H. KAPFERER.

LIQUID ELEVATING APPARATUS.

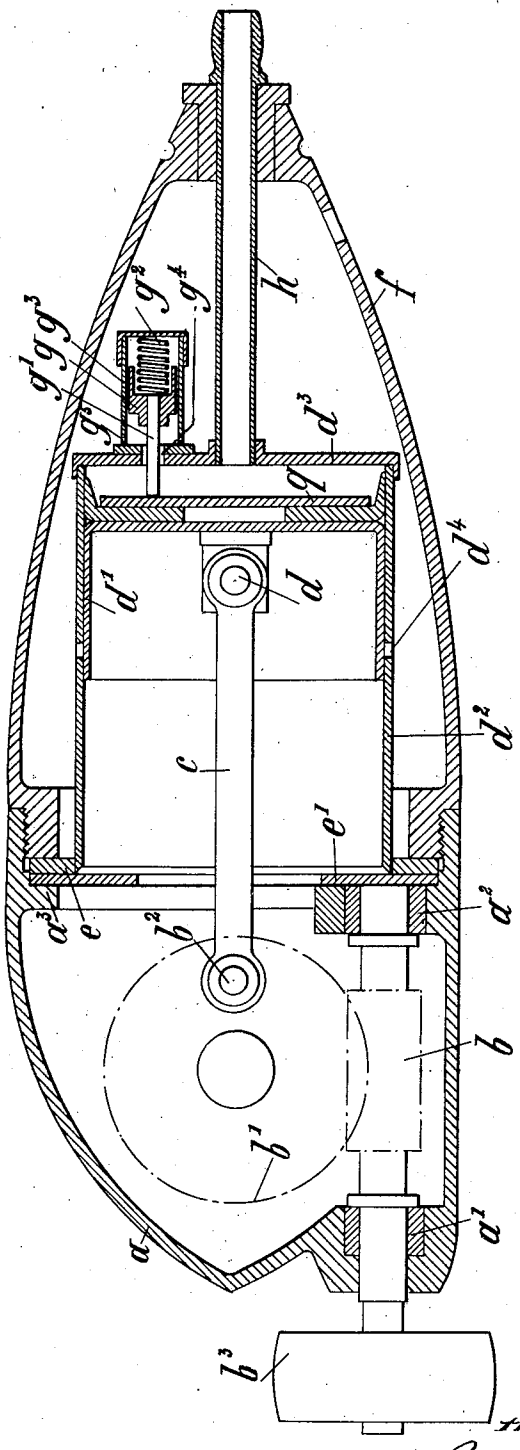
APPLICATION FILED MAR. 20, 1918.

1,405,595.

Patented Feb. 7, 1922.

2 SHEETS—SHEET 1.

Fig. 1.



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2 SHEETS—SHEET 2.

Fig. 2.

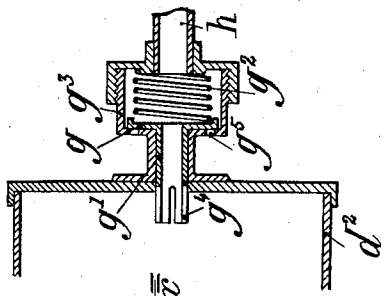


Fig. 4.

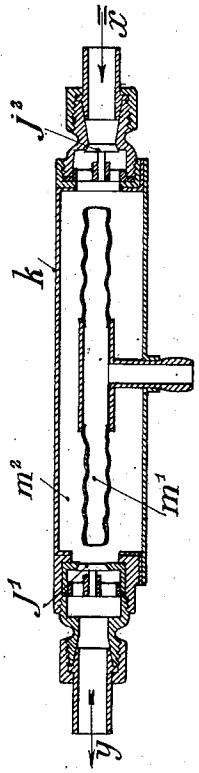


Fig. 3.

