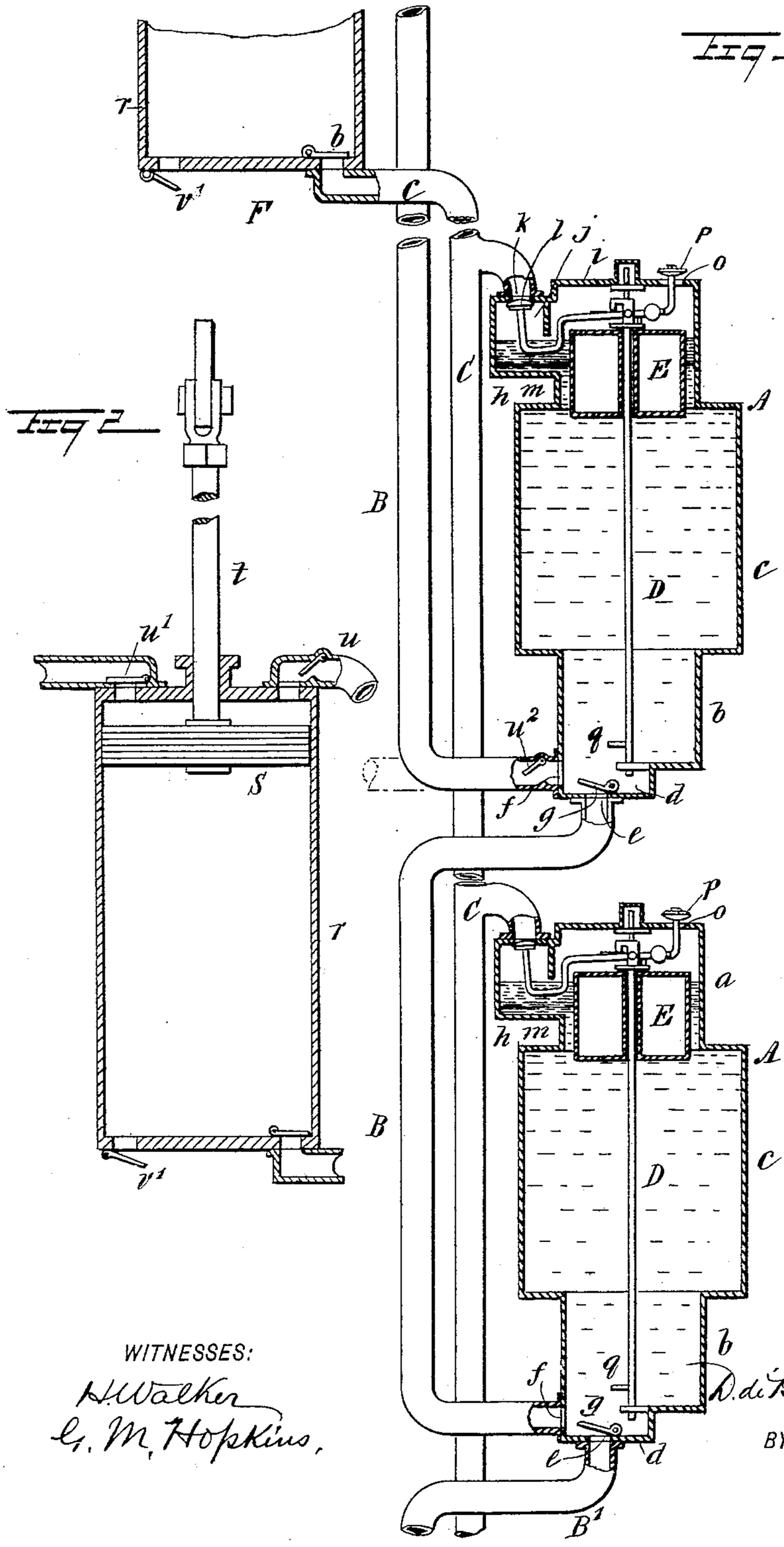
(No Model.) 3 Sheets—Sheet 1.

D. DI B. SAVORGNAN.

WATER ELEVATOR.

