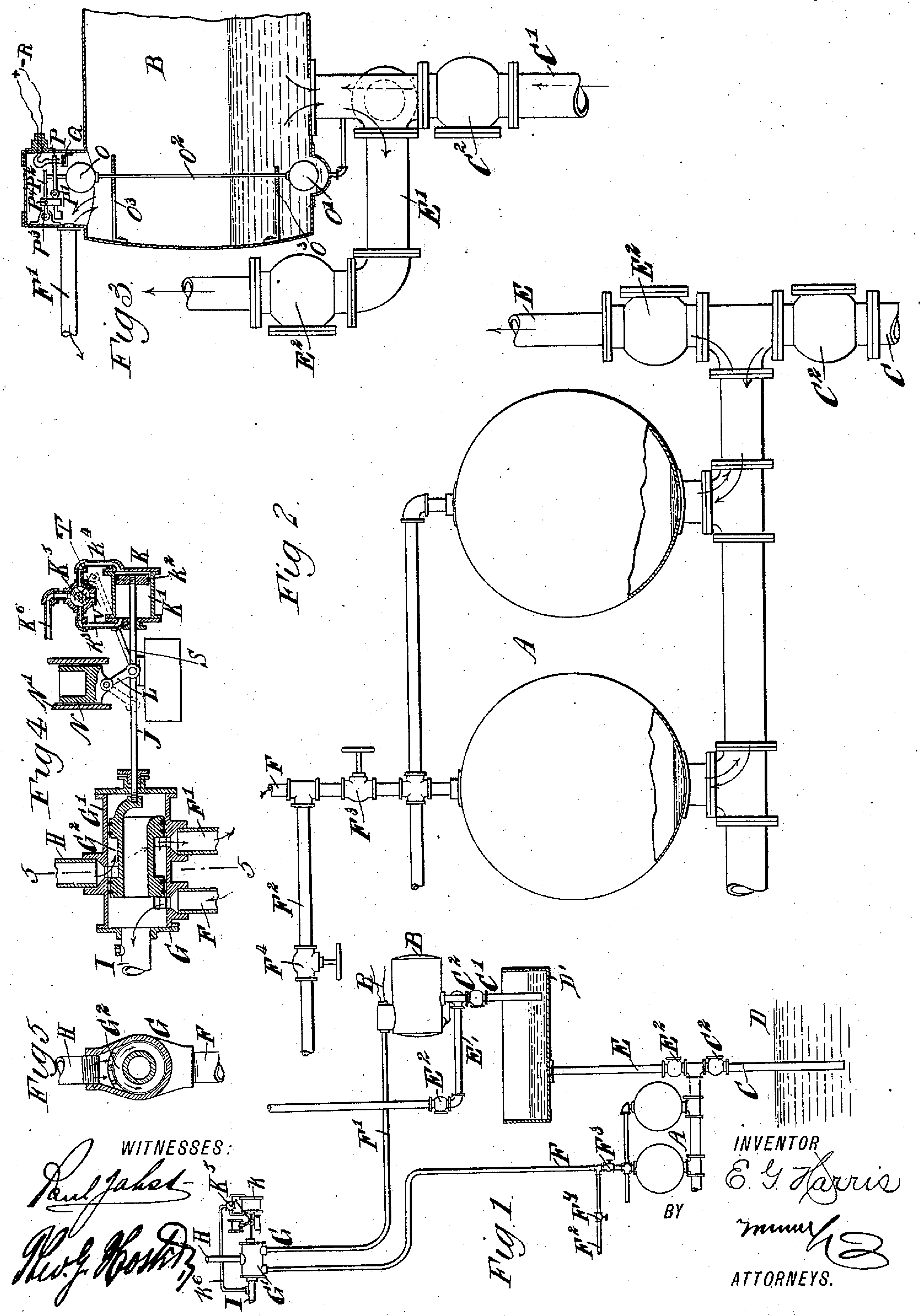
(No Model.)

E. G. HARRIS.

PUMP.

No. 580,687. Patented Apr. 13, 1897.



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PUMP.

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Application filed April 15, 1896. Serial No. 587,629. (No model.)

To all whom it may concern:

Be it known that I, ELMO G. HARRIS, of Rolla, in the county of Phelps and State of Missouri, have invented a new and Improved Pump, of which the following is a full, clear, and exact description.

The object of my invention is to provide a new and improved pump which is simple and durable in construction, arranged for economically using compressed air as a motive agent, and more especially designed for elevating water, as in mine-drainage, or for delivering water at any desired pressure in a water-service system used for supplying water for general purposes, fire protection, and the like.

The invention consists principally of two vessels each connected at the bottom with a water-supply and each having an air-pipe connected at its top and a switch connected with the inlet and discharge of an air-compressor and with the air-pipes of said vessels.

The invention also consists of certain parts and details and combinations of the same, as will be fully described hereinafter and then pointed out in the claims.

