

April 30, 1963

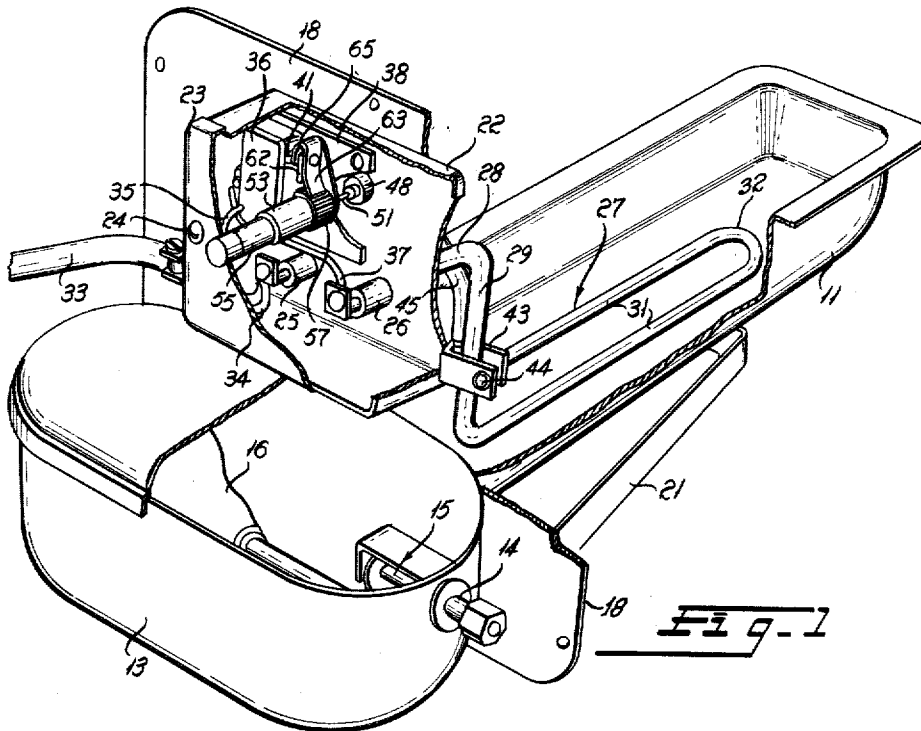
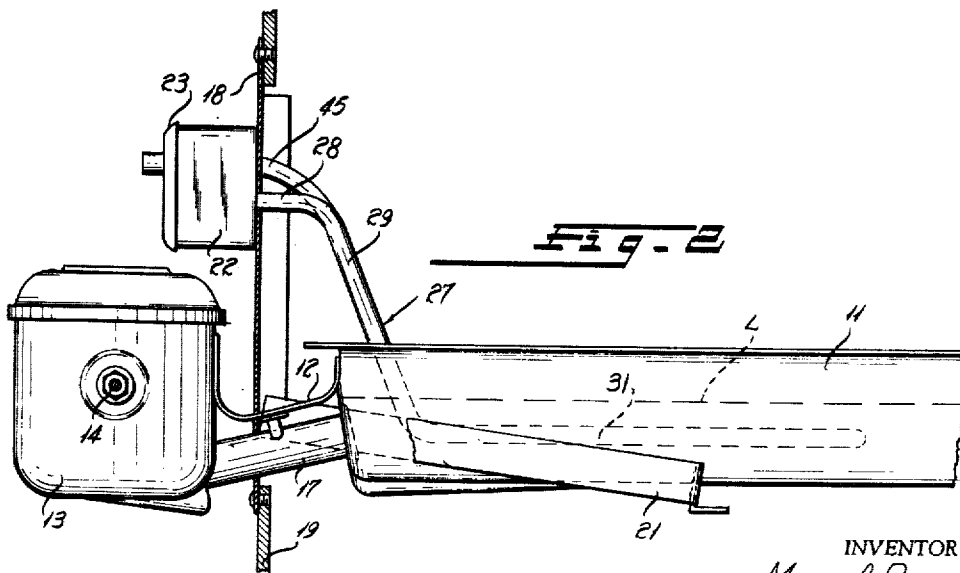
M. A. POWERS

