No. 721,810. PATENTED MAR. 3, 1903.

W. A. KERFOOT.

PUMP.

APPLICATION FILED MAY 25, 1901.

NO MODEL.

Fig. 3.

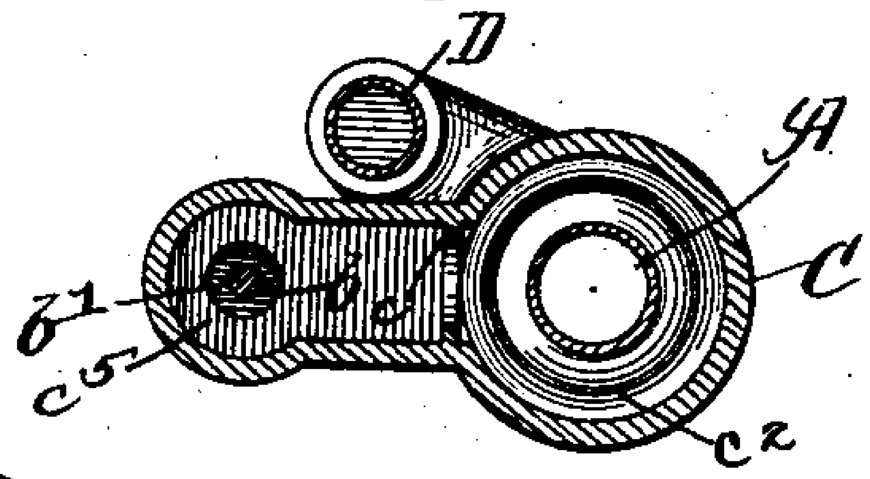


Fig. 1.

