Nov. 19, 1963 F. M. MELLETTE 3,111,160

MULTIPLE BURNER MONITOR

Filed Nov. 6, 1961 2 Sheets-Sheet 1

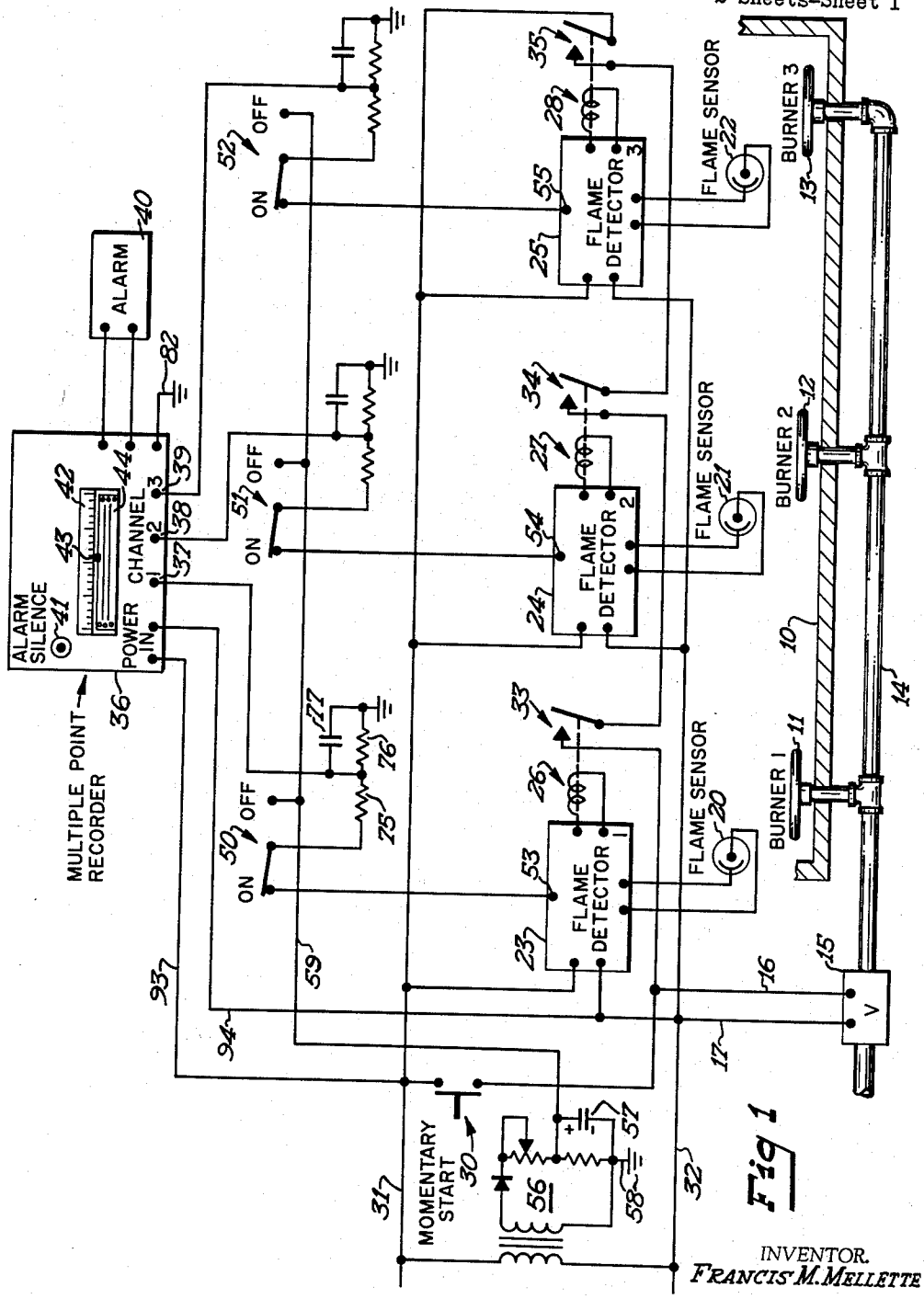

Fig 1

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2 Sheets-Sheet 2

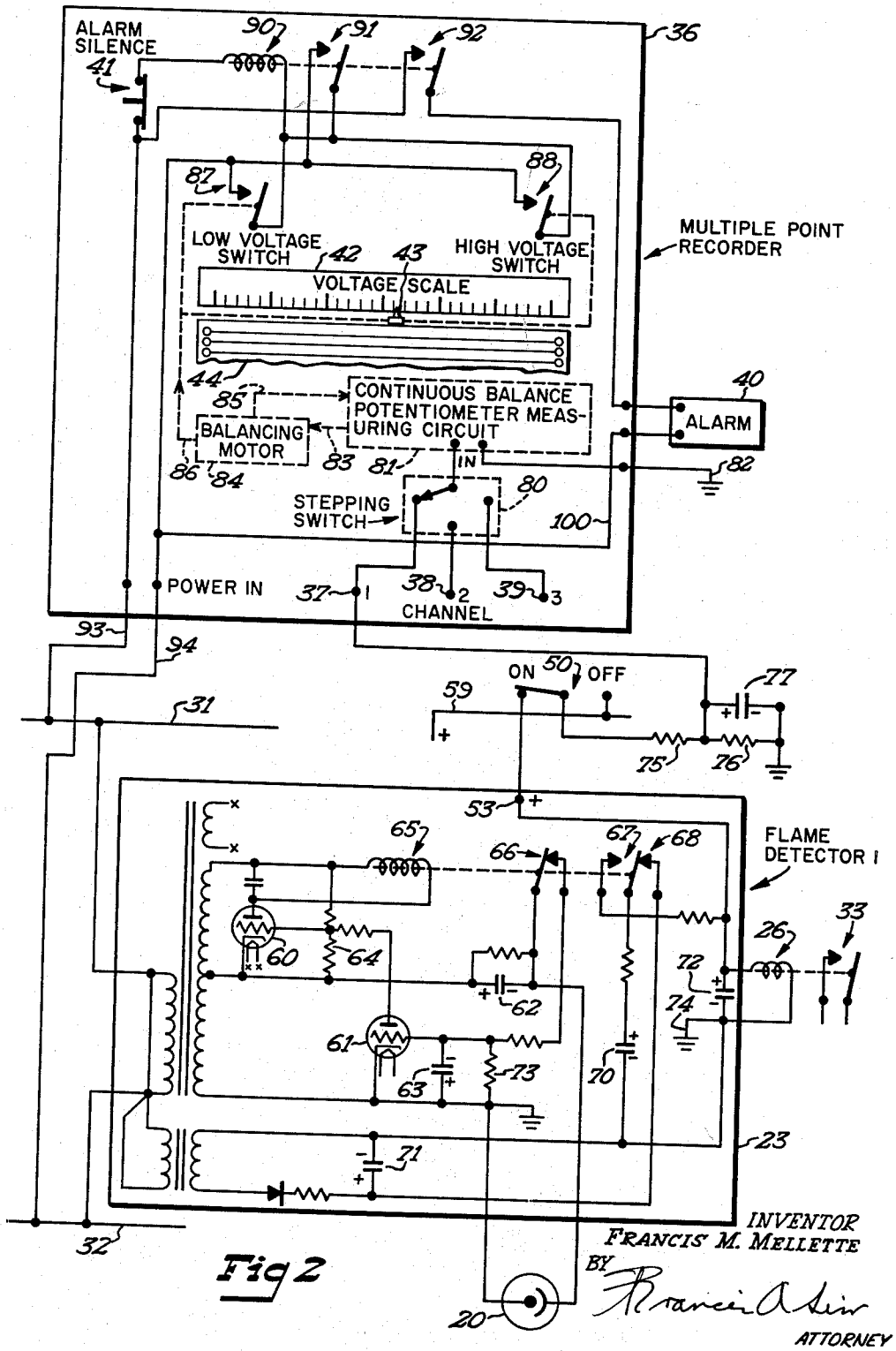

Fig 2

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3,111,160

MULTIPLE BURNER MONITOR

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The present invention is concerned with a multiple burner monitor system for safely monitoring the operation of a fuel burner installation having a plurality of individual fuel burners.

