May 21, 1940. C. D. GRAHAM 2,201,769

SWITCH FOR REFRIGERATING APPARATUS

Filed July 31, 1935 2 Sheets-Sheet 1

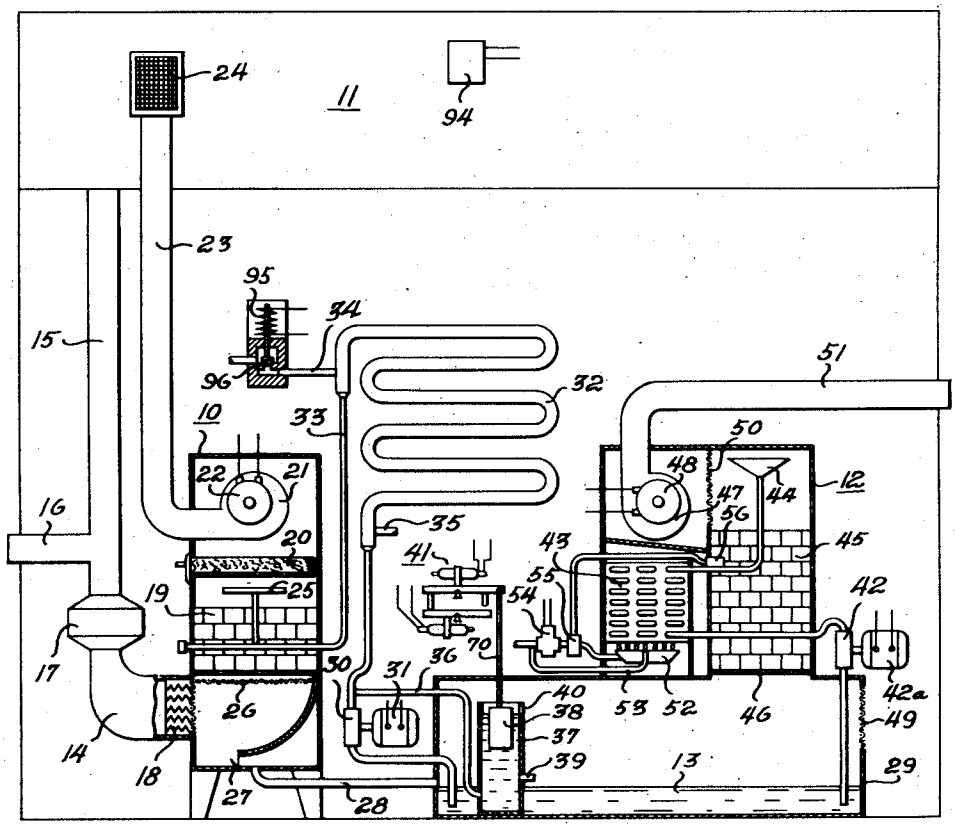


Fig. 1

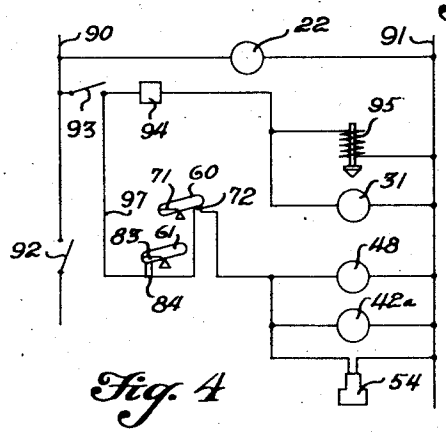


Fig. 4

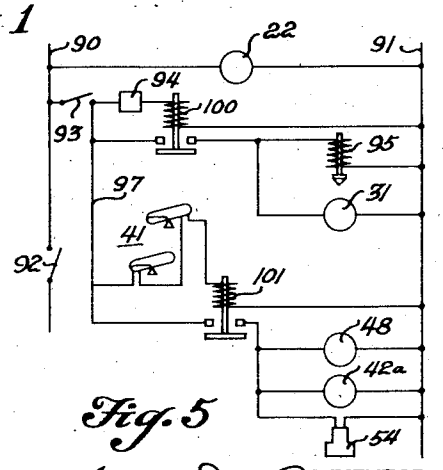


Fig. 5

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SWITCH FOR REFRIGERATING APPARATUS

