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FORCED AIR TEMPERATURE CONTROL SYSTEMS

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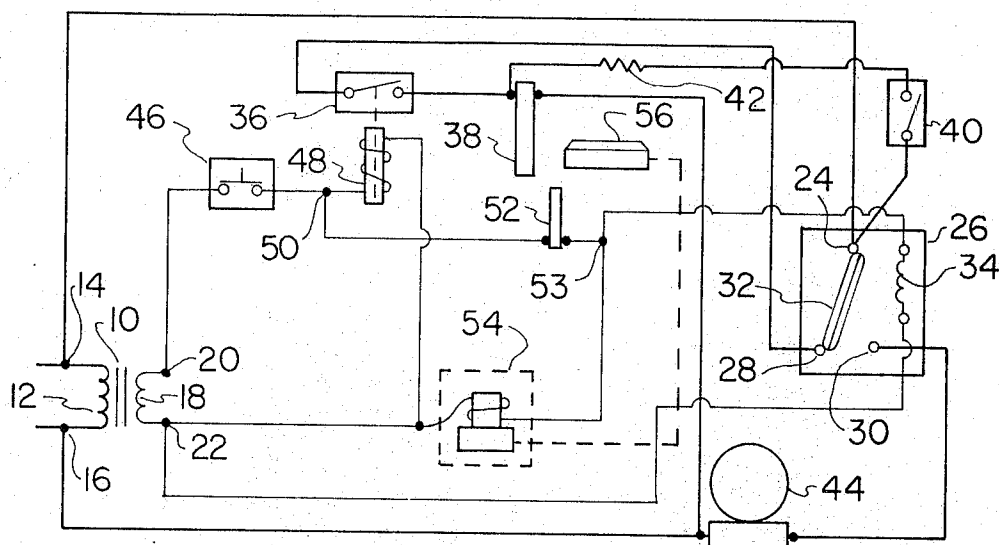


FIG. 1

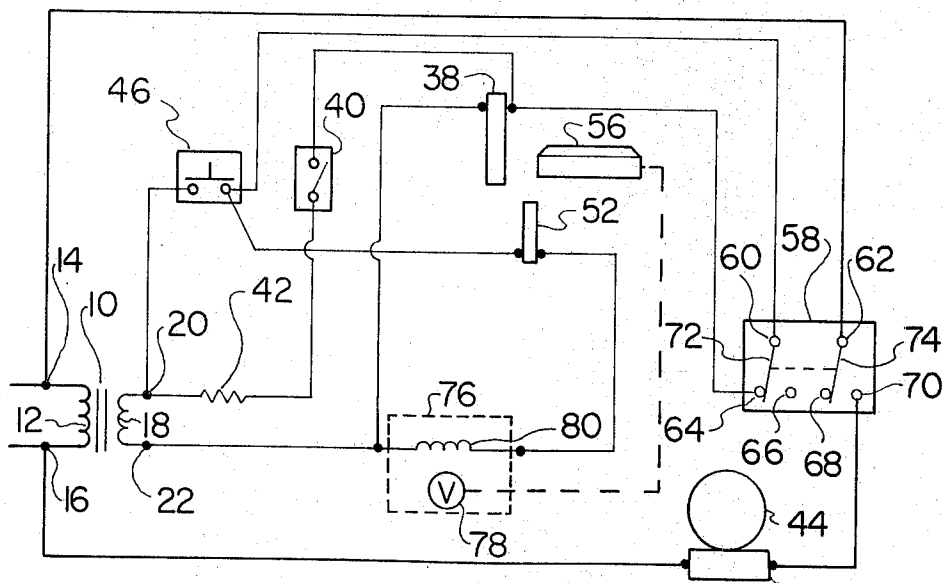


FIG. 2

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ATTORNEYS

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FORCED AIR TEMPERATURE CONTROL SYSTEMS

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9 Claims

ABSTRACT OF THE DISCLOSURE

Forced air temperature control systems having a circulation fan, a burner, an igniter, a fuel valve, a heat sensitive switch within heating proximity of the burner and the igniter, and a dual switch which controls both the igniter and the circulation fan whereby the dual switch is actuated either a predetermined time after the thermostat is closed or in response to temperature in the plenum chamber of a furnace to energize the circulation fan and deenergize the igniter.

