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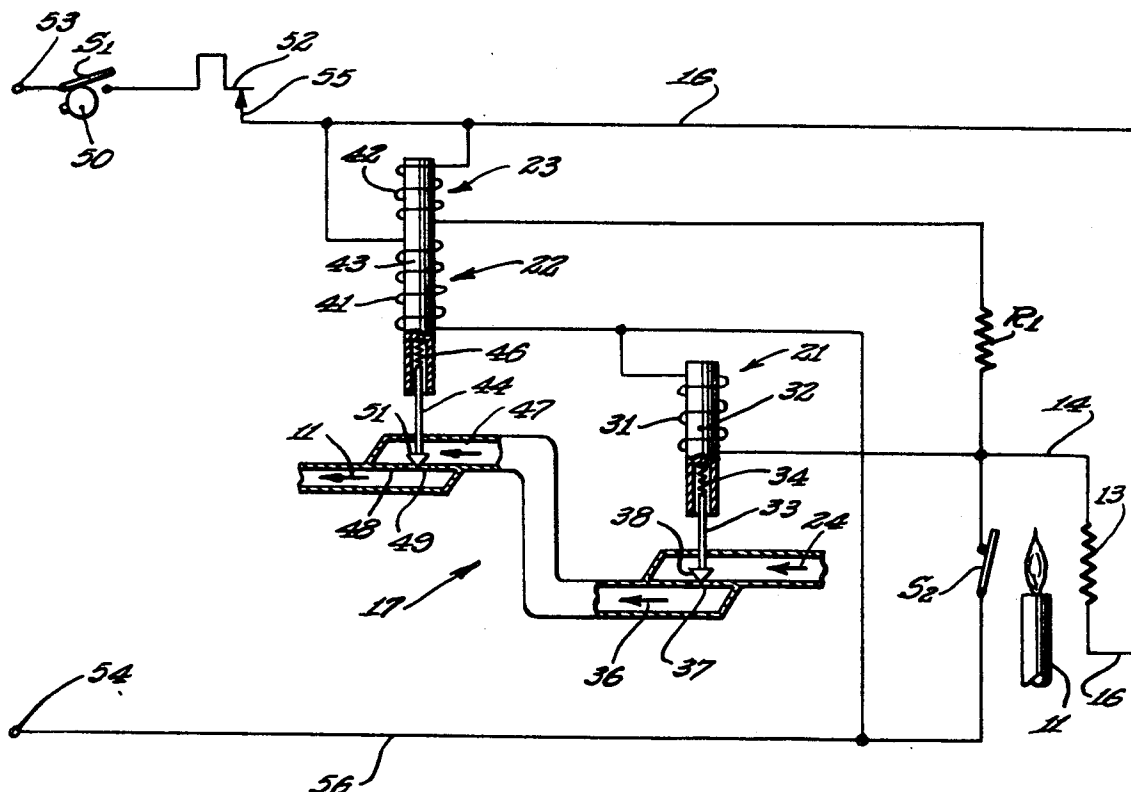
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