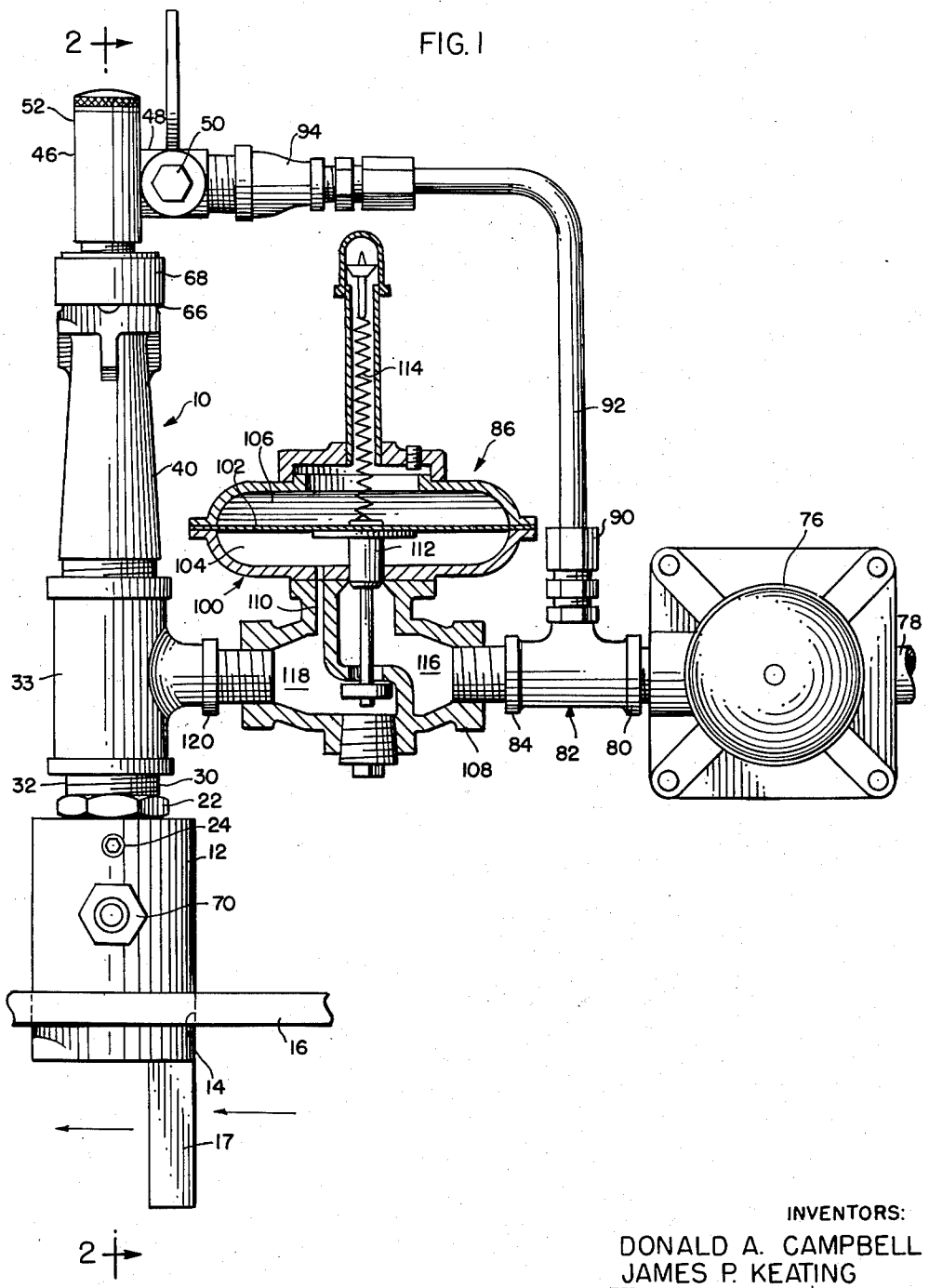
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DRAFT COMPENSATING BURNER SYSTEM