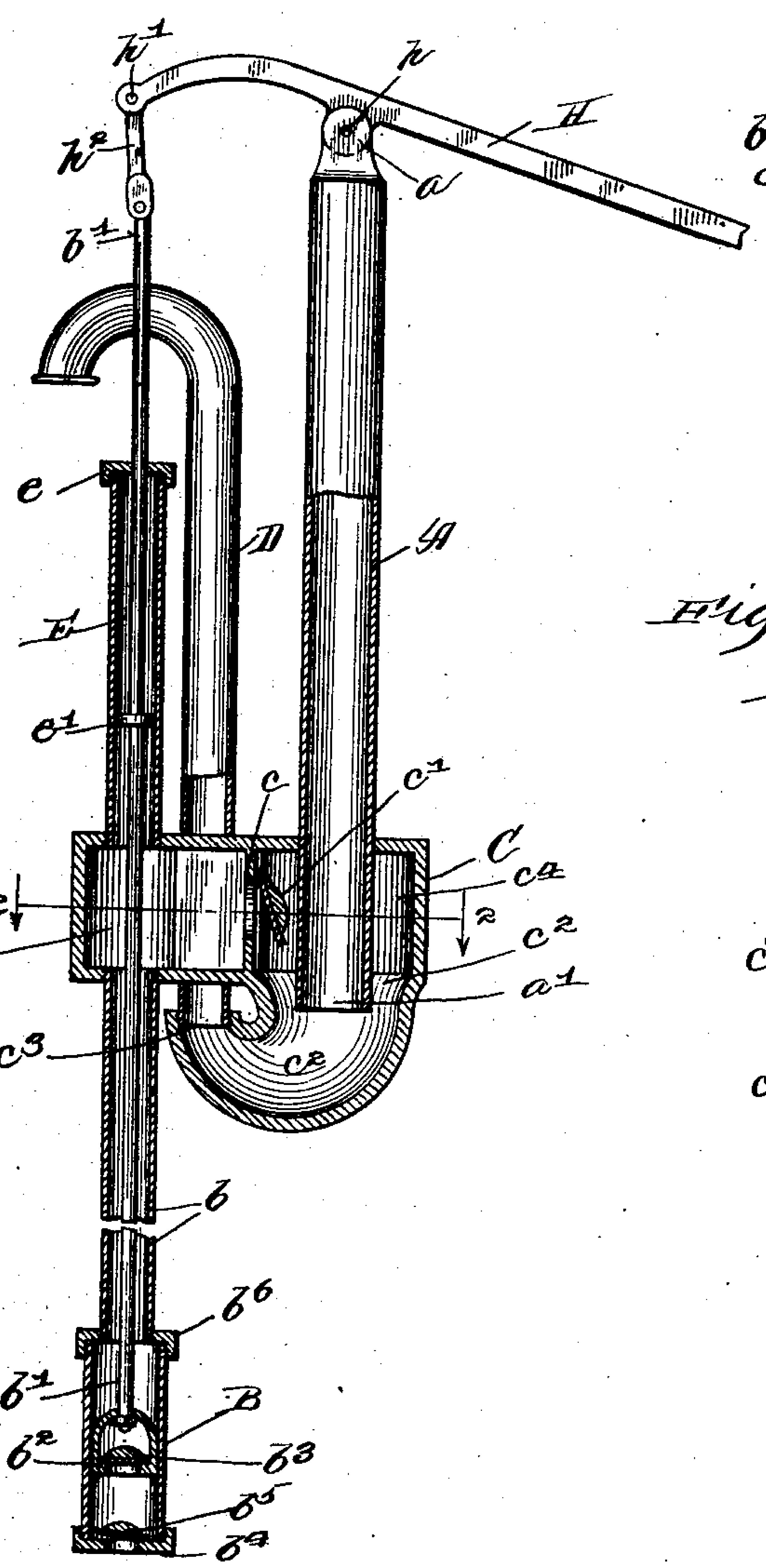
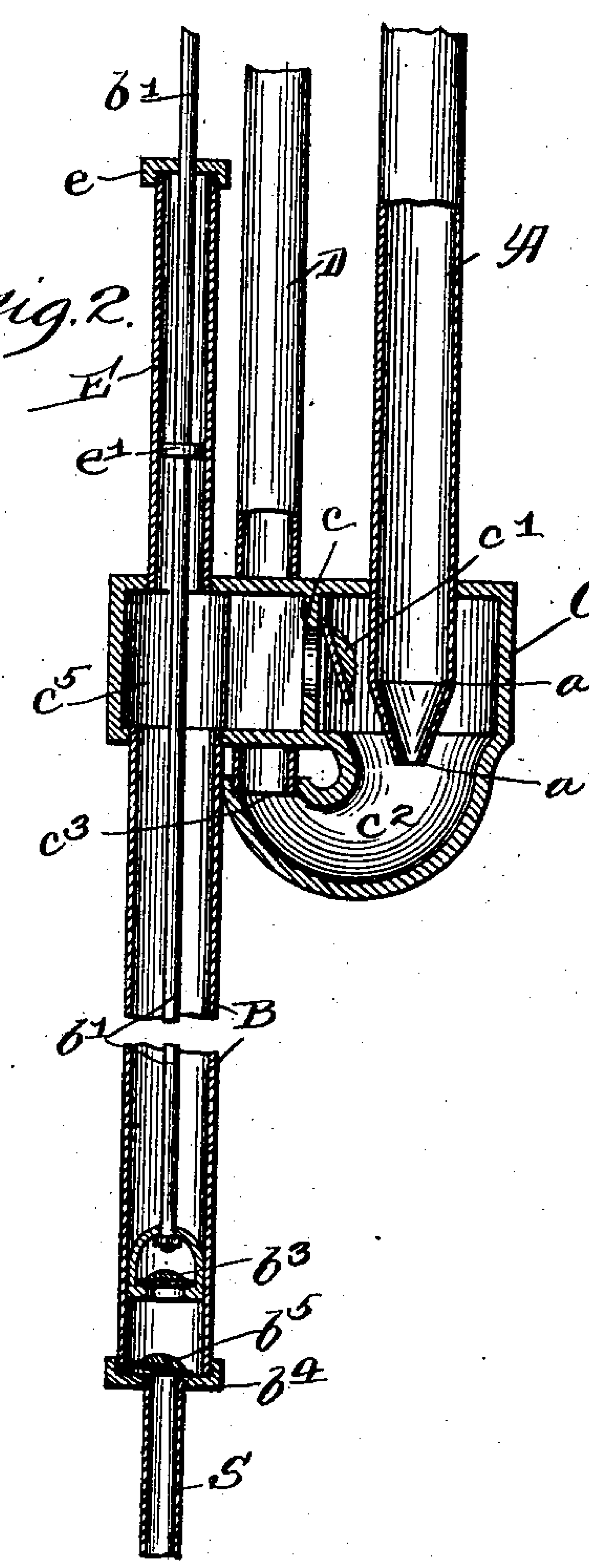


