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CONTROL DEVICE

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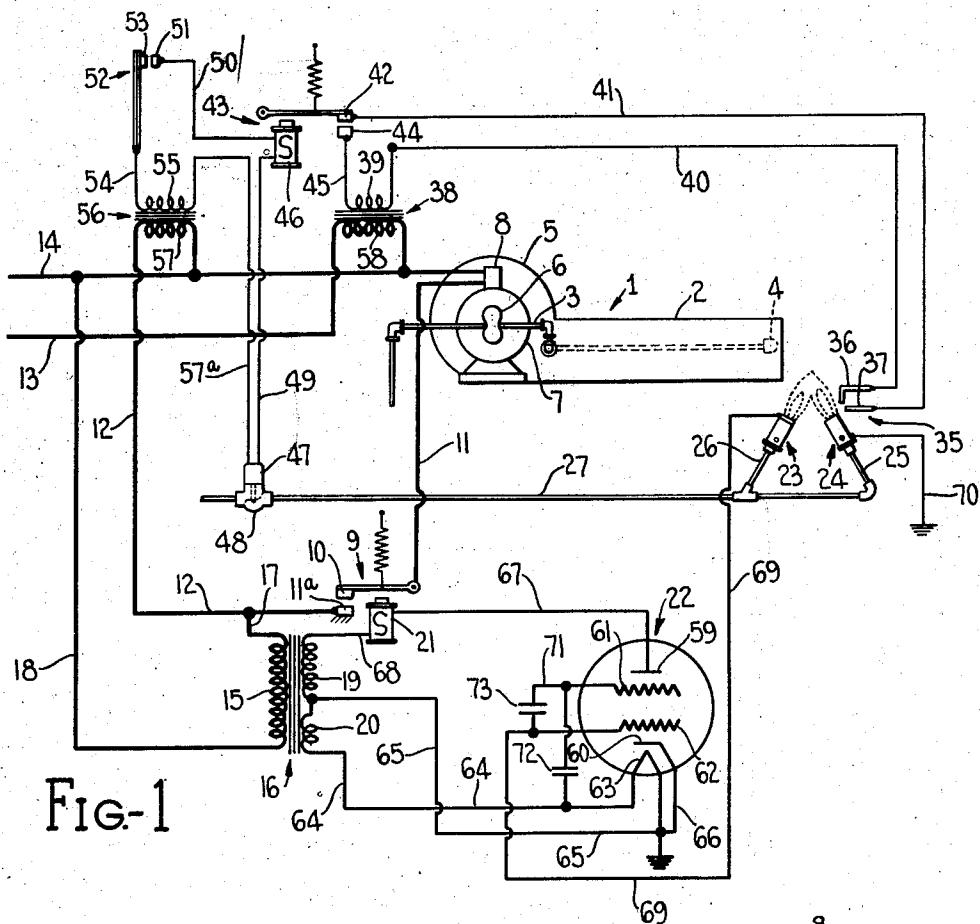


FIG-1

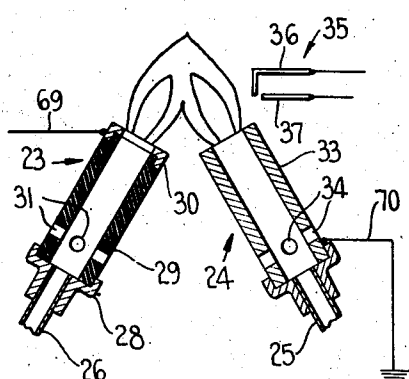


FIG-2

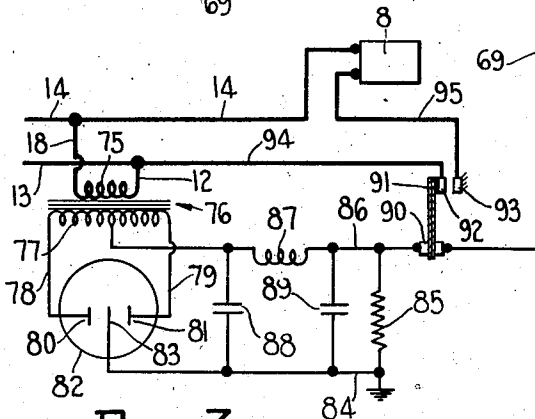


FIG-3

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CONTROL DEVICE

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15 Claims. (Cl. 158—28)

This invention relates to new and useful improvements in electric circuits and more particularly to such control by means of gaseous fuel burners.

