

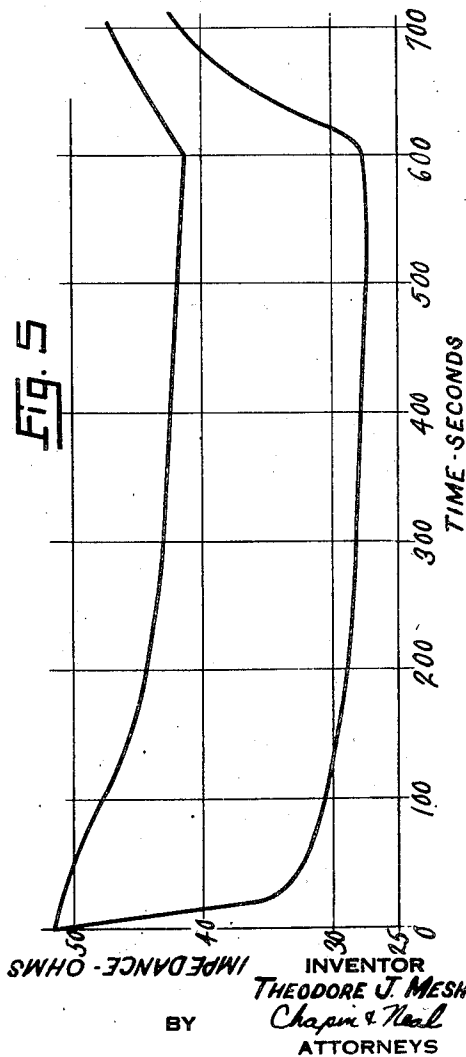
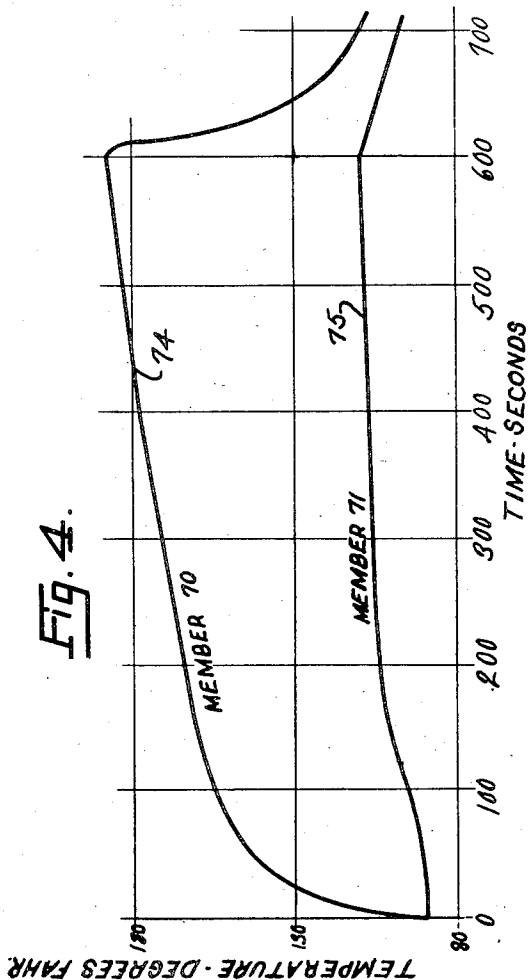
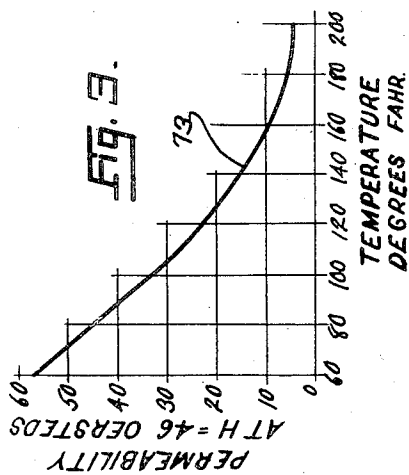
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COMBUSTION-RESPONSIVE MEANS FOR
BURNER CONTROL SYSTEMS

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COMBUSTION-RESPONSIVE MEANS FOR
BURNER CONTROL SYSTEMS

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This invention relates to an improved combustion-responsive means for use in burner control systems.

It is usual in such systems to provide a safety device which operates automatically to stop the burner within a predetermined time interval after the burner is started if combustion does not occur, or within a predetermined time interval after a combustion failure occurring during operation of the burner. A common use for the combustion-responsive means in a burner control system is to prevent operation of the safety device if combustion does occur within the aforesaid interval. It has been common heretofore to utilize as a combustion-responsive means for the purpose described a bi-metallic thermostat, responsive to heat from the burner and operating a switch, when combustion occurs, to control an electric circuit and prevent the safety device from operating.