No. 566,625. Patented Aug. 25, 1896.

Fig 1



WITNESSES:

H. Walker

G. M. Hopkins.

INVENTOR

D. di Brazza Savorgnan

BY

Munn & Co

ATTORNEYS.

(No Model.) 3 Sheets—Sheet 2.

D. DI B. SAVORGNAN.

WATER ELEVATOR.

No. 566,625. Patented Aug. 25, 1896.

Fig 3

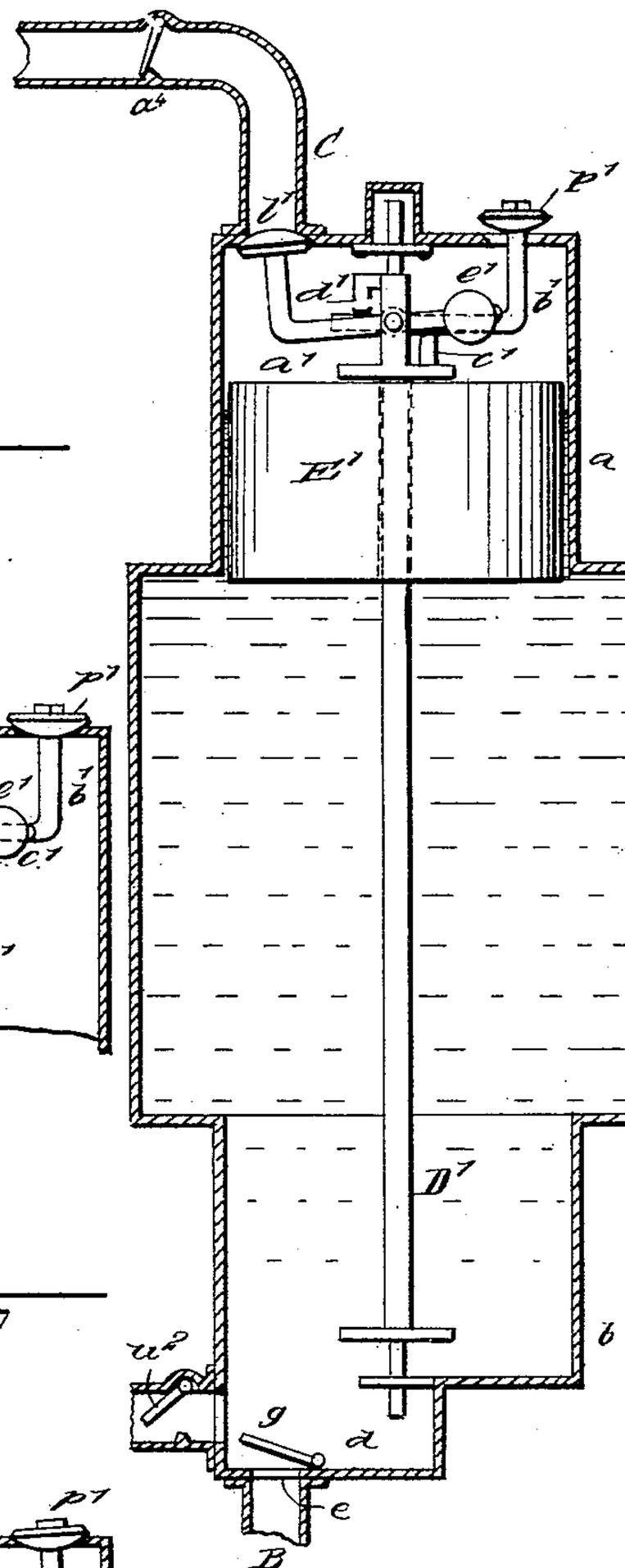


Fig 5

