

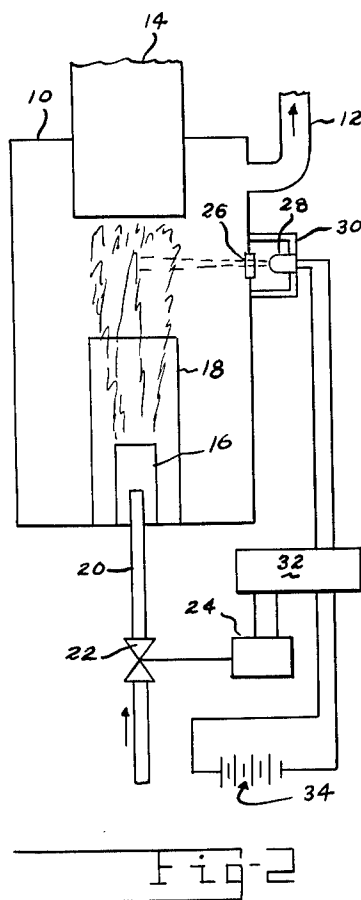
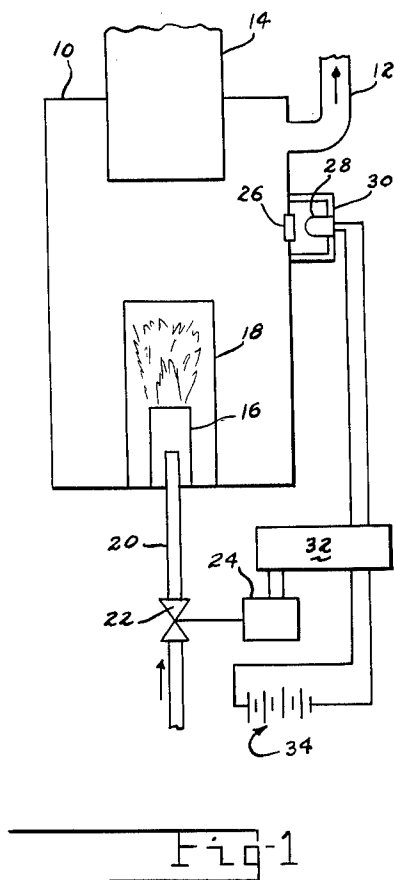
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ULTRAVIOLET LIGHT RESPONSIVE FLAME MODULATING CONTROL

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ULTRAVIOLET LIGHT RESPONSIVE FLAME MODULATING CONTROL

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1 Claim. (Cl. 158-28)

The invention described herein may be manufactured and used by or for the United States Government for governmental purposes without the payment to me of any royalty thereon.

This invention relates to fuel control systems for metering the quantity of fuel being injected into a combustion apparatus, and more specifically to an override for modulating the quantity of fuel, which would otherwise be combusted, when the length of the flame exceeds a predetermined limit. This invention is similar to that of application S.N. 415,856, Ultraviolet Light Sensitive Fuel Modulating Apparatus for Turbine Engines, filed November 25, 1964, and now United States Patent No. 3,212,261, issued October 19, 1965.

This invention is particularly useful on combustion apparatus, such as used in the process and chemical industries, where it is necessary to control the maximum flame length independent of the thermal control of the combustion. Such operating conditions often exist where an excess flame length would be drawn into fans or other operating elements, or would be apt to cause flash ignition of the materials being subjected to the heat from the combustion. The excess flame may occur on start-up, or at any time during normal operation, and there is no means provided for modulating the flame so long as the usual thermal control devices signal for more heat.

Such thermal devices, which are usually bimetallic devices generating an electrical signal, are placed in the areas serving as control points. Such areas may be in the heat receivers, plenum chambers, or in the stacks. Thermal devices, in addition to being relatively sluggish in response and short lived in extremely hot and corrosive environments, are unsuitable for flame modulation. This unsuitability is because thermocouples are thermal devices and, therefore, incapable of detecting flame position independent of temperature. The detecting device of the present flame modulating control is an optical device which is responsive to the ultraviolet portion of the flame spectrum independent of flame or environmental temperatures. The present modulating control will, therefore, receive a signal indicating excess flame even when the thermal devices signal for more heat.

The optical detector of the present invention has the inherent capability of being mounted outside the hot combustion area, the only requirement being optical communication with the flame. Being mounted outside the destructive combusting region, the optical detector has an extremely long and dependable service life. The optical detector also has a very fast response rate in comparison with a thermal device. This is because a thermal device must itself first respond to the changing environment in which it is acting, before it can change the value of the signal being generated. It is thus seen that the optical response will be instantaneous, whereas a thermal response will have time lag.

One object of the present invention is to provide a fuel modulating control using a sensing element having a response rate greater than that of a thermal device.

Another object of the present invention is to provide a fuel modulating control using the length of the combustion flame as the control parameter.