This invention has for an object the provision in a burner control system of an improved form of combustion-responsive means, wherein the heat from the burner flame is utilized to effect a change in the impedance of a closed electrical circuit and thereby cause the operation of an actuator which effects any desired work in the burner control system, such for example, as preventing the operation of the safety device aforesaid.

The invention has for another object to provide an improved combustion-responsive means, having a bridge circuit including two impedances the magnitudes of which are variable in response to the heat of combustion, a source of electromotive force connected to the bridge circuit, and an electrically-operated actuator connected to the output terminals of the bridge circuit, the magnitude of one impedance being variable in direct response and the magnitude of the other impedance being variable in indirect response to the heat of combustion at the burner, whereby on occurrence of combustion, the magnitude of one impedance changes more rapidly than the other and this relative change is utilized to increase the voltages at the output terminals of the bridge circuit and cause operation of the actuator, the indirectly-responsive impedance serving to compensate for changes in ambient temperature.

More particularly, the invention makes use of

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two impedances, which may for example be inductance coils, the inductance of which is variable by heat, and these are mounted in adjacent relation and so that both are affected by heat from the burner but so that one is directly exposed to radiation from the burner flame and the other is shielded from such radiation, whereby both respond substantially equally to ambient temperatures but only the exposed one responds quickly to the burner flame, so that a quick relative change in the magnitude of the impedances is effected. These impedances are connected in series with a suitable source of electromotive force in a closed electrical circuit and the actuator is connected to such circuit at a point between the two impedances and at an intermediate point of said source. The arrangement is such that the voltage impressed on the actuator, when the impedances are subjected to equal temperature, is insufficient to operate the actuator. The sudden relative change in the impedances, effected when combustion occurs, causes a sufficient increase in the voltage impressed on the actuator to cause it to operate.

The invention is characterized in that the flame detector elements are of stable material not readily affected adversely by heat or oil and calculated to have a long useful life and not to require servicing; that such elements are of small size, enabling a compact flame-detector structure capable of being mounted in the burner tube in back of the burner nozzle; that the use of electrical contacts and moving parts exposed to the heat of the burner is avoided; and that the flame-detector structure is of a character such as to enable it to be manufactured economically.

The invention will be disclosed with reference to the accompanying drawings, in which—

Fig. 1 is a diagrammatical view of a burner control system embodying the invention;

Fig. 2 is a fragmentary sectional view of a burner showing one way of mounting the heat-sensitive inductances;

Fig. 3 is a chart showing the temperature-permeability curve of one of the magnetic members used in the system;

Fig. 4 is a chart showing the changes in temperature which occur in said magnetic members during operation of the burner; and

Fig. 5 is a chart showing changes in imped-

ance which occur in the inductances of the system during operation of the burner.

Referring to these drawings; the invention makes use of a bridge circuit with impedances therein, the magnitudes of which are variable in any suitable way in response to the heat of combustion at the burner. The magnitude of one impedance is arranged to vary rapidly in direct response to combustion while the magnitude of the other impedance is arranged to vary more slowly in indirect response to combustion. The particular form of the impedances may vary widely, as well as the manner in which their magnitudes are variable by heat, and the form of the bridge circuit may vary.

In Fig. 1 is shown a special form of bridge circuit in which the electromotive force source includes the secondary 3 of a transformer connected in series by wires 4, 5 and 6 with the impedances, in this case, inductance coils 1 and 2. The output terminals of the bridge circuit are shown at 7 and 8, respectively located between the two inductance coils and at an intermediate point of the source. Such terminals are connected in any suitable way to an electrically-operated actuator 9 of any suitable form. In this case, the actuator is a direct current relay adapted when energized sufficiently to engage two contacts 10 and 11. Because of this form of relay, a suitable full-wave rectifier 12, such for example as a copper oxide or dry plate rectifier, is interposed in the connections between the output terminals of the bridge circuit and the relay, being connected to the output terminals 7 and 8 by wires 13 and 14 respectively and to the relay by wires 15 and 16. The secondary 3 is part of a transformer 17, the primary 18 of which is connected by wires 19 and 20 to a suitable source of electromotive force such for example as a 115 volt, 60 cycle, alternating current, supply source.

