J. K. SWEENY.

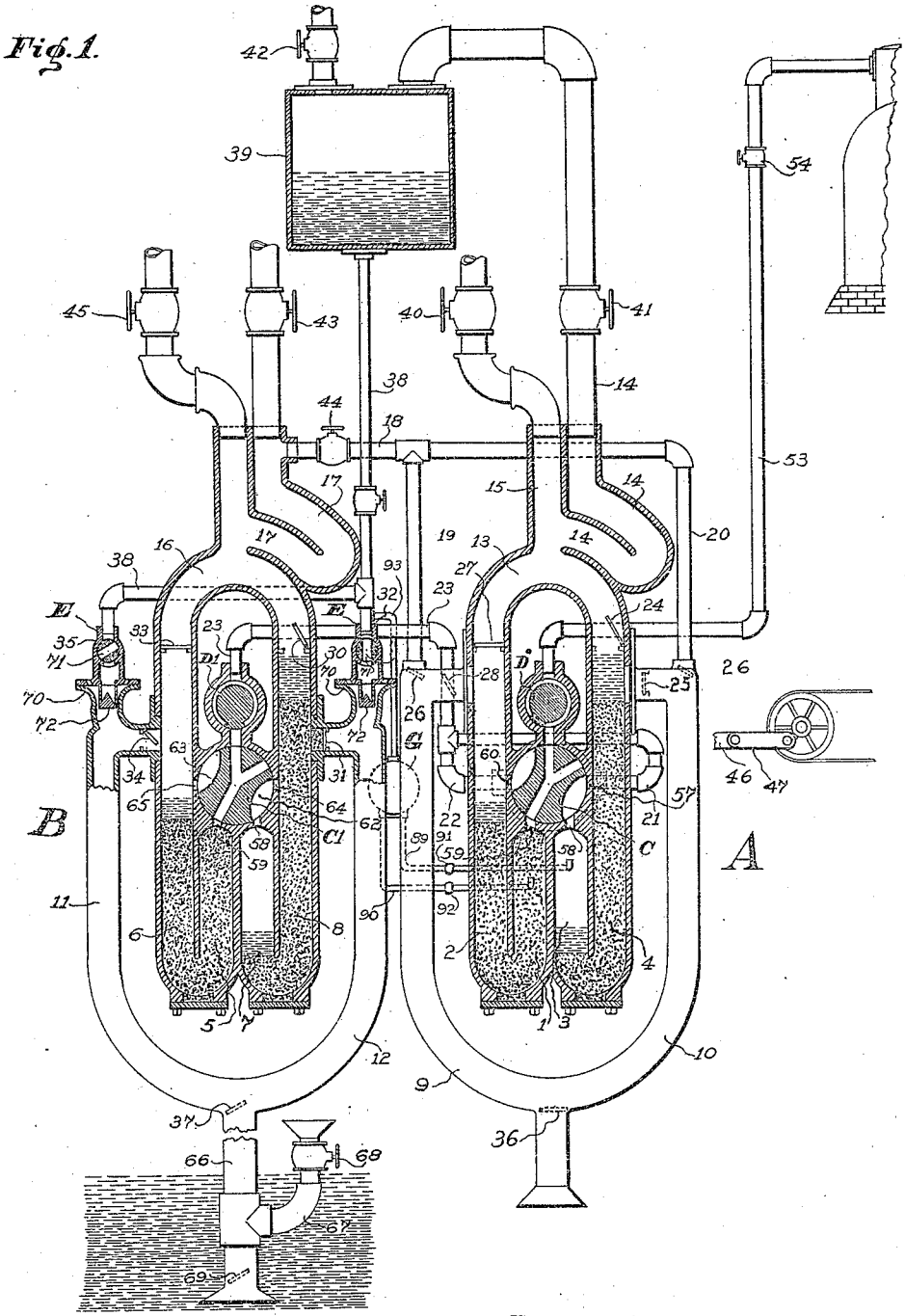
COMPOUND LIQUID PISTON AIR COMPRESSING AND PUMPING APPARATUS.

APPLICATION FILED MAY 27, 1907.

960,729. Patented June 7, 1910.

2 SHEETS—SHEET 1.

Fig. 1.



Witnesses.

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Fig. 3.

