Nov. 28, 1944. M. H. LOUGHRIDGE 2,363,539

SYPHON SYSTEM

Filed March 20, 1941 4 Sheets-Sheet 1

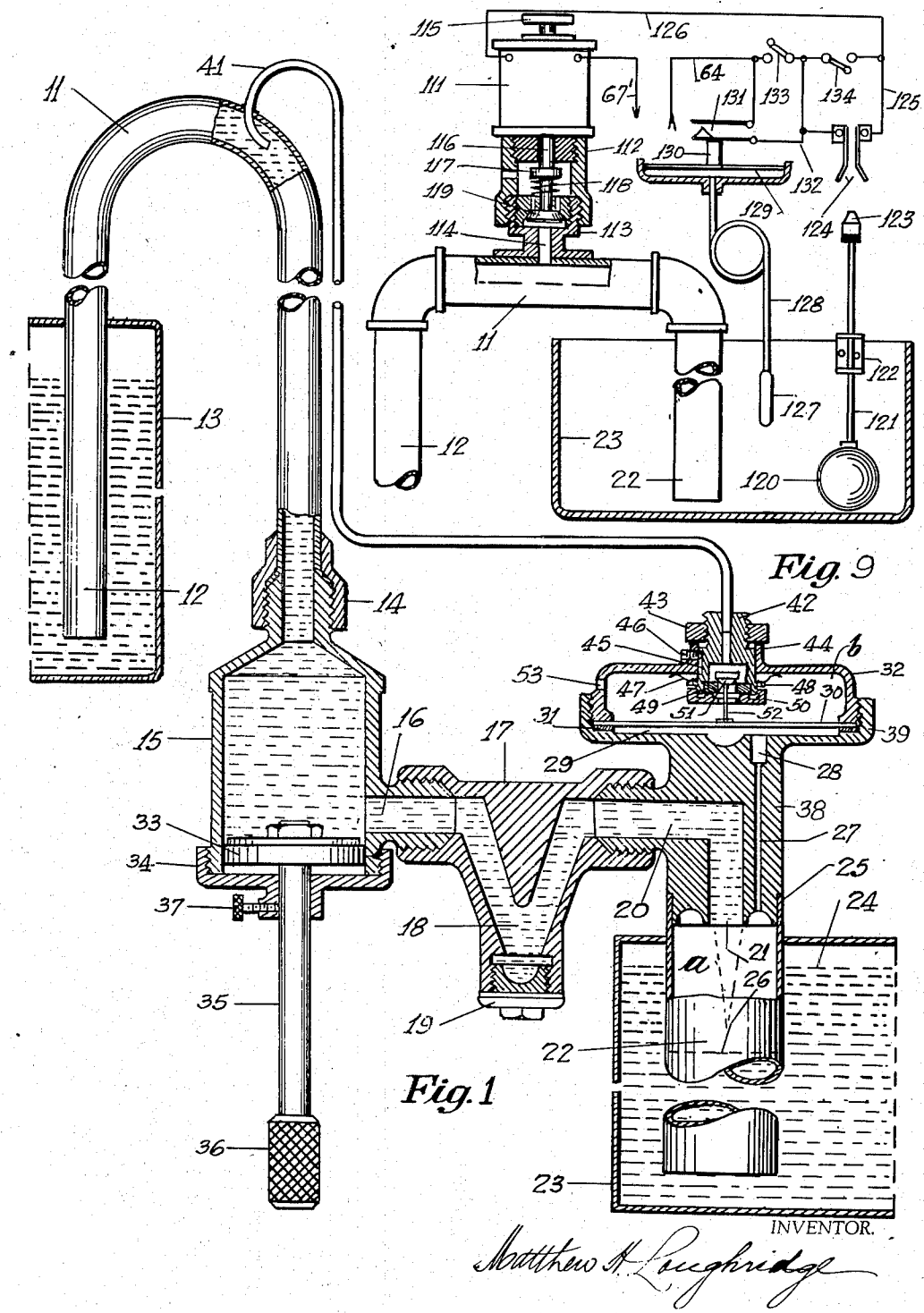


Fig. 9

Fig. 1

INVENTOR.