3,087,485

HUMIDIFIERS

Filed Sept. 6, 1957

3 Sheets-Sheet 1



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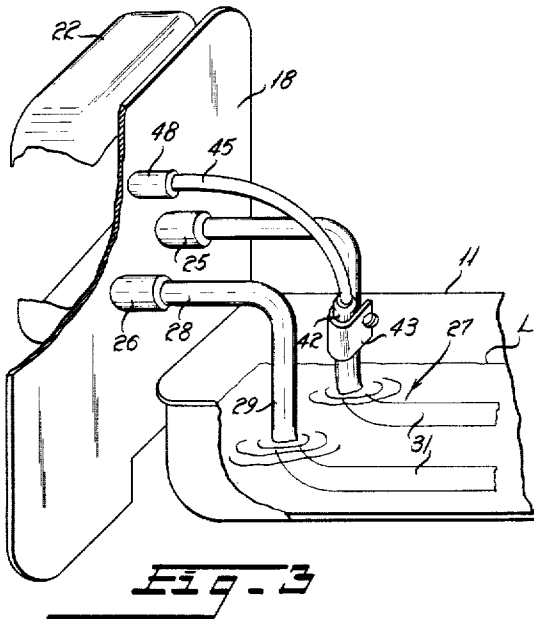


Fig. 4

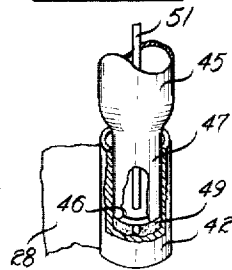
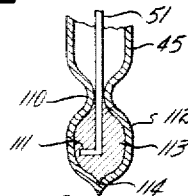
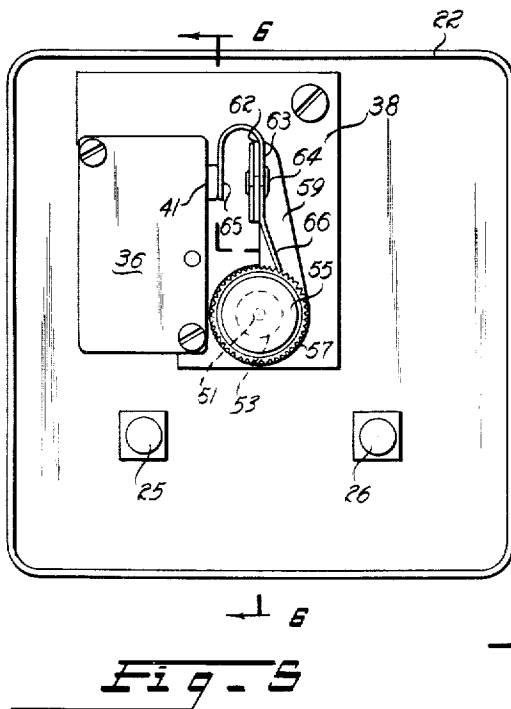
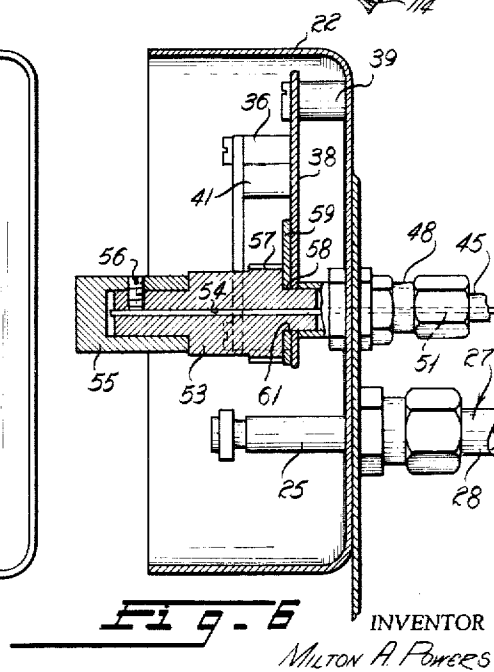


