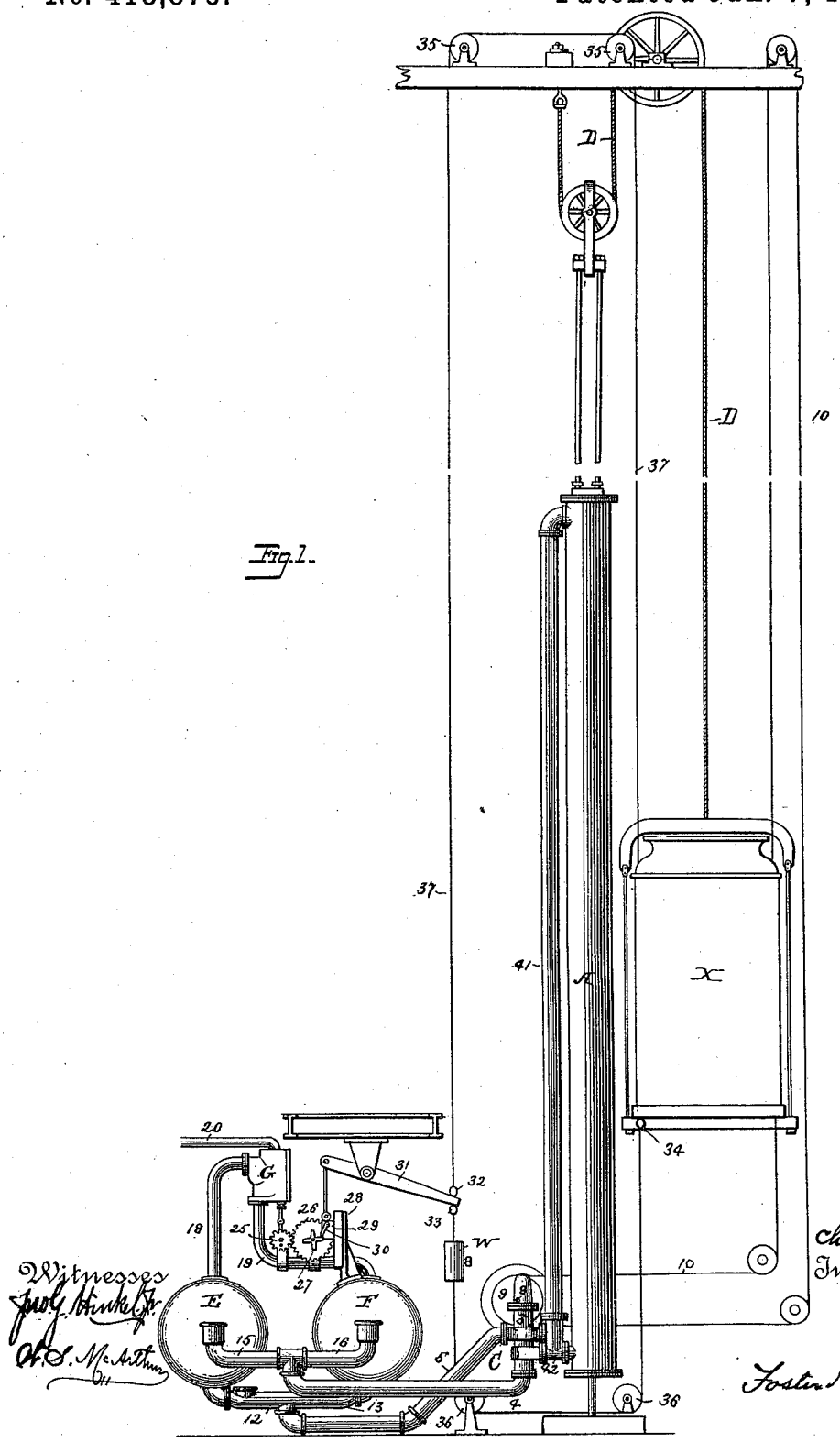
(No Model.) 3 Sheets—Sheet 1.

C. R. OTIS.

HYDROPNEUMATIC ELEVATOR.

No. 418,875. Patented Jan. 7, 1890.

Fig. 1.



Witnesses
Jno. J. Hinkle Jr.
A. S. McArthur

Chas. R. Otis
Inventor

Foster Freeman
Attorney

(No Model.) 3 Sheets—Sheet 2.