An additional object of the present invention is to

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provide a fuel modulating control using a sensing element which is mounted outside the hot gases of combustion.

A further object of this invention is to provide a fuel modulating control having a sensing element which is optically responsive to ultraviolet light rather than being thermally sensitive.

Yet another object of this invention is to provide a fuel modulating control having a sensing element which detects the ultraviolet tip of the above normal flame length during a period of overcombustion.

A still further object of this invention is to provide a fuel modulating control having a combustion sensing element with a long service life.

Additional objects, advantages and features of the invention reside in the construction, arrangement and combination of parts involved in the embodiment of the invention as will appear from the following description and accompanying drawing, wherein:

FIG. 1 schematically depicts a vertical combustion apparatus having a plenum housing a burner operating at normal flame length from an indicated fuel supply, and further showing the flame modulating elements joined to the shell of the combustion apparatus and to the fuel supply, and

FIG. 2 is a schematic as FIG. 1, but in which the flame length is of above normal length to activate the flame modulating elements.

Referring to the drawing, the combustion apparatus has an outer shell member 10, such as used on a furnace, providing a combustion chamber and terminating in a chimney 12 for the passage of the products of combustion. A heat absorber 14 is built into the upper portion of the shell member 10. The heat absorber may be a vessel as shown, a coil of pipe, a heat exchanger, or any other structure using or transferring heat. The lower portion of the shell member houses a burner 16 within an open end plenum 18 located to place the burner below the heat absorber. As used in this disclosure, the heat absorber is mounted to be downstream, or aft from the burner, regardless of the attitude of the combination. The burner is fed through a fuel conduit 20, the rate of flow being governed by conventional fuel control means (not shown). A normally open modulating valve 22 is installed in the fuel conduit to be between the fuel control means and the burner. This modulating valve, which is shown as having an integral solenoid 24 for the actuating means, does not shut off the fuel supply when the valve is actuated, but merely modulates the flow by some predetermined amount. This may be accomplished in several well known manners such as by having a flow passage through the gate in a gate valve, or by limiting the amount of valve closure.

A window means 26 is provided in the shell member 10. The window means, which is transparent, is longitudinally located to be between the plenum 18 and the bottom of the heat absorber 14. An ultraviolet responsive detector tube 28 is externally mounted over the window by a suitable bracket 30. A suitable ultraviolet detector tube for use with this invention is the Edison Solar Blind Ultraviolet Radiation Detector manufactured by the McGraw-Edison Company. This detector is insensitive to sun-light, cosmic radiation, infrared and ordinary incandescent and fluorescent light sources. The insensitivity of this detector to other than ultraviolet light makes it especially adapted to this invention. The spectral range of this detector is 1900-2900 Angstroms; peaking at 2200 Angstroms. The detector scans through the window into the combustion chamber within the outer shell at substantially normal to the flame of combustion. A control unit 32, powered by an electrical source such

as battery 34, is electrically disposed between solenoid 24 and detector tube 28.

When combustion is normal, as shown on FIG. 1, the modulating control is inactive, and the fuel is metered by the regular fuel control. When, however, the flame of combustion is too long, as shown on FIG. 2, the detector tube is energized by the ultraviolet cone within the flame and sends a signal to the control unit 32 which in turn energizes the solenoid 24 to actuate the modulating valve 22 and thereby modulate the fuel flow.

A suitable delay circuit may be used to hold the modulated fuel flow for a predetermined time interval. The excess flame length is usually caused by a temporary abnormal operating condition which passes after a short period of time, but which can be very destructive if not promptly modulated. The flame modulating control of this invention is completely independent of the usual thermal devices used to regulate normal fuel flow, and remains out of action until an abnormally long flame is produced.

It is to be understood that the embodiment of the present invention as shown and described is to be regarded as illustrative only and that the invention is susceptible to variations, modifications and changes within the scope of the appended claim.

I claim:

In combination: a combustion apparatus having an outer shell, a plenum inwardly extending into said outer shell and joined to a first end thereof, a heat absorber joined to a second end of said outer shell and providing a combustion chamber within said outer shell between the inner end of said plenum and said heat exchanger, and a burner within said plenum; a fuel conduit means

supplying metered fuel to the burner in said combustion apparatus; a normally open modulating control valve means in said fuel conduit means; a window means in the outer shell of said combustion apparatus longitudinally located in the combustion chamber region to the downstream from the visible flame emitting from the burner during normal combustion; an ultraviolet light responsive detector means externally mounted over said window means and scanning into the combustion chamber within said combustion apparatus substantially normal to the flame emitting from the burner; and a control unit means electrically disposed between said modulating control valve means and said ultraviolet light responsive detector means for receiving a signal generated in said detector means only during a period of overcombustion as signified by the ultraviolet light cone in the flame emitting from the burner lengthening to enter the scanning range of said detector means and thereby actuating said modulating control valve means to modulate the fuel flow to a predetermined lesser amount until such time as the signal generated in said detector means is cancelled.

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