

May 9, 1961.

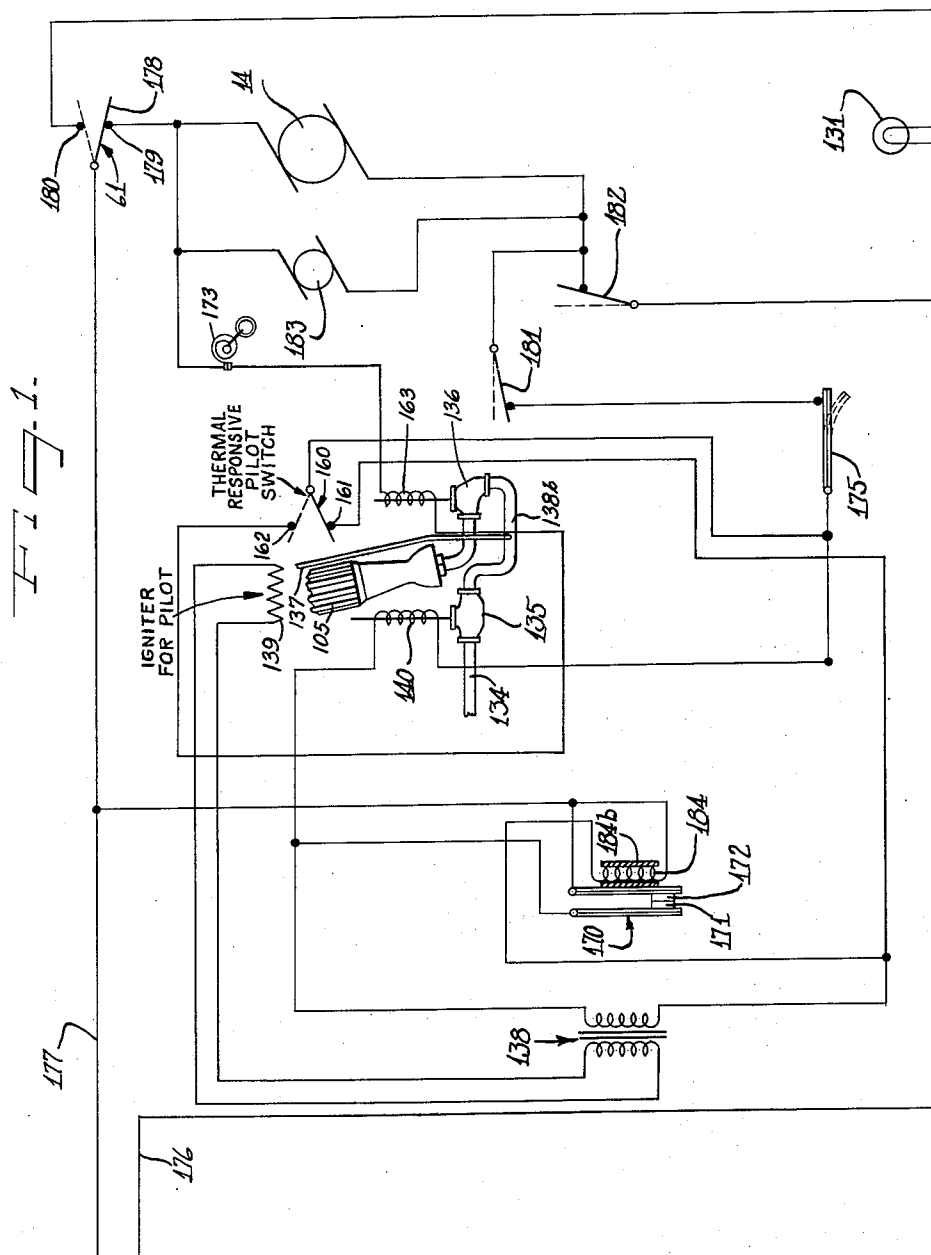
P. E. GELDHOF ET AL

2,983,314

1. AUTOMATIC GAS IGNITION AND CONTROL PARTICULARLY
ADAPTED FOR USE WITH CLOTHES DRIERS

Filed Nov. 5, 1959

2 Sheets-Sheet 1



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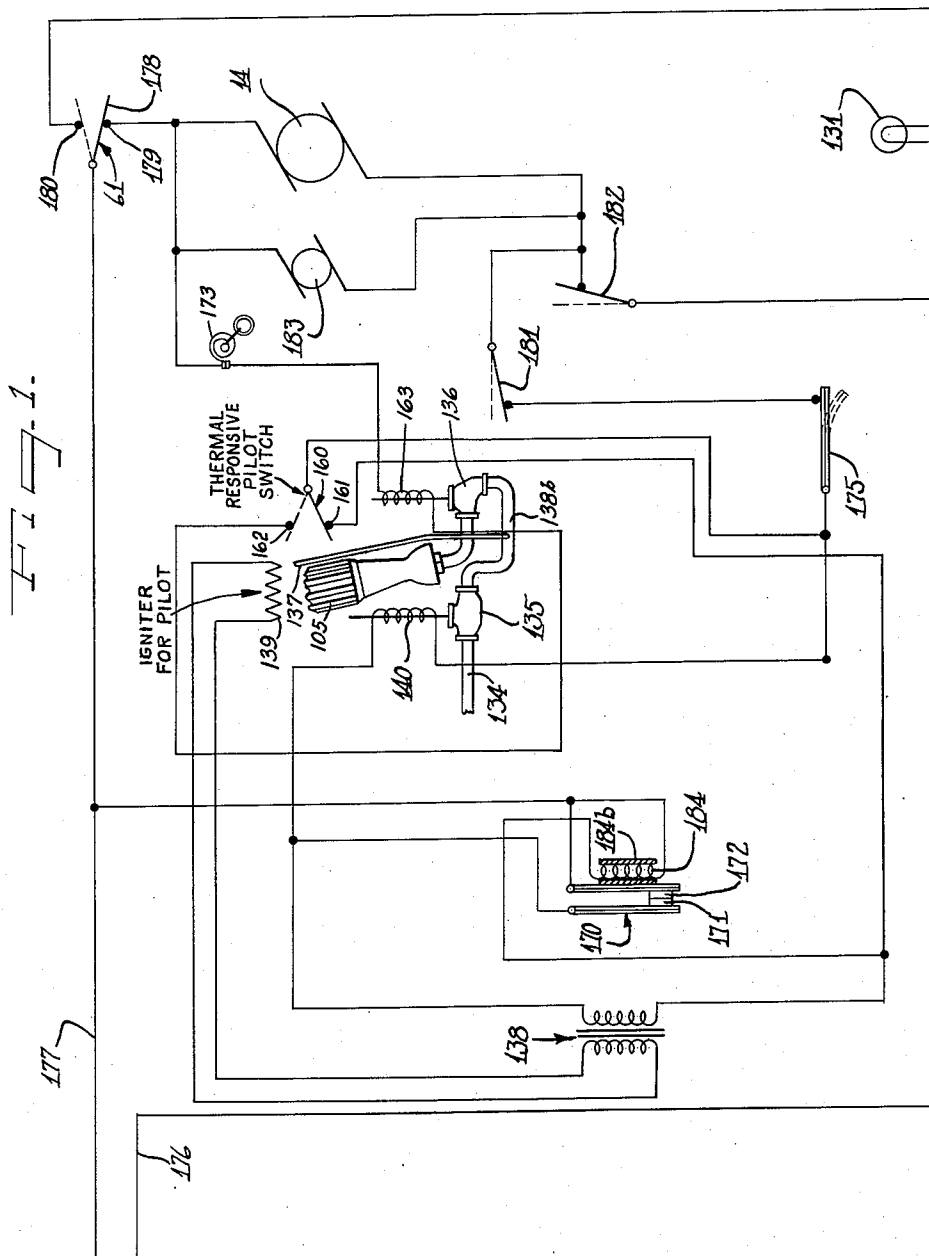
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AUTOMATIC GAS IGNITION AND CONTROL PARTICULARLY ADAPTED FOR USE WITH CLOTHES DRIERS

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Filed Nov. 5, 1959, Ser. No. 851,194

4 Claims. (Cl. 158—125)

This invention relates to improvements in gas burners and controls therefor, and more particularly, relates to improvements in gas burner and safety igniter circuits and controls therefor adapted for use in household clothes driers of the type where the clothes are tumbled in a rotating drum through which heated air from a gas burner is circulated.