Although the electrical characteristics of a flame have heretofore been utilized in the control of electric circuits, it has been found that when the burner control flame is created by gaseous fuel that the controlling operation is critical and that the circuit must be balanced or calibrated for different gaseous fuels. It has been found that this is due to the fact that in some instances the electron mass of the outer envelope of a gaseous flame will be definitely positive whereas with other gaseous flames the electron mass of the outer envelope will be definitely negative.

It is therefore one object of this invention to provide a control which will not be affected by the electrical characteristics of the fuel.

Another object is to provide a control which is particularly adapted for use with the burner of a heating apparatus.

The invention consists in the improved construction and in the combination of parts of the novel control to be more fully described hereinafter and novelty of which will be particularly pointed out and distinctly claimed.

In the accompanying drawing to be taken as part of this specification there are fully and clearly illustrated several preferred embodiments of the invention, in which drawing:

Figure 1 is a diagrammatic view of a heating apparatus in which the control circuits include an electron tube.

Fig. 2 is a detail view in section on the longitudinal axes of certain burners forming part of the control and showing their cooperative relation, and

Fig. 3 is a diagrammatic view of a portion of the electrical circuits of Fig. 1 and having a control crystal in lieu of the electron tube.

Referring to the drawing by characters of reference, 1 designates generally a fluid fuel burner such as an oil burner having an air tube or duct 2 and a fuel feed line 3 terminating in a spray nozzle 4 positioned within the duct 2. A fan or blower 5 is connected to the duct 2 to discharge air therethrough to form a combustible mixture with fuel, such as oil discharged from the nozzle 4 by the pump 6 which is intercalated in the fuel line 3. The fan 5 and pump 6 are driven by an electric motor 7 which may be provided with an electrically or electro-magnetically operated switch control 8. In series circuit with the electric

actuator and switch contacts of the control 8 there is a relay switch 9 having an armature carried contact 10 connected by a lead wire 11 to the control 8. The fixed contact 11^a of the switch 9 is connected by a lead wire 12 to the current supply line wire 13, the other supply line wire 14 being connected to the free terminal of the control 8. The primary 15 of a step down transformer 16 is connected by a lead wire 17 to the lead wire 12 and is connected by lead wire 18 to the supply wire 14. The transformer secondary having turns 19 and 20 supplies the relay coil 21 of switch 9 and also the electrical network of the electron tube 22 to be described hereinafter.

The igniting means for the main burner 1 comprises a pair of pilot burners 23, 24 having their single outlets directed so that the fuel streams discharging therefrom impinge against each other. The burners 23, 24 are further positioned adjacent the main burner 1 so that the flames of the impinging fuel streams are united to provide an igniting flame in the path of the combustible mixture discharged from the duct 2 and nozzle 4. The pilot burners 23, 24 are fed with gaseous fuel from branch supply pipes 25, 26 which may support the respective pilot burners and which are fed from a common supply pipe or conduit 27. The burner 23 has a supporting base 28 secured and sealed to the pipe 26 and carrying a mixing tube formed by a tubular portion 29 of electric insulating material and an electrical conducting cap ring element 30 of metal positioned at the burner tip. The tube portion 29 is provided with one or more air supply ports 31 for intermixing air with the fuel to be discharged from the burner 23. The burner 24 has a base member 32 secured and sealed to the branch pipe 25 and carrying a tubular member 33 of metal to provide an electrical conductor and forming the burner mixing tube. Air inlet 34, of which there may be one or more are provided through the member 33 so that there will be proper mixture of air with the fuel discharged from the burner 24. Positioned adjacent the outlet of the burner 24 there is an electrical sparking means 35 such as a spark plug having spark electrodes 36, 37 to provide a high tension spark for igniting the fuel supplied by the burner 24. The plug 35 is supplied with high tension current from an ignition transformer 38 having one side of its secondary 39 connected by a lead wire 40 to the electrode 36. The other electrode 37 is connected by a lead wire 41 to the armature carried contact 42 of a relay switch 43, the fixed contact 44 of switch 43 being connected

by a lead wire 45 to the free terminal of the transformer secondary 39.

