

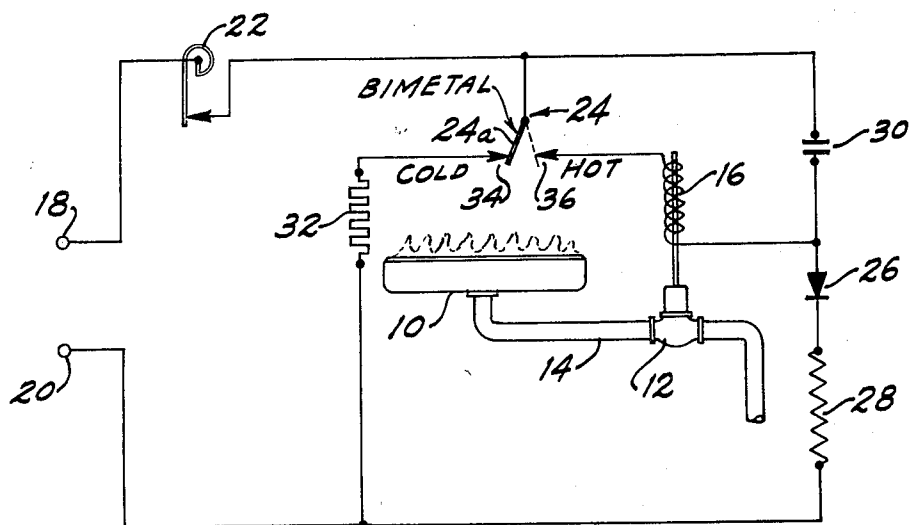
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BURNER IGNITION AND CONTROL SYSTEM

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1

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BURNER IGNITION AND CONTROL SYSTEM
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7 Claims

ABSTRACT OF THE DISCLOSURE

A direct ignition and control system for gaseous fuel burners employing an electrical resistance-type igniter, a biased closed solenoid actuated fuel valve, a double-throw switch normally completing an energizing circuit for the igniter and responsive to the radiant energy of the igniter when at ignition temperature to break the igniter circuit and complete an energizing circuit for the winding of the valve solenoid; the valve circuit including a series resistor limiting current flow through the solenoid winding to that which holds the valve open but will not open it, and further includes a normally charged capacitor which upon completion of the solenoid winding circuit by the double throw switch is discharged through the winding to effect opening of the valve; the double throw switch also being responsive to burner flame to retain completion of the valve hold open circuit and the igniter having sufficient mass to retain an igniting temperature for a brief period after de-energization.

This invention relates to systems for direct ignition and automatic control of gaseous fuel burners which include safety means to prevent the flow of unburned fuel.

Ignition and control systems for gaseous fuel burners employing an electrical resistance-type igniter of substantial mass and sensor means responsive to the radiant energy thereof at ignition temperature to simultaneously de-energize the igniter and effect opening of a fuel valve have been in use for several years. These sensors in these systems are also responsive to the burner flame when it is present to hold the fuel valve open and permit its closure when the flame disappears. These systems have, however, invariably employed two electromagnetically operated fuel valves series flow connected in the fuel line, thereby to insure fuel cutoff and preclude leakage due to obstructions which may prevent one or the other of the valves from completely closing. The electromagnetic windings of these series flow arranged dual valves have heretofore been jointly employed in various circuit arrangements to effect valve closure in event of burner flame failure, and to insure that the igniter is reheated to ignition temperature before both valves are reopened following their closure due to flame failure, or due to circuit interruption or power supply interruption.

These essential safety features, which preclude hazardous conditions arising from flame failure or momentary electrical power interruptions, have therefore been heretofore tied to the use of two or more electromagnetic valve windings; that is to say, these prior arrangements relied upon the relative impedances of multiple electromagnetic windings and did not function to provide these essential safety features with a single electromagnetic winding. There is, therefore, a need for a simple, inexpensive, direct ignition and control system which provides the described safety features and in which a single electromagnetic actuator winding may be employed.

The present invention has for an object the provision of a generally new and improved direct ignition and

2

control system for gaseous fuel burners employing an electrical resistance-type igniter with sensor means to effect fuel flow only when the igniter is at ignition temperature or when flame exists at the burner, which system is universally adaptable for use with either single or multiple electromagnetic valve actuators.