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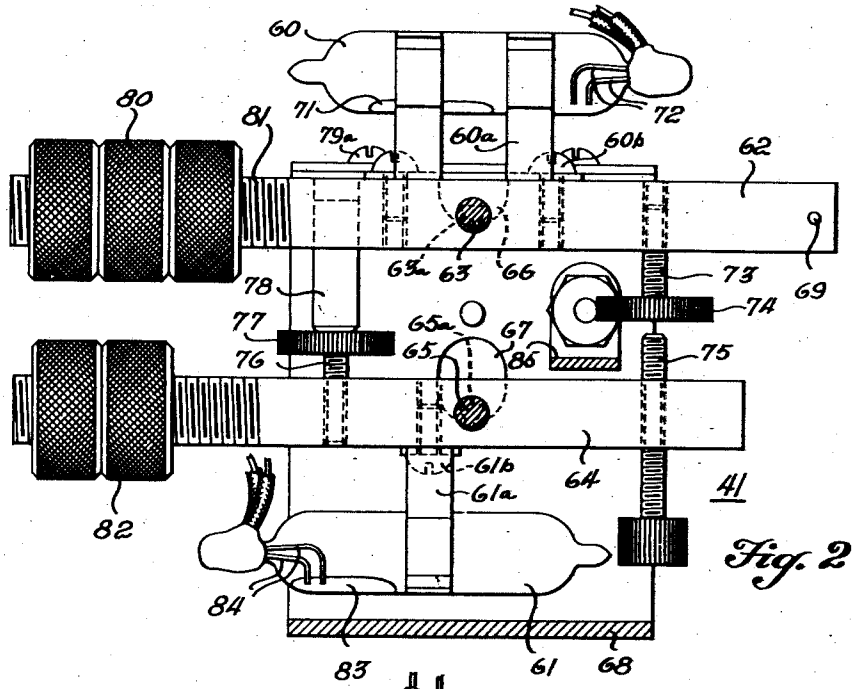


Fig. 2

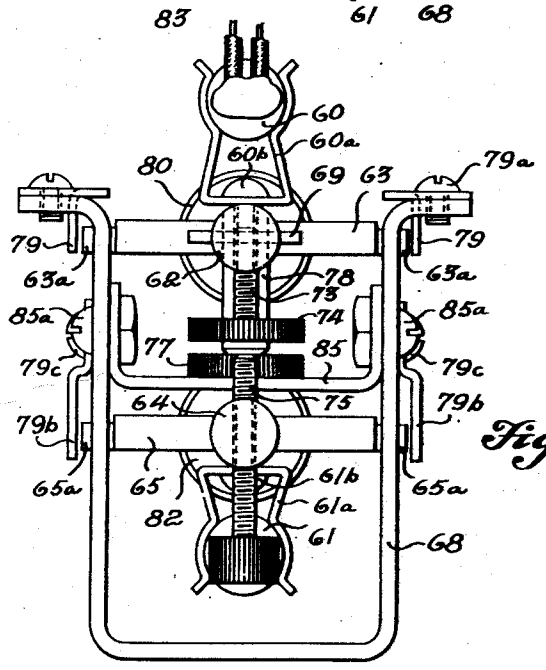


Fig. 3

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2,201,769

SWITCH FOR REFRIGERATING APPARATUS

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Application July 31, 1935, Serial No. 34,028

9 Claims. (Cl. 200—84)

This invention relates to apparatus for conditioning air or other gases.

An object of this invention is to provide an improved control for apparatus in which air or other gases are conditioned by a medium the specific gravity of which is to be regulated in order to impart proper conditions to the fluid being treated.

Further objects and advantages of the present invention will be apparent from the following description, reference being had to the accompanying drawings, wherein a preferred form of the present invention is clearly shown.

In the drawings:

Fig. 1 is a diagrammatic representation of an apparatus embodying features of this invention;

Fig. 2 is an enlarged vertical cross-sectional view of the switch mechanism;

Fig. 3 is an end view of the mechanism shown in Fig. 2;

Fig. 4 is a wiring diagram showing the electrical controls for the system shown in Fig. 1; and

Fig. 5 is a diagram, somewhat similar to that shown in Fig. 4, but showing the use of relays.

