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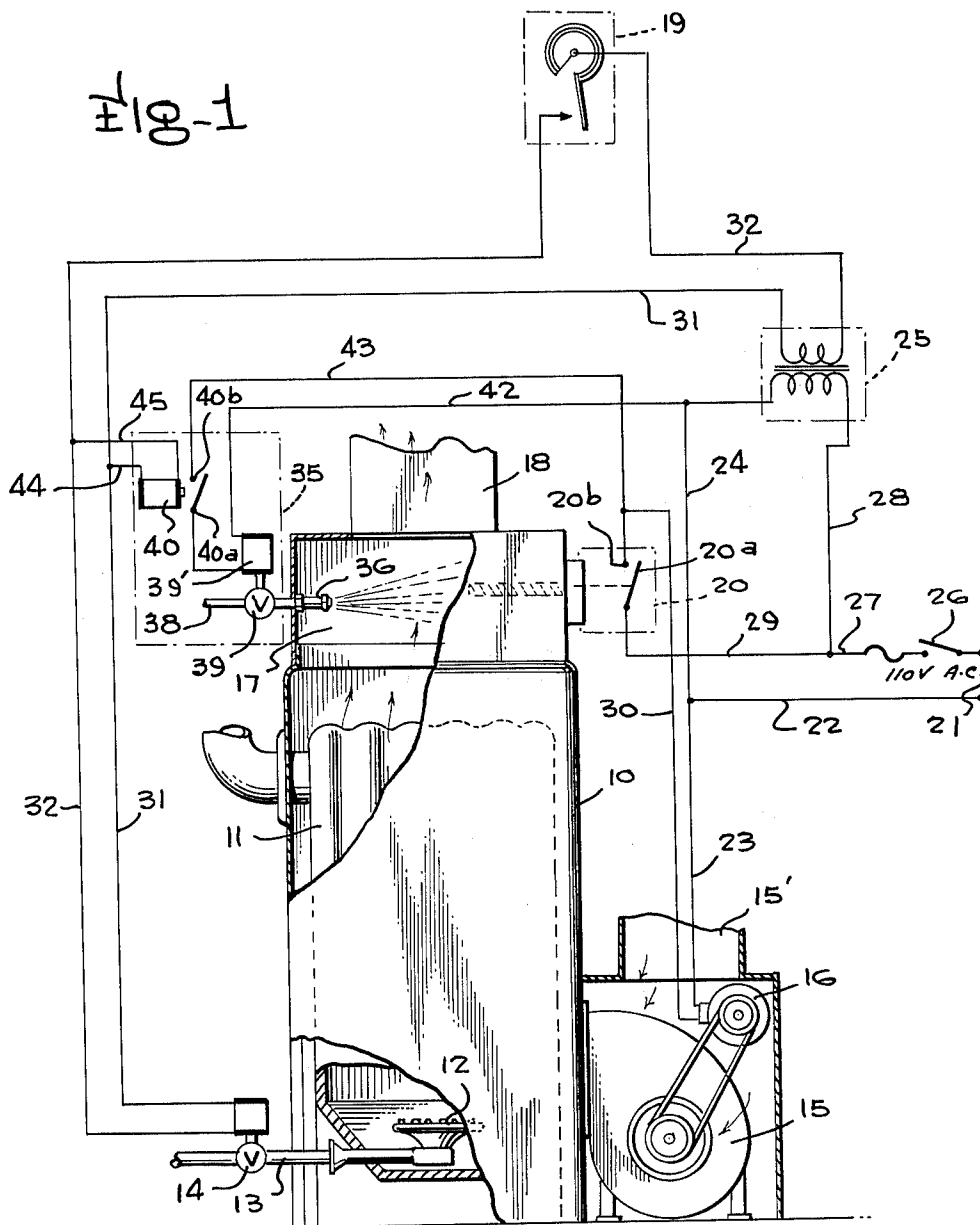
R. M. DAVIDSON

