

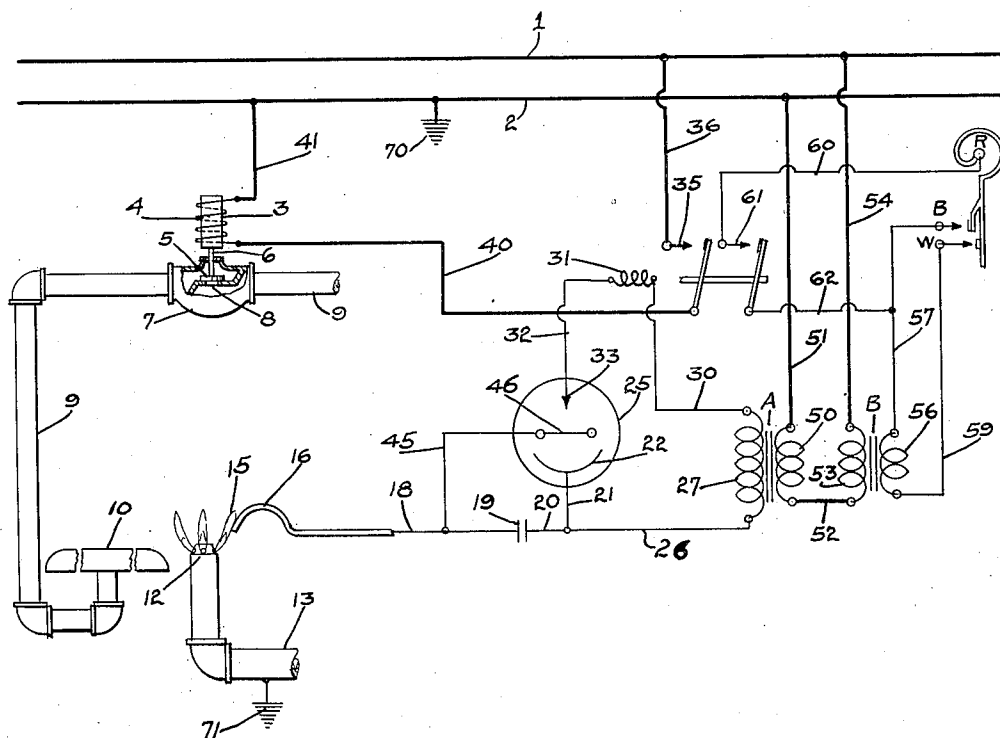
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FLAME CONTROLLED SYSTEM

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FLAME CONTROLLED SYSTEM

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This invention relates to a control system including a flame source and an electric circuit, the energization of which circuit depends upon the passage of current by the gas flame; that is, the circuit cannot be completed except through the elements of the flame. The invention has found valuable application as a device for interrupting fuel supply to a fuel burner in case of pilot flame extinguishment, and provides means controlled by the pilot flame and which is not adversely affected by ambient temperatures such as burner temperatures. In devices where a pilot flame is depended upon to ignite a burner, and in which it is desired to discontinue fuel supply to the burner if the pilot flame is extinguished, it is the practice to use a bimetallic or equivalent thermal member, as an element in a system for controlling fuel supply to the burner. This metallic thermal member, as a switch control element, is so placed as to be exposed both to pilot and furnace heat. Under these conditions, the metal becomes overheated and is moved such a degree that on cessation of pilot flame, an appreciable period of time elapses before it can affect its switch-closing function, to interrupt fuel feed as by closure of a valve. Therefore, fuel continues to be supplied, a great quantity is wasted and often explosion results when ignition is attempted.

It is, therefore, an important object of the present invention to use a means for immediately discontinuing fuel supply on pilot flame extinguishment, and to accomplish this result without the use of thermostatic metal and to provide a device which unfailingly operates and is not liable to become inoperative as the result of the large temperature overruns, as when exposed to main burner temperatures. Most safety pilots have operated upon the thermostatic principle and have therefore had, in order to be successful, to be compensated against furnace temperatures, or unless this was done their response was not dependable. The present invention utilizes a grid-glow-tube as part of the control system and in a manner to be entirely independent of the amount of heat present in the furnace. The tube is operable to permit pas-

sage of current, and opening of the fuel valve only when the circuit is completed by actual contact of the pilot flame with a conducting element of the circuit. This is a valuable feature.

