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APPARATUS ADAPTED TO DISTINGUISH BETWEEN THE PRESENCE
OF FLAME DUE TO COMBUSTION OF FUEL DISCHARGED
FROM A BURNER AND THE ABSENCE OF THE FLAME
Filed Feb. 19, 1960

FIG. 1

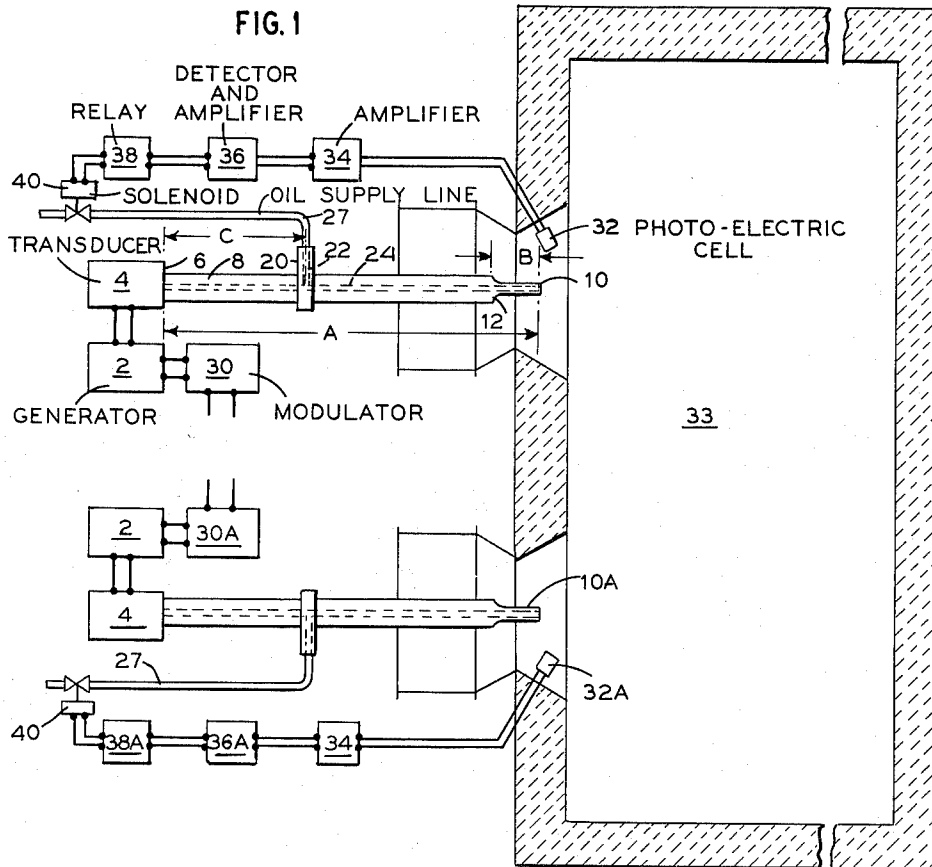
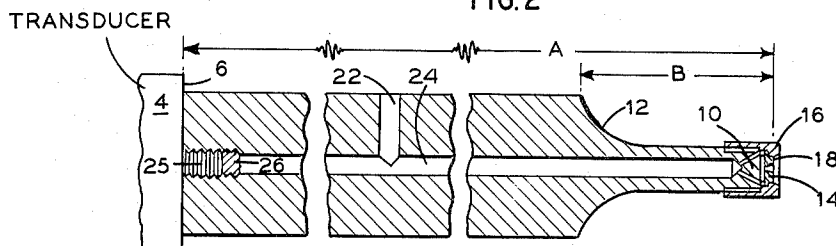


FIG. 2



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APPARATUS ADAPTED TO DISTINGUISH BETWEEN THE PRESENCE OF FLAME DUE TO COMBUSTION OF FUEL DISCHARGED FROM A BURNER AND THE ABSENCE OF THE FLAME

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6,860/59

13 Claims. (Cl. 158—28)

This invention relates to apparatus adapted to distinguish between the presence of flame due to combustion of fuel discharge from a burner and the absence of the flame. In known devices of the kind utilizing means responsive to flame radiation the difficulty arises, when a combustion space is supplied with fuel by a plurality of burners, that the flames from different burners may be adjacent and may even intermingle, with the result that discrimination between the different flames becomes difficult and a flame failure device applied to one burner may not operate upon failure of the flame at the burner if there is a flame from an adjacent burner.