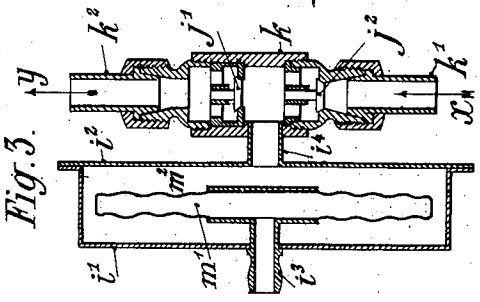
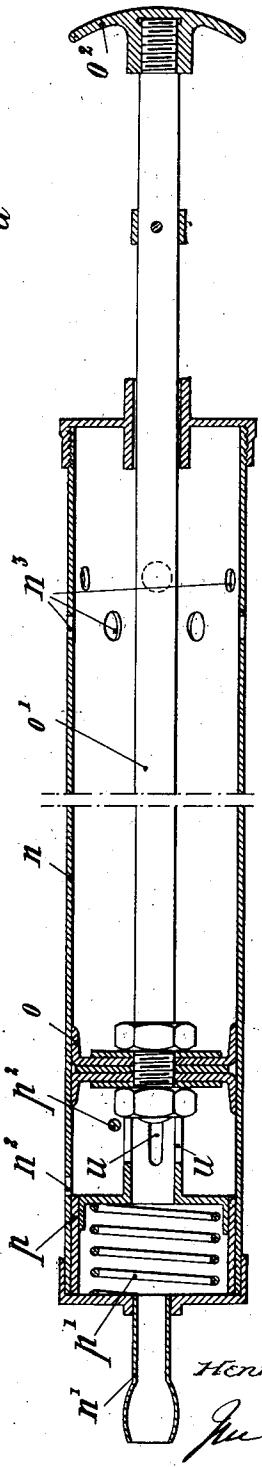


Fig. 5.



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UNITED STATES PATENT OFFICE.

HENRI KAPFERER, OF PARIS, FRANCE, ASSIGNOR TO LA SOCIETE ASTRA, OF BILLANCOURT, FRANCE, A COMPANY ORGANIZED ACCORDING TO FRENCH LAW.

LIQUID-ELEVATING APPARATUS.

1,405,595. Specification of Letters Patent. Patented Feb. 7, 1922.

Application filed March 20, 1918. Serial No. 223,585.

(GRANTED UNDER THE PROVISIONS OF THE ACT OF MARCH 3, 1921, 41 STAT. L., 1313.)

To all whom it may concern:

Be it known that I, HENRI KAPFERER, a citizen of the Republic of France, and resident of Paris, France, have invented certain new and useful Improvements in Liquid-Elevating Apparatus, of which the following is a specification.

The present invention relates to a liquid elevator essentially characterized by an air pump acting on a pulsator which separates the air space from that of the liquid and is combined with a non return valve in order to determine by the pulsations of the membrane or diaphragm of the pulsator and by the play of the clack or flap valves, the setting in motion of the liquid without any contact with the mechanical parts of the pump and under the best conditions of fluid tightness.

In the annexed drawing given by way of example only:—

Figure 1 is a longitudinal section of an air pump used in connection with a pulsator, in accordance with this invention.

Figure 2 is a longitudinal section of a portion of an air pump showing a modified non return valve.

Figures 3 and 4 illustrate two forms of pulsator pump, in accordance with this invention.

Figure 5 shows a longitudinal section of a manually operated air pump according to the present invention.

In the constructional form shewn in Figure 1, the air pump comprises a casing a in which rotates in the ball bearings a' a^2, a shaft having a worm b engaging with a worm wheel b' provided with a crank pin b^2. The crank pin b^2 is connected by a rod c to a gudgeon or trunnion pin bearing d in the interior of the piston d' in a cylindrical body d^2.

The shaft carrying the worm b is provided with a driving pulley b^3 or equivalent exterior of the casing a.

The cylindrical body d^2 comprises a flat ring e, which serves to fix it with a washer e' between an internal flange a^3 on the casing a and the circumference of a fuselage f which completes the pump. The cylindrical body d^2 is prolonged by a tube h having at the extreme end a globular or bulbous formation to which is suitably fixed the flexible hose connecting the pump to the pulsator.

