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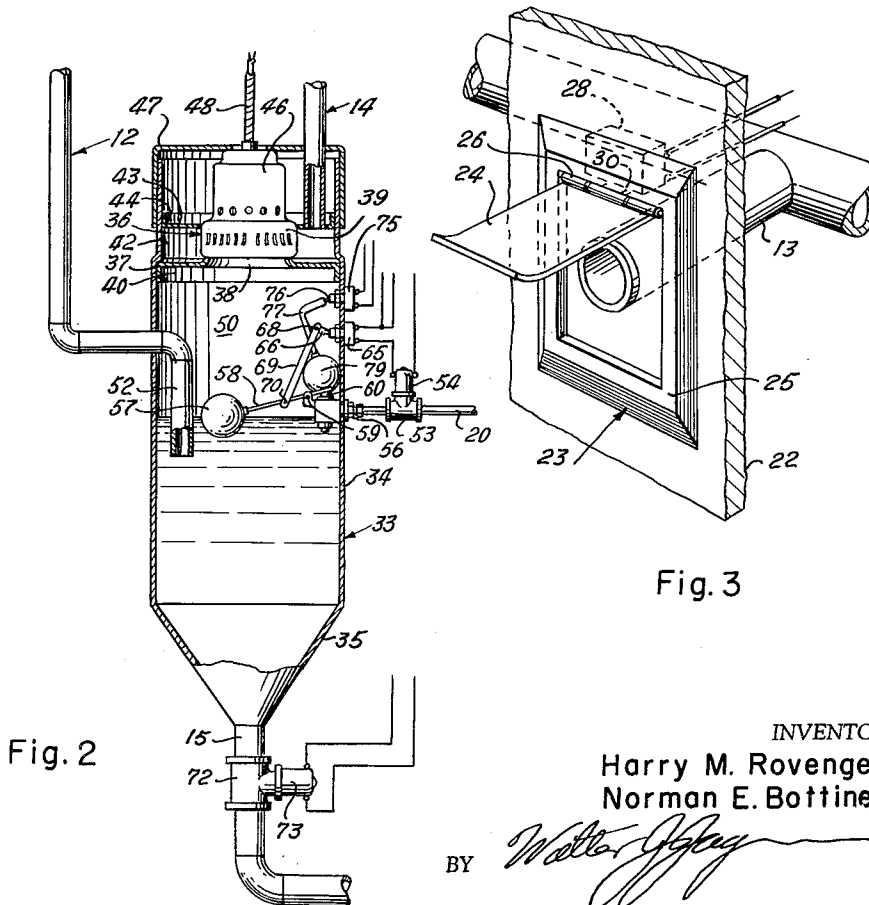
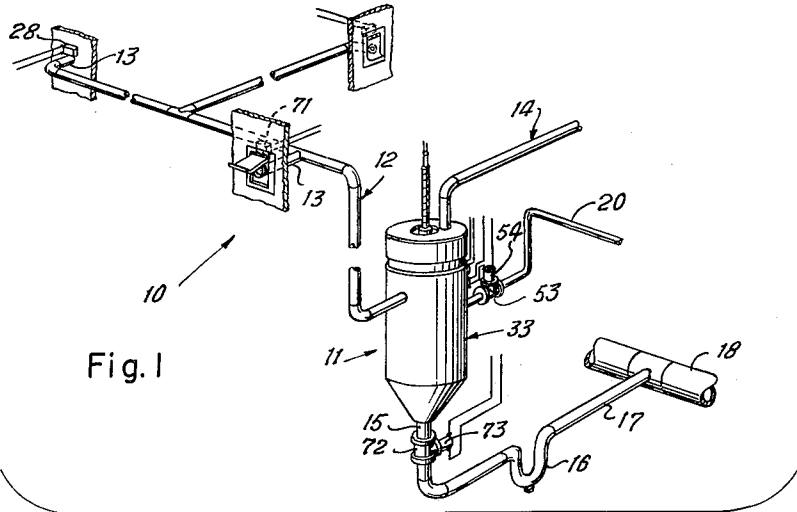


Fig. 3

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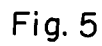
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2 Sheets-Sheet 2



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1

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PNEUMATIC SYSTEMS

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This invention relates to pneumatic systems and more particularly to pneumatic systems for building structures usable for the cleaning of the structures or the operation of pneumatic tools.

