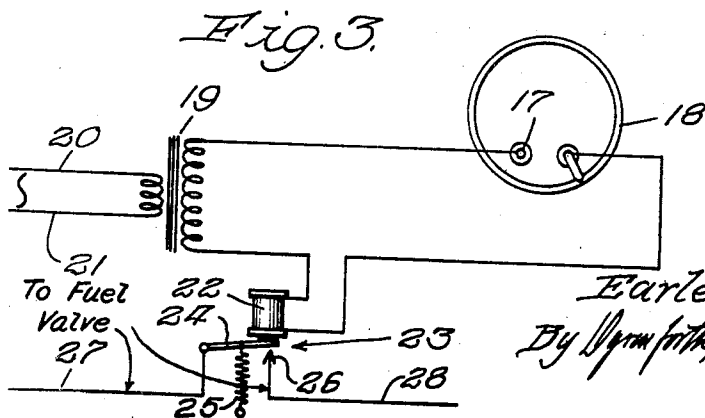
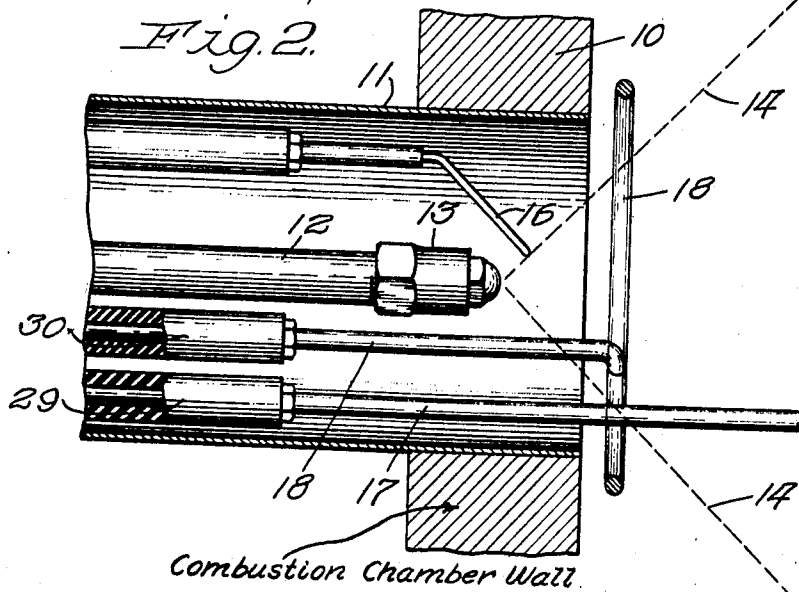
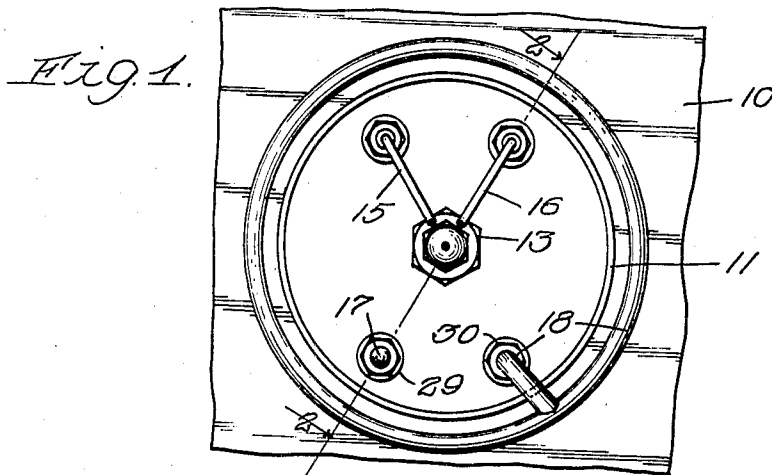


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FLAME FAILURE INDICATOR

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FLAME FAILURE INDICATOR

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This invention relates to a flame-controlled system and apparatus and, more particularly, to means for indicating flame failure.

One feature of this invention is that it acts substantially instantaneously upon flame failure; another feature of this invention is that it does not require complicated thermionic tube apparatus; yet another feature of this invention is that it is simple and readily installed in a combustion chamber; other features and advantages of this invention will be apparent from the following specification and the drawing, in which—

Figure 1 is an elevation of the apparatus mounted in the wall of a combustion chamber; Fig. 2 is a view partly in section along the line 2—2 of Fig. 1; and Fig. 3 is a diagrammatic view of the system.

In modern automatic combustion systems, it is highly important that some means be provided for giving an indication of flame failure, and having this indication preferably turn off the fuel or otherwise prevent flooding of the combustion chamber, with the subsequent possibility of explosions. Various systems are now in use to shut off further fuel feed, prevent reignition or the like, after a flame failure but all of these systems are open to various objections. Thermostats exposed to the action of the flame take an appreciable period to cool down after flame failure; and light sensitive thermionic tubes require expensive and delicate amplifying systems and are frequently rendered inoperative by depositions of soot. Some attempts have been made to use thermionic emission between electrodes, one of which is heated by the flame, but these have all been objectionable because of the long interval after flame failure before the current drops sufficiently to de-energize a relay or other controlled means.

I have discovered that the difficulties heretofore encountered with electrodes directly exposed to the flame have been in large measure due to the ionization of the gases within the combustion chamber, with a consequent ionization current even after flame failure. This invention, by fully insulating both electrodes not only from each other but from the furnace and ground, makes use of a thermionic current flow therebetween which stops almost instantaneously upon flame failure.