Fig. 2.



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UNITED STATES PATENT OFFICE.

WILLIAM A. KERFOOT, OF EVANSTON, ILLINOIS, ASSIGNOR TO KATHERINE KERFOOT, OF EVANSTON, ILLINOIS.

PUMP.

SPECIFICATION forming part of Letters Patent No. 721,810, dated March 3, 1903.

Application filed May 25, 1901. Serial No. 61,828. (No model.)

To all whom it may concern:

Be it known that I, WILLIAM A. KERFOOT, of Evanston, in the county of Cook and State of Illinois, have invented certain new and useful Improvements in Pumps; and I hereby declare that the following is a full, clear, and exact description thereof, reference being had to the accompanying drawings, which form part of this specification.

My invention relates to new and useful improvements in pumps.

The object of my invention is to provide a pump wherein the motion of the fluid being moved is not arrested nor impeded and wherein the surplus work or the *vis viva* or live energy which remains in the water within the vein at the conclusion of each stroke is stored up in compressed air within the air-chamber and afterward directed into the fluid-vein in such a manner as to accelerate the motion of the fluid then flowing through the pump, to the end that a steady constant stream of high velocity is discharged from the pump.

By reason of the peculiar construction and operation of my pump the fluid which passes through it is kept constantly in motion, although the power expended for that purpose is in the nature of a series of intermittent impulses. This result is produced by the operation of a trap-valve which separates the water-chamber containing the air-chamber from a similar chamber with which the pumping-cylinders communicate and the stored energy which has been conserved within the air-chamber. The trap-valve closes during the intermission between the successive impulses, at which time the expanding air within the air-chamber is directed into the flow of the moving column of liquid, which is thereby accelerated in a direction toward the discharge-pipe. The trap-valve being closed, the water that has passed the said valve being in motion must continue to flow toward the discharge by virtue of the maintained pressure due to the compressed air within the air-chamber, and hence the pressure within the water-chamber cannot be lowered by the water following the piston in its descent. The period of time that the trap-valve is closed is comparatively short. It occurs during the intermission of the reciprocations of the piston, at which time the pressure is higher in the chamber c^4 than in the chamber c^5. This effect is sufficient to arrest the motion of the column of moving liquid, and thereby greatly impair the efficiency of pumps in which a trap-valve is not employed.

