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MECHANICAL SHUTTER CHECKING DEVICE
Filed Dec. 27, 1967

X250-506

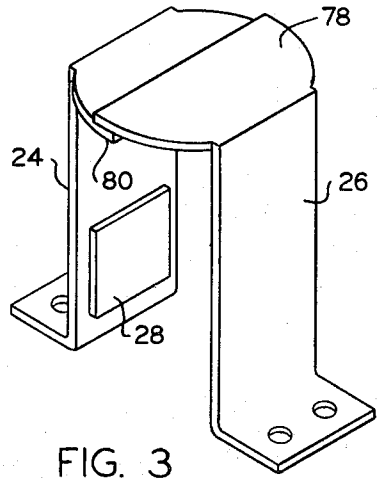


FIG. 3

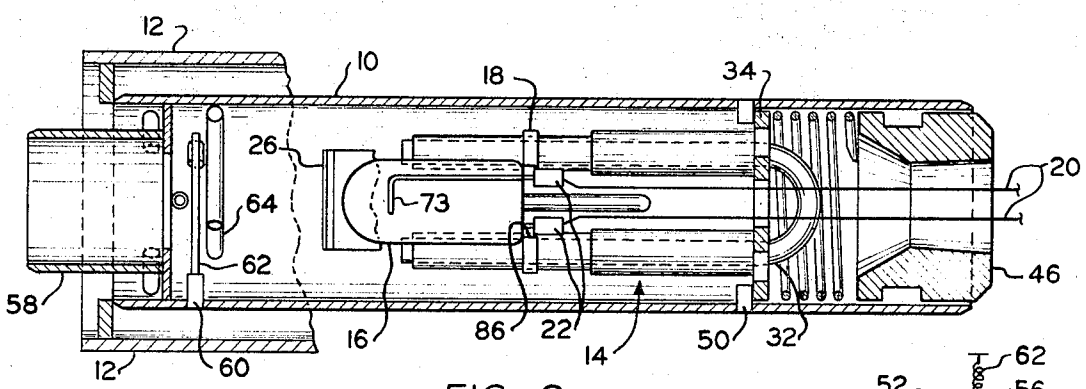


FIG. 2

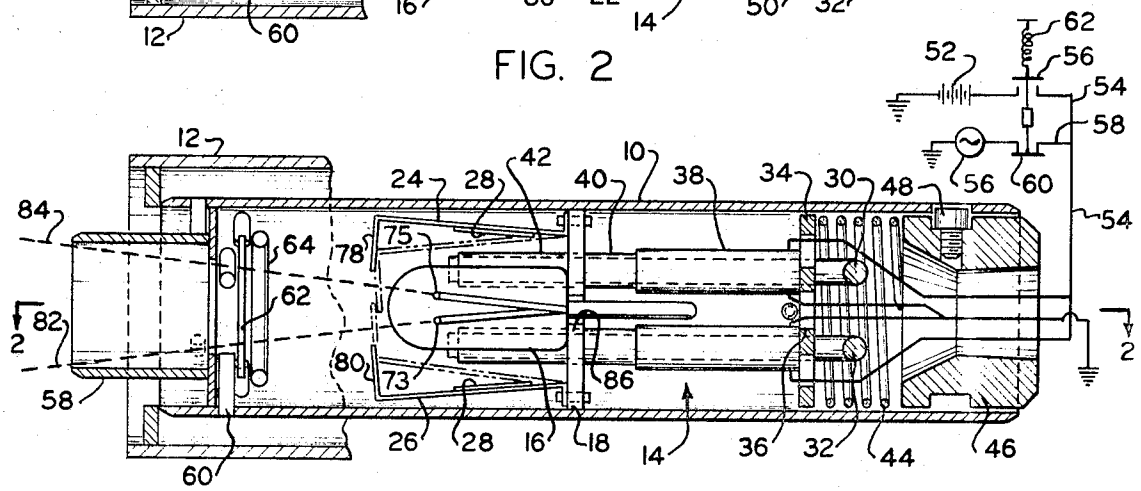


FIG. 1

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FLAME SCANNER WITH HEAD MEANS INCORPORATING MECHANICAL SHUTTER CHECKING DEVICE

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Int. Cl. G21f 5/00

U.S. Cl. 250—105 9 Claims

ABSTRACT OF THE DISCLOSURE

A head assembly for flame scanners utilizing sensing tubes, such as glow discharge tubes and Geiger Mueller tubes, which sense the presence of flame and through an electrical circuit provide an indication of the presence or absence of flame. Mounted within the head is a mechanical shutter mechanism, that is electro-magnetically actuated, to shield or blank off the tube from a flame periodically or when desired, thereby effectively testing the flame scanner tube and circuit for malfunctions.