The monitoring of hazardous fuels such as gas, oil or powdered coal, used in large industrial electrical power stations or process installations has employed various combinations of electrical and electronic components such as relays, timers and electronic amplifying circuits. These units are coordinated to program the safe and efficient burning of such hazardous fuels in industrial applications of this type wherein the burner installation, having a number of individual burners, is continuously operated for extensive periods of time without shutdown. Once the burners are lit, either automatically or manually, the continuous safe operation of each of the burners is monitored by its own individual flame detector, preferably an electronic flame detector utilizing amplification type circuits whose input is controlled by a flame sensing means, for example a photocell, and whose output constitutes a flame relay maintained in a particular condition in the presence of flame.

As is well known, electrical and electronic components have an uncertain life expectancy and can be expected to fail. Thus, there is a need for surveillance to determine an impending failure of such components. Such a failure may be a safe failure, or an unsafe failure. A safe failure is of the type wherein the failure causes a false sensing of the absence of flame. This is a safe failure since the sensing of the absence of flame, while false, results in the shutdown of the burner installation. This shutdown can, however, be characterized as a nuisance shutdown, and in the case of industrial power stations or processes this nuisance shutdown can be quite costly.

The other type of component failure which may exist is an unsafe failure which renders the electronic flame detector incapable of sensing a subsequent flame failure, that is, the false sensing of the presence of flame. The flame detector then continues to indicate the presence of flame even though the flame may in fact no longer exist. This type of failure is characterized as an unsafe failure since raw fuel is continuously fed to the burner which no longer supports a flame. An explosive accumulation of fuel may then result in an explosion.

The multiple burner monitor of my invention provides means for automatically sensing impending failure of electrical or electronic components of a flame detector to thus initiate an indication of an alarm signal in time to allow the flame detector suspected of malfunction to be replaced by a new flame detector, to thus avoid both the nuisance shutdown of the burner system and the more disastrous condition of an unsafe failure which may lead to an explosion.

Specifically, I provide a multiple burner monitor wherein an individual flame detector is associated with each of a plurality of fuel burners and the flame relays of the flame detectors are so interconnected as to interrupt the supply of fuel to all of the fuel burners in the event that a flame failure is sensed at any one of the burners. Furthermore, I provide a multiple point recorder which sequentially checks or monitors an electrical signal at each of the individual flame detectors, which electrical signal is indicative, when it lies outside the limits of a particular range, of an impending component failure. The

multiple point recorder records on a chart the individual signal of each of the plurality of flame detectors and incorporates a low signal switch and a high signal switch. In the event that either the high signal switch or the low signal switch is actuated, this indicating that the particular flame detector is approaching a component failure condition, an alarm is energized. The attendant at the multiple burner station can then review the chart record of the multiple point recorder and determine which of the many burners must have its flame detector replaced. To replace this flame detector, I provide manual switch means which may be switched to provide a reference signal to replace the signal normally received from this particular flame detector, the magnitude of this reference signal being within the range indicating proper operation of the flame detector. Thus, the alarm can be silenced and remains silent while the multiple point recorder continues the sequential monitoring of the plurality of individual flame detectors, while the attendant replaces the flame detector that is approaching a defective condition.

Thus, with the construction of my invention, both the nuisance shutdown and the explosive condition possible from the above described safe and unsafe failure of the flame detector is avoided.

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

FIGURE 1 is a schematic representation of a multiple burner system incorporating my invention, and

FIGURE 2 is a further schematic representation showing the details of the construction of one of the flame detectors of FIGURE 1 and of the multiple point recorder of FIGURE 1.

Referring specifically to FIGURE 1, the multiple burner system is disclosed as being provided with a fire box represented in part by the wall portion **10**. Supported within the fire box are three individual fuel burners **11**, **12** and **13**, also identified as burner **1**, burner **2** and burner **3**. Fuel is supplied to the burners from a common fuel supply conduit **14** having a normally closed electrically energizable valve **15** connected to receive electrical energy from conductors **16** and **17** connected thereto.

Associated with each of the burners is an individual flame sensor, identified by reference numerals **20**, **21** and **22**. These flame sensors may constitute photocells which are sensitive to the electromagnetic radiation given off by a flame present at its individual burner. The individual flame sensors are connected to flame detectors identified by reference numerals **23**, **24** and **25**. These flame detectors may preferably be of the electronic type having electron discharge devices constituting amplifying devices wherein the input is controlled by the flame sensor and the output constitutes a flame relay, each flame detector having its individual flame relay identified by reference numerals **26**, **27** and **28** respectively.

