United States Patent

Das et al.

[15] **3,689,194**

[45] **Sept. 5, 1972**

[54] **DIRECT BURNER IGNITION SYSTEM**

[72] Inventors: **Nalini R. Das**, Bethlehem; **Edwin H. Strain**, Allentown, both of Pa.

[73] Assignee: **Caloric Corporation**, Topton, Pa.

[22] Filed: **Dec. 16, 1970**

[21] Appl. No.: **98,495**

[52] **U.S. Cl.** **431/80**

[51] **Int. Cl.** **F23n 5/10**

[58] **Field of Search** 431/80, 67, 66, 72, 73

[56] **References Cited**

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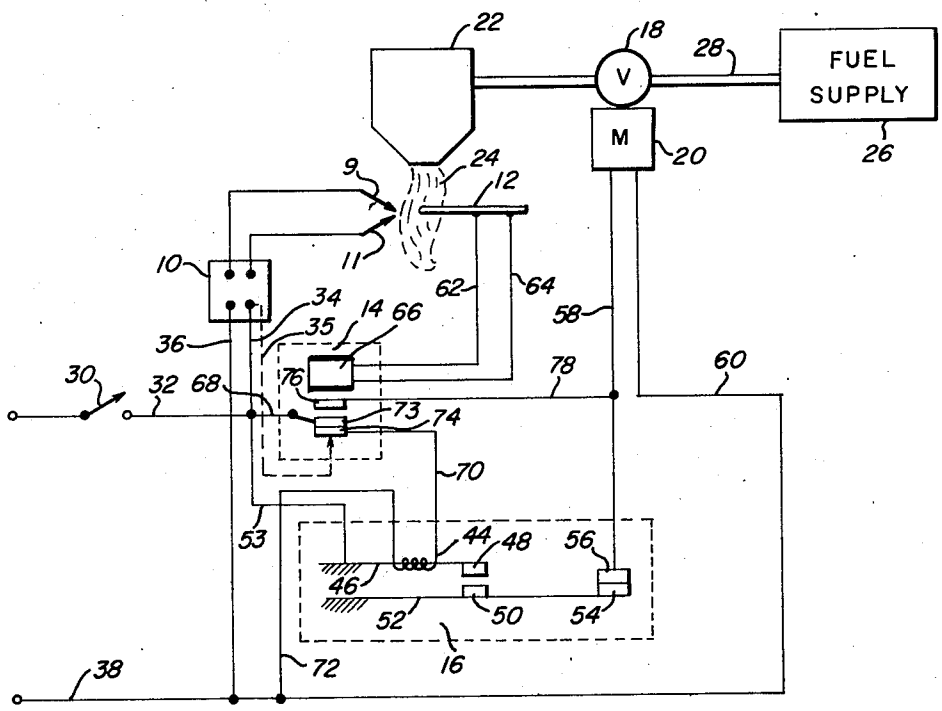
Primary Examiner—Edward G. Favors

Attorney—Harold A. Murphy and Joseph D. Pannone

[57] **ABSTRACT**

An ignition system for burners, such as gas- or oil-fueled, which includes a novel switch device, an ignitor, a magnetic relay, and a thermocouple, with circuit means being provided which assures fail safe operation or discontinuance of the system in the event of malfunction of any one of various components of the system, thereby preventing possibly dangerous accumulation of fuel without proper ignition.