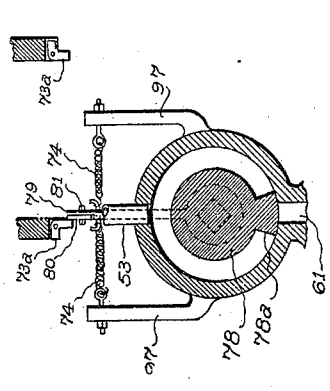
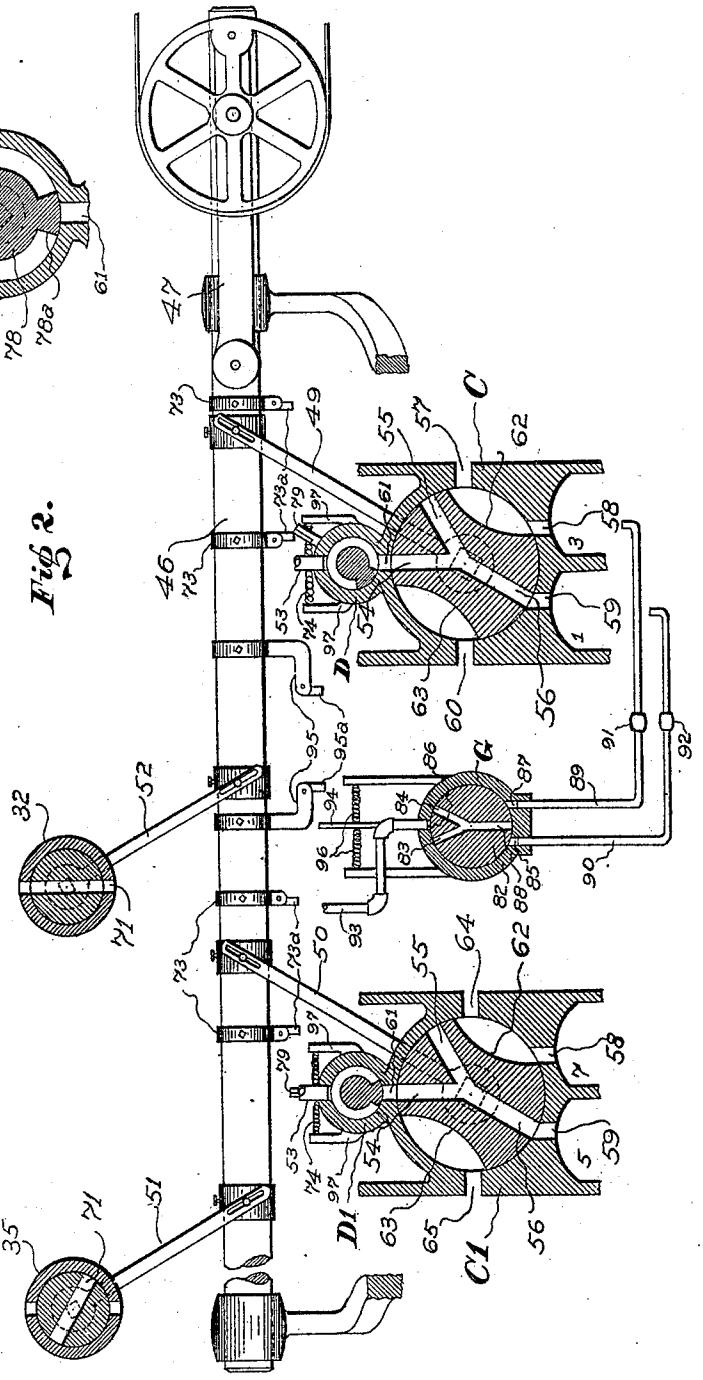


Fig 2.



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UNITED STATES PATENT OFFICE.

JAMES K. SWEENY, OF PUEBLO, COLORADO.

COMPOUND LIQUID-PISTON AIR COMPRESSING AND PUMPING APPARATUS.

960,729. Specification of Letters Patent. Patented June 7, 1910.

Application filed May 27, 1907. Serial No. 376,017.

