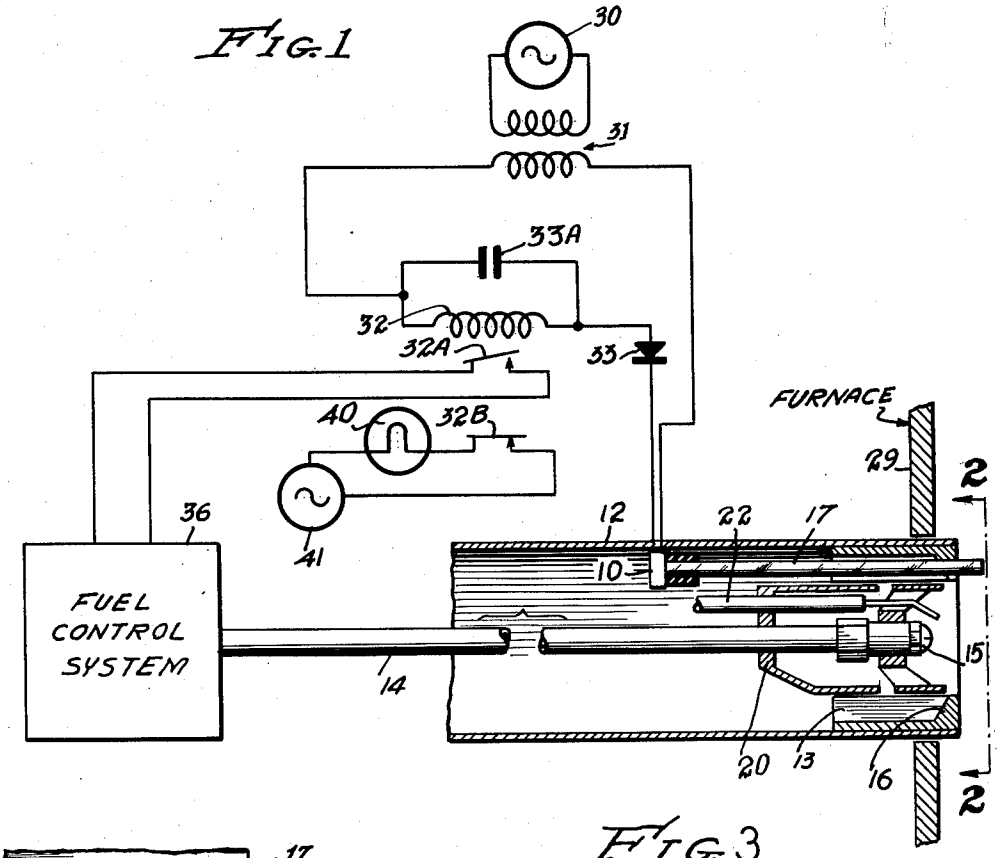
Feb. 5, 1963 W. A. RAY ET AL 3,076,495

FUEL BURNING AND FLAME DETECTION MEANS

Filed June 19, 1961

FIG. 1



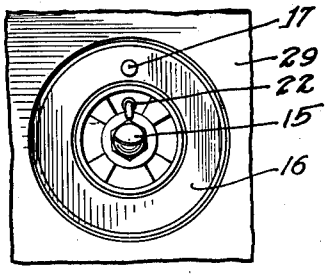


FIG. 2

FIG. 3

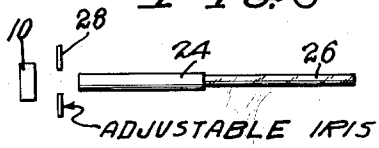
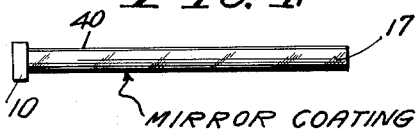


FIG. 4



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FUEL BURNING AND FLAME DETECTION MEANS

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The present invention relates to flame detection means involving the use of a cell such as, for example, a cadmium sulphide type cell which is used to control the flow of fuel to an oil burner.