The invention is diagrammatically represented in the single figure of the drawing and in said drawing: The numeral 10 indicates a burner, and the numeral 9 a fuel supply line for the burner. In the fuel line 9 is an electrically operable valve 7, including a movable valve element 5 controlling the flow orifice 8. The element 5 is connected to the core 3 of a solenoid, the coil of which is indicated at 4. Electrically operable means is provided for controlling the solenoid and, in this instance, comprises a relay, the coil of which is indicated at 31. This relay controls a contact 35 which is connected by conductor 36 with the hot line 1. The other side of this contact is connected by conductor 40 with one terminal of the coil 4, and the opposite side of the coil is connected by conductor 41 with the ground side 2 of the power line. A pilot device for the burner is indicated at 12 and the supply pipe for this pilot device is indicated at 13. The pilot flame, for convenience, is indicated at 15.

A transformer is indicated at A and comprises the secondary 27 and the primary 50. A choke coil is indicated at B and comprises a primary 53 and a secondary element 56. A grid-glow-tube is employed, the anode being indicated at 22, the grid at 46 and the cathode at 33. Connections across the power line include in series therein, the primaries of the transformer and choke coil. These connections include conductor 51 from the ground line to one terminal of the primary of the transformer, line 52 connecting the opposite terminal of this primary with the primary of the choke coil, the opposite terminal of the primary of the choke coil being connected by conductor 54 with the hot line 1.

Means is also provided for alternately energizing and de-energizing the choke coil and, therefore, varying the electrical effects in the transformer. In this instance, a heat-affectable device, such as a room thermostat, is used to control the circuit through the secondary

56 of the choke coil, and includes a movable element R and two contacts B and W. The contact W is connected by conductor 59 with one terminal of the secondary of the choke coil, the opposite terminal of this secondary being connected by conductor 57 with contact B. Contact W is first closed, and then contact B. A holding circuit is provided which is dependent on closure of contact 61 controlled by relay coil 31. Contact 61 is connected by conductor 60 with R of the room thermostat, and a conductor 62 connects the opposite side of this contact 61 with the conductor 57. After closure of 61 the secondary of the choke coil will not be de-energized after contact B is opened, the current being under these conditions maintained through contact W until opened by continued heating of the element R. The foregoing is only one of many means which can be used for varying the electrical effects of the transformer. The choke coil is used because only low voltage is required, and thus arcing and possible fusing of the thermostat contacts is prevented. A relay control circuit includes therein, in series, the secondary 27 of the transformer, relay coil 31, and the anode and cathode of the grid-glow-tube, and includes conductor 30 connecting one terminal of the secondary with one terminal of the coil 31, conductor 32 connecting the opposite end of the relay coil with the cathode 33, conductor 21 connecting the anode 22 with conductor 26 which latter conductor connects with the opposite side of the secondary of the transformer.

A grid circuit includes an electrode 16, in this instance formed of an alloy of nickel and iron, as means adapted to be impinged by the pilot flame to close the grid circuit. The grid circuit includes this element 16; conductor 18 connected to conductor 45 which latter conductor is connected with the grid 46; and ground connections 70 and 71 respectively from the ground line, and from the fuel supply pipe 13. A branch connection 20 is provided between the flame impingeable means 16 and the anode. This connection 20 has therein a condenser 19. The electrical characteristics of the tube and transformer are such that current sufficient to close the relay is only passed by the tube when flame is present and when the choke coil circuit is closed. This is more thoroughly explained herebelow. The condenser in the branch 20 is in series with the anode and grid and is also in series with the electrode and one terminal of the secondary of the transformer.

