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G. R. YOUNG & C. SHAW.

LIQUID RAISING APPARATUS.

APPLICATION FILED JAN. 18, 1902.

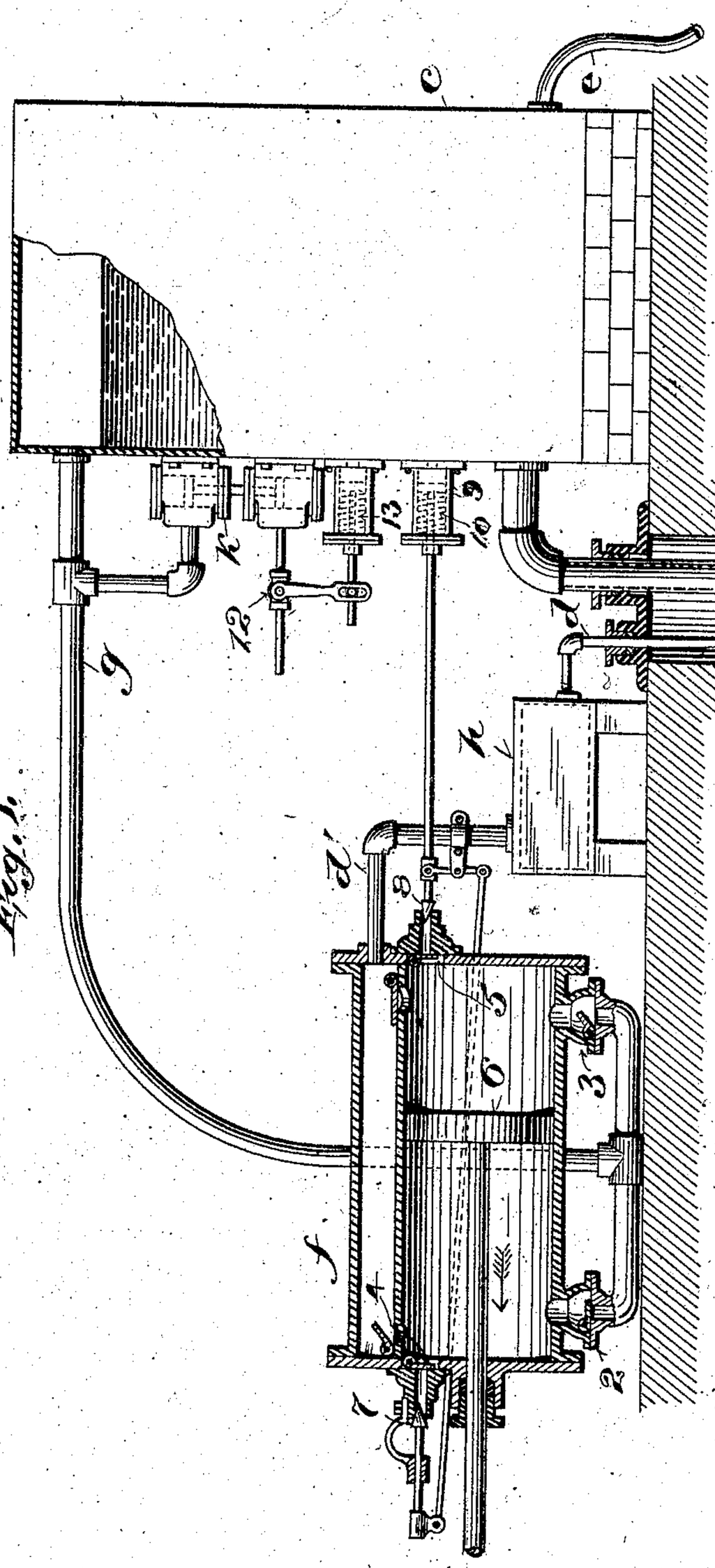

Fig. 1.

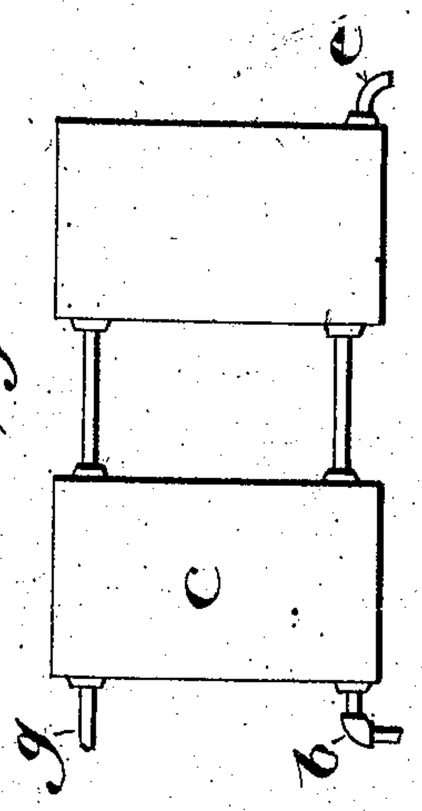

Fig. 2.

