(No Model.) 3 Sheets—Sheet 1.

W. E. HALE & N. C. BASSETT.

ELEVATOR

No. 419,148. Patented Jan. 7, 1890.

Fig. 1.

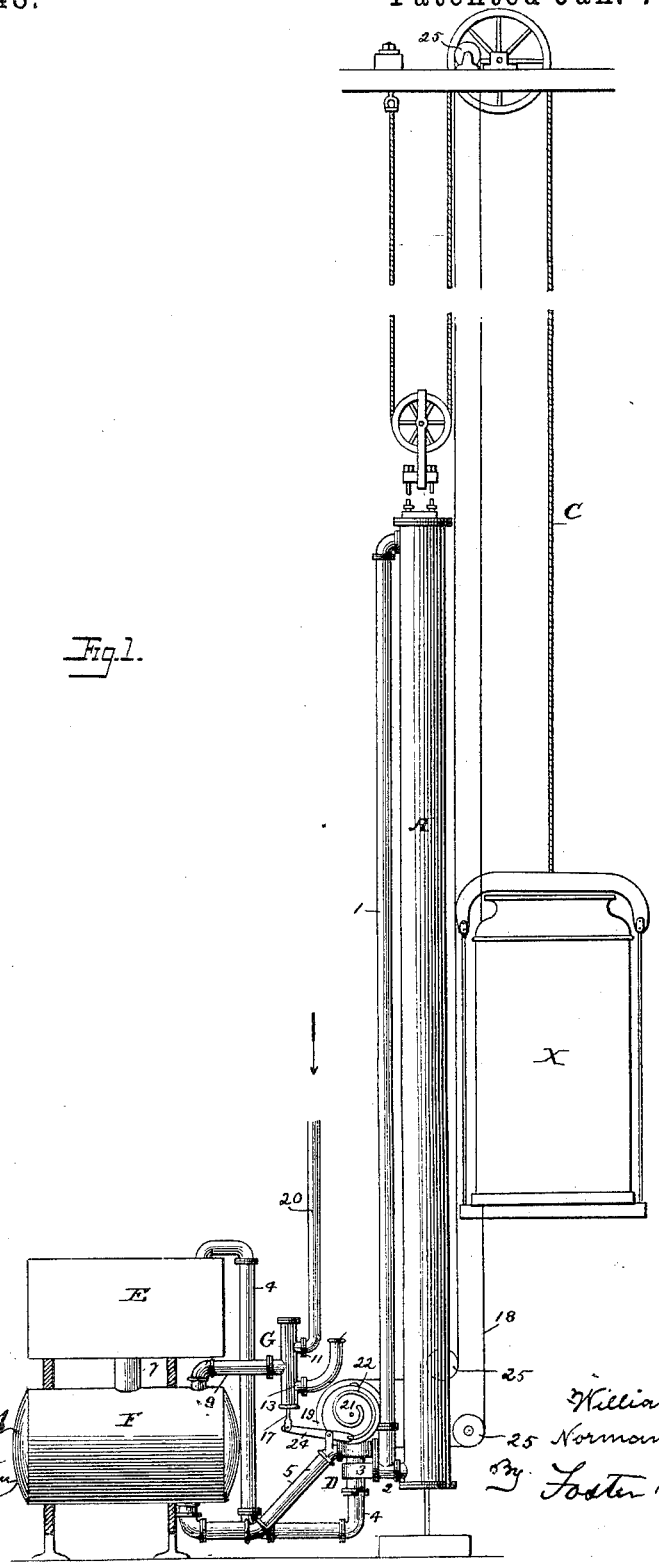

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Fig. 2.