Fig. 4A



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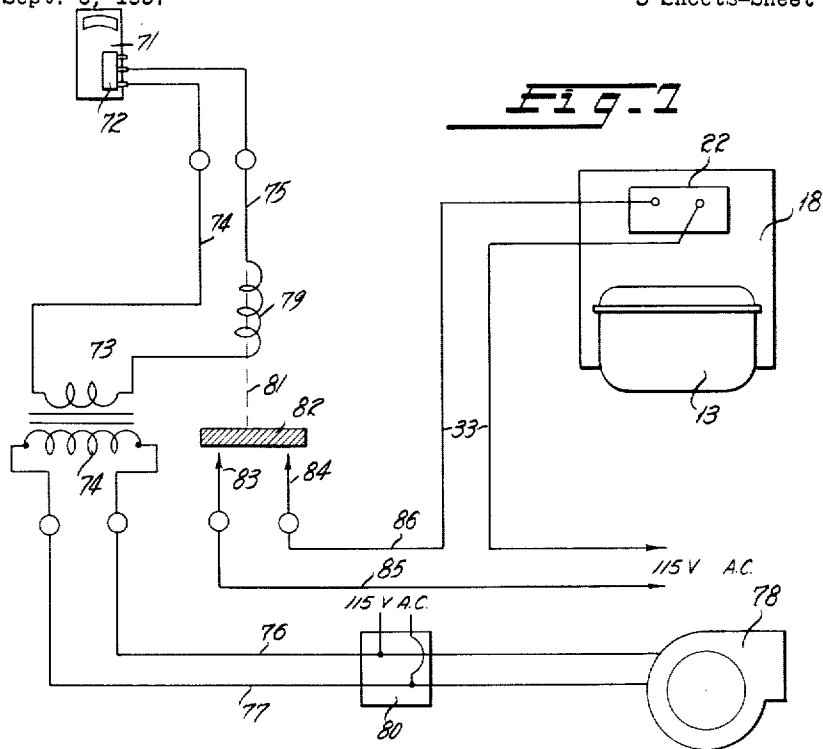
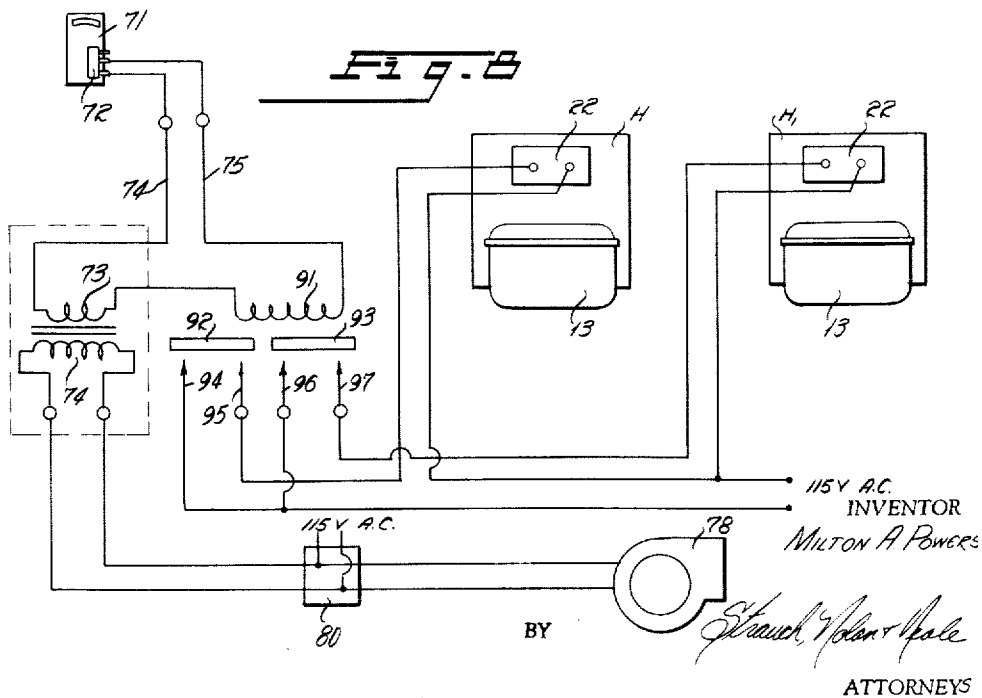
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HUMIDIFIERS

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Filed Sept. 6, 1957, Ser. No. 682,527
10 Claims. (Cl. 126—113)

This invention relates to humidifiers and associated controls, and is particularly concerned with arrangements for electrically heating the water to be evaporated and preventing overheating in a system wherein the water to be evaporated is electrically heated only during actuation of the warm air furnace or the like associated therewith.

The invention contemplates in a preferred embodiment a novel structural arrangement and mode of operation wherein a forced warm air furnace system or the like has a humidifier receptacle disposed in the air path from or to the furnace, and the water in the receptacle is electrically heated to control the evaporation rate, safety features being introduced in some aspects of the invention to prevent such electrical heating when the furnace blower fan is inoperative or when the heating element becomes overheated.