BACKGROUND AND GENERAL DESCRIPTION

In the art of flame scanning it is common to utilize glow discharge tubes as the sensing element with these tubes being designed to respond to photons in the ultra-violet spectrum and thus be selectively sensitive to flame while being insensitive to other sources of light such as glowing refractory in a furnace. These tubes are connected to electrical circuits of various designs which are utilized to actuate a mechanism for indicating the presence or absence of a flame or for connection into logic circuits as desired. The present invention is concerned with such flame scanners and is particularly well adapted for use with the circuit disclosed in my U.S. Pat. 3,286,093, issued Nov. 15, 1966, for "Flame Detector System Utilizing a Lightly Loaded Glow Discharge Detector Tube."

Reliability is one of the sought after objectives in a flame scanner system and many of the prior art designs have as their objective the overcoming of one or more problems relating to the reliability of operation of the scanner. It is extremely undesirable to have a flame scanner indicate the presence of a flame in a furnace when in fact there is no such flame. The reason for this is that a very dangerous condition develops if the operator continues to supply fuel to the furnace in reliance upon the scanner indication that there is a flame present therein when, in fact, there is no such flame. This continued supply of fuel creates an explosive condition which can have disastrous results. Scanners of prior art designs have been known to indicate the condition of flame long after the flame has been extinguished. One of the reasons for this malfunction of the scanner is that the glow discharge tube for some reason is operating in the same manner that it does in the presence of flame. One reason for this is that the tube is heated beyond its designated and acceptable operating temperature. It may then emit a signal which is identical with that emitted by the tube when it is sensing the presence of a flame. Furthermore, it is possible that there may be some other malfunction in the circuit of the flame scanner which will also cause an actuation of the circuit in the manner of that obtained when sensing a flame.

In order to test the scanner for such malfunctions there is provided, in accordance with the present invention, means for periodically shielding the tube or in other words, means to periodically interrupt the line of sight of the tube with the flame that it is to sense. This shielding of the tube prevents the energy of the flame from

entering the tube envelope and thus activating the tube. With the tube thus shielded from the flame the scanner should indicate that there is no flame present and if such indication is not obtained it is known that there is a malfunction of the scanner system.

The shielding of the tube is effected by means of a pair of mechanical shutters positioned adjacent the flame scanner sensing tube and within the cylindrical housing within which the tube is mounted. These shutters are biased to a lateral outward position which is their non-shielding position and they are actuated, through electro-magnetic actuating mechanism, to their extreme lateral inward position where they effectively shield the tube from the flame.

One form of preferred electro-magnetic actuator includes coils disposed about magnetic members with a magnetic field being created by the passing of a DC current through the coils. The magnetic members are placed with relation to the shutters which are of a magnetic material or have a magnetic member secured to them, such that they are drawn from their lateral outward to their lateral inward position by means of this magnetic field. Deactivation of the electro-magnetic actuators is provided by passing an AC current through the coils.

DESCRIPTION OF THE DRAWINGS

FIG. 1 is in the nature of a longitudinal sectional view through the scanner head of the invention;

FIG. 2 is a section taken generally along line 2—2 of FIG. 1, and;

FIG. 3 is perspective view of the shutter elements per se showing these elements in their shielding or laterally inward position.

DETAILED DESCRIPTION

Referring now to the drawing, wherein like reference characters are used throughout to designate like elements, the illustrative and preferred embodiment of the invention depicted therein includes a flame scanner head that has a tubular housing **10**, mounted within a rigid conduit member **12**. During operation of the scanner cooling air is passed through conduit member **12** as well as the tubular housing **10**, passing out the innermost ends of these elements (located to the left in FIGS. 1 and 2). Each of the elements **10** and **12** form the inner portion of a flame scanner which is preferably constructed in accordance with the disclosure of my U.S. Pat. 3,241,595 issued Mar. 22, 1966, with reference here being made to this patent for the details of such construction.

Mounted within the housing **10** is an assembly **14** which includes the glow discharge sensing tube of the scanner and the shutter mechanism together with the electro-magnetic actuating means for this mechanism for periodically blanking off the tube **16**. The sensing tube **16** preferably abuts the support plate or wafer **18**, as shown, with this wafer being oblong such that it snugly fits within the housing **10** while providing adequate space for the passage of air. In the FIG. 1 illustration, this wafer **18**, which is preferably made from electrical insulating material, snugly fits within housing **10** while in the FIG. 2 illustration there is a substantial space between this wafer and the inner wall of the housing. The tube **6** is retained in a butting relation with this wafer by means of the lead or connecting wires **20** which extend back through the scanner. These wires are connected with the tube via connectors **22**.