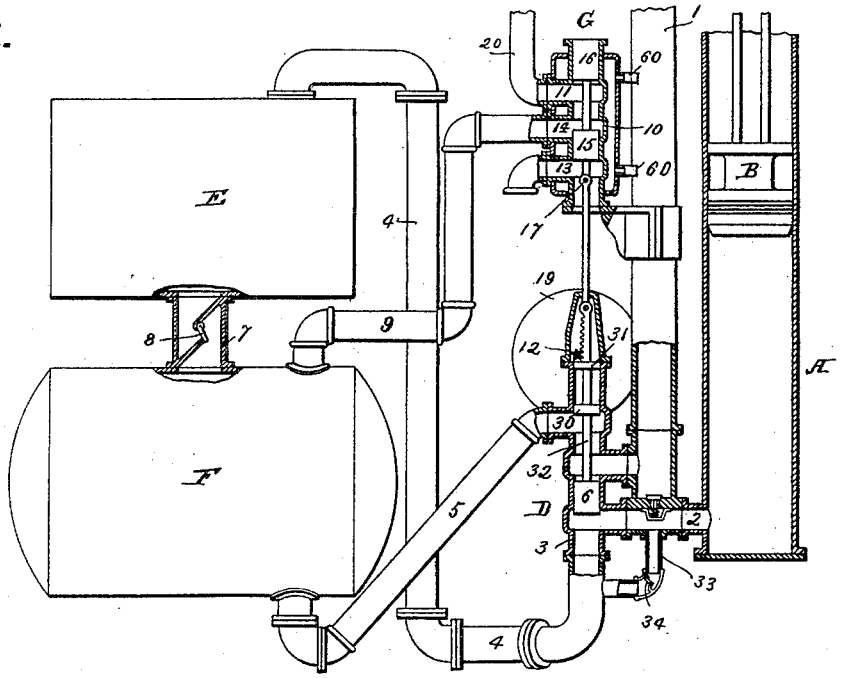
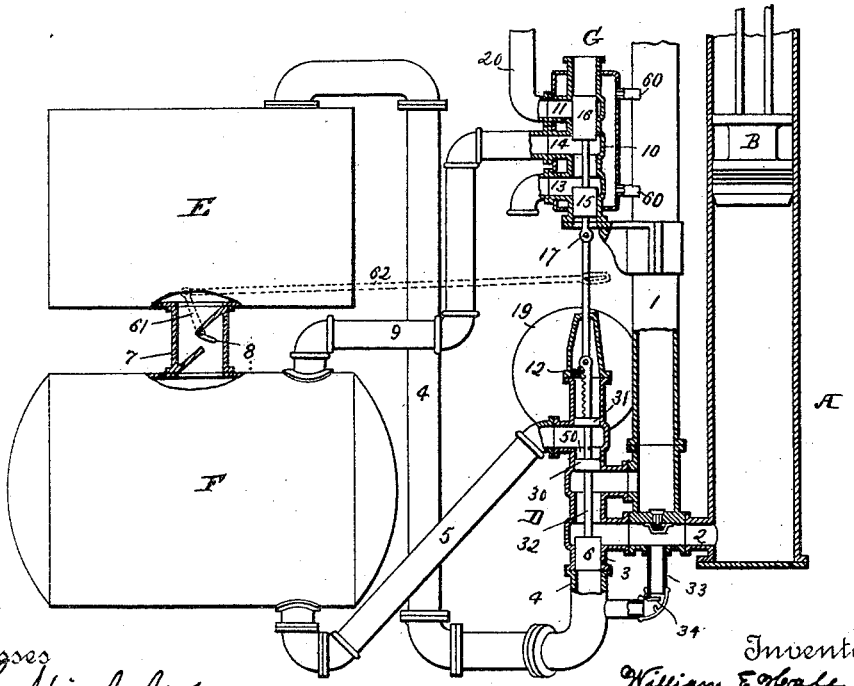


Fig. 3.



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(No Model.) 3 Sheets—Sheet 3.