In my invention the stored energy is directed immediately into the channel of the moving liquid in a manner similar to the method involved in the operation of a steam-injector, whereby a fluid may be forced against a pressure equal to the pressure of the motor fluid. The same effect is produced in my pump, to the end that while the fluid therein is in motion the stored energy due to the compressed air in the air-chamber is prevented from arresting the motion thereof and following the piston back into the barrel of the pump by means of a trap-valve, which is interposed between the said chamber and the said piston. The air and water under pressure within the air and water chamber in my pump is directed immediately into the channel of and in a direction with the moving liquid in such a way as to accelerate the flow of the said liquid. As a result the flow of water through the remaining channel or vein of the said pump is greater than the initial displacement of the piston. The reason for this is obvious. A certain amount of power and no more is required to be done on the piston in order to raise enough water from the well to fill the barrel. If more than this be done, as when an excess of power is applied to the piston by which it is moved faster than the water can immediately follow, the surplus effort manifests itself in the form of stored energy communicated to the water. If a means be afforded for expending the stored energy, as in the common suction-pump, by increasing the velocity of the water from the efflux-spout or by causing a sufficient difference of pressure to raise the valve in the barrel, then more water will be brought into the barrel as a result of the accelerated motion of water exercised by this surplus power than is due to the volume displaced by the piston. During the upstroke of the piston water is forced through the part of the trap-valve c' in the wall that divides the chambers c^4 and c^5 from the latter to the former. The water is then moved at a speed due to the excessive energy applied to the piston. If now there should be a restriction, head, or other resistance in the discharge-pipe, the excess energy due to the accelerated speed of the water would become manifest in compressing air in the air-chamber A. At the time of the pause between the upstroke and downstroke of the piston the pressure due to the compressed air in the air-chamber would be higher in the chamber c^4 than in the chamber c^5 and for the reason that the inertia of the water has caused a greater quantity of water to be projected into chamber c^4 than that due to the displacement of the piston. If the trap-valve did not close at this critical period, the difference in pressure between the two chambers would retard the flow of water through the discharge by forcing some of the water from the chamber c^4 back into the chamber c^5 and follow the column of water down as it settles back upon the piston in the barrel B. The entire column of water above the piston has been moved by the excessive impulse, a part of which will settle back upon the piston at the end of the stroke. By trapping the water in chamber c^4 and by applying the pressure of the air-chamber directly in line with the moving vein the water will continue to flow at a constant velocity at the discharge and the operation will be highly efficient.

In my pump it is only necessary to overcome the inertia of the water at one time, and that is at the time when the water is drawn into the barrel of the pump. After it leaves the barrel of the pump it is started into motion, which continues until it is discharged from the upper terminal of the pump. By this means the momentum due to the motion of the fluid is utilized, and the compressed air due to the excessive energy in the stroke of the pump is also utilized for accelerating the flow of the fluid through the fluid vein.

In the drawings which form part of this specification, Figure 1 is a central section in elevation. Fig. 2 is a similar view of a modification. Fig. 3 is a transverse section through line 2 2 of Fig. 1.

In all of the views the same reference-letters indicate similar parts.

A is an air-chamber.

B is a barrel or cylinder of the pump.

C is a water-chamber or casing.

D is a discharge-pipe.

E is an upper cylinder or barrel in line with the barrel B.

H is a handle by means of which a reciprocating motion is given to the pistons within the said cylinders. The handle is pivoted at a, which is a cap placed over the end of the air-chamber A. The said air-chamber is open at its lower end a'.

b is the ascension-tube, which connects the barrel B with the water-chamber C.

b^6 is a flaring flange or head carried by the tube b and internally screw-threaded for the attachment of barrel B thereto.

b^4 is a cap closing the lower end of barrel B and provided with an aperture covered by an inwardly-opening foot-valve b^5.

b' is the piston-rod, connected to the handle H at h' by means of the link h^2 and which reciprocates the pistons b^2 and e' in their respective cylinders. A partition c divides the water-chamber into two compartments. This partition is perforated, and over this perforation a trap-valve c' is swung.

c^2 is a depending flaring duct which is part of the chamber C, which terminates in an upwardly-contracted and upwardly-extended opening c^3, into which the discharge-pipe D is secured.

c^4 is a circular opening in the said chamber which is immediately above the flaring portion just described.

The air-chamber or pipe A passes through the circular opening c^4 and enters the flared opening c^2 just below the bottom of c^4.

c^5 is another compartment or portion of chamber C, into which the ascension-pipe b and the barrel E are secured.

In the modification, Fig. 2, the barrel B is shown to extend up to and directly enter the chamber c^5, and a suction-pipe S is attached to the lower end of the said barrel. The water is lifted by suction through the pipe S.

In Fig. 1 the barrel is designed to be placed within the reservoir and to be connected to the water-chamber by the ascension-tube b.