An apparatus embodying features of this invention includes, in general, an air or gas conditioning unit 10 which conditions the air or gases for the compartment 11. It also includes a regenerating unit 12 which is used to maintain the specific gravity of the body of liquid 13, such as a water solution of a lithium halide salt, within desired limits. Air or other gas to be conditioned enters the unit 10 through the inlet conduit 14. This air or gas may come from the compartment 11 through the pipe 15, or from the outside through the pipe 16, or both. It may pass through a filter 17 of any suitable construction. Baffles 18 are also provided. The air passes upwardly through a gas and liquid contact tower 19, thence through an eliminating filter 20 and is forced by the fan 21, driven by the motor 22, through the pipe 23 to the compartment 11, into which it is discharged through the grille 24. Hygroscopic liquid, such as lithium chloride water solution, is sprayed on the contact mass 19 by means of a revolving distributor head 25, so that the liquid trickles over the mass 19 and through the screen 26 and is gathered at the sump 27 from whence it returns through the pipe 28 to the tank 29 which holds the main body of liquid 13. The distributor head 25 may be a freely rotatably mounted pipe with tangential openings, so that the discharge of liquid rotates the pipe.

Liquid from the main body 13 is delivered to the conditioner 10 by means of a pump 30 driven by a motor 31. The liquid flows through an inner pipe of the interchanger 32 and is delivered through the pipe 33 to the distributor head 25. Cooling liquid, which may be ordinary city water, or artificially cooled water, enters through the pipe 34 into the outer pipe of the interchanger 32 and is discharged at the outlet 35.

A small portion of the liquid discharged by the pump 30 flows through the pipe 36 to a box 37 in which the hydrometer element 38 is placed. The liquid in box 37 is therefore representative, as to specific gravity, of the liquid in body 13. A small opening or pipe 39 is placed near the bottom of the box 37. The flow capacity of the opening 39 is made smaller than that of the pipe 36 so that when the pump 30 operates, the box 37 is filled and overflows at the point 40 as well as through the opening 39. When the pump 30 stops the box 37 is emptied down to the level of the opening 39. The hydrometer element 38 controls the switch element 41 in response to the specific gravity and the level of the liquid in box 37 in a manner to be more fully described.

The liquid in the main body 13 is regenerated by pumping a portion thereof by means of the pump 42 through the heater 43, from whence the heated liquid is discharged by the distributor head 44 on the contact mass 45 through which the liquid trickles and drains through the openings 46 back into the main body 13. Air is caused to flow through the contact mass 45 in contact with the heated liquid and this reconcentrates the liquid. This is accomplished by providing a blower 47, driven by a motor 48, which blower draws air through the inlet 49 in the tank 29 and causes the air to flow upwardly through the openings 46 and through the mass 45, and to pass through the screen 50 into the inlet of the blower 47. From thence the moisture laden air is discharged through the pipe 51 to the outside of the building.

The heater 43 may be of any suitable construction, but preferably is of the type in which a sinuous pipe is provided through which the liquid flows. This pipe may be heated by a gas burner 52 provided with a pilot light and tube 53. The burner 52 is controlled by a solenoid valve 54 and by a thermostatic valve 55. The valve 55 is controlled by a thermostat 56 placed at the outlet end of the heater 43 in such a manner that the flow of gas to the burner 52 is throttled when the liquid discharged from the heater 43 reaches a predetermined temperature, and thus maintains the discharge temperature of the liquid substantially constant.

The switch element 41 preferably comprises two switches 60 and 61 of the mercury tube type. The

switch 60 is mounted on a rocker arm 62 pivoted on the fulcrum bar 63. The mount 60*a* of the switch 60 is secured to the arm 62 by screws 60*b*. The switch 61 is suspended from the rocker arm 64 which is mounted on the fulcrum bar 65. The mount 61*a* is secured to the arm 64 by screws 61*b*. The bars 63 and 65 may be provided with triangular fulcrum surfaces 63*a* and 65*a* respectively, at both of their ends and may fit in openings 66 and 67 in the U-shaped base member 68.

The rocker arm 62 is provided with a pin 69 to which the connecting rod 70 is secured, the rod being also connected to the hydrometer element 38. As the hydrometer element 38 rises and falls in the liquid, when the box 37 is full, in response to changes in specific gravity of the liquid, it causes a slight rocking movement of the arm 62 which in turn causes the mercury drop 71 to open and close the contacts 72.

A lost motion connection is provided between the switch 61 and the switch 60 or the hydrometer element 38. This may be accomplished by providing a screw 73, which may be adjusted into and out of the arm 62. The head 76 of this screw is adapted to hit on the end of the screw 75 which is adjustably placed in the arm 64. Another screw 76 is positioned so that its head 77 contacts with a pin 78 secured in the arm 62. The amount of lost motion between the switches 60 and 61 can thus be adjusted to any desired extent.