The relay coil 46 of switch 43 is in series circuit with the solenoid coil 47 of an electrically operated fuel valve 48, one terminal of coil 46 being connected to one terminal of coil 47 by a lead wire 49. The other terminal of relay coil 46 is connected by a lead wire 50 to the fixed contact 51 of a control switch 52 having a movable contact 53 and which may be a room thermostat or other automatic switch responsive to the output of the main burner 1. The movable switch contact 53 is connected by a lead wire 54 to the secondary 55 of a step down transformer 56 which has its primary 57 connected across the lead wires 13, 14. From the other terminal of the transformer secondary 55 a lead wire 57^a connects to the free terminal of the solenoid coil 47. The primary 58 of the ignition transformer 38 is also connected across and fed from the lead wires 13, 14.

The electron tube 22 which, for example, may be of the type known on the market as the No. 2051 Radiotron has the usual electrodes 59, 60, being respectively the anode and the cathode. Interposed between the tube electrodes there is a screen grid 61 and a control element or grid 62. The usual filament 63 is provided for heating the cathode. A lead wire 64 connects from one terminal of the filament 63 to one end of the transformer secondary 20, from the other end of which a lead wire 65 connects to the other side of the filament to complete its circuit. The cathode 60 is connected by a lead wire 66 to the lead wire 65. From the anode, a lead wire 67 connects to the relay coil 21 and from the other coil terminal a lead wire 68 connects to the free end of the transformer secondary 19. From the burner tip conducting member 30 a lead wire 69 extends to the control grid 62 of the burner controlling electrically operable switch means comprising the tube 22 and relay 9. From the electrically conductive burner tube 33 a lead wire 70 connects to ground. Connected between the lead wire 71 of the screen grid 61 and the filament lead wire 64 there is a condenser 72 which, for example, may have a capacity of 200 mmf. Connected between the lead wires 71 and 69 there is a condenser 73 having a capacity which, for example, may be 50 mmf.

The operation of the heating apparatus of Figs. 1 and 2, assuming that the current supply to lead wires 13, 14, the gaseous fuel supply to the valve 48, and the liquid fuel supply to the pump 6 are available, is as follows: When the switch 52 is closed, as by a call for temperature increase, the relay coil 46 and the solenoid coil 47 are each energized by completion of the following circuit, from the transformer secondary 55 through lead wire 54, closed switch contacts 53, 51, lead wire 50, to one terminal of coil 46, from the other coil terminal through lead wire 49 to one terminal of the solenoid coil 47 and thence from the other terminal of coil 47 via lead wire 57^a back to the transformer secondary 55. The valve 48 is thus opened by the coil 47 and the relay switch 43 is closed at contacts 42, 44 to complete the circuit of the spark plug 35, which circuit is as follows: From the ignition transformer secondary 39 through lead wire 45 and switch contacts 44, 42 to lead wire 41 and one electrode 37 of the plug and thence across the spark gap to the other electrode 36 and via lead wire 40 to the other terminal of the transformer secondary 39. The gaseous fuel supplied

through the conduit 27 from the open valve 48 will mix with the air supplied to the burners 23 and 24 so that the fuel mixture discharging from the burner 24 will be ignited by the spark at the air gap of electrodes 36, 37. The flame of burner 24 will immediately ignite the fuel mixture discharging from burner 23. The substantially equal size impinging flames from these burners will bridge the gap between the terminals of the wires 69 and 70 at their connections to these burners and will therefore establish the circuit from the control grid 62 via lead wires 69 and 76 to ground. Since the pilot burners are supplied with the same kind of fuel and provide flames of substantially equal size, the impinging flames will provide a path of constant current flow or of the same resistance to current flow irrespective of the type or kind of gaseous fuel employed, because connecting positive to positive flame envelopes or negative to negative flame envelopes results in the flame contact establishing the maximum resistance which can be had across the flame path. This flame completed circuit will render the control grid 62 more positive so that the tube 22 will be energized and rendered capable of current flow to complete the circuit through the relay coil 21 from the transformer secondary 19. Energization of coil 21 will close the switch contacts 10, 11^a to complete the circuit through the motor control means or switch 8 so that air and fuel will be supplied by the fan 5 and pump 6 respectively to provide a combustible fuel mixture to be ignited by the impinging burner flames discharging from the pilot burners 23, 24. It will be apparent that should the flames issuing from the burners 23, 24 fail, or either of them, or should the flames not impinge each other, the control grid circuit to ground will be broken and the tube 22 thereby deenergized, which will stop operation of the burner 1 by the opening of switch 9 and the deenergization of the burner controlling switch means.

