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W. S. MORRISSEY ET AL

3,209,124

FLOAT-TYPE HUMIDIFIER

Filed May 16, 1963

2 Sheets-Sheet 1

Fig. 1

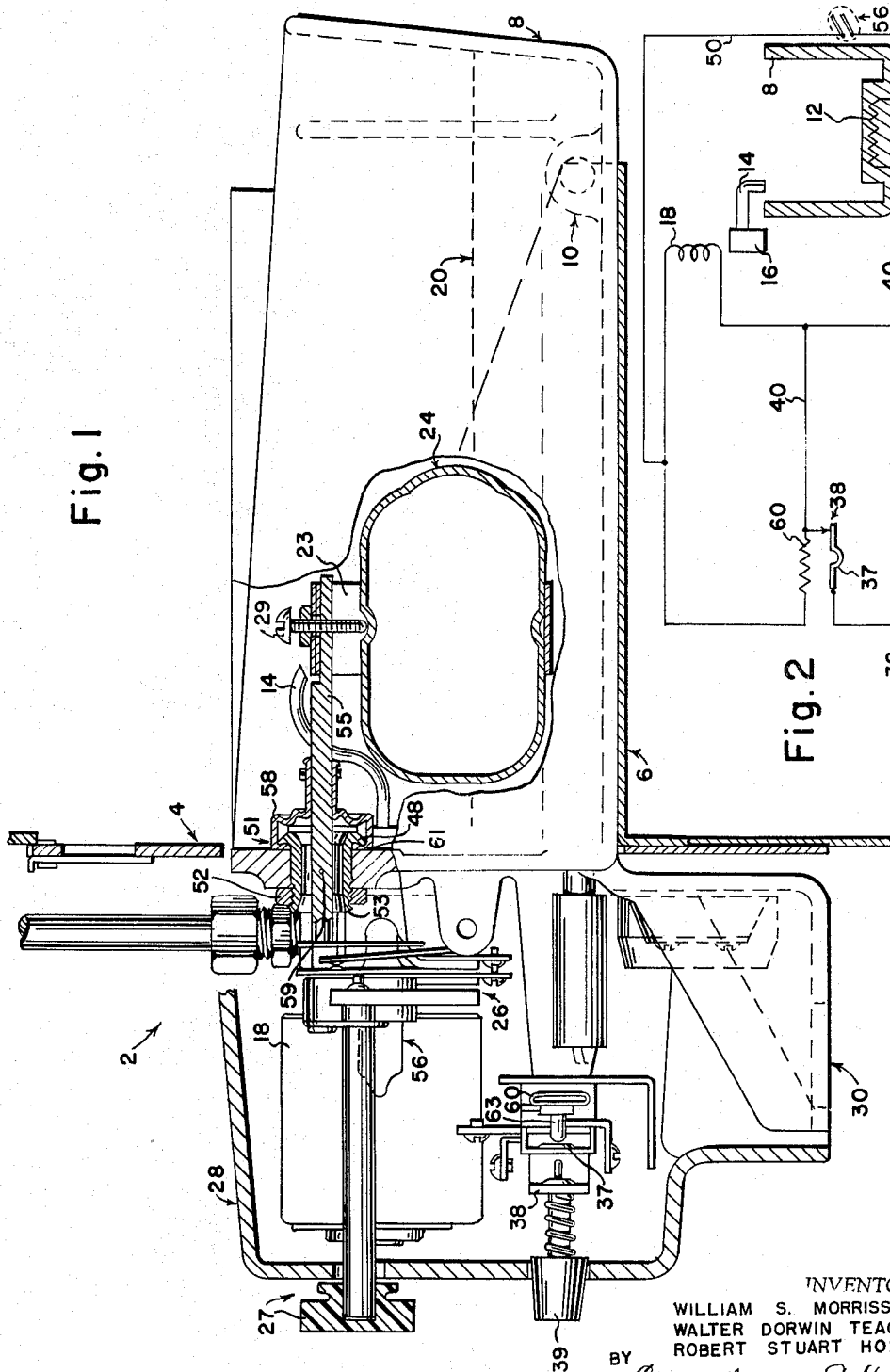
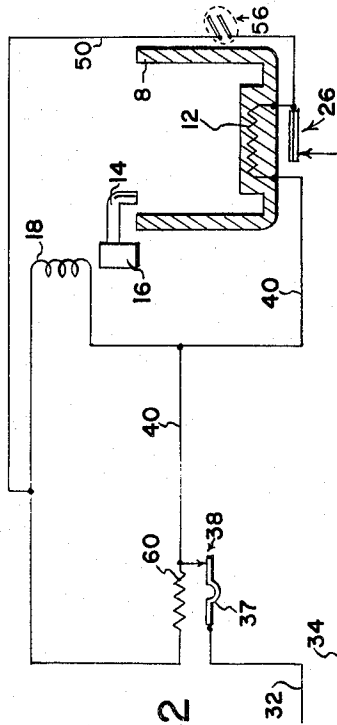