Extending through the coils 1 and 2 are magnetic members 68 and 69, respectively. Cooperating with the members 68 and 69 to form closed magnetic circuits are thin members 70 and 71, respectively, constructed of magnetic material, the permeability of which is rapidly variable by heat. A change in the magnetic quality of the members 70 and 71 will effect a change in the reactance of the closed electrical circuits in which coils 1 and 2 are included. One example of how these coils may be mounted is shown in Fig. 2. A magnetic member 72 is suitably fixed on and encompasses the oil conduit 23, which supplies the pressure-atomizing nozzle 24 of an oil burner, 25 represents the tube through which the air for combustion is supplied and from which the conduit 23 and this member 72, is suitably supported. 26 represents the electrodes of the electric ignition system of the burner. Fig. 2 may be considered as a sectional plan view looking upwardly, the lower half of the air tube 25 and member 72 having been cut away. In the front and rear faces of member 72 are annular grooves which receive the coils 1 and 2. The member 72 combines in one piece the members 68 and 69, shown separately in Fig. 1. The thin members 70 and 71 are shown as thin circular diaphragms suitably secured to the front and rear rims of member 72. The front member 70 is exposed to direct radiation from the burner flame. The rear member 71 is shielded from such radiation and only indirectly affected by the heat from the burner. Thus, when combustion occurs at the burner, there will be a much more rapid rise

in temperature in member 70 than in member 71 and the impedance of the circuit in which coil 1 is included will be changed to enable actuation of the relay 1.

As an example of one of many materials available for use in constructing the members 70 and 71, may be mentioned a nickel steel alloy known as "Temperature compensator 30 type 4" alloy and made by the Carpenter Steel Company of Reading, Pennsylvania. The curve 73 shown in Fig. 3 shows changes in permeability effected in a member 70 or 71 made of such material by variations in temperature. In Fig. 4, the curves 74 and 75 show typical changes in temperature of the members 70 and 71, which occur during operation of a burner. These curves, between the ordinates A and B, show a 600 second period of normal operation and, between the ordinates B and C, show the period immediately following a flame failure. In Fig. 5, the curves 76 and 77 show the changes in impedance which occur in the front and rear coils 1 and 2 as a result of the changes in permeability of the members 70 and 71, respectively. A large change (decrease) in impedance, sufficient to operate the relay, is effected in the first 20 seconds of operation. Thereafter, there is a nearly constant difference in impedance between the two curves up to the end of the period of normal operation. On flame failure, the impedance of the front coil changes more rapidly than that of the rear coil and in a short time, the relay will drop out and start the operation of the safety switch which will stop the operation of the burner motor in about 60 seconds.

It will be understood that wherever values have been given in the preceding description this has been done merely to facilitate an understanding of the invention. The various values given are not critical and may be varied within wide limits. These values are not to be taken as limitations.

The invention may be used in various ways in burner control systems, as will be readily understood by those skilled in the art. In the drawings, a single illustrative example is given. The burner motor 27 and the primary 28 of the ignition transformer 29 are connected in parallel in a circuit from the supply wires 19 and 20 and controlled by the contacts 30 and 31 of a relay having a coil 32. Thus, a wire 33 connects supply wire 19 to one terminal of motor 27 and to one terminal of primary 28, a wire 34 connects one terminal of the motor 27 and one terminal of primary 28 to contact 31; and a wire 35 connects contact 30 to supply wire 20. The relay coil 32 is connected in a low voltage circuit supplied from the secondary 3. In this low voltage are a room thermostat switch 36 with its anticipating heater 37, a thermostatic safety switch 38 and its electric heating coil 39, and initially-engaged contacts 41 and 40. This low voltage circuit may be traced as follows, from one terminal of secondary 3 by a wire 41 to heater 37, thence by wire 42 to contact 43 of switch 36, from contact 44 of switch 36 by a wire 45 to one terminal of relay coil 32, from the other terminal of the latter by a wire 46 to one terminal of switch 38, from the other terminal of the latter by a wire 47 to one terminal of heater 39, from the other terminal of heater 39 by a wire 48 to contact 41, and from contact 40 by a wire 49 to wire 5 and the other terminal of secondary 3.

On a demand for heat from the burner, the room thermostat switch will close and relay coil

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32 will be energized, thereby closing contacts 30 and 31 and starting motor 27 and energizing the ignition transformer 29. The heater 39 will also be energized and unless combustion occurs at the burner within a given time, say 60 seconds, for example, the switch 38 will open and stop the motor and the ignition means. If combustion does occur within the given time, then relay coil 9 will be energized and contacts 10 and 11 will engage and close a circuit to stop the heater 39. As shown, contact 10 is connected by a wire 50 to one terminal of the heater 39 and since contact 11 is connected to the other terminal of the heater, the latter will be short circuited by the closing of the contacts 10 and 11.