Cadmium sulphide type cells have heretofore been proposed for the purposes of flame detection or indication and/or the control of fuel to a burner with means found necessary for effectively amplifying the output of the cell to achieve these purposes.

In accordance with one important feature of the present invention, means and techniques are provided whereby these purposes are achieved without amplification means, i.e. an indication or control function is realized using the resistance changes in the cell directly.

In achieving these purposes, a cadmium sulphide type cell is associated with a special optical system involving quartz or Vicor glass rods in an assembly positioned to transmit flame radiation through such rods from the flame to the cell.

The present invention is particularly useful for sensing a flame in oil burning equipment. Another important feature of the present invention involves the particular placement of the cell and its radiation transparent rods in relationship to the burner such that sufficient radiation impinges on the cell while at the same time the same is not overheated to such an extent as to unduly shorten its life.

Another important feature of the present invention is to provide a radiation reflective coating on such radiation conducting rods such that dirt, carbon deposits and the like thereon after prolonged use produce no substantial change in radiation transmitted by such rods.

Another important feature of the present invention is to provide an arrangement of this character wherein the radiation-transmitting tube of quartz projects into the flame area to burn carbon deposits therefrom while at the same time the cell is not overheated.

Another important feature of the present invention is to provide an arrangement of this character wherein the cell is mounted in the blast tube itself.

It is therefore an object of the present invention to provide means and techniques whereby these above-indicated features are realized.

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:

FIGURE 1 illustrates a system embodying features of the present invention.

FIGURE 2 illustrates a view taken in the direction of the arrows 2—2 in FIGURE 1.

FIGURE 3 illustrates modified detecting means which may be substituted for the detecting means in FIGURE 1.

FIGURE 4 illustrates a modification in which the radiation transparent rod is coated to provide a mirror finish for preserving the internal reflections characteristic of the rod.

In one form of the invention illustrated in FIGURE 1, a cadmium sulphide cell **10** is mounted by suitable means inside of the blast tube **12** either on the upstream or

downstream side of the conventional combustion air twirling vanes **13** in tube **12**, although in some cases the blast tube may be provided without twirling vanes. Fuel oil is supplied through conduit **14** to the burner nozzle **15** which in conventional manner is located just inside the choke ring **16**. A radiation-conducting quartz rod **17** has one of its ends aligned or optically coupled with the light-receiving end of cell **10** and the other one of its ends extending through the choke ring **16** where the same may attain a temperature of approximately 1100° Fahrenheit or more so that any carbon deposits may be burned from the projecting end of rod **17**.

Because the rod **17** is subjected to high temperatures, the rod **17** is sufficiently prolonged so that the cell **10** is positioned for sufficient heat dissipation. As shown, the cell is positioned in the path of combustion air which serves to cool the same as well as the adjacent portion of the radiation-transmitting rod **17**. Also, preferably the cell is located such that a static shield is interposed between the burner nozzle **15** and cell **10** to prevent direct radiation between the region of the nozzle **15** and cell **10**. Such shield as shown is the cup-shaped shield **20** which is apertured for mounting on the oil supply conduit **14** and also apertured for mounting the spark electrode **22** which is used for igniting the fuel when the burner is initially placed in operation. While this shield **20** is in the path of direct flame radiation, the same is also cooled by combustion air flowing through the blast tube.

It has been found that accumulated dust or dirt on the sides of rod **17** impairs its light-transmission properties and to assure substantially the same light-transmission properties in prolonged use, the rod **17** is preferably provided with a mirror-like coating **40**, as illustrated in FIGURE 4, so that radiation in the tube is not otherwise absorbed by such dust or dirt. Such a mirror coating may comprise aluminum foil suitably bonded to the tube **17** along its full length.

In some cases, instead of using quartz or Vicor exclusively as the radiation-transmitting element, a section of Pyrex rod **24** as shown in FIGURE 3 may be used interposed between quartz rod **26** and cell **10**. It has been found that the Pyrex rod has the advantage of absorbing most of the radiation in the infrared region, thereby reducing considerably the temperature of cell **10**. The Pyrex rod **24**, however, does not transmit useful radiation in other portions of the spectrum as well as quartz and for that reason it is preferred not to use long lengths of Pyrex rod. Also, when using rods of different materials as shown in FIGURE 3, care is required to achieve good optical coupling between abutting ends of the Pyrex rod **24** and quartz or Vicor rod **26**.