The fulcrum bar 63 is kept in place by ears 79 secured to the upper ends of the base 68 by means of screws 79*a*. The fulcrum bar 65 is kept in place by ears 79*b* secured to the base member 68 by means of screws 79*c*.

The setting to which the switch 60 is responsive with respect to the specific gravity of liquid in the box 37 may be adjusted by means of weights 80, which may be moved along the length of the arm 62 by a turning movement on the threads 81. This alters the upward pull upon the float rod 70 thus altering the effective weight of the float 38 and thereby determining the specific gravity of the liquid at which the contacts 78 are closed. Likewise adjustable weights 82 are provided at the end of the arm 64. These weights are so adjusted that when the box 37 empties, then the weight of the hydrometer element 38, no longer freely floating in liquid, is sufficient to rock both arms 62 and 64 downwardly so that the mercury drop 83 opens the contacts 84. A stop member 85, in the shape of a U bar is secured to the brass member 68 by means of bolts 85*a* and prevents the right end of the rocker arm 64 from rising beyond a predetermined limit, this limit being such that the arm 62 is left free to rock in response to specific gravity changes of the liquid in the full box 37 and to open and close the contacts 72 as long as the box 37 remains full. However, when the box 37 empties, and the hydrometer element 38 no longer can float in liquid, then the arm 62 swings downwardly and causes the head 76 to impinge against the screw 75 which in turn rocks the arm 64 and opens the contacts 84. The switch 61 is therefore responsive to the level of the liquid in box 37.

The switch structure 61 is used to control the various electrical elements shown in Fig. 1. The method of control is indicated in the diagrams shown in Figs. 4 and 5. The motor 22 which drives the blower 21, is placed across the power lines 90, 91 under the control of the manual switch 92. When the switch 92 is closed, air circulation is insured for the compartment 11. If it is desired to condition this air, then the manual switch 93 is also closed. A condition responsive element 94 is provided in the compartment 11. This may be responsive to relative humidity, or to wet bulb temperature or both, or it may be made responsive to "effective temperature," which is a temperature in which the dry bulb and relative humidity are functions. The control element 94 is provided with a switch (not shown), which when closed energizes the solenoid 35 and the motor 31 which drives the pump 30. This causes hygroscopic liquid to be pumped from the main body 13 over the contact mass 19 and condition or dry the air passing through the unit 10. At the same time the solenoid 95 opens the valve 96 and causes cooling liquid or water to flow through the interchanger 32 and to impart desired temperature to the hygroscopic liquid before it is delivered to the mass 19. Soon after the pump 30 is thus started, the box 37 is filled causing the hydrometer element 38 to assume a position which is representative of the specific gravity of the main body of liquid 13. If the specific gravity is insufficient, the hydrometer element 38 tends to sink within the liquid causing the mercury bulb 71 to flow to the right and to close the contacts 72. When the box 37 is full, the normal position of the switch 61 is a closed position, and under such circumstances current can flow through the line 97, through the contacts 84 and through the contacts 72 to the motors 48 and 42*a* and to the solenoid gas valve 54. This causes the blower 47 to circulate air through the regenerator and causes the pump 42 to pump liquid through the regenerator and permits the burner 52 to be supplied with gas under the control of thermostatic valve 55. Thus as long as the instrument 94 requires air conditioning, the pump 30 is caused to operate and to supply liquid to the air conditioner and to the box 37. When the box 37 is maintained full the hydrometer element 38 controls the operation of the regenerator and its members causing regeneration to take place, if necessary. However, when the instrument 94 opens the circuit to the motor 31, which drives the pump 30, then box 37 is no longer supplied with liquid from the pipe 36 and becomes empty. When this occurs, the hydrometer element 38 no longer floats freely in liquid and thus moves the arm 62 downward a sufficient amount to move also the arm 64 and to open the contacts 84. This prevents operation of the regenerator elements until such a time as air conditioning is again required.

Fig. 5 is substantially the same as Fig. 4 except that a relay 100 is interposed between the control 94 and the electrical element to be controlled thereby, and relay 101 is interposed between the switch element 61 and the elements to be controlled thereby, thus reducing the amount of current which must flow through the switch elements. The remainder of the circuit shown in Fig. 5 will be readily understood from the description given with respect to Fig. 4.

While the form of embodiment of the invention as herein disclosed, constitutes a preferred form, it is to be understood that other forms might be adopted, all coming within the scope of the claims which follow.