Filed Dec. 29, 1958 2 Sheets-Sheet 1

FIG. 1



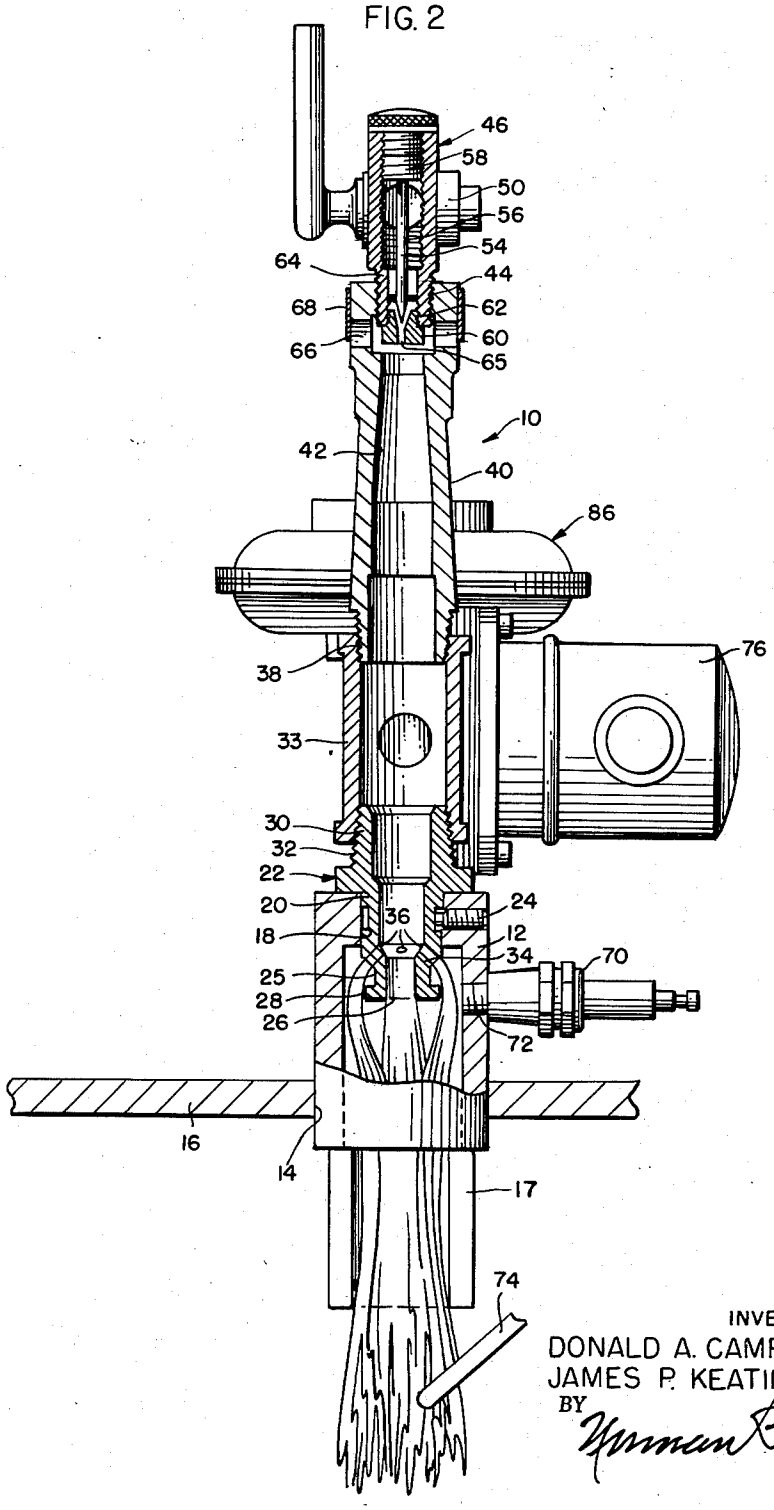
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FIG. 2



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DRAFT COMPENSATING BURNER SYSTEM

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The present invention relates to an apparatus and system for controlling the mixture of fluids, specifically a gaseous fluid such as fuel gas which is combustible with a second gaseous fluid such as air, oxygen or the like. The invention is specifically concerned with the operation of atmospheric burners, i.e., burners of the type which depend for their operation upon the creation of a draft in the vicinity of the burner nozzle to secure sufficient secondary air to effect combustion.