Fig. 2



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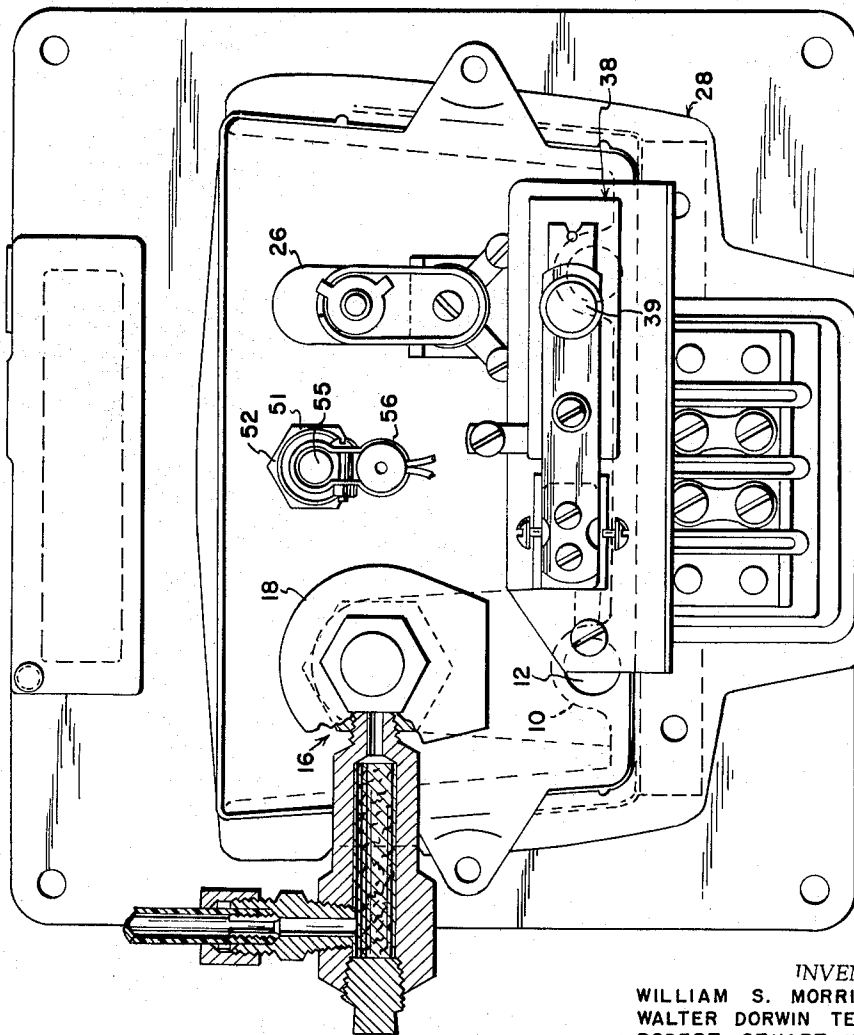
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FLOAT-TYPE HUMIDIFIER

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This invention relates to humidifiers, and more particularly to the construction and control of humidifiers of the type used in domestic heating systems.

An object of this invention is to provide improved humidifiers. A further object is to provide trouble-free control of the water level in humidifiers. A further object is to provide improved control of the electrical circuits in humidifiers of the above type where water is supplied through a valve and the water is evaporated by the use of electric resistance heating. Another object is to provide an electrical system for a humidifier of the above type which will operate properly during normal use and which will act under emergency or abnormal conditions to prevent damage to the system or to the premises, and particularly will prevent flooding. A further object is to provide for the above with a construction which is sturdy, dependable, relatively simple, and readily accessible for service. These and other objects will be in part obvious and in part pointed out below.

In the drawings:

FIGURE 1 is a sectional view of one embodiment of the invention;

FIGURE 2 is a schematic representation of the electrical circuit of FIGURE 1; and

FIGURE 3 is an elevation with some parts in section from the left in FIGURE 1.

