the air-admitting pipe extending up within the cylinder to a point above the liquid, a valve to admit air into such pipe and prevent its outflow through the same, the inlet in the upper part of the tank, the valve to admit ingress and prevent egress of air through the inlet, the eduction-pipe extending up into the cylinder to a point above the liquid, a second eduction-pipe communicating with the space within the upper part of the tank, and means

for raising and lowering the cylinder, substantially as and for the purpose shown.

3. In combination with the closed tank containing a body of liquid, the movable cylinder within the tank, having the closed top and the open lower end immersed in the liquid, air-inlets to admit air to the upper part of the tank and the interior of the cylinder, respectively, valves to admit ingress and prevent egress of air through such inlets, eduction-pipes connected, respectively, with the upper part of the tank and the interior of the cylinder above the liquid, check devices to prevent backflow of air through the pipes to the tank and cylinder, and means for raising and lowering the cylinder within the tank, substantially as and for the purpose set forth.

4. In combination with the closed tank containing a body of liquid, the movable cylinder therein having the closed top and the open lower end immersed in the liquid, air-inlets to admit air to the upper part of the tank and the interior of the cylinder, respectively, valves to admit ingress and prevent egress of air through such inlets, a second tank containing a body of liquid, the holder with closed upper end and open lower end immersed in the liquid, eduction-pipes leading, respectively, from the upper part of the first tank and the interior of the cylinder above the level of the liquid in such tank to the interior of the holder and provided with means for preventing the backflow of air through them from the holder, an eduction-pipe leading from the latter, and means for raising and lowering the cylinder within the closed tank, substantially as and for the purpose described.

5. In combination with the closed tank containing a body of liquid, the movable cylinder therein closed at its top and having the open lower end immersed in the liquid, inlets to admit air to the upper part of the tank and the interior of the cylinder, valves for such inlets to allow the inward passage of air and prevent its outward flow, a second tank containing a body of liquid, the holder having the closed upper end and the open lower end immersed in the liquid, eduction-pipes communicating, respectively, with the upper part of the closed tank and the interior of the cylinder therein at a point above the level of the liquid in that tank and extending up within the holder above the liquid in which the lower end of the latter is immersed and then running down into such liquid, an eduction-pipe leading from the interior of the holder above the liquid, and means for raising and lowering the cylinder within the closed tank, substantially as and for the purpose specified.

6. In combination with the piston and the cylinder in which it moves, means for admitting liquid under pressure into the cylinder and exhausting it therefrom, and an air-chamber in communication with the liquid in the cylinder, substantially as and for the purpose shown.

7. In combination with the piston and the cylinder within which it moves, means for admitting liquid under pressure into the cylinder and exhausting it therefrom, and the hollow piston-rod having its outer and inner ends closed and opened, respectively, substantially as and for the purpose set forth.

8. In combination with the piston and the cylinder within which it moves, the hollow piston-rod containing an air-chamber in communication with the interior of the cylinder, a source of supply of liquid under pressure, a valve to open and close such connection, an exhaust-valve to let the water out of the cylinder, the valve-rods, springs for moving the rods to open the valves, catch devices to hold the rods as moved to close the valves, buttons or collars on the rods, and devices moved by the piston, adapted as the piston approaches the limit of its motion in either direction to engage the button on the rod of the open valve and move it so as to close said valve and then to trip the catch holding the other rod, substantially as and for the purpose described.

9. In combination with the movable cylinder provided with valve-operating arms, the piston, the hollow piston-rod with closed upper end attached to the cylinder, the fixed cylinder in which the piston moves, a source of supply of liquid under pressure connected with the fixed cylinder, inlet and outlet valves for letting the liquid into and out of the latter, the valve-rods, springs for moving the same to open the valves, buttons or collars so situated on the inlet and outlet valve rods that the cylinder-arms engage them and move the rods to close the respective valves as the cylinder approaches the upper and lower limits of its motion, and a catch for each rod to hold the latter in valve-closing position adapted to be tripped by one of the cylinder-arms after the other arm has moved the other rod to close its valve, substantially as and for the purpose specified.

10. In combination with the tank containing a body of liquid, the movable cylinder therein having the closed top and its lower end open and immersed in the liquid, the piston, the fixed cylinder in which it moves, the hollow piston-rod attached to the movable cylinder, a source of supply of liquid under pressure connected with the fixed cylinder, inlet and outlet valves for the latter, the rods connected with the valves, springs to hold the rods moved to open the valves, arms on the movable cylinder, the buttons on the inlet and outlet valve rods, respectively, to be struck and moved by the cylinder-arms as the cylinder approaches the limit of its up-and-down movement, and a spring-catch device for each rod, adapted to be tripped by one of the arms after the other has moved the button on the other rod to close its valve, substantially as and for the purpose shown.

11. In combination with the closed tank containing a body of liquid, the movable cylinder therein having the closed upper end,

the open lower end immersed in the liquid, and valve-operating arms, the hollow piston-rod attached to the cylinder, the piston, the fixed cylinder in which it moves, the pipe connected with the lower end of such cylinder, the inlet and outlet valves closed by up-and-down movement, respectively, the rods connected with the two valves, a button on the inlet-valve rod above one of the arms on the movable cylinder, a button on the other rod below the other arm, catch devices for holding the two rods up and down, respectively, so situated that each will be tripped by one of the arms on the cylinder after the other arm has engaged the button on the other rod and moved the latter to close its valve, springs forcing the inlet and outlet valve rods down and up, respectively, valved inlets to admit air to the upper part of the tank and the interior of the cylinder, and eduction-pipes leading from within the cylinder above the body of liquid and the space within the upper part of the tank, substantially as and for the purpose set forth.

In testimony that I claim the foregoing I have hereunto set my hand this 12th day of March, A. D. 1891.

JOHN GARDINER HAINES.

Witnesses:
DANA S. LANDER,
JOSEPH B. PIPER.