An object of this invention is to provide a new and improved pneumatic system for building structures having a central vacuum producing device provided with inlet conduits opening into selected areas whereby vacuum operated cleaning devices may be connected to the system at such areas and be operable by the central vacuum device to remove the dirt from such areas.

Another object is to provide a vacuum cleaning system wherein the central vacuum device draws air through the inlet conduits and expels it outwardly of the building after drawing the dirt laden air through a body of water which separates the dirt from the air.

Still another object is to provide a vacuum cleaning system wherein the central vacuum device has a closed chamber, means for automatically filling the chamber to a predetermined level with water upon the initiation of operation of the cleaning system, and means for discharging the water upon the completion of the cleaning operation.

A further object is to provide a vacuum device having a closed tank or chamber in which a body of water may be retained, an inlet opening into the chamber below the top surface of the body of water and an outlet disposed above the top surface of the water, an air blower means for drawing air through the inlet and expelling it through the outlet and an outlet for permitting drainage of the water from the chamber.

A still further object is to provide a vacuum cleaning device having electrically controlled means for regulating the level of the water contained in the tank and for permitting flow of water through the drain outlet upon the completion of the cycle of operation of the cleaning system.

A still further object is to provide a pneumatic system having means for reversing the flow of the air between the air inlet and the air outlet when the chamber is empty of water to provide compressed air for the operation of pneumatically powered tools.

Additional objects and advantages of the invention will be readily apparent from the reading of the following description of devices constructed in accordance with the invention, and reference to the accompanying drawings thereof, wherein:

FIGURE 1 is a perspective diagrammatic view of a pneumatic system embodying the invention;

FIGURE 2 is a vertical partly sectional view of the vacuum device of the pneumatic system illustrated in FIGURE 2;

FIGURE 3 is an enlarged fragmentary perspective view of one of the branch inlets of the pneumatic system illustrated in FIGURE 1;

FIGURE 4 is a vertical partly sectional view of a modified form of the central vacuum device embodying the invention; and,

FIGURE 5 is a schematic diagram of the control circuit for operating the pneumatic system embodying the invention.

Referring now particularly to FIGURES 1 through 3 of the drawing, the pneumatic system 10 includes a

2

central vacuum device 11 having an inlet conduit 12. The inlet conduit has a plurality of branch inlets 13 which are disposed at spaced locations in the building structure and which open into desired areas of the building structure. The central vacuum device 11 also has an air conduit 14 which may extend to the exterior of the building structure or to any desired discharge point. The vacuum device 11 also has a drain conduit 15 which is connectible through a trap 16 and a drain pipe 17 to the sewer pipe 18. Water is introduced to the vacuum cleaning device 11 through a water supply pipe or conduit 20 which is connected to any suitable source of water under pressure.

The inlet branches 13 each extend through a suitable aperture in a wall 22 of the building to which is secured a closure device 23. Each closure device has an upwardly swinging plate 24 hingedly secured, as at 26, to the rectangular frame 25 of the closure device. A switch 28 is secured to the interior surface of each wall adjacent the plate 24 whereby it is actuated from open to closed position by a lever 30 which is actuated by the plate when the plate is moved to the fully open position illustrated in FIGURE 3.