An auxiliary clack valve or non return valve g provides for the restoration of the atmospheric pressure in the passage of the pump on the compression stroke. This valve g carries a rod g' and is subjected to the action of a spring g^2. It is disposed in a guide box or casing g^3 on the cover d^3 of the cylindrical body d^2 of the air pump; the valve box or casing g^3 is in communication with the air by openings g^5, and on the other side an opening $g^{4'}$, through which freely passes the rod g', allows of communication between the pump cylinder and consequently the tube h which is connected to the pulsator, and the valve box. When the valve g, under the action of the spring g^2 closes the opening g^4, the suction or compression of the air pump is directly exerted on the diaphragm of the pulsator, but when the rod g' bears on the washer q placed against the piston, which occurs about the end of the compression stroke, the valve g is forced away from the opening g^4 and atmospheric pressure is established through the openings g^5, the space between the washer q and the cover d^3 and in the tube h.

In the modification shewn in Figure 2, the valve g, under the action of the spring g^2 is slidably mounted in the tube h which connects the cylindrical body with diaphragm of the pulsator, and the tubular rod g' is provided with openings g^4 which about the end of the compression stroke places the pump body and the tube h in communication with the atmosphere, through the openings g^4 and g^5 and the clearance existing between the walls of the casing g^3 and the valve g.

The auxiliary valve limits the excess pressure at the end of the stroke and the air losses in the compression chamber of the air pump, and it always ensures at the beginning of the suction stroke, a constant volume of air, and consequently a definite and sufficient suction action on the pulsator diaphragm, whatever may be the relati-

positions of the pulsator and the lower reservoir containing the liquid to be raised.

With this arrangement the auxiliary valve, in effect, if the reservoir is lower than the valve casing of the pulsator, the depression necessary in this casing to raise the liquid, causes at the end of the suction stroke, the entry between the piston and the pulsator, of a certain quantity of supplementary air which stops the action of the pulsator.

The pulsator may be formed by a casing divided by a flexible diaphragm, into two compartments, one communicating with the air pump, the other with the liquid or column of liquid to be raised. The pulsator is preferably formed as shewn in Figures 3 and 4, by a perfectly fluid-tight aneroid metallic casing.

In the construction shewn in Figure 3, the pulsator comprises a rigid casing i' communicating by one wall and a tubular member i^4 with the valve casing k interposed in the length of the pipe x, y or passage in which the liquid rises. In the interior of the casing i' is arranged an aneroid box m' surrounded by the liquid and formed by flexible metallic walls which may be corrugated. One of the walls of this box or casing m' is provided with a tube i^3 passing fluid tightly through the adjacent wall i' of the rigid casing and to which tube i^3 is connected the induction nozzle of the air pump, the wall i^2 of the rigid casing being provided with a tube i^4, which communicates with the space between the two non-return valves j' j^2 superposed in the casing k. These two valves are arranged, the one j^2 on the end of the tube k' supported by the lower reservoir containing the liquid to be raised, the other j' on the tube k^2 connected to the upper reservoir which is to receive the elevated liquid.

In these conditions, and under the suction action of the pump, the depression which is produced in the interior of the box or casing m' determines the approach of the walls of the aneroid box in such manner that there results an increase in the capacity of the casing i' surrounding the box m', which determines the lift of the lower valve j^2 and the amount of liquid entering the space surrounding the box m' due to the variation in capacity thereof.

Before the end of the pump piston stroke, atmospheric air enters the air passage in order to neutralize the effect of the pressure, so that the walls of the box or casing m' return to their initial position, which causes the valve j^2 to close thereby retaining the quantity of liquid admitted.

On the compression stroke of the pump piston, the pressure of air which is exerted on the casing m' acts on the walls thereof in order to separate the walls one from the other, so that these walls act to compress the quantity of liquid previously admitted into the casing i' which liquid therefore passes through the valve j'. This latter valve then closes and retains the ascending liquid till the suction stroke of the pump again takes place.

In the construction shewn in Figure 4 the aneroid box m' is arranged in the interior of the valve box k, which is of suitable dimensions to contain the box m' whilst permitting of the pulsating action of the walls thereof.

The action of the apparatus shewn in Figure 4 is the same as that of Figure 3, that is to say, on the suction stroke of the pump, the box or casing m' is contracted under the effect of the depression, resulting in an increase in the capacity of the chamber k, containing the box, and this causes the opening of the valve j^2 and the admission of liquid into the said chamber. On the compression stroke of the pump, the quantity of liquid retained by the valve j^2 is compressed and the liquid is forced to ascend the pipe y through the non return valve j'.

