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HEATER IGNITION SYSTEM

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FIG. 1

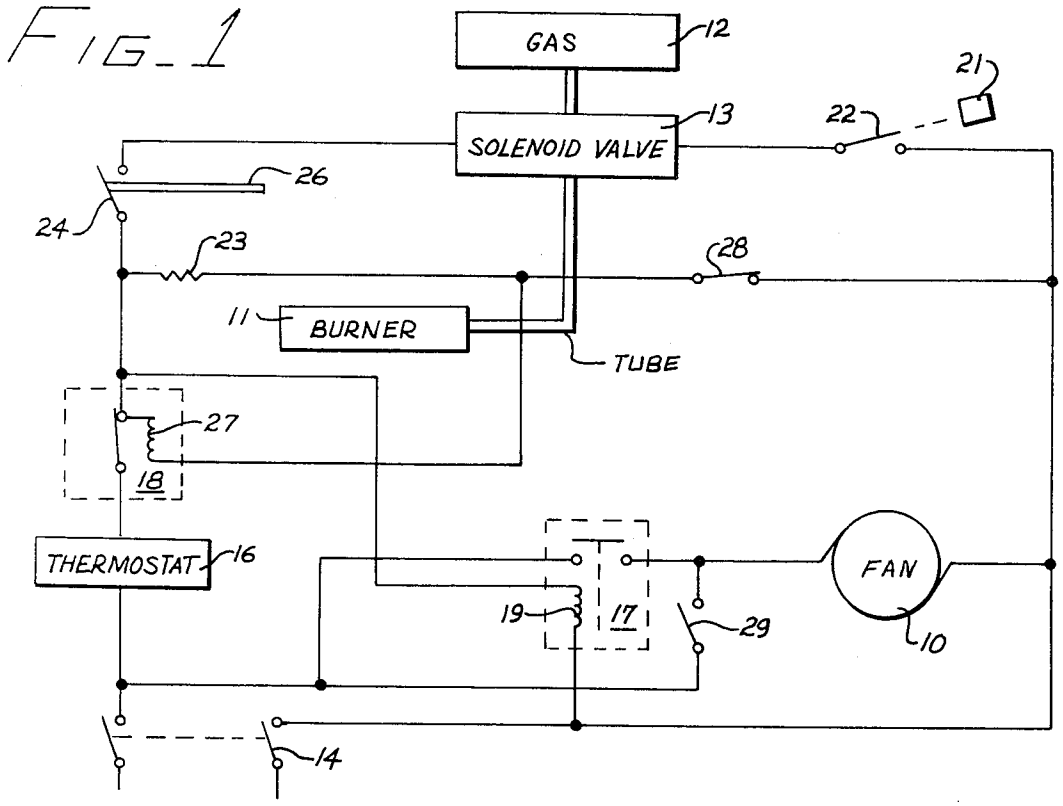
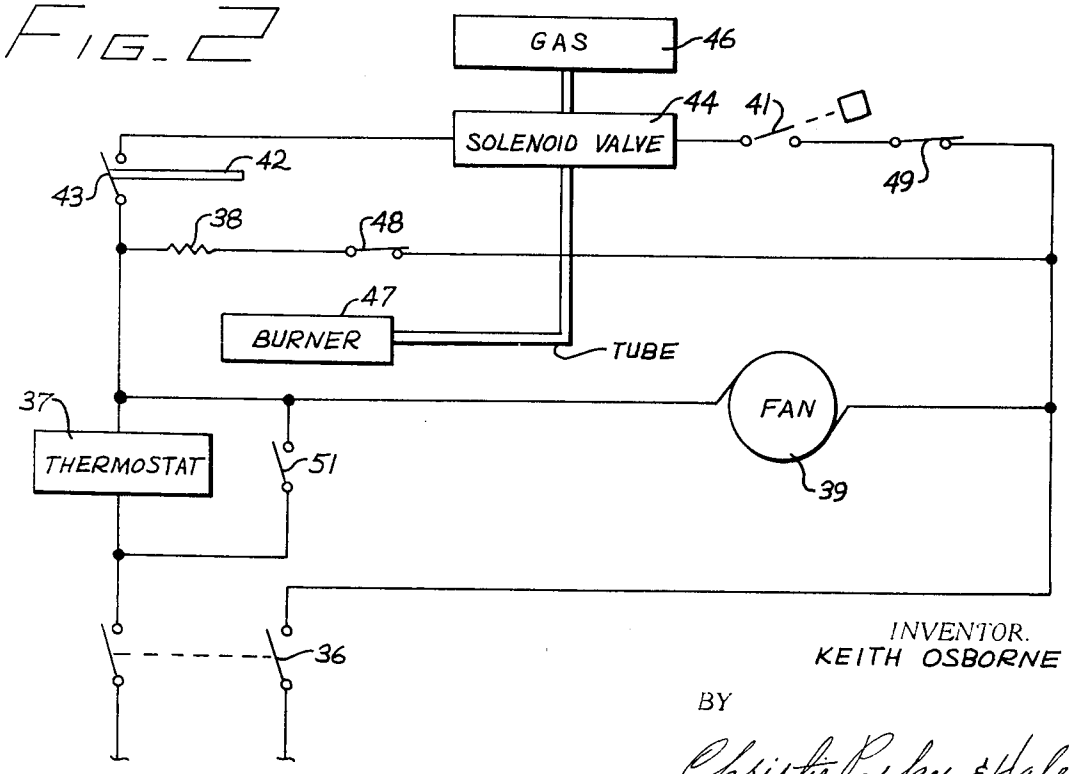