It is obvious that in connection with such atmospheric burners, for any given setting of the air openings, whether they be primary air openings or secondary air openings, the amount of air admitted to the burner for flow therethrough or therearound, will vary in substantially direct proportion to draft conditions. Under conditions of small draft variance, the consequent variation in the gas-air ratio is not important. Under conditions of large draft variance numerous problems or difficulties present themsevles. For example, in an air heater which is part of a circulating system and which employs an atmospheric burner, wide variations in draft are encountered during operation of the system. With the circulating fan shut off, the draft may be extremely low, whereas when the fan is in operation, a relatively high draft may exist at the burner. Furthermore, as the heating system warms up due to wind conditions or the like, the draft may fall to such low level that insufficient air is available to prevent the flame from becoming so rich that it will blow away from the burner nozzle and thus become extinguished. Conversely, if, in such a system, an automatic change from a condition of low draft at the burner to a condition of high draft takes place, the induced air will reach such proportion that it is far in excess of the quantity of available gas so that stoichiometrical conditions cannot possibly be maintained.

In combustion installations employing flame protection systems wherein the ground contact of the flame with an electronic flame rod is depended upon for continuity of operation of a pilot burner, for example, the variations in air-gas ratios of the pilot burner frequently cause the pilot flame to push away, so to speak, from the nozzle or be extinguished so that ground contact is no longer maintained and the system becomes automatically shut down. Such shutdowns are quite frequent in connection with conventional pilot burners and have become a source of irritation to operators of such systems.

The present invention is designed to overcome the above-noted limitations that are attendant upon the use of conventional atmospheric burners and systems, and toward this end, it contemplates the provision of a novel combustion system which will enable an atmospheric burner, which normally can depend only on the kinetic energy of the gas jet to pull to the burner the requisite quantity of air for a proper or stoichiometric gas-air ratio, to rely upon an increase in the draft to supply in the correct proportion the necessary additional gas which

may be needed for such stoichiometric gas-air conditions.

The provision of a combustion system of the character briefly outlined above being among the principal objects of the invention, another and important object is to provide a system utilizing an atmospheric burner which will at all times maintain a proper gas-air ratio at the burner nozzle over extremely wide variations in draft conditions.

Numerous other objects and advantages of the invention not at this time enumerated will become more readily apparent as the following description ensues.

In the accompanying two sheets of drawings forming a part of this specification, one illustrative embodiment of the invention has been shown.

In these drawings:

FIG. 1 is a plan view of an apparatus embodying the principles of the present invention; and

FIG. 2 is a sectional view taken substantially along the line 2—2 of FIG. 1.

Referring now to the drawings in detail, the particular draft compensating burner system selected for illustration comprises a more or less standard atmospheric burner **10** which has been modified to a certain extent to adapt the same to the present system by excluding secondary air around and in the immediate vicinity of the nozzle. For purposes of definition, throughout this description, primary air may be regarded as air which is introduced to the burner for mixture with fuel gas prior to combustion, or in other words, ahead of the combustion zone. Secondary air may be regarded as such air as is introduced to the burner in the vicinity of the nozzle or to the combustion zone of the furnace or other piece of equipment with which the burner is associated for immediate combustion.

The burner **10** involves in its general organization a cup-shaped holder **12**, the forward open end of which projects through and is sealed within an opening **14** provided in a draft chamber wall **16**. The forward open end of the holder **12** is provided with a forwardly extending shield **17** which is positioned in the path of secondary air passing through the draft chamber as indicated by the arrows in FIG. 1. The end wall of the holder **12** is provided with an opening **18** through which there projects the medial cylindrical body portion **20** of a burner nozzle **22**. The nozzle **22** is held in position within the holder **12** by means of a set screw **24**. The reduced forward end region **25** of the nozzle **22** projects inwardly of the holder **12**, and the rim of the nozzle orifice **26** is flanged as at **28**. The rear end region of the nozzle is enlarged as at **30**, this region being threaded exteriorly as at **32** for threaded reception of the nozzle within one end of a T-fitting **33** which constitutes an element of the burner as a whole. The nozzle **22** is formed with a frusto-conical section **34** connecting the medial body portion **20** with the reduced forward end section **25** and a series of small inclined passages or weepholes **36** extend through the wall of the frusto-conical section **34** for purposes that will be made clear presently.