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

Figure 1 is a side elevation of the improvement arranged for lifting water in stages. Fig. 2 is an enlarged elevation with part in section of one of the vessels and the pipes leading thereto and therefrom. Fig. 3 is a sectional side elevation of the other vessel and connected parts. Fig. 4 is an enlarged sectional side elevation of the switch with automatic shifting mechanism, and Fig. 5 is a transverse section of the switch on the line 5 5 of Fig. 4.

The improved pump is provided with two vessels A and B, placed at the same or at different levels and provided with water-inlet pipes C C′, respectively, connected with sources of water-supply D D′, respectively, in case the vessels are at different levels, but if at the same level both pipes C C′ may be connected with the same source. The pipes C C′ are connected with the bottom of the vessels and also with the discharge-pipes E E′, respectively, through which the water passes to higher levels. For instance, as shown in Fig. 1, the pipe E may lead to the supply D′ for the pipe C′, and the pipe E′ lead to a still higher level, so that the water is raised in stages. The pipes C C′ are provided with check-valves C^2, and similar check-valves E^2 are arranged on the discharge-pipes E E′.

From the tops of the vessels A and B lead air-pipes F F′, respectively, to a switch G, having a casing in the form of a cylinder G′, connected by a pipe H with the discharge of an air-compressor and by a pipe I with the inlet thereof. In the cylinder G′ is arranged a piston-valve G^2, adapted to connect the pipe H with the pipe F′, as illustrated in Fig. 4, said valve when in this position also connecting the pipes I and F, and when the valve is shifted then the pipe F′ is connected with the pipe I and the pipe F with the pipe H.

The piston-valve G^2 is provided with a valve-stem J, to which a handle or lever may be attached by which the switch can be shifted by hand or to which the mechanism for automatically shifting the switch may be attached, as illustrated in Fig. 4.

The automatic shifting mechanism K consists of a cylinder K′, in which reciprocates a piston K^2, held on the valve-stem J; a valve K^5, connected with the ends of the cylinder by pipes K^3 and K^4, with the compressor intake-pipe I by the air-pipe K^6, and with the free air by the opening V; a connecting-rod S between some point on the rod J and a crank arranged to turn the valve K^5, and an adjustable weight N, constrained to move vertically by suitable guides N′ and connected by a link L with the rod J.

The valve K^5 is so set and operated that one end of the cylinder K′ is in communication with free air, while the other end is in communication with the compressor inlet-pipe I. Hence when the pressure in the pipe I falls below that of the atmosphere there will be a force tending to propel the piston K^2 through its stroke. The pressure in the pipe I, at which the switch should act, is that at which the vessel from which the air is being exhausted becomes filled with water. The weight N is made adjustable and by it the switch is held to the end of its stroke until the proper pressure is reached. As the piston-valve G^2 moves from one extreme position

to the other the valve K^5 is revolved through ninety degrees by the rod S and crank T, thus reversing the action in the cylinder K.

In order to enable the attendant to know the proper time for actuating the switch or at which it should act automatically, I provide an alarm mechanism located in one of the vessels A or B. As shown in the drawings, said mechanism is located in the vessel B. This alarm mechanism is provided with two floats O O′, held on the upper and lower ends of a stem O^2, fitted to slide in suitable bearings O^3, secured within the vessel B. The float O′ is sufficiently weighted to hold both floats suspended as long as the float O′ is submerged in the water, but when the vessel B is empty then the float O′ will sink farther down and draw the float O in the same direction, and when the vessel fills with water to the float O then the latter is lifted by the rising water.

The upper end of the stem O^2 projects above the float O, and has a lug projecting between a lever P, pivoted at P′, and a lever P^2, fulcrumed at P^3, the levers being connected with each other by a link P^4. The free end of the lever P carries the ends of two wires of a circuit containing an alarm, and the ends of said wires are adapted to be moved by the lever P into a mercury-cup Q whenever the float O or O′ is actuated, as above described. When the ends of the wires pass into the mercury-cup, the circuit is closed and the alarm is sounded. When the vessel B is empty and the float O′ sinks, then the lever P is drawn downward to cause the ends of the wires to pass into the mercury-cup, and when the float O is lifted upon the vessel B being filled with water then the upper lever P^2 is swung upward, and in doing so its link P^4 pulls on the other lever P to move the wires again into the mercury to close the circuit and sound the alarm.

The system is put in operation as follows: The air-compressor being in action, let the air be exhausted from one of the vessels—vessel B, for instance. Water will thus be drawn into the vessel through the pipe C′ and check-valve C^2. When the vessel is filled with water, the switch must be shifted, after which air will be driven back into B and exhausted from A. Let the exhaustion of air from A continue until that vessel is drawn full of water. Then let the compressor take air from the atmosphere and pump it into B until the water is driven out through the pipe E′ and check-valve E^2 and the vessel B emptied, at which time the switch must again be shifted. This will bring the system into regular operation. No more air will be taken from the atmosphere except as it may become necessary to replace leakage. The air already in the system will be transferred from one vessel to the other by means of the switch and air-compressor.

