

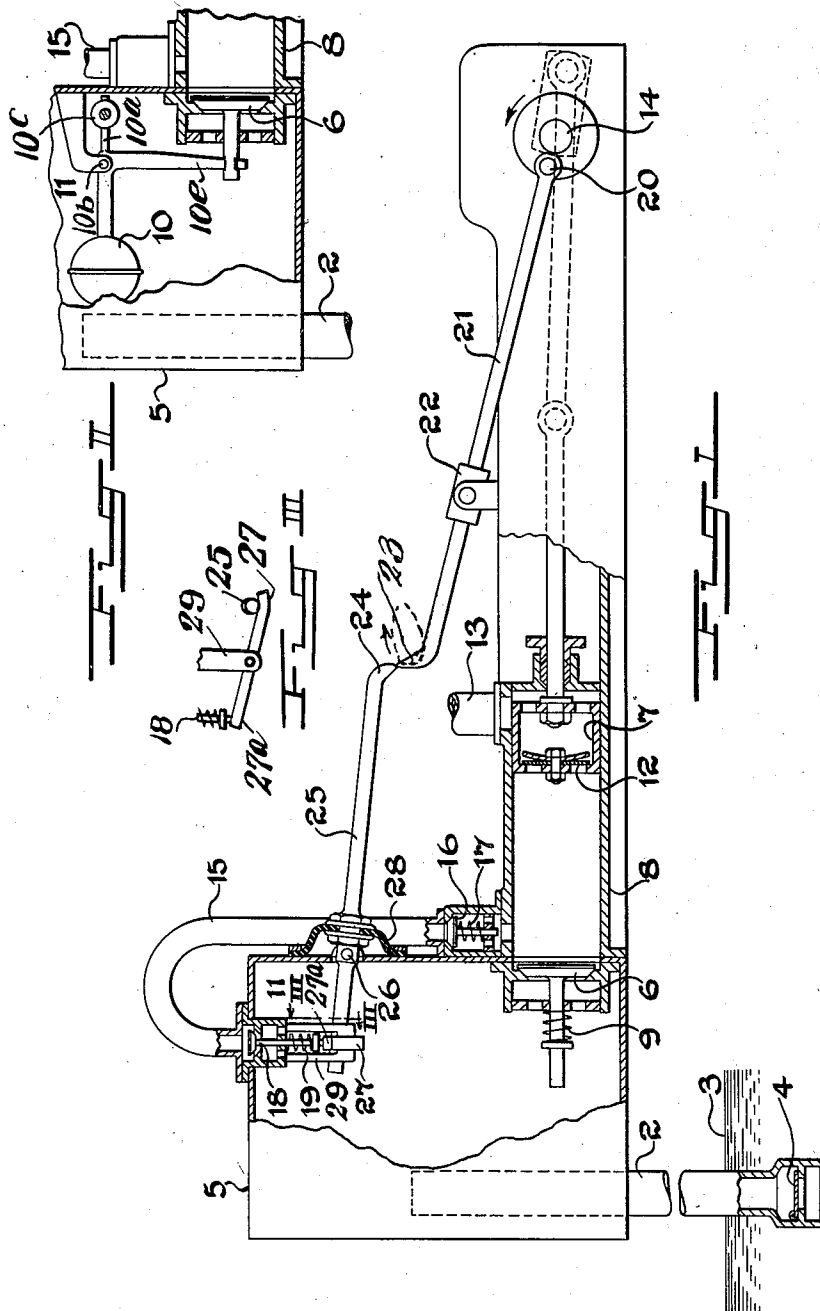
July 20, 1937.

C. N. CARDINAL

2,087,663

LIQUID RAISING APPARATUS

Filed Oct. 16, 1935



INVENTOR
CHRISTOPHER NORTH CARDINAL
BY *Haseltine, Lake & Co.*
ATTORNEYS

UNITED STATES PATENT OFFICE

2,087,663

LIQUID RAISING APPARATUS

Christopher North Cardinal, Kimberley, Union of
South AfricaApplication October 16, 1935, Serial No. 45,212
In the Union of South Africa October 27, 1934

2 Claims. (Cl. 103—1)

The present invention relates to liquid raising apparatus comprising a lift pipe through which liquid is raised by atmospheric pressure, as a consequence of vacuous conditions being set up at the upper end of the pipe.

Hitherto in liquid raising apparatus of this kind the height to which the liquid can be raised in useful quantities has been restricted by the accumulation, above the liquid column, of air separated from the liquid by the vacuum, or air injected into the column to assist its rise. The term "air" is here used to include gas or vapor generally.

It is an object of the invention to provide apparatus of the kind described, whereby the arithmetical product of the height of lift and the quantity lifted, may be increased, more particularly by increasing the height factor.

The invention consists in the combination with a vacuum lift pipe, of means to exhaust air from above the column of liquid therein, and means for discharging liquid from the upper end of the column whilst maintaining the vacuum thereat.

The means for discharging the liquid is conveniently an ordinary reciprocating pump, the inlet valve to which is situated below the usual level of the liquid column. A separate air suction outlet is provided above the liquid column level for exhausting the air. The air suction may be produced by a separate mechanism; or by the aforesaid reciprocating pump, as hereafter described.

