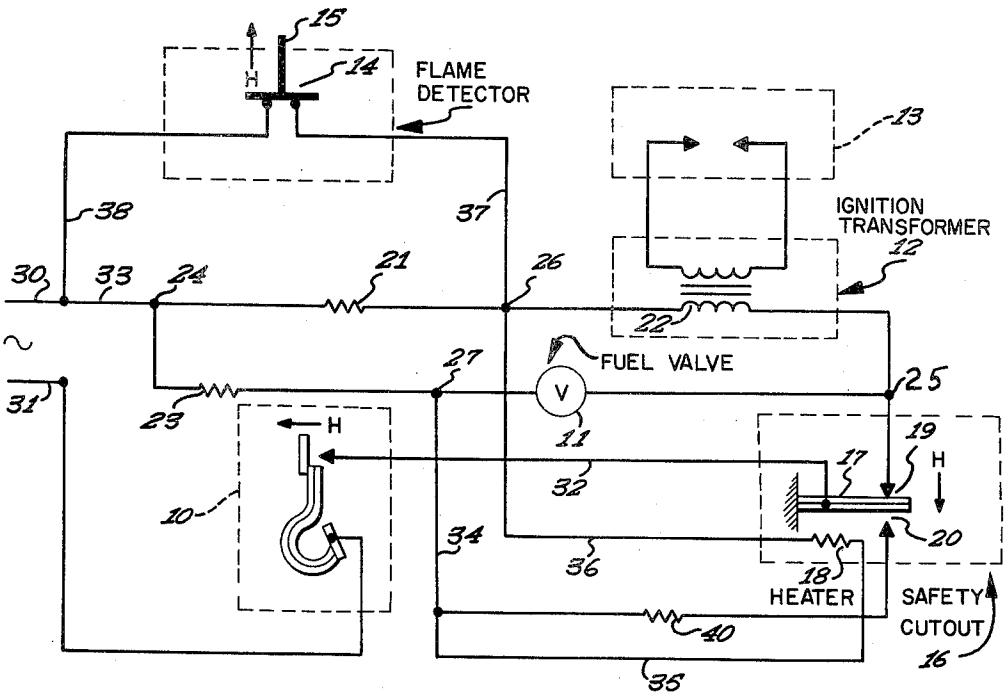
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BURNER CONTROL SYSTEM

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BURNER CONTROL SYSTEM

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This invention is concerned with an improved burner control system and particularly with such a system having a minimum number of components and being constructed and arranged to provide direct ignition of a main burner by the use of line voltage components.

The burner control system of my invention utilizes a unique bridge circuit construction by which an ignition means, in the form of an ignition transformer, and a fuel controller, in the form of a fuel valve, are connected in legs of the bridge circuit, the remaining legs of the bridge circuit being formed of resistors. The energization of the bridge circuit, by way of its input and output terminals, is controlled by a controller switch which is adapted to close upon the need for operation of an associated fuel burner unit, and by a normally closed switch of a safety cutout means having a bimetal and a heater which form a time delayed switch actuator.

A further portion of the bridge circuit includes a normally closed flame switch which is connected in parallel with the resistor bridge leg in series with the ignition transformer bridge leg. Thus, detection of flame is effective to place this resistor in series with the ignition transformer to operatively de-energize the same upon the presence of flame.

The output terminals of the bridge are connected to the heater of the safety cutout means so that unbalance of the bridge is effective to operatively energize this heater. After a time period of heater energization, indicative of a failure to establish or maintain flame, cutout occurs and circuit means are provided to maintain the safety cutout means in this cutout condition by maintaining its heater energized.

My invention will be apparent to those skilled in the art upon reference to the following specification, claims and drawing, of which:

The single figure is a schematic representation of a preferred embodiment of my invention.

Referring to the single figure, reference numeral **10** designates a controller in the form of a thermostat bimetal switch which is responsive to the temperature of an area to be heated by an associated fuel burner, not shown. Upon the temperature of this area dropping, indicating a need for operation of the fuel burner, controller **10** closes its switch.