While putting the system in operation, the weight N can be so adjusted that the switch and alarm will act simultaneously, or if the alarm is not put into the system any other means of determining when the tanks are filled or emptied may be resorted to while adjusting the automatic switching mechanism. A water-gage on one tank would suffice for this purpose. Now it will be seen that by the arrangement described water is continuously elevated as long as the air-compressor is in motion, it being understood that the vessels are so proportioned and so placed relatively to the source of supply and that the quantity of air in the system is so adjusted that when one vessel becomes empty of water the other becomes filled. Thus one of the vessels receives air and delivers water, while the other receives water and delivers air.

By passing air from one vessel to the other by means of the air-compressor all the energy of expansion possessed by the air when in a compressed state will be saved.

If it be desired to take water from more than two places, as may occur in mine-drainage, one vessel, as A, can be shut out of the system by closing a gate, as F^3, on the air-pipe leading thereto and another vessel in another locality admitted into the system by opening a gate, as F^4, on a branch air-pipe leading to said other vessel.

The alarm mechanism O, O′, O^2, O^3, O^3, P, P′, P^2, P^3, P^4, Q, and R is not essential when the automatic switching mechanism is used, but if it is put in it will serve as a check on the switching mechanism. If serious leakage of air has occurred, the fact will be revealed by the switch and alarm not acting simultaneously.

It should be clearly understood that no valves are required within the vessels A and B nor on the air-pipes F and F′ leading therefrom to the air-compressor except the switch G, and that the switch G can be placed within the compressor-room, where its action can be easily observed and regulated.

It is further understood that where the word "vessel" occurs in this description and these claims it must be understood to mean either a single vessel or a group of vessels directly connected, as illustrated by Fig. 2, where the vessel A is composed of two or more tanks connected at top and bottom.

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

1. In a pneumatic water-elevating device, the combination of two closed pumping chambers or vessels having pipe connections at their bottoms for admitting and discharging water, and at their tops connections for admitting and discharging air, and an air-compressor; with a shifting valve or switch forming part of the connections from both the inlet and discharge pipes of the air-compressor to the pumping-chambers, and an operating mechanism for said shifting valve, consisting of a movable piston, operating connections between the piston and the shifting valve,

and a reversible connection from the inlet side of the air-compressor to either side of the said piston and from the opposite side of the piston to the free air, substantially as shown and described.

2. A valve-shifting mechanism for pneumatic pumping devices, consisting of a valve placed to control the inlet and discharge pipes of the air-compressor and capable of crossing the same, in combination with an operating mechanism therefor, consisting of a cylinder and a piston connected at one end to the air-compressor suction and at the other end to the atmospheric air and a weight movable at right angles to the motion of the piston and connected to said piston by a link, whereby it will resist the motion of the piston during the first half of its travel and assist it during the latter half of its travel, substantially as shown and described.

3. A valve-shifting mechanism for pneumatic pumping devices, consisting of a valve placed to control the inlet and discharge pipes of the air-compressor and capable of crossing the same, in combination with an operating mechanism therefor, consisting of a cylinder and a piston connected at one end to the air-compressor suction and at the other end to the atmospheric air, a valve by which said connections may be reversed, and connections from said valve to the piston; with means for shifting the valve and crossing the pipes, operated by atmospheric air on one side and a reduction below atmospheric air in one of the pumping-chambers on the other side, and a weight movable at right angles to the motion of the piston and connected to said piston by a link, whereby it will resist the motion of the piston during the first half of its travel and assist it during the latter half of its travel, substantially as shown and described.

4. A pump, consisting of two vessels each having at its bottom a pipe connection for admitting and discharging water and each having at its top a pipe connection for admitting and discharging air; a switch connecting the air-pipes of said vessels with two other pipes leading to the inlet and discharge, respectively, of an air-compressor, said switch being adapted to reverse the connections of said air-pipes with said pipes leading to the inlet and discharge of an air-compressor, and an engine for automatically operating the said switch through the medium of atmospheric pressure in conjunction with a partial vacuum created in the intake-pipe of the compressor, said engine comprising a cylinder, piston and piston-rod, a valve arranged to admit free air to propel the piston and to allow the opposing air to escape into the intake-pipe of the compressor, said valve being operated by a rod connected at one end to the said piston-rod and at the other end to a crank or valve-stem, arranged to actuate the valve; and an adjustable weight mounted between vertical guides above said piston-rod and connected thereto by a link which in its extreme positions is inclined so that said weight must be lifted as the piston moves from either end of its cylinder, substantially as shown and described.

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Witnesses:
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