The relay coil 9, as herein shown, also operates, when energized, to separate contact 11 from a contact 40. This creates a gap in the low voltage supply circuit for the relay coil 32. However, when the latter was energized, it caused a pair of contacts 51 and 52 to engage and close a circuit across said gap by means of the wires 53 and 54. The burner will thus continue in operation until the demand for heat from the burner is satisfied or until the burner is stopped by some safety device, such as the switch 38. Then the relay 32 will be deenergized, causing the contacts 30 and 31 to separate and stop the motor 27 and deenergize the ignition transformer 29 and causing the contacts 51 and 52 to separate. The circuit to relay coil 32 cannot be again closed until the relay coil 9 is deenergized to a sufficient extent to allow contact 11 to engage contact 40. This cannot occur until the resistor 1 cools sufficiently to lower the voltage impressed on the coil 9 of the relay to the "drop-out" voltage of the relay. Thus, after the burner has been stopped, it cannot again be started until the flame-detecting means has cooled enough to be able to properly perform its function.

As above described, the actuator of the combustion-responsive means consists of a direct current relay. Such a relay is preferred to an alternating current relay for the reason that more reliable operation may be had with the low power quantities that are available to operate it in the system described. Since a direct current relay is used, the alternating current is rectified, as by the full-wave copper oxide rectifier 12. Any other suitable rectifying means may be used for the purpose.

The invention provides a combustion-responsive means which is operative without the use of switches and moving parts exposed to the heat of the burner. Such means responds to combustion at the burner by effecting a quick relative change in the impedance of a closed electrical circuit and by this change an actuator is operated to effect the desired work in a burner control system.

I claim:

1. Combustion-responsive means for a burner control system, comprising, a bridge circuit including two inductance coils of similar characteristics and arranged one in each of two separate arms thereof, means for each coil affording a closed magnetic circuit looped through the same, said means including members one for each coil and having similar characteristics, the permeability of each member being rapidly variable by variations in temperature, one such member adapted to be directly exposed to the radiation of heat from a burner and the other being

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shielded from such direct radiation and responsive only indirectly to such heat, a source of electromotive force connected to said bridge circuit, and an electrically-operated actuator connected to the output terminals of the bridge circuit, the changes in permeability of said members effecting changes in the reactances of said coils, the reactances of said coils when their members respond to equal temperatures being such that the voltage at the actuator is insufficient to operate the same, the reactance of that coil whose member is directly responsive to burner heat being changed more rapidly than that of the other coil when combustion occurs and causing the voltage at the actuator to be increased sufficiently to operate the same.

2. Combustion-responsive means for a burner control system, comprising, a bridge circuit including two inductance coils of similar characteristics and arranged one in each of two separate arms thereof, means for each coil affording a closed magnetic circuit looped through the same, said means including two relatively thin diaphragm members one for each coil and having similar characteristics, the permeability of each member being rapidly variable by variations in temperature, one such member adapted to be directly exposed to the radiation of heat from a burner and the other being shielded from such direct radiation and responsive only indirectly to such heat, a source of electromotive force connected to said bridge circuit, and an electrically-operated actuator connected to the output terminals of the bridge circuit, the changes in permeability of said members effecting changes in the reactances of said coils, the reactances of said coils when their members respond to equal temperatures being such that the voltage at the actuator is insufficient to operate the same, the reactance of that coil whose member is directly responsive to burner heat being changed more rapidly than that of the other coil when combustion occurs and causing the voltage at the actuator to be increased sufficiently to operate the same.

3. Combustion-responsive means for a burner control system, comprising, a bridge circuit including two inductance coils of similar characteristics and arranged one in each of two separate arms thereof, magnetic means affording two annular recesses, said coils being mounted one in each said recess, a relatively thin diaphragm member retaining each coil in its recess and co-operating with said means to complete a magnetic circuit through its coil, said members having similar magnetic characteristics and the permeability of each member being rapidly variable by variations in temperature, one such member adapted to be directly exposed to the radiation of heat from a burner and the other being shielded from such direct radiation and responsive only indirectly to such heat, a source of electromotive force connected to said bridge circuit, and an electrically-operated actuator connected to the output terminals of the bridge circuit, the changes in permeability of said members effecting changes in the reactances of said coils, the reactances of said coils when their members respond to equal temperatures being such that the voltage at the actuator is insufficient to operate the same, the reactance of that coil whose member is directly responsive to burner heat being changed more rapidly than that of the other coil when combustion occurs

and causing the voltage at the actuator to be increased sufficiently to operate the same.
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REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
822,323	Thompson	June 5, 1906
1,858,265	Dahlstrom	May 17, 1932

Number	Name	Date
2,139,504	King	Dec. 6, 1938
2,171,955	Sullivan	Sept. 5, 1939
2,223,796	Sparrow	Dec. 3, 1940
2,231,420	Gille	Feb. 11, 1941
2,250,738	Wittmann	July 29, 1941
2,261,343	DeFlorez et al.	Nov. 4, 1941
2,290,091	Brown et al.	July 14, 1942
2,302,320	Hintze et al.	Nov. 17, 1942
2,305,507	Wilson	Dec. 15, 1942
2,324,330	Smith	July 13, 1943