BACKGROUND OF THE INVENTION

The present invention pertains to temperature control systems, and more particularly, to such systems utilizing a single switch to control an igniter and a circulating fan.

It is conventional in forced air heating systems to employ a switch to start a circulation fan after air heated by the furnace has reached a predetermined temperature and to stop the circulation fan after air heated by the furnace drops below the predetermined temperature to avoid the circulation of cold air before the furnace is in full operation and to receive the maximum heat from the furnace after it is shut down. Such switches may be responsive to the temperature in the plenum chamber of the furnace or duct temperature, or they may be time delay switches which are not actuated until a predetermined time after the heating cycle has been initiated, such as by the closure of a thermostat, and which are not deactuated until a predetermined time after the furnace is shut down. Such forced air heating systems also conventionally include a separate switch to control an electric igniter.

SUMMARY OF THE INVENTION

In accordance with the present invention, a forced air temperature control system includes a single dual switch utilized to control an electric igniter and a circulation fan, and a heat sensitive switch utilized to control a fuel valve in response to heat emitted by both the igniter and a burner. The heat sensitive switch is located in close proximity to the igniter so that after the igniter is fully energized the heat sensitive switch conducts to open a valve to supply fuel to the burner; after the dual switch is actuated, which starts the circulation fan and deenergizes the igniter, the heat from the burner maintains the heat sensitive switch conducting to keep the valve open.

An object of the present invention is the construction of a temperature control system utilizing a dual switch to control an igniter and a circulation fan, and a heat sensitive switch, responsive to heat from a burner and the igniter, to control a fuel valve.

Another object of the present invention is the use of a time delay valve in a temperature control system where a dual switch is utilized to control an igniter and a circulation fan.

The present invention has another object in that a temperature control system utilizes a dual switch having a time delay to control an igniter and a circulation fan such that the system will recycle upon defective ignition.

Other objects and advantages of the present invention will become apparent from the following detailed description of the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a schematic diagram of a first embodiment of the present invention; and

FIG. 2 is a schematic diagram of a second embodiment of the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

The present invention may be utilized in any temperature control systems, such as heating and/or cooling systems, and the present invention is described hereinafter as used in a heating system for exemplary purposes only.

FIG. 1 illustrates a first embodiment of the present invention including a step-down transformer 10 having a primary winding 12 connected to leads 14 and 16, which are adapted to be connected to a conventional source of electric power (not shown) and a secondary winding 18 having terminals 20 and 22. Lead 14 is connected to a pole 24 of a dual switch 26 which includes contacts 28 and 30, a bimetal arm 32 and a heating coil 34. A normally open switch 36 and an electric igniter 38 are connected in series between contact 28 and lead 16, and a switch 40 is in series with a resistor 42 and igniter 38 between pole 24 and lead 16. Contact 30 is connected to lead 16 through a circulation fan 44 which requires full primary winding voltage for operation. Terminal 20 of secondary winding 18 is connected to terminal 22 through a thermostat 46 and a relay 48 in series, having a junction 50 therebetween. A heat sensitive device, of any suitable type such as a semiconductor switch 52, is connected in series between junction 50 and a junction 53, and a solenoid operated valve 54, which controls a flow of fuel from a fuel supply (not shown) to a burner 56, and heating coil 34 are connected in parallel between junction 53 and terminal 22.

Dual switch 26 is in its normal state when arm 32 connects with contact 28, and arm 32 will connect with contact 30 when dual switch 26 is actuated. Dual switch 26 is shown as being responsive to heating coil 34 which is dependent upon conduction of heat sensitive switch 52; however, heating coil 34 may be connected directly across thermostat 46 and secondary winding 18 so that it is energized a predetermined time after thermostat 46 is closed. Dual switch 26 may also be constructed without any heating coil by exposing arm 32 to the heat in the air ducts or the heat in the plenum chamber of the furnace so that dual switch 26 is actuated only after the temperature in the furnace increases to a desired value. When dual switch 26 is in its normal state and thermostat 46 is closed, igniter 38 is on and circulation fan 44 is off, and when dual switch 26 is actuated, igniter 38 is either off or in a standby condition and circulation fan 44 is on.

Electric igniter 38 is located in igniting proximity to burner 56 and may be either off, fully energized or in a standby condition dependent upon switches 26 and 40. Heat sensitive switch 52 is located adjacent both igniter 38 and burner 56 so that it is responsive to the heat from both, and thermostat 46 is located in the area to be temperature controlled.