A further object is to provide a particularly simple, reliable, and inexpensive system for the safe and direct ignition and control of gaseous fuel burners, wherein fuel is admitted to flow to the burner only when the temperature of a glow-type igniter is detected as being sufficiently high to insure ignition and electrical supply line voltage is above a predetermined point or when a normal flame exists at the burner.

A further object is to provide a direct ignition and control system for gaseous fuel burners in which a temperature responsive double throw switch has a cold position in which it completes energization of an electrical resistance-type igniter having considerable mass, and a hot position to which it moves in response to ignition temperature of the igniter, when attained, to break the igniter circuit to complete a hold open but not pull open energizing circuit for a biased closed solenoid valve and to effect the discharge of a capacitor through the solenoid winding to effect opening of the valve, the switch being held in its hot position thereafter by the heat of flame at the burner and the capacitor being charged when the switch is not in its hot position, whereby upon closure of the valve due to electrical power failure, or circuit interruption due to burner flame failure or other cause, the temperature responsive switch is required to cool to its cold position, thereby to re-energize the igniter, effect a response of the double throw switch, and the discharge of the capacitor in order to reopen the solenoid fuel valve.

Other objects and advantages will appear from the following description when read in connection with the accompanying drawing.

The single figure of the drawing is a diagrammatic illustration of a direct ignition and burner control system constructed in accordance with the invention.

Referring to the drawing, a gaseous fuel burner is indicated at 10 and a biased closed solenoid operated valve interposed in a fuel supply line 14 and including a solenoid winding 16 controls the flow of fuel to the burner. The solenoid winding is connected across A.C. power supply terminals 18 and 20 in series with a thermostat 22 responsive to the temperature of the space heated by burner 10, a double throw temperature responsive switch 24, a diode 26, and a current limiting resistor 28. A capacitor 30 connected in parallel with the solenoid winding 16 and double throw switch 24 also connected across the power supply terminals in series with diode 26, resistor 28, and space thermostat 22. Also connected across the power supply terminals 18 and 20 in series relationship with the double throw temperature responsive switch 24 and space thermostat 22 is an electrical resistance igniter 32.

The double throw switch 24 has a "cold" position, as shown in full line, in which its blade 24a closes with a contact 34 to complete a circuit connecting igniter 32 across the power supply terminals, and a "hot" position, as shown in dotted line, in which its blade closes with a contact 36 to complete a circuit connecting the valve winding 16, the diode 26, and the resistor 28 in series relationship across the power supply terminals. The capacitor 30 charges to line voltage during the conductive half-cycles of diode 26 while switch 24 is in its cold position and thermostat 22 is closed, or at least when the blade 24a of switch 24 is in an open position with respect to contact 36.

When switch 24 moves to its hot position, the capacitor discharges through the solenoid winding 16. The de-

3

scribed circuit connecting the solenoid winding 16 across the power supply terminals through the diode 26 and limiting resistor 28 effects the energization of winding 16 to a degree that it will hold the normally closed valve 12 in an open position once it has been opened, but will not open the valve from a closed position. However, the discharge of capacitor 30 through the solenoid winding when switch 24 closes with its hot side contact 36 provides an augmenting energizing pulse which, together with the hold open circuit energization, effects the opening of the solenoid operated valve 12 from its closed position.

The double throw switch may be of any suitable construction; for example, as illustrated, it may simply comprise a blade 24a constructed of bimetal which when at ambient temperature closes with contact 34 and when heated sufficiently by the igniter 32 when it is at ignition temperature warps so that its free end breaks with contact 34 and closes with contact 36. The spacing of the bimetal blade 24a with respect to the igniter 32 and the burner 10 is such that the radiant energy received by it from the igniter when at room temperature, and from a normal flame at the burner when it exists, is sufficient to respectively cause the bimetal blade to warp from its cold to hot position and to remain in its hot position after the igniter is de-energized. The switch 24 preferably further includes suitable means providing the snap action operation thereof between its cold and hot positions.

The igniter 32 is preferably constructed of a ceramic material having sufficient mass to retain an igniting temperature for a short period of time after being de-energized and having a coefficient of electrical resistance acting to limit current flow therethrough when being heated in the ignition temperature range.

Because of voltage variation in commercial power supply lines, capacitor 30 is carefully sized so as to provide an adequate energy pulse upon discharge to effect opening of valve 12 only when it is charged to an A.C. supply line voltage which is high enough to heat igniter 32 to a temperature which will insure ignition of the fuel, but will not provide a valve opening pulse when partly charged or fully charged to a lower line voltage. This provides a safety feature paralleling that provided by the temperature responsive double throw switch 24 and functions to preclude opening of the fuel valve even through switch 24 moves from its cold to hot position, for any reason, in response to something slightly less than an igniter temperature which will insure ignition of the fuel.