A principal object of our invention is to provide a new and improved form of gas burner and safety igniter circuit and control therefor, arranged with a view toward utmost simplicity in control and safety in operation.

A further object of our invention is to provide a novel and efficient form of gas burner and safety control therefor particularly adapted for use with gas-heated household clothes driers so arranged as to prevent the passing of unburned gas to the drier cabinet in case the pilot burner should fail to ignite.

Still another object of our invention is to provide a new and improved form of gas burner particularly adapted for supplying heat to household types of clothes driers including safety igniter and control means therefor having a master valve and a main burner valve connected in the gas supply line in series, and so controlled as to prevent unburned gas from passing through the main gas burner, upon interruption of the gas supply thereto or upon the interruption of the electric system controlling operation thereof.

These and other objects of our invention will appear from time to time as the following specification proceeds and with reference to the accompanying drawings wherein:

Figure 1 is a schematic wiring diagram of a control circuit for the drier and burner valves; and

Figure 2 is a schematic wiring diagram of a modified form of control circuit.

This application is a continuation-in-part of Serial No. 341,441, filed March 10, 1953, and now abandoned, as a division of application, Serial No. 123,018, filed on October 22, 1949, now Patent No. 2,635,354, and entitled "Gas Heated Drier," and of application Serial No. 208,708, filed January 31, 1951, now Patent No. 2,678,814, and entitled "Gas Burner and Control Therefor Particularly Adapted for Use With Clothes Drier."

The main burner and pilot controlled by the burner circuit of our invention are particularly adaptable to supply heat to a clothes-drying drum (not shown) of a household type clothes drier as shown and described in our parent application. The drier itself, therefore, need not be described herein.

The drier drum (not shown) is rotatably driven by means of an electric motor 14 (see Figure 1). Air may be heated for circulation into and out of the drier drum by means of a main burner 105.

Referring now in particular to Figure 1 of the drawings, illustrating the gas burners and control circuits therefor, a pipe 134 leading from a gas supply main is connected to deliver gas to a first gas valve 135 which will hereinafter be termed a master valve and delivers

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gas to a main burner supply valve 136 through a pipe 138b. The master gas valve 135, opens upon the energization of a solenoid coil 140 and upon being opened, also supplies gas to a pilot burner 137.

The main burner 105 may be of well known construction and is supplied with gas from the main burner valve 136. A pilot burner 137 disposed adjacent the end of the main burner 105 is provided to supply a gas flame for igniting the gas passing through said main burner under control of the main burner valve 136. The pilot burner flame may be ignited by a glow coil 139 energized by the secondary of a transformer 138. The glow coil 139 is positioned adjacent the pilot burner 137 to ignite gas passing through said pilot burner.

The gas supply and the ignition of the gas is under the control of an especially designed electrical safety circuit, so arranged as to assure safe and efficient operation of the drier. This control, as may best be seen from an inspection of Figure 1, includes a warp switch 170 having metallic contact elements 171 and 172 opening by resistor heat after a predetermined time delay interval and deenergizing the control circuit to a solenoid coil 140 for the master gas valve 135, and to the glow or ignition coil 139, in the event the pilot burner does not ignite in the time required.

The control also includes a flame-detecting switch 160 adjacent to the main burner valve 136, which is in its "cold" position upon the absence of a pilot burner flame to complete a circuit through a cold contact 161. The flame-detecting switch 160 passes to its "hot" position upon the presence of a pilot burner flame and engages a hot contact element 162 in this position to complete a circuit to a solenoid coil 163 for operating the main burner valve 136. An adjustable thermostat 173 is provided to make or break the circuit to the coil 163 and turn the main burner on and off during normal operation of the drier, and thereby control the temperature within the clothes-drying drum. A safety thermostatic switch 175, herein shown as being a bi-metal switch is provided for emergency purposes and is arranged to open at a substantially higher temperature than that of thermostat 173. This safety thermostatic switch 175 may be located adjacent the hot air supply duct for the drier (not shown).

