Sept. 21, 1965 P. W. THOMPSON 3,207,204

FUEL BURNER CONTROLS

Filed Sept. 13, 1963 3 Sheets-Sheet 1

FIG. 1

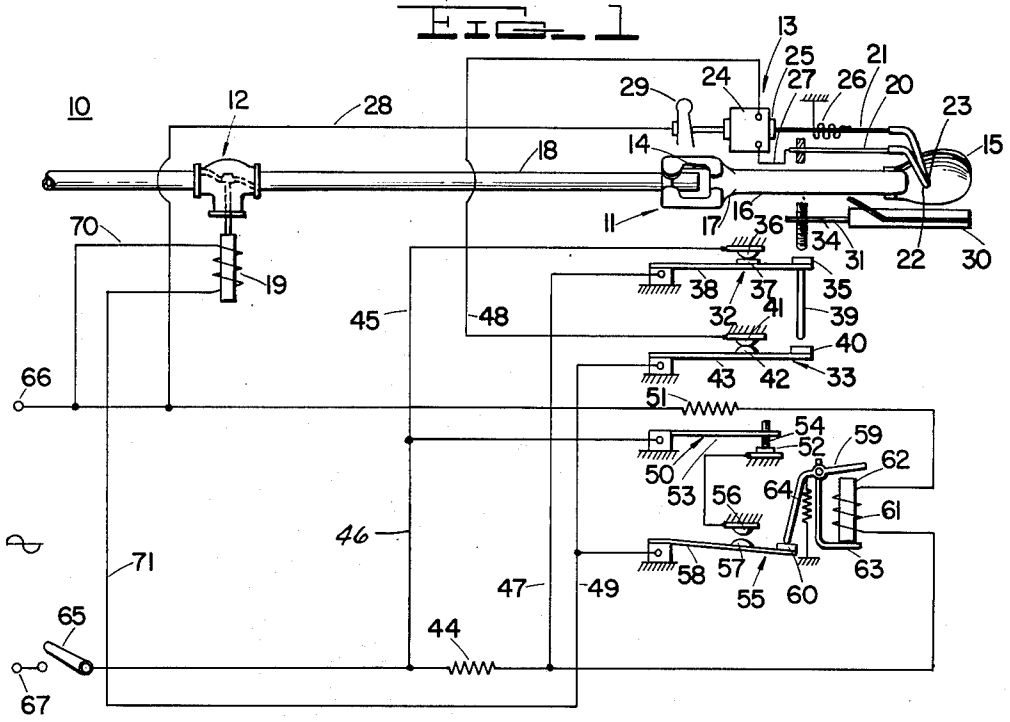
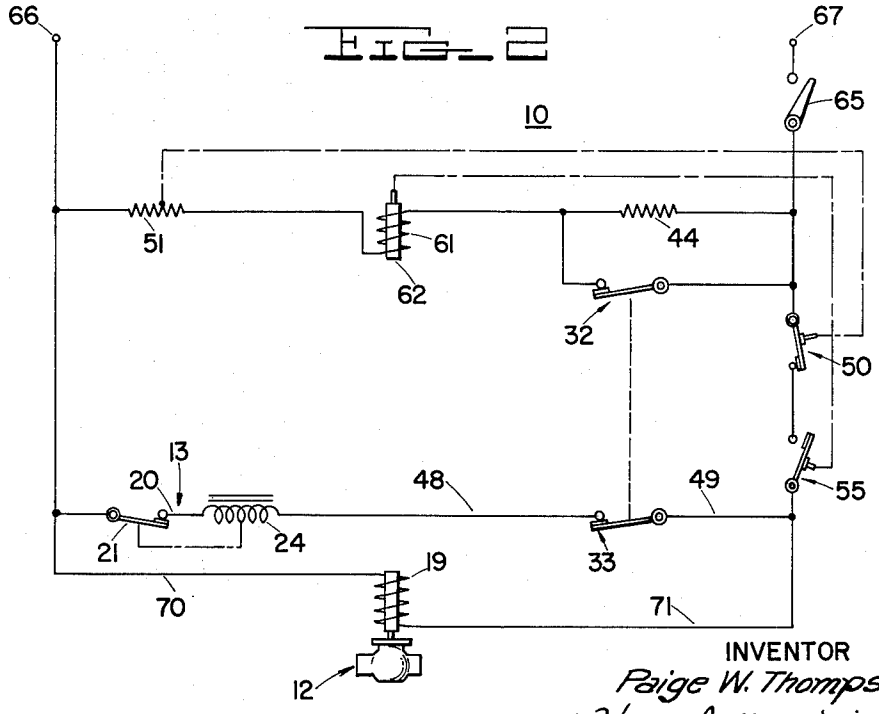


FIG. 2



INVENTOR
Paige W. Thompson,
BY Henry J. Marciniak
Attorney.