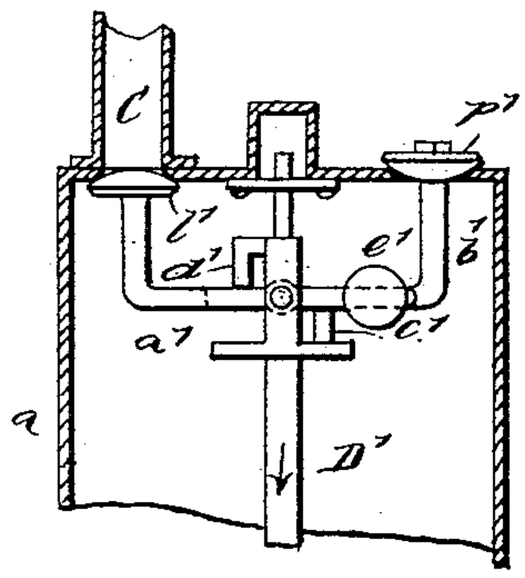


Fig 7

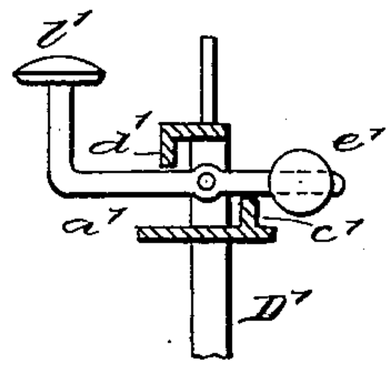


Fig 6

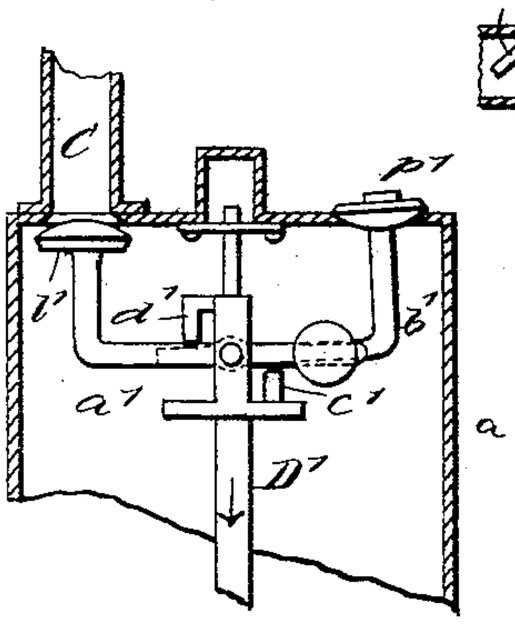


Fig 8

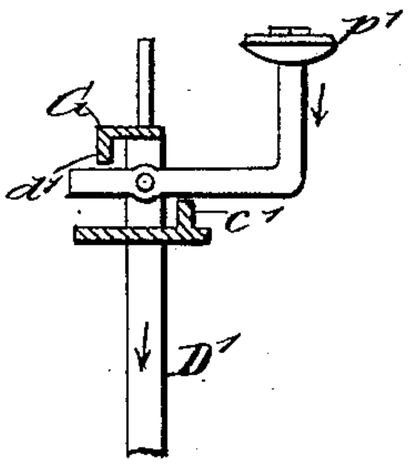
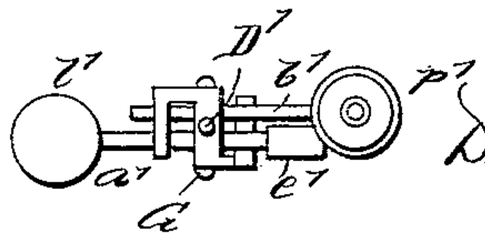


Fig 4



WITNESSES:

D. H. Walker

G. M. Hopkins.

INVENTOR

Detalmodi Brazza Savorgnan

BY Munn & Co

ATTORNEYS.