Matthew H. Loughridge

Nov. 28, 1944. M. H. LOUGHRIDGE 2,363,539

SYPHON SYSTEM

Filed March 20, 1941 4 Sheets-Sheet 2

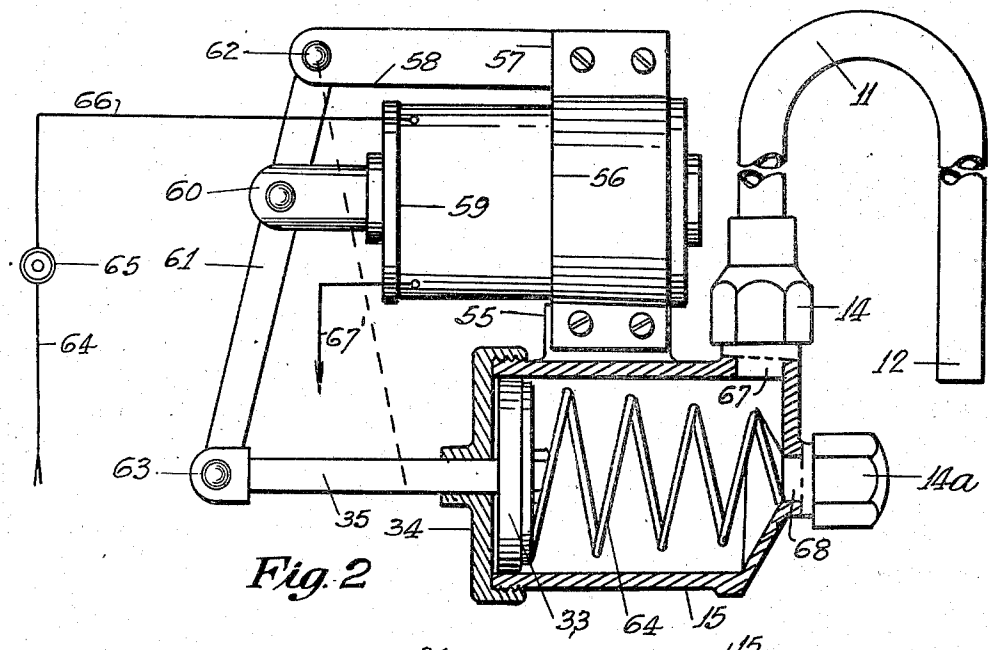


Fig. 2

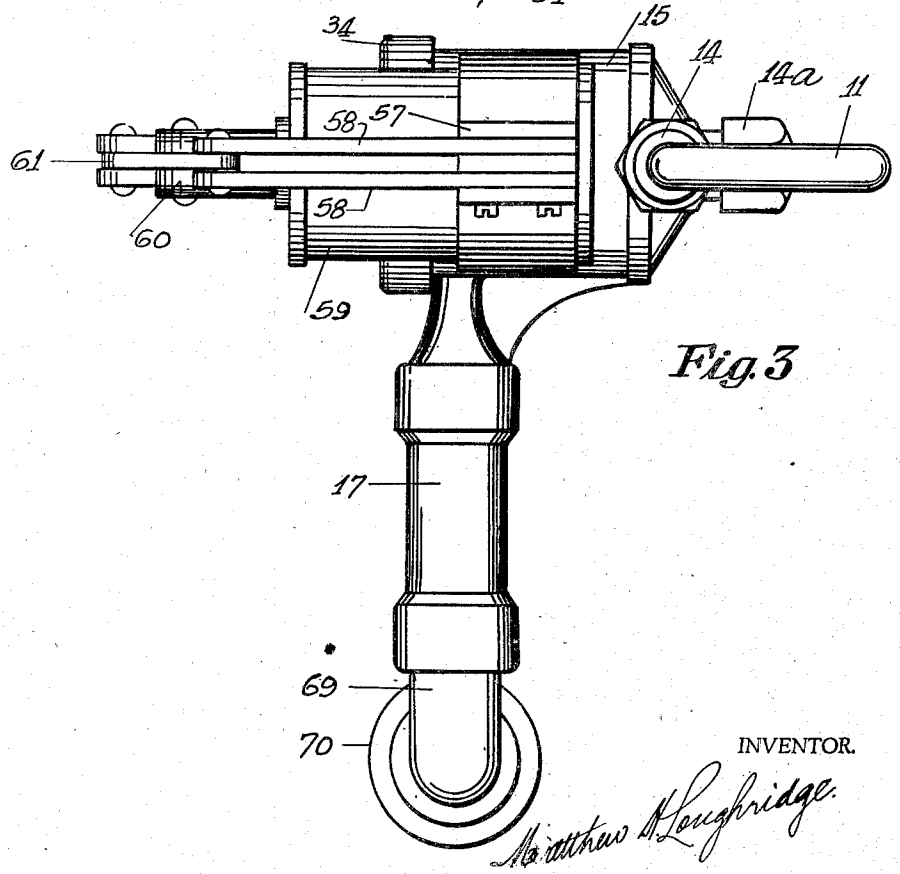


Fig. 3

INVENTOR.

Matthew H. Loughridge.

