

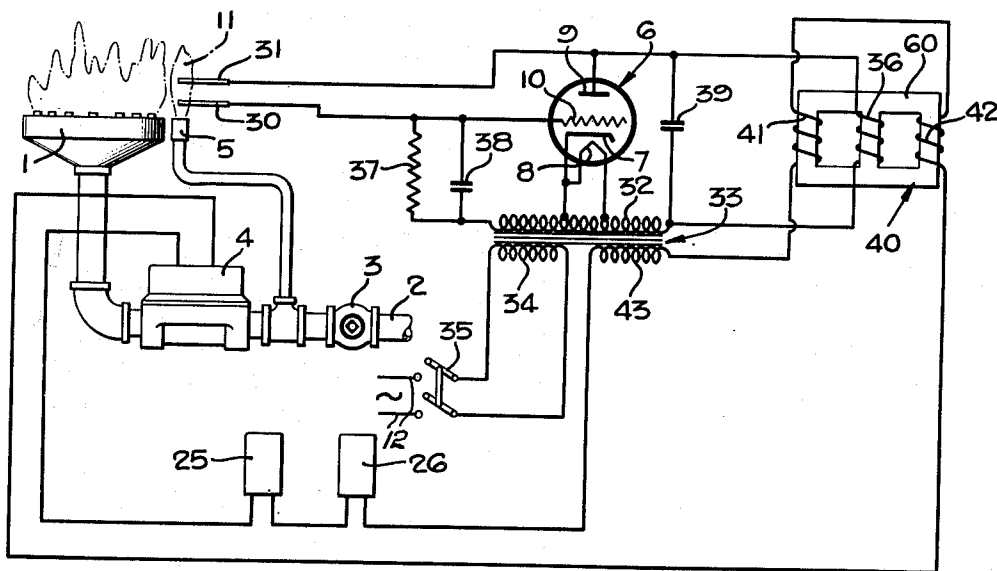
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FUEL BURNER SAFETY CONTROL USING FLAME CONDUCTION

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FUEL BURNER SAFETY CONTROL USING
FLAME CONDUCTIONFred E. Cairns, Jr., North Hollywood, Calif., as-
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2 Claims. (Cl. 158-123)

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This invention relates to a burner control for automatically opening a burner valve upon establishment of a pilot flame, and for automatically causing the burner valve to close upon extinguishment of a pilot flame.

This automatic control, in this instance, is effected by utilizing the electric conductivity of a flame; thus, the pilot flame is made a part of an electric circuit that controls the flow of current to an electrically operated valve supplying fuel to the main burner.

It is one of the objects of this invention to utilize the conducting property of the flame in conjunction with an electronic emission device for causing an operative current to flow to the main burner valve.

It is another object of this invention to provide a control system of this character in which the rectifying property of a flame is employed in a simple and effective manner to control the supply of power to an electromagnet.

It is another object of this invention to employ flame conduction for controlling the rate of current flow in an output circuit of an electronic emission device, in which the output circuit includes a reactance that is decreased sharply in value when the flame is in existence.

This invention possesses many other advantages, and has other objects which may be made more clearly apparent from a consideration of one embodiment of the invention. For this purpose, there is shown one form in the drawings accompanying and forming part of the present specification. This form will now be described in detail, illustrating the general principles of the invention; but it is to be understood that such detailed description is not to be taken in a limiting sense, since the scope of the invention is defined by the appended claims.

The single figure is a diagrammatic representation of a system incorporating the invention.

In the system shown in the drawing, a main burner 1 is shown supplied with gaseous fuel from a conduit 2. This conduit 2 is controlled by a shut-off valve 3. Passage of fuel to the main burner 1 is controlled by an electromagnetically operated valve 4.

A pilot burner 5 is arranged in proximity to the main burner 1, and is connected to the conduit 2 between the valves 3 and 4. The pilot burner 5 is shown somewhat exaggerated in size in relation to the main burner 1.

The electromagnetically operated valve 4 has a circuit energized by a secondary winding 43 of a transformer 33. The transformer 33 may be

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of the cored type. In this energization circuit are thermostatically operated switching means 25, a limit control switching means 26, and two series connected coil sections 41 and 42. The coil sections 41 and 42 are respectively wound upon branch legs of a core 60 of a saturable reactor 40.

A primary transformer winding 34 of the transformer 33 may be connected to a source of alternating current supplied by mains 12. The supply of energy is controlled by a circuit controller 35.

A saturating coil 36 is wound upon the central leg of the core 60. The saturable reactor 40 is such that when its core 60 is unsaturated, the combined impedance of the coils 41 and 42 is sufficiently high to prevent operation of the electromagnetically operated valve 4. However, when the core 60 is substantially saturated, the reactance of the coils 41 and 42 is reduced, and the valve 4 may be operated by a substantial alternating current.

Saturating current flows through the saturating coil 36 only in the event that a pilot flame 11 is in existence. For this purpose, flame electrodes 29 and 31 control an electronic emission device 6, the output circuit of which includes the saturating winding 36.