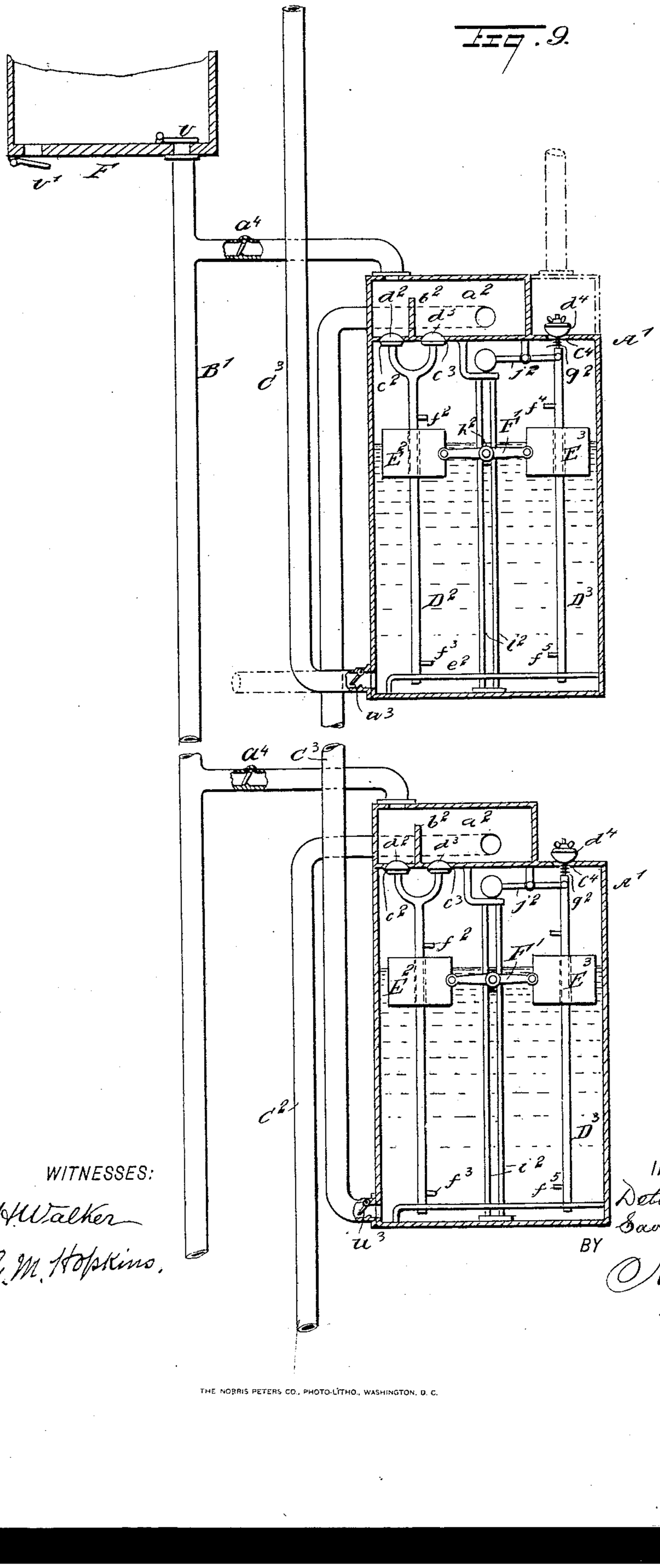
(No Model.) 3 Sheets—Sheet 3.

D. DI B. SAVORGNAN.

WATER ELEVATOR.

No. 566,625. Patented Aug. 25, 1896.

Fig. 9.



WITNESSES:

H. M. Walker

G. M. Hopkins.

INVENTOR.

Detalmo di Brazza Savorgnan

BY

Munn & Co

ATTORNEYS.

UNITED STATES PATENT OFFICE.

DETALMO DI BRAZZA SAVORGNAN, OF ROME, ITALY, ASSIGNOR TO CORA ANN SLOCOMB DI BRAZZA SAVORGNAN, OF MORUZZO, ITALY, AND NEW YORK, N. Y.

WATER-ELEVATOR.

SPECIFICATION forming part of Letters Patent No. 566,625, dated August 25, 1896.

Application filed December 5, 1894. Renewed February 5, 1896. Serial No. 578,170, (No model.)

To all whom it may concern:

Be it known that I, DETALMO DI BRAZZA SAVORGNAN, of Rome, Italy, have invented a new and Improved Water-Elevator, of which the following is a full, clear, and exact description.

The object of my invention is to construct a simple and effective device for elevating water and other liquids in large quantities by an air-pressure, the apparatus being particularly designed for use in mines and deep wells where ordinary pumps are objectionable or of little practical value.