The operation of the embodiment of FIG. 1 is first described with switch 40 open which provides only on-off control of igniter 38. The system is in its off condition when there is no heat demand and thermostat 46 is open which causes igniter 38 to be off, valve 54 to be closed and circulation fan 44 to be off.

When there is a demand for heat, signified by closure of thermostat 46, a circuit is completed from terminal 20

through thermostat 46 and relay 48 to terminal 22 to energize relay 48 and close switch 36. The closure of switch 36 completes a circuit from lead 14 through pole 24, contact 28, switch 36 and igniter 38 to lead 16 to fully energize igniter 38 by applying the full primary winding voltage thereto. After igniter 38 is fully energized, heat sensitive switch 52 conducts in response to heat therefrom and completes a first circuit from terminal 20 through thermostat 46, heat sensitive switch 52 and valve 54 to terminal 22 to open valve 54 and supply fuel to burner 56, and a second circuit from terminal 20 through thermostat 46, heat sensitive switch 52 and heating coil 34 to terminal 22 to begin heating arm 32. Thus, in the heat demand condition, igniter 38 is fully energized, valve 54 is open and circulation fan 44 is off.

A predetermined time after heat sensitive switch 52 conducts, dual switch 26 is actuated which places the system in its full heating condition if there is proper ignition. With dual switch 26 actuated, a circuit is completed from lead 14 through pole 24, contact 30 and circulation fan 44 to lead 16 to start circulation fan 44. The actuation of dual switch 26 also opens contact 28 to deenergize igniter 38. Heat sensitive switch 52 remains conducting even though igniter 38 is deenergized due to the heat sensed from burner 56 which maintains valve 54 open. Thus, in the full heating condition, igniter 38 is off, valve 54 is open and circulation fan 44 is on. Should burner 56 fail for any reason, dual switch 26 will be placed in its normal state due to the non-conduction of heat sensitive switch 52 which will reenergize igniter 38 and cause the system to recycle.

If burner 56 is not properly ignited by the time dual 26 is actuated, the lock of heat sensed by heat sensitive switch 52 causes it to stop conducting which closes valve 54 and deenergizes heating coil 34. After arm 32 cools and dual switch 26 is returned to its normal state, the system will recycle.

Thermostat 46 will open after heating satisfaction which maintains igniter 38 off and closes valve 54; however, circulation fan 44 will remain on to circulate the remaining heat until dual switch 26 is placed in its normal state due to the cooling of arm 32.

The operation of the embodiment of FIG. 1 with switch 40 closed is the same as the operation described above, except that in the off condition igniter 38 is in its standby condition due to the circuit from lead 14 through pole 24, switch 40, resistor 42 and igniter 38 to lead 16, which applies only a portion of the primary winding voltage to igniter 38 due to the voltage drop across resistor 42. In the heat demand condition the closure of switch 36 bypasses resistor 42 and fully energizes igniter 38. In the full heating condition igniter 38 is in its standby condition due to the opening of contact 28 to remove the bypass of resistor 42.

If it is desired to have a system that utilizes a time delay dual switch, but does not recycle upon defective ignition, the upper lead from heating coil 34 may be connected to junction 50 instead of junction 53.

Heating coil 34 and its circuitry may be removed altogether in which case dual switch 26 is actuated in response to the temperature in the plenum chamber of the furnace or in the heat circulating ducts. The operation of the system of FIG. 1 with dual switch 26 responsive to the temperature in the plenum chamber of the furnace, is similar to the operation described above. That is, in the off condition igniter 38 is either off or at standby, circulation fan 44 is off and valve 54 is closed. In the heat demand condition igniter 38 is fully energized, valve 54 is open and circulation fan 44 is off, and when burner 56 is ignited and the temperature in the plenum chamber of the furnace increases to the required value, dual switch 26 is actuated which places the system in its full heating condition with igniter 38 off or at standby, valve 54 open and circulation fan 44 on. After heating satisfaction, the system will

revert to its off condition; however, circulation fan 44 will remain on until the temperature in the plenum chamber of the furnace decreases sufficiently to return dual switch 26 to its normal state.