9 Claims, 2 Drawing Figures



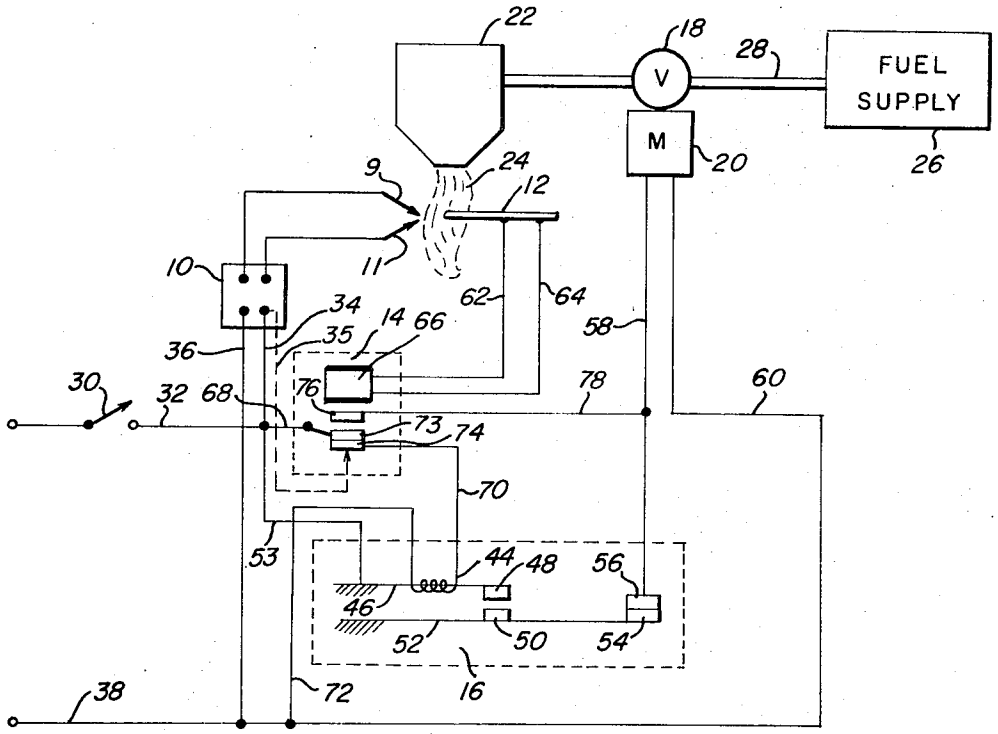

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FIG. 1

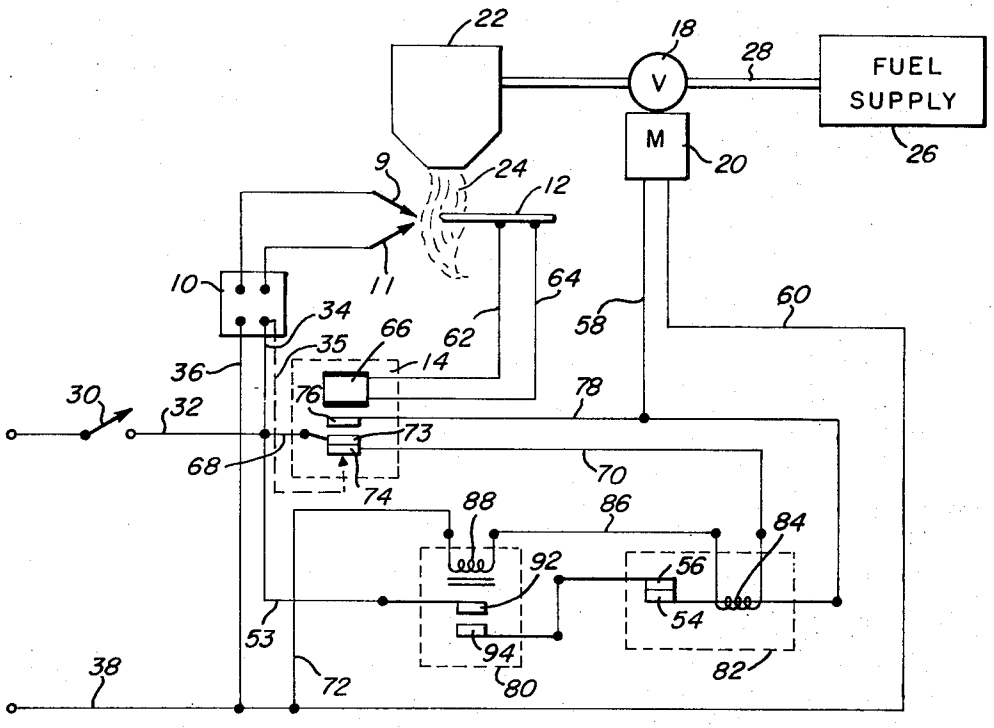
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FIG. 2

DIRECT BURNER IGNITION SYSTEM

BACKGROUND OF THE INVENTION

Many different types of systems have been developed for igniting a fuel for burning in devices such as domestic, commercial or industrial appliances, jet engines, etc. Most common has been the constant burning pilot system where fuel is constantly supplied to a small pilot burner located adjacent a burner to be ignited, and valve means which is manually operated to supply fuel to the burner whereupon it becomes ignited by the pilot flame. However, such pilot flame often becomes extinguished by draft, or by contaminated air. This type of failure is well known, for example, in connection with broil burners in single cavity ovens or power burners in restricted combustion chambers.