My invention consists in one or more vacuum-chambers provided with valves and valve-operating mechanism and in a pump for alternately exhausting the air and removing the water from the vacuum-chambers.

It also consists in the construction of the vacuum-chamber, whereby the quick opening of the vacuum and air valves is secured, all as will be hereinafter more fully described.

Reference is to be had to the accompanying drawings, forming a part of this specification, in which similar letters of reference indicate corresponding parts in all the views.

Figure 1 is a vertical transverse section of my improved water-elevator. Fig. 2 is a vertical transverse section of the air and water pump used in the water-elevator. Fig. 3 shows a modified form of the elevator. Fig. 4 is a plan view of the valve and valve mechanism. Fig. 5 shows both valves in a closed position. Fig. 6 shows the vacuum-valve open. Fig. 7 is a detail view of the vacuum-valve. Fig. 8 is a detail view of the air-inlet valve, and Fig. 9 is a vertical section of another modification.

In the form shown in Figs. 1 and 2 the vacuum-chamber A, which is preferably of cylindrical form, is made in two diameters, the end portions *a b* being smaller in diameter than the middle portion *c*. The lower part of the vacuum-chamber is provided with a recess *d*, having openings *e f*, a valve *g* being provided for closing the opening *e*. A pipe B connects the opening *e* of each vacuum-chamber with the opening *f* of the vacuum-chamber next below it, with the exception of the lower vacuum-chamber of the series, where the pipe B′, connected with the opening *e*, forms the suction-pipe.

The upper end of the vacuum-chamber A is furnished with a side extension *h*, having a downwardly-projecting transverse partition *i*, forming an air-lock *j*. The top of the side extension *h* is provided with an opening *k*, with which is connected the suction-pipe C, and a valve *l* is provided which is capable of closing the opening *k*. The valve *l* is carried by an offset arm *m*, which projects from and is pivoted to the rod D and extends downwardly under the partition *i* and upwardly through a guide projecting from the wall of the extension *h*. The rod D extends through fixed guides in the chamber A and carries a valve *p*, whose arm is pivoted to the said rod D and which is capable of closing the opening *o*. On the rod D is placed a float E, provided with a central opening for receiving the rod, and the said rod D is provided with a short laterally-projecting arm *q* near its lower end. The connections of the valves and valve-rod will be more fully explained in connection with Figs. 3 to 8, inclusive.

The pump F, connected with the apparatus, comprises a cylinder *r*, a piston *s*, and rod *t*, attached thereto, the water-suction valve *u* and water-discharge valve *u′*, the air-suction valve *v*, and the air-discharge valve *v′*. The water-suction pipe B communicates with the water-suction valve *u*, and the air-suction pipe C communicates with the air-suction valve *v*.

In the upper pipe B is placed a foot-valve u^2 in some cases, and the water may be discharged through the pipe B^2 (shown in broken lines) when it is not desirable to carry it to the pump F.

When the piston *s* is moved upwardly, the air is exhausted from the pipe C and the lower vacuum-chamber will be filled with water. The float E will lift the rod *o*, lifting the valves *l* and *p*, thus closing the opening *k* and establishing communication between the interior of the vacuum-chamber and the external air. On the upward movement of the piston a vacuum will be formed in the pipe C and the vacuum-chambers. The water contained by the lower vacuum-chamber will be drawn into

the next vacuum-chamber above. On the downward movement of the piston *s* the water contained in the second chamber from the bottom will be transferred to the third, and the lower one will be filled with water, while the second one remains empty. In this manner the vacuum-chambers will be alternately filled and emptied until the upper portion of the pump-cylinder receives water from the upper chamber, when the water will be discharged by the pump.

The contraction of the chamber A at its upper and lower ends causes the float E to move quickly at the upper and lower portions of its travel, thus opening the valves quickly and insuring prompt action.