Also secured to the support wafer **18** are the two shutter members **24** and **26**. These members are connected at their base with the wafer **18** by suitable fastening means or the like and the natural disposition of these members is in their lateral outward position as shown in FIG. 1. These members are preferably constructed of

a heat resistant material with the resiliency of the material biasing the shutters to their outward position. One such material that has provided quite satisfactory is identified by the trame name Elgiloy. This is a non-magnetic stainless metallic material which has a spring constant that is not adversely effected by being exposed to high temperature. When the shutter members are made of a non-magnetic material, it is necessary to add to each of them a piece of magnetic material, with this preferably being spaced somewhat from the inner ends such that it will be subjected to a less severe temperature environment. Thus when Eligiloy is utilized in fabricating the shutter members each of them is provided with a portion 28 of magnetic material which may be spot welded or otherwise secured to the Elgiloy.

In the illustrative and preferred embodiment the shutters 28 are actuated by means of electro-magnetic devices which are constructed in a manner to hold the entire assembly 14 together. These electro-magnetic actuators include a pair of U- or horseshoe-shaped members 30 and 32. These members are received within complementary openings in the support or wafer member 34 with this wafer being placed as far down toward the base of the horseshoe members as is possible. This wafer 34 is effective to maintain the base end of these horseshoe members in proper relation within the housing and it is provided with a central opening 36 for the passage of lead wires therethrough as well as having an outer configuration which provides for accurate centering of the wafer within the housing and also provides numerous openings around the outer region of the wafer. These openings facilitate the flow of air through the housing. The wafer 34 is retained in place on each of the horseshoe members by means of the coils 38 provided on each leg of the horseshoe members and the sleeves 40 extending from these coils to the wafer 18. The outermost extremity of the legs of the horseshoe members have secured thereto a tubular member 42 and thus the entire assembly which includes the two support wafers, the horseshoe members and the shutters are held together in fixed relation. The sleeves 42 may advantageously be "heat shrink tubing" which is shrunk onto the legs of the horseshoe members by being heated to a predetermined temperature. This entire assembly 14 is held in place by means of the spring 44 which is interposed between the support wafer 34 and the bushing 46. This bushing is retained in place by means of the set screw 48 and thus spring 44 urges the wafer 38 into engagement with the stops 50 (FIG. 2).

The extremities of the legs of the horseshoe members 30 and 32 are positioned adjacent the shutter members 24 and 26, respectively, as shown in FIGS. 1 and 2, such that energization of the coils 38 with a DC voltage sets up a flux path which attracts the magnetic armatures 28 so that they move to shorten the flux path and thus draw the shutters to a lateral inward position, shown in dotted lines in FIG. 1, whereby the inner ends or the inner laterally directed regions of the shutters are effective to blank the tube 16 with relation to the open end of the housing 10 and thus prevent energy from a flame entering the housing and firing the tube.

There is shown, in FIG. 1, in very diagrammatic fashion a circuit for energizing the coils 38 with a DC current. This circuit includes the DC power supply 52 connected at one end with ground and at the other end with the various coils by the lead wire 54. Connected within the lead wire is the switch 56 such that upon closing this switch a DC current will pass through the coils 38.

It has been found desirable to pass an AC current through the coils 38 when it is desired to deactivate the shutter members to have them move by their own resilience to their laterally outward or unshielding position. This is to use the residual magnetism retained within the shutters as a repelling force to snap open the shutters 24 and 26, upon termination of the DC current to the coils 38. If the AC demagnetizing current is not applied, the shutters will move away from their blocking position after the residual magnetism force has fallen below the shutter spring force. There is shown in FIG. 1, in a very diagrammatic fashion, a circuit for supply AC voltage to the coils 38 of this circuit, including the AC source 56 connected at one end to ground and at the other end to the coils via the conductors 58 and 54. Connected within the conductor 58 is switch 60 such that upon closing this switch the AC source is connected with the coils 38. The switches 60 and 62 are preferably ganged such that when one is closed the other is open and there is furthermore preferably provided a bias, such as spring 64, to move these ganged switches to a position such that switch 60 is closed and 56 is open, therefore an AC voltage will normally be applied to the coil 38. It is found that the AC current necessary to effect the desired results is quite small, being in the neighborhood of 100 milliamps in one preferred embodiment.

The distal or inner end of the tubular member 10 is preferably provided with a collimator tube 66 retained in place by means of the pins 68 with there being held against these pins the lens member 70 by means of the spring clip lens retainer 72. The lens fits loosely within housing member 10 to permit the free passage of cooling air therearound.