Solenoid operated valve 54 may be replaced by a time delay valve, as shown in FIG. 2. This will prevent any possibility of valve 54 opening temporarily with the flame at burner 56 extinguished and igniter 38 not at ignition temperature when thermostat 46 is opened and closed in quick succession. Such a condition could occur with the use of a solenoid operated valve if the cooling rate of igniter 38 is faster than the cooling rate of heat sensitive switch 52.

The embodiment of FIG. 2 differs from the embodiment of FIG. 1 basically in that a low voltage igniter is used in FIG. 2 operating from the secondary winding voltage. The elements of FIG. 2 which are identical to elements already described in FIG. 1, are given identical reference numerals and are not described again for the sake of brevity.

In FIG. 2 lead 14 is connected to a dual switch 58 at a pole 62. Dual switch 58 includes poles 60 and 62, contacts 64, 66, 68 and 70 and blades 72 and 74 which are mechanically connected together. A circulation fan 44 is connected from contact 70 to lead 16, and contacts 66 and 68 are open. A thermostat 46 connects terminal 20 to pole 60, and contact 64 is connected to terminal 22 through igniter 38. A resistor 42 is in series with a switch 40 between terminal 20 and igniter 38, and a heat sensitive switch 52 is in series with a time delay valve 76 between thermostat 46 and terminal 22. Time delay valve 76 includes a conventional heat operated valve 78 which controls a flow of fuel from a fuel supply (not shown) to a burner 56 and a heating coil 80.

Dual switch 58 is in its normal state when blades 72 and 74 connect poles 60 and 62 to contacts 64, and 68, respectively, and when dual switch 58 is actuated, blades 72 and 74 connect poles 60 and 62 to contacts 66 and 70, respectively. Dual switch 58 is heat activated by constructing either or both of blades 72 and 74 as bimetal, or blades 72 and 74 may be driven by a common bimetal. Dual switch 58 may be responsive to the temperature in the plenum chamber of the furnace, or it may be responsive to a heating coil connected between heat sensitive switch 52 and terminal 22 to actuate dual switch 58 a predetermined time after heat sensitive switch 52 conducts, or it may be connected between thermostat 46 and terminal 22 to actuate dual switch 58 a predetermined time after thermostat 46 is closed.

Electric igniter 38 is located in igniting proximity to burner 56 and may be either off, gully energized or in a standby condition dependent upon switches 58 and 40. With switch 40 open, igniter 38 is fully energized when thermostat 46 is closed and dual switch 58 is in its normal state since full secondary winding voltage is applied to it, and igniter 38 is off when either thermostat 46 is open or dual switch 58 is actuated. With switch 40 closed, igniter 38 is fully energized when thermostat 46 is closed and dual switch 58 is in its normal state since full secondary winding voltage is applied to it, and igniter 38 is in its standby condition when either dual switch 58 is actuated or thermostat 46 is open due to the voltage drop across resistor 42.

The operation of FIG. 2 is first described with switch 40 open which provides on-off control of igniter 38. In the off condition thermostat 46 is open which keeps valve 76 closed, igniter 38 off and dual switch 58 in its normal state to deenergize circulation fan 44. When there is a demand for heat, thermostat 46 closes to complete a circuit from terminal 20 through thermostat 46, pole 60, contact 64 and igniter 38 to terminal 22 to fully energize igniter 38. The full energization of igniter 38 causes heat sensitive switch 52 to conduct which completes a circuit from terminal 20 through thermostat 46, heat

sensitive switch 52 and heating coil 80 of valve 76 to begin heating heat operated valve 78.

A full heating condition is obtained after heat operated valve 78 has opened to supply fuel to burner 56 and raise the temperature in the plenum chamber of the furnace to the value necessary to actuate dual switch 58. At this time, a circuit exists from lead 14 through pole 62, contact 70 and circulation fan 44 to start circulation fan 44, and igniter 38 is off due to the opening of contact 64. Thus, in the full heating condition, igniter 38 is off, valve 76 is open and circulation fan 44 is on.

After heating satisfaction, thermostat 46 opens which opens the energizing circuit for valve 76 and closes it thereby stopping the flow of fuel to burner 56. Circulation fan 44 will continue to operate until the temperature in the plenum chamber of the furnace drops sufficiently to place dual switch 58 in its normal state. After circulation fan 44 is deenergized, the system is in its off condition and is ready for the next cycle.