In the modification shown in Figs. 3 to 8, inclusive, the float-rod D′ is provided at its upper end with a double bearing G for the bent valve-levers a' b'. The lever a' carries the vacuum-valve l', and the lever b' carries the air-valve p'. The rod D′ carries a finger c', on which rests the lever b' while the valve p' is being opened and after it is open. The rod D′ also carries a finger d', which engages the lever a' as the said rod is made to descend by the weight of the float E′. The lever a' is prolonged beyond its pivot and carries a counterweight e', which tends to hold the valve l' in an elevated position. The valves l' p' have convex faces, which are seated in concave valve-seats, so as to admit of a certain amount of movement of the valve-levers while the valves are closed. When the float E rises, the finger c' opens the valve p'. When it descends and strikes the arm q at the lower end of the rod D′, the valve p' is closed and the valve l' is opened. On the return of the float to the top of the chamber the valve l' is first closed. Afterward the further movement of the float opens the valve p'. By this construction air is prevented from passing the valve p' and entering the pipe C. In other respects the construction and operation are the same as described in connection with Fig. 1.

In the modification shown in Fig. 9 the vacuum-chamber A′ is provided with an upper compartment a^2, which is divided by a transverse partition b^2. In the bottom of the compartment a^2, on opposite sides of the partition b^2, are formed valve-openings c^2 c^3, to which are fitted valves d^2 d^3, the said valves being attached to the forked end of a rod D^2, the lower end of the said rod being inserted in the guide e^2. The rod D^2 is provided with pins f^2 f^3, and on the said rod, between the pins, is placed a centrally-apertured float E^2.

Upon the opposite side of the vacuum-chamber A′, in the top of the chamber, is formed a valve-opening c^4, and to the valve-opening is fitted a valve d^4. The said valve d^4 receives the upper end of the rod D^3, the lower end of which is received by the guide e^2 at the bottom of the chamber. The part of the rod D^3 extending through the valve d^4 is reduced in diameter, and between the under surface of the valve and a shoulder formed on the rod is placed a spiral spring g^2, and upon the threaded upper end of the rod is placed a wing-nut, by means of which the valve is adjusted on the rod. The rod D^3 is provided with pins f^4 f^5, between which on the rod is placed the centrally-apertured float E^3. The floats E^2 E^3 fit loosely their respective rods and are connected by a lever F′, which is pivoted at its center to a slide h^2, fitted to the guide-rods i^2, supported in the vacuum-chamber A′. On a fixed support in the casing is fulcrumed a lever j^2, pivotally connected with the rod D^3 at one end and provided with a weight at the opposite end for counterbalancing the rod and valve attached thereto. Although a single vacuum-chamber may be used, I prefer to use several such vacuum-chambers containing mechanism as described and arranged in series, connecting them up in the manner illustrated in the drawings, that is to say, the lower compartment a^2 is provided with a suction-pipe C^2, which extends downwardly into the water. The bottom of the vacuum-chamber is connected by a pipe C^3 with the compartment a^2 of the next vacuum-chamber, and the bottom of the second chamber is connected with the compartment a^2 of the third, and so on. The pipes leading from the bottom of the vacuum-chamber are provided with check-valves u^3, and the upper end of the pipe extending from the bottom of the upper vacuum-chamber is connected with the top of a pump-cylinder F, as shown in Fig. 2. The pipes C^2 C^3 enter the compartments a^2 on the side of the partition b^2 at which is located the valve-opening c^3. An air-pipe B′ is connected with the top of each compartment a^2 at a point above the valve-opening c^2, the said pipe B′ being connected with the lower end of the pump F, as indicated in Fig. 2. This form of apparatus can be operated by means of compressed air when provided with a compressed-air pipe communicating with the valve-opening c^4, as indicated in dotted lines in the upper portion of Fig. 9. The floats E^2 E^3 are arranged to move freely up and down upon the rods D^2 D^3. When the floats are down, resting on the pins f^3 f^5, the valves d^2 and d^3 are open and the valve d^4 is closed.