C. R. OTIS.

HYDROPNEUMATIC ELEVATOR.

No. 418,875. Patented Jan. 7, 1890.

Fig. 3.

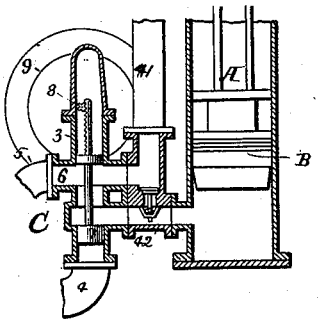


Fig. 2.

Witnesses
Jno. G. Hinkel Jr.
Ed. S. McArthur

Inventor
Chas. R. Otis
by Foster Freeman
Attorneys

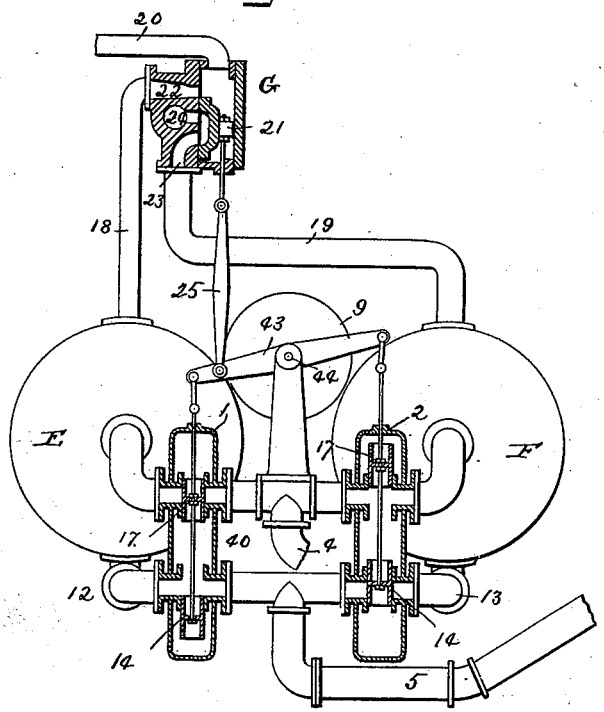
(No Model.) 3 Sheets—Sheet 3.

C. R. OTIS.

HYDROPNEUMATIC ELEVATOR.

No. 418,875. Patented Jan. 7, 1890.

Fig. 4.



Witnesses
Jno. Ashkel Jr.
B. L. Johnson

Charles R. Otis
Inventor
By Peter & Freeman
Attorneys

UNITED STATES PATENT OFFICE.

CHARLES R. OTIS, OF YONKERS, NEW YORK, ASSIGNOR TO THE HYDRAULIC ELEVATOR COMPANY, OF CHICAGO, ILLINOIS.

HYDROPNEUMATIC ELEVATOR.

SPECIFICATION forming part of Letters Patent No. 418,875, dated January 7, 1890.

Application filed January 7, 1889. Serial No. 295,687. (No model.)

To all whom it may concern:

Be it known that I, CHARLES R. OTIS, a citizen of the United States, residing at Yonkers, in the county of Westchester and State of New York, have invented certain new and useful Improvements in Hydropneumatic Elevators, of which the following is a specification.

Heretofore it has been common in hydropneumatic elevators to employ air as a motor-fluid in connection with a body of water interposed between the air and the piston of the elevator-engine, which water serves as a means for locking the piston and securing a more steady movement of the same than would result by acting upon it directly with the compressible fluid, and a tank has been used in connection with the cylinder and piston of the engine, receiving both the water and the air, and cocks have been employed for admitting the air to exert a pressure upon the water in the tank and for cutting off the air-supply and allowing that in the tank to escape according as the piston is to be depressed or elevated.

The employment of a single tank is attended with difficulties which it is the object of my invention to avoid, and I therefore make use of two tanks in which the discharged water from the elevator-cylinder is received alternately and to which the motor-fluid is admitted alternately, so that one tank may be filled while the air-pressure is in the other; and in order to effect these operations in proper unison I make use of connecting pipes, valves, and valve-operating apparatus which I will now describe, reference being made to the accompanying drawings, in which—

Figure 1 is a side view showing a Baldwin elevator in connection with an apparatus for carrying out my improvements. Fig. 2 is an enlarged side elevation, in part section, of part of the elevator apparatus. Fig. 3 is a sectional view of the water-valve device. Fig. 4 is a part sectional elevation showing a modification.