Closing of controller **10** is effective, as will be apparent, to energize a fuel valve **11** and an ignition transformer **12**. Fuel valve **11** is connected in a fuel conduit, not shown, and is a normally closed fuel valve which is effective when operatively energized to allow fuel to flow to the fuel burner where it is then ignited by means of ignition electrodes **13** connected to the secondary winding of ignition transformer **12**.

A flame detector is shown in schematic form as having a closed switch **14** which is adapted to open on the presence of flame at the burner. An operator **15** is adapted to open switch **14** of the flame detector and this operator may be controlled electrically, as by a relay responsive to a photocell viewing the flame, or may be operated by a bimetal actuator, or similar actuator responsive to the presence of flame at the burner. It suffices to say that switch **14** opens on the presence of flame.

Reference numeral **16** identifies safety cutout means having a bimetal **17**, a heater **18** associated with bimetal **17** to form an actuator, a closed switch **19** and an open switch **20**. Energization of heater **18** for a given time

period is effective to cause bimetal **17** to move in the direction of the arrow labelled H to open switch **19** and close switch **20**.

As I have mentioned, my unique burner control system utilizes an arrangement in the form of a bridge circuit. This bridge circuit can be seen to have a first leg including a resistor **21**, a second leg including the primary winding **22** of ignition transformer **12**, a third leg including a resistor **23**, and a fourth leg including fuel valve **11**. The terminals identified by reference numerals **24** and **25** can be considered to be input terminals of the bridge circuit, whereas the terminals identified by reference numerals **26** and **27** can be considered to be the output terminals of this bridge circuit.

As can be seen, resistor **21** is shorted by flame detector switch **14** when this switch is in a position indicating the absence of flame. Also, the output terminals that is terminals **26** and **27** of the bridge circuit, are connected to opposite terminals of heater **18** of safety cutout means **16**.

The input terminals **24** and **25** of the bridge circuit are connected to a pair of power line conductors **30** and **31** by means of a series circuit which includes the switch of controller **10** and the closed switch **19** of safety cutout means **16**.

Considering the operation of my improved burner control system, a call for operation of an associated fuel burner unit is evidenced by closing of controller **10**. A circuit can now be traced from conductor **31** through controller **10**, conductor **32**, bimetal **17** and switch **19** of safety cutout means **16**, input terminals **25** and **24** of the bridge circuit, and conductor **33** to the other power line conductor **30**.

Fuel valve **11** is energized to "pull in" by way of a circuit which can be traced from bridge input terminal **25** through fuel valve **11**, bridge output terminal **27**, conductors **34** and **35**, safety cutout means heater **18**, conductor **36**, bridge output terminal **26**, conductor **37**, closed flame detector switch **14**, and conductor **38** to power line conductor **30**.

The primary winding **22** of ignition transformer **12** is operatively energized, to produce sparking at electrodes **13**, by way of a circuit which can be traced from bridge input terminal **25** through primary winding **22**, bridge output terminal **26**, conductor **37**, flame detector switch **14**, and conductor **38** to power line conductor **30**.

It should also be noted that circuits can be traced from bridge input terminal **25** to power line conductor **30** by way of fuel valve **11** and resistor **23**, and by way of primary winding **22** and resistor **21**. However, the impedance magnitude of the resistors **23** and **21**, respectively, are such that while limited electrical energization is applied to both the fuel valve and the ignition transformer through these circuits, the fuel valve and the ignition transformer are not operatively energized by way of these circuits. Operative energization of transformer **12**, and "pull in" of valve **11** requires that flame detector switch **14** be closed to establish the first above traced circuits.

More particularly, the impedance value of resistor **23**, connected in circuit with fuel valve **11**, is such as to maintain the fuel valve operatively energized, or "pulled in," once it is initially "pulled in" by means of the first above traced circuit. The impedance value of resistor **21** is such that opening of flame detector switch **14** operatively de-energizes ignition transformer **12** to interrupt the sparking at electrodes **13** thereof.