An object of the invention is the provision of apparatus capable of distinguishing the flame from an associated burner from the flame or flames from another burner or other burners.

The present invention includes apparatus adapted to distinguish between the presence of flame due to combustion of liquid fuel discharged from a first burner and the absence of the flame in the presence of flame due to combustion of fuel discharged from one or more adjacent burners, including modulating means adapted by imparting pulses to the fuel discharged from the first burner to effect modulation of the flame at predetermined frequency, radiation responsive means subject to radiation from the flame and detecting means subject to the output from the radiation responsive means and adapted by responding to the frequency of flame modulation to distinguish between the presence and the absence of flame from the first burner in the presence of flame from the adjacent burner or burners.

The invention also includes apparatus adapted to distinguish between the presence of flame due to combustion of liquid fuel discharged from a first burner and the absence of the flame in the presence of flame due to combustion of fuel discharged from one or more adjacent burners, including modulating means adapted by imparting vibrations to the burner tip to effect modulation of the flame at predetermined frequency, radiation responsive means subject to radiation from the flame and detecting means subject to the output from the radiation responsive means and adapted by responding to the frequency of flame modulation to distinguish between the presence and the absence of flame from the first burner in the presence of flame from the adjacent burner or burners.

The invention will now be described, by way of example, with reference to the accompanying drawings, in which:

FIG. 1 is a diagrammatic representation of a multiple oil burner installation firing into a common furnace together with a means for effecting modulation of the burners flames and detecting means responsive to the modulated flames; and

FIG. 2 is a partly diagrammatic, fragmentary sectional elevation of a burner barrel and atomizing head.

Referring to the drawings, there is shown an oil burner similar to that disclosed in a co-pending application Serial No. 9,827, filed February 19, 1960, now Patent No. 3,145,931, in which a signal generator 2 operates a magnetostrictive transducer 4 attached to the rear end face 6

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of a burner barrel 8 and arranged to vibrate an atomizer head 10 at an ultrasonic frequency in the region of 20 kilocycles per second.

The burner barrel 8 at the forward end thereof includes a stepped velocity transformer 12 which has the effect of increasing the amplitude of vibrations transmitted to the atomizer head 10. A spray plate 14 is secured to the atomizer head 10 by means of a cap nut 16 and the front end face 18 of the atomizer head is positioned at an exact multiple of one half of the wavelength of the vibration applied to the burner barrel 8 by the transducer 4 from the rear end face 6. A mounting means 20 including an oil feed inlet 22 connecting with an axial duct 24 in the burner barrel is positioned with the center thereof an exact odd multiple of one quarter of the wavelength of the applied vibration from the rear end face 6.

The burner barrel 8 is manufactured from a metal having a low acoustical impedance, such as mild steel, brass or stainless steel, and is formed in one piece, the axial duct 24 being drilled from the rear face 6 towards the atomizer head 10 and the portions 25 of the duct adjacent the rear end face 6 enlarged and tapped. A plug 26 is secured, e.g. screwed and welded, into the enlarged portion 25 of the duct, the remaining section of the enlarged portion being utilized to secure the transducer 4 to the burner barrel 8 by means of a threaded stub (not shown) on the transducer. Alternatively, the barrel 8 can be formed as two portions, the portions being welded together by a weld extending through the thickness of the material and positioned at a node in order to obtain a good acoustical coupling between the two portions.

A modulator 30 is arranged to modulate the signal generated by the generator 2 and transmitted to the transducer 4.

A flame detecting unit includes a germanium junction photo-electric cell 32, focused upon the flame produced by the burner, connected to an amplifier 34 operating at the frequency of vibration of the transducer 4, a detector and amplifier 36 tuned to the modulated frequency imposed by the modulator 30 and a relay 38 arranged to be operated by the detector and amplifier 36.