A major object of the invention is to provide a novel electrically heated humidifier assembly.

It is another object of the invention to provide a humidifier arrangement for a warm air furnace or the like wherein novel controls are provided to prevent overheating.

It is a further object of the invention to provide a humidifier system associated with a warm air furnace wherein the humidifier contains an electrical water heating unit which can be energized only when the furnace is in operation.

A further object of the invention is to provide a novel humidifier assembly for a warm air furnace or the like wherein an electrical heater unit is normally submerged in the water to be evaporated and a safety switch is provided in the heater unit circuit to automatically open the circuit when the unit overheats.

It is a further object of the invention to provide a novel switch control arrangement in a humidifier assembly wherein a normally open switch is held closed during normal humidifier operation by a spring biased thermally responsive system associated with an electrical water heater unit in the humidifier assembly, which system acts to open the switch upon overheating of the unit.

A further object of the invention is to provide a novel thermally responsive switch control wherein a heat sensitive element located at a relatively inaccessible place is connected in a novel manner to a switch that is located remotely therefrom.

A further object of the invention is to provide a novel control system wherein a switch actuator is connected to a heat sensitive device at a heating zone by a torsion spring coupled at one end to the actuator and anchored at its other end within a heat fusible mass in the device.

It is a further object of the invention to provide a remote switch control for general application wherein it is desired to provide a heat sensitive element at a distant relatively inaccessible point and a torsion stressed wire

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housed mainly in a rugged tube not easily susceptible to easy damage connected between the element and the switch so that the switch will be actuated upon a predetermined change in condition at the heat sensitive element.

A further object of the invention is to provide a novel control system circuit wherein a humidostat in calling for increased humidity functions only when the system blower is in operation, but while so doing will not appreciably increase the electrical load on the blower circuit but rather will obtain needed further power for an electrical element in the humidifier from an independent circuit of adequate capacity.

Further objects of the invention will appear as the description proceeds in connection with the appended claims and the annexed drawings wherein:

FIGURE 1 is a perspective assembly view of a humidifier according to a preferred embodiment of the invention;

FIGURE 2 is a side elevation view partly in section of the assembly of FIGURE 1;

FIGURE 3 is a perspective fragmentary view showing the attachment of the thermally responsive switch control to the heater unit;

FIGURES 4 and 4A are fragmentary views partly in section showing optional forms of the heater end of the torsion spring control for the safety switch;

FIGURE 5 is a front elevation of the safety switch;

FIGURE 6 is a section on line 6—6 of FIGURE 5; and

FIGURES 7 and 8 are circuit diagrams for incorporating the humidifier in desired association with a hot air furnace control.

The humidifier of the preferred embodiment of the invention comprises an open-topped tray-like water receptacle 11 that is rigid with a bracket 12 supporting a float chamber 13 having a water inlet 14 leading to a valve assembly 15 controlled by a float 16. A conduit 17 extends from the bottom of chamber 13 into the lower portion of receptacle 11, and the arrangement is such that float 16 maintains such a level of water in the float chamber as will maintain the level indicated at L in FIGURE 2.

A panel 18 is adapted to be peripherally secured over a suitable aperture in the wall 19 of a warm air furnace into the ducts carrying the air to or from such furnace so that when installed the flat-bottomed receptacle is disposed in the path of flow of the air being blown through the system. It works equally well in either warm air from the furnace or cool air returning to the furnace, or within the furnace itself as the heat for evaporation is supplied independently by the electric heating element within the humidifier. A suitable support bracket 21 extends rigidly from the panel to the underside of the receptacle 11 for added support.

Secured to the front or external face of panel 18 is a housing 22 having a front cover 23 removably secured thereto as by screws 24. Housing 22 contains two terminals 25 and 26 representing the opposite ends of an essentially U-shaped electrical resistance type heater unit 27, the resistance element being enclosed and insulated within a hollow stainless steel tube. Each leg of the unit has a horizontal portion 28 projecting through the rear hous-

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ing wall, a downwardly extending portion 29 extending into the receptacle 11, and a horizontal portion 31 disposed above and parallel to the bottom surface of receptacle 11, with a rounded end portion 32 joining the horizontal portions 31 near the outer end of the receptacle.

The unit 27 is so disposed that the lower ends of portions 28 and the horizontal portions 31 are below the normal water level L in the receptacle.