In order to obtain optimum results in connection with the tube 16 receiving the maximum possible energy from the flame viewed through the open end of housing 10 while necessitating the minimum amount of lateral movement of the shutters 24 and 26, the electrodes 73 and 75 of tube 16 are parallel with the edges 78 and 80 provided on the inwardly directed end portions of the shutter members. Stated in another way: the electrodes are parallel with the longitudinal axis of the slot or elongated opening that is created when the shutter members are in their lateral outward position. This positioning of the electrodes with respect to the shutters is assured by providing a slot 86 in wafer 18 within which the connectors 22 are received such that rotation of the tube relative to the wafer is prevented. Thus the energy entering the open end of the housing 10 within the confines of the dotted lines 82 and 84 will all be available to strike the electrodes 74 and 76 thus causing the tube to operate.

Reference is made to my aforementioned Pat. No. 3,286,093 for details of the circuit into which the tube 16 may be connected in order to provide the desired operating results. Furthermore, reference is made to the application filed concurrently herewith by Martin L. Seelig for "Sensor Testing Device" for details of a logic circuit into which the electro-magnetic actuating mechanism for the shutters 24 and 26 may be connected to provide a desired operation of the shutters.

It is to be understood that the invention is not limited to the specific embodiment herein illustrated and desribed but may be used in other ways without departure from its spirit and that various changes can be made which would come within the scope of the invention which is limited only by the appended claims.

I claim:

1. In a flame scanner a head member having a tubular housing with an open end for receiving energy from a flame and a sensing tube mounted in said housing at a location for impingement of said energy thereon, the improvement comprising: means within said housing for controllably shielding said tubular member from impingement of said energy, said means including mechanical shutter means biased laterally outward to a non-shielding position, with said shutter means including a pair of metallic members extending generally longitudinally of the housing and secured at their base to a mounting in the housing, the opposite ends of said members having an inwardly directed portion effective to shield the tube when said members are in their laterally inward position, means for moving said shutter from said lateral outward to a lateral inward position where it ef-

fectively blocks said tube member, this last-named means including an electro-magnetic actuator.

2. The organization of claim 1 wherein the resilience of the metallic members provides the outward bias therefor.

3. The organization of claim 1 wherein the shutter means has at least a portion thereof which is of a magnetic material and wherein the electro-magnetic actuating means is disposed such that when activated it will, through magnetic action, draw the shutter means to its lateral inward position.

4. The organization of claim 3 including a DC source of potential and means to controllably apply this potential to the electro-magnetic actuator to activate the same to move the shutter means to its shielding position, an AC source of potential and means for applying said AC source to said electro-magnetic actuator to cause release of the shutter means and permit it to move by its bias to the lateral outward position upon termination of application of said DC.

5. A flame scanner head comprising in combination a tubular head housing having an opening for viewing a flame, a sensing tube mounted within said body so as to receive energy from said flame, a pair of resilient shutters disposed on each side of said tube and having inwardly extending end portions adapted to shield the tube from a flame when said shutters are in a lateral inward position while permitting energy from said flame to reach said tube when in a lateral outward position, said shutters being biased to a lateral outward position and having at least a portion thereof of magnetic material, an electro-magnetic actuator associated with each shutter and effective when energized to draw the respective shutter, through magnetic action, to a lateral inward position.

6. The organization of claim 5 wherein each of the electro-magnetic actuating means includes a U-shaped member of magnetic material, a coil disposed about each leg of the U-shaped member, a base member to which the U-shaped member is secured, a base member within which the tube is retained, means securing the tube base member to the U-shaped member and means resiliently biasing this assembly to a predetermined position within the housing.

7. The organization of claim 5 including means effective to apply a DC voltage to the magnetic actuator to cause movement of the shutter to a lateral inward position and means for applying an AC voltage to said magnetic actuator to cause release of the shutter from its lateral inward position and permit movement of the effect of said bias to the lateral outward position.

8. The organization of claim 5 including inwardly extending portions of said shutters being of such configuration that when the shutters are in their lateral outward position a lateral slot is formed between the extremities of these portions through which energy of the flame passes to impinge upon the sensing tube, said sensing tube having a pair of spaced electrodes extending generally normal to the tube axis and generally parallel to the longitudinal axis of this slot.

9. In a flame scanner the combination of a tubular housing having an open end through which energy from a flame is to be received, an assembly mounted within said housing including a sensing tube, a pair of shutter members and an electro-magnetic actuating means, said shutters being of a resilient non-magnetic metallic material and being movable intermediate an inward position where they effectively shield the sensing tube from energy entering said open end of the housing and a lateral outward position where they permit impingement of said energy upon said tube, said members having secured thereto a magnetic member, said members being biased by their own resilience to said lateral outward position, said electro-magnetic actuator being so disposed with relation to said members as to move them against this bias to the lateral inward position upon actuation of the actuator.

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95—55; 250—83.3, 106, 229