Sept. 21, 1965 P. W. THOMPSON 3,207,204

FUEL BURNER CONTROLS

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FIG. 3

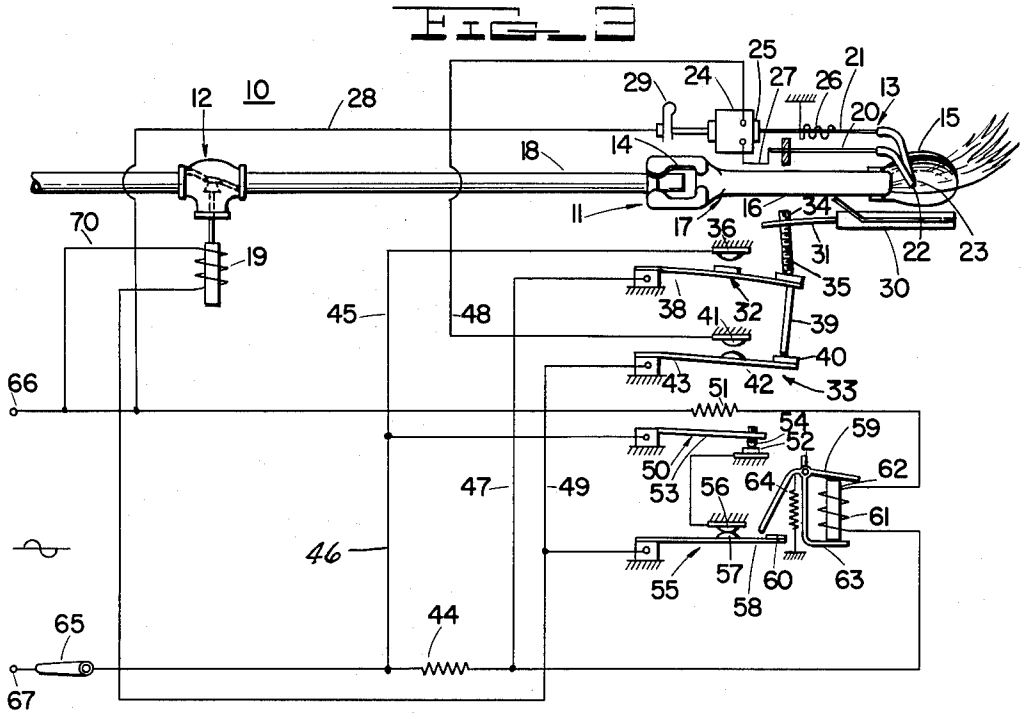
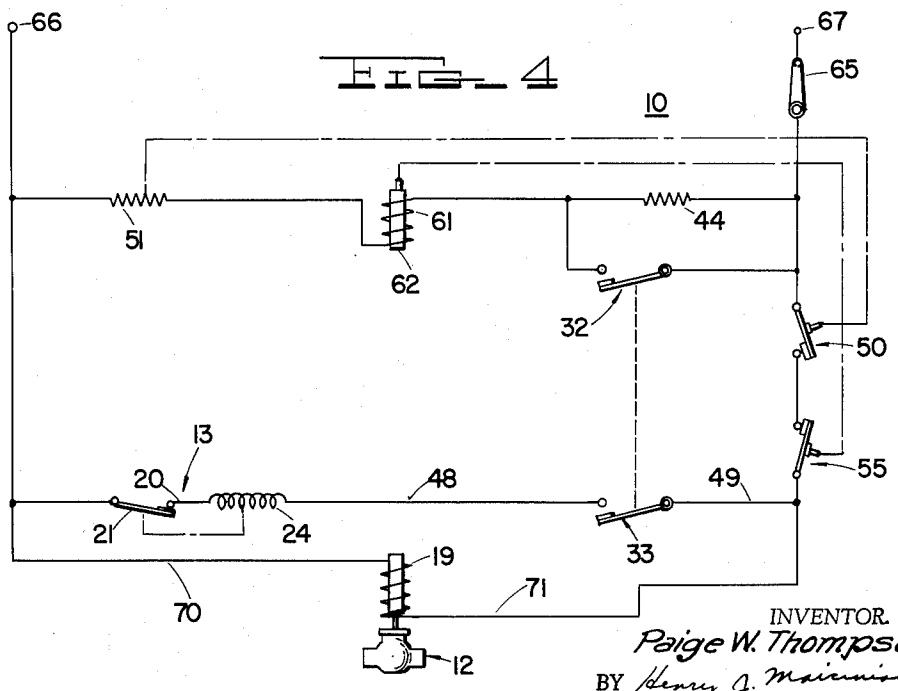


FIG. 4



INVENTOR.
Paige W. Thompson,
BY Henry J. Maiorisk
Attorney.

Sept. 21, 1965 P. W. THOMPSON 3,207,204

FUEL BURNER CONTROLS

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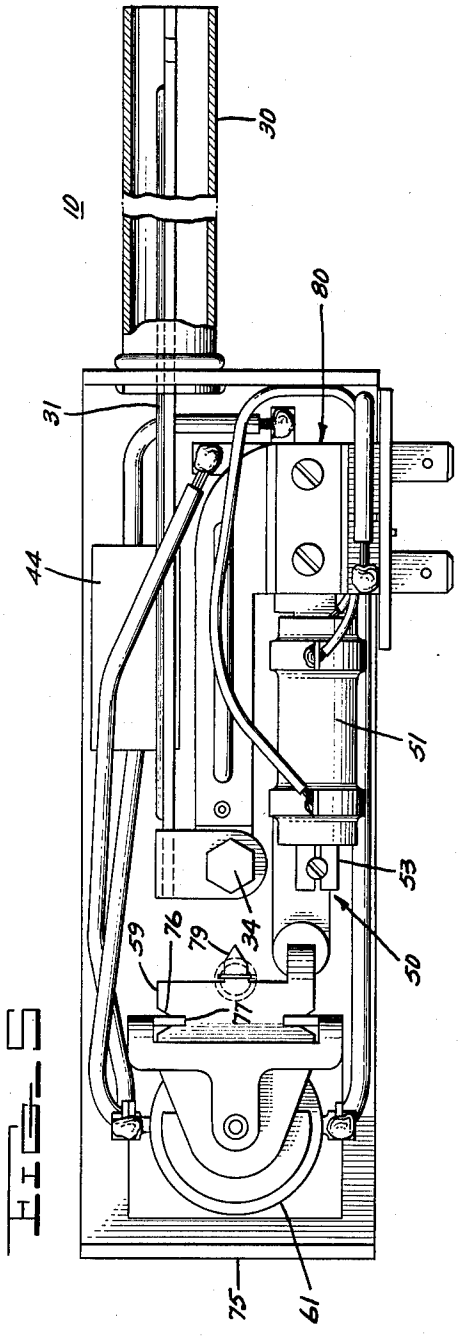

