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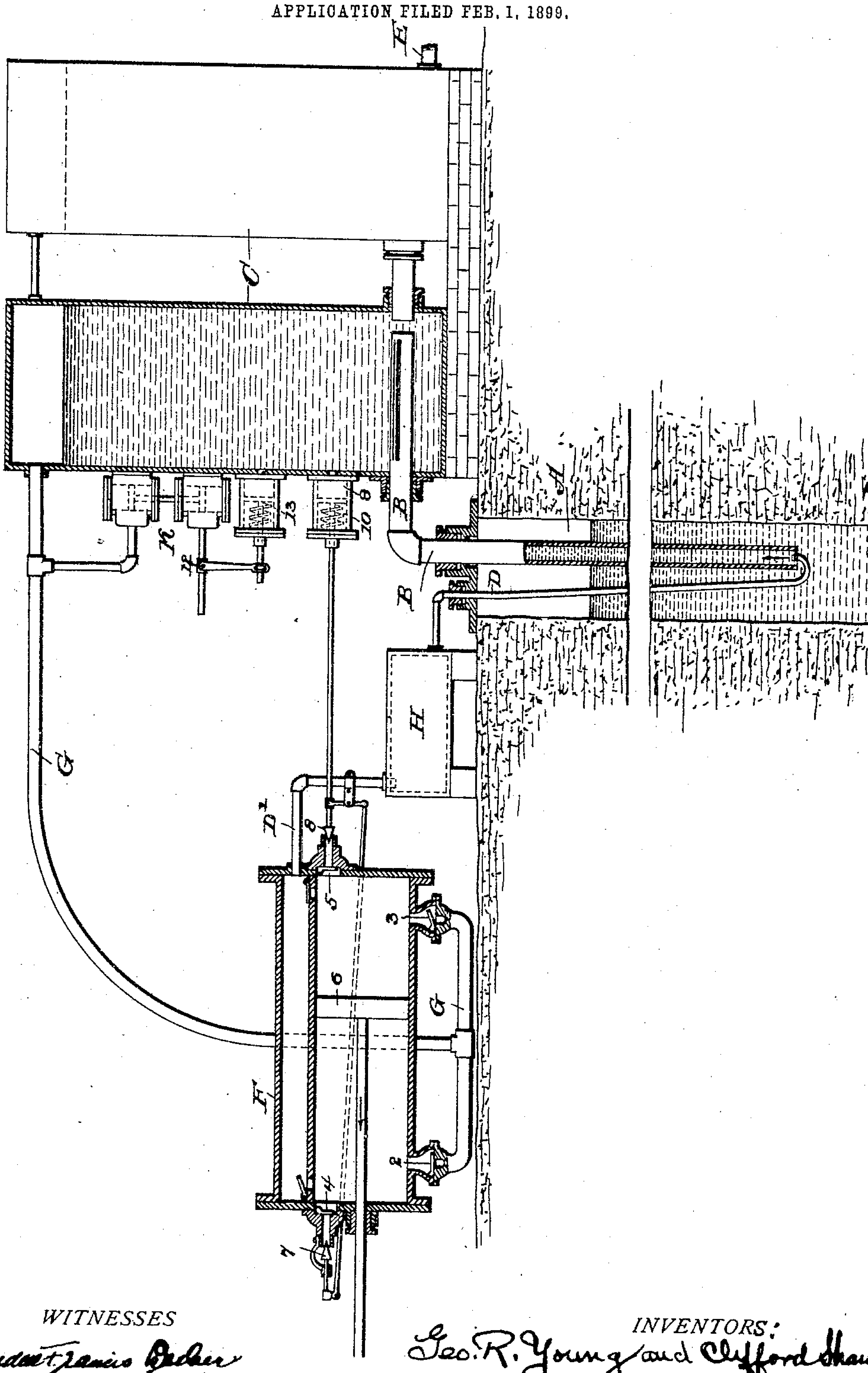
G. R. YOUNG & C. SHAW.

LIQUID RAISING PROCESS.

APPLICATION FILED FEB. 1, 1899.



WITNESSES

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No. 779,456. Patented January 10, 1905.

UNITED STATES PATENT OFFICE.

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

LIQUID-RAISING PROCESS.

SPECIFICATION forming part of Letters Patent No. 779,456, dated January 10, 1905.

Application filed February 1, 1899. Serial No. 704,104.

To all whom it may concern:

Be it known that we, GEORGE R. YOUNG, residing at Ridgewood, in the State of New Jersey, and CLIFFORD SHAW, residing in the city and State of New York, both citizens of the United States, have invented certain new and useful Improvements in and Relating to Liquid-Raising Processes, of which the following is a specification, with accompanying drawing, illustrating one preferred embodiment of the invention, partly in elevation and partly in section.

This application is filed as a continuation of our application, Serial No. 659,128, filed November 19, 1897.

In Letters Patent No. 592,037, granted by the United States of America to us October 19, 1897, an improvement on the so-called "air-lift" is set forth. In this 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 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 which we have just mentioned 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 aerate it for the purpose of raising 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. We have made discovery of a way 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, such 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. To produce these results is the object of this invention.

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 sufficiently 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. According to the improved system of this invention, increased efficiency is obtained. Gas at increasing pressures 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 drawing.

From the well A the uptake B arises 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. First, the tanks C are of such a height that the 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 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 we provide duplex or plural separating-chambers C. 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 air-bubbles 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 condenser 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 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 fifteen 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 use of a tank of sufficient height to act as a regulator in this manner is a part of the subject-matter of another application, Serial No. 697,263, filed November 23, 1898, by us.

The apparatus described forms the subject-matter of a separate claim by a divisional application, Serial No. 90,292, filed January 18, 1902.

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

1. The process of raising liquid, which consists in introducing a lighter fluid into a column of the liquid and causing the liquid to rise with the lighter fluid, upon its way to the point of discharge, subsequently separating the lighter fluid from the liquid at greater than atmospheric pressure and while the liquid is on its said way to the point of discharge, discharging the separated liquid at substantially said pressure, and again forcing the lighter fluid down and into the column of liquid, and maintaining the continuous circulation or cycle of the said fluid.

2. The process of raising liquid, which consists in forcing air into the lower portion of a column of liquid and causing the liquid to rise with the air upon its way to the point of discharge forming a substantially hydrostatic column of liquid above the point of discharge, separating the air from the liquid at greater than atmospheric pressure, after substantial raising of the liquid, at approximately the temperature of the liquid, and forcing such air back to and into the lower portion of the column of liquid in a continuous cycle.

3. The process of raising liquid to a given height and discharging it therefrom under pressure, which consists in introducing a lighter fluid under pressure from a suitable source into a column of the liquid, thereby lightening the column and causing hydrostatic pressure to raise it, in receiving and separating the liquid and fluid while still confined under pressure, in discharging the separated liquid under the last-said pressure to its point of delivery and in discharging the said fluid under the last-said pressure and again subjecting it to the greater pressure required to again introduce it into the said column, and continuing such circulation of the lighter fluid in a continuous cycle, substantially as set forth.

Signed this 31st day of January, 1899, at New York.

GEORGE R. YOUNG.
CLIFFORD SHAW.

Witnesses:
GEORGE H. SONNEBORN,
HAROLD BINNEY.