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APPARATUS AND METHOD OF COMBUSTION CONTROL

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FIG. 1

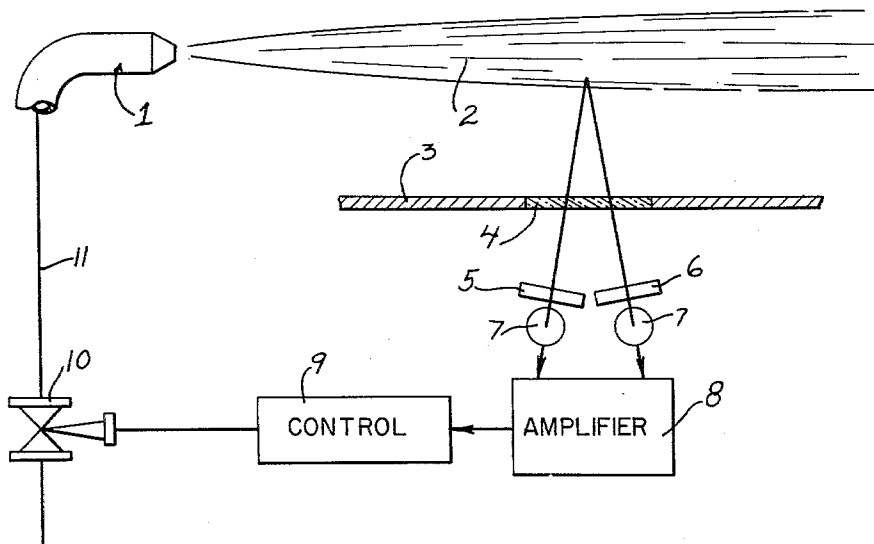
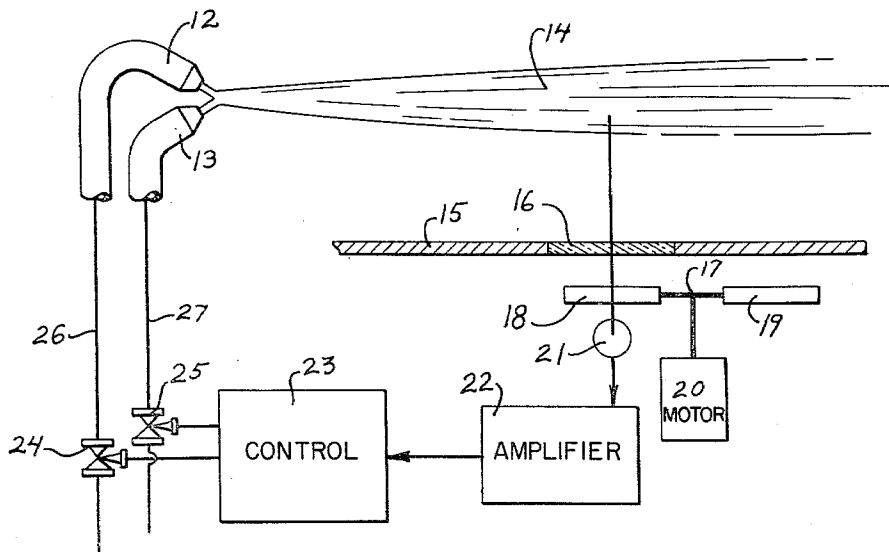


FIG. 2



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1

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APPARATUS AND METHOD OF COMBUSTION CONTROL

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2 Claims. (Cl. 236-15)

This invention relates to apparatus and method of combustion control and included in the objects of this invention are:

First, to provide apparatus and method of combustion control which utilizes the ratio of intensities of two or more selected radiations of different wave length occurring in a flame to operate means for controlling the combustion which produces the flame so as to maintain the flame in a preselected condition.

Second, to provide apparatus and method of combustion control of this class which is particularly sensitive to change in the selected radiations, and capable of such quick response as to anticipate and compensate for impending unfavorable change in the combustion apparatus subject to control.

Third, to provide apparatus and method of combustion control which directly monitors a flame to maintain peak economy and/or stability of operation even under varied demands.

Fourth, to provide apparatus and method of combustion control which may be utilized to control, one, several or all components to be supplied to a fuel mixture.

With the above and other objects in view which may appear hereinafter, reference is directed to the accompanying drawings in which:

FIGURE 1 is a diagrammatical view illustrating one apparatus and method of combustion control.

FIGURE 2 is a similar diagrammatical view showing a modified form of the apparatus.

A combustion unit suitable to control my apparatus and method includes a nozzle 1 which may be a simple nozzle capable of discharging all components of a combustible mixture or may be an elaborate nozzle assembly involving many jets arranged to discharge the pre-mixed fuel components or separated fuel components. It is to be understood that the combustion unit or assembly is conventional.