A two wire electric power supply cable 33 enters the side of housing 22. One wire 34 is connected directly to terminal 25. The other wire 35 is connected through a biased-open switch unit 36 which wire 37 goes to terminal 26. Thus when switch 36 is closed the input circuit to heater unit 27 may be completed by closure of a relay switch as later described and the unit will be energized to heat and evaporate water in receptacle 11. However for most efficient operation the electrical heater is such that its portions above the normal water level do not produce appreciable heat in normal operation. This is accomplished by providing the usual coiled heat producing resistance wire within the immersed horizontal heater unit portion 31 and only part way up the vertical portions 29, and providing a substantially straight non-heat producing wire through the remainder of portions 29 and 28 to the terminals 25 and 26.

Thus little heat is released from the heater unit above the water level, and the purpose of this arrangement will presently appear.

As shown in FIGURE 6, switch unit 36 is mounted on a plate 38 fixed on posts 39 outstanding from the back wall of housing 22, and a control button 41 is normally spring biased outwardly of switch unit 36 to switch open position. This is a conventional type micro-switch and it is not closed unless button 41 is depressed as shown in FIGURE 5.

The invention contemplates a switch closing arrangement which automatically releases when the temperature of rod unit 27 exceeds a predetermined amount.

This arrangement may comprise a thermally responsive device best shown in FIGURE 4 wherein a small metal cup 42 is clamped in tight surface contact with an upright portion 29 of the heater unit. A suitable U-shaped metal clamp 43 tightened by screw 44 secures cup 42 in place non-rotatably on the heater unit. As shown in FIGURES 1 and 3 the clamp 43 may attach cup 42 to either upright of the heater unit 27. The cup is closed at its bottom and at its open top receives the lower end of a rugged but relatively flexible metal tube 45 having an end wall 46. Preferably the lower end of tube 45 is shaped at 47 to have a tight friction fit within cup 42. Cup 42 may be located above or below the water level of the receptacle. The upper end of tube 45 is secured within a hollow thimble 48 in the back wall of housing 22.

The bottom of cup 42 below wall 46 is filled with a slug 49 of low melting point metal such as solder, which at normal room and operating temperatures is frozen solid to rigidly grip and attach to cup 42 the lower end of a torsion spring consisting of a length of spring steel wire 51 that has its lower end extending freely through wall 46 to be imbedded in the solder body. The end of the wire within the solder may be curled, spiraled or otherwise formed to have a large area engagement with the solder for secure anchoring therein and also to prevent its withdrawal through wall 46.

As shown in FIGURE 6, a setting member is rotatably mounted on plate 38 and the end of thimble 48 and comprises a shaft 53 which is hollow at 54 to freely pass the other end of wire 51. A knurled cap 55 is mounted on the reduced end of shaft 53 and a radial set screw 56 secures cap 55 on the shaft and anchors the end of wire 51 to shaft 53.

Shaft 53 is integrally formed with an annular ratchet tooth section 57, and it has a cylindrical bearing section 58 between teeth 57 and plate 38. An arm 59 is freely journaled on bearing 58, this arm essentially being a flat

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sheet metal stamping having an enlarged end formed with bore 61 adapted to fit about bearing 58.

At the upper end of arm 59 a rigid tab 62 is provided at right angles, and a stiff metal leaf spring element 63 is fixed on tab 62 as by rivet 64. Spring leaf 63 is formed at its upper end with a U-shaped terminal having a flexible arm 65 engaging switch button 41. At its lower end element 63 is formed with an inclined terminal 66 the lower straight edge of which engages the ratchet teeth 57.

The wire 51 is a torsion spring that is anchored at opposite ends to solder slug 49 and shaft 53. The solder anchored end is normally fixed. Spring 51 is energized by manually rotating shaft 53 clockwise in FIGURE 5 as permitted by flexible leaf 66 ratcheting over teeth 57 which are suitably oriented. When the spring 51 is under torsion, shaft 53 is released by the operator and the spring now tends to rotate shaft 53 counterclockwise. However in this direction of rotation of shaft 53 teeth 57 abut the edge of spring leaf 66 and arm 59 is thereby caused to rotate counterclockwise until flexible arm 65 is engaged with button 41. In operation spring 51 is sufficiently energized that it effectively holds switch button 41 in depressed condition so as to close the circuit, spring arm 65 being compressed and steadily biasing the button 41 to the left in FIGURE 5.

