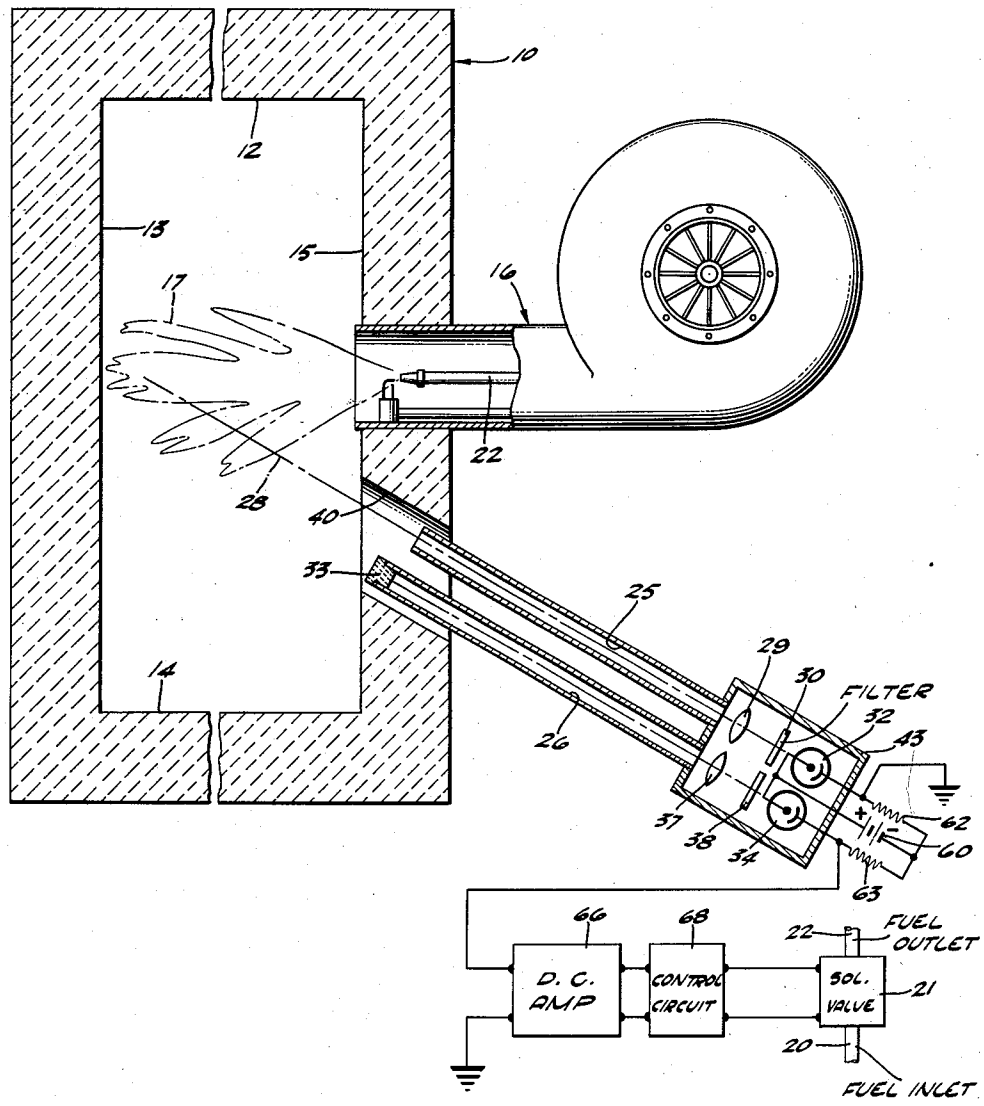
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FLAME RESPONSIVE DEVICE USING PLUGGED COMPENSATORY TUBE

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FLAME RESPONSIVE DEVICE USING PLUGGED COMPENSATORY TUBE

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The present invention relates to means and techniques for detecting the presence of a flame and for controlling the flow of fuel to such flame.

The problem of detecting the presence of a flame in a furnace gives rise to certain difficulties, mainly, because the radiation from the heated walls of the furnace may, unless certain precautions are taken, have the same effect as the radiation from the flame itself, with the result that a false indication may be produced, leading to the creation of a dangerous situation.

Briefly, the present invention relates to improved means and techniques for producing an indication or control which takes into account the radiation from the heated furnace walls as well as the radiation from the flame, by establishing a certain "differential effect", such differential effect being essentially in accordance with the difference in radiation, due on the one hand, to the flame itself and, on the other hand due to a body heated by the flame.

For this purpose two photocells are provided, one to receive radiation from the flame and furnace wall, and the other photocell being arranged to receive radiation from a body which is heated by the flame to a temperature comparable to the temperature of the furnace wall. The radiations as "measured" by the two photocells are electrically subtracted so as to produce a net result, i. e., a net voltage which has a relatively large value when a flame is present and which has a relatively small value or "zero" value when there is no flame, such net voltage being amplified and used to produce either an indication or to control the flow of fuel to the flame.

It is, therefore, a general object of the present invention to provide means and techniques of the character indicated above.

A specific object of the present invention is to provide improved means and techniques of this character which requires no moving elements.

Another specific object of the present invention is to provide improved means and techniques of this character which requires the use of only one relatively small viewing aperture in the furnace wall.

Another specific object of the present invention is to provide means and techniques of this character which is relatively insensitive to sporadic fluctuations in intensity of the flame.