Nov. 28, 1944. M. H. LOUGHRIDGE 2,363,539

SYPHON SYSTEM

Filed March 20, 194. 4 Sheets-Sheet 3

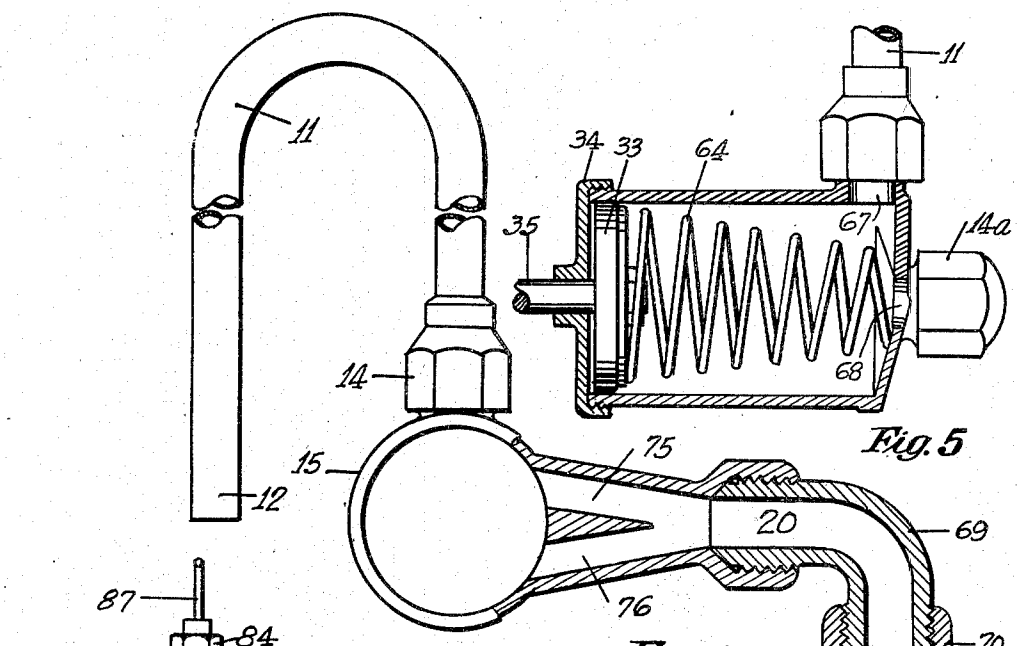


Fig. 5

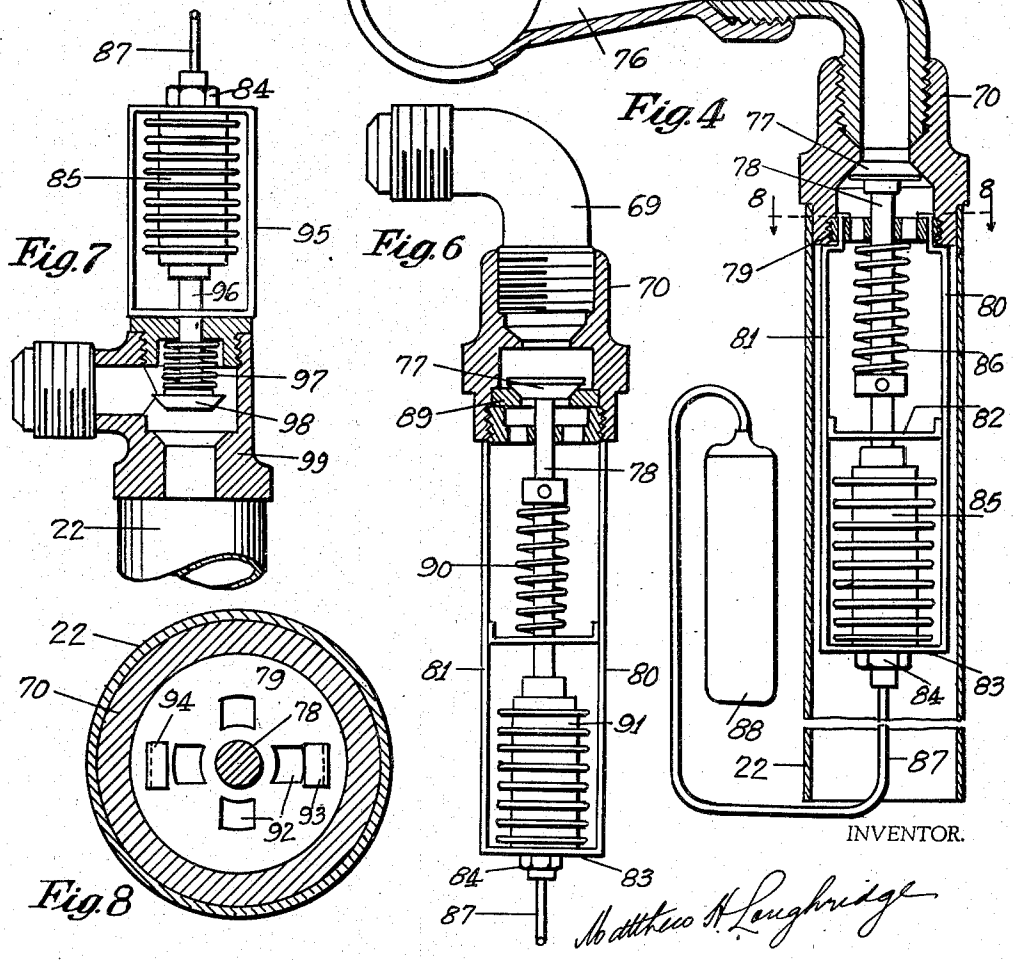


Fig. 4

Fig. 7

Fig. 6

Fig. 8

INVENTOR.