While the elevator-engine itself may be of any suitable construction, I have shown an ordinary "Baldwin" engine, consisting of a vertical cylinder A, piston B, connected by flexible suspensories D with the the cage X, circulating-pipes 41 42, and water-valve device C, having a casing 3 communicating with said pipes, and with a discharge-pipe 4 and an inlet-port 6 communication with the water-inlet pipe 5. In the casing is a counterbalanced piston-valve 7, which is raised and lowered to direct the fluid to either end of the cylinder or to discharge the same therefrom by rotating the shaft 8, provided with a pulley 9, around which the ordinary hand-rope 10 passes through the cage, so that said pulley and its connected valve may be operated from the cage, as usual. With the parts thus constructed or formed in any of the ways usual in hydraulic elevators I combine two tanks E F, which are connected with the water-valve device C, and with another valve device G, which controls the flow of air or other elastic motor-fluid to and from the said tanks, and said tanks are so arranged, constructed, and controlled in any suitable manner that an elastic fluid-pressure from any suitable reservoir or source of air-supply may be brought upon water in the tanks alternately to force it from one tank and against the piston of the engine while the other tank receives the discharged water from the cylinder A, while either tank may be in communication with the circulating-pipes while the piston rises on the descent of the load.

Various arrangements of connecting pipes or channels and valve devices and appliances for controlling them may be employed without departing from the main features of my invention. I will now proceed to describe those which I believe to be most effective, and modifications thereof. The water-inlet pipe 5 communicates through two branches 12 13 with the lower portions of the two tanks E F, and the discharge-pipe 4 communicates through two branches 15 16 with the two tanks E F at points above the bottom of the same, and two pipes 18 19, for air or other elastic motor-fluid, leading from an air-valve device G, communicate with the upper portions of the tanks, the said air-valve device being in communication with an air-supply pipe 20. In each pipe 12 13 is a valve 14, and in each branch 15 16 is a valve 17, and these valves may be check-valves, as shown in Fig.

2, or positively-operated valves, as shown in Fig. 4. The air-valve device G, as illustrated, consists of a D-valve 21, operating upon a face having two outlet-ports 22 23, communicating with the pipes 18 19, respectively, and an intermediate exhaust-port 24, the arrangement being such that in one position of the valve (see Fig. 2) the port 22 will be in communication with the supply-pipe 20 to permit the air to pass to the tank E, while the port 23 is open through the valve 21 to exhaust 24, allowing the air from the tank F to exhaust therefrom. In the reverse position of said valve the port 23 will be in communication with the supply-pipe for the passage of air to the tank F, while the port 22 is open through the valve to the exhaust-port 24, allowing the air from tank E to exhaust. The stem of the valve 21 is connected by a jointed rod with a wrist-pin upon a pinion 25, gearing with a toothed wheel 26, at the side of which is a ratchet 27, having four teeth, and on a vertical guide 28 slides a carrier 29, to which is pivoted a pawl 30, arranged to engage one of the teeth of and turn the ratchet 27 when the carrier descends, but to yield and pass the ratchet without turning it when the carrier ascends. There may be provided a stop-pawl 50, engaging with the teeth of wheel 26, to prevent a backward movement of the ratchet; but ordinarily it will not be needed, as the friction of the parts connected with the toothed wheel 26 will be sufficient to prevent all liability thereof on the idle movement of the carrier. From the above it will be seen that the connections between the carrier 29 and the air-valve device G are such that upon one movement of the carrier the ratchet and the toothed wheel 26 will be given a quarter-turn, and as the pinion 25 is one-half the size of the wheel 26, or has one-half the number of teeth of the latter, said pinion will be turned a half-revolution, thus reversing the position of the valve 21 each time the ratchet 27 is turned, the return movement of the carrier being an idle one.

With the carrier 29 are combined any suitable or operating devices connecting, preferably, with the cage, whereby the carrier may be lifted to move the ratchet one step to shift the position of the valve 21 with respect to its ports each time the cage makes a complete up and down movement, the carrier descending by its own weight.

As shown, the operation of the valve device G is effected automatically at each complete movement of the cage as it approaches or finally reaches the limit of its lowermost position; but automatic operation is not essential—for instance, the action may be effected by the attendant at the points where the valves are located. This arrangement is effective when the invention is used in connection with a crane or other like elevating device in which the cage or platform is replaced by a hook, grapples, or other support for the load.