Provision is also made for illuminating the interior of the clothes drum when the door is opened, which is herein shown as being an electric lamp 131 connected in series with a door switch 61 operated by opening and closing of the drier door (not shown).

The particular manner in which the various elements are electrically connected will now be described. Electrical energy is derived from a suitable source of power through conductors 176 and 177. The door switch 61 is shown as being connected in the conductor 177. This door switch 61 includes a movable contact element 178 and two stationary contacts 179 and 180 actuated upon opening and closing of the door, as described in our parent application, Serial No. 123,018, of which this application is a continuation-in-part.

When the door is in its closed position, the movable contact element 178 engages the stationary contact 179 and completes an energizing circuit to the motor 14. When the door is in its open position, the movable contact 178 engages the stationary contact 180 and deenergizes the motor 14 and completes a circuit to the lamp 131, to illuminate the interior of the drier drum.

The ignition or glow coil 139 is provided to ignite gas passing through the pilot burner 137 upon opening of the master valve 135. The glow coil 139 is shown as being energized from the secondary of a transformer 138, the primary of which is energized through the warp switch 170, the cold contact 161 of the flame-detecting

switch 160 and two timer control switches 181 and 182. The timer control switches 181 and 182 close upon the setting of a timer motor 183 to its time-setting position and will remain closed for the desired setting of the timer. The switch 182 may stay closed for a longer period of time than the switch 181, to continue operation of the motor 14 and rotation of the drier drum and tumbling of the clothes, after the main burner 105 has been turned off.

It will be seen from Figure 1 that with the closing of the timer switches 181 and 182 that current will flow through the timer switches 181 and 182, the safety thermostatic switch 173, cold contact 161 of the flame-detecting switch 160 through the primary coil of the transformer 138, and through warp switch 170 to the conductor 177. Current induced in the secondary of the transformer 138 will also flow through the glow coil 139. The voltage impressed across the primary of transformer 138 and the warp switch 170 is also impressed across the warp switch heater coil 184. Current will also flow from the safety thermostatic switch 175 through the solenoid coil 140 for opening the master gas valve 135, through the contacts 171 and 172 of the warp switch 170 to the conductor 177. The master gas supply valve 135 will then open and gas will be supplied to the pilot burner 137 on the supply side of the main burner valve 136.

The heating element or coil 184 is shown as having a metal sheath 184b, which absorbs resistor heat. The heater coil 184 and sheath 184b provide heat to open the contacts 171 and 172 in a predetermined delayed time interval. The interval of time delay in the opening of the contacts 171 and 172 may be approximately 5 minutes at normal line voltage and is provided to deenergize coil 140 and thereby close the master gas supply valve 135 in case the flame-detecting switch 160 should not pass from its cold to its hot position, as when the pilot burner should fail to ignite.

It will also be observed from an inspection of Figure 1 that upon closing of the door and the door switch 61 the main drive motor 14 will be energized through the timer switch 182, while the timer motor 183 will be energized through a parallel circuit around the main drive motor 14.

It will further be seen that the solenoid coil 163 for the main valve 136 can only be energized through the hot contact 162 of the flame detecting switch 160 and therefore cannot be energized until the pilot burner 137 has been ignited and has heated a temperature-sensitive bulb or temperature-responsive element associated therewith to an extent sufficient to actuate the switch 160 to move against a spring to its "hot" position into engagement with the contact 162, to complete a circuit there-through and to the solenoid coil 163. When the flame-detecting switch 160 is in its hot position and the door is closed, the solenoid coil 163 for the main burner valve 136 will be energized to supply gas to the main burner 105 through the master valve 135 and main burner valve 136.

It will be noted that the adjustable temperature-responsive thermostat 173 is in series with the energization circuit for the main burner valve 136 and that the solenoid coil 163 is immediately deenergized and said valve shuts off upon the opening of the contacts of said thermostat, when the temperature within the drier drum, for which said thermostat is set, is reached.