Matthew H. Loughridge

Nov. 28, 1944. M. H. LOUGHRIDGE 2,363,539

SYPHON SYSTEM

Filed March 20, 1941 4 Sheets-Sheet 4

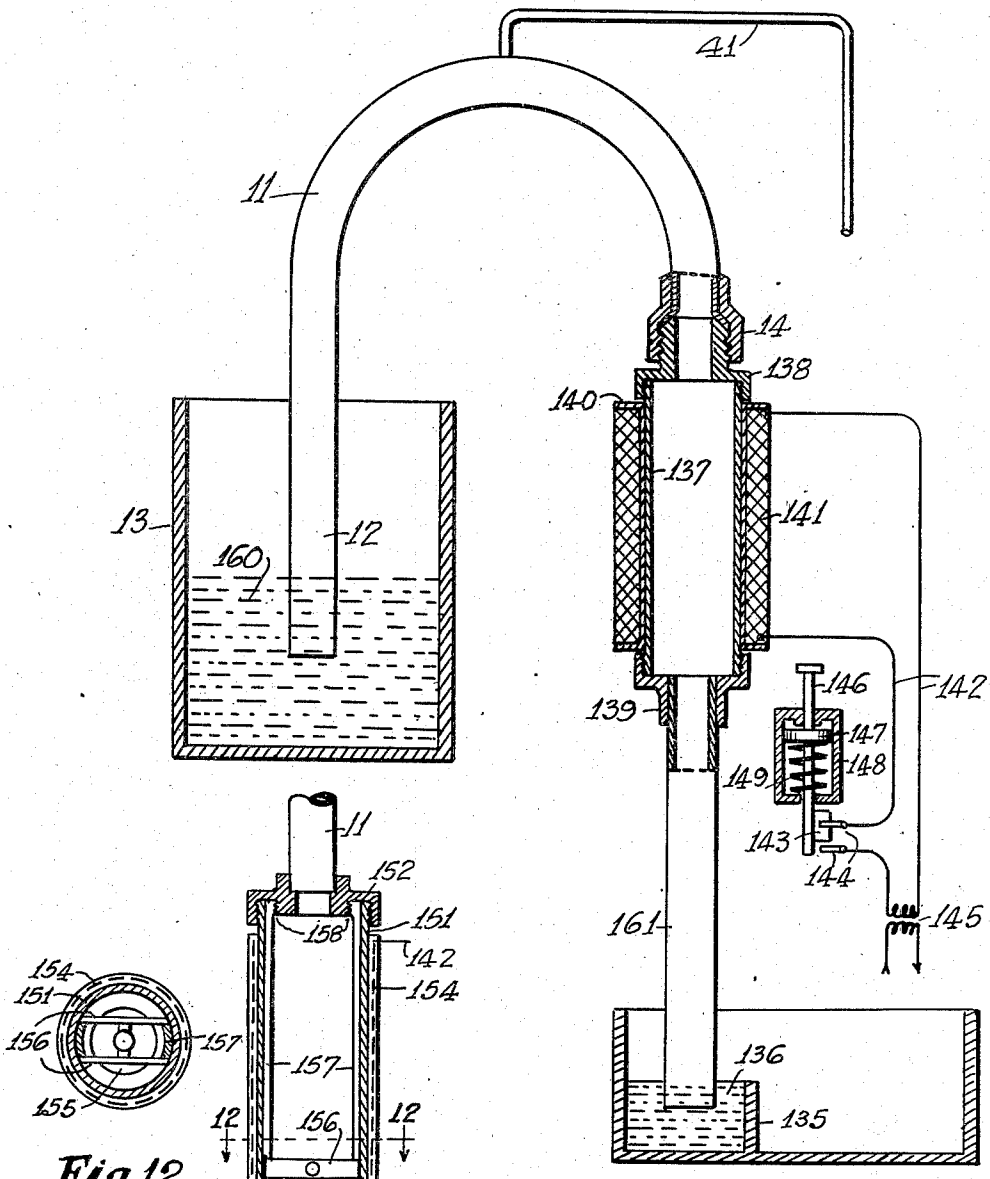


Fig. 10

Fig. 12

Fig. 11

INVENTOR.