The operation in the construction shown is as follows: Supposing the parts to be in the position shown in full lines, Fig. 2, and that a quantity of fluid is in the tank E, the air passing in the direction of the arrows in full lines from the pipe 20 through the port 22 and pipe 18 will enter and bear upon the water in said tank E, and water discharged from the cylinder will flow into the tank F, and the air will pass from the latter through the pipe 19, port 23, and the exhaust 24. The water-valve being in position to open the port 6 to the pipe 41, the water under pressure will pass to the top of the piston B to lower it and raise the cage, and there is an open communication between the lower end of the cylinder and the discharge-pipe 4, so that the discharged water passes to the tank F. This result will ensue every time the valve 7 is moved to open communication with the discharge after having closed it. It will be understood that the water discharged from the cylinder A always flows to the tank that is at that time open to the discharge from the cylinder. When check-valves are used, the air-pressure in the tank from which the water flows to the pressure end of the cylinder will of course hold the check-valve 17 in the branch pipe leading to the other cylinder firmly to its seat, while the other check-valve 17 being free to lift will be readily passed by the discharging water. The parts described will continue to retain the position illustrated in Figs. 1 and 2 during the movements of the elevator-cage, whatever they may be, controlled, as usual, by the water-valve device C, through the ordinary hand-rope 10, until the cage descends to its lowermost position. On such descent of the cage the water-valve will be shifted to the position shown in Fig. 3, so that the water above the piston may be circulated from the top of the cylinder to its opposite end below the piston, the circulating-pipes being in communication with the pipe 5 and with the tank from which the water was expelled to the top of the cylinder. When, however, the cage reaches its lowermost position, it will make contact with the valve-reversing device, and will move the carrier 29 and its pawl downward, turn the toothed wheel 26 a quarter-revolution and the pinion 25 a half-revolution, reversing the position of the air-valve 21, as indicated by dotted lines, Fig. 2. The motor-fluid now passes in the direction of the arrows in dotted lines from the pipe 20 through the port 23 and pipe 19 into the tank F, which has received all or a major portion of the water from the cylinder A by the complete descent of the piston B, and the water in the tank F will therefore be expelled under pressure through the water-valve device and pipe 41 against the piston B whenever the valve 7 is adjusted to secure this result, and the discharged water from the cylinder A will then flow through the pipe 4 and branch 15, past the valve therein into the tank E, from which

the air previously introduced will escape through the port 22 and exhaust 24. If now the cage is to descend, the valve 7 is shifted so as to put the pipes 41 and 42 in communication in the usual manner, (see Fig. 3,) when the water will circulate from the top to the bottom of the cylinder A, as before.

Any suitable connections may be employed between the cage and the air-valve device. I have shown a lever 31, connected at one end to the carrier 29 and at the other end engaging a rope 37, that extends from the lever over guide-pulleys 35, down through the cage under guide-pulleys 36 and back to the lever. As shown, the lever 31 is slotted at its end to pass the rope 37, which is provided with two contact-pieces 32 33 above and below said lever 31, so that the latter will be positively raised and lowered by the movements of the rope, and said rope is provided with a weight W, (or the end of the lever might be weighted,) which tends to lower that section of the rope connected with the lever 31 and to maintain the latter and the carrier 29 in the position shown in Fig. 1 and in full lines, Fig. 2. The rope 37 is also provided with a contact-piece 34, arranged in such position as to be struck by the elevator-cage or some connection therewith, just as the cage completes its downward movement, so that the rope is then shifted to vibrate the lever 31 to the position indicated in dotted lines, Fig. 2, and shift the valve 21. When the cage rises, it leaves the contact-piece 34, and the weight W carries the rope downward to its first position and restores the lever 31 and the carrier to the position shown in Figs. 1 and 2, the pawl 30 passing the ratchet 27 without moving the latter, and hence without changing the position of the air-valve 21. From this it will be seen that by means of connections with the cage both the water-valve device C and the air-valve device G may be operated at the will of the attendant, the former (as is common) to control the direct movement of the cage, and the latter, when the necessity arises, to shift the air-pressure from one tank to the other. Thus, should the cage be stopped before it reaches the predetermined point at which it will cause the air-valve 21 to be shifted automatically, the said valve may be shifted through the medium of the rope 37 by hand should the quantity of water in the tank be so exhausted or limited as to render this necessary.