Referring now particularly to FIGURE 2, the central vacuum or cleaning device 11 includes a tank 33 having a cylindrical vertical wall 34 to whose lower end is secured the conical bottom portion 35 whose lower end is connected to the drain outlet conduit 15. A blower or air pump 36 is mounted in the upper portion of the tank by means of a circular plate 37 having an annular depending flange 40 which abuts the internal wall surfaces of the cylindrical wall 34. The support plate 37 may be secured to the cylindrical wall in any suitable manner, as by welding, to provide an air tight connection therebetween.

The support plate 37 is provided with a central aperture 38 which opens into the blower housing 39. The blower housing has outlet ports 40 which open outwardly into a chamber 42 formed by the cylindrical wall 34, the support plate 37 and a divider plate 43 which is disposed in the upper portion of the tank. The divider plate has an annular flange 44 which abuts the internal surfaces of the cylindrical wall 34 and is secured thereto in air-tight relation by any suitable means, such as welding. The upper portion of the housing 39 extends into a central aperture of the divider plate and is secured thereto in any suitable manner to provide an air-tight seal therebetween. Any suitable blower or fan is rotatably mounted in the housing 39 and is driven by a motor 46 mounted in the upper portion of the housing and disposed in the upper portions of the tank above the divider plate. A cover 47 telescopes over the upper end of the cylindrical wall and is provided with a central aperture through which a cable 48 of the motor extends.

The air conduit 14 extends through suitably aligned apertures in the cover 47 and in the divider plate 43 whereby air drawn from the chamber 50 of the tank below the support plate 37 may be caused to move upwardly through the aperture 38 into the blower housing 39 and thence through the lateral ports 40 thereof into the chamber or passageway 42 and into the lower end of the air pipe 14.

The inlet air pipe 12 extends through a suitable aperture in the cylindrical wall into the chamber 50 and is provided with a downward extension 52 whose lower end is disposed below the upper surface of a body of water contained in the chamber during normal operation of the device 11.

The water inlet pipe 20 is provided with a valve 53 which normally is held in closed position and which is operable by a solenoid 54. The solenoid opens the valve 53 when it is energized. A valve 55 is connected to the inner end of the pipe 20 which is connected, by any suit-

able fitting 56, to the cylindrical wall 34 of the tank 33. The valve 55 is operated by a float 57 on the end of a lever 58 which is pivotally connected intermediate its ends, as at 59, to the valve 55. The valve 55 has an operating plunger 60 which is moved to closed position to close the valve 55 when the float 57 is moved to an upper position by the water when the water in the tank attains a predetermined level.

A switch 65 is mounted on the cylindrical wall 33 and has an operating lever 66 disposed in the chamber 55 whose outer end is pivotally connected, as at 63, to a link 69 whose other end is pivotally connected to the float lever 58, as at 70. Switch 65 is normally closed and is moved to open position by the float when the water attains a predetermined height in the tank. The float switch 65 is thus operative to disconnect the solenoid 54 from a source of electricity whenever the water attains a predetermined height in the cylindrical tank to cause the valve 53 to close and thus prevent further flow of water into the tank.

The drain conduit or pipe 15 at the lower end of the tank is provided with a valve 72 which is held in open position when the solenoid 73 thereof is not energized and which is moved to closed position when the solenoid 73 is energized. Operation of the solenoid 73 during use of the system for cleaning purposes is controlled by the switch 75 mounted on the wall 34 whose actuating lever 76 is pivotally connected to a lever 77 on whose lower end is disposed the float 79. The float 79 moves the actuating lever 76 of the normally closed switch 75 to open position when the level of the water exceeds the normal predetermined height by a predetermined amount whereupon the de-energization of the solenoid 73 causes opening of the drain valve 72 and the escape of a predetermined amount of water from the tank thus lowering the level of the water in the tank. It will be apparent that once the level of the water in the tank drops to a predetermined height, the float 79 moves back downwardly toward the position illustrated in FIGURE 2 and causes closing of the switch 75 and thus the energization of the solenoid 73 and the closing of the drain valve.

It will thus be apparent that by the provision of the two switches 65 and 75 controlled by the floats 57 and 79 the level of the water may be maintained at a desired level within the tank.