In the particular embodiment of this invention illustrated in the accompanying drawing, the wall 10 of a combustion chamber has opening therein a duct 11 adapted to supply air to support combustion. Oil supply means 12 is here shown

as substantially centrally mounted in the duct 11 terminating in a nozzle 13 adapted to project atomized oil particles in a cone therefrom, as indicated by the dotted line 14 representing the flame. Standard ignition points 15 and 16 are provided to initiate the flame.

Two electrodes are provided, here shown as 17 and 18. The electrode 17 is a substantially straight metal tube having the end portion thereof projecting into the flame. The electrode 18 has an annular ring adjacent to the flame but separated therefrom by a small distance so that it is not heated thereby to as high a temperature as the portion of the electrode 17 in the flame.

Referring more particularly to Fig. 3, a step-up transformer 19 has the primary thereof supplied with current from a commercial source of A. C. fed by the leads 20 and 21. The secondary of the transformer has one terminal thereof connected to the electrode 17 and the other terminal thereof connected to the electrode 18 through the energizing coil 22 of a relay or current responsive means 23. The relay 23 is provided with an armature 24 normally held away from said energizing coil 22, as by spring means 25. A contact point 26 is provided adapted to be contacted by the armature 24 when the relay 23 is de-energized, whereby a circuit through the leads 27 and 28 is completed. This relay is of a standard sensitive type, adapted to be energized by a small current measurable only in milliamperes.

The step-up transformer 19 is adapted to create and maintain a voltage differential of a relatively high value between the electrodes, preferably in the neighborhood of 2,000 volts A. C. Since a portion of the electrode 17 is heated to incandescence by the flame, a thermionic current will flow between the electrodes 17 and 18 as a result of the application of this voltage. The voltage used is sufficiently high to maintain a saturation current between the electrodes, and thus a unidirectional or pulsating current will flow through the energizing coil 22 of the relay 23, which current is sufficiently high to keep the armature 24 separated from the contact 26. Immediately upon failure of the flame, however, the current passed between the electrodes will drop substantially immediately to a negligible value, resulting in the de-energizing of the relay and the closing of the circuit completed by the leads 27 and 28. This circuit may be used to turn off the fuel supply, prevent reignition, furnish an indication of flame failure at a removed point, or in any other desired way.

Since a portion of the electrode 17 is heated to

incandescence, there is a thermionic emission therefrom as from the filament of a vacuum tube. The other electrode 18 may be likened to the plate of such a tube so that there is a space current or thermionic current flow between the electrodes when the electrode 18 is positive. This flow is increased by the fact that a large portion of its path is through the flame. It will be noted that the electrodes 17 and 18 are carried by insulated mounting means 29 and 30, respectively, which mountings not only insulate the electrodes from each other, but also from ground and from any part of the furnace connected to ground. It is important that the circuit comprising the electrodes, the secondary of the transformer 19 and the energizing coil 22 of the relay be nowhere grounded. It has been found that as a result of the combustion therein, the walls and flues of a furnace combustion chamber have a voltage built up on them as a result of the ionization of the gases of combustion. Where any part of the control circuit is grounded, it has been found that an ionization current flows through the electrodes to ground for an appreciable interval after flame failure, thus destroying the effectiveness of the system.

While I have shown and described certain embodiments of my invention, it is to be understood that it is capable of many modifications. Changes, therefore, in the construction and arrangement may be made without departing from the spirit and scope of the invention as disclosed in the appended claims, in which it is my intention to claim all novelty inherent in my invention as broadly as permissible, in view of the prior art.

What I claim as new, and desire to secure by Letters Patent, is:

1. Apparatus controlled by the flame in a combustion chamber, including: an electrode having an appreciable portion thereof in said flame heated to incandescence thereby; a second electrode adjacent said flame but sufficiently spaced therefrom to remain at a temperature below incandescence, both of said electrodes being insulated from ground and each other; means for maintaining a voltage differential of at least about 500 volts between said electrodes, whereby a current flows therebetween while said portion in said flame is heated thereby; and current responsive means in series with said electrodes.

2. Apparatus controlled by the flame in a combustion chamber, including: an electrode having an appreciable portion thereof in said flame heated to incandescence thereby; a second electrode adjacent said flame but sufficiently spaced therefrom to remain at a temperature below incandescence, both of said electrodes being insulated from ground and each other; means for maintaining a voltage differential in the neighborhood of 500 to 5,000 volts between said electrodes, whereby a saturation current of thermionic emission flows therebetween while said portion in said flame is heated thereby; and a relay having the winding thereof in series with said electrodes and adapted to be energized by said saturation current.

3. Apparatus controlled by the flame in a combustion chamber having positive fuel and air feed thereto, including: an electrode having an appreciable portion thereof in said flame heated to incandescence thereby, said portion being in the path of said air feed; a second electrode adjacent said flame but sufficiently spaced therefrom to remain at a temperature below incandescence, both of said electrodes being insulated from ground and each other; means for maintaining a voltage differential of at least about 500 volts between said electrodes, whereby a current flows therebetween while said portion in said flame is heated thereby; and current responsive means in series with said electrodes.

4. Apparatus controlled by the flame in a combustion chamber having positive fuel and air feed thereto, including: an electrode having an appreciable portion thereof in said flame heated to incandescence thereby, said portion being in the path of said air feed; a second electrode adjacent said flame but sufficiently spaced therefrom to remain at a temperature below incandescence, both of said electrodes being insulated from ground and each other; means for maintaining a voltage differential of about 2,000 volts between said electrodes, whereby a saturation current of thermionic emission flows therebetween while said portion in said flame is heated thereby; and a relay controlling said fuel feed, said relay having the winding thereof in series with said electrodes and adapted to be energized by said saturation current.

EARLE W. BALLENTINE.