Operation

Let it be first assumed that there is no flame. Under these conditions the condenser 19 is affecting the grid 46 in a manner to prevent passage of current between anode and cathode and therefore relay 31 could not be closed on closure of the thermostat at

B—W. It will be understood that the duty of condenser 19 is to charge the grid when no current is in the flame-electrode branch of the grid circuit.

Now assume the pilot to be lighted. The grid-electrode circuit is affected to cause condenser leakage sufficient to overcome the grid-charging effect of the condenser, and condition the tube for passage of current. However, at this time the electrical effects are not such as to energize relay 31. On closure at B—W, the secondary 56 of the choke coil is shorted, and voltage is reduced in coil 53, increased in coil 50, and increased in coil 27 so that the combined effects of grid and transformer are sufficient to energize coil 31 of the relay, close the relay and open the fuel valve. If, however, the pilot flame 15 is extinguished (and the flame-electrode circuit therefore broken) and if, during this period, a call for heat is made at the thermostat, no energization of relay coil 31 is possible because it is only by the combined action of the flame-electrode and the transformer circuits that this energization can be accomplished.

It will be noted that, what may be termed, a valving action is performed by the choke coil and grid-glow-tube. When both valves are properly open, sufficient current can pass to energize the relay. When either is closed, the other cannot effect sufficient energization of the relay to close it. The "open-valve" action of the grid-glow-tube is dependent on the presence of flame, and only if flame is present, and only if the choke coil is energized, can sufficient current pass through the tube to energize the relay.

It is obvious that any electrically-controllable means can be used to control the fuel flow to the burner, and it is equally obvious that means other than a room thermostat may be used to control the circuit to the choke coil. Indeed, electrical variations in the primary of the transformer may be accomplished in many ways, so that when the proper electrical effects appear in the secondary and when flame is present, the grid-glow-tube passes sufficient current to close the relay or equivalent device. A very small amount of current passes through the flame, which is highly resistant. The amount of current capable of passing is unable to affect any but a very sensitive electrical instrument, which the grid-glow-tube is. The very small current passed by the flame is utilized for conditioning the tube to pass current, so that as soon as the room thermostat or equivalent control device operates to properly affect the transformer, the relay is closed.

In the presence of flame, that is as soon as the flame 15 contacts the electrode 16, the grid charge is so affected as to condition the tube to pass sufficient current to close the relay, if the electrical effects in the transformer have reached a predetermined level.

When the current in the grid circuit is operative, enough leakage takes place to overcome the grid-charging effect of the condenser, to condition the tube to pass current on a call for heat by the room thermostat, at which time the secondary of the choke coil circuit is closed.

The broad feature of this invention is the control by use of the flame as circuit maker and breaker.

I claim as my invention:

1. A control system for a burner including a low voltage circuit, a room thermostat controlling the low voltage circuit, an electrically operated burner control device, a medium voltage circuit for energizing the control device, a grid-glow-tube, a high voltage circuit including therein the anode and cathode of the grid-glow-tube, a grid circuit including an element adapted to be impinged by flame to complete the same, means associated with the room thermostat and low voltage circuit for controlling the current flow through said high voltage circuit, and means associated with said high voltage circuit for controlling the flow of current through said medium voltage circuit thereby to control the operation of said burner control device.

2. A control system for a burner including a low voltage circuit, a step-down transformer therefor, a room thermostat controlling the low voltage secondary thereof, an electrically operated burner control device, a medium voltage circuit for energizing the control device, a grid-glow-tube, a step-up transformer having its primary in series with the primary of the first mentioned step-down transformer and having its secondary in a high voltage circuit including therein the anode and cathode of the grid-glow-tube, a grid circuit including an element adapted to be impinged by flame to complete the same, and means in the secondary circuit of the step-up transformer to control the circuit of the burner control device, said room thermostat serving to control the operative energization of the step-up transformer by short circuiting the secondary of the step-down transformer.

In witness whereof, I have hereunto set my hand this 28th day of November, 1930.

FREDERICK S. DENISON.

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