Matthew H. Loughridge

BY

ATTORNEY.

Patented Nov. 28, 1944

2,363,539

UNITED STATES PATENT OFFICE

2,363,539

SIPHON SYSTEM

Matthew H. Loughridge, Bogota, N. J.; William R. Lockridge administrator of said Matthew H. Loughridge, deceased

Application March 20, 1941, Serial No. 384,365

6 Claims. (Cl. 137—106)

This invention relates to siphon systems and relates particularly to systems for the control of the flow of a liquid in a siphon. An object of the invention is to automatically balance the flow of the liquid through the siphon when the liquid in the discharge tank is at a higher level than the liquid in the receiving tank; another object of the invention is to provide an air bell, with or without a liquid trap, at the discharge end of the siphon for controlling the liquid flow therein; another object of the invention is to control the operation of the siphon pneumatically by the air pressure in a bell tube at the discharge end of the siphon; another object of the invention is to provide a cylinder forming part of the siphon tube adapted to be used in a vertical or in a horizontal position; another object of the invention is to operate the starting cylinder of the siphon by remote control; another object of the invention is to regulate the flow of liquid through the siphon by the characteristic of the liquid itself, and another object of the invention is to provide for control of the flow of liquid through the siphon by a bell tube applied to the discharge end of the siphon and by a valve controlled by the characteristic of the liquid itself.

Other objects of the invention will be more particularly understood from the following specification and from the accompanying drawings, in which

Fig. 1 is an elevation of a siphon, partly sectioned, showing its application for the control of flow of liquid from a tank at a higher level to a receiving tank at a lower level;

Fig. 2 is a side elevation, with the cylinder sectioned, showing the apparatus remotely operated for starting the siphon;

Fig. 3 is a top plan view of the apparatus shown in Fig. 2;

Fig. 4 is a sectional elevation of a siphone tube including a bell tube on the discharge end and a valve for controlling the discharge;

Fig. 5 is a cross section of the starting cylinder used in Fig. 4;

Fig. 6 is a vertical elevation, partly sectioned, of a valve mechanism controlling the discharge from the siphon in the reverse order from Fig. 4;

Fig. 7 is an elevation, partly sectioned, of a valve controlling mechanism, placed on top of the discharge end of the siphon, and

Fig. 8 is an enlarged section on line 8—8 of Fig. 4.

Fig. 9 is a diagram, showing a valve mechanism in section for breaking the siphon and electrically controlled.

Fig. 10 shows, in section, the application of an electric coil and a time controlled circuit controller for starting the siphon;

Fig. 11 is another modification shown in section of the application of an electric heating coil for starting the siphon, and

Fig. 12, is a cross section on line 12—12 of Fig. 11.

Siphons are commonly used for the flow of the liquid from a higher to a lower level. The rate of flow, or head, of the siphon depends upon the difference in level between the discharge tank and the receiving tank. When the liquid level in the receiving tank rises to the same height as the liquid level in the discharge tank the siphon is balanced and the flow ceases, but the flow will be resumed again if the liquid level in either tank is raised above the level in the other tank. In the present invention the siphon is balanced without raising the level of the liquid in the receiving tank to the same height as the level of the liquid in the discharge tank. This is secured by applying a "bell" tube on the discharge end of the siphon so that as the liquid level rises in the receiving tank and surrounds this tube the air pressure within the tube is gradually increased, opposing the flow of the liquid and reducing the rate of flow until ultimately it is stopped. The position, or height, of the liquid in the receiving tank at which the flow stops depends mainly upon the head of the siphon and upon the length of the bell tube in which the air pressure is generated by the rising liquid. This position can readily be determined so that, if the liquid level in the discharge tank is kept fairly constant, the level to which the liquid will rise in the receiving tank can be predetermined and an overflow in the receiving tank avoided.

When the flow of the liquid through the siphon is balanced, it can be started again by increasing the height of the liquid in the discharge tank or by lowering the level of the liquid in the receiving tank so that the system can be used to automatically replace liquid drawn off from the receiving tank.

When the liquid flow through the siphon reaches a position of balance and the level of the liquid in the receiving tank is raised by agitation or otherwise, this will tend to break the siphon and in order to stabilize the operation on account of this condition and also to prevent the air from escaping that is confined in the bell tube, a liquid trap is inserted in the siphon above the bell tube.

The flow through the siphon may be controlled by the bell tube alone, or the air compressed in

this tube may be arranged to operate a valve that will admit air to the highest point of the siphon and thereby break the siphon.