FIG. 5

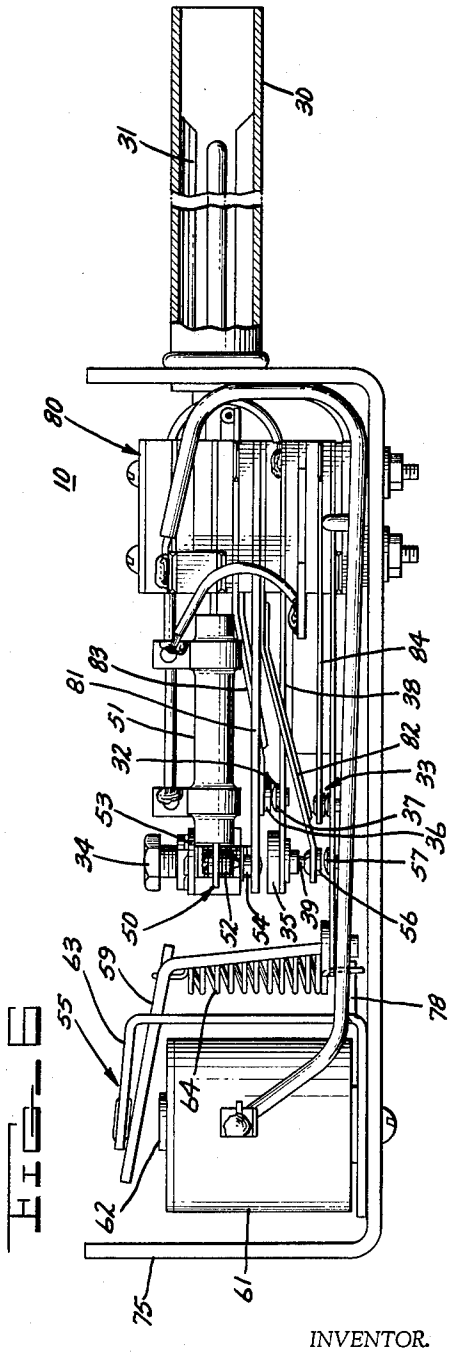

FIG. 6

INVENTOR.
Paige W. Thompson,
BY Henry J. Marcinak
Attorney.

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3,207,204

FUEL BURNER CONTROLS

Paige W. Thompson, Morrison, Ill., assignor to General Electric Company, a corporation of New York

Filed Sept. 13, 1963, Ser. No. 308,897
6 Claims. (Cl. 158—128)

This invention relates to fuel burner controls and more particularly to an improved control for automatically igniting and controlling the operation of a gas burner.

In the type of controls used for operating fuel burners, for example, the master control used to operate the gas burner in a clothes dryer, space heater and other gas-fired equipment, it is necessary that some means be provided for shutting off the supply of gas in the event the burner flame is extinguished or if ignition of the gas fails to take place. Generally, in the event of such failures, the control will allow the gas or other fuel to be supplied to the burner for a predetermined interval and if ignition does not occur within the interval, the control will cause the supply of the gas to be shut off to prevent dangerous accumulations of gas.

A commonly used control for a gas burner employing electric ignition, utilizes a safety lockout switch, which is operated with a delayed action by a lockout heater connected in parallel with a hold resistor. The safety lockout switch comes into play to cut off the power to the solenoid or coil of the gas valve, when the gas fuel is not within a permissible interval, initially ignited, or reignited after a flame failure. Such conventional controls do not usually cause the system to fail safe, i.e., shut off the power to gas valve solenoid and to the igniter, when the connections to the safety lockout heater or the lockout heater itself fails during the operating condition of the fuel burner. It is particularly desirable that a control for a fuel burner cause the system to completely fail safe when such failures occur.

Accordingly, a general object of the present invention is to provide a control for operating a fuel burner incorporating improved safety features.

A specific object of the invention is to provide a fuel burner control that will cause the system to fail safe in the event that the lockout heater or connections thereto fail.

It is another object of the present invention to provide an improved fuel burner control that utilizes components that are relatively simple and inexpensive in construction and that insure safe operation of the burner.

In accordance with one form of my invention I have provided an improved control for use in conjunction with a fuel burner, a fuel control valve and an electrical igniter. The control includes a safety lockout heater for actuating a lockout switch, a main relay coil for operating a normally open relay switch and a hold resistor for limiting the current to the relay coil to a value above its holding current value but below the value required to activate the safety lockout heater. The lockout heater, the relay coil and the hold resistor are connected in series circuit relationship in an operating circuit branch. The operating circuit branch is connected in circuit across the supply terminals or connections provided for energization from an alternating current source.