FIG. 2



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HEATER IGNITION SYSTEM

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ABSTRACT OF THE DISCLOSURE

A simple ignition system for a space heater or the like is provided wherein gas or similar fuel flow is controlled by a solenoid valve. A heat sensitive switch and an air flow sensitive switch are serially connected to the solenoid valve for preventing gas flow in the absence of ignition or air flow, respectively. An electric glow igniter adjacent the heat sensitive switch initiates combustion and is disconnected after ignition for prolonged life. If desired, a time delay for disabling the heater in the absence of ignition can be employed if, for example, the heater is a nonsealed system.

BACKGROUND

In small inexpensive space heaters such as may be employed, for example, in mobile homes, small apartments, or individual rooms, it is desirable to employ a small low-cost, highly reliable control system. Such a system must provide full safety for room occupants under all conditions and still be inexpensive.

BRIEF SUMMARY OF THE INVENTION

Thus, in practice of this invention according to a presently preferred embodiment there is provided a heater control combination for a fuel operated space heater or the like having a blower, a burner, and a solenoid valve for controlling fuel flow. The control combination includes an electric igniter for the fuel burner, a heat sensitive switch adjacent the igniter and the burner and in series with the solenoid valve, plus an air flow responsive switch in the blower air flow path and in series with the solenoid valve. Means may be provided for disconnecting the igniter after fuel ignition occurs. A time delay relay may be used to turn off fuel flow in case there is a failure to ignite.

DRAWINGS

These and other features and advantages of the present invention will be appreciated as the same becomes better understood by reference to the following detailed description of a presently preferred embodiment when considered in connection with the accompanying drawings wherein:

FIG. 1 illustrates in block diagram form a control system suitable for a nonsealed heating system; and

FIG. 2 illustrates in block form a control system suitable for a sealed system.

DESCRIPTION

FIG. 1 illustrates in block form a control system constructed according to principles of this invention. As illustrated in this embodiment, the heater, which may, for example, be a small space heater for a mobile home or the like, includes a fan **10** for distributing heated air into the space to be heated. The fan or blower **10** may also supply a pressure head to the air intake of the combustion system of the heater for combustion with a fuel, such as, natural gas. A conventional burner **11** is provided for heating the air.

In a so-called sealed space heater, the air inlet flowing to the burner **11** and the exhaust for the combustion products are completely separate and remote from the air flow path through the heater to the space to be heated. In a sealed system there is thus no opportunity for depleting air from the space nor for discharging the exhaust products into the space, either of which could be hazardous to the occupants. In a nonsealed system, on the other hand, the combustion product exhaust is separate but the air intake to the combustion system is in parallel with the air intake for heating, and typically a fraction of the air intake is recirculated from the space to be heated and another fraction is "make-up" air from the external environment. In a nonsealed system, the occupant's safety is protected by a reliable, safe control system that effectively prevents depletion of a room's air or discharge of combustion products into a room.

In a space heater, as provided in practice of this invention, the flow of gas from a gas supply **12**, such as the main or a storage tank, is controlled by a conventional solenoid valve **13**, and control of the solenoid valve provides the principal safety features of the heater.