I will also be apparent that the provision of valve 55 which is mechanically actuated by the float 57 is a safety device which functions in the event that the valve 53 cannot be closed due to some malfunction of either the solenoid 54, the switch 65 or some other cause.

The control circuit for the pneumatic system 10 includes a master switch 90 whose movable contact 91 is connected to one side of an input circuit 92 by a main conductor 93. The other side of the input circuit is connected to another main conductor 95. The master switch has stationary contacts 96 and 97. The stationary contact 96 is connected to one side of the motor 46 through conductors 100 and 101, a relay contact 102 when it is in closed position and a conductor 103. The other side of the motor is connected to the main conductor 95 by the conductor 105. The stationary contact 96 of the master switch is also connected to one side of the solenoid 54 of the water valve 63 by the conductors 100 and 103, the switch 65 when it is in closed position and the conductor 109. The other side of the solenoid valve 54 is connected to the main conductor 95 by the conductor 110.

The stationary contact 96 of the master switch is connected to one side of the solenoid 73 of the drain valve 72 by the conductor 100, the switch 75 when it is in closed position and the conductor 112. The other side of the solenoid 73 is connected to the main conductor 95.

The relay contact 102 is moved to closed position to connect one side of the motor to the stationary contact 96 of the master switch whenever the relay winding 115 is energized. One side of the relay winding 115 is con-

nected to one side of the secondary winding 116 of the transformer 117 by the conductor 119. The other side of the relay winding 115 is connected to the other side of the secondary winding 116 by the conductor 120 and any one of the switches 28, when in closed position, the switches 28 being connected in parallel between the secondary winding 116 and the conductor 120. The primary winding 122 of the transformer 117 is connected to the main conductors 93 and 95 by the conductors 125a and 126a, respectively.

The stationary contact 97 is connected to one side of the motor 46 by the conductor 128, the conductor 129 and the conductor 103 and to one side of the solenoid 73 of the drain valve 72 by the conductors 128 and 112.

It will thus be apparent that the motor 46 will be energized whenever the movable contact 91 of the master switch is moved into engagement with the stationary contact 96 if any one of the switches 28 is closed by the lifting of a plate 24 at any one of the inlet branches 13. Closing of any one of the switches 28 energizes the relay winding 115 which causes its contact 102 to move to closed position whereupon the motor is connected across the main conductors 93 and 95 and therefore across the input circuit 92.

When the system is not in operative condition, the movable contact 91 is in the open position illustrated in FIGURE 5. As a result, the solenoids 54 and 73 are not energized even though the switches 65 and 75 are now in closed position since there is no water in the tank and the floats are in their lowermost positions. The motor 46 of course cannot now be energized by the closing of any one of the switches 28.

When it is desired to place the pneumatic system in operation to cause air to be drawn through the inlet conduit 12 and expelled through the air conduit 14, passing through water contained in the tank in the process, the switch 91 is moved into engagement with the stationary contact 96. Since the switches 65 and 75 are now in closed position, their solenoids 54 and 73 are connected across the input circuit and the valve 72 is closed and the valve 53 is open. Water then flows in through the water inlet pipe 20 from any suitable source of water under pressure into the tank through the valve 55 which is also open since the float 57 is in its lowermost position. Since the drain valve is now closed, water will accumulate in the tank rising therein until the float 57 moves to its upper position illustrated in the drawing wherein the switch 65 is opened. The solenoid 54 is disconnected from the input circuit and the valve 53 closes. Simultaneously the mechanical valve 55 will close. The motor 46 of course remains inoperative until the operator opens one of the cover plates 24 in order to connect a flexible hose to a branch inlet 13. When this occurs, the relay winding 115 is connected across the secondary winding 116 of the transformer 117 and causes the contact 102 to move to closed position. The motor will now operate the blower or fan 36 and cause air to be drawn in through the flexible hose, to whose free end a suitable cleaning implement is attached, the associated inlet branch 13 and the inlet conduit 12 into the chamber 50. Since the dependent portion 52 of the inlet conduit is below the surface of the water, the air is caused to move through the water prior to its passage upwardly through the blower housing to the outlet conduit 14. Any dirt carried by the air of course is thus caused to come in contact with the water and remains entrapped by the water settling to the bottom of the tank while the air moves upwardly to the outlet conduit 14.