In order to detect the presence or absence of combustion, I have provided a combustion responsive means which actuates a first and a second normally closed combustion switch to an open condition when combustion is established. One of the combustion responsive switches is connected across the hold resistor to provide a shunt path so that the current to the relay coil and lockout heater will be at a level sufficient to actuate the relay coil, and to activate the lockout heater if combustion

is not established after a predetermined time interval. The second combustion switch is connected in series circuit relation with the igniter. Further, the igniter and the second combustion switch are connected in series in a starting circuit branch connected across the supply terminals, and a gas valve control coil is connected in parallel circuit across the starting circuit branch. The lockout and relay switches are joined in series circuit between the operating circuit branch and the starting circuit branch and in circuit with one of the supply terminals so that when either of these switches are in the open position, the power to the igniter and the gas valve control coil is interrupted.

With the safety lockout heater connected in series circuit relation with the hold resistor and the main relay coil, the control causes the fuel burner system to fail safe in the event that the safety lockout heater or the connections thereto fail. This safety feature is accomplished without the need for additional components, such as switches and the like.

Further aspects of the invention will become apparent from the more detailed description of the invention which follows. It will be understood that the specification concludes with claims which particularly point out and distinctly claim the subject matter which I regard as my invention. The invention, however, both as to organization and method of operation, may be best understood with reference to the following description taken in connection with the accompanying drawings in which:

FIGURE 1 is a diagrammatical view of the improved control embodying one form of the invention particularly adapted for a gas burner application, the switches being shown in their normal position for the "cold" condition of the control;

FIGURE 2 is a simplified circuit diagram of the control illustrated in FIGURE 1 with the components of the control shown schematically and arranged to more clearly illustrate the relative circuit connections between the components;

FIGURE 3 is a diagrammatical view of the control corresponding to the view shown in FIGURE 1 and showing the relative positions of the switches when the control is in the "hot" or operating condition;

FIGURE 4 is a simplified circuit diagram of the control corresponding to FIGURE 3 with the components of the control shown schematically and arranged to more clearly illustrate the relative circuit connections between the components;

FIGURE 5 is a plan view of the control with the cover plate removed to show the physical arrangement of the components; and

FIGURE 6 is a side elevational view of the control corresponding to the view shown in FIGURE 5.

Referring now in more detail to the drawings, I shall now more particularly describe the improved control **10** as applied to a gas burner **11** having associated therewith a solenoid operated valve **12** and an igniter **13**. The gas burner **11** includes the adjustable air intake openings **14**, a reflector **15**, and an essentially tubular chamber **16** formed with a narrow throat section **17**.

Gaseous fuel is admitted to the burner **11** by a gas inlet pipe **18** which projects into the gas burner **11** through an opening provided at the end thereof. A controlled supply of air is admitted to the burner **11** through the adjustable air intake openings **14**. During operation of the burner **11**, a mixture of the gaseous fuel and air is conducted through the chamber **16**, which functions as a venturi tube, and the mixture of air and fuel is ignited in the vicinity of the outlet by the igniter **13**.

The supply of gaseous fuel is controlled by an electromagnetically operated gas valve **12** which is opened

by energizing gas valve control coil **19**. When the coil **19** is deenergized or when the current through the coil **19** falls below the holding value, the valve **12** returns to the closed position by gravity, a spring or other suitable bias means (not shown).

In order to initiate combustion of the fuel, a pair of electrodes **20**, **21** of the igniter **13** have their igniter tips **22**, **23** disposed near the burner outlet in proper location with respect to the fuel stream. It will be seen that electrode **20** is fixed while the other electrode **21** is arranged for relative rotational movement with respect to the fixed electrode **20**. The movable electrode **21** is driven by the armature **25** and oscillated at a relatively low frequency when the igniter coil **24** is energized. Further, it will be noted that the movable electrode **21** is biased by a spring **26** to a normally closed position. An electric arc is generated between the igniter tips **22**, **23** as the movable electrode **21** is intermittently rotated out of engagement with the fixed electrode **20**. The fixed or stationary electrode **20** is connected in electrical circuit with the coil **24** by means of a connection **27** and the movable electrode **21** is connected in electrical circuit with lead **28** through the contact **29** to join the electrodes **20**, **21** in series circuit relation with the igniter coil **24**. The spring force exerted by the spring **26**, the inertia of the armature-electrode mass system, and the torque developed by the armature **25** are the factors that determine the frequency at which the igniter tips **22**, **23** are opened and closed during the ignition period. A frequency of approximately 10 cycles per second provides satisfactory ignition in the illustrated application.

The combustion responsive means used in the exemplification of the invention includes a flame detector tube **30** positioned in proximity to the burner **11**, an operating arm **31** and a pair of combustion switches **32**, **33**. The presence of the gas flame near one side of the tube **30** results in a temperature differential between one side and the other, which causes the flame detector tube **30** and the operating arm **31** to deflect to the position shown in FIGURE 3. When so deflected, the operating arm **31** actuates the first combustion switch **32** and the second combustion switch **33** to the open position. It will be seen that an adjustable screw **34** carried by the operating arm **31** provides a means for adjusting the position of the arm **31** with respect to the push button **35**.