3,262,444

SPRAY HUMIDIFIER FOR HEATING SYSTEMS

Filed Sept. 23, 1965

3 Sheets-Sheet 1



INVENTOR

RICHARD M. DAVIDSON

BY
Mason, Fenwick & Lawrence
ATTORNEYS

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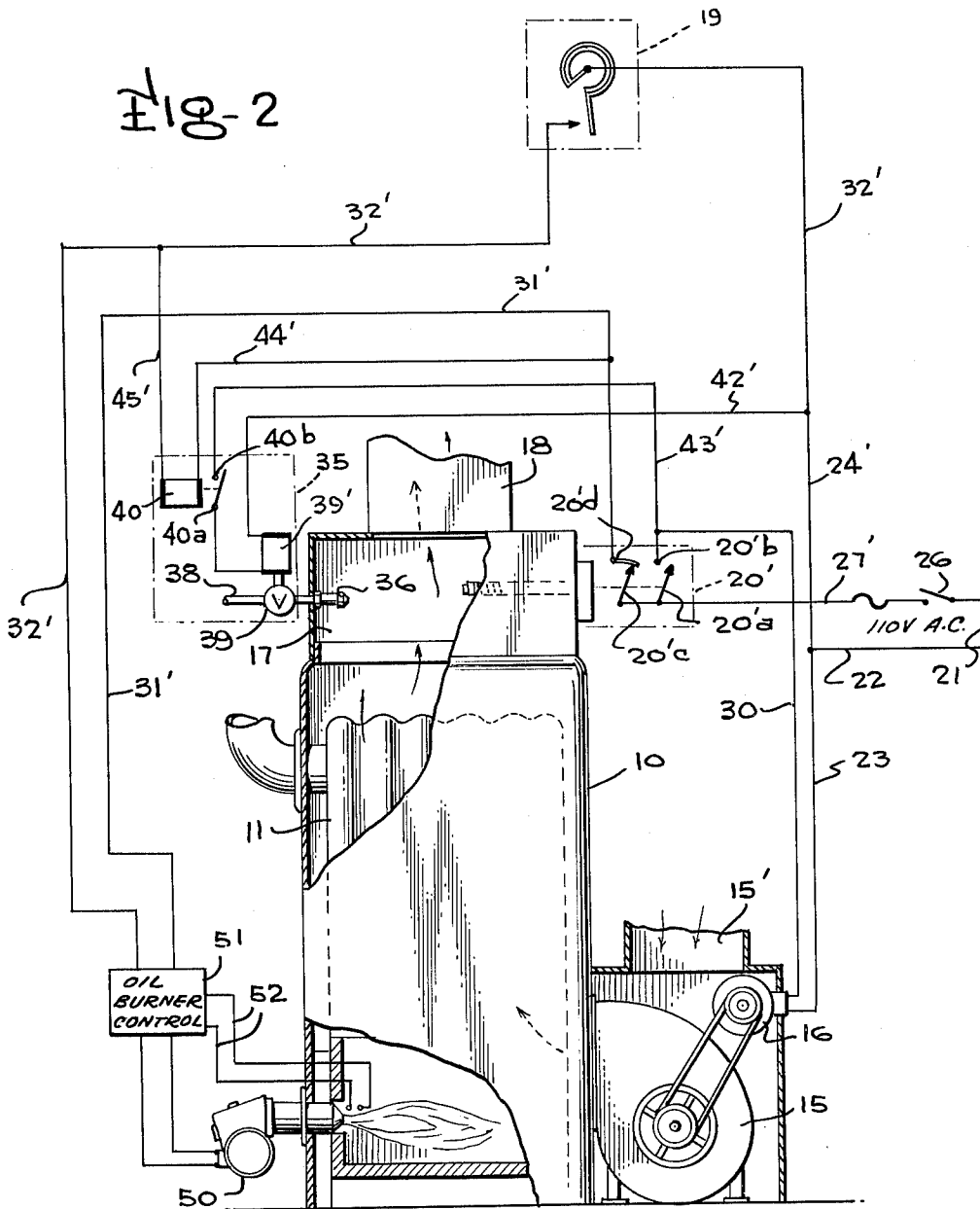
R. M. DAVIDSON

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Mason, Fenwick & Lawrence
ATTORNEYS