It will be apparent that the cleaning tool at the end of the flexible hose may be used to pick up excess water from the floors which have been washed and of course the dirt drawn in with the water also settles in the tank 33. The flexible hose may also be used to clean carpets and the like whereby only air containing dirt and no moisture is drawn into the tank.

In the event that the amount of water or the amount of dirt drawn into the tank exceeds a predetermined amount which causes the level of the water to rise to a predetermined height, the float 79 causes the switch 75 to open whereupon the drain valve 72 opens and a sufficient amount of water and dirt is permitted to drain downwardly into the sewer to cause the water to again fall to the desired predetermined level whereupon the float 79 drops to its original position again opening the switch 75. In this manner the level of the water is maintained substantially constant or within a predetermined range regardless of the amount of dirt or water drawn in through the inlet conduit 12 into the chamber 50.

When the cleaning operation has been completed, it is desirable to discharge the water from the tank together with the accumulation of the dirt and to flush the tank to insure that it is left clean until the next cleaning operation is to be performed. In this event, the movable contact 91 of the master switch 90 is moved to the stationary contact 115. As soon as the movable contact is moved out of engagement with the stationary contact 96, the motor 46 is disconnected from the input circuit and will not operate even if one of the switches 28 is closed. The solenoids 54 and 73 of the water in drain valves 53 and 72, respectively, are also disconnected from the input circuit whereupon the valve 54 remains in closed position but the drain valve 75 opens to permit the water to escape through the drain conduit 15 to the sewer pipe. When the movable contact 91 however engages the stationary contact 115, the solenoid 54 is again connected across the main leads 93 and 95 through the movable contact 91, the stationary contact 115, the conductor 116, the conductor 109, the conductor 110 and the conductor 95. Water will then continue to flow into the tank flushing the tank and any dirt accumulated therein until the movable contact of the switch is again moved to its inoperative position as illustrated in FIGURE 5. The operator holds the movable contact in engagement with the stationary contact 115 for any desired length of time to insure that the tank is properly cleaned or flushed. It will be apparent of course that the outlet of the mechanical valve 55 may be provided with any desired type of opening which will cause the water flowing therefrom to be directed to all surfaces of the tank which might be covered by dirt. The master switch 91 is then moved back to its inoperative position illustrated in FIGURE 1 and the pneumatic system is then ready to repeat the above cycle of operation the next time a cleaning operation is desired to be performed.

It will now be seen that a new and improved pneumatic system has been illustrated and described which includes a vacuum device 11 having a tank 33 which provides a chamber 50 into which extends the inlet conduit 12, the tank having a means for introducing water into the chamber, a means at the lower end of the chamber for draining water from the chamber and an outlet aperture 38 at its upper end through which air may be drawn from the upper end of the chamber by a fan or blower 36 and expelled through an air conduit 14.

It will further be seen that the inlet pipe 12 may be provided with a plurality of branch inlets 13 having open ends to which are connectable flexible hoses or the like whereby air may be drawn through the flexible hoses and any suitable implements or tools secured to the free ends thereof, and through the inlet branches and the inlet conduit into the chamber to be expelled thereunto below the surface of the water contained in the chamber.

It will further be seen that an automatic control system has been illustrated and described which causes water to be introduced into the chamber to a predetermined height on the initiation of operation of the cleaning system and which causes the water and accumulated dirt to drain out of the chamber upon the completion of the cleaning operation.