Having more specific reference now to the combustion switches **32** and **33**, I will now more fully describe these switches. The first combustion switch **32** includes a relatively fixed contact **36** and a movable contact **37** carried near the free end of a flexible strip **38** supported fixedly at the other end. A finger **39** extends downwardly from the free end of the flexible strip **38** so as to engage the push button **40** of the second combustion switch **33** when the operation arm **31** is deflected. The second combustion switch **33** includes a relatively fixed contact **41** and a movable contact **42** carried on a flexible strip **43**. The first combustion switch **32** is connected across the hold resistor **44** by leads **45**, **46**, **47**, to short-circuit the hold resistor **44** when the switch **32** is closed. The second combustion switch **33** is connected in the second circuit branch containing the igniter **13** by leads **48** and **49** and opens the electrical circuit in the second circuit branch when switch **33** is actuated to the open position. Thus, when combustion is established, this switch causes the igniter **13** to be deenergized.

A lockout switch **50** operable by a lockout heater **51**, interrupts the power to the gas valve coil **19** and igniter **13** under certain conditions as will hereinafter be more fully discussed. The lockout switch **50** includes a relatively fixed contact **52** and a deflectable switch arm **53** carrying a contact **54**. In the illustrated exemplification of the invention, if combustion did not take place within less than 90 seconds after the control **10** was energized, the heat generated in the lockout heater **51** was sufficient to deflect the switch arm **53** and open the lockout switch **50**. It will be understood, as will hereinafter be more fully explained, that when the hold resistor **44** is not short-circuited, the current supplied to the lockout heater **51** is insufficient to actuate the lockout switch **50**.

A main relay switch **55**, which is normally in an open position when the control **10** is in the "cold" condition, is almost instantaneously closed when the control switch **65** is closed in response to a demand for combustion. The switch may be a thermostat, a timer or other switching means. The type of switch employed, will, of course, depend upon the particular application of the control **10**. The relay switch **55** includes a relatively fixed contact **56** and a movable contact **57** carried near the free end of the flexible strip **58**, a pivotally supported operating arm or armature **59**, a push button **60**, a relay coil **61**, a core **62** and a support bracket **63**. The operating arm **59** is normally biased by a spring **64** to hold the relay switch **55** in a normally open position when the relay coil **61** is not energized or when the current through the relay coil **61** falls below the holding current value of the relay switch. The relay coil **61** used in the exemplification of the invention had a pick-up value of .095 ampere and a holding current value of .035 ampere. As will hereinafter be more fully described in connection with the description of the operation of the circuit, an open circuit type of failure in the lockout heater **51**, the relay coil **61** or the hold resistor **44** will cause the relay switch **55** to be deenergized and restored to its normally open position.

Supply terminals or connections **66**, **67** are provided for energization from a suitable alternating current supply, such as a 120 volt, 60 cycle supply. In the exemplification of the invention terminal **67** was adapted for connection to the ungrounded or black lead of the power supply.

Having more specific reference now to the simplified schematic circuit diagrams of the control **10** as shown in FIGURES 2 and 4, I will now more fully describe the circuit connections of the components of the control **10**. The lockout heater **51**, the relay coil **61** and the hold resistor **44** are connected in series circuit relation with each other in the first or operating circuit branch which is connected across the supply terminals **66**, **67**. It will be noted that the first combustion responsive switch **32** is connected in a shunt across the hold resistor **44**. Thus, when control switch **65** is initially closed to energize the control **10**, the hold resistor **44** is short-circuited. The current through the operating circuit branch is essentially limited only by the impedance of the lockout heater **51** and the relay coil **61** and is sufficient to close the relay switch **55**.

The igniter electrodes **20**, **21**, the igniter coil **24** and the second combustion responsive switch **33** are connected in series in the starting circuit branch of the control **10**. It will be noted that the gas valve control coil **19** is connected across the starting circuit branch by leads **70**, **71**. The lockout switch **50** and the relay switch **55** are connected, preferably, in circuit with the terminal **67** between the operating and starting circuit branches, as shown, so that when either the lockout switch **50** or the relay switch is open, the supply of power is interrupted to the starting circuit branch and to the gas valve control coil **19**.

In FIGURES 5 and 6, I have illustrated a plan and side view to show the physical arrangement of the components of the control **10** as employed in the illustrated embodiment of the invention. It will be appreciated that these views are not intended to show the specific circuit connections. The control **10** is housed in a control box with the cover plate (not shown) and is supported on a U-shaped frame **75**. It will be seen that the control or main relay **55** is attached to the U-shaped frame **75** at the left end. The relay **55** includes the relay coil **61**, the core **62** disposed within the coil **61**, the armature or operating arm **59**, the spring **64** and the bracket **63**. The

operating arm **59** is pivotally carried on the bracket **63** by assembling the indented portion **76** of the arm **59** into a recess **77** formed in the bracket **63**, as will be seen in the view illustrated in FIGURE 5. The spring **64** is attached at one end to a tab **78** extending from the bracket **63** and is attached at the other end to a tab **79** on the arm **59**.

As shown in FIGURE 5, the hold resistor **44** is connected to a terminal of the relay coil **61**. At the right hand side of the U-shaped frame **75** a stack **80**, on which switching elements of the control **10** are supported, is attached to the frame **75**.