In some cases that end of the radiation transparent rod adjacent the cell **10** may be in mechanical abutment with the window of cell **10** and in other cases the same may be spaced a slight distance therefrom to allow mounting of an adjustable iris **28** as shown in FIGURE 3, particularly when an assembly is provided for universal mounting in different types of oil burner blast tubes.

While it is preferred to mount the assembly inside of the burner blast tube as shown in FIGURE 1 since it has been found that the response of the cell is very fast to flame conditions, the assembly may be mounted outside of the blast tube with the extreme end of the radiation-transmitting rod projecting into the furnace **29** and with the cell positioned outside of the furnace **29** where it is cooled. In the latter case, however, it is found that the response of the cell is not as fast since a large amount of radiation from the refractory material defining the inside of the furnace **29** impinges on the rod and thus serves to obscure or override that radiation from the flame itself.

It has also been found that after extensive use some

devitrification occurs at the end of quartz rod **17** but the same does not materially decrease the light transmission when, as shown, the rod **17** is installed in a burner blast tube with such rod end projecting past the choke ring **16** a distance of approximately one-half of one inch (½").

In each one of the arrangements the cell **10** may be connected electrically, as illustrated in FIGURE 1, to provide either a control function or an indicating function.

Thus, in FIGURE 1 the cell **10** is energized with a rectified A.C. current supplied from a 115-volt A.C. source **30** which has its terminals connected to the primary winding of step-down transformer **31**. The secondary winding is connected in series with the relay coil **32**, rectifier **33** and cell **10**, the coil **32** being shunted by a 10-microfarad condenser **33** for prolonging the drop-out time of the relay having coil **32** and associated relay switches **32A** and **32B** so that the control is not operated by transient conditions, i.e. flame flicker or flutter. When a flame is present, the flame radiation impinging on cell **10** lowers its resistance and maximum current flows through coil **32** with the result that the normally closed relay switch **32A** is open and the normally closed relay switch **32B** is closed. Swith **32A** is connected to a conventional fuel burner control system **36** which controls the supply of fuel to the burner conduit **14**. When switch **32A** is open, fuel is permitted to flow to the burner but when switch **32A** is closed (when there is no flame) the flow of fuel is automatically interrupted by control system **36**. Likewise, when switch **32B** is closed (when there is no flame), this condition, i.e. flame failure, is indicated by indicating lamp **40** which is connected in a series circuit with voltage source **41** and switch **32B**.

While the particular embodiments of the present invention 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 the true spirit and scope of this invention.

We claim:

1. In a flame controlling and/or indicating system of the character described comprising a blast tube for oil-burning equipment through which combustion air passes, a burner nozzle within said tube, a choke ring in said tube encircling said burner nozzle, a radiation-transmitting rod having one of its ends extending through and beyond said choke ring, and a photoconductive cell within said tube and receiving flame radiation through the other end of said rod.

2. A system as set forth in claim 1 in which a heat shield is positioned between said burner nozzle and said cell.

3. A system as set forth in claim 1 in which an adjustable iris is positioned between said cell and said other end of said rod.

4. A system as set forth in claim 1 in which said rod has its cylindrical wall provided with a mirror coating.

5. A system as set forth in claim 1 in which said rod is of quartz.

6. A system as set forth in claim 1 in which said rod comprises a rod of quartz and a rod of Pyrex-type glass in end-to-end relationship.

7. A system as set forth in claim 1 including an energizing source, a relay, and said source, relay and cell being connected in a series circuit, and means controlled by said relay for producing an indication of the condition of said flame.

8. A system as set forth in claim 1 including an energizing source, a relay, and said source, relay and cell being connected in a series circuit, and means controlled by said relay for controlling the flow of fuel to said nozzle.

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