W. E. HALE & N. C. BASSETT.

ELEVATOR

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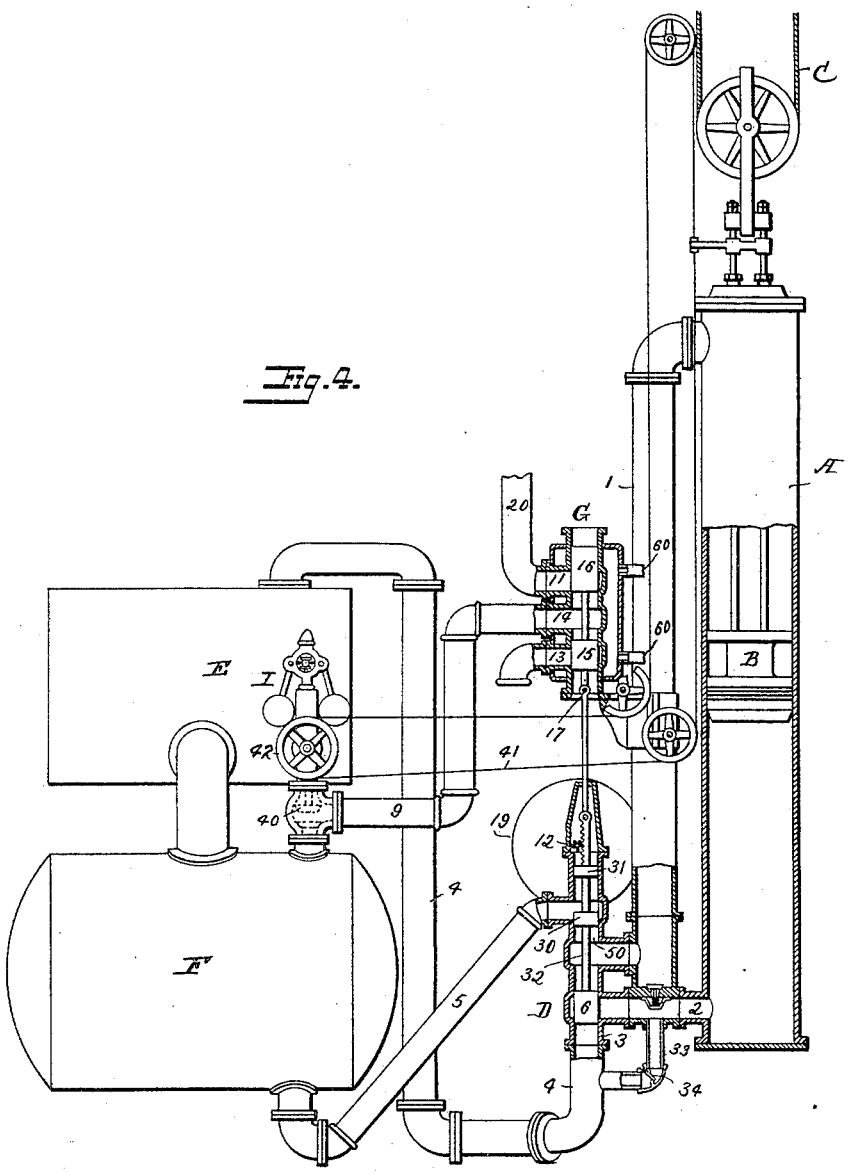
Fig. 4.



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UNITED STATES PATENT OFFICE.

WILLIAM E. HALE AND NORMAN C. BASSETT, OF CHICAGO, ILLINOIS, ASSIGNORS TO THE HYDRAULIC ELEVATOR COMPANY, OF SAME PLACE.

ELEVATOR.

SPECIFICATION forming part of Letters Patent No. 419,148, dated January 7, 1890.

Application filed January 30, 1889. Serial No. 298,124. (No model.)

To all whom it may concern:

Be it known that we, WILLIAM E. HALE and NORMAN C. BASSETT, both citizens of the United States, and residents of the city of Chicago, in the county of Cook and State of Illinois, have invented certain new and useful Improvements in Elevators, of which the following is a specification.

Our invention relates, mainly, to that class of elevators in which an elastic motor-fluid acts upon the piston of the engine through an intervening body of non-compressible fluid; and our invention consists in constructing the parts of an elevator, as fully set forth hereinafter, so as to utilize the power of the elastic fluid to as great an extent as possible, avoid the waste of either fluid, and facilitate the operation of the engine.

In the accompanying drawings, Figure 1 is an elevation illustrating one form of elevating apparatus embodying our invention. Figs. 2, 3, and 4 are enlarged part-sectional views of parts of the apparatus, showing the valves in different position.