In the arrangement illustrated, the diode 26 is connected across the power supply terminals in series with solenoid valve winding 16 so that the valve hold open energizing circuit described is half wave, the valve receiving some continuing current flow during the non-conductive half cycle due to discharge of the parallel connected capacitor 30 which is partially charged during each conductive half cycle. The igniter 32, however, is connected across the power supply terminals in parallel with diode 26 and therefore receives full wave A.C. current. If, due to conditions, it appears desirable to employ an igniter of smaller size or of less total electrical resistance, the diode 26 may be conveniently moved to a position in the circuit in which it is series connected across the power supply terminals with both the igniter 32 and valve winding 16.

OPERATION

The double throw switch 24 is shown in its cold position, which it assumes when the burner is inoperative. Under these conditions, upon closure of the space thermostat 22, the igniter is energized and capacitor 30 begins charging through diode 26 and resistor 28. When the igniter becomes heated sufficiently, somewhat above the minimum temperature at which it will dependably light the fuel, the capacitor 30 will be charged to the existing supply line voltage over a period of several cycles and the switch 24 will move from its cold to hot position.

The action of switch 24 in breaking with contact 34

4

and making with contact 36 de-energizes igniter 32 and causes the opening of valve 12 by effecting the discharge of capacitor 30 through the solenoid winding and by completing the valve hold open circuit. Fuel now flows from burner 10 and is ignited by igniter 32, which has retained sufficient temperature during the short period of elapsed time between the opening valve 12 and appearance of fuel at the burner ports to ignite it. The energy of the burner flame now received by switch 24 via radiation maintains the bimetal blade 24a in its warped hot position, whereby the fuel valve is held open.

In event the existing supply line voltage is insufficient to heat the igniter to ignition temperature, the switch 24 will not respond. However, if the existing supply line voltage is at such critical value that it may heat the igniter sufficiently to cause the response of switch 24 but not sufficiently to insure ignition of the fuel, the valve 12 will not be opened due to insufficiency of the energy pulse delivered by capacitor 30 when charged to this critical voltage.

If, however, the valve 12 opens in a normal starting sequence, but the fuel fails to ignite at the burner for any reason, or if the fuel at the burner ignites in the normal starting sequence and the flame subsequently fails for any reason, the switch 24 will cool and return from its hot to cold position, wherein the valve 12 will be de-energized and close and the igniter 32 will be re-energized and the starting cycle repeated.

In event the valve hold open circuit is interrupted or the power supply is interrupted for any reason during normal burner operation, the valve will close, but will not reopen upon recompletion of the circuit or upon restoration of power supply until the switch 24 cools to its cold position, thereby re-energizing the igniter circuit and again effecting the movement of switch 24 to its hot position.

A single valve 12 with a single solenoid actuator winding is herein illustrated. Obviously, two valves series flow arranged in the supply line and operated by a single solenoid actuator could be substituted to insure fuel cut off if one of the valves failed to close completely. Also, a second series flow valve having a separate solenoid actuator with its winding connected across the power supply terminals in series with the thermostat, but in parallel with the described igniter and valve circuits, could be added to the illustrated circuit to insure complete cut off of fuel in event one of the solenoid actuators hung up, without departing from the spirit of the invention disclosed. The exclusive use of these alternate valve arrangements is contemplated.

The igniter 32 when dimensioned to provide considerable mass insures the retention of an ignition temperature for a sufficient period of time following its de-energization to permit gas to appear at the burner ports, and also emits ample radiant energy when heated electrically to ignition temperature to insure the response of a simple, low cost, temperature responsive switch 24. The current flow through an igniter of such dimensions is considerable, so that it is usually desirable to cut off the energization thereof to conserve power as well as to extend the use life of the igniter. It is to be understood, however, that the current flow through the igniter may, for any reason, merely be reduced, instead of being completely de-energized, when switch 24 responds to move to its hot side, thereby to substantially reduce the temperature and current flow through the igniter. This may readily be accomplished by connecting the igniter 32 across the power source terminals through a limiting resistor connected in parallel with switch 24.