To all whom it may concern:

Be it known that I, JAMES K. SWEENY, a citizen of the United States, residing at Pueblo, in the county of Pueblo and State of Colorado, have invented certain new and useful Improvements in Compound Liquid-Piston Air Compressing and Pumping Apparatus; and I do declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same, reference being had to the accompanying drawings, and to the letters and figures of reference marked thereon, which form a part of this specification.

My invention relates to improvements in a compound steam operated liquid piston air compressing and pumping apparatus combined, for compressing air and raising liquids, using steam as the motor fluid, as applied to a plurality of liquid pistons composed of water, mercury or other fluid for an intermediary substance, said pistons being carried from vertically disposed pressure chambers into the vertically disposed discharge or compression chambers of equal or greater length, through the unobstructed passages connecting the interiors of the two chambers at their bottoms, and which constitutes the receptacle for each piston, and into the compression chambers of the receptacles for each piston, is received the air to be compressed and the liquid to be raised, and each having suitable ports and controlled valves and means for actuating same as hereinafter fully set forth and as illustrated in the accompanying drawings in which:

Figure 1 is a vertical cross section through the compound apparatus, shown flat to simplify and clearly illustrate the interior actions of the fluids contained therein. Fig. 2 a diagram of the controlled valve operating mechanism and Fig. 3 a cross section through the governor valve.

While the apparatus may consist of a single chamber of two compartments, as here shown it consists of two duplex apparatus A, B, connected and operated together. Apparatus A receiving the operating motor fluid at a high pressure and relieves or exhausts it, expanded to a lower pressure, into the controlled valve device of apparatus B. For the purpose of simplifying and to better illustrate the working actions of the apparatus and the fluids therein, the drawing Fig. 1 represents a vertical cross section shown flat, but in actual construction is grouped more compactly, retaining however, the main features.

It is not my purpose broadly to claim an invention of a pumping device in which the pressure of the motor fluid is steam as applied to liquid pistons in vertically disposed chambers having two compartments connected in the bottoms, nor to make any claims covered by that certain patent heretofore issued to me under date of May 5th, 1908, No. 886,440, but in the description of the device herein there are certain special features and improvements which are not embodied in the said patent executed to me.

There is in each apparatus two vertically disposed pressure chambers 1 3 and 5 7, each connected at the bottom by an unobstructed passage with a corresponding vertically disposed compression chamber 2 4 and 6 8 of equal or greater length. The receptacles thus constructed have the form of inverted siphons having legs of equal or unequal length, and the receptacles are partially filled with water mercury or other suitable fluid which constitutes the pistons or intermediary substance between the motor fluid and the liquid or gas being acted upon in the compression chamber of the receptacle. The compression chambers have at their upper ends check valves 27 30 and 33 24 opening outward into the union discharge chambers 13 16 and inlet openings in the sides of the upper ends, regulated by inwardly opening check valves 25 28 and 31 34, for admitting the inflow of the air to be compressed or the liquid to be pumped, and in the sides of the upper ends of the compression chambers 6 and 8 of the low pressure apparatus B are openings 64 65 to admit the partially expanded steam from pressure chambers 5 7 through side connecting ports 62 63 of the controlling valve device C^1, which is located over the upper ends of the pressure chambers 5 7 with ports 58 59 opening into the chambers. A similar device C is located over the upper ends of pressure chambers 1 3 of apparatus A and admits and regulates charges of the motor fluid from the boiler through valve 54 and pipe 53 and governor valve D alternately into and from each pressure chamber 1 3. The ports 57 60 in the casing of the valve device C of apparatus A, open into and are connected with passages 21 22 which combine into passage 23 leading into controlling valve C^1 through

governor valve D^1, permitting the exhaust from apparatus A at high pressure to become the motor fluid of apparatus B. The branch supply pipes 11 12 extend from ports of intake valves 31 34 to a junction with main supply pipe 66 having an upward opening check valve 37 below the junction of the two pipes, and there may be a foot valve 69 in the inlet pipe 66 below the surface of the body of water.