WITNESSES

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GEORGE R. YOUNG, OF RIDGEWOOD, NEW JERSEY, AND CLIFFORD SHAW, OF NEW YORK, N. Y., ASSIGNORS TO BACON AIR LIFT COMPANY, A CORPORATION OF NEW JERSEY.

LIQUID-RAISING APPARATUS.

No. 827,341. Specification of Letters Patent. Patented July 31, 1906.

Original application filed February 1, 1899, Serial No. 704,104. Divided and this application filed January 18, 1902. Serial No. 90,292.

To all whom it may concern:

Be it known that we, GEORGE R. YOUNG, residing at Ridgewood, State of New Jersey, and CLIFFORD SHAW, residing at New York city, State of New York, have invented certain new and useful Improvements in Liquid-Raising Apparatus, of which the following is a description, which with the accompanying drawings together form this specification.

This is a division of our application filed February 1, 1899, Serial No. 704,104.

In United States Letters Patent No. 592,037, granted to us October 19, 1897, is disclosed a means for the separation of the air from the water in a so-called "air-lift" water-raising system. This invention forms in part an improvement on the device shown therein.

In this water-raising system air is forced into the lower portion of a column of water in an uptake-pipe. The air rising in bubbles of course diminishes the weight of the column of water in the pipe, causing it to rise to a higher level and to overflow on reaching the top of the uptake. In the improvement described in the patent above referred to the mixed water and air on reaching the mouth of the uptake-pipe are separated one from the other in a closed chamber, the water passing out through a pipe leading to the final point of delivery and the air being discharged separately through an air-pipe. The air-pipe delivers the air into the water in the discharge-pipe in order to again by aeration raise it to the final level or point of delivery. The object of the intermediate separation of the air and its second introduction into the water is to obviate the troubles which arise in delivering the mixed air and water through a horizontal pipe, because in such a pipe the air instead of remaining in small bubbles accumulates in quantity and gives trouble. Of course, however, if the water is to be delivered to a point at a higher level than the mouth of the uptake-pipe and of the separating-chamber a static pressure must be maintained in the chamber sufficient for the purpose of forcing the water to the higher level or else pumping apparatus or auxiliary devices must be employed.

The object of this invention is the construction of an apparatus by which the air may be separated from the water at the head of the uptake-pipe under a sufficient head to cause the delivery of the water without aeration to the final level, and yet at the same time there will result no loss of efficiency, as by the escape into the atmosphere of the compressed air in the separator, but, on the contrary, an increased economy in the cost of operation, in the size of the air-compressors required, and in the general construction and operation of the system.

Briefly stated, the invention consists in its preferred use in raising the water by an air-lift system and in separating the air from the water in a closed separator at a pressure in excess of atmospheric pressure to give the desired force or head in the separator and in the water-discharge pipe leading from the separator. The air under pressure and at the cool temperature of the well-water is returned to the air-compressor and after being compressed to the amount required to force it down into the well and into the uptake-pipe in the well is delivered to the foot of the uptake-pipe and thence rises with the water in the uptake-pipe to and into the separator, where it separates from the water and recommences its cycle. The air is subjected to an approximately adiabatic compression and to isothermal expansion in the cool water of the well and is always at a pressure which is greater than atmospheric. Thus a new and improved economy in the system is obtained. Gas at increasing pressure becomes proportionately less compressible in the sense that, for example, a volume of gas under pressure of two atmospheres can be compressed under, say, ten pounds increase of pressure to only one-half as much as the same volume of gas under pressure of one atmosphere.

Having thus fully explained our new process, we refer to the accompanying drawings.

Figure 1 is a vertical side view of the apparatus, parts of the separator being broken away. In this view but one separator is shown. Fig. 2 is a plan view of a duplex separator which may be used.

From the well *a* the uptake *b* rises to the separator *c*. The final discharge-pipe *e* from the separator leads to the desired place and level of delivery. The air is carried from the separator through the air-pipe *g* to the inlet-valves 2 3 of the compressor. The compressor

is only illustrated in diagram, since its details are to a large extent familiar matters of engineering. The piston is indicated at 6. The air as it is compressed passes to the delivery-chamber *f*, and thence through air-pipe *d'*, reservoir-tank *h* to the downtake air-pipe *d*, to the bottom of the uptake-pipe *b*.

The system may be simplified by the omission of reservoir-tank *h*, whose object is to overcome the slight pulsations of pressure due to the compressor.