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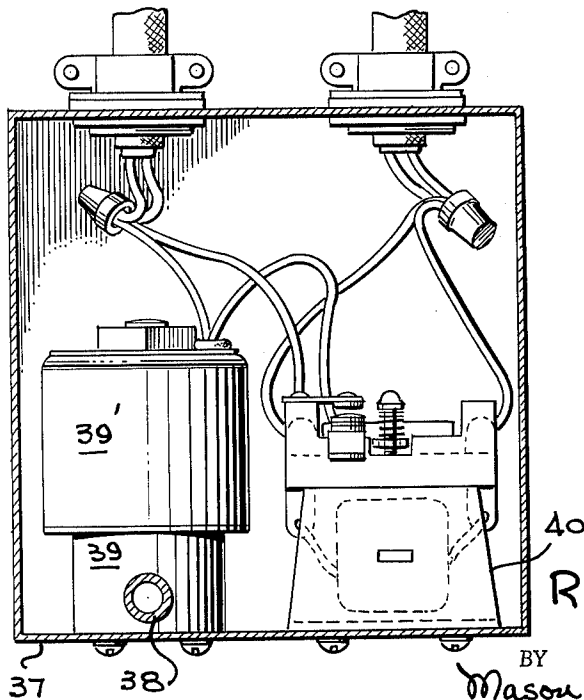
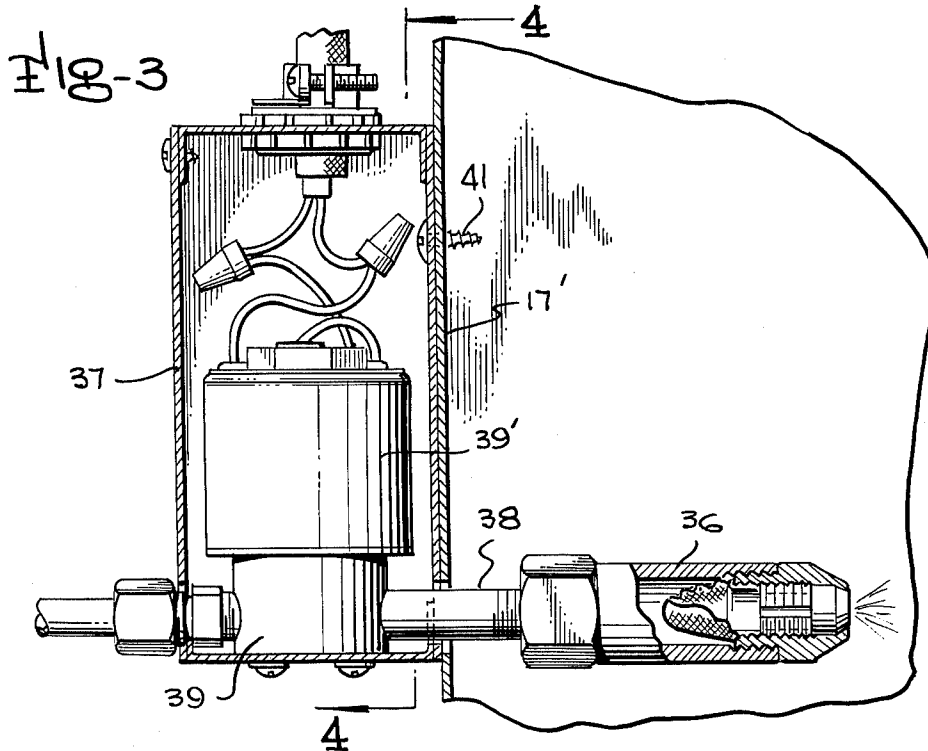
R. M. DAVIDSON

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3 Sheets-Sheet 3



INVENTOR

RICHARD M. DAVIDSON

BY
Mason, Fenwick & Lawrence
ATTORNEYS

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SPRAY HUMIDIFIER FOR HEATING SYSTEMS

Richard Moore Davidson, Winston-Salem, N.C., assignor to Aqua-Mist, Incorporated, Winston-Salem, N.C., a corporation of North Carolina

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5 Claims. (Cl. 126—113)

The present invention relates in general to air humidifiers, and more particularly to a humidifier spray unit for attachment to or incorporation in a warm air furnace to introduce adequate humidity to air being heated in the bonnet of the furnace prior to its discharge into the living space served by the furnace.