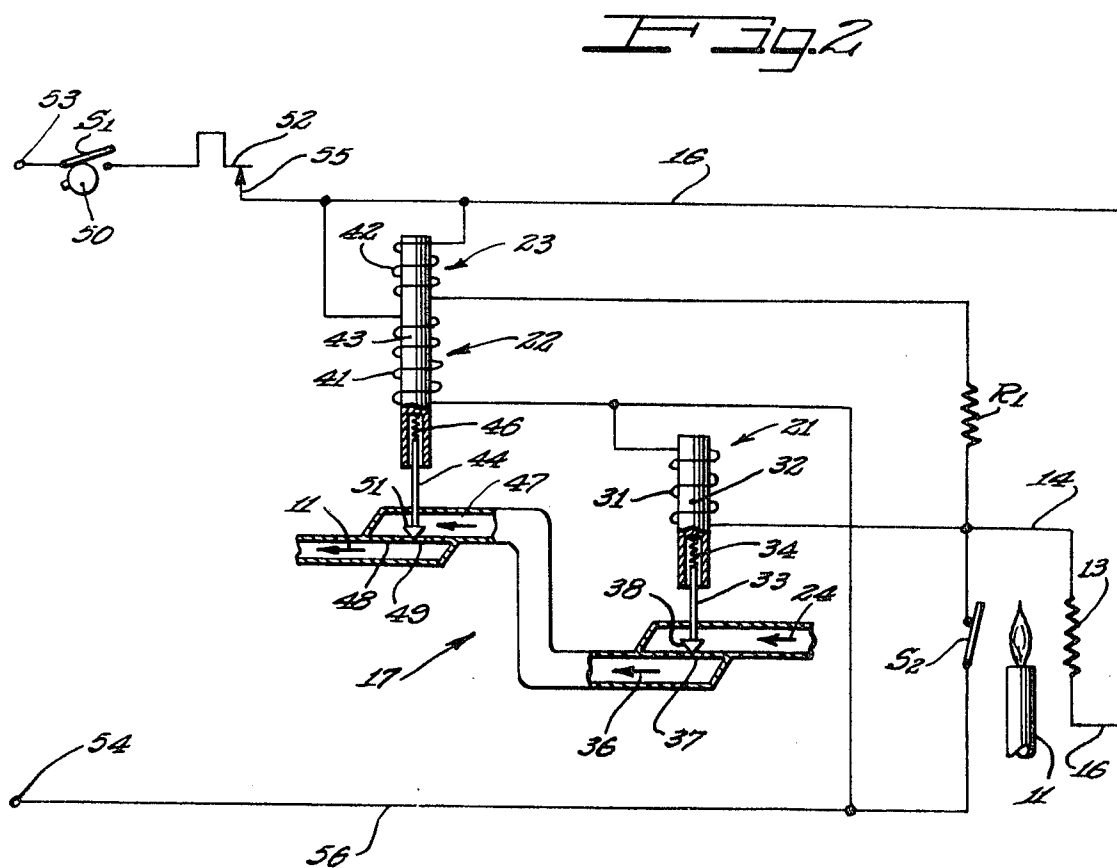
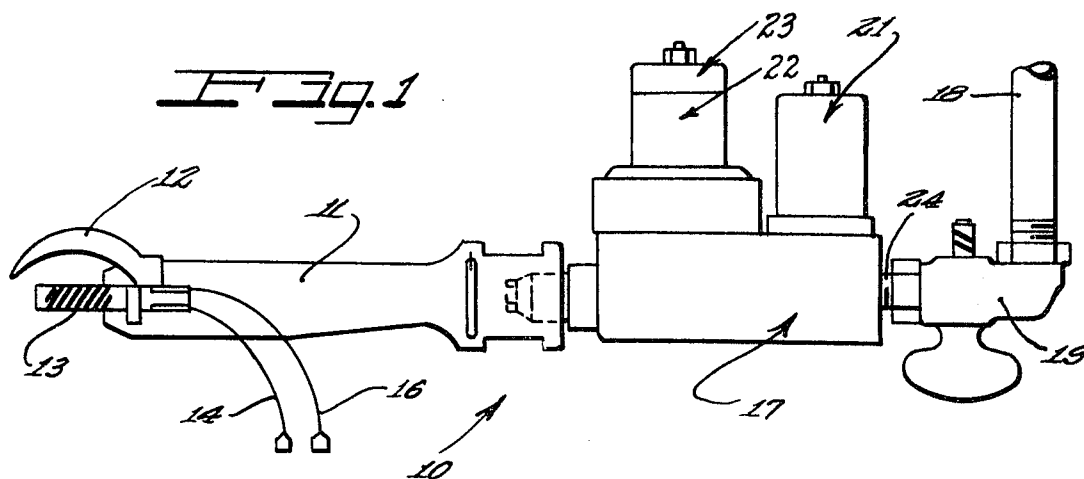
[54] DUAL COIL GAS BURNER CONTROL CIRCUIT
8 Claims, 2 Drawing Figs.