This FIGURE 5 position of the switch and arm 59 once set is maintained during normal operation, and energization of the heater unit 27 depends on the external controls, later to be described. During normal operation, the electrical heating element being submerged under the water and the temperature of the position of the heater normally above water being such as not to produce appreciable heat as mentioned earlier, the resultant temperature of the solder pot does not greatly exceed 212° F. However, should all water evaporate from receptacle 11 the temperature of heater unit 27 will rise above a predetermined amount and this will melt the solder slug 49 to release the inner end of torsion spring 51. In actual practice, common 50—50 solder having a melting point of approximately 361° F. functions effectively. This removes the force compression spring leaf 65 and holding the button depressed, and now the switch button spring inside the unit 36 acts to extend the button and the electrical circuit to heater unit 27 is broken.

As the heater unit 27 now cools the solder resolidifies about the end of wire 51 but this does not reset the switch. It is necessary to manually rotate shaft 53 to do this, and usually this is done after the condition which causes the heater unit 27 to overheat has been corrected.

Referring to FIGURE 7, the usual settable room humidostat is indicated at 71 adjustable to make its switch 72 close at a predetermined low room humidity and open at a predetermined higher room humidity. Switch 72 is in a 24 volt circuit comprising the transformer secondary 73 and leads 74, 75. The transformer primary 74 is in the main circuit consisting of leads 76, 77 that pass through a junction box 80 where the 115 volt A.C. control circuit for the furnace blower 78 is joined.

A relay coil 79 is provided in lead 75 and the relay armature 81 carries a switch bar 82 adapted to bridge switch points 83, 84 on the ends of leads 85, 86 respectively from an independent 115 volt A.C. source. Lead 86 extends as cable 33 of FIGURE 1 up to the control housing 22 as indicated.

In operation the junction box 80 is energized to start the furnace blower 78 when the room thermostat calls for heat. Simultaneously this energizes the humidostat circuit through the transformer 73, 74 and when the humidity drops below the desired value relay 79, 81 closes the normally open switch at 82, 83, 84 to thereby energize the heater unit 27 in the water receptacle 11. Thus heater unit 27 may be energized only when the furnace blower is operating to blow warm air past receptacle 11.

FIGURE 8 illustrates an embodiment wherein two

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humidifier units H and H₁ may be used in the furnace that contains blower 78 and junction box 80 as in the FIGURE 7 embodiment if increased humidification capacity is desired. Here the relay coil 91 in the 24 volt circuit lead 75 controls two armatures carrying switch bars 92 and 93 adapted to bridge respectively switch points 94, 95 and 96, 97 controlling the supply of current to the humidifiers. This also enables the use of humidifiers of different size to attain a desired evaporation rate.

In the invention described it will be observed that the water to be evaporated into the warm air stream produced by blower 78 in the usual hot air furnace manner is maintained at a constant level in the evaporator receptacle 11 and is heated by rod unit 27 so as to be more readily evaporated. The safety switch at 36 insures against heater unit 27 being active when there is no water in receptacle 11, and the FIGURES 7 and 8 circuits insure that heater unit 27 cannot be energized unless the furnace blower is being operated.

FIGURE 4A shows an alternative form of thermally responsive element that may be more practical commercially. The end of metal tube 45 is here formed to provide the solder cup to be held by clamp 43. The tube 45 is cut off at proper length and a reduced neck section 110 formed by spinning. Wire 51 passes freely through neck 110 and its lower end is bent angularly at 111 within the cup-forming section 112. This bent section 111 insures a large area grip with the solder body 113 and prevents pull of the wire out of the cup when the solder melts. Then molten solder is introduced into the cup at 113, and it is prevented from entering tube 45 by neck 110. Then the end of the tube is spun to close it at wall 114 and complete the cup wherein the solder solidifies to grip the end of wire 51. Wire 51 now cannot rotate until the solder is again molten.

Regardless of which thermally sensitive element is used its preferable location is on the upper riser portion of the heater rod where the non-heat producing wire passes through above the normal water level. When, due to lack of water the rod heater 27 becomes too hot, this heat readily conducts up the metal tubing and there is no appreciable lag in action of the heat responsive solder joint.

