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[54] **IGNITION AND CONTROL SYSTEMS FOR GAS BURNERS**

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[58] **Field of Search** 431/67, 73, 254

[56] **References Cited**

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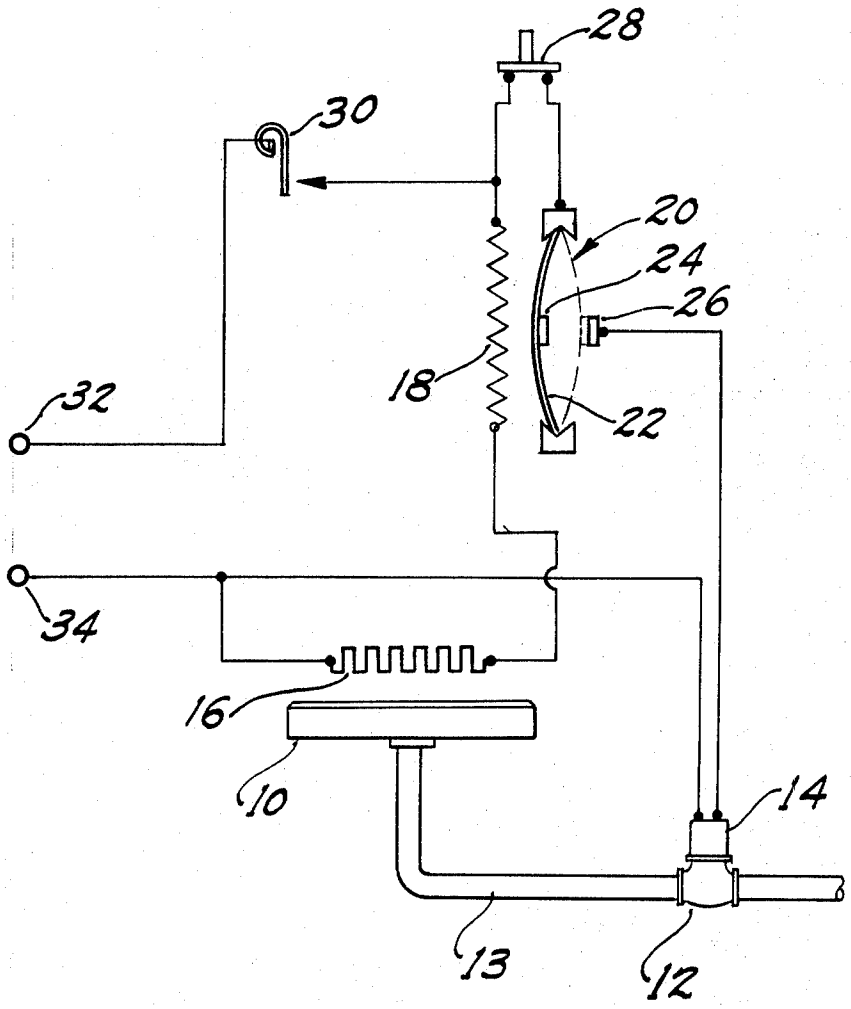
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[57] **ABSTRACT**

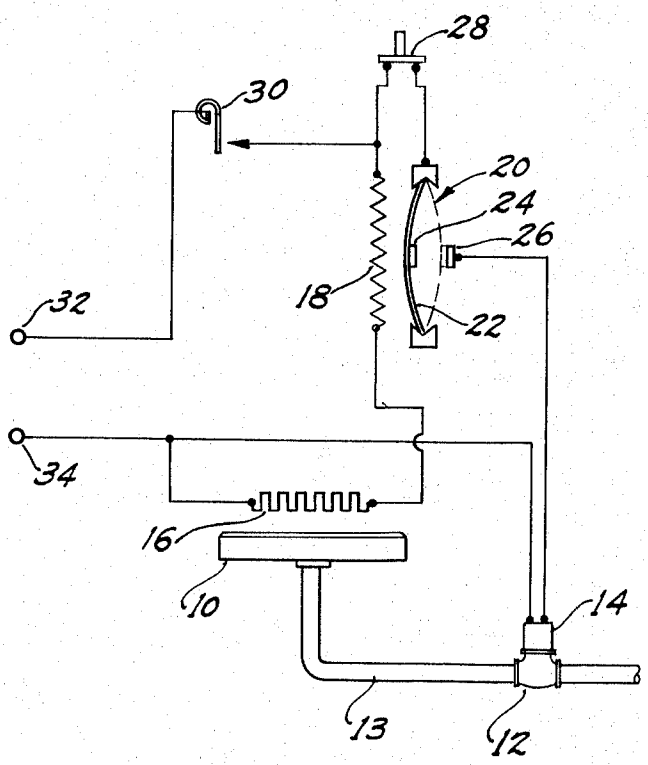
A burner ignition and control circuit in which a normally open thermal relay having an electrical resistance heater series connected across a power source with an electrical resistance glow igniter closes to effect the energization and opening of a normally closed solenoid gas vale when the igniter and resistance heater have been energized for a period of time sufficient to insure that the igniter has attained gas ignition temperature.