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[50] Field of Search..... 431/66, 26

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ABSTRACT: A fuel control and ignition system for a gaseous fuel burning apparatus such as a clothes dryer which uses an igniter and includes two gas valves in series in the gas fuel line to the burner. Both of the gas valves must be turned on before the burner can ignite. The first valve is controlled by a pair of coils in circuit with the timing switch and thermostat one coil of which is in circuit with a temperature responsive switch and the second valve is controlled by a coil in circuit with the timing switch and thermostat and also the igniter element. The temperature responsive switch is connected in parallel with the coil of the second valve to bypass it until the temperature sensitive switch opens in response to the igniter and burner to allow the second valve to be actuated.





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DUAL COIL GAS BURNER CONTROL CIRCUIT

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates generally to control systems for an appliance and in particular to a control system which has particular utility when used with a clothes dryer of the gas type.

2. Description of the Prior Art

Fuel control and ignition systems of the prior art have utilized ignition elements in which a single thermostat is used to turn on the fuel supply when the igniter is at ignition temperature and the same thermostat is used to turn off the fuel supply if the burner happens to fail to ignite. Temperature sensing elements have been mounted adjacent the burner and igniter to detect when the igniter is at ignition temperature and to actuate a fuel valve when this temperature is reached. At the same time the igniter heating current is disconnected but it retains a temperature sufficient to ignite fuel for a certain time after the power is disconnected from it. If for some reason the fuel is not ignited the temperature responsive element will deenergize the fuel valve and reenergize the igniter and the cycle will be repeated.

SUMMARY OF THE INVENTION

The present invention comprises a fuel control system for an appliance such as a clothes dryer which has a pair of valves in series with the fuel line both of which must be opened before fuel may be supplied to the burner. One of the valves is controlled by a pair of coils, one of which is connected across the line in series with a thermostat and timer cam-operated switch and the other which is connected in series with a line through the timer cam switch and the thermostat, an impedance and a second temperature responsive switch which is placed adjacent the igniter and burner. The energizing coil of the second valve is connected across the line in series with the igniter and the timer cam-operated switch and thermostat and the second temperature responsive switch is connected in parallel with the coil of the second valve to short it out when the switch is closed. This arrangement assures that unburned fuel will not be released in the burner chamber of the appliance upon failure of the igniter, momentary power failure, or failure of the igniter temperature sensing switch. The system of this invention provides protection if the igniter temperature sensing switch fails to open or if it fails to close. It also provides protection if the ignition elements fails in the open condition or alternatively if it fails in the shorted condition.

Other and further objects, features and advantages of the present invention will become apparent to those skilled in the art from the following detailed disclosure thereof and the drawings attached hereto and made a part hereof.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a side elevational view of the burner and control valves according to the invention; and

FIG. 2 is a schematic view of the burner control system of this invention.

DESCRIPTION OF THE PREFERRED EMBODIMENT

FIG. 1 illustrates a burner structure 10 of an appliance such as a dryer comprising an input fuel line 18 which is connected to an on-off valve 19 which allows the burner to be serviced or replaced. An output line 24 of the valve 19 connects to a control valve housing 17 of this invention. The control valve housing 17 contains a pair of valves which are solenoid actuated. The first valve has a solenoid coil mounted in a housing 21 attached to the housing 17. The second valve is controlled by a pair of solenoid windings mounted in housings 22 and 23 connected to the housing 17. The burner 11 is connected to the output side of the valve housing 17 and has a deflector 12 and an igniter 13 mounted at the output port of the nozzle. The ig-

niter 13 may be constructed of silicone carbide composition manufactured by the Carborundum Company and sold under the trademark "GLOBAL." Electrical leads 14 and 16 are connected to the igniter 13.