An example of the invention according to the last-named arrangement, is shown in the accompanying drawing in which:

Figure I is a longitudinal view partly in section.

Figure II shows a modification of part of Figure I.

Figure III is a detail view sectioned on the plane III—III of Figure I.

2 indicates the lift pipe, the lower end of which extends into the pond 3 and is fitted with the usual non-return valve 4.

Its upper end extends into a closed tank 5. In the lower portion of the tank, and preferably below the upper end of the lift pipe is a non-return valve 6 permitting flow from the tank to the pump 7, 3 and fitted with a spring 9 tending to close it. The upper portion 11 of the tank is thus made to act as the chamber in which air can separate from the water column and form a body distinct therefrom.

Figure II shows a float 10 substituted for the

spring 9. Said float is mounted on one arm, 10a of a bell-crank lever which is balanced about its pivot 10b by a weight 10c adjustable along an extension 10d of said lever. The second arm 10e of the lever engages the stem of the valve 6 so that the buoyant force of the float tends to keep the valve 6 closed, but, similarly to the force of the spring 9, it can yield to superior force acting on valve 6 to permit said valve to open.

The pump cylinder 8 is conveniently arranged horizontally. The form of pump shown has a bucket valve 12 in its piston 7 and a delivery 13 at the end opposite the valve 6. The piston is driven in the direction indicated by the adjacent arrow by a crank-shaft 14 which is itself driven by any convenient source of power.

15 indicates the conduit for withdrawing air from the top of the air chamber 11. In the example shown it leads to the cylinder 8. At the cylinder end of said conduit is provided a non-return valve 16 opening towards the cylinder, and pressed to its seat by the spring 17. The tank end of the conduit is fitted with a valve 18 which is strongly held to its seat by the spring 19 and is periodically opened and closed rapidly. Mechanism suitable for thus opening and closing it, comprises an additional crank pin 20 on the crank shaft 14. To said crank pin 20 is connected a rod 21 which is so carried in a stationary support 22 that it may both slide and tilt relatively thereto. Its bent-up farther end 23 accordingly describes the elliptical path 30 in the direction indicated by the adjacent arrow and while it is rising at the left-hand end of its path it momentarily contacts with the bent down end 24 of a lever 25, and jerks up the said end 24. The lever 25 enters the tank 5 and is pivoted thereto at 26. Its inner end engages one end of a transverse rocking lever pivoted within the tank on a hanger 29. The other end of said lever 27 engages beneath the stem of valve 18. Accordingly when the end 24 of lever 25 is jerked up, its inner end similarly forces down the adjacent end of lever 27 and raises the other end thereof, thus momentarily lifting the valve 18 from its seat. An air tight joint between the tank and the lever 25 is maintained by a flexible closure 28. The closing spring 17 of the air valve 16 is relatively weaker than the closing spring 9 of valve 6, so that when vacuous conditions are set up in cylinder 8, the air valve 16 tends to open before the valve 6.

In operation, when the pump piston starts its suction stroke, that is from left to right, all the valves are closed. A vacuum is thereby produced

in the cylinder, in consequence of which and of the relative lightness of spring 17, the valve 16 is opened. The relatively small amount of air contained in conduit 15 passes into cylinder 8, and a vacuum is created in the conduit 15. As the piston stroke continues, the vacuous condition of the cylinder 8 and the pressure of water in the tank 5 combine to cause valve 6 to open and water from the tank flows freely into the cylinder 8. This free entry of water reduces the vacuum in the cylinder and allows valve 16 to close since there is insufficient pressure in the conduit 15 to keep it open. The vacuum produced in conduit 15 is thus sealed therein.

The piston then completes its suction stroke and begins to return, at about which stage valve 6 closes. Soon afterwards the valve 18 is momentarily opened by the means described above, allowing any air which has accumulated in the chamber 11 to rush into the evacuated conduit 15. Water may also flow in with the air if the quantity of air in the tank 5 is small. Said air, or air and water, passes into the pump cylinder 8 when valve 16 next opens.

As the piston makes its return stroke, the water and air in the cylinder 8 pass through valve 12 into the delivery pipe 13.

By thus withdrawing air from the top of the liquid column through a separate outlet and under high vacuum, it has been found possible to obtain a higher vacuum over the water column than if no separate air suction is provided.

I claim:

1. Liquid raising apparatus comprising a vacuum lift pipe, an air collecting chamber at the upper end of the lift pipe, air and liquid outlets from the chamber, a reciprocating pump in communication with the liquid outlet for discharging liquid therefrom, a conduit connecting the air outlet to the pump cylinder, a non-return valve controlling flow at the cylinder end of said conduit and opening towards the cylinder, a non-return valve permitting flow from the chamber to the cylinder, a valve controlling outflow from the chamber to the conduit, and means for opening the last-named valve while the other two valves are closed.

2. Liquid raising apparatus as claimed in claim 1 in which the valve controlling the pump end of the conduit and the valve permitting flow of liquid to the pump from the chamber are so biased that during the suction stroke of the pump, the former tends to open before the latter.

CHRISTOPHER NORTH CARDINAL.