Connected into the supply pipe, preferably below the water line, is an inlet pipe 67, the outer end extending upward above the surrounding water and having a hand valve 68 to regulate the quantity of air admitted with the water or to close the air out entirely, when the apparatus is used for pumping water only. For compressing air other inlets 32 35 are provided. These open into the tops of inlet pipes 11 and 12 and into these openings are connected combination water and air nozzles E with the air inlets 70 70 opening to the atmosphere and the water pipes 38 connecting into the bottom of receiving tank 39. The discharge from the compression chambers 6 8 of apparatus B passing through valves 30 33 enters the union chamber 16 which has an opening from the top into the air trap passages and pipes 17 which permits the air to separate from the water, or if valves 43 45 are closed the entire discharge of water and air will pass through valve 44 and passage 18 into the inlet and compression chambers of apparatus A through branch pipes 19 20 and inwardly opening check valves 26 26 and 25 28, check valve 36 preventing any escape of liquid or pressure from inlet passage 9 10, which from their position, remain filled with liquid at rest, when used in combination as shown. The union chamber 13 receives the discharge of apparatus A through check valves 24 27 as stated. It also opens from the top into vertically disposed air trap passages 14 from which extends air pipe 15 and extension of liquid passage 14 through hand valve 40 and 41 to points desired; but as shown, hand valve 40 in air pipe 15 is closed and the entire discharge passes into the receiving tank 39 through passages 14 and hand valve 41. In the tank the liquid separates from the air by its own gravity and hand valve 42 permits discharge of air as required for use.

The controlling valves of valve device C and C^1 have arms 49 50 Fig. 2, movably connected with operating rod 46 which receives a reciprocating motion from any suitable motor, cam or mechanism, through connecting rod 47. The arms 51 52 of valve 71 71 in the water pipes of combination nozzles E are also movably connected to operating rod 46. In the combination nozzles E the air inlet pipes 70 70 are enlarged to a funnel shape into which is fitted an adjustable baffle plate in the form of a cone 72 and causes the water to pass through a narrow circular opening and tends to draw the air through the opening and to reduce the temperature of the water. This will be desired to thoroughly condense the steam in the compression chambers 6 8 that has been partially condensed by the liquid piston in this portion of the casing falling through it.

To regulate the quantity of steam desired to be admitted into the expansion chambers at each charge, a cut off governor valve device D D^1, Figs. 2 and 3, is placed immediately over the inlet port 61 of each controlling valve which is also the outlet port of the governor valve, the inlet being steam supply pipe 53. The valve 78 with its cut-off element 78^a, is given a rocker movement by the dog 73^a on collar 73 which is adjustable along the main valve rocker rod 46, coming in contact with the extension blocks 80 that are adjustably attached to the valve arms 79 by set screws 81. The valve 78 is closed and held closed in a central position by any elastic means, as shown spiral springs 74 are attached to opposite sides of lever 79 in the line of its movement their outer ends being adjustably attached to support 97. The tension of the springs is ample to pull the valves to a closed central position when released by the dog 73^a and by these means the valves may be adjusted to cut off the steam intake at any part of the valve rod movement upon each reciprocation.

For the purpose of reducing or dissipating the pressure of the steam that remains in the expansion chambers 1, 3, after the exhaust port is closed and before a new charge of steam is admitted, there is an independent valve device G, Fig. 2, having an inlet port 86 at the top and two outlet ports 87 88 at the bottom, the valve 82 having ports 83, 84 and 85 through it in the form of a Y which is operated by a lever 94 and is closed and held closed by any suitable elastic means as soon as released, by either of dogs 95^a which are adjustably attached by means of collars 95, to the valve rocker arm 6, which travels in a straight line, while the valve lever is moved in the arc of a circle. By these adjustable means the valve can be opened for an instant during any portion of the travel of the rocker arm and cause a jet of water to pass from tank 39 through pipes 38, 93 and 89 or 90 alternately into expansion chambers 1, 3. Check valves 91 and 92 in the pipes may be used to prevent back flow of steam pressure. This reduction of pressure caused by the partial condensation of the steam, permits the liquid pistons to return of their own gravity into the expansion chambers, and into the compression chambers is received a full charge of air and water from the discharge chambers of apparatus B, through the connecting passages,

as heretofore described, in which the pressure has been maintained. Instead of the condensing spray, it will be evident that the same result would be accomplished by having valve G open a passage between the tops of the interiors of the expansion and compression chambers and condense the remaining steam therein, as in apparatus B. Neither of the condensing methods is necessary, if mercury is used for pistons in apparatus A and water for those in apparatus B by reason of the greater specific gravity of the mercury. From the fact that water is let into the compression chambers of apparatus B with the air to condense the steam, it will be evident that if in correct operating condition, the same amount of water should pass out of the chamber at each expulsion of air, which insures a complete expulsion of the air, at each "stroke" of the piston and a more complete vacuum when the steam is condensed. It will also be seen that the compressed air passes through water in the pipes and channels below the level of the receiving tank 39 and pipe 18, said water is kept in circulation through pipe 38, and the quantity may be added to at any time through suction pipe 66.