Any known means may be used to start the siphon but in the drawings a starting cylinder is placed in the siphon tube and used for this purpose. This cylinder may be located with its axis vertical or it may be located with its axis horizontal, by changing the siphon connections. The plunger of the cylinder may be operated manually for starting purposes, or it may be pushed into the cylinder and held in this position to stop the flow through the siphon. When the siphon is to be started by remote control a solenoid magnet is mounted on top of the cylinder and the plunger of this magnet is used to operate the plunger in the cylinder against a spring so that momentarily closing the circuit of the magnet starts the siphon.

In some applications it is necessary not only to control the quantity of the liquid that flows into the receiving tank, but also to control the flow with reference to the characteristic of the liquid, such, for instance, as heat, cold, specific gravity, etc. For this purpose the bell tube may be used on the discharge end of the siphon to control the quantity of flow and a bellows controlled by a bulb located in the liquid may be used to operate a valve controlling the orifice of the siphon.

The flow of the liquid through the siphon may be remotely controlled by an electro-pneumatic valve arranged to admit air to the high point of the siphon tube, thereby breaking the siphon. This control may be operated cooperatively by the quantity of the liquid in the receiving tank and by the character of this liquid.

The balanced siphon was shown in application, Serial No. 223,514, as filed August 6, 1938, now Patent 2,242,401, May 20, 1941.

In the drawings, 11 is the siphon tube with the receiving end 12 located in the discharge tank 13. This tube is connected by the flare nut 14 to a nipple on the end of the cylinder 15. Through the cylinder the siphon is continued by the nozzle 16 and trap 17, having the liquid pocket 18 which is accessible through the cap screw 19 and from the trap the siphon is continued at 20 to the discharge orifice 21 where it discharges into the space *a* in the bell tube 22, located in the receiving tank 23. Tube 22 is secured to the head 38 as indicated at 25, either by soldering or other construction which makes an air-tight connection.

When the liquid rises to the level indicated at 24 it rises to a position corresponding with line 26 in tube 22, compressing the air in space *a*. This air pressure, gradually increases as the liquid rises, thereby reducing the flow through the siphon until a condition of balance is established and the flow ceases. This condition of balance normally remains intact until the liquid level at 24 is lowered, or until the liquid level in 13 is raised, when the normal flow of the siphon is again resumed until the liquid level at 24 again balances the flow of the siphon. In order to prevent escape of the air compressed at *a* through the horizontal tube 20 and past the starting cylinder, the trap 18 is provided to increase the stability of the system.

The siphon is started by the piston 33 in the cylinder 15, held in place by the cap 34 and operated by the plunger 35, through the handle 36. One stroke of the plunger is sufficient to exhaust the air from the siphon tube and start the siphon. The plunger 35 may be locked in the raised position by the screw 37, thereby stopping the flow through the siphon. The plunger 35 and handle 36 may be weighted sufficiently to move the piston 33 downwards after it has been raised so that the comparatively slow movement of the plunger downwards will start the siphon flow.

In addition to controlling the flow through the siphon by the bell tube 22, it may be further controlled so as to break the siphon in case of emergency or for other reasons. In this case the vent pipe 41 is connected to the top of the siphon tube and is connected to the stem 42 which slides in the aperture at 44 of the cover 32. For this purpose a spline is formed in 42 at 45 and is engaged by screw 46 so that the nut 43 on stem 42 can be used to raise or lower this stem against the flat spring 47 which engages the collar 48 on stem 42. A valve seat 49 is clamped to the stem 42 by the clamping nut 50 and the valve 51 connects by stem 52 with the diaphragm 30. The diaphragm 30 is seated on a gasket 31 and is clamped between the cover 32 and the orifice 39 of the chamber 29 which connects through the passage 27 with the air chamber *a* in the bell tube 22. This passage may be closed at 28 when this part of the mechanism is not used.

When the air pressure in *a* rises to a predetermined value, determined by the adjusting nut 43, it acts upon the diaphragm 30 and unseats valve 51, permitting air, which enters the chamber *b*, through the orifice 53, to enter tube 41 and thereby stop the siphon.

When the liquid trap is not required a straight nipple may be used to connect the cylinder with the discharge head 38.

In Fig. 2 the cylinder 15 is shown in the horizontal position in which case the aperture 67 connects by the flare nut 14 with the siphon tube 11 and the end aperture 68 is closed by the cap nut 14*a*. When the cylinder is placed in the vertical position, the cap nut 14*a* is used to close the orifice 67 and the siphon tube is connected to the orifice 68. When the cylinder is used horizontally the connection to the discharge head 38 is turned through 90° from the position shown in Fig. 1, otherwise no change is necessary in adapting the cylinder for use in either the vertical or horizontal position.