By reason of its particular construction the aneroid box or casing m' is absolutely fluid tight, both to air and liquid.

The air pump in place of being mechanically operated may be operated by hand, a construction of this type being shewn by way of example in Figure 5.

The hand pump comprises a cylindrical body n having a tubular extension n' on the extreme bulbous end of which is fixed the flexible or other hose connecting the pump with the pulsator. In the interior of the cylindrical body is a piston o, provided with a rod o' terminating in an operating knob or button o^2, a non return valve p having a tubular extremity provided with openings u is arranged at the end of the cylinder and is subject to the action of a spring p' the displacement of the valve p being guided and limited by a stop p^2 or stops. Openings n^2 and n^3 are provided in the cylindrical body n.

The action is as follows:—

On the suction stroke the valve p under the action of the spring p' covers the openings n^2 and closes the admission of atmospheric air to the cylinder n; a reduction in pressure in the passage or passages and in the bottom of the cylinder n, and consequently in the capacity for air of the pulsator.

At the end of its stroke, when the piston o passes the openings n^3 atmospheric air enters the cylinder n and continues to do so until the piston moving in the opposite direction passes the openings n^3.

The pressure in the cylinder n then increases and consequently the air capacity of

the pulsator; atmospheric pressure is again re-established when, at or about the end of the compression stroke, the piston o acts in the valve p' so as to uncover the openings n^2.

What I claim is:—

1. In a liquid elevating apparatus, a cylinder, a piston mounted to reciprocate therein, a valve connected with the cylinder and having means to contact with the piston and be opened thereby when the piston approaches the end of its compression stroke, a conduit receiving the liquid to be conveyed, inlet and outlet check valves connected in the conduit, a shell connected with the conduit between the check valves, a flexible diaphragm arranged within the shell, and a conduit for connecting the cylinder and diaphragm.

2. In liquid elevating apparatus, a pulsator having a flexible diaphragm, an air pump arranged in a casing of stream line form, the body of the pump being connected to the pulsator by a flexible hose and being provided on the support of the said flexible hose with an auxiliary valve having a rod extending to the interior of the pump body and displaceable by the pump piston, and openings in the auxiliary valve casing adapted to place the pump body and the interior of the flexible hose in communication with the atmosphere.

3. In a liquid elevating apparatus, a cylinder, a piston mounted to reciprocate therein, an air inlet valve associated with the cylinder, a stem connected with the valve and projecting into the path of travel of the piston to be moved thereby to open the valve, a spring to move the valve in an opposite direction to close it, a liquid conveying conduit, inlet and outlet check valves connected in the conduit, a shell connected with the conduit between the valves, a flexible diaphragm arranged within the shell, a conduit connected with the cylinder and adapted for connection with the diaphragm, and means to move the piston.

4. In liquid elevating apparatus, a pulsator having a flexible diaphragm, an air pump arranged in a stream line casing; the cylindrical body of the said pump being connected by a flexible hose to the pulsator and provided at the bottom with an auxiliary non return valve having a rod actuated by the pump piston about the end of the compression stroke so as to place the body of the pump and the flexible hose connecting with the pulsator in communication with the atmosphere, the pulsator being formed by an aneroid box having thin metallic walls, flexible and capable of being contracted and expanded under the combined effects of decreased and increased pressure induced by the pump placed in the valve box and dividing this latter into two compartments, one of which communicates with the pump and the other with and between two non return valves opening and closing in the same directive sense and interposed on the length of the ascending column of liquid to be raised.

5. In liquid elevating apparatus, a pulsator having a flexible diaphragm, formed by a box divided into two compartments, one communicating with a non return valve box interposed in the length of the ascending column of liquid to be raised, a pump having a cylindrical body connected to the other compartment of the pulsator box and of which the piston abuts or strikes at the end of the compression stroke against a spring pressed valve thereby uncovering openings provided in the body of the pump which allow of the body of the pump and the flexible hose connecting it with the pulsator communicating with the atmosphere.

In testimony whereof I have hereunto signed my name.

HENRI KAPFERER.