While a multiplier burner system of this type disclosed in FIGURE 1 may have a complex interconnection of relays and timers, I have disclosed a relatively simple arrangement. It is to be recognized, however, that my invention is applicable to the more detailed constructions. Reference numeral **30** identifies a momentary contact start switch which, when closed, is operative to connect valve **15** across power line conductors **31** and **32** by means of a circuit which can be traced from power line conductor **31** through switch **30**, conductor **16**, valve **15**, and conductor **17** to conductor **32**. The flame relays **26**, **27** and **28** are each provided with a normally open switch **33**, **34** and **35** respectively. These switches are adapted to be moved to a closed condition upon energization of their respective flame relays. As can be seen from FIGURE 1, the switches

33, 34 and 35 are connected in series and this series connection is connected in parallel to the momentary start switch 30. To initiate burner operation, the momentary start switch 30 is closed to admit fuel to the individual burners. The individual burners are then lit, either by means of a standing pilot, not shown, or they are lit manually. In any event, once the burners are lit, the momentary start switch 30 can be released and valve 15 is maintained energized by virtue of the circuit including the switches 33, 34 and 35 connected in series. Thus, should one of the electronic flame detectors sense the absence of flame at its individual burner at some time subsequent to this, the circuit to valve 15 is opened and the flow of fuel to all of the burners is interrupted.

Thus far, I have disclosed a more or less conventional multiple burner system. As pointed out above, one of the features of my invention is the use of a multiple point recorder, identified by means of reference numeral 36. This multiple point recorder is provided with a plurality of input channels, identified by reference numerals 37, 38 and 39, and also as channels 1, 2 and 3. Also, the multiple point recorder 36 is provided with an output including an indicator or alarm device 40 and an alarm silence switch 41, this switch being of the momentary push button type. The recorder also includes a scale member 42, which may be calibrated in terms of voltage. Cooperating with this scale is a movable indicating recorder head 43 adapted to print a recording image for each of the three channels upon a strip chart 44.

Reference numerals 50, 51 and 52 identify a plurality of manual switch means having a first position designated as "on" and a second position designated as "off." With the switch means 50, 51 and 52 in the "on" position the individual input channels of multiple point recorder 36 are connected to terminals 53, 54 and 55 respectively of the individual flame detectors. As will be apparent upon reference to FIGURE 2, the voltage or electrical signal present at the terminals 53, 54 and 55 is of a magnitude indicative of the state of operation of the individual electronic flame detector. So long as the magnitude of this voltage or signal lies within a predetermined range, that particular electronic flame detector is operating properly. However, should the magnitude of this voltage or signal change to a value either below or above this range, this magnitude of voltage indicates that an impending component failure is approaching with regard to that particular electronic flame detector. This impending component failure may take place by virtue of the gradual change of an electrical component such as a capacitor connected in the flame detector circuit. Also, such a component failure may occur as a result of the loss of emission of the cathode surface of an electronic discharge device incorporated within the flame detector. In any event, regardless of the reason for the impending component failure, it is necessary for safe operation that this electronic flame detector be replaced by an electronic flame detector which operates properly.

In order to accomplish the changing of a flame detector, the switch 50, 51 or 52 associated with the flame detector to be replaced is moved to the "off" position. In this position the particular input to the multiple point recorder is connected through a capacitor resistor network to a reference voltage source identified by means of reference numeral 56. This reference voltage source is constructed and arranged to provide a D.C. voltage across a capacitor 57, the negative terminal of which is grounded at 58 and the positive terminal of which is applied to a conductor 59, this conductor being connected to the "off" contact of each of the switches 50, 51 and 52.

Referring now to FIGURE 2, I have disclosed in greater detail the interconnection of flame detector 1, also identified by means of reference numeral 23, and the multiple point recorder 36. The electronic flame detector 23 may be of the type manufactured by the Minneapolis-Honeywell Regulator Company and identified as type No. R4075A. The multiple point recorder may be of the type manufactured by the Brown Instruments Division of the Minneapolis-Honeywell Regulator Company and identified by the type No. Series 153.