The nozzle or nozzle structure as the case may be discharges combustion components in such a manner that they will be ignited to produce a flame 2. The flame is all or partially contained within a chamber which includes a wall 3. Provided in the wall is a small window 4 exposing to view a portion of the flame 2. Disposed outside the wall are two or more filters shown as 5 and 6 formed of glass or other material capable of passing radiation of preselected wave-length. The wave-lengths passed by filters 5 and 6 differ from each other and are selected for the purpose of passing a pre-determined wave length emitted by a particular product of combustion present in the flame; for example, one filter may be selected to pass wave lengths in the region of 4,280 angstrom units and for the purpose of detecting CH radiation and the other filter may be selected to pass wavelengths in the region of 5,080 angstrom units for the detection of C₂. A band width of 100 angstrom units is permissible. The radiations passed by the filters 5 and 6 are detected, such as by the use of a standard photomultiplier tube 7, which might be an RCA type 931-A. The energy outputs (from the two photomultiplier tubes) are fed into a suitable amplifier arranged to determine the ratio of radiation intensities passed by the filters. A resulting signal proportionate to the radiation intensities is passed from

2

the amplifier 8 to a control unit 9 having a mechanical power output capable of operating a valve 10 connected with a fuel line 11 which supplies the nozzle 1. In the arrangement shown in FIGURE 1, control of the flame 2 is effected by control of the fuel supply, air or oxidant being introduced by other means such as by an air intake duct not shown. If desired, both the fuel and the oxidant may be controlled as represented diagrammatically in FIGURE 2.

With reference to FIGURE 2, the apparatus here shown involves a pair of nozzles 12 and 13 intended to supply the fuel and oxidant respectively and as in the first described structure the nozzles may be simple jets or elaborate multiple jet structures depending upon the nature of the combustion unit to be controlled. The discharge from the nozzles 12 and 13 impinge in a manner to permit the establishment of a flame 14 within a suitable chamber having wall 15 provided with a window 16 as in the first described apparatus.

In the arrangement shown in FIGURE 2 the radiations from the flame passing through the window 16 are interrupted by a chopper 17 involving a rotating element carrying a pair or several pairs of filters 18 and 19 selected to pass particular wavelengths. The chopper 17 is rotated by a motor 20 so that the filters 18 and 19 pass successively across the window 16. A mechanism such as a single photomultiplier tube 21 detects alternately the energies of the wavelengths passed by the filters 18 and 19 and the resulting signal is fed into an amplifier 22 having circuitry arranged to determine a ratio of intensities of two selected wavelengths as in the first described apparatus. The signal representing the ratio of radiation intensities is fed into a control unit 23 having two output arranged to control valves 24 and 25 disposed in a fuel line 26 and oxidant line 27 leading to the nozzles 12 and 13.

When the combustion unit is operating properly there will be a corresponding ratio of intensity between two emitting combustion components such as CH and C₂. Experimentation can determine the maximum and minimum ratios of the selected combustion products which are suitable to proper combustion. Detection of approach toward an unstable ratio is virtually instantaneous so that correspondingly quick compensation may be effected; in fact, detection and correction may be sufficiently rapid that no appreciable change in output of the combustion unit will be noted. This will be true whether the change occurs in the fuel supply or in the oxidant or secondary air supply as change in either component will affect the ratio.

Having thus described certain embodiments and applications of my invention, I do not desire to be limited thereto, but intend to claim all novelty inherent in the appended claims.

I claim:

1. The method of combustion control comprising heating a furnace with a flame burning from a nozzle, regulating by separate intake valves at least two selected combustion constituents being fed to the nozzle, sighting separately from the flame by radiation the wave lengths of the two constituents selected for control, filtering separately the constituent wave lengths for purpose of emitting only the desired wave length, boosting separately with a photomultiplier tube the wave length of each constituent to be controlled, amplifying the signal of each controlled constituent to determine the ratio of radiation intensities passed by the filters, changing the electric signal from the amplifier to mechanical energy in the control unit and said control unit operating the valves to maintain the desired ratio of selected combustion constituents.

3

2. An apparatus for combustion control by regulation of carbon and carbon hydride in fuel, comprising a nozzle for a combustion flame, control valves for individually regulating the feed of these combustion constituents to said nozzle, a filter sighted on the combustion flame and designed to emit only the wave length by radiation attributed to carbon, a second filter similarly sighted and designed to emit only the wave length of carbon hydride, a photomultiplier tube for each filter operative for detecting the radiations of each constituent, an amplifier for receiving the output of both tubes and designed to hold a preselected ratio within a prescribed range of said combustion constituents and a control unit adapted to convert the electrical signal of the amplifier to mechanical operation of each valve to maintain the desired ratio of said combustion constituents as detected from the flame emitted from the nozzle.

4

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