Electronic ignitions have been built but have been relatively unsuccessful because of their use of many electronic components with complex inherent failure modes. In particular such systems require many electronic components for flame detection by flame rectification. Needless to say, an electronic system employing a spark ignitor for igniting a fuel when a fuel supply valve is opened, for example, is not sufficient without safeguards such as means for detecting ignition and for closing the valve should ignition not occur because of failure of the sparking device, or the like.

Accordingly, an economical and dependable direct burner ignition system with complete fail safe operation has long been sought as a solution to the problems of prior art direct ignition systems.

SUMMARY OF THE INVENTION

The above and other objectives are achieved by the present invention wherein there is provided a direct burner ignition system having fail-safe features. According to this invention the system includes a thermostat which operates to complete a first electrical circuit to a spark ignitor and simultaneously completes a second circuit through a single pole double throw magnetic relay to the heater coil of a novel fail safe switch. After a relatively short predetermined time interval the switch closes through a first set of contacts to complete a third

Referring to FIG. 2, it will be noted that the switch 16 of FIG. 1 has been replaced by a normally open magnetic relay 80 and a conventional normally closed time delay relay 82. In this embodiment closing of thermostat 30 completes a circuit through wires 32 and 68, contacts 73 and 74, wire 70, heater coil 84 of relay 82, wire 86, coil 88 of relay 80, and wires 72 and 38. This in turn closes the contacts 92–94 in relay 80 and starts the timing cycle in the normally closed time delay relay 82. When the contacts 92–94 close, they complete the circuit to motor 20. This energizes the valve 18, allowing gas to

In accordance with this invention the system embodies fail-safe features whereby the valve will be closed to shut off the supply of fuel in the event the thermocouple or the magnetic relay fails to operate, in which case the novel switch will open the circuit through the second set of contacts to close the valve. In the event the ignitor fails to operate, the novel fail safe switch will again operate to open the circuit through its second set of contacts to close the valve. Also, if the heater coil of the switch fails to operate, the switch will

remain open and the circuit to open the valve will not be completed.

Therefore, undesired and possibly dangerous outflow of unignited fuel is prevented in the system embodying this invention.

BRIEF DESCRIPTION OF THE DRAWINGS

The foregoing and other objectives have been achieved by the present invention as illustrated in the accompanying drawings, wherein:

FIG. 1 is a schematic diagram illustrating one form of the invention; and

FIG. 2 is a schematic diagram similar to FIG. 1 a modification of the invention.

DESCRIPTION OF THE PREFERRED EMBODIMENT

The novel direct burner ignition system with safety shut-off according to this invention utilizes as ignitor 10 to ignite a fuel such as gas, for example, and a thermocouple 12 combined with a single pole double throw magnetic relay 14 for flame detection. A key component in this system may be a fail safe safety switch 16 (FIG. 1) to be described which operates to turn on a gas valve 18 by means of a motor 20 for a trial ignition period and provides added safety in the different failure modes, as will be apparent as this description proceeds. The novel switch 16 is fully disclosed in copending U. S. patent application Ser. No. 98,496, filed Dec. 16, 1970 by the present inventors.

Instead of the switch 16, however, there could be employed a normally open magnetic relay coupled with a conventional normally closed time delay relay which will be described more fully in connection with the embodiment of FIG. 2.

Referring more explicitly to FIG. 1, there is shown, as one example of utilization of the invention, a gas burner 22 which may be of any suitable type which produces a flame 24 when gas from a supply 26 is ignited in air. Valve 18 controls the flow of gas from the supply 26 to burner 22 through piping 28.

The electrical circuit includes a thermostat 30 which when closed completes an electrical circuit to the ignitor 10 through wires 32, 34, 36 and 38. The ignitor 10 may be any suitable device such as a sparking device wherein sparks are produced across a gap when the device is energized, or a hot wire device which reaches fuel ignition temperatures when current is passed through it.