Turning first to electronic flame detector 23, this electronic flame detector incorporates a pair of electron discharge devices 60 and 61 interconnected in amplifying circuit fashion. The input of discharge device 61 is connected to receive an electrical signal from a circuit which is connected to photocell 20. Photocell 20 is a rectification type photocell and is effective, upon being subjected to flame, to provide a D.C. voltage at capacitor 62, this voltage being of the polarity indicated. The voltage on this capacitor is applied to a further capacitor 63 connected at the input of discharge device 61. Considering first the interconnection of discharge devices 60 and 61, when flame is not present at the associated fuel burner 11, discharge device 61 is conductive to apply a control voltage across a resistor 64, this control voltage being such as to render discharge device 60 nonconductive. The output of discharge device 60 includes a cycling relay 65 having switches 66, 67 and 68. With relay 65 de-energized, as it is when discharged 60 is nonconductive, switch 66 is closed to connect capacitor 62 to capacitor 63. Also, switch 68 is closed and a capacitor 70 is connected to be charged from a D.C. source constituted by a further capacitor 71.

If a flame is sensed by photocell 20, capacitor 62 is charged, as above described, and this charge is transferred to capacitor 63 to render discharge device 61 nonconductive. With discharge device 61 nonconductive, the control input signal across resistor 64 is no longer effective to maintain discharge device 60 nonconductive and this discharge device becomes conductive to energize its output relay 65. Energization of relay 65 opens switches 66 and 68 and closes switch 67. The closing of switch 67 causes the charged capacitor 70 to discharge into and to thus charge a further capacitor 72, capacitor 72 being connected across flame relay 26. The opening of switch 66 disconnects capacitor 62 from capacitor 63, and thus capacitor 63 is allowed to discharge across a resistor 73, this discharge proceeding to the point where discharge device 61 is again rendered conductive to render discharge device 60 nonconductive. Thus, switch 67 opens and switches 66 and 68 close. The closing of switch 68 again allows capacitor 70 to charge, and the closing of switch 66 again allows capacitor 63 to charge from capacitor 62. In this manner, relay 65 continues to cycle, alternately causing capacitor 72 to be charged from capacitor 70 and thus maintain flame relay 26 continuously energized so long as cycling relay 65 continues to cycle. As can be seen from FIGURE 2, terminal 53 of electronic flame detector 23 is connected to the upper positive terminal of capacitor 72, the lower negative terminal being grounded at 74. This voltage present on capacitor 72 is supplied to the resistor-capacitor network including resistors 75 and 76 and capacitor 77 to thus charge capacitor 77 from capacitor 72, the charge being of the polarity indicated in FIGURE 2. In this manner, so long as the manual switch means 50 is in the "on" position, the positive voltage present at capacitor 77 is applied to the channel 1 terminal 37 of the multiple point recorder 36.

While the above description deals with the single electronic flame detector 23, this description applies equally well to the electronic flame detectors 24 and 25, each of these flame detectors having a terminal 54 and 55 respectively corresponding to terminal 53 of electronic flame detector 23. Each electronic flame detector also has associated with it a resistor capacitor network connected to the manual switch means to apply a positive voltage to the channels 2 and 3 terminals respectively, these channels having terminals identified by reference numerals 38 and 39.