It will also be evident that by opening of various hand valves and closing of others, each apparatus in itself becomes a complete air compressor or pumping apparatus or both combined.

Without limiting myself to the precise construction of parts shown I claim as my invention—

1. In a liquid piston pump the combination with two pumping units each consisting of an actuating fluid receiving chamber, an air pumping chamber provided with valved inlet and outlet ports at its upper portion, the two chambers being connected at their lower portions by an unobstructed passage, and a liquid piston filling said passage and partly filling said chambers, of a supply passage for actuating fluid connected to one actuating fluid receiving chamber, a passage connecting said actuating fluid receiving chamber with the other actuating fluid receiving chamber, whereby the exhaust passage of the first is made the supply passage of the second, a passage for exhausting the actuating fluid from the second chamber, a series of valves for governing the supply and exhaust of actuating fluid through said passages and means for actuating said valves in proper order, a fluid trap connected with the outlet passage of the pumping chamber for the separation of actuated fluids having different specific gravities, a receiving tank for the storage under pressure of the actuated fluid, valve regulated inlet and outlet passages connecting the same with the pumping unit, whereby a portion of the actuated fluid may be circulated through the connected system of actuating units and passages, valved air inlet passage into the actuated fluid supply passage, for the purposes as set forth.

2. The combination in a compound liquid piston pump composed of a plurality of pumping units, each pumping unit consisting of a plurality of actuating fluid receiving chambers and a plurality of pumping chambers for the fluid to be actuated with valved inlet and outlet ports in their upper portions, each actuating fluid receiving chamber of each pumping unit being connected at its lower portion by an unobstructed passage with a corresponding pumping chamber and a liquid piston filling each of said connecting passages and partly filling each of the connected vertical chambers, of a control valve casing over the upper ends of the actuating fluid receiving chambers of each pump unit, two ports in the bottom of each of said control valve casings, passages connecting the said ports with the interiors of each of the said actuating fluid receiving chambers at their upper ends, an exhaust port in each side of the valve casing of the first pumping unit connected to a passage leading into the supply port of the control valve of the other pumping unit, a circular valve in each casing with ports through the same, said ports adapted to coincide with the ports in the valve casing, at certain positions of its movements, a recess in the sides of each of said circular valves of sufficient dimensions to overlap the supply ports of each actuating fluid receiving chamber and its corresponding exhaust port, constituting a passage between said ports, a passage connecting each exhaust port of the control valve of the second pumping unit with the interior of its corresponding pumping chamber near its vertical center, a main valve operating rod, supports for the same, a pivoted link to connect said operating rod to any motor or mechanical means that will operate to produce a horizontal reciprocating rectilinear movement of the rod in the bearings of its supports, collars, adjustable longitudinally along said operating rod and provided with lugs, slotted operating levers to connect the control valves with said lugs, adapted to actuate the same in unison to produce a rocker movement to said control valves whereby the ports therein are caused to coincide with those in their respective casings and to open each actuating fluid supply port into each actuating fluid receiving chamber while the opposite chamber is in connection with its corresponding exhaust port, alternately at each reciprocation, substantially as set forth.

3. The combination in a compound liquid piston pump composed of a plurality of pumping units, each pumping unit consisting of a plurality of actuating fluid receiv-