Closing of the thermostat 30 also completes a circuit to the heater coil 44 of the safety switch 16 through wires 32 and 68, normally closed contacts 73–74 of the magnetic relay 14, and wires 70, 72, and 38. The coil 44 is located in adjacent or surrounding relation to a bimetallic strip 46 carrying a first contact 48 of a pair of normally open contact, the other 50 of said contacts being fixed to a flexible conductive strip of blade 52. When the coil 44 is energized for a predetermined time interval the bimetallic element will respond by flexing in the well-known manner so that contacts 48–50 will close. This completes a circuit to motor 20 through wires 32 and 53, strip 46, contacts 48–50, blade 52, normally closed contacts 54–56, and wires 58 and 60.

Energizing of motor 20 will cause valve 18 to open, allowing gas to flow into the burner 22.

The electrode pair 9, 11 is located relatively close to the burner outlet so that when the gas flows out from the burner 22 the sparks which are being produced by the energized ignitor 10 will cause the desired gas ignition to produce flame 24.

The thermocouple 12 is positioned so as to be heated by the resultant flame and thus generates a voltage which passes current through wires 62–64 to the coil 66 of relay 14. The energized coil 66 causes contacts 73–74 to open and contacts 73–76 to close. This establishes a second circuit to the motor 20 through wires 32 and 68, contacts 73–76, wires 78 and 58, and wires 60 and 38. This allows the valve 18 to remain open. At the same time, opening of contacts 73–74 cuts off power to the coil 44 of switch 16, allowing the contacts 48-50 to again open. The ignitor 10 is allowed to continue functioning during the entire time that the thermostat 30 is closed and the valve 18 open as a safety measure. However, the ignitor may, if desired, be connected so as to be interrupted after the flame has been established. This is accomplished by removing wire 34 and by adding wire 35 from ignitor 10 to contact 74 in relay 14, as shown by the dotted line in FIG. 1.

When the thermostat 30 opens, this opens the circuit to all the components and allows them to return to their normal conditions. The motor 20 is of the type which, when power is removed, will automatically close the valve 18 and thus cut off the flow of gas to the burner. Two well-known types of such motor and valve combinations are a solenoid, and an electric valve using a bimetal strip and heater.

It will be apparent that the described system has many desirable safety features. For example, if the thermocouple 12 or the magnetic relay 14 fails to function, the safety switch 16 would operate to prevent damage or destruction. To achieve this, since the relay will not function to open contacts 73–74, the heater coil 44 will continue to heat the bimetallic element 46, causing continued bending of the element which will, through pressure on blade 52 by the closed contacts 48–50, cause the blade 52 to bend and thereby open the normally closed contacts 54–56. This will deenergize the motor 20 and close the valve 18.

Should the ignitor 10 fail, the safety switch 16 will again function as described in the preceding paragraph to close the valve 18.

Should the heater coil 44 fail, switch contacts 48–50 will remain open whereupon the motor 20 will not be energized to open valve 18. flow to burner 22.

It will be apparent that should the coils 43 or 45 fail, contacts 92–94 will remain open, whereupon the motor 20 will not be energized to open valve 18.

From the foregoing it will be apparent that all of the objectives of this invention have been achieved by the novel fail safe system described. It will also be apparent that the described system may be used for many types of fuel-fired burners other than the burner disclosed. Furthermore, the present system has many other advantages over the prior art electronic and pilot type ignition systems.

With the present system ignition has been found to occur as soon as the gas is available at the burner port. Time cycles are adjustable through variations in structure of the bimetallic element in the safety switch and in the positions of the junctions in the thermocouple.

It is to be understood that various changes may be made by those skilled in the art without departing from the spirit of the accompanying claims.

We claim:

1. A direct burner ignition system comprising electrically operable valve means for controlling flow of fuel to a burner, ignition means for igniting fuel at the burner and producing a resultant flame therefrom, and means for controlling the valve means in response to detection or non-detection of said flame, said last means comprising a thermocouple located within said flame when the flame exists, a safety switch connected to said valve means and including a heating element, a relay connected to a source of electrical energy in series with said heater element, the thermocouple being connected to said relay to operate the relay to break the circuit to said heater element in response to detection of said flame, and said switch being operable to shut off said valve means in the event the thermocouple does not detect a flame and consequently does not operate the relay.