The cylinder 15 is provided with a retriever spring 64 engaging the piston 33 and a rib 55, at the top of the cylinder, by means of bracket 56, clamps the solenoid magnet 59 and clamps the arm 58 at 57 in operative relation to the cylinder. The lever 61 is pivoted at 62 to arms 58 and is pivoted to the plunger 60 at the solenoid magnet 59 and is pivoted at 63 to the plunger 35 of the cylinder 15, so that when the circuit from the energy wire 64, through switch 65, wire 66 and return wire 67' to energy is closed, the plunger 35 is forced against spring 64 to the position indicated by the dotted line and, as soon as the circuit of magnet 59 is interrupted, the plunger 35 is projected by the spring, the air is exhausted from the cylinder and the siphon starts. This is a matter of convenience that has considerable utility in supplying oil, for instance, from a reserve tank to an operating tank. An elbow 69 is screwed into the trap 17 and is provided with an air bell at 70 to control the flow.

The application in Fig. 4 shows the elbow 69 connecting the passage 20 with the passages 75 and 76 leading to the cylinder 15. The passages 75 and 76 are smaller than the passage 20 and do not take up as much of the vertical height of the cylinder as would be required for the passage 20, while the two passages have the same capacity as

the passages 20. The end of the elbow 69 has a screw head 70 applied thereto which is recessed to receive the end of the bell tube 22. A seat is provided in 70 for the valve 77, mounted on stem 78 which is connected with the bellows 85 and guided by the cross brace 82 in the frame 80, 81. The bellows 85 are secured at 84 to the end 83 of the frame and a tube 87 connects the bellows with the bulb 88 which is placed in the liquid. The coil spring 86 normally holds valve 77 open and the bellows 85 operate in opposition to this spring to close the valve. The stem 77 passes through the disc 79, screwed into the head 70 and having apertures 92 for the flow of the liquid in the siphon. This disc is also provided with apertures for the side 80 and the side 81 of the frame, which sides are bent over as indicated at 93 and 94 in Fig. 8 in assembly. This enables the entire valve mechanism to be removed from the head 70 by unscrewing the disc 79 when it is not required. In this arrangement the flow through the siphon is restricted as the air pressure in the bell tube increases; it is also restricted and may be stopped entirely as the bulb 88 responds to the controlling characteristic of the liquid.

The application in Fig. 6 shows a valve 77 on valve seat 89 controlling the discharge orifice of the siphon. In this application the spring 90 tends to hold the valve 77 open and the bellows 91 operating against the spring 90 tends to hold the valve closed, subject to the control by tube 87.

In Fig. 7 the frame 95 is mounted on top of the discharge head 99 and the bellows 85, through the stem 96, connects with the valve 98 and operates this valve in opposition to the coil spring 97 in accordance with the control that is connected with the tube 87 of the bellows.

This invention may be used as a simple siphon device indicated in Fig. 1, which has no moving parts except the starting plunger and which automatically controls the flow of liquid through itself by the bell tube. To this may be applied the control to break the siphon. With the bell tube control the valve control as indicated in Figs. 4 and 6 may be applied or the valve control for the discharge orifice of the siphon may be applied by itself.

In the diagram in Fig. 9 an electro-pneumatic valve 111 is used to control the vent 114 at the top of the siphon tube 111. This valve, through the mounting 112 is connected to the vent 113 and is provided with an armature 115, having a stem 116 which engages the head 117 and depresses valve 119 against spring 118 so that when the magnet 111 is energized valve 119 is open and the siphon tube is vented to break the siphon. Magnet 111 is controlled from the energy wire 64 through contact 131, controlled by diaphragm 129 and stem 130, wire 132, contact 124 established by 123, wire 125 and wire 126 to magnet 111 and return to energy by 67'. The float 120 in tank 23, by stem 121, moving in guide 122 establishes the circuit between 123 and 124. Bulb 127, when the liquid rises in tank 23 to reach this bulb, through pipe 128, raises diaphragm 129 to close the circuit at 131. The controller 131 and the controller 124 are connected in series so that when both of these controllers are operated at the same time, magnet 111 is energized, but when either one is energized and the other deenergized the magnet remains deenergized. When desired, controller 131 may be shunted by the manually operated switch 133 and controller 124 may be shunted by the manually operated switch 134. The electric controlled valve for breaking the siphon provides a ready means for stopping the siphon flow from any remote point.

The siphon shown in Figs. 10, 11 and 12 is started by the direct application of an electric current. In the application shown the electric current is used to heat the air in an expanded portion of the siphon tube which is sealed at both ends, and one of the seals is a liquid seal or is of the type that will release the pressure in the siphon tube. The electric current may be applied, as in Fig. 11, to the heating coil which heats the siphon tube and thereby expands the air, or it may be applied inductively when alternating current is used, so that the eddy currents generated in the portion of the siphon tube subject to the inductive influence operates to heat the air in the tube. The heated air expands and bubbles out from the end of the tube immersed in the liquid, thereby reducing the air in the siphon tube so that when the heating effect is removed and the tube cooled, the subnormal pressure in the siphon tube permits the siphon to start. The circuit of the electric coil may be controlled by a time switch which maintains the heat for a predetermined interval sufficient to start the siphon.