The electronic emission device 6 includes a cathode 7 indirectly heated by heater 8, an anode 9, and a control electrode 10. The cathode 7 of the electronic emission device 6 is connected to an intermediate point of another secondary transformer winding 32 of the transformer 33. One terminal of this winding 32 is connected through the saturating coil 36 to the anode 9. A bypass condenser 39 shunts the coil 36. The other terminal of this winding 32 is connected to the control electrode 10 by way of a high resistance 37. A grid leak condenser 38 bridges this resistance. Energy is transmitted to the secondary winding 32 upon energization of the primary winding 34. The cathode heater 8 is connected across a section of the secondary winding 32.

During a cycle in which the right-hand terminal of the winding 32 is positive, there is a sufficient positive potential impressed upon the anode 9 to permit the passage of a space current. However, the space current is normally controlled by the control electrode 10 which is maintained at a negative potential. This is effected because the left-hand terminal of the winding 32 is negative with respect to the right-hand terminal thereof during this portion of the cycle. During that half of the cycle in which the right-hand terminal of winding 32 is negative, no space cur-

rent can flow, since the cathode 7 is at a higher potential than the anode 9.

In order to make it possible for current to flow in the output circuit of the electronic emission device 6 and to pass a saturating current through the coil 36 to operate the valve 4, the pilot flame 11 must be in existence. Under such circumstances, the flame electrodes 30 and 31 cause the control electrode to assume a positive potential during that half cycle in which the anode 9 is positive.

For this purpose, the electrodes 30 and 31 are arranged to be in the flame 11 and in the direction of flame propagation. Thus, electrode 30 is nearer the root of the flame 11, and electrode 31 is nearer the tip. Electrode 30 is directly connected to the control electrode 10, and the electrode 31 is similarly directly connected to the anode 9.

The pilot flame 11, when in existence, provides a conducting medium to complete an electrical conducting path between the anode 9 and the control electrode 10. The arrangement of the electrodes 30 and 31 is such that the current flows quite readily through the flame 11 from anode 9 to the control electrode 10.

The control electrode 10 then assumes the potential of the anode 9 when the anode is positive. Thus, a rectified current flows between the cathode 7 and the anode 9 in response to the existence of a pilot flame 11. This space current energizes the saturating coil 36, and the saturation of the core 60 permits operation of the valve means 4.

As soon as the flame 11 is extinguished, either accidentally or otherwise, a conducting medium between electrodes 30 and 31 is no longer provided, and the potential of the control electrode 10 returns to a negative value whenever the anode is positive. Thus, no substantial current can pass to the saturating winding 36, and the valve means closes.

Initiation of the operation of the system requires opening of the valve 3 and the closing of the circuit controller 35. Assuming pilot flame 11 to be in existence, and the switching devices 25 and 26 closed, the main burner is supplied with fuel and may be lighted by the pilot flame. The limit switch 26 may be arranged to open upon a predetermined condition, such as the attainment of a definite pressure or level, or the like, and switch 25 may be caused to respond to temperature. For space heating, the limit switch 26 may be omitted.

What I claim is:

1. In a control system for a main burner and a pilot burner: electrically operated valve means for controlling the flow of fuel to the main burner; first and second electrical transducers, each having an electrical output; a circuit for the electromagnetically operated valve means, including the output of said first electrical transducer, and a reactor coil in series therewith; a magnetic core for said reactor coil; a saturating winding for saturating said magnetic core; the impedance of said reactor coil permitting effective energization of said electromagnetically operated means only when the core is substantially saturated; a circuit for said saturating windings, including the output of said second elec-

trical transducer and an electronic emission device having a cathode, an anode, and a control electrode, said cathode, anode, and the output of said second transducer being in series with said saturating winding; means forming a biasing circuit for said electronic emission device for normally imposing a bias on said control electrode such as to prevent conduction of current between said anode and said cathode; a pair of electrodes adapted to project into the flame of said pilot burner and along the direction of flame propagation; a connection between one of said electrodes and said anode; a connection between the other of said electrodes and said control electrode; and means for energizing said transducers.

2. In a control system for a main burner and a pilot burner: electrically operated valve means for controlling the flow of fuel to the main burner; a circuit for the electromagnetically operated valve means, including a first transformer winding, and a reactor coil in series therewith; a magnetic core for said reactor coil; a saturating winding for saturating said magnetic core; the impedance of said reactor coil permitting effective energization of said electromagnetically operated valve means only when the core is substantially saturated; a circuit for said saturating winding, including a second transformer winding and an electronic emission device having a cathode, an anode, and a control electrode, said cathode, anode, and one portion of said second transformer winding being in series with said saturating winding; means forming a biasing circuit for said electronic emission device, comprising a resistor and another portion of said second transformer winding, said resistor and said other portion of said second transformer winding being in series with said cathode and said control electrode for normally imposing a bias on said control electrode such as to prevent conduction of current between said anode and said cathode; a pair of electrodes adapted to project into the flame of said pilot burner and along the direction of flame propagation; a connection between one of said electrodes and said anode; a connection between the other of said electrodes and said control electrode; an energizing transformer winding; and means magnetically coupling said energizing transformer windings with said first and second transformer windings.

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