Heretofore, various means have been employed to supply water vapor to heated air in warm air heating systems to humidify the air. These have customarily involved water receiving receptacles in the bonnet or riser of a warm air furnace exposed to the warm air to evaporate water vapor into the air which becomes rapidly corroded or faulty and unreliable in operation. Spray diffusing nozzle systems discharging a mist or fog of water droplets into the bonnet have also been used, usually with a target plate, collecting trough, or other facility to collect unvaporized discharge from the nozzle, but such devices have usually required an additional humidistat or hygrometer as a component of the control system for the humidifier and have been found to involve unwanted discharge, such as drips, from the nozzle which accumulate in the furnace and produce corrosive precipitate solids adversely affecting the life or operation of the furnace. These prior art spray humidifier systems have usually required complex special controls in addition to the usual controls for the furnace and customarily produce spray during the entire period of operation of the furnace blower assuming the humidistat is signalling that greater humidity is required. Since the blower control switch for furnaces remains in circuit-closing condition from a selected blower cut-on temperature considerably below the burner cut-off temperature until bonnet temperature falls below the blower cut-off temperature to a level not far above 100° F., there is not an adequate temperature in the bonnet in such systems when the blower and spray are simultaneously cut off to insure that all the spray droplets will be vaporized and carried off through the ducting to the rooms to be served.

An object of the present invention is the provision of a novel spray humidifier for warm air furnaces which is simple and compact in construction, can be manufactured inexpensively, and is simple to install in existing furnaces.

Another object of the present invention is the provision of a novel spray humidifier system for warm air furnaces which may be installed in warm air furnaces of either the gas-fired, oil-fired, stoker coal-fired, electric resistance heating-fired, or heat pump-fired types using the existing fuel supply and blower motor controls, customarily employed in such furnaces, and which does not require the addition of a humidistat or hygrometer to regulate operation of the spray system.

Another object of the present invention is the provision of a novel spray humidifier system for warm air furnaces wherein a spray nozzle discharges a mist or fog of water droplets into the bonnet of the furnace only during the portion of the furnace operating cycle between initiation of blower operation and termination of fuel supply to the furnace, to insure complete vaporization of the water droplets and delivery of the same to the living space served by the furnace before termination of blower operation in each operating cycle.

Other objects, advantages and capabilities of the present invention will become apparent from the following detailed description, taken in conjunction with the ac-

companying drawings illustrating preferred embodiments of the invention.

In the drawings:

FIGURE 1 is an elevation view of a warm air furnace of the gas-fired type having the spray humidifier system of the present invention incorporated therein and including a schematic diagrammatic illustration of the electrical circuitry associated therewith, parts of the furnace being broken away to illustrate interior portions thereof;

FIGURE 2 is an elevation view of a warm air furnace of the oil-fired type having the spray-humidifier system of the present invention incorporated therein and including a schematic diagrammatic illustration of the electrical circuitry associated therewith, parts of the furnace being broken away to illustrate interior portions thereof;

FIGURE 3 is a vertical section view through the spray humidifier unit of the present invention assembled on an adjacent wall of a furnace bonnet chamber, illustrating the physical arrangement of the parts of the humidifier unit; and

FIGURE 4 is a vertical section view taken along the line 4—4 of FIGURE 3.

Referring to the drawings, wherein like reference characters designate corresponding parts throughout the several figures and particularly to FIGURE 1 illustrating the spray humidifier unit in a gas-fired warm air furnace installation, there is shown a conventional gas-fired warm air furnace 10 having the usual fire-box or combustion chamber 11 therein including a burner 12 in the lower region thereof supplied with gas-fuel through the supply conduit 13 controlled by a normally closed solenoid valve 14. The usual blower or fan 15 driven by an electric motor 16 receives air from a return duct 15' in the usual manner and propels the same into the air space provided in the furnace 10 between the fire-box 11 and the jacket or outer shell of the furnace to be heated by heat exchange with the fire-box and rise into the bonnet chamber or riser 17 above the fire-box 11 and through the outlet duct 18 to the registers or warm air ducting system in the living space served by the furnace.

The fuel supply valve 14 and blower motor 16 are automatically controlled in the usual manner by a room thermostat 19 disposed in the living space to be served by the heating system and by a conventional thermostatic bonnet switch 20 responsive to the temperature of the air within the bonnet 17 and operative in the usual manner to close upon attainment of a selected blower cut-on temperature, for example about 120° F., and to cut off or return to normal open circuit condition when the bonnet temperature falls to a somewhat lower value than the blower cut-on temperature. To this end, the conventional commercially available supply voltage, for example nominal 110 volts alternating current, is applied across input terminals 21, one of which input terminals is connected by lead 22 and branch lead 23 to one terminal of the blower motor 16 and through lead 22 and branch lead 24 to one end of the primary winding of step-down transformer 25. The other input terminal 21 is connected through master switch 26 and fused line 27, to line 28 connected to the other end of the primary winding of transformer 25, and through lead 29 to the normally opened contacts 20a, 20b of bonnet switch 20, contact 20b being connected through lead 30 to the other terminal of the blower motor 16. The secondary winding of step-down transformer 25, providing a suitable lower voltage for operation of the solenoid coil of fuel supply valve 14, is connected through leads 31 and 32 and through the contacts of the room thermostat 19 interposed in lead 32, to the solenoid coil of fuel supply valve 14.