Referring again to the initial energizing circuit of fuel valve **11**, this initial energizing circuit includes in series therewith heater **18** of safety cutout means **16** to operatively energize this heater. Since fuel is supplied to the burner and ignition transformer **12** is energized, flame is normally established at the burner within a short time period, shorter than the timing period of safety cutout

means 16. Flame detector switch 14 then opens. The opening of this switch places resistor 21 in series with primary winding 22 of ignition transformer 12, and as above mentioned, operatively de-energizes this ignition transformer. Also, the opening of flame detector switch 14 now causes fuel valve 11 to be maintained operatively energized through a circuit which can be traced from the bridge input terminal 25 through the fuel valve, bridge output terminal 27, resistor 23, bridge input terminal 24, and conductor 33 to power line conductor 30. As has been mentioned, this circuit supplies sufficient electrical energy to the fuel valve to maintain the fuel valve energized, but not of a magnitude to initially operatively energize the fuel valve.

Heater 18 of safety cutout means 16 is connected across the output terminals 26 and 27 of the bridge circuit formed of the components 21, 22, 23 and 11. Once flame is detected, the bridge circuit is substantially balanced and heater 18 is operatively de-energized. This is the running condition of my improved burner control system.

If a flame failure is consequently experienced, flame detector switch 14 closes and the above described initial conditions are re-established whereby ignition transformer 12 is again energized and the bridge is unbalanced to the extent that safety cutout means heater 18 is now energized.

If flame is not subsequently re-established, safety cutout means 16 is effective, after a time period of energization of heater 18, to open switch 19 and close switch 20.

The opening of switch 19 disconnects the bridge input terminal 25 from the source of voltage 30–31.

The closing of switch 20 completes a series circuit which now connects the bridge output terminals 26 and 27 to power line conductors 30 and 31. Since heater 18 is connected directly to these output terminals 26 and 27, heater 18 is likewise connected to the power line conductors 30 and 31. This can be seen by tracing a circuit from power line conductor 31 through controller 10, conductor 32, bimetal 17 and switch 20 of safety cutout means 16, a resistor 40, conductor 34, bridge output terminal 27, bridge output terminal 26, conductor 37, flame detector switch 14, and conductor 38 to power line conductor 30. Since heater 18 is directly connected to the bridge output terminals 26 and 27, heater 18 is maintained energized by way of this above traced circuit, resistor 40 functioning as a current limiting resistor. Thus safety cutout means 16 is maintained in an actuated or "cutout" condition, with switch 19 open and switch 20 closed. To reset safety cutout means 16 to the starting condition, it is necessary that controller 10 be manually opened for a time period sufficient to allow bimetal 17 to cool and again close switch 19 and open switch 20. The apparatus is then in a condtion to again attempt to establish flame at the fuel burner. Thus, it is possible to reset safety cutout means 16 from a remote position, since electrical reset is provided.

From the above description, it can be seen that I have provided a unique burner control system wherein an ignition transformer and a fuel valve are connected in legs of a bridge circuit including limiting resistors, and wherein the bridge output terminals are connected to energize safety cutout means with switches of the safety cutout means and a flame detector switch being interconnected in the bridge circuit to provide safe and reliable operation of an associated fuel burner unit.

Modifications of my invention will be apparent to those skilled in the art and it is thus intended my invention be limited solely by the scope of the appended claims.

I claim as my invention:

1. Burner control apparatus in the form of a bridge circuit having first, second, third and fourth legs, and having input and output means, comprising; a pair of input terminals; a first resistor and ignition means connected in series between said input terminals to form the first and second legs of the bridge circuit with the interconnection point being a first output terminal, a closed flame switch connected in parallel with said first resistor and movable to an open position in the presence of flame; a second resistor and a fuel valve connected in series between said input terminals to form the third and fourth legs of the bridge circuit with the interconnection point being a second output terminal; time delayed safety cutout means having a closed switch and a time delayed actuator adapted to open said switch after a time period of energization of said actuator; circuit means connecting said safety cutout means actuator between said first and second output terminals; and circuit means including said safety cutout means switch connecting said pair of input terminals to a source of voltage.