Upon the shutting off of the main burner valve 136, the master gas supply valve 135 will remain open unless the flame should be extinguished or the pilot burner 137 should go out of operation due to a momentary interruption in supply of gas or disturbance in the flow of air, and the flame detecting switch 160 should pass to its cold position into engagement with the contact 161. In this condition of the flame detecting switch 160 and with the contacts of the warp switch 170 open, the solenoid coil 140 will be deenergized and the master gas supply valve 135 will close.

When, however, the main burner valve 136 is turned off by opening of the contacts of the adjustable thermostat 173, and the pilot burner is still on to maintain the flame detecting switch 160 in its hot position in engagement with the contact 162, the solenoid coil 140 for the master valve 135 will remain energized in series with contacts 171 and 172 of warp switch 170 completing the circuit between supply lines 176 and 177. Since the pilot burner flame maintains the flame detecting switch 160 in its hot position in engagement with the contact 162, after the thermostatic switch 173 is opened and upon dropping of temperature within the drier drum effected by closing of the master burner valve 136, the thermostatic switch 173 upon reclosing will again open the main burner valve 136, and the main burner will be ignited by the flame of the pilot burner 137.

In operation of the igniter circuit, the contacts 171 and 172 of the time delay warp switch 170 are normally in engagement with each other and the movable contact of the flame detecting switch 160 is engaged with a cold contact 161 of said switch. The solenoid coil 140, the primary of the transformer 138 and the coil 184 of the time-delay relay or warp switch 170 are all connected in parallel between the supply lines 176 and 177. In normal operation, the fuel issuing from the pilot burner 137 will be ignited from the glow coil 139 and a movable contact of the flame-detecting pilot switch 160 will be moved by the heat of the pilot burner flame into engagement with a hot contact 162, to energize the main burner through the thermostat 173. If, for some reason, the pilot burner 137 should fail to ignite, the heater coil 184 of the time-delay means or bi-metal warp switch 170 will open the contacts 171 and 172 after a predetermined time interval. If this should happen, the solenoid 140 as well as the primary of the transformer 138 will be deenergized and the contacts 171 and 172 will be maintained in open position.

In normal operation, after flame detecting switch 160 has moved to its hot position and energized the solenoid 163 of the main gas valve, the master valve solenoid 140 remains energized through contacts 171 and 172 of warp switch 170. The glow coil transformer 138 and the warp switch heating coil 184 are deenergized because of the shifting of the movable contact of switch 160 to its hot position.

Timer switches 181 and 182 are so arranged that timer switch 181 opens a predetermined period of time before the opening of timer switch 182, thus assuring a running of the machine without heat for a predetermined time after the heat is shut off. After this additional period of time has elapsed, contact 182 opens, thus deenergizing both main motor 14 and timer motor 183.

Certain additional safety switches are provided in the circuit for reasons which will be apparent to those skilled in the art. In the event the flame-detecting switch 160 on the main burner valve does not move from its "cold" to its "hot" position due to failure of current to the glow coil 139, a defective glow coil, or failure of gas supply, or any other failure of the pilot burner flame or igniter, the warp switch element 170 will open to shut off current to the master gas valve 135 and the transformer 138. The warp switch may be of any conventional construction and is diagrammatically illustrated as a bimetal thermostatic element which is gradually warped by means of its associated heater coil 184 until the elements of the switch which have different flexing characteristics, separate to open the circuit through the contacts 171 and 172. When the warp switch is open, the motor 14 will continue to run and the current to the resistor core 184 of the warp switch will hold the contacts 171 and 172 open. In the event power should not be shut off, the timer will continue to run to the end of its schedule and then shut off all current to the machine. When the current has been shut off and the warp switch cools, it will reset itself

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and be ready for operation again after the defect has been corrected.