The humidifier unit of the present invention, indicated generally by the reference character 35, is of the physical construction more clearly illustrated in FIGURES 3 and

4, and comprises essentially a fog or mist producing nozzle 36 projecting from substantially rectangular housing 37 by means of a water supply pipe 38 extending through the lower portion of the housing 37 and regulated by a conventional solenoid valve 39 having a coil 39' fixed within the housing. The housing 37 also encloses a relay 40 fixed within the housing 37 having normally open contacts 40a, 40b. This unit is readily assembled on a wall of the bonnet chamber 17, for example the wall 17' illustrated in FIGURE 3, by means of self-tapping screws 41 or other conventional fasteners extending through the wall of the housing 37 adjoining the furnace and through the bonnet wall 17'. A suitable opening must, of course, be provided in the bonnet wall 17' through which the water supply pipe 38 can extend.

This highly compact and simple humidifier unit 35 is intercoupled to the conventional controls for the warm air furnace by connecting one terminal of the coil 39' of solenoid valve 39 through lead 42 to branch lead 24 and supply lead 22, and connecting the other terminal of coil 39' through relay contacts 40a, 40b and lead 43 to the terminal 20b of bonnet thermostatic switch 20. The coil of relay 40 is connected by leads 44, 45 to leads 31, 32 regulating the fuel supply solenoid valve 14.

By this arrangement the humidifier unit 35 is regulated by the conventional controls found on the gas-fired warm air furnace to discharge water spray into the bonnet chamber only during the period between blower cut-on by bonnet switch 20 and termination of fuel supply through solenoid valve 14. Relating this action to the circuit illustrated in FIGURE 1, it will be observed that when the contacts of room thermostat 19 close signifying demand for heat to the living space, power is supplied from transformer 25 through leads 31, 32 to the coil of solenoid valve 14 to admit fuel through supply line 13 to burner 12, initiating combustion in the furnace. Completion of the circuit through leads 31, 32 also applies power through leads 44, 45 to the coil of relay 40, closing its contacts 40a, 40b. However, this closure of relay contacts 40a, 40b does not energize the humidifier unit valve 39, since its supply circuit is broken by the open contacts 20a, 20b of bonnet thermostatic switch 20.

However, when the temperature of the air in the bonnet chamber 17 rises to the blower cut-on level, due to combustion at burner 12 and heat exchange with the air in the bonnet chamber, the bonnet switch contacts 20a, 20b close responsive to attainment of the blower cut-on temperature (or example, about 120° F.) in the bonnet chamber completing the supply circuit through leads 42, 43 and the now closed relay contacts 40a, 40b to energize valve solenoid 39' and open valve 39 to admit water through supply pipe 38 to nozzle 36 and discharge the same into the bonnet chamber 17 in the form of a fine droplet fog or mist. As the temperature continues to rise in bonnet chamber 17, the humidifier supply valve 39 stays open until the heat demand in the living space is satisfied, whereupon the contacts of room thermostat 19 open, breaking the supply circuit to fuel valve 14 and relay 40 to close valve 14 and open relay contacts 40a, 40b. Opening of relay contacts 40a, 40b breaks the supply to humidifier valve solenoid 39', closing valve 39 and terminating water supply to the nozzle 36. However, the blower 15 continues to operate, propelling the heated air and any entrained water droplet therein into the living space until the falling temperature in the bonnet chamber 17 reaches the blower cut-off temperature where the bonnet switch contacts 20a, 20b open and break the supply circuit to the blower motor 16.