The operation of FIG. 2 with switch 40 closed is similar to the operation described above; however, igniter 38 will assume its standby condition rather than its off condition when the system is in its off condition and its full heating condition. The standby condition is obtained through resistor 42 which enables igniter 30 to have a voltage less than full secondary winding voltage applied to it when either thermostat 46 is open or dual switch 58 is actuated. When dual switch 58 is in its normal state and thermostat 46 is closed, resistor 42 is bypassed to fully energize igniter 38.

If dual switch 58 is responsive to a heating coil connected between thermostat 46 and terminal 22, dual switch 58 is actuated a predetermined time after thermostat 46 is closed. Connecting the heating coil between heat sensitive switch 52 and terminal 22 actuates dual switch 58 a predetermined time after igniter 38 is fully energized and provides recycling if burner 56 is not ignited by that time.

The time delay associated with valve 76 prevents any possibility of its opening temporarily with the flame at burner 56 extinguished and igniter 38 not at ignition temperature when thermostat 46 is opened and closed in quick succession. Such a condition could occur if the cooling rate of igniter 38 is faster than the cooling rate of heat sensitive switch 52.

Since the present invention is subject to many variations, modifications and changes in detail, it is intended that all matter contained in the foregoing description or shown in the accompanying drawing shall be interpreted as illustrative and not in a limiting sense.

What is claimed is:

1. A forced air heating control system comprising apparatus adapted to heat a flow of circulated air including a burner, valve means for said burner, an electric igniter for igniting said burner, and a fan for circulating the air; switch means connected with said igniter and said fan and having a first state and a second state; input means connected with said igniter and said fan through said switch means to energize said igniter when said switch means is in said first state and to energize said fan when said switch means is in said second state; and control means including electrically conductive heat sensitive means disposed in heat sensing proximity to said igniter and connected with said input means and said valves means, said heat sensitive means being responsive to the heat of said igniter to control the operation of said valve means whereby said igniter is proven to be at ignition temperature before said valve means is opened.
2. The invention as recited in claim 1 wherein said switch means includes actuating means for changing the state of said switch means and said control means in-

cludes means connected with said actuating means and said heat sensitive means whereby said switch means changes states after said igniter is at ignition temperature.

3. The invention as recited in claim 1 wherein said control means includes a thermostat connected with said input means and said heat sensitive means, and said switch means includes actuating means connected with said input means through said heat sensitive means, said switch means having a time delay whereby said switch means changes states a predetermined time after said thermostat is closed and said igniter is at ignition temperature.

4. The invention as recited in claim 1 wherein said igniter has a standby partially energized condition and a fully energized condition, said control means includes a thermostat having an open position and a closed position and resistive means connected with said input means and said igniter, said thermostat being coupled with said igniter to control the energization thereof whereby said igniter is in said standby condition when said thermostat is in said open position and when said thermostat is in said closed position but said switch means is in said second state, and said igniter is in said fully energized condition when said thermostat is in said closed position and said switch means is in said second state.

5. The invention as recited in claim 1 wherein said valve means includes means for delaying the opening of said valve means.

6. The invention as recited in claim 1 wherein said heat sensitive means is disposed in heat sensing proximity to said burner to be responsive to heat from both said igniter and said burner whereby said heat sensitive means conducts when either said igniter is energized or said burner is in operation.

7. The invention as recited in claim 6 wherein said switch means includes means responsive to heat from said burner to change the state of said switch means.

8. In an electrical control system, the combination comprising:

an input circuit,
an energizing coil adapted to control a valve,
heat sensitive means,
means connecting said energizing coil and said heat sensitive means in series in said input circuit,
switch means,
an electric fan,
means connecting said switch means and said electric fan in series with said input circuit,
an electric igniter,
energizing means for said igniter including means connecting said switch means and said electric igniter in series with said input circuit, and
means locating said heat sensitive means within heat sensing proximity of said electric igniter whereby said heat sensitive means conducts when said igniter is energized.

9. The invention as recited in claim 8 wherein said energizing means for said igniter includes resistance means and means connecting said resistance means and said igniter in series with said input circuit.

References Cited

UNITED STATES PATENTS

2,221,164	11/1940	Denison et al. -----	236—11 X
2,230,446	2/1941	Baker.	
2,291,805	8/1942	Denison -----	431—66 X
2,549,633	4/1951	Ottmar -----	431—66 X
2,786,632	3/1957	Cunnien.	

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