Turning now to a description of the multiple point

recorder 36, this recorder includes components which are represented in a diagrammatic form, it being recognized that the detailed construction of the multiple point recorder 36 does not add to the understanding of the details of the present invention. Specifically, the multiple point recorder 36 incorporates a stepping switch 89 which sequentially connects the input of a continuous balance potentiometer circuit 81 to the input channels of the multiple point recorder. The construction of the continuous balance potentiometer measuring circuit is such as to measure the electrical signal or voltage present at the particular input channel then connected to the input of the measuring circuit by means of the stepping switch, this potential existing between the terminals 37, 38 or 39 and a ground or reference potential established by connection 82. The measuring circuit includes an electrical output identified by the broken line 83 which is connected to control a balancing motor 84 to reversibly energize this balancing motor 84 to cause it to run in one direction or the other, depending upon the condition of unbalance of the measuring circuit. The balancing motor is mechanically connected by virtue of the broken line 85 to establish a rebalance of the measuring circuit, that is, to bring the measuring circuit to a condition of balance at a new position of motor 84, this position being indicative of the input voltage then applied to the measuring circuit. Motor 84 is also connected by virtue of the broken line 86 to control the position of the recording head 43 cooperating with the voltage scale 42 and the strip chart 44. The mechanical connection 86 also controls a low voltage switch 87 and a high voltage switch 88. The switches 87 and 88 are normally open switches and are adapted to be closed upon the recording head 43 being driven to a predetermined low voltage position or to a predetermined high voltage position respectively. The construction of the multiple point recorder 36 is such that the relative positions at which the switches 87 and 88 are actuated may be adjusted, and for the purpose of my invention these switches are adjusted to establish the high and low limits of a predetermined range of voltages in which it is known that the electronic flame detector 23 is operating properly. However, should the voltage present at terminal 53 of electronic flame detector 23 drop to a value below this range or rise to a value above this range, then the low voltage switch 87 or the high voltage switch 88 respectively will be closed to indicate that an impending malfunction of electronic flame detector 23 exists. Furthermore, the multiple point recorder 36 is constructed and arranged such that the recording head 43 prints individually identified records on the strip chart 44 for each of its input channels. Thus, the operator of the multiple burner installation may refer to the strip chart 44 to determine which of the input channels and thus which of the electronic flame detectors 23 has the impending component failure condition existing.

Connected in circuit with the switches 87 and 88 is a relay 90 having a holding switch 91 and an alarm energizing switch 92. The energizing circuit for relay 90 can be seen by tracing a circuit from power line conductor 31 through conductor 93, alarm silence switch 41, relay 90, low voltage switch 87 in parallel with low voltage switch 88, and conductor 94 to power line conductor 32.

Considering now the over-all operation of my invention, it will be assumed that a flame has properly been established at the burners 1, 2 and 3, also identified by reference numerals 11, 12 and 13. This flame is properly sensed by flame sensors 20, 21 and 22 and thus flame relays 26, 27 and 28 are in an energized condition to maintain the energizing circuit for valve 15. As has been explained, this condition may exist for a very long period of time and during this time the multiple point recorder 36 continuously causes the voltage present at terminals 53, 54 and 55 of the flame detectors 23, 24 and 25 to be sequentially read and recorded on the strip chart 44. During this period of time, and for each of the individual input channels, the measuring circuit 81 is effective to control balancing motor 84 to cause a rotation of this motor to a position to indicate the voltage being read on the particular channel and to also rebalance the measuring circuit. The recording head 43 is accordingly driven to the appropriate voltage scale position and the appropriate symbol is printed on the chart 44, this symbol being coordinated with the particular channel then being measured.

If it is assumed that an electrical component within a particular electronic flame detector changes its characteristics, possibly by virtue of the aging of the component, so as to cause the voltage across its flame relay to change appreciably, this voltage is sensed at the respective terminals 53, 54 or 55, in the manner described in connection with FIGURE 2 and capacitor 72. The measuring circuit 81 controls balancing motor 84 to drive the recording head 43 to a position to close either the low voltage switch 87 or the high voltage switch 88, depending upon the type of component failure which is being approached. In any event, the relay 90 is energized and upon being energized its switch 91 maintains this relay in an energized condition, switch 91 being connected in parallel with the parallel connected switches 87 and 88. Energization of relay 90 also causes its switch 92 to close and a circuit is then established to energize the alarm 40, this circuit being traced from power line conductor 31 through conductor 93, switch 92, alarm 40, conductor 100, and conductor 94 to power line conductor 32.

The multiple point recorder 36 continues to monitor the various electronic flame detectors in a sequential fashion under the control of stepping switch 89 and thus when the stepping switch moves on to the next channel, the recording head 43 again moves to the proper voltage range, it being assumed that the next succeeding electronic flame detector to be checked does not have an impending component failure. However, by virtue of the switch 91 of relay 90, relay 90 is maintained energized and alarm 40 continues to sound, calling the attendant's attention to the fact that one of the electronic flame detectors has an impending component failure. The attendant may then review the strip chart 44 to determine which of the electronic flame detectors should be replaced. The manual switch associated with this flame detector, for example, switch 59 associated with flame detector 23, is placed in the "off" position to connect the input channel of the multiple point recorder for this particular electronic flame detector to conductor 59, the positive reference voltage. Thus, the next time that the multiple point recorder 36 is connected to the particular flame detector being replaced, a reference voltage having a magnitude within the proper range is applied so that the alarm will not again sound. After the electronic flame detector has been replaced, the manual switch is again placed in an "on" position so that the multiple point recorder 36 may monitor this replaced flame detector for an impending component failure.