In operation, the modulator 30 modulates the signal produced by the generator 2 and transmitted to the transducer 4 in a manner characteristic to the burner. The modulated ultrasonic vibrations are applied by the transducer 4 to the burner barrel 8 and are transmitted through the burner head 10 to the liquid fuel and thence to the burner flame, thereby modulating at least the infra-red portion of the flame. The germanium junction photo-electric cell 32 responds to the radiation emanating from the flame and produces an output which is modulated at the characteristic frequency. The output from the photo-electric cell 32 is fed to the amplifier 34 operating at the applied frequency. The amplified output at the applied frequency is fed to the detector and amplifier 36 tuned to the modulated characteristic frequency and which produces a signal dependent only upon the characteristic frequency. The signal output of the detector and amplifier 36 is fed to the relay 38 which is arranged so that the absence of a signal causes the relay 38 to operate giving warning of the absence of flame at the burner and also energizing shut-off means 40 for the oil supply line 27 to the burner.

Since the detector and amplifier 36 is tuned to the modulated frequency of vibration, the output is independent of any other flame within the field of sight of the photo-electric cell 32 and the relay 38 will operate upon absence of flame at the burner regardless of the presence of flame at adjacent burners 10A firing into a common combustion chamber 33.

It will be appreciated that the flame of an adjacent liquid fuel burner 10A is modulated at different fre-

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quencies, such as by a modulator 30A tuned to a different frequency than modulator 30 of burner 10, and a respective detecting unit 36A associated with a photo-electric cell 32A focused on the individual flame is tuned to the frequency characteristic of the flame, so that the respective relay 38A operates upon the absence of the flame from the associated burner.

It will be understood that the vibrations may be applied to the burner flame by means other than the magnetostrictive transducer 4, such as by a barium titanate piezo-electric transducer, a magneto-electric transducer or other suitable mechanical means, and that other suitable photo-electric cells, such as a lead sulphide cell, may be used instead of the germanium junction photo-electric cell.

It will also be understood that the flame of any liquid fuel burner having a fuel discharge orifice may be modulated at a characteristic frequency so that the invention is applicable to oil burners of the return flow type or of the steam or air atomizing type.

The modulator 30 is an essential part of the apparatus since it is the signal modulated thereby that is detected, with different burner flames being modulated with different modulation signal frequencies in order to distinguish one flame from the other when in the presence of one another when a number of burners are operating.

While in accordance with the provisions of the statutes there is illustrated and described herein the best form and mode of operation of the invention now known to the inventors, those skilled in the art will understand that changes may be made in the form of the apparatus disclosed without departing from the spirit of the invention covered by the claims, and that certain features of the invention may sometimes be used to advantage without a corresponding use of other features.

What is claimed is:

1. In combination, a combustion chamber, a plurality of burners each discharging a flame into said combustion chamber with the flame from each burner exposed to radiation from at least one other burner, means supplying fuel to said burners, means associated with each of said burners for distinguishing the presence or absence of their respective flames in the presence of flame due to the combustion of fuel from one or more other of said burners, each of said distinguishing means including a modulating means imparting pulses to the radiation of its respective burner flame at a predetermined frequency other than that of said other burners, radiation responsive means operably associated with said burners and oriented to sight the radiation of said flames to produce a fluctuating output signal corresponding to the frequency of the radiation of each of said flames, and means responsive to said radiation responsive means for detecting the fluctuating output signal corresponding to the frequency of the radiation of a given flame from the output signals corresponding to the radiation of said other flames to distinguish between the presence and absence of said given flame.

2. Apparatus as claimed in claim 1 wherein said modulating means includes a transducer applied to the outer end of the burner, said transducer being adapted to produce longitudinal vibrations in the burner, and the length between the said outer end and the burner tip comprising an even number of quarter wavelengths of the vibrations.

3. Apparatus as claimed in claim 2, wherein a part of the burner extending rearwardly from the tip is formed as a velocity transformer.

4. Apparatus as claimed in claim 2, wherein the burner is formed as one piece having an axial bore extending therethrough and terminating at the inner end thereof in a passage of smaller diameter than the bore, a plug closing the outer end portion of the bore, and a liquid fuel inlet extending radially through the barrel to connect with the bore.

5. Apparatus as claimed in claim 4, wherein the trans-

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ducer is mounted in abutment with the outer end face of the burner.

6. Apparatus as claimed in claim 2, including a mounting means located on said burner at an odd number of quarter wavelengths of the applied vibrations from the outer end of the burner.