FIGURE 2 illustrates a circuit arrangement for the humidifier unit incorporated in an oil fired warm air furnace installation, wherein those components which are identical to components of the FIGURE 1 system are designated by the same reference character and components or leads which functionally resemble components of the FIGURE 1 system have reference characters which

are the primes of reference characters used in FIGURE 1. In the FIGURE 2 system, the oil burner is shown at 50 and is regulated by a conventional oil burner control unit 51 which also supplies electrical energy to a burner ignition circuit 52. The bonnet switch 20' in this circuit has a first set of contacts 20'a, 20'b corresponding to the blower control contacts 20a, 20b of the first embodiment and an additional set of contacts 20'c, 20'd which regulate the power supply to the burner control 51 through lead 31'. The contacts 20'c, 20'd are normally closed, and may be of the high limit cut-off type as indicated schematically by the arcuate contact strip 20'd in FIGURE 2, to open the circuit through contacts 20'c, 20'd when the bonnet temperature reaches a selected high value well above the blower cut-on temperature. In this circuit, the room thermostat 19 is in lead 32', between the oil burner control 51 and supply lead 32' connected through lead 24' to input lead 22. The relay coil 40 of the humidifier unit 35 is connected by leads 44', 45' to leads 31' and 32' (or alternatively across the pair of leads from burner control unit 51 to burner unit 50, if desired) and valve solenoid 39' is connected by lead 42' to lead 24' and through contacts 40a, 40b and lead 43' to contact 20'd of bonnet switch 20'.

This oil fired furnace system operates in much the same manner as the previously described gas fired furnace system, the closing of the contacts of room thermostat 19 completing a supply circuit through lead 32', and through lead 27', normally closed bonnet switch contacts 20'c, 20'd and lead 31', to the oil burner control unit 51 to energize the burner 50 and ignite the fuel. This completion of the supply through leads 31', 32' also energizes relay 40 through leads 44', 45' to close relay contacts 40a, 40b. The circuit to valve solenoid 39' is not completed, however, until bonnet switch contacts 20'a, 20'b close responsive to attainment of blower cut-on temperature in the bonnet chamber 17, whereupon solenoid 39' is energized to open valve 39 and discharge the water fog or mist through nozzle 36. When the room temperature demand is satisfied, as signaled by opening of the contacts of room thermostat 19, or when the bonnet temperature reaches a high enough level to open bonnet switch contacts 20'c, 20'd, whichever first occurs, the supply circuit through either lead 32' or 31' is broken, cutting off the burner 50 and de-energizing relay 40 to open its contacts 40a, 40b and close valve 39. The blower 15 continues to operate, purging the bonnet chamber 17 of warm air and any entrained water droplets until the bonnet temperature falls enough to open contacts 20'a, 20'b.

It will be appreciated that the humidifier unit 35 may also be employed in a stoker coal fired furnace installation in the same manner as with the oil fired furnace system described above, substituting a conventional stoker control box and motor driven stoker for the burner control 51 and oil burner unit 50 and connecting the humidifier unit 35 in the same way as in the oil fired furnace system. Also the bonnet switch of the gas-fired system previously described may include high limit contacts similar to contacts 20'c, 20'd of FIGURE 2 to cut-off the supply circuit to the fuel valve and relay 40 if the bonnet temperature reaches the high cut-off level before the contacts of room thermostat 19 open.

It will be apparent from the foregoing description that the simple and compact humidifier unit is intercoupled with the ordinary fuel supply control circuit and blower control circuit of conventional gas fired, oil fired, or stoker coal fired warm air furnace installations in such a manner that the water spray is discharged into the bonnet chamber only during the period when the bonnet temperature is in the ascending portion of its cycle between blower cut-on temperature and fuel cut-off, insuring sufficient heat in the bonnet chamber to produce instant evaporation of the water spray. When the room thermostat is satisfied or the high fuel cut-off temperature is reached, the water supply to the spray nozzle is instantly cut-off

concurrently with termination of fuel supply, while the blower continues to operate until the bonnet temperature falls below the blower cut-off level, continuing drying of the bonnet chamber as the heat built up in the bonnet is distributed to the living space, and effectively purging the bonnet of any traces of moisture which otherwise might have remained therein. By interconnecting the humidifier unit relay and valve solenoid with the standard controls of the furnace in the manner described, the use of a humidistat or other special controls is not required (although in some unusual and special conditions, use of a humidistat may be desirable). The nozzle of the humidifier unit is merely sized to generally correlate the same to the B.t.u. capacity and c.f.m. air capacity of the furnace and thus insure complete evaporation of the water discharged into the bonnet.