It will be seen that the lockout heater **51** is wrapped around the flexible arm **53** and is supported thereon. The contacts **52**, **54** of the lockout switch **50** are shown in the closed position. Further, it will be noted that relatively fixed arms **81**, **82** supporting contacts **52**, **56** of the lockout and relay switches **50**, **55** are sandwiched together in the stack **80** to provide a good electrical connection therebetween.

As will be seen in the view shown in FIGURE 6, the relatively fixed contact **36** of the first combustion responsive switch **32** is carried on an angled support arm **83**. The relatively fixed contact **42** carried on a similarly angled support arm **84** lies under the flexible strip **38** which carries the relatively movable contact **37** of the first combustion responsive switch **32**. The support arm **84** carrying the contact **42** is located under the first combustion switch **32** so that when the operating arm **31** of the flame detector tube **30** is deflected downwardly, as seen in FIGURE 6, the actuating screw **34** engages the push button **35** and effects a displacement of the free end of flexible strip **38** and finger **39** to thereby open the first and second combustion responsive switches **32**, **33**.

The flame detector tube **30** is supported in an aperture provided in the U-shaped frame **75** and extends outwardly of the frame **75** so that the tube can be properly positioned with respect to the burner **11**. When the flame detector tube **30** is heated at one side so that a temperature differential exists between one side of the tube **30** and the other side, the tube **30** warps effecting a downward movement of the actuating screw **34**. In this manner both of the combustion responsive switches **32**, **33** are actuated from a normally closed to an open position.

Referring now more particularly to the diagrams shown in FIGURES 1–4, I will now more fully describe the operation of the improved control **10**. In FIGURES 1 and 2 I have shown the position of switches **32**, **33**, **50**, **55** and **65** for the "cold" condition of the control **10**.

The control **10** is energized when switch **65** is closed in response to a demand for heat. Initially, current flows only in the operating circuit branch, and the path of current flow during an arbitrary half cycle of the alternating supply is through the supply connection **67**, switch **65**, combustion responsive switch **32**, relay coil **61**, lockout heater **51** and the supply connection **66**. Since the hold resistor **44** is essentially short-circuited, the magnitude of the current in the operating circuit branch is now above the pickup value of the relay coil **61**, and the relay switch **55** closes almost instantly when the control **10** is energized to supply power to the igniter **13** and the gas valve control coil **19**.

Normally, under these conditions the gas fuel will be ignited. The presence of a flame in the vicinity of the flame detector tube **30** will cause a deflection of the tube **30**, and the combustion switches **32**, **33** will be actuated to the open position as shown in FIGURES 3 and 4. When this occurs, the power supplied to the igniter **13** is interrupted to turn off the ignition, and the shunt path across the hold resistor **44** is opened. The hold resistor **44** is now effective in the operating circuit branch to limit the level of the current flowing therein so that it is above the holding value of the relay coil **61**. In the illustrated exemplification of the invention the ohmic value of the hold resistor **44** was 2200 ohms. When the hold resistor **44** is not short-circuited by switch **32**, the power supplied to the lockout heater **51** is not sufficient to activate the flexible strip **53** of the lockout switch **50**.

When switch **65** is opened in response to a demand for a cessation of heating, the relay switch **55** immediately opens to interrupt the supply of power to the gas valve control coil **19** thereby stopping the supply of gas fuel to burner **11**. The absence of flame is detected by the flame detector tube **30**, and after a pretermined interval (approximately 6 seconds in the illustrated embodiment) the combustion switches **32**, **33** are restored to a closed position. The control **10** is now ready to reply to a demand for heat if required to do so.

If, when the control **10** is energized in response to a demand for heat, combustion of the gas is not successfully established within the interval in which the lockout heater **51** is heated to a point where it causes the lockout switch to open, the supply of gas and ignition is turned off. In the exemplification of the invention this interval was approximately between 10 and 90 seconds for maximum and minimum supply voltages. The lockout switch **50** will remain in the open position until the operating circuit branch of the circuit is deenergized by opening the control switch **65**. It will be appreciated that when the lockout switch **50** is open and relay switch **55** is closed, the supply of power to both the gas control valve coil **19** and the igniter **13** is interrupted. Since the first combustion switch **32** is closed during this condition of the control **10**, the holding resistor **44** is bypassed and the current in the operating circuit branch is above the pick-up value of the relay coil. Consequently, the relay switch **55** is closed during this condition of the control **10**.

When the control **10** is in the running or operating condition, as shown in FIGURES 3 and 4, and a flame failure occurs, the temperature across the sides of the flame detector tube **30** will equalize and the operating arm **31** will return to its "cold" position to reset the combustion switches **32**, **33** to their closed position. With these switches closed, the igniter **13** is energized to provide ignition and the hold resistor **44** is short-circuited. If combustion is established within the permissible interval (the time required to heat the lockout heater **51** to the point where the lockout switch **50** will open), the control **10** will restore the burner **11** to its running condition. However, if combustion is not established within this interval, the lockout switch **50** opens to deenergize the gas valve control coil **19** and the igniter **13**. The control **10** will remain in the lockout condition until the control switch **65** is opened.

Let us assume that the control **10** is in the runing condition as shown in FIGURES 3 and 4 and an open circuit type of failure occurs in the lockout heater **51**. An open circuit in the lockout heater **51** results in an interruption in the current supplied to the operating circuit branch of the control **10**. Thus, the current to the relay coil **61** is interrupted, and the relay switch **55** is opened. With the relay switch **55** in the open position, power to the igniter **13** and gas valve control coil **19** is cut off. Consequently, the burner **11** fails safe.