4 Claims, 1 Drawing Figure



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IGNITION AND CONTROL SYSTEMS FOR GAS BURNERS

This invention relates to ignition and control systems for the safe operation of gas burners and particularly to those employing glow igniters and normally closed electromagnetically operated fuel control valves which open to supply fuel to the burner only when the igniter temperature is sufficient to ignite it.

Although some gases may be ignited at considerably lower temperatures, the assurance of quick, safe ignition of commercially available cooking and heating gases by electrical resistance glow igniters requires that the igniter temperature be in the order of 2000° F. Due to these high temperatures with resulting oxidation and flame erosion, glow igniters for gas service constructed of the economically practical materials previously used or proposed did not provide the operational life desired in many applications. More recent commercially available glow igniter constructions of silicon-carbide are capable of withstanding these destructive conditions and therefore have considerably longer operational life in gas burner ignition service even when they are continuously heated to ignition temperature by electrical current during operation of the gas burner.

Present ignition and control systems for gas burners employing silicon-carbide glow igniters rely upon temperature sensing means responsive to the heat or radiant energy of the igniter when at ignition temperature to effect the flow of gas to the burner. In order to provide a margin of safety in these systems and assure that the igniter temperature, to which the sensing means responds, is high enough to ignite the burner, the sensing means is calibrated to respond to some igniter temperature considerably above gas ignition temperature to effect the flow of fuel. The sensing means in these systems is relatively expensive and inasmuch as they are required to be positioned in proximity with the igniter and burner in order to be effective they are subjected to high temperatures which may preclude their use in some applications which are attended by high ambient temperatures.

A quite simple and economical ignition and control circuit for gas burners employing a silicon-carbide glow igniter with a negative coefficient of electrical resistance has been proposed which comprises merely connecting the igniter and the winding of a normally closed solenoid gas valve in series across a power source. In this arrangement the electromagnetic winding of the solenoid is designed to effect the opening of the gas valve when the current flow therethrough is equal to or greater than that permitted by the resistivity of the series connected igniter when at gas ignition temperature. The successful and reliable operation of this control circuit obviously requires that the rate of change of resistivity of the igniter with temperature increase be relatively high and continuous through a temperature range extending substantially below and above gas ignition temperature.

A suitable rate of unidirectional change in resistivity with temperature change through a temperature range extending from substantially below to above gas ignition temperature does not, however, occur in present commercially available silicon-carbide glow igniters. In these igniters resistivity decreases at a relatively high rate with temperature increase up to a temperature considerably below gas ignition temperature and thereafter the rate of decrease of resistivity levels off to zero and then increases at a low rate as the temperature increases through gas ignition temperature.

This characteristic levelling off and reversal of the resistance-temperature curve with increasing temperature functions to preclude run-away current flow through the igniter in the absence of suitable series impedance. However, it does not provide the rate of change in resistivity with temperature change extending through ignition temperature required for reliable discrimination by the solenoid valve actuator. It will be understood that current flow through a solenoid winding series connected with the igniter may be varied by variations in commercial power supply voltage sufficiently to effect premature opening of the fuel valve.

It is on object of the present invention to provide an ignition and control system for gas burners in which means responsive to the flow of electrical current through an electrical resistance glow igniter is operative to effect the flow of fuel to a burner after a period of electrical energization of the igniter sufficient to assure it's attaining gas ignition temperature.

More specifically, it is an object of this invention to provide an ignition and control system for gas burners in which a silicon-carbide glow igniter is series connected with a resistance heater across a power source and in which the heater is operative to effect the closing of a heat responsive switch and the consequent energization and opening of a normally closed solenoid gas valve after a period of time sufficient to permit the igniter to attain the predetermined ignition temperature.

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

The single FIGURE of the drawing is a schematic illustration of an ignition and control system for gas burners constructed and arranged in accordance with the present invention.

Referring to the drawing, the primary elements of the system are: a gas burner **10,** a normally closed solenoid operated fuel valve **12** including a solenoid winding **14** and interposed in a gas supply conduit **13** leading to burner **10,** a glow igniter **16,** an electrical resistance heater **18,** a bi-metal snap switch **20** comprising a bi-metal disc **22** and contacts **24** and **26,** an interrupter switch **28,** a space thermostat **30** and power source terminals **32** and **34.**

The resistance heater **18** and the glow igniter **16** are connected in series across the power source terminals **32** and **34** through the space thermostat **30.** The solenoid winding **14,** the bi-metal snap switch contacts **24-26** and interrupter switch **28** are also connected in series across the power source terminals **32** and **34** through space thermostat **30** and in parallel with the glow igniter **16** and resistance heater **18.**

The snap switch **20** comprises a round disc **22** constructed of bi-metal, a movable contact **24** attached to the central portion thereof and a stationary contact **26.** The bi-metal disc **22** is shown in solid lines in an open position which it assumes when in unheated condition. When the bi-metal disc **22** is sufficiently heated it snaps through a planar form to an oppositely bowed, closed position as shown in dotted line with movable contact **24** in engagement with a stationary contact **26.** The electrical resistance heater **18** is positioned adjacent the switch disc **22** thereby to heat the blade **22** to a

temperature which effects it's snap action operation from a cold, open to a hot, closed position.