It will further be seen that the control means also provides for the flushing of the chamber with water on the completion of a cleaning operation.

It will further be seen that the control means also includes means for opening the drain valve whenever the water in the tank rises above a predetermined level in order to prevent any water to be drawn upwardly through the fan or blower 36.

It will further be seen that the water inlet pipe 20 is provided not only with an electrically operable valve 53 but also with a mechanically operable valve 55 which closes whenever the level of the water in the chamber rises above a predetermined height whereby flooding of the chamber to an undesired degree with water is prevented even in the event of failure of the water valve 53.

It will further be seen that the valves 53 and 72 are respectively closed and open when the solenoid valves 53 and 73 are de-energized whereby flooding of the chamber due to malfunction of the solenoids or of the electrical system is precluded.

In FIGURE 4 is illustrated a modified form of the cleaning system 10a which provides for the drawing in of the air from the air conduit 14 by the blower 36 and expelling it through the conduit 12 whereby tools to be driven by compressed air may be connected to the inlet branches 13.

The inlet conduit 14 of the pneumatic system illustrated in FIGURE 4 is provided with a valve 125 having a passage 126. The valve 125 when rotated to the position illustrated in FIGURE 4 connects the lower portion 14a of the air conduit with a bypass conduit 132 and prevents passage of air between the section 14b and the section 14a. The inlet conduit 12 has a similar valve 130 provided with a flow passage 131 which, when it is rotated to the position illustrated in FIGURE 4, causes the inlet conduit section 12b to be connected to the bypass conduit 132 and simultaneously closes off communication between the inlet conduit sections 12a and 12b. A second bypass conduit 137 is connected between the conduit sections 12a and 14b and is provided with a valve 138 which when in its open position permits passage of air through its passage 139 between the section 14b and the section 12a.

It will now be apparent that when the valves are in the positions illustrated in FIGURE 4, air moved by the fan or blower 36 is drawn inwardly through the air conduit 14b, which may open to the atmosphere, the flow passage 139 of the valve 138, the bypass conduit 137 and the inlet conduit section 12a into the chamber 50 of the tank 33 and is moved under pressure by the fan through the conduit section 14a, the flow passage 126 of the valve 125, the bypass conduit 132 and the flow passage 131 of the valve 30 to the inlet conduit section 12b and thence the inlet conduit branches 13. A flexible hose or the like may be secured to any one of the inlet branches so that the air under pressure may be utilized to drive any suitable pneumatically driven tool which is connected to the flexible hose.

In the event that the pneumatic system is to be used in this manner, the master switch 90 is provided with the stationary contact 97. When the movable contact 91 of the master switch 90 engages the stationary contact 97, the solenoid 73 is connected across the input circuit and closes the drain valve 72. No water is now present in the tank since upon the completion of the prior cleaning operation the drain valve 72 was opened. The motor 46 is also placed in operation when the movable contact 91 engages the switch 97 since it is then connected across the input circuit. As a result the chamber is closed at its lower end and air will be drawn into the chamber only through the air conduit 14b and not from the sewer pipe. In addition, since the air flowing through the chamber 50 does not now come into contact with any water, the air supplied to the pneumatically powered tool 75 is dry.

When it is desired to employ the pneumatic system 10a for cleaning purposes, the valve 125 is rotated so that its flow passage 126 connects or permits communication between the air conduit sections 14a and 14b and the valve 130 is rotated so that its flow passage 131 permits communication between the flow passages of the inlet conduit sections 12a and 12b. The valves 125 and 130 of course when rotated to such positions close off the bypass conduit 128 at each end thereof. The bypass valve 138 is then moved to its closed position preventing any flow through the bypass conduit 137. When the motor 46 is now energized air will be drawn in from the inlet conduit 12 and expelled to the atmosphere through the conduit 14.