In that class of elevators in which a body of incompressible fluid is interposed between the piston and an elastic motor-fluid it has been customary to force the liquid, as water, out of a receptacle and against the piston by the introduction into the receptacle under pressure of the motor-fluid, as air, and the water is carried back to the receptacle on being discharged from the elevator-cylinder, and the air is admitted to said receptacle to discharge the water therefrom when the piston is to be again depressed. In all constructions heretofore adopted the movement of the piston in either direction renders it necessary to carry the water to or from the air and water receptacle or vessel, the water is employed only upon one side of the piston, and the advantages resulting from circulating the water from end to end of the cylinder on the descent of the load cannot be secured. To secure the advantages of such circulation while retaining also those resulting from the use of an elastic motor-fluid, we make use of two vessels, one to receive both elastic and inelastic fluids, which we shall term the "air and water vessel," although other fluids may be used, and the other to receive the inelastic fluid discharged from the cylinder, and which vessel we shall term the "discharge-tank," and we provide for the transfer of the liquid from the tank to the vessel during the time the piston is moving upward to lower the load, whether the same be upon a cage, platform, or the grapple, block, or other load-supporting device of a crane.

In the construction of apparatus illustrated in the drawings we have shown an ordinary elevator-engine having a vertical cylinder A, piston B, connected by flexible suspensories C with a cage X, and provided with circulating-pipes 1 2, and with a valve device D, having a casing 3 with inlet, discharge, and circulating ports communicating with an inlet-pipe 5, discharge-pipe 4, and circulating-pipes 1 2. This valve device we term the "water-valve device," and, as shown in Figs. 2 to 7, the valve thereof consists of a piston-valve 6, for controlling the discharge, a disk-valve 30, for controlling the passage between the inlet and circulating pipes, and a counterbalancing-disk 31, all upon a stem 32, which may be raised and lowered, as usual, by turning a pulley 19, from which a hand-rope 18 passes around guide-pulleys to the cage X.

The cage is raised by lifting the valve 6 toward the position shown in Fig. 2, to admit the liquid to bear on the top of the piston B and to permit that below the piston to flow to the discharge-pipe 4, and the cage will descend when the valve is moved to the position shown in Fig. 3, so that the piston B can rise under the weight of the cage and the liquid circulate from the top to the bottom of the cylinder A, through the pipes 1 and 2, and through the valve-casing 3.

The general features of the apparatus thus far described, except the valve 30, do not differ materially from those of ordinary elevators in which water-pressure is used to move the piston; but in order to effectively make use of air or other elastic fluid-pressure we supply the cylinder, circulating-pipes, and valve device D with a body of incompressible fluid, as water, oil, glycerine, or other like liquid, and discharge the same from the cylinder into a tank E, and connect the said tank with the air and water vessel F, which communicates with the inlet-pipe 5 at the bottom and at the top with an air-supply pipe 20 through

pipe 9, in which is the valve device G, that controls the flow of the elastic fluid to and from the vessel. As shown, the valve device G, which we term the "air-valve device," although it may control the flow of steam or other elastic motor-fluid, consists of a casing 10, having an inlet-port 11, communicating with the supply-pipe 20, an exhaust-port 13, and an intermediate port 14, communicating with that portion 9 of the supply-pipe 20 leading to the vessel F, and the valve of said device consists of two piston-valves 15 and 16, connected by a stem 17.

The air-valve and the water-valve are preferably connected to move in unison, thereby facilitating their manipulation from the cage. One means of connection is illustrated in Fig. 1, in which the pulley 19 is shown as provided with a spiral groove receiving a stud upon the lever 24, connected with the stem 17 of the air-valve, so that the revolution of the pulley when the water valve is adjusted vibrates the lever and adjusts the air-valve. A preferable construction is shown in Figs. 2, 3, and 4, in which the valve-stem 17 is in line with and connected to the valve-stem 32, so that the movement of the latter by the operator in the cage or otherwise will carry with it the air-valve.