Referring to Fig. 3, the lead wires 12 and 18 from the line wires 13 and 14, respectively, are connected to the primary 75 of a step down transformer 76 having a center-tapped secondary 77. The end terminals of the secondary 77 are connected by lead wires 78, 79 to the anodes 80, 81 of a full-wave rectifier tube 82 having a cathode 83. The electrical network is the usual rectifier circuit having the cathode lead wire 84, which is grounded, connected by a resistance load 85 to a lead wire 86 from the center tap of the transformer secondary 77. Positioned between the transformer secondary and the load 85 there is, in the lead wire 86, a choke coil 87. Condensers 88, 89 are bridged across the lead wires 86, 84, one on each side of the choke coil 87. The lead wire 86 is connected at its free end as at 90 to one of the laminations of a Rochelle salts warping crystal or control element 91. The other lamination of the crystal 91 is connected to the flame lead wire 69 of Fig. 1, so that the burner controlling electrically operable switch means comprising the crystal 91 may be connected to ground through the impinging pilot flames. Upon subjecting the crystal lamination connected to the lead wire 86 to a continuous unidirectional potential, effected by the full wave rectification, the crystal warps or bends to actuate a movable insulated switch contact 92 into closing engagement with a fixed switch contact 93 to complete a high voltage electric circuit from the line wires 13, 14 to and through the motor control switch

8, the contact 92 being connected by a lead wire 94 to the lead wire 13 and the contact 93 being connected to the control switch 8 by lead wire 95.

The operation of the heating apparatus when provided with the circuit arrangement of Fig. 3 will, it is believed, be apparent from the foregoing description of Fig. 1 and of the circuit of Fig. 3. However, it may be noted that the resistance load 85 is such that the tube 82 will be maintained energized at all times so that immediately upon impingement of the flames from the burners 23, 24, a circuit to ground is completed through the impinging flames so that a continuous unidirectional voltage will be applied to the crystal 91 which will warp and close the relay contacts 92, 93, thereby placing the burner 1 in operation.

It will be apparent that the burner 1 has been shown as a liquid fuel burner solely for the purpose of illustration and that it may be a gaseous fuel burner having an electrically operated or solenoid valve positioned in the burner gas line in lieu of the control switch 8 and motor 7.

Having thus described the invention, what is claimed and is desired to be secured by Letters Patent of the United States is:

1. A control device comprising a plurality of gaseous fuel burners so constructed and arranged that a fuel stream discharging from one of said burners impinges against a fuel stream discharging from another of said burners, means to produce flame sizes substantially equal to each other at said burners and to supply said burners with the same kind of gaseous fuel, a control means, an electrical conductor operable to connect the flame of one of said burners to said control means, and an electrical conductor to connect the flame of the other of said burners to ground, the impingement of said flames closing the circuit between said conductors thereby to render said control means effective.

2. A control device comprising a plurality of gaseous fuel burners so constructed and arranged that a fuel stream discharging from one of said burners impinges against a fuel stream discharging from another of said burners, means to produce impinging flames of substantially equal size at said burners and to supply said burners with the same kind of gaseous fuel, a control means, one of said burners having insulating means to electrically insulate its flame from ground, an electrical conductor to connect the insulated flame to said control means, and an electrical conductor to connect the flame of the other of said burners to ground, the impingement of said flames closing the circuit between said conductors thereby to render said control means effective.

3. A control device comprising an electron tube having electrodes and a control element, a plurality of gaseous fuel burners so constructed and arranged that a fuel stream discharging from one of said burners impinges against a fuel stream discharging from another of said burners, means to produce impinging flames of substantially equal size at said burners and to supply said burners with the same kind of gaseous fuel, means operable to electrically connect the flame of one of said burners to said control element, means to electrically insulate the flame of said last-named one of said burners from ground, and means to electrically connect the flame of the other of said burners to ground, the impingement of said flames closing the circuit between said conductors thereby to control the operation of said tube.