Preferably the system is provided with means for introducing additional air under pressure from time to time, because usually the well-water will absorb air, and this coupled with loss due to leakage requires compensation. Regulators for this purpose and, indeed, for the regulation of the discharge through pipe *e* and for the control of the water-level in the water-separators may be introduced at will. In the drawings three cooperating means of regulation are shown. Firs , the tanks *c* are of such a height that columns of water within them act as hydrostatic regulators, for if the air-pressure in the tanks is constant a variation of two feet in the height of the water in the tanks will determine a variation of approximately one pound in the discharge-pipe *e*, or, in other words, will cause more or less water to be delivered through the pipe, and thereby tend to preserve the level in the separator-tank at a certain standard point. For the better separation of air from water and to prevent the carrying out of considerable quantities of air in minute bubbles through the pipe *e* duplex or plural separating-chambers *c* are provided. The slotted mouth of the uptake *b* allows nearly all the air to rise and escape from the water in the first tank. Small bubbles of air, however, entangled in the water are carried into the second tank, where the water is less disturbed by the discharge of the air. As the pipe *e* leads from the bottom of the second tank, very few, if any, of these smaller bubbles of air are carried out with the water, for they rise slowly to the surface in the second tank and pass thence through the air connection illustrated to the first tank and to the air-pipe *g*.

A second device for preserving a constant static pressure in the separator-tanks and also regulating the whole system and compensating for the loss of air consists in the inlet flap-valves 4 and 5 in the compressor and the automatic regulating plugs or valves 7 and 8, which are controlled and adjusted by means of the cylinder 9 and regulating spring-piston 10, which receives pressure from the separator *c* through the small hole shown. When the pressure falls below the standard for which the regulator is set, the spring draws the valve 8 toward the right and the valve 7 toward the left, allowing more air to be drawn in from the atmosphere to the cylinder of the compressor. To produce the suction for drawing in the air, the outlet-valves from the compressor are so placed that the piston 6 reaches them at the end of its stroke after it has covered the inlet-valves 2 or 3. Therefore when the piston again begins to move toward its central position and away from the end of the cylinder it can draw in air through the valve 4 or 5 before uncovering the valve 2 or 3, respectively. Some such provision as this is necessary, because the pressure beneath the valves 2 and 3 is greater than the atmospheric pressure beneath the valves 4 and 5.

A third means for regulating the system consists in auxiliary air-pump *k*, the actuating-valve 12 of which is controlled by the pressure-regulator 13. When the pressure in the tank *c* is below the normal or desired standard, valve 12 is opened and the air-pump *k* operates continuously, forcing air from the atmosphere into the system until the normal pressure is reached and the valve 12 thereby closed.

In order to illustrate the operation of the system and to explain our process by a concrete example, we may suppose that it is necessary to raise water one hundred feet above the level in the separating-tank and that the level in the well *a* is fifty feet below the level in the tank *c*. Also let the mouth of the downtake air-pipe *d* be about two hundred and twenty feet below water-level in the well *a*. The automatic regulators may then be set to preserve an air-pressure of somewhat less than fifty pounds to the square inch in the tank *c*. Before any water is allowed to escape from the discharge-pipe *e* it will be seen that the compressor will compress air into the tank *h* until somewhat above one hundred pounds pressure is obtained, and thereupon the air will begin discharging through the downtake *d*. As soon as the water begins to rise in the separator-tank *c* and the air-pressure therein produced by the air-compressor *k* and the air separating from the water approaches fifty pounds the water may be forced through the pipe *e* to a height one hundred feet above the level in the tank *c*. As the pressure rises in the tank *c* the automatic valve 12 closes and the operation is established. The height of the separator-tank *c* need not be more than about ten feet in order to act as a hydrostatic regulator for the discharge of the water under a hundred-foot head through the pipe *e*.

The process described herein forms the subject-matter of a separate claim by a divisional application.

Having now fully explained the nature of our invention and illustrated it, we claim by this application and desire to secure the following characteristic features:

1. In combination, an air-compressing mechanism, an uptake for liquid, a downtake

air-pipe conveying air from the compressor to the said uptake, a pressure-supporting separating-chamber into which the said uptake passes, a water-discharge passage leading from the separating-chamber and discharging against a static or dynamic resistance, an air-pipe leading from the said chamber to the said compressing mechanism, and means controlled by the static pressure of the liquid in said chamber for introducing additional air into the system.

2. In combination, an air-compressing mechanism, an uptake for liquid, a downtake air-pipe conveying air from the compressor to the said uptake, a separating-chamber into which the said uptake passes, a water-discharge passage leading from the separating-chamber, an air-pipe leading from the said chamber to the said compressing mechanism, and means for maintaining constant or substantially constant pressure greater than that of the external atmosphere in the said separating-chamber.

3. In combination with an uptake for liquid, means for introducing air under pressure into the column of liquid in such uptake and a plurality of air-tight communicating separating-tanks into which the liquid is introduced from the uptake, the said uptake delivering to one of the said tanks and a discharge-pipe delivering from another of the said tanks, for the purposes set forth.

4. In combination, an air-compressing mechanism, an uptake for liquids, a downtake air-pipe delivering air from the said compressing mechanism to the said uptake, a separating-chamber into which the said uptake discharges, a water-discharge passage leading from the said separating-chamber, an air-pipe leading from the said separating-chamber to the said compressing mechanism, and means for maintaining a substantially constant pressure in said separating-chamber.

Signed this 18th day of November, 1901, at New York.

GEORGE R. YOUNG.

Witnesses:
WM. R. BOYCE,
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Signed this 14th day of November, 1901, at Cincinnati, Ohio.

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