Referring to FIGURE 1 of the drawings, a humidifier 2 is mounted as a "plug-in" unit to the wall of the hot air chamber of a furnace and is supported upon the furnace wall by a mounting plate 4 and a shelf 6. Humidifier 2 has a tank 8 with a ridge 10 in its bottom wall which encloses a resistance heater element 12 (see also FIGURES 2 and 3). During operation water in tank 8 is evaporated by the heat of heater element 12, thus to raise the relative humidity in the house which is heated by the hot air from the furnace. As represented schematically in FIGURE 2, water is supplied to tank 8 through a tube 14 projecting through the side wall of the tank under the control of a normally-closed, solenoid valve 16 having a solenoid 18. The water in tank 8 is maintained at a water level 20 (FIGURE 1) under the control of a float assembly having a heat-proof glass float 24. The components of the electrical supply and control system are enclosed in a casing 28 and a lower box at 30. The water-flow control mechanism of the illustrative embodiment has only the float assembly in the corrosive atmosphere of tank 8 and no electrical wires enter the tank. The float assembly is of corrosive resistant materials. The components of the electrical supply and control system include: an adjustable thermostatic switch 26 which has an adjusting shaft and knob 27, and is mounted upon the tank wall so as to be responsive to the tank temperature; a mercury switch 56 which is mounted to be opened and closed by the rising and falling of float 24; and, a thermostatic time-delay switch 38 which has a snap-acting contactor arm 37 which is normally closed, but is moved to the open position by the action of a bi-metallic strip which has an operating pin 63 and is surrounded by a heater element 60. When electrical current flows through the heater element for a predetermined time the bi-metallic strip acts through its pin 63 to push to the left on switch

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arm 37 so that the arm flexes and snaps to its open-switch position. As will be explained more fully below the opening of the switch disconnects the electrical supply with the result that heater element 60 is de-energized and the bi-metallic strip cools and returns to its rest position at the right. However, switch arm 37 remains in its open switch position until plunger 39 is pushed manually; that action causes the end of the plunger to flex and snap the switch arm to the right to its closed-switch position. Hence, switch 38 acts as a time-delay disconnect switch which opens the electrical circuit whenever the heater element 60 is energized for a sufficient time to heat the bi-metallic strip, and the switch acts to "lock out" the circuit until the switch is closed manually. The opening of switch 38 also opens the circuit of heater element 12 so as to prevent further heating of the water in tank 8 until the switch is closed again. Float 24 is mounted upon one end of a float arm 55 by a metal band 23 which extends around the float with its ends clamped between the arm and a nut on a screw 29. The end of the screw 29 is tightened against the float so as to hold the float and band together. Mounted upon the other end of the arm is the mercury switch 56. Arm 55 is pivotally mounted in an opening in the front wall of tank 8 by a pivot assembly 51 having a pivot pin 59. A flexible boot 58 surrounds the pivot arm and provides a flexible seal between the arm and the tank wall. A bushing 53 is positioned in the opening in the tank wall and is clamped in place by a nut 52. Bushing 53 has a circular channel flange 48 which mates with an annular flange 61 on boot 58 so that the tightening of nut 52 provides a tight seal between the boot and the tank wall. Integral with its flange 61, the boot has a cylindrical portion which is connected through a corrugated flange to a sleeve portion which snugly fits float arm 55 and is clamped thereto so as to provide a seal between the boot and the float arm. Hence, casing 28 within which the electrical and control components are positioned is sealed from the water in the tank, but the float assembly has complete freedom of action to rock about its pivot 59. Therefore, float 24 rises and falls freely so as to be responsive to the level of the water in tank 8, and the rocking movement swings mercury switch 56 between its opened position when the water level rises and its closed position when the water level falls. As will be explained more fully below, the closing of switch 56 energizes solenoid 18 and opens valve 16. Thereafter, when the water level rises and switch 56 is closed by the raising of float 24, switch 56 is reopened and valve 16 is reclosed.

Referring to FIGURE 2, electrical power is supplied to the humidifier through a pair of lines 32 and 43. Line 32 is connected to one side of switch 38 and the other side of the switch is connected through a line 40 to one side of each of: heater element 12, solenoid 18 of valve 16, and heater element 60 of switch 38. The other side of heater element 12 is connected through thermostatic switch 26 to line 34. The other sides of solenoid 18 and heater element 60 are connected together, and through a line 50 and mercury switch 56 and thence through switch 26 to line 34. Hence, when the humidifier is being supplied with electrical power and switches 26 and 38 are closed, the tank heater element 12 is energized from line 32 through switch 38 and line 40, and from line 34 through switch 26. Also, when switches 26 and 38 are closed and the water level falls so that float 24 closes the mercury switch 56, solenoid valve 18 is energized so as to open valve 16 and supply water through tube 14 to tank 8. Also, with those conditions, the closing of switch 56 energizes the heater element 60 which starts a thermostatic timing cycle.

In discussing the operation, it is assumed that switch 26 is closed so that heater element 12 is energized, that

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switch 56 is open so that solenoid 18 is de-energized, and that switch 38 is closed. Thus, when the water level falls by evaporation and float 24 drops to the position where mercury switch 56 closes, solenoid 18 is energized and the normally-closed valve 16 is opened to admit make-up water to tank 8 through tube 14. As the water level rises, float 24 moves up and opens switch 56, whereupon solenoid 18 is de-energized and valve 16 closes. Hence, float 24 maintains the desired water level.