In Fig. 10 the receiving tank is provided with the pilot tank 135 from which the liquid 136 overflows and which maintains the end 161 of the siphon tube normally closed by the liquid 136. The receiving end of the siphon tube 12 is immersed in the liquid 160 in the tank 13 so that both ends of the tube are normally sealed. The siphon may be controlled by the control pipe 41.

The siphon tube 11 is provided with the expansion chamber 137, connected by a screw head 138 and nipple 14 to pipe 11 and by the bottom screw head 139 to the pipe 161. The chamber 137 is surrounded by a spool 140 upon which the coil 141 is wound and by circuit 142 switch controller 143 and contacts 144 the coil 141 is energized by transformed 145.

The switch controller 143 is time controlled by the plunger 147, operating in the dash pot 148, against spring 149 and operated by the stem 146. When the stem 146 is depressed the circuit is established at 144 and coil 141 is energized from the source 145. The electric energy in coil 141 heats the walls of the expansion chamber 137 and thereby heats the air in the siphon tube which air is sealed in this tube but may escape through the liquid at either end. This heating process is stepped up until sufficient air is exhausted from the tube so that upon cooling the siphon will be started. The time necessary to secure this result may be obtained by the dash pot control of 143 which slowly restores to the open circuit position under the action of spring 149.

The construction in Figs. 11 and 12 correspond to Fig. 10, except that a valve is used to close the lower end of the expansion chamber under the action of the heat from the electric coil and after the valve is closed the air is heated and expanded from the siphon.

This comprises a head 152 into which the tube 151 is screwed at the top and a corresponding head 153 into which the lower end of tube 151 is screwed. This tube makes the expansion chamber of the siphon and is surrounded by the heating coil 154 which is connected to a suitable source of electric current. Screwed to the head 152 at 158 are the arcuate legs 157 sliding within the tube 151 and preferably in contact with this tube. These legs are connected at the bottom by the crossbars 156 and are linked at 158 with the

valve 155 which closes the lower end of the siphon tube.

The legs 157 are secured at the top only and are free to slide within the tube 151. These legs are made of a material which has a much greater coefficient of expansion than the tube 151, for instance, the tube 151 may be made of iron and the legs 157 may be made of copper, so that the copper legs expand much more rapidly than the tube 151 and thereby close the valve 155 by the initial heating of the coil, after which the coil operates to heat and expand the air in the siphon tube. The release of the air starts the siphon and the liquid from tank 13 accelerates the cooling of the legs 157 which opens the valve 165 and permits the siphon to flow after the current has been disconnected from coil 154.

This type of starting mechanism may be used on siphons except those where heat cannot be applied to the siphon tube.

Having thus described my invention, I claim:

1. In a siphon system an upper tank containing a liquid, a receiver tank, a siphon tube connecting said tanks for the flow of the liquid and a bell on the discharge end of said siphon and sealed as the liquid rises in the receiver tank, whereby the air pressure in said bell opposes the flow of the siphon.

2. In a siphon system an upper tank containing a liquid, a receiver tank, a siphon tube connecting said tanks for the flow of the liquid and a bell on the discharge end of said siphon and sealed as the liquid rises in the receiver tank whereby the air pressure entrapped in said bell balances the flow of the siphon and maintains a predetermined level of liquid in the receiver tank.

3. In a siphon system, an upper tank containing a liquid, a receiver tank, a siphon tube connecting said tanks for the flow of the liquid, a bell tube on the discharge end of said siphon and sealed as the liquid rises in the receiver tank to balance the flow of the siphon by the air pressure entrapped in said bell and a liquid trap connecting said siphon tube with said bell tube.

4. In a siphon system an upper tank containing a liquid, a receiver tank, a siphon tube connecting said tanks for the flow of the liquid, a bell tube on the discharge end of said siphon and sealed by the liquid in the receiver tank to retard the flow of the siphon by the air pressure in the bell and an air seal connecting said siphon tube with said bell tube.

5. In a siphon system, an upper tank containing a liquid, a receiver tank, a siphon tube connecting said tanks for the flow of the liquid, a bell on the discharge end of said siphon and sealed by the rise of the liquid in the receiver tank, and translating means operated by the air pressure in said bell.

6. In a siphon system, an upper tank containing a liquid, a receiver tank, a siphon tube connecting said tanks for the flow of the liquid, a bell on the discharge end of said siphon and sealed by the liquid in the receiving tank, and means whereby a predetermined air pressure in said bell balances the flow of said siphon, and translating means connected with said bell and operated by said air pressure.

MATTHEW H. LOUGHRIDGE.