A similar condition results if a connection to the relay coil **61** or the coil **61** itself fails during the running condition of the control. Also, an open circuit failure of the hold resistor **44** during the running condition will cause the relay coil **61** to be deenergized and open the relay switch **55**. If the failure of the hold resistor **44** occurs when the control is in the "cold" condition, the control **10** when energized will cause combustion to be established. However, when the combustion switch **32** opens, the operating circuit branch is not open-circuited and the relay switch **55** opens. This will shut the gas off, but upon resetting and closing of switch **32**, the device will reignite. Upon detection of flame switch **32** again opens and causes relay coil **61** to be deenergized. This condition may be repeated several times until the lockout

resistor 51 opens switch 50. Thus, the control 10 causes the burner 11 to fail safe.

If an open circuit type of failure occurs in the igniter coil 24 during the running condition, this will have no immediate effect on the operation of the burner 11 until operation is stopped in response to a demand for a cessation of heating and the switch 65 is again closed in response to a demand for heat. With an open-circuited igniter coil 24, ignition is not provided, and the combustion switches 32, 33 remain closed. The lockout heater 31 comes into play and opens the lockout switch 50 to cause the fuel burner 11 to fail safe.

An open circuit type failure of the gas valve control coil 19 during the running condition will cause the gas valve 12 to close. The flame detector tube 30 quickly detects the absence of the flame and closes the combustion switches 32, 33. Since the hold resistor 44 is now short-circuited, the lockout heater 51 takes over and actuates the lockout switch 50 to the open position thereby causing the burner 11 to fail safe.

From the foregoing description of the control and its operation, it will be apparent that I have provided an improved arrangement for safely controlling the operation of a fuel burner. An important advantage of the improved arrangement is that if the safety lockout heater, the main relay coil, or their connections fail, the control will cause the burner to fail safe.

Although the present invention has been described by reference to a particular embodiment thereof, it is to be understood that many modifications may be made to the improved control arrangement by those skilled in the art without actually departing from the invention. For example, it will be apparent that other suitable forms of combustion responsive devices may be used to detect the presence or absence of combustion. Also, it will be apparent to those skilled in the art that the relay coil, the safety lockout heater and the holder resistor can be rearranged in the circuit without basically changing the functional arrangement. It is, therefore, intended by the appended claims to cover all such modifications that fall within the true spirit and scope of the invention.

What I claim as new and desire to secure by Letters Patent of the United States is:

1. In a control for use with a gas burner, a gas valve including a control coil and an igniter including an igniter coil, a lockout heater and a lockout switch operable by said lockout heater when the current through the lockout heater is at a first predetermined level for a selected interval, a relay coil and a relay switch operable by the relay coil for closing the relay switch when the current through the relay is at the first predetermined level, said relay coil being connected in series circuit relation with said lockout heater, a current limiting means connected in series circuit relation with said serially connected relay coil and lockout heater to limit the current to a second predetermined level below the value required to actuate the relay switch and at a value sufficient to hold the relay switch closed but insufficient to heat the lockout heater to actuate the lockout switch, a pair of supply terminals for connection to an alternating current supply, circuit means connecting said serially connected lockout heater, relay coil and current limiting means in a circuit branch across said supply terminals without any circuit connection in parallel with said lockout heater in the circuit branch connecting said relay coil across said supply terminals, at least one combustion responsive switch, said combustion responsive switch being connected in shunt with said current limiting means to cause current to be provided to said relay coil and lockout heater at said first predetermined level when said switch is closed and at the second predetermined level when opened, said combustion responsive switch being actuated when combustion is initiated, and circuit means for connecting the igniter in parallel with the gas valve control coil across the supply terminals, said lockout and relay switches being joined in a series circuit with one of the supply terminals, the gas control valve coil, and the igniter to thereby cause the gas control valve coil and igniter to be deenergized when either said lockout switch or said relay switch is opened.

2. In a control for use in conjunction with a gas burner; an igniter, a gas valve including a control coil, a lockout switch, a lockout heater coupled with the lockout switch to actuate said lockout switch with a delayed action, a relay switch, a relay coil coupled with the relay switch to actuate said relay switch, said relay coil connected in series circuit with said lockout heater, a hold resistor connected in series circuit with the serially connected relay coil and lockout heater to limit the current to the relay coil to at least the holding current value of the relay coil, a pair of supply connections for energization from an alternating current supply, a first circuit branch connected across said supply connections and including said lockout heater, relay coil and hold resistor, a combustion responsive switching means including at least one switch, said switch being connected in shunt with said hold resistor, and being actuated to the open position in response to the initiation of combustion, a second circuit branch connected in circuit across the supply connections and including the igniter coil, means connecting the gas valve coil in parallel with said second circuit branch, said lockout switch and said relay switch joined in series with one of said supply connections and said parallel connected second circuit branch and gas valve coil circuit to interrupt the power to said second branch and the gas valve coil when either of said lockout and relay switches is open, whereby an open-circuit type of failure in said lockout heater causes said fuel burner to fail safe.