The closing of the circuit through lines 40 and 50, which opens water valve 16, also energizes heater element 60 of switch 38 so as to start a timing cycle. This is, the energization of heater element 60 starts to heat the bi-metallic strip; and, switch arm 37 is moved to its open-switch position automatically if the heating continues for more than a predetermined time. The opening of the switch disconnects line 40 from line 32, thus de-energizing solenoid 18 and closing valve 16 so as to cut off the supplying of water to tank 8. However, the time characteristic of switch 38 is such that, during normal operation, the level of water in tank 8 is raised to the desired level 20 before the bi-metallic strip acts to open the switch. Therefore, during normal operation, switch 38 does not open, and float 24 acts to open switch 56 when the desired water level is reached. The opening of switch 56 opens the circuit through line 50 so as to de-energize solenoid 18, and that also de-energizes the heater element 60. Hence, during normal operation switch 38 remains closed and at the end of each period when the water has been supplied to the tank the de-energizing of heater element 60 stops the timing operation of switch 38 so that the switch components cool again and are in condition for another timing operation when tank 8 requires filling again.

However, when abnormal operations cause solenoid 18 to remain closed for an excessive period the heating of the bi-metallic strip is sufficient to open switch 38, and the switch remains opened until the humidifier has been given attention. In this way, switch 38 acts as a safety device to prevent damaging or otherwise objectionable operation. For example, switch 38 de-energizes heater element 12 and prevents continued heating when there is a deficiency in the water supply; and, it prevents flooding which might otherwise result from the float becoming damaged or stuck, or if anything else should cause solenoid 18 to remain energized for a period of time longer than that required to fill tank 8. As indicated, when switch 38 is opened, it does not close automatically, but remains open until closed by pushing plunger 39. This acts as a dependable safety feature which renders the entire system inoperative until attention has been given to the device. It has been indicated above that thermostatic switch 26 is responsive to the temperature of tank 8 and that it opens automatically when the tank temperature becomes excessive. The opening of switch 26 disconnects the heater element 12 and it also de-energizes the water supply circuit, thus de-energizing the entire system. This prevents the supplying of water to the tank if abnormal conditions have caused the tank to approach a temperature at which there would be resultant damage.

It is thus seen that the water level is maintained at the desired level at all times during normal operation, and the safety features of the circuit prevent damage or inconvenience due to malfunction of the equipment.

As many possible embodiments may be made of the mechanical features of the above invention, and as the art herein described might be varied in various parts, all without departing from the scope of the invention, it is to be understood that all matter hereinabove set forth, or shown in the accompanying drawings is to be interpreted as illustrative and not in a limiting sense.

We claim:

1. A humidifier comprising, a tank which is to be posi-

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tioned within a hot air chamber with one side wall at one side of the chamber, mounting plate means for supporting said tank in cantilever fashion within the hot air chamber; an electrical tank heating element operatively associated with said tank, means constituting a supply of water to said tank and including a water supply pipe and a solenoid valve which is normally closed and which has a solenoid which is energized to open the valve, water-level sensing means to sense the level of water therein comprising a float unit formed by a float rockably mounted within said tank upon a float arm and mounting means at said side wall of said tank whereby a change in the water level in said tank rocks said float arm, a mercury switch mechanically connected to said float arm and exterior of said tank and adapted to be opened and closed by the rocking movement of said float arm resulting from changes in the water level within said tank, an electrical circuit connecting said solenoid in series with said mercury switch and thence to a pair of electrical supply lines to which a source of electricity is connected, said electrical circuit including a normally-closed electrical timing switch assembly formed by a bimetallic strip which moves to a closed-switch position when at ambient temperatures and which moves to an open-switch position at a predetermined elevated temperature, said bimetallic strip having the characteristic that it does not move to its closed-switch position because of a reduction in its temperature below said predetermined elevated temperature, means to move said bimetallic strip from its open-switch position to its closed-switch position, a heater element connected in parallel with said solenoid and positioned adjacent said bimetallic strip to heat the same simultaneously with the energization of said solenoid, said electrical circuit further including means connecting said electrical tank heating element to said electrical supply lines, said switch assembly and said heater element being so related that said bimetallic strip is heated to said predetermined elevated temperature only when said heater element has been energized for a predetermined period of time whereby said bimetallic strip remains in its closed-switch position during normal operation and moves to its open-switch position only under abnormal conditions which cause said heater element to be energized for an excessive period of time.

2. A humidifier as described in claim 1 wherein said mounting plate means is of the "plug-in type" and includes a shelf which is mounted upon the wall of the hot air chamber and supports said tank.

3. A humidifier as described in claim 1 wherein said float unit comprises a rigid arm which is pivotally mounted in an opening in said side wall, and a flexible boot surrounding said float arm and attached to said side wall and providing a flexible seal therewith.

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