The features of the present invention which are believed to be novel are set forth with particularity in the appended claims. This invention itself, both as to its organization and manner of operation, together with further objects and advantages thereof, may be best understood by reference to the following description taken in connection with the accompanying drawings in which:

The single figure of the drawing illustrates a conventional furnace with associated conventional flame-producing means with apparatus embodying the features of the present invention, the apparatus being shown partly in structural form and partly in schematic form.

The furnace **10** is of conventional construction and is considered to be lined with firebrick and is defined by

the four walls **12, 13, 14** and **15**. The conventional flame-producing means **16** serves to produce the flame **17**, such flame-producing means being supplied with fuel which normally flows from the fuel inlet **20** through the solenoid valve **21** to the fuel outlet **22**, such outlet being deemed to be in communication with the conventional apparatus **16**.

The flame **17** may be considered as that being due either to the burning of oil or to the burning of gas.

Two radiation channels are provided, namely, radiation channels **25** and **26** in the form of tubes. The tube **25** is oriented so as to receive the radiation not only from the flame **17**, but also from the heated furnace wall **13** along a path indicated by the line **28**, such radiation being focused by a condensing lens **29** and applied through a suitable filter **30** onto the photocell **32**. The other radiation tube **26** has one of its ends closed by a circular refractory plug **33** and the other one of its ends in communication with the photocell **34**. A lens **37** and filter **38** are optically disposed in that order, between the tube **26** and the photocell **34**.

The plug **33** of refractory material is heated to an incandescent state by the flame **17** to substantially the same temperature as the temperature of the furnace wall. Both tubes **25, 26** extend into the same opening **40** in the furnace wall. The various lenses, filters and photocells are enclosed within a light-tight rectangular box **43**, such box, of course, being in communication with the open ends of tubes **25** and **26**.

The photocell **32** is energized electrically to produce an electrical quantity which represents the combined radiation of the flame and the furnace wall; while the photocell **34** is energized electrically to produce an electrical quantity which represents the radiation from the furnace wall itself, it being assumed that for all practical purposes the plug **33** may be considered to represent the furnace wall itself.

In order to achieve the aforementioned differential effect, the electrical outputs of the two photocells **32** and **34** are subtracted and it is understood, that while different means may be employed to obtain such subtraction, the bridge circuit as now described is preferred. The anode of both tubes **32** and **34** are each connected to the positive terminal of source **60** which has its negative terminal connected to the cathodes of tubes **32** and **34** through resistances **62** and **63**, respectively. The cathode of tube **32** is grounded while the cathode of tube **34** is connected to the ungrounded input terminal of the direct current amplifier **66**. The output of the amplifier **66** is applied to conventional control circuit **68** which includes a relay for controlling the energization of the solenoid valve **21**.

It is understood that in the presence of a flame, the solenoid valve **21** is energized to allow the flow of fuel to the burner **16**; and, when the flame **17** is extinguished for any reason whatsoever, the solenoid valve **21** is de-energized to allow the spring means normally associated with conventional solenoid valves of this character to interrupt the flow of fuel to the burner or flame-producing means **16**.

It is observed that the voltage developed across the resistance **62** is representative of the radiation from both the flame **17** and a body heated by such flame, i. e., the wall **13**; and that the voltage across the resistance **63** is representative of the radiation received from a body heated by the flame, namely, the body or plug **33**. These two electrical quantities developed across resistances **62** and **63** are effectively compared and their resultant, a third electrical quantity is applied to the input terminals of the amplifier **66** to control the flow of fuel to the flame or to the flame-producing means **16**.

While the particular embodiments of the present in-

vention have been shown and described, it will be obvious to those skilled in the art that changes and modifications may be made without departing from this invention in its broader aspects and, therefore, the aim in the appended claims is to cover all such changes and modifications as fall within their scope.

I claim:

1. In apparatus for detecting the presence of a flame, means for producing said flame, an enclosure having a body heated by said flame, said enclosure having a single aperture therein through which conditions in said enclosure may be determined, a first light tube aligned with said aperture and with said flame and said body, a second light tube aligned with said aperture, one end of said second light tube being plugged by a body heated by said flame, first photocell means in communication with said first light tube for producing an electrical quantity representative of the radiation from said flame and said body, second photocell means in communication with said second tube for receiving radiation from said body which plugs said second light tube, said second photocell means producing an electrical quantity representative of the radiation from said body plugging said second tube, means for comparing the first and second electrical quantities to derive a third electrical quantity, means controlling the flow of fuel to said flame producing means in accordance with the said third electrical quantity.

2. In apparatus for detecting the presence of a flame, means for producing said flame, an enclosure having a body heated by said flame, said enclosure having a viewing aperture, a first light tube for viewing said flame and said body, a second light tube aligned with said aperture, a plug in said second light tube and heated by said flame, means responsive to the radiation transmitted through said first and second tubes and controlling the flow of fuel to said flame producing means.

3. In apparatus for detecting the presence of a flame, means for producing said flame, an enclosure having a body heated by said flame, a pair of light tubes, one of said light tubes viewing said flame and said body heated by said flame, the other light tube having a plug near one end thereof and heated by said flame, and means sensitive to the radiation transmitted through both said tubes for controlling the flow of fuel to said flame producing means.

4. Apparatus as set forth in claim 1 in which the last-mentioned means cuts off the flow of fuel to the flame upon extinguishment of the flame.

5. Apparatus as set forth in claim 2 in which the last-mentioned means cuts off the flow of fuel to the flame upon extinguishment of the flame.

6. Apparatus as set forth in claim 3 in which the last-mentioned means cuts off the flow of fuel to the flame upon extinguishment of the flame.

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