It will now be seen that a new and improved pneumatic system which may be used either as a cleaning system which operates by suction to draw in dirt, cleaning liquids or the like into the air chamber 50 of the tank or where the dirt and liquid is retained while the air is expelled to the atmosphere through an air conduit 14 or which may alternatively be used to supply air under pressure to pneumatically powered tools, the air being drawn in through the air conduit 14 into the chamber 50 and forced from the chamber 50 into the conduit 12.

It will further be seen that a control means have been provided for easily and quickly converting the pneumatic system to either the cleaning operation or the air tool driving operation.

The foregoing description of the invention is explanatory only, and changes in the details of the construction illustrated may be made by those skilled in the art, within the scope of the appended claims, without departing from the spirit of the invention.

What is claimed and desired to be secured by Letters Patent is:

1. A pneumatic system including: means providing a closed chamber; conduit means providing an outlet from the upper end of said chamber; blower means communicating with the upper end of said chamber for moving air from the upper portion of the chamber outwardly thereof through said outlet conduit means; inlet means opening into the interior of said chamber intermediate the upper and lower ends thereof; drain means providing a drain opening at the lower end of said chamber; water inlet means providing for the introduction of water into said chamber intermediate the upper and lower ends thereof; and electrically operable control means operatively associated with said water inlet means, said drain means and said blower means for closing said drain means and opening said water inlet means upon the initiation of operation of said device; and means responsive to the level of water in said chamber for maintaining the level of the water in said chamber at a predetermined height above said inlet means.

2. A device including a tank; means for supporting a blower means in the upper portion of said tank and forming a chamber therebelow; air blower means disposed in the upper portion of said tank and supported by said supporting means for moving air out of said chamber; air inlet means opening intermediate the upper and lower ends of said chamber; air conduit means opening into the upper end of said chamber and communicating with said blower means for conducting air moved by said blower means outwardly of said tank; a water inlet conduit opening into said chamber intermediate the ends thereof having a first electrically operable valve for controlling flow of water therethrough into said tank, said tank having a drain conduit opening into the bottom

of said tank provided with a second electrically operable valve; and control means for operating said water inlet valve and responsive to the level of the water in said chamber for energizing said valve to open the valve whenever the level of the water in said chamber falls below a predetermined level; and means responsive to the level of the water in said tank for opening said drain conduit valve to permit flow of water from said tank when the level of the water in the tank exceeds a predetermined height.

3. A device including: a tank; means for supporting a blower means in the upper portion of said tank and forming a chamber therebelow; air blower means disposed in the upper portion of said tank and supported by said supporting means for moving air out of said chamber; air inlet means opening intermediate the upper and lower ends of said chamber; air conduit means opening into the upper end of said chamber and communicating with said blower means for conducting air moved by said blower means outwardly of said tank; a water inlet conduit opening into said chamber intermediate the ends thereof having a first electrically operable valve for controlling flow of water therethrough into said chamber, said tank having a drain conduit opening from the bottom of said chamber provided with a second electrically operable valve; and control means for controlling the operation of said blower means and said first and second valve, said control means including a main switch movable to a first operative position to energize said first and second valves to open said first valve and close said second valve, means responsive to the level of water in said tank for closing said first valve when the level of the water in the tank attains a predetermined height and for opening said second valve whenever the level of the water in said chamber exceeds a predetermined height.

4. The device of claim 3 wherein said main switch has a second operative position wherein said blower means is prevented from being placed in operation and said first and second valves are held in open positions.

5. The device of claim 4 wherein said inlet means is provided with a plurality of inlet branches having closures and switch means operatively associated with said closures for preventing energization of said blower means except when a closure is in open position.

6. The device of claim 3 wherein said air inlet means and said air conduit means are connected by by-pass means provided with valve means whereby air may be moved by the blower means through said chamber selectively from said air conduit means to said air inlet means and from said air inlet means to said air conduit means.

7. The device of claim 6 wherein said main switch has a third operative position wherein said blower means is placed in operation and said second valve is in closed position.

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