ing chambers and a plurality of pumping chambers for the fluid to be actuated with valved inlet and outlet ports in their upper portions, each actuating fluid receiving chamber of each pumping unit being connected at its lower portion by an unobstructed passage with a corresponding pumping chamber and a liquid piston filling each of said connecting passages and partially filling each of the said connected vertical chambers, a main valve for the control of the actuating fluid and a main valve operating rod, of an auxiliary valve connected to the main operating valve for the further governing of the supply of actuating fluid, ports in the casing of the auxiliary valve for the passage of the actuating fluid into and therefrom into the main control valve, a segment valve in said auxiliary valve casing adapted to overlap and close the outlet port in the casing when in a central position, a stem projecting beyond the casing, an adjustable lever attached to said valve stem, extending upward, adjustable elastic means attached to each side of said lever in the line of its movement adjusted to maintain said valve in a central and closed position, valve operating lugs adjustably attached to the main valve operating rod, trip dogs on the outer ends of said lugs adapted to contact with the valve lever of the auxiliary valve for a regulatable period of time, at each reciprocation, in unison with the main control valves to cause the proper coincidents of the ports of both valves at the proper periods of time to permit the unobstructed flow of the actuating fluid into or from the said actuating fluid receiving chambers, substantially as set forth.

4. The combination in a compound liquid piston pump composed of a plurality of pumping units each pumping unit consisting of a plurality of actuating fluid receiving chambers and a plurality of pumping chambers for the fluid to be actuated, with valved inlet and outlet ports in their upper portion, each actuating fluid receiving chamber of each pumping unit being connected at its lower portion by an unobstructed passage with a corresponding pumping chamber a liquid piston filling each of said connecting passages and partially filling each of the said connected vertical chambers, main and auxiliary valves for the control of the actuating fluid, a valve operating rod and an actuating fluid receiving tank of an auxiliary valve for the regulation of the passage of condensing fluid from the actuated fluid receiving tank into the actuating fluid receiving chambers, a passage connecting the bottom of the receiving tank with the inlet port of the valve, passages leading from separate outlet ports of the valve into the upper portion of each of the actuating fluid receiving chambers of the first pumping unit, check valves in said passages to prevent the backward movement of fluid therein, a circular valve in the chamber of the casing of the said auxiliary valve, ports through the valve adapted to coincide with the ports in the casing at certain positions of its movement, a valve stem projecting from the casing, an adjustable lever attached to said valve stem and extending upward, adjustable elastic means attached to each side of the said lever in the line of its movement adjusted to maintain the valve in a central and closed position, an arm adjustably attached to the main valve operating rod, a trip dog at the outer end of said adjustable arm adapted to contact with the said upright valve lever and to move the same to an open position to permit the passage of a regulatable amount of condensing fluid into each actuating fluid receiving chamber alternately at each reciprocation, substantially as and for the purposes set forth.

5. The combination in a compound liquid piston pump composed of a plurality of pumping units, each pumping unit consisting of a plurality of actuating fluid receiving chambers, and a plurality of pumping chambers for the fluid to be actuated with valved inlet and outlet ports in their upper portions, each actuating fluid receiving chamber of each pumping unit being connected at its lower portion by an unobstructed passage with a corresponding pumping chamber, a liquid piston filling each of said connected passages and partially filling each of the connected vertical chambers, main and auxiliary valves for the control of the actuating fluid, a valve operating rod and an actuated fluid receiving tank, of auxiliary valves for the regulation of the condensing fluid from the actuated fluid receiving tank into the pumping chambers of the second pumping unit through the inlet ports thereto, each of said valves consisting of a casing with inlet and outlet ports therein, pipes from the actuated fluid receiving tank into the inlet ports of each of said valves, a passage from each outlet port into the suction inlet of its corresponding pumping chamber, a valve in each casing with a port through the same, levers adjustably connected to the main valve operating rod and adapted to open each valve for a regulatable period of time when the control valve of its corresponding pumping chamber is in the exhaust position, for the purposes set forth.

6. The combination in a compound liquid piston pump of the character described of an air inlet passage into each pumping chamber, consisting of a funnel, a nozzle projecting into the funnel, an adjustable cone shaped plug in the outlet end of the nozzle to partially obstruct the same and

produce an annular orifice for the passage of liquid into the funnel in the form of a spray, for the purposes set forth.

7. The combination in a compound liquid piston pump of the character described of a pipe connected into the suction supply pipe at a point below the surface of the body of liquid to be actuated, the outer end extending above the surface of said liquid, a valve in the air inlet pipe for the regulation of the quantity of air admitted as fully set forth.

In testimony whereof, I affix my signature, in presence of two witnesses.

JAMES K. SWEENY.

Witnesses:

Mrs. R. B. SWEENY,

ALICE C. KNIGHT.