Other modifications of the present invention will be apparent to those skilled in the art and thus it is intended that the scope of the present invention be limited solely by the scope of the appended claims.

I claim as my invention:

1. Multiple burner monitor apparatus for use with a multiple fuel burner installation, comprising; a plurality of electrically operable flame detectors one of which is adapted to be associated with each burner and to be effective to sense the presence or absence of flame thereat, recorder means, means sequentially connecting said recorder means to each of said plurality of flame detectors to measure an electrical voltage characteristic thereof the magnitude of which is indicative of the operativeness of the flame detector and may be indicative of an impending component failure within the flame detector, indicator

means, and means connecting said indicator means to said recorder means to be controlled by said voltage characteristic and thereby to indicate such an impending component failure.

2. Multiple burner monitor apparatus for use with a plurality of fuel burners, comprising; a plurality of electrically operable flame detectors one of which is adapted to be associated with each of the burners and to be effective to sense the presence or absence of flame thereat, further means controlled jointly by said flame detectors and effective to stop the flow of fuel to the burners in the event the absence of flame is detected at one of the burners, recorder means, means sequentially connecting said recorder means to each of said flame detectors to measure an electrical voltage characteristic thereof the magnitude of which is indicative of the operative condition of the flame detector and may be indicative of an impending component failure to render the flame detector inoperative to sense the actual presence or absence of flame at its burner, output means, and means connecting said output means to said recorder means to thereby actuate said output means upon said recorder measuring a voltage characteristic of a magnitude indicative of an impending component failure.

3. In combination, a plurality of fuel burners adapted to be supplied with fuel from a common fuel supply, a plurality of electrically operable flame detectors one of which is adapted to be associated with each of said burners and to be effective to sense the presence or absence of flame thereat, a plurality of flame relays one of which is associated with each of said flame detectors, means jointly controlled by said flame relays to interrupt the supply of fuel to said plurality of burners upon the absence of flame being detected by one of said flame detectors, recorder means having a plurality of input channels and having means sequentially connecting the input channels of said recorder means to each of said flame detectors in a cyclic manner to supply voltage to each of said input channels the magnitude of which may be indicative of an impending component failure within its associated flame detector, indicator means, and means connecting said indicator means to be controlled by said recorder means to actuate the indicator means upon said recorder means sensing a voltage magnitude indicative of an impending component failure.

4. Multiple burner monitor apparatus for use with a plurality of fuel burners, comprising; a plurality of electrically operable flame detectors one of which is adapted to be associated with each of the multiple burners and to be effective to sense the presence or absence of flame thereat, output means jointly controlled by said plurality of flame detectors and effective upon one of the flame detectors sensing the absence of flame at its fuel burner to interrupt the supply of fuel to all of the burners; recorder means having a plurality of input channels with stepping switch means to sequentially connect each of said input channels to a measuring circuit whereby an individual record is produced on chart means for each of said input channels, said recorder means being provided with a normally open low magnitude switch and a normally open high magnitude switch adapted to be closed upon said measuring circuit being subjected to a signal of a predetermined low or a predetermined high magnitude respectively; indicator means, means connecting said indicator means to be actuated upon closing of either said low magnitude switch or said high magnitude switch; and means connecting each of said plurality of input channels to one of said plurality of flame detectors to measure an electrical voltage signal thereof the magnitude of which is indicative of the operative condition of the flame detector, a proper operative condition being evidenced by said electrical signal being within a predetermined range of magnitudes.