When a vacuum is formed in the pipe B′, the air is exhausted from all of the vacuum-chambers A′. Water is drawn through the pipe C^2 into the compartment a^2 of the lower vacuum-chamber and falls through the valve-opening c^3 into the chamber, while the air continues to pass out of the valve-opening c^2. As the water rises in the lower vacuum-chamber the floats E^2 E^3 are carried upwardly until the valves d^2 d^3 are closed and the valve d^4 is opened. Before the valves d^2 d^3 are closed and the valve d^4 is opened there is a balance of pressure in the upper portion of the lower vacuum-chamber, so that water cannot rise in the pipe C^2, but as soon as the valve d^4 has been opened air enters the upper part of the vacuum-chamber A′ and forces

the water contained by the chamber through the pipe C^3 into the compartment a^2 of the second vacuum-chamber, when the filling of this chamber takes place in the manner already described in connection with the lower vacuum-chamber. When the water has been transferred to the second vacuum-chamber, the valves d^2 d^3 of that chamber are closed and the valve d^4 is opened, admitting air to the chamber, and the water then ascends through the pipe C^3, connected with that chamber, to the third chamber. When the lower chamber has been emptied of water, the valves d^2 d^3 are again opened, and the valve d^4 is closed by the action of the floats, when water again enters the lower vacuum-chamber, and what has been described is repeated with all the chambers in the series in rotation, the pipe C^3 of the upper chamber being connected with the upper portion of the pump, as previously described in connection with Fig. 1. It will be observed that the pin f^2, projecting from the rod D^2, is lower than the pin f^4, projecting from the rod D^3, and the pin f^5, projecting from the rod D^3, is higher than the pin f^3, connected with the rod D^2, so that the floats in their upward movement first close the valves d^2 d^3 and then open the valve d^4, while as they descend the valve d^4 is first closed, and then the valves d^2 d^3 are opened. The compartment a^2 contains a small reserve of water, which serves to equalize the action of the several vacuum-chambers, and causes them to work in proper time by supplying a quantity of water which may enter through the valve-opening c^3 as soon as the valve d^3 is open, thus furnishing enough water to cover the mouth of the pipe C^3 and supply any deficiency in the water supply received by the vacuum-chamber, which deficiency may result from air in the vacuum-chamber or from a difference in the capacity of the vacuum-chambers. It will be observed that the water last received by the compartment a^2 is retained until the float descends and closes the valve d^4 and opens the valve d^3 at the bottom of the compartment a^2. To prevent the return of air from the pipe B′ to any of the compartments a^2, a check-valve a^4 is inserted in each branch of the said pipe.

It is obvious that the pump for operating the vacuum-chambers may be placed in any convenient locality without reference to the level or position of the vacuum-chambers.

Having thus described my invention, I claim as new and desire to secure by Letters Patent—

1. In a water-elevator, a vacuum-chamber provided with a portion of reduced diameter at the end, a float adapted to fill the reduced end portion of the chamber, separate and independent air and vacuum valves operated by the float, and connections for causing one valve to operate before the other, substantially as specified.

2. In a water-elevator, the combination, with a vacuum-chamber provided with air and vacuum valves, of a float and float connections constructed to move one valve before moving the other valve, substantially as specified.

3. In a water-elevator, the combination, with a series of vacuum-chambers containing floats and provided with separate and independent float-operated vacuum and air valves, of a series of pipes connecting the bottom of one vacuum-chamber with the top of the adjoining vacuum-chamber, and an exhaust-pipe connected with the tops of all of the vacuum-chambers in the series, substantially as specified.

4. The combination, with a series of vacuum-chambers and pipes connected therewith, of a double-acting pump connected at one end with the water-suction pipe, and connected at the opposite end with the vacuum-pipe and adapted to receive water from the vacuum-chambers on one side of the piston, and air from the vacuum-chambers on the other side of the piston, the water contained by the pump-cylinder forming a lubricant and packing for the piston substantially as specified.

5. In a water-elevator, the combination with a series of vacuum-chambers, provided with water-receiving reservoirs in the upper portions thereof, of separate and independent float-operated vacuum and air valves, and a series of pipes connecting the bottom of one vacuum-chamber with the top of the next vacuum-chamber above, and an exhaust-pipe connected with the tops of all of the vacuum-chambers in the series, substantially as specified.

DETALMO DI BRAZZA SAVORGNAN.

Witnesses:
GEO. M. HOPKINS,
C. SEDGWICK.