2. A direct burner ignition system comprising electrically operable valve means for controlling fuel flow to a burner, ignition means for igniting fuel at the burner to produce a flame, thermostat means connected to said ignition means for energizing and deenergizing the ignition means, flame detecting means for developing current when flame is detected, and safety means for deenergizing the valve means after a predetermined time period when no flame is detected, said safety means comprising a relay and a switch in series between the ignition means and the valve means, said relay having a pair of normally closed contacts, and said switch having a heater element connected to said relay contacts.

3. A direct burner ignition system as set forth in claim 2 wherein said switch includes bimetallic means operable by heat from said heater element, a second pair of normally open contacts adapted to be closed upon operation of said bimetallic element, and means for completing a circuit through said second pair of contacts when closed to the valve means.

4. A direct burner ignition system as set forth in claim 2 wherein said switch includes bimetallic means operable by heat from said heater element, a first pair of normally open contacts adapted to be closed upon operation of said bimetallic means, and a second normally closed pair of contacts, completing a circuit to said valve means.

5. A direct burner ignition system as set forth in claim 4 wherein said relay includes switch means operable in response to said flame detecting means for opening the circuit to the switch heater element and for completing energization of the valve means through another circuit.

6. A direct burner ignition system as set forth in claim 4 wherein said bimetallic means comprises a movable member for initially closing said first pair of contacts when the heater element is operated and for subsequently opening the second pair of contacts at the end of a predetermined time interval and for thereby causing closure of said valve means.

7. A direct burner ignition system as set forth in claim 2 wherein said safety means further comprises a pair of second and third relays each including a heating element, the first relay being connected to said flame detecting means and having a pair of normally closed contacts in a series hookup with the heater elements of the second and third relays between the ignition means and the valve means.

8. A direct burner ignition system as set forth in claim 7 wherein said first relay includes switch means operable in response to said flame detecting means for opening the circuit to the heater elements of the second and third relays and for completing energization of the valve means through another circuit.

9. A direct burner ignition system comprising electrically operable valve means for controlling flow of fuel to a burner, ignition means for igniting fuel at the burner and producing a resultant flame therefrom, and means for controlling the valve means in response to detection or non-detection of said flame, said last means comprising flame sensing means located in proximity to said flame when the flame exists, a safety switch connected to said valve means, a relay connected to a source of electrical energy in series with said switch, the flame sensing means being connected to said relay to operate the relay to break the circuit to said heater element in response to detection of said flame, and said switch being operable to shut off said valve in the event the flame sensing means does not detect a flame and consequently does not operate the relay.

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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,689,194 Dated September 5, 1972

Inventor(s) Nalini R. Das and Edwin H. Strain

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

On cover sheet, line [73], change Assignee from "Caloric Corporation Topton, Pa." to -- Raytheon Company Lexington, Ma.--

Column 1, line 45, after "third" insert -- circuit through a second set of contacts to an electric valve which opens to supply fuel to a burner. When the burner is operated, a thermocouple detects the heat from the burner and through operation of the relay establishes another circuit to the valve, keeping it open, and breaking the circuit to the fail safe switch, whereupon the valve will remain open as long as the thermocouple detects heat from the burner, or until the thermostat opens to break the circuit to the valve and to the ignitor. --

Column 1, lines 46-57, delete the entire paragraph.

Column 2, line 14, after "FIG. 1" insert -- illustrating --
Column 2, line 60, delete "contact" and insert --contacts--
Column 3, line 54, after "valve 18." delete "flow to burner 22."

Column 3, at line 55, insert the following paragraph:

-- Referring to FIG. 2, it will be noted that the switch 16 of FIG. 1 has been replaced by a normally open magnetic relay 80 and a conventional normally closed time delay relay 82. In this embodiment closing of thermostat 30 completes a circuit through wires 32 and 68, contacts 73 and 74, wire 70, heater coil 84 of relay 82, wire 86, coil 88 of relay 80, and wires 72 and 38. This in turn closes the contacts 92-94 in relay 80 and starts the timing cycle in the normally closed time delay relay 82. When the contacts 92-94 close, they complete the circuit to motor 20. This energizes the valve 18, allowing gas to flow to burner 22. --

Signed and sealed this 1st day of May 1973.

(SEAL)
Attest:

EDWARD M. FLETCHER, JR.
Attesting Officer

ROBERT GOTTSCHALK
Commissioner of Patents

FORM PO-1050 (10-69)

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* U.S. GOVERNMENT PRINTING OFFICE : 1969 O—366-334