5. Multiple burner monitor apparatus for use with a plurality of fuel burners, comprising; a plurality of electrically operable flame detectors one of which is adapted to be associated with each burner and to be effective to sense the presence or absence of flame thereat recorder means having measuring means and a plurality of input channels and having means to sequentially connect each of said input channels to said measuring means, output means associated with said measuring means adapted to provide an output only when the input presented to said measuring means is outside of a predetermined range, indicator means, means connecting said indicator means to be controlled by said output means to be actuated upon said indicator means being subjected to an input outside of said predetermined range, and means connecting each of said plurality of input channels to one of said flame detectors to measure an electrical voltage characteristic thereof the magnitude of which may be indicative of an impending component failure within the flame detector, the impending component failure being evidenced by the voltage magnitude being either higher or lower than a predetermined range of magnitudes.

6. Multiple burner monitor apparatus for use in monitoring the safe operation of a multiple burner installation, comprising; a plurality of electrically operable flame detectors having output relays, one of said flame detectors being adapted to be associated with each of the burners to be effective the presence or absence of flame thereat, means controlled jointly by said relays to interrupt the supply of fuel to the burners upon the absence of flame being detected, recorder means having a plurality of inputs and having stepping means to sequentially connect each of said inputs to electrical voltage signal measuring means, switch means controlled by said measuring means to be actuated thereby in the event that an electrical voltage signal of a magnitude above or below a given range is applied to one of the inputs and means connecting said inputs, one to each of said flame detectors to apply an electrical voltage signal thereto the magnitude of which may be indicative of an impending failure of the flame detector.

7. Multiple burner monitor apparatus for use in monitoring the safe operation of a multiple fuel burner installation, comprising; a plurality of electrically operable flame detectors having output relays, one of said flame detectors being adapted to be associated with each of the burners to be effective to sense the presence or absence of flame thereat, means controlled jointly by said relays to interrupt the supply of fuel to the burners upon the absence of flame being detected, recorder means having a plurality of inputs and having stepping means to sequentially connect each of said inputs to electrical voltage signal measuring means, switch means controlled by said measuring means to be actuated thereby in the event that an electrical voltage signal of a magnitude above or below a given range of magnitudes is applied to one of the inputs, a plurality of manual switch means one associated with each flame detector, a source of voltage having a magnitude within said given range of magnitudes, and means controlled by said manual switch means selectively connecting each of said inputs to said source of voltage or to said flame detectors to apply an electrical voltage signal thereto the magnitude of which may be indicative of an impending failure of the flame detector.

8. Multiple burner monitor apparatus for use in monitoring the safe operation of a multiple burner installation, comprising; a plurality of electrically operable flame detectors, one of said flame detectors being adapted to be associated with each of the burners to be effective to sense the presence or absence of flame thereat, means controlled jointly by said flame detectors to interrupt the supply of fuel to the burners upon the absence of flame being detected, recorder means having a plurality of inputs and having stepping means to sequentially connect each of said inputs to electrical voltage signal measuring means, switch means controlled by said measuring means

to be actuated thereby in the event that an electrical voltage signal of a magnitude above or below a given range is applied to at least one of said inputs, means connecting said inputs one to each of said flame detectors to apply an electrical voltage signal thereto the magnitude of which is indicative of the state of operativeness of the flame detector and thus may be indicative of an impending failure of the flame detector, chart recorder means, and means including said chart recorder means and said measuring means to provide visual indication of the magnitude of electrical voltage signal being measured at each of said inputs.

9. Multiple burner monitor apparatus for use in monitoring the safe operation of a multiple burner installation, comprising; a plurality of electrically operable flame detectors, one of said flame detectors being adapted to be associated with each of the burners to be effective to sense the presence or absence of flame thereat, means controlled jointly by said flame detectors to interrupt the supply of fuel to the burners upon the absence of flame being detected, recorder means having a plurality of inputs and having stepping means to sequentially connect each of said inputs to electrical voltage signal measuring means, switch means controlled by said measuring means to be actuated thereby in the event that an electrical voltage signal of a magnitude above or below a given range is applied to at least one of said inputs, a plurality of manual switch means one of which is associated with each of said flame detectors, a source of electrical voltage signal of a magnitude within said given range, circuit means controlled by each of said manual switch means operative to selectively connect each of said inputs to said source of electrical voltage signal or to an individual flame detector to sense an electrical voltage signal therefrom, the magnitude of which when in said given range is indicative of an operative flame detector, chart recorder means, and means including said chart recorder means and said measuring means to provide visual indication of the magnitude of electrical voltage signal being measured at each of said inputs.

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