The glow igniter **16** may be constructed of any suitable material which may be heated by electrical current to gas ignition temperature and which has sufficient resistance to the flow of electrical current at gas ignition temperature for the purpose. Preferably the glow igniter **16** comprises a silicon-carbide crystallin structure in which resistance to electrical current may decrease at a substantial rate with temperature increase up to temperatures approaching gas ignition temperature but in which rate of change in resistivity with temperature change becomes relatively small as the temperature approaches and exceeds gas ignition temperature. The resistor **18** may be constructed of any suitable material such as nickle-chromium alloy wire. The electrical resistance of resistance heater **18** is not greater than the resistance of igniter **16** at ignition temperatures above that predetermined to be adequate for safe ignition.

OPERATION

The system is shown in a cold, inoperative condition. When space thermostat **30** closes in response to a decrease in the temperature of the space being heated by burner **10,** the resistance heater **18** and series connected glow igniter **16** are energized. The temperature of glow igniter **16** now rises to a predetermined ignition temperature in a predetermined time and the resistance heater now heats the bi-metal disc **22** sufficiently to effect the snap action closing of switch **20** in a predetermined time which is somewhat greater than the time required to heat glow igniter **16** to ignition temperature. The difference in time required to heat the igniter to ignition temperature and the time required to effect closing of switch **20** may be varied as desired by design of the heater **18** or by varying it's heat transfer relationship with the bi-metal disc **22.**

The closing of switch **20** effects energization of solenoid winding **14** and, consequently, the opening of fuel valve **12** and the flow of fuel to burner **10** where it is ignited. The igniter **16** remains energized to or near ignition temperature and the resistor **18** remains energized to retain the switch **20** in a heated closed position while thermostat **30** is closed. When the temperature of the space being heated rises sufficiently, thermostat **30** opens thereby de-energizing the system. The switch blade **22** of switch **20** now cools and returns to it's open position.

If, during operation of the system, it is desired to cut-off burner operation for a brief period, as for example, to permit safe access to the drying drum of a clothes dryer heated by the burner, the interrupter switch **28** is opened. The opening of switch **28** effects cut-off of fuel and burner operation without effecting operation of the resistor **18,** the switch **20** or the igniter **16.** When switch **28** is again closed, ignition occurs immediately at the burner.

It will be seen that variations in the power supply voltage which vary the time required to heat glow igniter **26** to ignition temperature will also vary the time, in the same direction required for resistance heater **18** to effect closing of switch **20** so that an established time differential will remain substantially constant under conditions of varying supply voltage.

We claim:

1. In an ignition and control system for gas burners, a source of electrical power, a burner, a space thermostat, electrically operated fuel supply means operative when energized to supply gas to said burner, a silicon-carbide glow igniter heated by electrical current passed therethrough to a predetermined ignition temperature in a predetermined period of time, a normally open thermal relay operative when closed to effect energization of said fuel supply means, an electrical resistance heater operative to close said thermal relay when energized for a period of time greater than said predetermined period of time required to heat said igniter to ignition temperature and operative as a sole means to heat and maintain said relay closed, and circuit connections connecting said resistance heater, said glow igniter, and said thermostat in series relationship across said power source.

2. In an ignition and control system for gas burners, a burner, a source of electrical power, a space thermostat, a silicon-carbide glow igniter, a normally open bi-metal switch, a resistance heater operative as a sole means to heat and effect the closure of said bi-metal switch and to maintain said switch closed, a biased closed solenoid operated gas valve including a solenoid winding, circuit connections connecting said thermostat, said resistance heater, and said glow igniter in series relationship across said power source, and circuit connections connecting said bi-metal switch and said solenoid winding in series across said power source, in series with said thermostat, and in parallel with said resistance heater and said glow igniter, said glow igniter requiring a predetermined period of energization to attain a predetermined gas ignition temperature, and said series connected resistance heater being so constructed and arranged as to require a predetermined greater period of energization to heat and effect the closing of said bi-metal switch.

3. The ignition and control system claimed in claim **2** in which the electrical resistance of said glow igniter when at ignition temperature is greater than that of said resistance heater.

4. The ignition and control system claimed in claim **2** which further includes an interrupter switch connected in series with said normally open switch, said solenoid valve winding and said thermostat and in parallel with said resistance heater and said glow igniter, whereby said burner operation may be interrupted without effecting operation of said glow igniter and said resistance heater or the closed position of said bi-metal switch.

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