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AUTOMATIC FUEL SHUTOFF MEANS FOR
COMBUSTION APPARATUS

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The invention relates to the operation of combustion apparatus designed to utilize a variable volume of flowable fuel such as oils, gases, and powdered solids; and more especially to means for shutting off automatically the fuel supply to a burner, of the type whose flame length varies proportionately to the fuel supply, only in the event that the flame discharged into the apparatus becomes extinguished or the mixture becomes excessively varied.

It has for an object to provide, in combustion apparatus having an initial or ignition zone, instantaneously acting means operative from conditions prevailing in said zone to shut off the fuel supply only when the flame becomes extinguished or there is an excessive variation of the mixture of the combustible and air.

A further object of the invention is to provide for more effective operation of photoelectric means, heretofore utilized, by causing said means to be so located with respect to direction of propagation of the flame that its axis will intersect said axis of propagation substantially at the far end of a minimum combustion-maintaining flame.

A still further object of the invention is to so locate the photoelectric means that its optical axis will clear any emissive surface of the initial or ignition chamber portion of the combustion apparatus which constitutes a most intense and proximate temperature zone.

In carrying out the invention, the combustion apparatus is constructed preferably of an initial or ignition chamber or zone and a combustion chamber coaxial therewith located adjacently to said ignition chamber and in direct communication therewith. A burner directs combustible matter at the outer end of the ignition chamber into both of said chambers and the wall of the former chamber is provided with an aperture to the interior of the ignition chamber with which chamber is aligned electronic means such as a photoelectric cell.

The longitudinal axis of this aperture and the optical axis of the photoelectric cell are located in a novel manner to secure the objects of the invention, said optical axis to this end being directed to intersect the axis of flame propagation substantially at the far end of the minimum or combustion-maintaining flame. This is at an angle less than 45° therewith and substantially 30° for best results. The relationship between the ignition chamber and the axis of the electronic means is such, moreover, that this axis will clear the inner edge of the surface of the said

ignition chamber to avoid reflection from the walls of the said ignition chamber which constitute a most intense temperature zone, the wall of the combustion chamber being sufficiently remote as not to affect appreciably the said electronic means.

The nature of the invention, however, will best be understood when described in connection with the accompanying drawing, in which:

Fig. 1 is a front elevation of a portion of a furnace with burner attached and equipped with the novel arrangement for effecting the shut-off of the fuel supply.

Fig. 2 is a fragmentary horizontal section thereof, shown on a reduced scale, with a diagrammatic representation of the control means.

Referring to the drawing, 10 designates the front wall of a furnace to which is attached by a suitable plate a burner 11 of the proportional type whereby a flame of variable length may be secured, for example, a burner as set forth in U. S. Letters Patent #2,219,118, #2,219,119, and #2,290,785, granted to applicants' assignee. The furnace itself is of the type which includes an initial or ignition chamber 12 terminating in a coaxial, enlarged combustion chamber 13 wherein the main combustion of the fuel occurs. The minimum length of flame capable of maintaining combustion is indicated at the flame tip 14 and the flame is variable from this length to, for example, the length indicated at the tip 15, these variations being secured by correspondingly manipulating the operating handle 16 of burner 11 to vary the volume of fuel.

In accordance with the invention, provision is made for shutting off the fuel supplied to the burner 11 in the event that the flame becomes extinguished as by being reduced in length below that indicated at 14, or in the event that the combustible mixtures becomes too lean or too rich, in which case its luminosity or intensity becomes so reduced that it will no longer affect sufficiently an electronic means which is associated therewith to control the supply of fuel.

We are aware that it has been proposed heretofore to shut off the fuel to a burner automatically upon the extinguishment of the flame and the means herein indicated beyond the electronic means may be of the usual well-known type and arrangement for this purpose. Thus, the leads 20 from the electronic means, such as a photoelectric cell 21, are connected to electrical control means indicated at 22 and fed from a suitable source of power as the mains 23.

From the electrical control mechanism extend

leads 24 to a solenoid-controlled valve 25 which is arranged to shut off the supply of fuel to the burner 11 when the cell 21 is not sufficiently energized by the energy radiated from the flame. A starting connection 26 is also provided to eliminate temporarily the effect of the cell 21, all of which is well understood and forms no particular part of the present invention.