As previously pointed out, the safety bimetal switch 175 operates at a higher temperature than the thermostat 173. It thus eliminates danger to the clothes which might be caused by the failure of the thermostat 173, for upon opening of the safety bimetal switch 175, the main gas burner valve 136 will close, the master valve 135 will also close. The motor 14 and timer motor 183, however, will be energized through the timer switch 182 and will continue to operate until the end of the timing period or until the door switch 61 opens.

In Figure 2, a schematic diagram of a modified control circuit is illustrated. In this circuit, the elements are exactly the same as in Figure 1 and will be designated by the same reference numerals plus an affix "a."

In this modified circuit, a shut off switch 25a is connected in the conductor 176a to deenergize the entire drier circuit. The safety thermostatic switch 175a and the timer switches 181a and 182a instead of being connected in the energizing circuit for the coil 140a of the master gas supply valve 135a, as in the circuit illustrated in Figure 1, are connected in the energizing circuit for the coil 163a for opening the main burner valve 136a. The energizing circuit to the coil 140a for the master valve 135a is thus through a conductor 140b connected directly to the conductor 176a on the outer side of the switch 25a. The drier drum motor 14a and timer motor 183a are thus connected directly to the conductor 176a through a conductor 176b, and are connected to the conductor 177a through the timer switch 182a and the door switch 61a.

The pilot burner 137a is thus supplied with gas as long as the switch 25a is closed regardless of whether the adjustable thermostat 173a or the timer switches 181a and 182a, or the safety thermostat 175a are open or closed, provided the contacts of warp switch 170a are closed. The warp switch contacts will remain closed as long as switch 160a is in contact with hot contact 162a. However, if for any reason the pilot burner flame is extinguished, switch 160a will move to its cold position closing contact 161a to energize resistor 184a, opening the warp switch contacts after a predetermined time has elapsed to deenergize coil 140a and close master valve 135.

With this circuit, after one drying cycle is complete, another drying cycle can be immediately started without waiting for the transformer 138a to energize and heat the glow coil 139a to ignite the pilot burner, and then subsequently actuate the flame detecting switch 160a to move to its hot position and energize the solenoid coil 163a to open the main burner valve 136a.

It will be understood that modifications and variations may be effected without departing from the scope of the novel concepts of the present invention.

We claim:

1. In an automatic gas igniter and burner control system, a pilot burner fuel supply means, a main burner fuel supply means, first and second valve means connected in series and controlling the supply of fuel to both said main burner and said pilot burner fuel supply means and to only said main burner fuel supply means, respectively, first and second electrical operator means for said first and second valve means, respectively, a hot and cold position flame detector switch having hot and cold contacts and being operatively responsive to the heat of combustion of fuel from the pilot burner supply means, a time delay switch having normally closed contacts and including energizing means for said time delay switch for opening said normally closed contacts after a predetermined time interval upon pilot ignition failure, an electrical igniter to ignite the fuel from the pilot burner supply means, and circuit means for effecting the cyclical energization of the system including a first energizing circuit for energizing said first electrical operator means through said time delay switch, a second energizing circuit for

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energizing said igniter and said energizing means for said time delay switch through the cold contacts of said flame detector switch, and a third energizing circuit for energizing said second electrical operator means through said hot contacts of said flame detector switch, whereby de-energization of said first electrical operator means through the opening of said time delay switch will require complete recycling of the circuit means to restore the system to operation.

2. In a burner control system in combination, a pilot burner, and a main burner, a fuel control means having in serial connection with one another a normally closed first valve, a normally closed second valve, said first valve controlling the supply of fuel to both said main burner and said pilot burner, said fuel control means further including an outlet between said first and second valves for supplying fuel to said pilot burner, whereby said first valve controls the flow of fuel to both burners and said second valve controls the flow of fuel to said main burner only when said first valve is open, an electromagnetic actuator for said first valve, an electromagnetic actuator for said second valve, an electrically operated igniter for said pilot burner, a flame-sensitive switch including hot and cold contacts and having a normally cold position and being responsive to move from said cold position to a hot position in response to a flame at said pilot burner, a time delay switch, an energizing circuit for said igniter and for said time delay switch including said flame-sensitive switch for energizing said igniter and said time delay switch through said cold contacts, an energizing circuit for said actuator for said second valve including said flame-sensitive switch when in a hot position, and an energizing circuit for said actuator for said first valve including said time delay switch, whereby closure of said first valve will prevent the supplying of gas to both of said burners and deenergization of said actuator for said first valve through the opening of said time delay switch will require complete recycling of the circuit means to restore the system to operation.