7. Apparatus as claimed in claim 2, including a fuel inlet to the burner located at an odd number of quarter wavelengths of the applied vibrations from the outer end of the burner.

8. Apparatus as claimed in claim 7, including a mounting flange for and the fuel inlet to the burner at the same location in the length of the burner.

9. Apparatus as claimed in claim 1, wherein said modulating means includes a transducer, an electric oscillator for energizing the transducer, and characteristic signal means arranged to modulate or pulse the electric oscillations at a frequency characteristic of said burner.

10. Apparatus as claimed in claim 9, including an amplifier connected to the output of the radiation responsive means tuned to the frequency of the electrical oscillations and having an output connected to a relay through an amplifier and detector tuned to the characteristic frequency.

11. In combination, a combustion chamber, a plurality of burners each discharging a flame into said combustion chamber with the flame from each burner exposed to radiation from at least one other burner, means supplying fuel to said burners, means associated with each of said burners for distinguishing the presence or absence of their respective flames in the presence of flame due to the combustion of fuel from one or more other of said burners, each of said distinguishing means including a modulating means imparting pulses to the radiation of its respective burner flame at a predetermined frequency other than that of said other burners, a radiation responsive means operatively associated with each burner and oriented to sight the radiation of its respective flame, and tuned detecting means responsive to the output from its respective radiation responsive means and responding to the frequency of flame modulation to distinguish between the presence and absence of flame at its respective burner in the presence of flame from an adjacent burner, and means responsive to an indication of an absence of flame by said detecting means to stop the flow of fuel to the respective burner.

12. In combination, a combustion chamber, a plurality of burners each discharging a flame into said combustion chamber with the flame from each burner exposed to radiation from at least one other burner, means supplying fuel to said burners, means associated with each of said burners for distinguishing the presence or absence of their respective flames in the presence of flame due to the combustion of fuel from one or more other of said burners, each of said distinguishing means including a modulating means imparting pulses to the radiation of its respective burner flame at a predetermined frequency other than that of said other burners, radiation responsive means operably associated with said burners and oriented to sight the radiation of said flames to produce a fluctuating output signal corresponding to the frequency of the radiation of each of said flames, and means responsive to said radiation responsive means for detecting the fluctuating output signal corresponding to the frequency of the radiation of a given flame from the output signals corresponding to the radiation of said other flames to distinguish between the presence and absence of said given flame, said modulating means including a transducer applied to the outer end of the burner, said transducer being adapted to produce longitudinal vibrations in the burner.

13. Multiple burner apparatus comprising, in combination, a plurality of burners in a common fire box, individual means for respectively supplying fuel to said burners, each said means including valve means normally operative to shut off said fuel supply, individual means associated with each said fuel supply for imposing a different fre-

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quency fluctuation on each said fuel supply for causing the flame of each associated said burner to flicker at the associated said different frequency, monitoring means common to a plurality of said burner flames and responsive coincidently to said different frequency fluctuations of said burner flames, individual means associated with each said valve means and operable by said monitoring means for individually manifesting the presence of the associated said flames, and thereby holding said associated valve means inoperative.

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15		JAMES W. WESTHAVEN, <i>Primary Examiner.</i>	
		PERCY L. PATRICK, <i>Examiner.</i>	

UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,233,650

February 8, 1966

Alfred Frank Cleall

It is hereby certified that error appears in the above numbered patent requiring correction and that the said Letters Patent should read as corrected below.

In the grant, lines 1 to 3, for "Alfred Frank Cleall, of London, England," read -- Alfred Frank Cleall, of London, England, assignor to Babcock & Wilcox Limited, of London, England, a company of Great Britain, --; line 12, for "Alfred Frank Cleall, his heirs" read -- Babcock & Wilcox Limited, its successors --; in the heading to the printed specification, line 6, for "Alfred Frank Cleall, 209 Euston Road, London NW. 1, England" read -- Alfred Frank Cleall, London, England, assignor to Babcock & Wilcox Limited, London, England, a company of Great Britain --; column 1, line 64, for "burners" read -- burner --; column 4, line 69, for "longiutdinal" read -- longitudinal --.

Signed and sealed this 27th day of September 1966.

(SEAL)

Attest:

ERNEST W. SWIDER
Attesting Officer

EDWARD J. BRENNER
Commissioner of Patents