The air-chamber A has a contracted end a' in Fig. 2 to increase the velocity of the efflux into the moving vein of fluid flowing through the pump.

The operation of the pump is as follows: When the piston b^2 is depressed within the cylinder or barrel B, the foot-valve b^5 is closed, and water contained within the barrel B below the piston will flow through the trap-valve b^3 above the piston. When the piston is raised, the entrapped water will be lifted through the ascension-pipe b into the chamber c^5, through the trap-valve c' into chamber c^4, from whence it will be discharged through the efflux-pipe D. Now if the piston be suddenly lifted so it leaves the water that is in the barrel below the piston a partial vacuum is effected between the water and piston which will accelerate the water flowing through the valve b^5. The momentum therefore will carry it through the trap-valve b^3 above the piston to an extent greater than the displacement of said piston. When the pistons are suddenly depressed, the air contained within the barrel E between the piston or plunger e' and the fluid below will be thereby compressed and will contribute to maintain a constant stream flowing through the vein of the pump.

The result of the operation just described forces water into the lower end of the air-chamber A, which will rise to a point therein consistent with the inducing cause and the pressure of the air compressed in the upper portion of said air-chamber by the rising water. Whenever the pressure within the chamber c^5 and its connecting-channels falls below the pressure within the chamber c^4 and its connecting-channels, the trap-valve c' will be closed, and the increased pressure will not cause the fluid in chamber c^4 to be returned upon its path and retard the flow of the incoming fluid. The pressure within the air-chamber A will force the fluid into the midst of the outgoing stream and accelerate its movement. The degree to which the accelerating effect may be adjusted to some extent is determined by the size of the discharge-opening, (shown at a' in Fig. 2.)

There are a number of modifications that could be made from that represented by the drawings without departing from the gist and spirit of my invention.

I may suggest that the pump can be made single-acting instead of double-acting, as shown, or that the cylinders B and E may be made of equal size or of different proportions.

Having described my invention, what I claim as new and useful, and desire to secure by Letters Patent of the United States, is—

1. In a pump a water-chamber divided into two compartments, a valve separating said compartments, a piston adapted to be reciprocated communicating with one of said compartments, a discharge-duct leading from the bottom of the other compartment and curving upwardly, a discharge-pipe fitted to the upper end of said duct, and an air-chamber associated with the last said compartment, and provided with a discharge-outlet arranged within the discharge-duct of the compartment.

2. In a pump, a water-chamber divided into two compartments, a trap-valve separating said compartments, a final-discharge pipe, and an air-pressure chamber communicating with one compartment, a tapered, open-end, flaring conduit between said compartment and said discharge-pipe, an opening from said air-pressure chamber located in the center of the flaring, open end of said conduit, a cylinder in the other compartment of said water-chamber, and a piston in said cylinder adapted to be reciprocated, substantially as set forth.

3. In a pump a water-chamber divided into two compartments, a trap-valve separating said compartments, influx and efflux tubes connected with the respective compartments, an air-chamber in the latter compartment, and a contracted discharge-orifice in said air-chamber arranged to discharge into the center of said efflux-tube, substantially as set forth.

4. In a pump a water-chamber divided into two compartments, a trap-valve separating said compartments, an influx-tube, an efflux-tube, an open flared passage-way connecting the efflux-tube with said water-chamber, an air-chamber, and an orifice in said chamber adapted to discharge into the open flared terminal of said passage-way, substantially as set forth.

5. In a pump an influx-tube b, connected with a compartment c^5, a compartment c^4, a valve c' separating said compartments, an air-chamber A, an open flared passage-way c^2, from said chamber to a discharge-pipe, said air-chamber adapted to discharge into the center of the open, flared end of said passage-way, and a discharge-pipe D connected with said passage-way, substantially as set forth.

In testimony that I claim the foregoing as my own I affix my signature in presence of two witnesses.

WILLIAM A. KERFOOT.

In presence of—
FORÉE BAIN,
M. F. ALLEN.