3. In an automatic fuel ignition and control system, a main burner and a pilot burner, conduit means for supplying fuel to said burners, a main burner valve in said conduit means controlling fuel flow to said main burner, connection means connecting said pilot burner to said conduit means upstream of said main burner valve, a master valve in said conduit means in series with said main burner valve and positioned upstream of both said main burner valve and said connection means to thereby control fuel flow to both of said burners, an electrical control circuit including an electrical main burner valve operator controlling said main burner valve, an electrical master valve operator controlling said master valve, ignition means for igniting fuel emanating from said pilot burner, a normally closed time delay switch in series with said master valve operator and in series with said ignition means, a flame detection switch having a hot contact electrically connected to said main burner valve operator and a cold contact electrically connected to said ignition means and further including a temperature sensitive element movable from said cold contact to said hot contact to deenergize said ignition means and energize said main burner valve operator in response to the presence of flame from said pilot burner, and means electrically connected to said cold contact for automatically opening said normally closed time delay switch at a predetermined time after the energization of said master valve actuator if said temperature sensitive element fails to move from said cold contact, thereby to deenergize said master valve operator upon opening of said time delay switch and requiring complete recycling of the circuit means to restore the system to operation.

4. In a burner control system in combination, a pilot burner, a fuel control means having in serial connection with one another a normally closed first valve, a normally

closed second valve, and a main burner, said fuel control means further including an outlet between said first and second valves for supplying fuel to said pilot burner, whereby said first valve controls the flow of fuel to both of said burners and said second valve controls the flow of fuel to the main burner only when said first valve is open, an electromagnetic actuator for said first valve, an electromagnetic actuator for said second valve, an electrically operated igniter for said pilot burner, a time delay switch, a first energizing circuit for said actuator for said first valve and for said igniter and controlled by said time delay switch, and a second energizing circuit for said actuator for said second valve including a flame sensitive means responsive to a flame at said pilot burner to control energization of said second valve, said first energizing circuit being closed when said actuator for said

second valve is deenergized and opened when said actuator for said second valve is energized, whereby closure of said first valve will prevent the supplying of gas to both of said burners, said time delay switch upon opening operable to deenergize said first valve actuator thereby requiring complete recycling of the circuit means to restore the system to operation.

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UNITED STATES PATENT OFFICE
CERTIFICATION OF CORRECTION

Patent No. 2,983,314

May 9, 1961

Peter Eduard Geldhof et al.

It is hereby certified that error appears in the above numbered patent requiring correction and that the said Letters Patent should read as corrected below.

Column 1, line 50, strike out the paragraph starting with "This application is a continuation-in-part" and ending with "Clothes Drier." in line 57, same column, and insert instead the following:

This application is a continuation of application Serial No. 341,441, filed March 10, 1953, and now abandoned. Application Serial No. 341,441 was a continuation-in-part of application Serial No. 123,018, filed October 22, 1949, and entitled "Gas-Heated Drier," now Patent No. 2,635,354, and of application Serial No. 208,708, filed January 31, 1951, and entitled "Gas Burner and Control Therefor Particularly Adapted for Use With Clothes Driers," now Patent No. 2,678,814.

in the heading to the printed specification, line 8, for "Filed Nov. 5, 1959, Ser. No. 851,194" read -- Continuation of abandoned application Ser. No. 341,441, filed March 10, 1953. This application Nov. 5, 1959, Ser. No. 851,194 --; in the heading to the drawings, Sheets 1 and 2, line 4, for "Filed Nov. 5, 1959", each occurrence, read -- Original Filed March 10, 1953 --.

Signed and sealed this 6th day of February 1962.

(SEAL)
Attest:

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Attesting Officer

DAVID L. LADD
Commissioner of Patents