FIG. 2 is a schematic view of the valve control system of this invention wherein a pair of input terminals 53 and 54 are connected to a suitable energizing source as, for example, 115 volts AC. A timer operated cam switch S is controlled by the timer cam 50 of the timer motor (not shown) of the dryer. The switch S₁ is closed when the dryer is on. A thermostat switch 52 is connected in series with the switch S₁ and has the outer terminal 55 connected to line 16. The line 16 is connected through the igniter 13 to line 14 and through a temperature sensitive switch S₂ to line 56 which is connected to input terminal 54. The temperature switch S₂ is mounted adjacent the igniter 13 and the burner nozzle 11 and will open when the igniter 13 reaches ignition temperature. The temperature sensitive switch will remain open as long as the burner is lighted due to the heat of the burner. The line 14 is also connected to the coil 31 of solenoid 21 and the other side of coil 31 is connected to line 56. The coil 31 is mounted about solenoid core 32 which has an actuator 33 that extends through a wall of input fuel line 24 and carries a valve 38 which seats in a seat 37 between the input line 24 and an intermediate line 36. A spring 34 holds the valve 38 seated in seat 37 except when the solenoid 21 is energized. The intermediate line 36 connects to a second valve portion 47 which has a partition 48 that separates it from the burner conduit 11. A valve seat 49 receives a valve 51 which is connected to an actuator 44 that is mounted in solenoid core 43 and which is spring-biased by a spring 46 to hold the valve 51 in the seat 49. Windings 41 and 42 are wound about the solenoid core 43 to control the valve. The winding 41 has one side connected to lead 16 and the other side connected to lead 56. The winding 42 has one side connected to lead 16 and the other side connected to an impedance R₁ which has its other side connected to lead 14.

In operation, if the dryer is turned on the timer cam 50 will close switch S₁ and the thermostat 52 will be closed when heat is demanded in the dryer. Current will flow from input terminal 53 through the switch S₁, thermostat 52 to line 16 through winding 41 to the other side of the power supply 56. At the same time current will flow from line 16 through winding 42, resistor R₁ and switch S₂ to the other power line 56. Coils 41 and 42 are arranged magnetically in series so that when both windings 41 and 42 are energized the actuator 44 will be moved against the spring 46 to move the valve 51 out of the valve seat 49 and the valve will be opened.

However, at this time, the temperature sensitive switch S₂ is connected across the input terminals of coil 31 and valve 38 will remain closed. Current will also flow from line 16 through the igniter 13 to line 14 and through the temperature sensitive switch S₂ to the other power line 56 thereby heating the igniter. When the igniter element 13 reaches ignition temperature, the temperature sensitive switch S₂ will respond to the increase in temperature and will open and at this time the current flowing through the igniter 13 and resistor R₁ will pass through the coil 31 to line 56 and the valve 38 will be moved out of the valve seat 37. When the valve 38 opens gas flow from input line 24 through valve seat 37 into intermediate line 36 and through valve seat 49 to the burner 11. The igniter 13 will ignite the gas and the heat of the fuel burning will cause temperature sensitive switch S₂ to remain open.

It is to be noted that when the switch S₂ is open that the impedance of the coil 31 is in series with the igniter 13 which will cause the current through the igniter to drop and therefore the temperature of the igniter will decrease. The current through the coil 42 will also decrease due to the addition of the impedance of coil 31 in its conduction path. This will cause the magnetic flux in solenoid core to decrease. However, the reduced flux is sufficient to keep valve 51 open.

In the event that the fuel leaving the burner 11 does not ignite, the temperature sensitive switch S₂ will close since the temperature of the igniter 13 is not sufficient to keep it open

when the igniter current is flowing through the winding 31. When the temperature sensitive switch S_2 closes the winding 31 is shorted out and valve 38 will reseal in the seat 37 and simultaneously the current through the igniter 13 will increase due to the reduction in impedance and the igniter will again heat to a temperature sufficient to cause the temperature sensitive switch S_2 to open again opening valve 38 and supplying gas to the burner 11.

Thus, if the burner fails to ignite the cycle will be repeated indefinitely until the timer cam opens switch S_1 .