It is to be further understood that the switching means responsive to the ignition temperature of the igniter to cut off or substantially reduce the current flow through the igniter, and to complete the hold open valve circuit and effect the discharge of the capacitor through the valve solenoid winding to effect valve opening, need not be a double throw switch, as illustrated. This switching means

5

may, on the other hand, comprise two, separate, single throw, temperature responsive switches, one being normally open at ambient temperatures and arranged to close to complete the hold open valve circuit and the discharge of the capacitor in response to ignition temperature of the igniter, and to remain closed in response to burner flame to hold the valve open; and the other being normally closed at ambient temperatures and arranged to open in response to ignition temperature of the igniter to de-energize or reduce the energization of the igniter and remain open in response to burner flame. The arrangement of two single throw switches permits the delay of de-energization, or reduced energization, of the igniter until after the fuel valve has opened, and further permits determination of a delay or scavenging period following flame out or power failure by merely constructing the normally closed switch so that its response time is greater than that of the normally open switch.

We claim:

1. In an electrical control system for the ignition and control of a gas burner, a burner, an A.C. power source, an electrical resistance type igniter, a biased closed electromagnetic valve including a winding, a diode, a capacitor, and a resistor, circuit means including temperature responsive switching means having a cold position in which it is operative to connect said igniter across said power source and responsive to its heat at ignition temperature to move to a hot position and break said connection and being further responsive to burner flame to remain in said hot position, circuit connections connecting said capacitor, said diode, and said resistor in series relationship across said power source, whereby said capacitor is charged to line voltage, circuit connections including said temperature responsive switching means when in its hot position connecting said valve winding in parallel with said capacitor and in series relationship with said diode and said resistor, whereby said capacitor is discharged through said valve winding and said winding is connected across said power source through said resistor when said switching means moves to its hot position, said resistor having such value as to limit the level of energization of said valve winding to that which will hold the valve open but will not open it, and the additional transitory energization of said valve winding resulting from the discharge of said capacitor being sufficient to open said valve.

2. A burner ignition and control system as claimed in claim 1 in which said capacitor is sized so that when charged to a line voltage which is less than that which will heat said igniter to a predetermined ignition temperature its discharge through said valve winding will not effect opening of said valve.

3. A burner ignition and control system as set forth in claim 1 in which said diode is connected across said power source in series relationship with said igniter and said capacitor.

4. In an electrical control system for the ignition and control of a gas burner, an A.C. power source, a burner, a biased closed solenoid valve including a winding, an electrical resistance igniter, a double throw temperature responsive switch sensitive to the heat of the igniter and

6

to the heat of burner flame, said switch having a cold position which it assumes in the absence of burner flame and when the igniter temperature is less than a predetermined ignition temperature and a hot position to which it moves in response to the heat of the igniter when heated to predetermined ignition temperature and in which hot position it remains in response to the heat of burner flame, said switch being operative in said cold position to complete an energizing circuit for said valve winding which sufficiently energizes said valve winding to hold said valve open but not sufficiently to open said valve, and means including a capacitor connected across said power source so as to be charged to power source voltage when said switch is in its cold position and so as to be discharged through said valve winding when said switch moves to its hot position, thereby to effect opening of said valve.

5. In an electrical control system for the ignition and control of a gas burner, an A.C. power source, an electrically operated igniter which when connected across a power supply source of sufficient voltage is rendered operative to ignite gas at said burner, circuit means including a switch having a normal cold position and a hot position and operative in its cold position to connect said igniter across said power source, said switch including actuating means responsive to the operative condition of said igniter to move to its hot position thereby to break said igniter circuit, a biased closed electromagnetically operated fuel valve including a winding, impedance means, circuit means including said switch in its hot position connecting said winding and said impedance across said power source, said impedance having such value as to limit energization of said valve winding to that which will hold the biased closed valve open, but will not open it, a capacitor current rectifying means, circuit connections connecting said capacitor across said power source in parallel with said valve winding and said switch and in series with said rectifying means, whereby said capacitor is charged to line voltage when said switch is in a cold position and is discharged through said valve winding when said switch moves to its hot position, thereby to effect a transient energization of said valve winding operative to pull open said valve, and said switch actuating means being responsive to the presence of flame at the burner to hold said switch in its hot position.

6. A system as claimed in claim 5 in which said capacitor is sized so that a supply line voltage which will heat said igniter sufficiently to insure ignition of the burner is required to charge said capacitor sufficiently to effect opening of said valve when discharge through said valve winding.

7. A system as claimed in claim 8 in which said switch is a double throw switch and includes means effecting the snap action operation thereof between its cold and hot positions.

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