2. Burner control apparatus in the form of a bridge circuit having first, second, third and fourth legs, and having input and output means, comprising; a pair of input terminals; a first resistor and the primary winding of an ignition transformer connected in series between said input terminals to form the first and second legs of the bridge circuit with the interconnection point being a first output terminal, a closed flame switch connected in parallel with said first resistor and movable to an open position in the presence of flame; a second resistor and a fuel valve connected in series between said input terminals to form the third and fourth legs of the bridge circuit with the interconnection point being a second output terminal; time delayed safety cutout means having a closed switch, an open switch, and a time delayed actuator adapted to actuate said switches after a time period of energization of said actuator; circuit means connecting said safety cutout means actuator between said first and second output terminals; circuit means including in series a switch controller and said safety cutout means closed switch connecting said pair of input terminals to a source of voltage; a third resistor, and circuit means including in series said switch controller, said third resistor, said flame switch, and said safety cutout means open switch connecting said first and second output terminals to a source of voltage upon failure to establish flame during said time period.

3. Burner control apparatus for use with a fuel burner installation having an electrically energizable normally closed valve to control the flow of fuel to a burner, and having electrically energizable ignition means associated with the burner to directly ignite the fuel, the apparatus being characterized as a bridge circuit having input terminals "*a*" and "*b*" and output terminals "*c*" and "*d*," the apparatus comprising: a flame detector having a normally closed switch adapted to open upon the establishment of flame at the burner, a safety switch having an electrically energizable time delay actuator and a normally closed switch controlled thereby, circuit means connecting a first resistor between bridge terminals "*a*" and "*d*" to form a first leg of the bridge circuit, circuit means adapted to connect the valve between bridge terminals "*d*" and "*b*" to form a second leg of the bridge circuit, ciruit means adapted to connect the ignition means between bridge terminals "*b*" and "*c*" to form a third leg of the bridge circuit, circuit means connecting a second resistor and the normally closed switch of said flame detector in parallel between bridge terminals "*c*" and "*a*" to form a fourth leg of the bridge circuit, circuit means connecting said safety switch actuator between bridge terminals "*c*" and "*d*," and circuit means including the normally closed switch of said safety switch adapted to connect bridge terminals "*a*" and "*b*" to a source of electrical voltage.

4. Burner control apparatus for use with a fuel burner installation having an electrically energizable normally closed valve to control the flow of fuel to a burner, and having electrically energizable ignition means associated with the burner to directly ignite the fuel, the apparatus being characterized as a bridge circuit having input terminals "*a*" and "*b*" and output terminals "*c*" and "*d*,"

the apparatus comprising: a flame detector having a normally closed switch adapted to open upon the establishment of flame at the burner, a safety switch having an electrically energizable time delay actuator and a normally closed and a normally open switch controlled thereby, circuit means connecting a first resistor between bridge terminals "*a*" and "*d*" to form a first leg of the bridge circuit, circuit means adapted to connect the valve between bridge terminals "*d*" and "*b*" to form a second leg of the bridge circuit, circuit means adapted to connect the ignition means between bridge terminals "*b*" and "*c*" to form a third leg of the bridge circuit, circuit means connecting a second resistor and the normally closed switch of said flame detector in parallel between bridge terminals "*c*" and "*a*" to form a fourth leg of the bridge circuit, circuit means connecting said safety switch actuator between bridge terminals "*c*" and "*d*," circuit means including the normally closed switch of said safety switch adapted to connect bridge terminals "*a*" and "*b*" to a source of electrical voltage, and circuit means including a third resistor and the normally open switch of said safety switch in series adapted to connect bridge terminals "*a*" and "*d*" to the source of electrical voltage.

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