The tank E is in communication with the vessel F through a channel or port controlled by a valve 8, and, as shown, the tank is above the vessel, and the valve is a check-valve, arranged to open under the weight of the water in the tank to discharge it into the vessel, but to close against its seat when the pressure in the vessel exceeds that in the tank.

When the parts are in the position shown in Fig. 2, the car or load will be lifted, inasmuch as the exhaust-port 13 of the air-valve is closed, and the air under pressure flows into the vessel F and forces out the liquid through the inlet-pipe 5 and water-valve casing and ports and pipe 1 into the cylinder A, and upon the top of the piston which descends and raises the load, and the liquid below the piston escapes through the pipe 2 and discharge port and pipe 4 into the tank E so long as the piston continues to descend.

The movement of the cage is arrested by carrying the valves to the position shown in Fig. 4, when the liquid will be locked between the valve 6 and the main piston B, while the valve 16 closes the air-inlet port 11 and the valve 15 closes the air-exhaust port 13. When the load is to descend, the liquid, instead of being forced back into the tank, as heretofore in hydropneumatic apparatus, is circulated, as in hydraulic elevators, by adjusting the valves to the position shown in Fig. 3, so that the water from above the piston B is carried by the lifting of the piston on the descent of the load through the pipe 1, valve-casing 3, and pipe 2 into the cylinder below the piston while the escape-port 13 of the air-valve device is open, and the air passes from the vessel F until the pressure therein is no longer in excess of that in the tank E. The weight of the liquid in the tank E will now lift the valve 8, and the said liquid, which was discharged from the cylinder on the previous descent of the piston B, will flow into the vessel F, to be again forced therefrom when the air-pressure in said vessel is increased by shifting the valve to the position shown in Fig. 2.

Inasmuch as the space occupied by the piston-rods in the cylinder above the piston B diminishes the capacity of this portion of the cylinder, it is necessary, to prevent a vacuum in circulating the water from the top to the bottom of the cylinder, to supply additional fluid to that discharged from above the piston, and this is effected by closing the communication between the vessel F and cylinder by means of the disk-valve 30, and by providing a communication between the space below the piston and any part of the machine containing liquid and inserting in the channel an upwardly-opening check-valve. Thus a pipe 33 connects the pipe 2 and the bend of the pipe 4, (which is always supplied with liquid,) and contains the lifting check-valve 34, which rises when there is any tendency to a vacuum in the lower part of the cylinder and permits the water from the pipe 4 to flow into the same, the valve closing as soon as there is any pressure above it.

There is a valve 30 on the water-valve stem, and the casing 3 has a port 50 between the vessel F and the circulating-pipes, the said port being closed by the valve 30 when the circulating-ports are in communication, so that the liquid in the cylinder and circulating-pipes is cut off from communication with the air and water vessel as the discharge-pipe is closed.

It will be apparent that if the valve 6 is raised to discharge the water from below the piston before pressure is brought upon the top of the latter the piston may rise under the weight of the load when the discharge-port is open and until the air-pressure is upon the water above the piston. To prevent this result we so set the valves that the air-inlet valve to the vessel F shall open slightly in advance of the opening of the discharge-port. Thus the parts are arranged as shown in Fig. 4, the valve 6 having greater lap than the air-valve 16, which uncovers the air-inlet port 11 before the valve 6 uncovers the discharge-port.

The air-pressure upon the fluid in the vessel F may be regulated automatically, so as to provide a safety means preventing the cage from moving at any time at an excessive speed and regulating the volume of air admitted to the vessel F to the weight of the load. Thus there is a valve 40 in that portion of the air-supply pipe communicating with the vessel F, with which valve is connected a suitable governor I, driven by the movement of the cage—for instance, by an endless cable 41, connected with the cage or other moving part of the engine and passing

round guide-pulleys and around the pulley 42 of the governor—whereby any undue increase in the speed on the movement of the cage will carry the valve toward its seat, throttle the passage, and reduce the pressure in the vessel. This automatic reduction of the air-pressure results in a large saving in the amount of air employed. For instance, if the load can be raised by one-half of the full air-pressure, the full pressure, imparting an increased speed to the cage, will cause the valve to approach its seat, cutting off one-half of the air admitted to the vessel, in which the air will expand with a reduction of one-half of the pressure upon the liquid therein.