The system and circuit of this invention is safe for all possible failures as follows:

1. Momentary failure of the power supply. When this occurs the valve 51 will close and will not reopen until the temperature of the burner has decreased sufficiently to allow the switch S_2 to close again. This turns the burner off and the valve 38 would close when the power fails. When switch S_2 closes again, the igniter 13 will reheat switch S_2 as explained above and the burner will be ignited in a safe manner.
2. If the igniter temperature sensing switch S_2 fails to open, valve 38 will not open. This is because the switch S_2 shorts out winding 31 which actuates valve 38 and this valve cannot open until switch S_2 is opened.
3. If the igniter temperature sensing switch S_2 fails to close, there will be insufficient current through coil 42 to open valve 51. This is because the coil 42 is in series with coil 31 when switch S_2 is open. This produces insufficient flux to open valve 51.
4. If the igniter 13 has an open circuit, valve 38 cannot open. This is because the igniter 13 is in series with coil 31 and if the igniter is open circuited, the valve 38 cannot open.
5. If the igniter element 13 has a short, there will be insufficient current through coil 42 and valve 51 will not open. This is because igniter 13 is in parallel with coil 42 and resistor R_1 and a short in igniter 13 will substantially reduce voltage across the coil 42.

It is seen that this invention provides a dual coil gas burner control circuit which has improved safety and reliability.

It will be understood that modifications and variations may be effected without departing from the spirit and scope of the novel concepts of the present invention.

The embodiments of the invention in which I claim an exclusive property or privilege is defined as follows:

1. A fuel ignition system for controlling fuel flow to a burner from a supply line comprising (a) a pair of solenoid actuated valves arranged in series in said supply line, (b) first and second windings in control of said first solenoid valve, (c) a third winding in control of said second solenoid valve, (d) a temperature responsive switch connected in parallel with at least one of said windings to shunt it when said switch is closed, and (e) an igniter mounted in heat transfer relationship to said temperature sensitive switch and connected in se-

ries therewith, said ignition also being connected in parallel with at least one of said windings and in series with another of said windings for reducing the holding power of the winding in parallel with said igniter when said switch is open.

2. A fuel ignition system for controlling fuel flow to a burner from a supply line comprising (a) a pair of solenoid-actuated valves arranged in series in said supply line, (b) first and second windings in control of said first solenoid valve, (c) a third winding in control of said second solenoid valve, (d) a pair of power leads connected to opposite sides of the first windings on said first solenoid valve, (e) said second and third windings connected in series between said first and second power leads, (f) a temperature responsive switch connected in parallel with said third winding, and (g) an igniter mounted in heat transfer relationship to said temperature sensitive switch and connected in parallel with the second winding.

3. A fuel ignition system for controlling fuel flow to a burner from a supply line comprising (a) flow control means comprising first and second solenoid-actuated valves connected in series in said supply line, (b) first and second actuating means comprising first and second windings on the first solenoid, (c) third actuating means comprising a third winding on the second solenoid, (d) a temperature responsive electrical circuit connected to the third actuating means to control it as a function of temperature and wherein said temperature responsive electrical circuit comprises a pair of power leads with the first sides of the first and second windings connected to a first of said power leads, (e) an igniter with one side connected to said first power lead, the second side of the first winding and the first side of the third winding connected to the second of said power leads, the second sides of said second and third windings and the igniter connected together, and (f) a temperature sensitive switch mounted in heat transfer relationship to said igniter and said burner and connected between the second power lead and the second sides of the second and third windings and the igniter.

4. A fuel ignition system for controlling fuel flow to a burner from a supply line according to claim 3 comprising an impedance connected between the second winding and the second side of said igniter.

5. A fuel ignition system for controlling fuel flow to a burner from a supply line according to claim 4 wherein said impedance comprises a resistor.

6. A fuel ignition system for controlling fuel flow to a burner from a supply line according to claim 3 wherein said igniter comprises a silicon carbide resistive element.

7. A fuel ignition system for controlling fuel flow to a burner from a supply line according to claim 3 comprising a thermostat switch connected in series with one of said power leads.

8. A fuel ignition system for controlling fuel flow to a burner from a supply line according to claim 3 comprising a timer controlled switch connected in series with one of said power leads.