3. In a control for use in conjunction with a fuel burner; a fuel valve including fuel valve control means, a pair of supply connections from an alternating current supply, a normally closed lockout switch, a lockout heater coupled with the lockout switch to open the lockout switch when the current through said lockout switch remains above a predetermined level for a selected interval, a normally open relay switch, a relay coil for nected in series circuit relation with said lockout heater operating said relay switch, said relay coil being conand closing the relay switch when energized with current at said predetermined level, a hold resistor connected in series with said serially connected relay coil and lockout heater and limiting the current thereto to at least the holding current level of the relay coil, a first circuit means connecting said relay coil, said lockout heater and said hold resistor across the supply connections, a combustion responsive switching means having a switch connected in parallel with the hold resistor and, a second circuit means connecting the fuel valve control means across the supply connections, said lockout switch and relay switch being connected in said second circuit means to thereby cause said gas valve to be deenergized when either said lockout or said relay switch is in the open position, whereby an open-circuit type of failure in the lockout heater or the relay coil causes said control to fail safe.

4. In a control for use with a gas burner; a gas control valve including a control coil and an igniter, a lockout heater and a lockout switch being operable by said lockout heater when the current through the lockout heater is held at a first predetermined level for a selected interval, a relay coil and a relay switch operable by the relay coil for closing the relay switch when the current through the relay is at the first predetermined level, said relay switch being in a normally open position and said lockout switch being in a normally closed position, said relay coil and said lockout heater being connected in series circuit relation, a current limiting means connected in series circuit with said serially connected relay coil and lockout heater to limit the current thereto to a second pre-

determined level sufficient to hold the relay switch in a closed position, a pair of supply connections from an alternating current supply, circuit means connecting said serially connected lockout heater, relay coil and current limiting means in a circuit branch across said supply connections without any circuit connection in parallel with said lockout heater in the circuit branch connecting said relay coil across said supply connections, a combustion responsive switching means including a first and second combustion switch, said combustion switches being actuated in response to the presence of combustion, said first combustion switch being connected in bypass relation with said current limiting means to cause current to be provided to said serially connected relay coil and lockout heater at the first predetermined level when in the closed position and at the second predetermined level when in the open position, and circuit means for connecting the igniter in series with said second combustion switch and connecting said serially connected igniter and second combustion switch in parallel with the gas valve control coil across the supply connections, said lockout and relay switches being joined in series circuit with one of said supply connections and said gas valve control coil to thereby cause at least the gas control valve to be deenergized when either said lockout switch or said relay switch is open.

5. In a control for use with a gas burner, a gas valve including a control coil and an igniter, a pair of supply terminals for energization from an alternating current supply, a first circuit branch connected in circuit across the supply terminals, a second circuit branch connected in circuit across the supply terminals and in parallel with said first circuit branch, means for joining the gas valve control coil in parallel circuit relation across the second circuit branch, a lockout switch and a lockout heater, said lockout heater connected in said first circuit branch to open the lockout switch if ignition fails or does not occur, a relay switch and a relay coil, said relay coil connected in series with said lockout heater in said first circuit branch, a hold resistor connected in series with said serially connected lockout heater and relay coil, said hold resistor limiting the current to said serially connected lockout heater and relay coil to a predetermined level, a combustion responsive switching means including at least one combustion switch, said combustion switch being connected across said hold resistor to cause current to be provided to said serially connected relay coil and said lockout heater at another predetermined level when the combustion switch is closed, means connecting the igniter in said second circuit branch, said lockout switch and said relay switch in series circuit with one of said supply terminals and said second circuit branches to thereby interrupt the power to the igniter and gas control valve coil when either said lockout switch or said relay switch is actuated to the open position, whereby an open circuit type of failure of said lockout heater or said relay coil causes the gas burner to fail safe.

6. In a control for use with a fuel burner, an igniter means and a fuel valve for controlling the supply of fuel to the fuel burner, a fuel valve control coil for opening and closing said fuel valve, said fuel valve being opened by energizing said fuel valve control coil and closed by deenergizing the coil, and said igniter means having electrodes and an igniter coil, said igniter coil when energized causing an electrode to be actuated to provide an electric arc for ignition, a pair of supply terminals for connection to an alternating current supply, an operating circuit branch connected in circuit across the supply terminals, a starting circuit branch connected in circuit across the supply terminals and in parallel with said operating circuit branch, a normally closed lockout switch, a lockout heater connected in said operating circuit branch to open said lockout switch in a predetermined interval if ignition fails or does not occur, a normally closed relay switch, a relay coil connected in series with said lockout heater in said operating circuit branch for closing the relay switch, a hold resistor connected in said operating circuit branch in series with said lockout heater and relay coil to limit the current to the relay coil to a level sufficient to hold the relay switch in a closed position but insufficient to cause the lockout heater to actuate the lockout switches, a combustion responsive switching means having a first normally closed switch connected in shunt with the hold resistor for short-circuiting the hold resistor during the ignition period and a second normally closed switch for energizing the igniter during the ignition period, said first and second switches being actuated to the open position in response to the initiation of combustion, said second switch being connected in series circuit relation with said igniter in said starting circuit branch, circuit means for connecting the fuel valve control coil across said starting circuit branch and including connections placing said lockout switch and relay switch in series circuit between said operating and starting branches and in circuit with one of said supply terminals, whereby an open-circuit type of failure in said lockout heater causes said fuel burner to fail safe.

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FREDERICK L. MATTESON, JR., *Primary Examiner.*

MEYER PERLIN, JAMES W. WESTHAVER,
Examiners.