The electrical control system comprises a double pole switch **14** controlling the input power to the system. At least one line of the input power is controlled by a conventional thermostat **16** sensitive to temperature of the air in the space to be heated, and located either in an inlet line to the space heater or remote therefrom at some other location in the room. Input power is also applied to one contact of a normally open relay **17** that controls operation of the fan **10**. From the thermostat **16** when it is turned on, power is applied to a conventional normally closed time-delay relay **18**, and thence to the coil **19** of the fan relay **17**. Thus, when the thermostat turns on, power is immediately applied to the relay coil **19** closing the relay **17** and causing the fan **10** to immediately start operation.

Operation of the fan **10** causes air to commence flowing in the ducts of the heater, and the moving air acts on the sail **21** of a normally open sail switch **22**. The sail switch is merely a sensitive switch actuated by a mechanical coupling to a lightweight member or sail **21** that is easily deflected by air flowing through the heater and can be located either in the inlet or outlet duct. A sail switch is preferred in such an arrangement as compared with a pressure sensitive switch since safety is related to flow of air through the unit rather than to pressure in the ducts. A sail switch is sensitive to failure of the fan to operate properly or to blocking of the air inlet or the air outlet. A pressure switch would not be sensitive to blockage of the outlet, for example.

When the thermostat **16** closes, power is also applied to a conventional glow igniter **23**, which is typically a helically wound heater coil or resistor formed of recrystallized graphite or other heat resistant material. The igniter quickly reaches a temperature in excess of the ignition temperature of a fuel-air mixture when power is applied thereto. Arranged immediately adjacent the igniter **23** is a normally open heat sensitive switch **24** that is closed by a thermally responsive member **26** when that member has been sufficiently heated. Such a device is commercially available and often known as a flame switch. The thermally responsive member **26** that causes the switch **24** to operate may be, for example, a gas bulb or a solid thermal expansion material or may include material having a substantial volume change upon melting so as to cause mechanical motion and close the switch **24** when a preselected temperature has been attained. In one embodiment, the heat responsive member **26** is arranged concentrically with the igniter **23** for very rapid thermal response.

The flame switch **24** and sail switch **22** are in series with the normally closed solenoid valve **13** so that the valve

is open only when both the normally open flame switch and normally open sail switch are closed in response to proper operation of the igniter and fan, respectively. Thus, when the thermostat closes, power is applied to the fan to close the sail switch **22**, and power is also applied to the igniter **23** for closing the flame switch **24**, thereby opening the solenoid valve **13** with a time delay that is only that time required to operate the two switches **22** and **24**, and in practice it is found that this time delay is quite small.

Connected in series with the igniter **23** and the delay operating coil **27** of the time-delay relay **18** is a normally closed thermally responsive igniter cut out switch **28**. The heat sensitive cut out switch **28** is sufficiently remote from the igniter **23** that it is not heated thereby to the point that it leaves its normally closed condition. The heat responsive switch **28** is, however, located in the region of the heater heated by the burner **11**, and hence when the burner **11** operates, the cut out switch **28** is heated and opens in response thereto.

Opening of the heat responsive switch **28** cuts off the power to the igniter **23** so that it is no longer electrically heated. It, and the flame switch actuator **26**, are in the region heated by the burner **11** so that even if the igniter is off the flame switch **24** remains closed while combustion continues. The igniter cut out switch **28** is desirable since the temperature of the igniter in response to heating by the burner **11** is less than its temperature in response to electrical heating, and hence the operating lifetime of the igniter is greatly increased.

The igniter cut out switch **28** also disables the time-delay relay **18**, which is normally closed, so that it remains closed. In the absence of such disabling, the time-delay relay after a selected time would open and remove power from the fan relay coil **19** and from the solenoid valve **13**, thereby shutting down the entire heater unit. Normally a time delay of about 90 seconds is appropriate for good safety. The time-delay relay **18** provides an additional back-up safety factor in a nonsealed heater so that if the solenoid valve **13** should open and the burner **11** not ignite, no more than a small amount of unburned gas could be discharged from the heater before the solenoid valve was closed due to operation of the time-delay relay. When the burner **11** operates properly, the cut out switch **28** disables the time-delay relay **18** and permits the solenoid valve **13** to remain open.