It will be obvious that electrical or other connecting operating devices may be arranged between the valve 21 and the cage, so as to be operated thereby as it approaches the limit of its movement in either direction, and to shift the valve at each complete movement of the cage, or as often as may be necessary.

While I have shown valves of a particular construction, it will be obvious that valves of any usual forms suitable for the purposes set forth may be employed. Thus in the construction shown in Fig. 4 the valves 14 17 in the pipes connected with each tank are piston-valves, both connected to one stem, with seats in a single casing 40, and the two stems 1 2 are connected to the opposite ends of a lever 43, connected to the link attached to the air-valve rod 25. This connection is such that the valve 14 of the branch 12 will be positively opened and the valve 17 of the branch 15 will be positively closed as the air-valve is brought to the position shown in Fig. 4, while the opposite valve 14 is closed and the opposite valve 17 is opened by the same movement, and the positions of all the valves are positively reversed when the air-valve is shifted. This shifting may be effected from the cage by the operator through a hand-rope 10, passing round a pulley 9 upon the lever-shaft 44.

Without limiting myself to the precise construction and arrangement of parts shown, I claim—

1. The combination, with the cylinder and piston of an elevating apparatus, of a valve device, two air and water tanks, each communicating alternately with the inlet and with the outlet of the valve device, an air-supply pipe leading from an air-reservoir to said tanks and provided with a valve device having two outlet-ports affording communication with each of the said tanks, and an exhaust-port, substantially as described.

2. The combination, with two tanks connected with the water-valve device of a hydraulic elevator, of an air-pipe, and valves controlling the air and water outlet and inlet ports, and connected to open the air-inlet and water-outlet ports of one tank when the water-inlet and air-outlet ports of the other tank are open, substantially as described.

3. The combination, with the cylinder, piston, and water-valve device and pipes of a hydraulic elevator, of two tanks, each connected with said water-valve device, an air-supply pipe extending to a source of air-supply, and valves controlling the communication between the air-pipe and the tanks and between the latter and the water-valve device, substantially as described.

4. The combination, with a cage and hydraulic elevating-engine having a water-valve device, of two tanks adapted to be used alternately as the supply and waste tanks of the elevator communicating with the water-valve device, an air-supply pipe extending from an air-reservoir to said tanks, and air-valve device controlling the flow of air to and from the tanks and connected with the cage to be operated therefrom, substantially as described.

5. The combination, with a cage and hydraulic elevating-engine provided with a water-valve device, of two tanks connected with the water-valve device, an air-pipe communicating with an air-reservoir and with said tanks, and an air-valve device, said valve devices being connected independently with

the cage to be operated therefrom, substantially as described.

6. The combination, with a hydraulic elevating-engine, cage, and water-valve device thereof connected with the cage, of two tanks connected with said water-valve device, an air-pipe and valve device controlling the flow of air to and from the tanks, and shifting devices connected with the air-valve to shift the same automatically to throw the pressure into one tank and open the other on the completion of the movement of the cage, substantially as described.

7. The combination, with the cylinder, piston, and water-valve device of an elevator, of two air and water tanks adapted to be used alternately as the supply and waste tanks of the elevator, each communicating with the inlet and with the outlet ports of the valve device and provided with valves, an air-supply pipe extending to a source of air-supply and provided with a valve device having two outlet-ports, one communicating with each of said tanks, and an exhaust-port, and connections between the air-valve and the cage and between the water-valve and the cage, substantially as set forth.

8. The combination, with the elevator-engine, of two air and water tanks adapted to be used alternately as the supply and waste tanks of the elevator, a supply-pipe conveying air to both tanks, connections between the latter and the valve device of the engine, and an air-valve device for the supply-pipe, and connections between the air-valve and a contact-piece arranged to be struck upon the completion of the movement of the elevator-cage to shift the air-valve and change the air-supply from one tank to the other, substantially as set forth.

9. The combination, with the valve of the air-valve device, and with the elevator-cage and its operating-engine, and air and water tanks and connections, of a ratchet connected with the air-valve, a pawl for engaging said ratchet, and connections between the pawl and a contact-piece arranged to be struck on the completion of the movement of the cage, substantially as set forth.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

CHARLES R. OTIS.

Witnesses:

EVERETT BARNES,

EDWARD K. ANDERTON.