In the present arrangement, cell 21 is associated with an aperture 27 through a wall of the ignition chamber, and the longitudinal axis of this aperture which coincides with the optical axis of the cell 21, indicated by the broken line 28, is so directed with respect to the ignition chamber 12 that it will intersect in a novel manner the longitudinal axis of this chamber and the combustion chamber, or axis of propagation of the flame. Thus, it will cross this axis substantially at the inner end or tip 14 of a minimum combustion-maintaining flame and will also clear the inner edge 29 of the surface of the ignition chamber 12.

By this expedient, not only will the cell 21 be unaffected by any reflections from the inner wall 30 of said ignition chamber which would tend to maintain a supply of fuel to the burner 11, but when the flame has become extinguished by reduction beyond the length indicated at 14, cell 21 will no longer receive effective radiations and will thus shut off the supply to the burner. Similarly, if the main flame becomes sufficiently weak through a too-lean or a too-rich mixture of the combustible, the effect of the radiations on the cell 21 will be insufficient to actuate the control circuits for maintaining the supply of fuel.

We have found that this angle between the two axes should be less than 45° and preferably about 30°, with the aperture 27 located at the near end of the ignition chamber.

We claim:

1. In combustion apparatus including an ignition chamber of reduced diameter and an adjacent coaxial combustion chamber in communication therewith, together with a burner for flowable fuel discharging in the direction of the longitudinal axis of the two chambers to afford a variable length flame with variable volume of the fuel: means for shutting off the supply of fuel to the burner, comprising a single electronic means located at the outer end of the ignition chamber and aligned with an opening through the ignition chamber wall to be responsive to the luminosity of flame therein, the optical axis of said electronic means being directed to clear the inner end of the ignition chamber and to intersect within the said chamber the axis of flame propagation substantially at the far end of a minimum combustion-maintaining flame, and means actuated from said electronic means to control the burner fuel supply.

2. In combustion apparatus including an ignition chamber of reduced diameter and an adjacent coaxial combustion chamber in communication therewith, together with a burner for flowable fuel discharging in the direction of the longitudinal axis of the two chambers to afford a variable length flame with variable volume of the fuel: means for shutting off the supply of fuel to the burner when the flame therefrom becomes extinguished, is reduced to minimum flame-maintaining length, or the combustible mixture becomes too lean or too rich, said means com-

prising a single electronic means located at the outer end of the ignition chamber and aligned with an opening through the ignition chamber wall to be responsive to the luminosity of flame therein, the optical axis of said electronic means being directed to clear the inner end of the ignition chamber and to intersect within the said chamber the axis of flame propagation substantially at the far end of a minimum combustion-maintaining flame and to clear the inner edge of the surface of the ignition chamber, and means actuated from said electronic means to control the burner fuel supply.

3. In combustion apparatus including an ignition chamber of reduced diameter and an adjacent coaxial combustion chamber in communication therewith, together with a burner for flowable fuel discharging in the direction of the longitudinal axis of the two chambers to afford a variable length flame with variable volume of the fuel: means for shutting off the supply of fuel to the burner comprising a single electronic means located at the outer end of the ignition chamber and aligned with an opening through the ignition chamber wall to be responsive to the luminosity of flame therein, the optical axis of said electronic means being directed to clear the inner end of the ignition chamber and to intersect within the said chamber the axis of flame propagation at an angle less than 45° therewith, and means actuated from said electronic means to control the burner fuel supply.

4. In combustion apparatus including an ignition chamber of reduced diameter and an adjacent coaxial combustion chamber in communication therewith, together with a burner for flowable fuel discharging in the direction of the longitudinal axis of the two chambers to afford a variable length flame with variable volume of the fuel: means for shutting off the supply of fuel to the burner comprising a single electronic means located at the outer end of the ignition chamber and aligned with an opening through the ignition chamber wall to be responsive to the luminosity of flame therein, the optical axis of said electronic means being directed to clear the inner end of the ignition chamber and to intersect within the said chamber the axis of flame propagation substantially at an angle of 30° therewith, and means actuated from said electronic means to control the burner fuel supply.

5. In combustion apparatus including an ignition chamber of reduced diameter and an adjacent coaxial combustion chamber in communication therewith, together with a burner for flowable fuel discharging in the direction of the longitudinal axis of the two chambers to afford a variable length flame with a variable volume of the fuel: means for shutting off the supply of fuel to the burner comprising a single electronic means located at the outer end of the ignition chamber and aligned with an opening through the ignition chamber wall to be responsive to the luminosity of flame therein, the optical axis of said electronic means being directed to intersect within the ignition chamber the axis of flame propagation substantially at an angle of 30° therewith and to clear the inner edge of the surface of the ignition chamber, and means actuated from said electronic means to control the burner fuel supply.

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