A normally open heat responsive switch **29** is provided in parallel with the contacts of the fan relay **17** for providing an alternative way of applying power to the fan **10**, whether or not the thermostat **16** is closed. When the temperature in the portion of the heater where the heat responsive switch **29** is located is above a preselected value, the normally open switch is closed, thereby applying power to the fan **10** whether or not the relay **17** is closed. Thus, any time the heater is hot, the fan **10** will operate. An example of such operation is when the thermostat turns off, thereby turning off the burner **11**. In such a situation there is a short time delay before all parts have cooled sufficiently due to the sensible heat of the various parts of the heater. During this time, the heat responsive switch **29** keeps the fan **10** operating for cooling the heater, and as soon as it is sufficiently cool, the fan turns off.

FIG. 2 illustrates in block form a somewhat simplified control system such as may be employed with a sealed space heater. As illustrated in this embodiment, power is applied to the control system by way of a double pole switch **36** which applies power to a conventional thermostat **37**. Closing of the thermostat switch when, for example, a room is too cool, applies power to an igniter **38** in the form of an electrical heater which is heated to a temperature in excess of the ignition temperature of a gas-air mixture.

The thermostat also applies power to a fan **39** for circulating air through the heater. Movement of air through the heater operates a sail switch **41** in the same manner as hereinabove described in relation to FIG. 1. The igniter **38** heats the thermally responsive member **42** of the conventional flame switch **43**, also in the same manner as hereinabove described. The closing of the normally open sail switch **41** and normally open flame switch **43** enables operation of a solenoid valve **44** which opens to permit gas to flow from a gas supply **46** to a burner **47**. Ignition of gas from the burner **47** by the igniter **38** results in opening of a normally closed thermal cut out switch **48** connected in series with the igniter **38** so that power is removed from the igniter to enhance its lifetime.

A high limit cut out switch **49** is also provided in series with the solenoid valve **44**. The cut out switch **49** is normally closed and in response to a temperature in excess of a preselected limit, the switch **49** opens, thereby cutting off the flow of gas through the solenoid valve **44**. Such a high limit switch **49** is conventionally employed for preventing overheating of space heaters and other appliances, and although not specifically described in relation to the embodiment of FIG. 1, can also be incorporated therein.

A normally open thermally responsive switch **51** is provided between the source of power and the fan **39** so that if the temperature in the heater is above some preselected limit the fan is operated in order to cool the heater. This, for example, is useful after the thermostat is turned off to cool the heater to a safe temperature.

Although only two embodiments of space heater control arrangements have been described and illustrated herein, many modifications and variations can be provided by one skilled in the art. It is, therefore, to be understood that within the scope of the appended claims the invention may be practiced otherwise than as specifically described.

What is claimed is:

1. A fuel operated heating apparatus comprising:
- a fuel burner;
- a fan;
- an electrically operated igniter for the burner;
- an electrically operated valve for controlling the flow of fuel to the burner;
- a heat responsive switch adjacent the igniter and in series with the valve for operating the valve only in response to a temperature in excess of a preselected limit;
- a sail switch in series with the valve and operably mounted in the air flow path of the fan for operating the valve only in response to air flow in the heater;
- a second heat responsive cut out switch in series with the igniter for disabling the igniter in response to operation of the burner; and
- a time-delay relay having normally closed contacts in series with the valve and the igniter and operable in response to the second heat responsive cut out switch for remaining closed when the burner is operating and opening after a selected time delay when the burner is inoperative.

2. A heating apparatus as defined in claim **1** wherein the igniter comprises an electrically heated resistor.

3. A heating apparatus as defined in claim **2** wherein the heat responsive element of the first heat responsive switch is concentric with the igniter resistor.

4. In a fuel operated heating apparatus including a fuel burner, an air blower, and an electrically operated fuel flow valve, the improvement comprising:
- an electrically heated igniter;
- a heat responsive switch responsive to the igniter and in series with the valve;
- an air movement responsive switch responsive to blower air flow and in series with the valve, whereby the valve is enabled only when both the heat responsive switch and the air movement responsive switch are closed; and

a second heat responsive switch in series with the igniter for disabling the igniter when a temperature in the heater is in excess of a selected limit.

5. In an improved fuel operated heating apparatus as defined in claim 4 the further improvement of:

a time-delay relay having normally closed contacts in series with the valve and igniter and operable in response to the second heat responsive cut out switch for remaining closed when the burner is operating and opening a selected time delay when the burner is inoperative.

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U.S. Cl. X.R.

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