The invention furthermore comprises basically the disclosed humidifier and controls of FIGURES 1 and 7 (or 8) without the safety switch. In such the electrical input leads from the transformer-relay are connected directly to terminals 25 and 26, instead of through the switch assembly shown in FIGURE 1, and the tube 45 and heat sensitive element of FIGURES 4 or 5 are not used. Further this humidifier construction is part of the invention whether or not those electrical input leads are connected to a humidostat, as all will appear in the claims.

The invention may be embodied in other specific forms without departing from the spirit or essential characteristics thereof. The present embodiments are therefore to be considered in all respects as illustrative and not restrictive, the scope of the invention being indicated by the appended claims rather than by the foregoing description, and all changes which come within the meaning and range of equivalency of the claims are therefore intended to be embraced therein.

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

1. In combination, a heat sensitive device adapted to be in a heated zone, an electrical circuit control switch located distantly from said device and having an actuator, a torsion spring interposed between said device and actuator, said spring consisting essentially of a length of wire fixed at opposite ends to said device and actuator, said wire being fixed to said device by being imbedded in a body of fusible metal that melts only at a predetermined high temperature, means for placing said wire under torsional stress between said actuator and said end anchored in said device to hold said switch in circuit

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closed condition while said end is anchored in said device, and a stationary tubular shield for said wire between said device and said actuator.

2. In the combination defined in claim 1, said tubular shield being a length of tubing closely housing and directing said wire and permitting free rotation of the wire therewith, and said tubing being bendable to assume a desired contour without interfering with the action of said spring so that the latter may connect the actuator and device when they are out of alignment.

3. In combination with a switch having an actuator, a heat sensitive device comprising a contained body of normally solid heat fusible material adapted to be located in a heated zone, and motion transmitting control means operatively connecting said device to said switch comprising a torsion wire spring secured at one end to said actuator and imbedded at the other end within said body, and means for twisting said wire to place it under torsional stress between the actuator and said end imbedded in said material for urging said actuator to one switch control position while said other end of the wire is so imbedded, said stress being effectively released when said material becomes fused.

4. The combination defined in claim 3, wherein said fusible material is solder having a melting point above the boiling point of water.

5. The combination defined in claim 3, wherein said means for twisting said wire comprises a manually operable uni-directionally rotatable member.

6. In combination in a humidifier, a biased-open electric circuit control switch having an actuator, a receptacle for containing liquid to be evaporated, and electrical heater unit extending into said receptacle and adapted to be at least partially submerged in said liquid, a heat sensitive device mounted on said unit remote from said switch, a length of torsion spring wire connected at opposite ends to said device and said actuator, manually operated means connected to said actuator for stressing said spring, means providing an operative connection between said actuator and said switch adapted to exert a circuit closing force on said switch when the spring has been stressed, and means in said device for automatically releasing the torsion spring when the temperature at said device exceeds a predetermined amount.

7. In the combination defined in claim 1, manual means for selectively actuating said means for placing the wire under torsional stress.

8. A switch control assembly for an electrical humidifier liquid heater unit comprising a normally open switch adapted to be connected in the heater unit circuit, a normally solid heat fusible body adapted to be mounted on said heater unit, a rotatable arm, a torsion spring wire having an end imbedded in said body, a rotatable member to which the other end of said wire is secured, means connecting said arm to rotate with said member in one direction, and manually operable means for rotating said member in said one direction and holding it in rotated position for energizing said spring and biasing said arm into switch closed coupling with said switch, said body being fusible only at a predetermined temperature above the boiling point of said liquid for releasing said spring to permit opening of the switch.

9. The switch control assembly defined in claim 8, wherein said member is a manual handle fixed to one end of said wire, and said connection of the arm to said member includes ratchet means limiting rotation of said arm to one direction.

10. In a humidifier, a receptacle adapted to contain a body of liquid to be evaporated, a heating unit of the electrical resistance type mounted in said receptacle to be at least partially submerged in said liquid, means for maintaining a normal liquid level in said receptacle, and means including a switch in the energizing circuit for said unit, operator means for normally holding said switch

closed to permit energization of said unit, automatic

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control means including heat sensitive means mounted directly on said unit for automatically releasing said operator means to inoperative condition upon said unit attaining a predetermined high temperature whereby said switch may automatically open to deenergize said unit to prevent overheating, said operator means remaining in said inoperative condition until manually reset, said unit having a heat conductive non-heat producing portion and said control means being mounted directly on said portion of said unit so as to be immediately responsive to temperature variations in said unit, and manual means for resetting said operator means to hold said switch closed.

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