It will be appreciated that in geographical areas where the water grain hardness is quite high, it may be desirable to install the humidifier nozzle in the air return duct just ahead of the furnace filter bank so that the filtering medium will assist in prevention of undue accumulation of precipitate solids in the bonnet chamber.

While several modifications of the present invention have been particularly shown and described, it will be apparent that various modifications may be made within the spirit and scope of the invention, and it is desired, therefore, that only such limitations be placed on the invention as are imposed by the prior art and set forth in the appended claims.

What is claimed is:

1. A warm air heating system comprising a furnace adapted to heat air for supply to a living space, air passage means extending through said furnace for circulation of air through said furnace, electrically controlled burner means for heating air in said air passage means, a room thermostat responsive to temperature in said living space for operating said burner means during the period said thermostat occupies a demand condition, an electrically driven blower for circulating air through said air passage means to said living space, switch means responsive to temperature in a selected zone of said furnace for operating said blower during the period the temperature in said zone is above a selected level, water spray means in said air passage means to humidify air circulating therethrough, valve means controlling water supply to said spray means, and electrical control means for said valve means intercoupled with said room thermostat and said switch means for opening said valve means only during concurrent operation of both said burner means and said blower.

2. In a warm air heating system of the type including a furnace to heat air for supply to a living space, air passage means for circulation of air through said furnace to said living space including a bonnet chamber in said furnace, electrically controlled burner means for heating air in said bonnet chamber, an electrically driven blower for propelling air through said bonnet chamber and air passage means, a first electrical control circuit including a room thermostat responsive to temperature in said living space for operating said burner means while said thermostat is in a heat demand condition, a second electrical control circuit including bonnet switch means responsive to the temperature in said bonnet chamber to establish operation of said blower upon attainment of a selected blower cut-on temperature in said bonnet chamber and to terminate said blower operation when the bonnet temperature falls to a blower cut-off temperature causing continued operation of said blower for a selected period following termination of operation of said burner means; a humidifier unit comprising water spray means in said air passage means to humidify air circulating therethrough, valve means controlling water supply to

said spray means, and electrical control means for said valve means connected with one of said first and second control circuits through contacts conditioned by the other of said control circuits to open said valve means only when said first and second control circuits are conditioned to concurrently operate both said burner means and said blower.

3. A system as defined in claim 2, wherein said spray means comprises a water spray nozzle located in said bonnet chamber.

4. A system as defined in claim 2, wherein said electrical control means for said valve means comprises a valve member and solenoid coil for opening and closing said valve member, a relay having a relay coil and normally open contacts, means connecting said relay coil with said first control circuit to close said relay contacts only when said room thermostat is in heat demand condition, and means connecting said solenoid coil through said relay contacts to said second control circuit for energizing said solenoid coil to open said valve member only when said blower is operating and said room thermostat is in heat demand condition causing operation of said burner means.

5. In a warm air heating system of the type including a furnace to heat air for supply to a living space, a bonnet chamber in said furnace provided with an outer side wall having an opening therein, electrically controlled burner means for heating air in said bonnet chamber, an electrically driven blower for propelling air through said bonnet chamber for heating of the air and delivery to the living space, a first electrical control circuit including a room thermostat responsive to temperature in said living space for operating said burner means while said thermostat is in heat demand condition before a selected high limit temperature is reached in said bonnet chamber, a second electrical control circuit including bonnet switch means responsive to the temperature in said bonnet chamber to establish and terminate operation of said blower upon attainment of a selected blower cut-on temperature and blower cut-off temperature, respectively, in said bonnet chamber below said high limit temperature causing continued operation of said blower for a selected period following termination of operation of said burner means; a humidifier unit comprising a housing mounted externally on said wall having a spray nozzle projecting therefrom to be located internally in said bonnet chamber, water conduit means extending from said nozzle to said housing through said wall opening having a normally closed solenoid valve controlling flow of water through said water supply conduit, relay means having a relay coil and normally open relay contacts, means electrically connecting said relay coil to said first electrical control circuit for energizing said relay to maintain said relay contacts in closed condition during the period of operation of said burner means, and electrical circuit means connecting said solenoid valve through said relay contacts with said second electric control circuit only when said relay contacts are closed and said blower is operating whereby said solenoid valve means is opened to admit water to said discharge nozzle only during the portion of the furnace operation cycle when both said burner means and said blower are concurrently operating.

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JAMES W. WESTHAVER, *Primary Examiner*.