What is claimed is as follows:

1. A control for gas conditioning apparatus or the like, comprising a box, flow means for flowing liquid into said box to fill said box to a predetermined level, means for changing the specific gravity of the said liquid, a drain opening of less flow capacity than said flow means, a hydrometer

element in said box adapted to float in liquid in said box when filled, a switch having contacts opened and closed by said hydrometer element in response to the specific gravity of liquid when said box is filled, and a second switch having contacts altered by a fall in liquid level in said box one of said switches being provided with means for avoiding the operation of the second switch when the first switch is operated by variations in the specific gravity of the liquid.

2. A control for gas conditioning apparatus or the like, comprising a box, flow means for flowing liquid into said box to fill said box to a predetermined level, means for changing the specific gravity of the said liquid, a drain opening of less flow capacity than said flow means, a hydrometer element in said box adapted to float in liquid in said box when filled, a first switch, a first switch arm connected to said switch and to said hydrometer element, a second switch, and a second switch arm having a lost motion connection with said first switch arm whereby said first switch is responsive to specific gravity conditions of liquid when said box is filled and whereby said second switch is responsive to the level of liquid in said box.

3. A control for gas conditioning apparatus or the like, comprising a box, flow means for flowing liquid into said box to fill said box to a predetermined level, means for changing the specific gravity of the said liquid, a drain opening of less flow capacity than said flow means, a hydrometer element in said box adapted to float in liquid in said box when filled, a first switch, a first switch arm connected to said switch and to said hydrometer element, a second switch, and a second switch arm having a lost motion connection with said hydrometer element whereby said first switch is responsive to specific gravity conditions of liquid when said box is filled and whereby said second switch is responsive to the level of liquid in said box.

4. A control for gas conditioning apparatus or the like, comprising a box, flow means for flowing liquid into said box to fill said box to a predetermined level, means for changing the specific gravity of the said liquid, a drain opening of less flow capacity than said flow means, a hydrometer element in said box adapted to float in liquid in said box when filled, a first switch, a first switch arm connected to said switch and to said hydrometer element, a second switch, and a second switch arm having a lost motion connection with said first switch arm, said lost motion connection being adjustable, whereby said first switch is responsive to specific gravity conditions of liquid when said box is filled and whereby said second switch is responsive to the level of liquid in said box.

5. A control comprising a hydrometer element associated with a liquid, a first switch having contacts and being connected to said element, adjustable means for changing the floating power of said hydrometer element to vary the relationship between the specific gravity of the liquid and the changing of said contacts, a second switch having contacts and being connected by lost motion to said hydrometer element whereby said second switch is responsive to changes in level of the liquid with which said hydrometer element is associated.

6. A control comprising a hydrometer element, a first switch having contacts and being connected to said element to be responsive to specific gravity of liquid with which said element is associated, a second switch having contacts and being connected by lost motion to said hydrometer element whereby said second switch is responsive to changes in level of said liquid, and means for adjusting said lost motion.

7. A control means including a float chamber, means operable to maintain a predetermined level of liquid within said float chamber, means for changing the level of liquid in said float chamber when said first named means is inoperative, a float within said float chamber, a first switch means connected to said float and opened and closed by variations in the specific gravity of the liquid in the float chamber when said first named means is operative, and a second switch means operated by said float when the level of the liquid in said float chamber is changed materially from said predetermined level, one of said switch means being provided with means for avoiding operation of the second switch means when the first switch means is operated by variations in the specific gravity of the liquid.

8. A control means including a float chamber, means operable to maintain a predetermined level of liquid within said float chamber, means for lowering the level of liquid in said float chamber when said first named means is inoperative, a float within said float chamber, a first switch means connected to said float opened by a rise in specific gravity and closed by a fall in specific gravity when said predetermined level is maintained, and a second switch means moved to open position by said float when the liquid level falls materially below said predetermined level, one of said switch means being provided with a lost motion connection for avoiding operation of the second switch means when the first switch means is operated by variations in the specific gravity.

9. A control means including a float chamber, means operable to maintain a predetermined level of liquid within said float chamber, means for changing the level of liquid in said float chamber when said first named means is inoperative, a float within said float chamber, a first switch means connected to said float and opened and closed by variations in the specific gravity of the liquid in the float chamber when said first named means is operative, and a second switch means operated by said float when the level of the liquid in said float chamber is changed materially from said predetermined level, said second switch means having a lost motion connection to said float.

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