4. A control device comprising a Rochelle salts

control element, means to supply a unidirectional continuous potential to one side of said element, a plurality of gaseous fuel burners so constructed and arranged that a fuel stream discharging from one of said burners impinges against a fuel stream discharging from another of said burners, means to produce impinging flames of substantially equal size at said burners and to supply said burners with the same kind of gaseous fuel, means operable to electrically connect the flame of one of said burners to the other side of said control element, means to electrically insulate the flame of said last-named one of said burners from ground, and means to electrically connect the flame of the other of said burners to ground, the impingement of said flames subjecting said control element to said continuous potential thereby to actuate said control element.

5. A control device comprising an electron tube having electrodes and a control element, a burner having a tube portion of electric insulating material, an electrical conductor carried by said tube portion and positioned for conducting relation with the burner flame, a burner having a grounded tube portion of electric conducting material in conducting relation with its burner flame, said burners having a fuel discharge of one burner directed against a fuel discharge from the other burner, means electrically connecting said conductor to said control element so that said electron tube will be capable of current flow by impingement of the burner flames, and means to supply the same kind of gaseous fuel to each of said burners and to provide substantially equal flame sizes at both burners so that a path of constant current flow will be established by the impinging flames.

6. A control device comprising a plurality of gaseous fuel burners, one of said burners being constructed and arranged to discharge a gaseous fuel stream in impinging relation to a gaseous fuel stream discharged from another of said burners, means operable to electrically connect the flame of one of said burners to ground, means to electrically insulate the flame of the other of said burners from ground, means to produce flames of substantially the same size at said one and said other burner, an electrical conductor adapted to be in electric conducting relation to the flame of said last-named other of said burners, an electron tube having a circuit controlled thereby and having a control element electrically connected to said electrical conductor, and a conduit for supplying the same kind of gaseous fuel to each of said burners so that the substantially equal size impinging flames will provide a path of constant current flow irrespective of the kind of fuel and will electrically connect said control element to ground, thereby to render said tube conducting.

7. A control device comprising a plurality of gaseous fuel burners, one of said burners being constructed and arranged to discharge a gaseous fuel stream in impinging relation to a gaseous fuel stream discharged from another of said burners, means operable to electrically connect the flame of one of said burners to ground, means to electrically insulate the flame of the other of said burners from ground, means to produce flames of substantially the same size at said one and said other burner, an electrical conductor adapted to be in electric conducting relation to the flame of said last-named other of said burners, an electron tube having a circuit controlled thereby and having a control element electrically

connected to said electrical conductor, a conduit for supplying the same kind of gaseous fuel to each of said burners, and electric sparking means for igniting the fuel discharged from said last-named one of said burners thereby to ignite the fuel discharged from said last-named other of said burners.

8. A burner control device comprising a main fuel burner, means controlling the supply of fuel to said burner, a plurality of gaseous fuel pilot burners at least one of which has a fuel stream directed to ignite the fuel discharged from said main burner, said pilot burners being so constructed and arranged that a fuel stream discharging from one of said pilot burners impinges against a fuel stream discharging from another of said burners, means to supply said pilot burners with the same kind of gaseous fuel and to produce flames of substantially equal size at said pilot burners, electrically operable switch means controlling the operation of said burner controlling means, means to ignite the fuel discharging from said pilot burners so that there will be impinging flames, means to electrically connect the flame of one pilot burner to said switch means, electric insulating means interposed between said connecting means of said last-named one pilot burner and ground, and means to electrically connect the flame of said other pilot burner to ground so that said switch means will be energized by impingement of the pilot burner flames.

9. A burner control device comprising a main fuel burner, means controlling the supply of fuel to said burner, a plurality of gaseous fuel pilot burners at least one of which has a fuel stream directed to ignite the fuel discharged from said main burner, said pilot burners being so constructed and arranged that a fuel stream discharging from one of said pilot burners impinges against a fuel stream discharging from another of said burners, means to produce impinging flames of substantially equal size at said burners and to supply said pilot burners with the same kind of gaseous fuel, an electron tube having a circuit controlling said burner controlling means and having a control element, means to ignite the fuel discharged from one of said pilot burners thereby to ignite the fuel discharged from the other of said pilot burners, means to electrically connect the flame of said last-named other pilot burner to said control element, electric insulating means interposed between said connecting means of said last-named other pilot burner and ground, and means to electrically connect the flame of said last-named one pilot burner to ground so that said electron tube will be capable of current flow by impingement of the pilot burner flames.