On elevators employing water in contact with the piston it is essential to use packings, as a close fitting of the piston to the cylinder would result in undue friction, and in elevators in which a compressible and incompressible fluid is employed water is objectionable, inasmuch as the discharge of air from under compression into the atmosphere or the passing of the same through a reducing-valve results in a rapid expansion and absorption of heat, which passes quickly from the water, causing it to freeze in the pipes or passages. Even when water does not come into contact with the expanding or compressed air the condensing and cooling of moisture in the atmosphere cause an objectionable accumulation of ice upon parts of the apparatus. To avoid these difficulties we make use of a liquid that will not rapidly part with its heat, and preferably a lubricating-oil instead of water, the same remaining fluid at an extremely low temperature and so thoroughly and effectually lubricating the piston and other parts that close fittings may be secured without the use of packings.

In order to prevent the accumulation of ice in or upon the air-valve device, we provide the same with a surrounding heater of suitable construction that will maintain it at a comparatively high temperature. Thus the heater may contain a surrounding chamber, in which hot water, air, or steam is circulated through pipes 60 60. (See Fig. 4.)

While the tank E is preferably placed directly above the vessel F, this is not absolutely essential, and the valve 8, instead of being a check-valve, may be opened positively. Thus an arm 61, dotted lines, Fig. 3, is secured to the stem of the valve 8, and is connected by a rod 62 with the valve-spindle 32, so that the valve 8 is positively opened as the valve 6 is closed and as the valve 15 opens the exhaust-air port.

Without limiting ourselves to the precise construction and arrangement of parts shown, we claim—

1. The combination, with the cylinder, piston, and valve device of an elevator-engine, of a vessel containing a body of incompressible liquid and communicating with the said valve device, and with a pipe provided with a valve to supply an elastic motor-fluid under pressure, and a tank communicating with the discharge-port of the elevator-valve device and connecting through a port provided with a valve with the said vessel, substantially as set forth.

2. The combination, with an elevator-engine, of an air and water vessel communicating therewith, and with a pipe leading to a supply of elastic fluid and provided with a valve, and a tank arranged to receive the water discharged from the engine and communicating through a port provided with a check-valve with the said vessel to discharge the water into the latter, substantially as set forth.

3. The combination, with the cylinder, piston, inlet, discharge, and circulating pipes, and the valve device having inlet, discharge, and circulating ports, of an air and water vessel communicating with the inlet-port of said valve device and with an air-supply pipe and an air-valve device in said supply-pipe, the two valve devices being connected to work in unison, and a tank arranged to receive the fluid discharged from the cylinder and communicating with the vessel through a port provided with a valve, substantially as set forth.

4. The combination, with an elevator-engine and its valve device, of an air and water vessel, an air-valve device connected to work in unison with that of the engine, and a tank communicating with the vessel through a port provided with a valve and arranged to receive the water discharged from the cylinder of the engine, substantially as set forth.

5. The combination, with an elevator-engine and valve device, of an air and water vessel communicating with the inlet-port of said valve device, a discharge-tank communicating with the discharge-port of said device, a valve governing the communication between the tank and the vessel, and a supply-pipe communicating with the vessel and provided with an air-valve connected with the engine-valve, substantially as set forth.

6. The combination, with an elevator-engine, its circulating-pipes, and valve device having inlet, discharge, and circulating pipes and ports, of a vessel containing a liquid and communicating at its lower part with the inlet-port of the valve device and at the upper part with a pipe leading to an elastic fluid-supply, and provided with a valve device having inlet and exhaust ports, and a water-tank arranged to receive the water discharged from the engine and communicating with said vessel through a port provided with a valve, substantially as set forth.

In testimony whereof we have signed our names to this specification in the presence of two subscribing witnesses.

WILLIAM E. HALE.
NORMAN C. BASSETT.

Witnesses:
W. E. CARR,
C. VALLETTE KASSON.