10. A burner control device comprising a main fuel burner, means controlling the supply of fuel to said burner, a plurality of gaseous fuel pilot burners at least one of which has a fuel stream directed to ignite the fuel discharged from said main burner, said pilot burners being so constructed and arranged that a fuel stream discharging from one of said pilot burners impinges against a fuel stream discharging from another of said burners, means to produce impinging flames of substantially equal size at said burners and to supply said pilot burners with the same kind of gaseous fuel, an electric switch controlling the operation of said burner controlling means, a warping crystal operable to actuate said switch, means to supply a unidirectional continuous potential to one side of said crystal, means to ignite the fuel discharged from one of said pilot

burners thereby to ignite the fuel discharged from the other of said pilot burners, means to electrically connect the flame of said last-named other pilot burner to the other side of said crystal, electric insulating means interposed between said connecting means of said last-named other pilot burner and ground, and means to electrically connect the flame of said last-named one pilot burner to ground so that said crystal will be warped upon impingement of the pilot burner flames.

11. A burner control device comprising a main fuel burner, a plurality of pilot burners operable to produce flames of substantially equal size and so related that their respective flames will impinge each other, means to supply the same kind of gaseous fuel to said pilot burners, at least one of said pilot burners being so related to said main burner that the flame of said one pilot burner can ignite the fuel supplied to said main burner, an electron tube having a control grid with a controlling circuit, means forming a series gap in said grid circuit and positioned to be bridged by the impinging pilot burner flames, and means controlling the initial supply of fuel to said main burner and controlled by said tube, said tube being rendered effective upon completion of said grid circuit by the impinging pilot flames.

12. A burner control device comprising a main fuel burner, a plurality of pilot burners so related that their respective flames will impinge each other, at least one of said pilot burners being so related to said main burner that the flame of said one pilot burner can ignite the fuel supplied to said main burner, warpable means having a circuit controlling its operation, said circuit having spaced terminals providing a gap to be bridged by the impinging pilot burner flames, and means controlling the initial supply of fuel to said main burner and controlled by said warpable means, said controlling means being rendered effective upon completion of said circuit by the impinging pilot flames.

13. A burner control device comprising a main fuel burner, electrically operable fuel supply means for said burner and having a circuit, a normally open switch controlling said circuit, electrically energized means operable to close said switch, a pair of pilot burners so positioned that their respective flames will impinge each other, at least one of said pilot burners directing its flame to ignite said main burner, means to produce substantially equal flame sizes at said pilot burners, means to supply the same kind of gaseous fuel to each of said pilot burners, said electrically energized means having a controlling circuit, said pilot burners being positioned in series in said controlling circuit and being spaced to provide a series gap in said controlling circuit, and means to ignite the fuel supplied to said pilot burners to provide impinging flames bridging said gap thereby to complete said controlling circuit for closure of said normally open switch.

14. A burner control device comprising a main fuel burner, electrically operable fuel supply means for said burner and having a circuit, a normally open switch controlling said circuit, electronic means operable to close said switch, a pair of pilot burners so positioned that their respective flames will impinge each other, at least one of said pilot burners directing its flame to ignite said main burner, means to produce substantially equal flame sizes at said pilot burners, means to supply the same kind of gaseous fuel to each of said pilot burners, said electronic

means having a grid controlling circuit, said pilot burners being positioned in series in said grid controlling circuit and being spaced to provide a series gap in said controlling circuit, and means to ignite the fuel supplied to said pilot burners to provide impinging flames bridging said gap thereby to complete said controlling circuit for closure of said normally open switch.

15. A fluid fuel burner safety starting means comprising a pair of pilot burners directed relative to each other for flame impingement and electrically insulated from each other to provide a circuit gap, means to supply the same kind of

5 gaseous fuel to said burners and to provide substantially equal flame sizes, a main burner starting switch, electrically controlled means for closing said switch and a controlling circuit for energizing said electrically controlled means and having said pilot burners intercalated therein so that the impinging flames will complete said controlling circuit thereby to render operation of said electrically controlled switch closing means dependent upon impingement of said pilot burner flames.

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