The rear end of the T-fitting **33** threadedly receives as at **38** the forward end of a venturi conversion sleeve having a flared venturi throat **42**, the rear small end of which threadedly receives as at **44** a gas cock **46**. The gas cock **46** is of T-shape design and has a short leg **48** provided with a manually operable valve **50** therein,

the leg 48 communicating with a leg 52 which extends axially of the burner 10. A manually settable needle valve 54 including a valve stem 56 and adjusting head 58 cooperates with a valve seat 60 threadedly received as at 62 in the forward reduced end 64 of the leg 52 and having a gas port 65 leading therefrom. A series of radial passages 66 which constitute primary air passages, are formed in the injector tube 42 adjacent the rear end of the latter and these passages may have the effective size thereof regulated by means of a shutter 68 which is movable longitudinally along the injector tube 40.

In the nozzle region of the burner 10, a spark plug 70 may be threaded as at 72 through the wall of the holder 12 and affords a convenient means for initially igniting the burner. The burner 10 may have associated therewith a conventional flame failure system including an electronic flame rod such as has been schematically shown at 74 and which preferably is disposed in the path of the flame issuing from the burner nozzle. It will be understood that the flame rod 74 is operatively disposed in an electronic circuit including relay and other devices which operate, when the flame issuing from the nozzle fails to afford good ground contact with the holder 12 by virtue of its being extinguished, its pushing away from the nozzle orifice, or for any other reason, an instrumentality such as a solenoid valve or the like by means of which fuel is supplied to the burner to close the valve and shut off the gas supply. The use of such a flame protection system in connection with the present draft compensating system is merely incidental and it is illustrated herein in connection with a solenoid valve 76 through which fuel gas is caused to pass before being conducted to the burner as will become clear presently.

The solenoid valve 76 is of conventional design and serves, when in its normally energized condition, to allow fuel gas to flow from a supply line 78 through one leg 80 of a T-fitting 82 having a leg 84 connected to a conventional zero-governor 86, and having a leg 88 connected through a fitting assembly 90 to a conduit 92 which, in turn, is connected through a fitting assembly 94 to the short leg 48 of the gas cock 46.

The zero-governor 86 may be of any preferred construction, but in the present instance, it is shown as comprising a casing 100, a pressure responsive member 102 within the casing and defining therein adjacent chambers 104 and 106, a valve body 108 vented as at 110 on its discharge side to the chamber 104, a valve member 112 connected to the pressure responsive member 102, and a spring 114 connected to the diaphragm and normally urging the same in a direction tending to close the valve. The valve body 108 is divided by the valve member 112 into two chambers including an inlet chamber 116 which is connected to the leg 84 of the T-fitting 82, and a discharge chamber 118 which is connected to a leg 120 of the T-fitting 33 and which leg establishes a second gas inlet port for the burner 10. The function of the zero-governor 86, as is well understood in the art, is to permit fuel gas to flow therethrough only when the pressure at the outlet or discharge side thereof is a negative pressure below atmospheric pressure.

In the operation of the above described burner system, the solenoid valve 76 will, under the influence of the flame protection system, permit fuel gas to flow from the gas supply conduit 78, through the T-fitting 82 and conduit 92 to the gas cock 46. The gas passing through the gas cock 46 and leaving the port 65 enters the throat 42 of the injector tube 40 and, by a Venturi action, draws from the primary air openings 66 a quantity of air for admixture with the gas in the throat 42. The amount of air which may be thus drawn through the openings 66 may be regulated by the shutter 68. Under conditions of no draft in the vicinity of the burner nozzle, or under conditions of slight draft, the burner will function in the manner of conventional atmospheric burners and a relatively rich flame will be created at the burner nozzle due to the fact that the quantity of air entering the throat 40 through the openings 66 is small. The flame produced at the burner nozzle orifice 26 thus fills the entire holder 12 and extends beyond the holder rim and into contact with the flame rod 74 and produces excellent ground contact therewith.

As the draft within the combustion chamber 124 on the side of the wall 16 remote from the burner 10 is increased, whether suddenly under the influence, for example, of the operation of an air circulating fan, wind conditions in connection with a high chimney or the like, or gradually under the influence of a general warming up of the furnace, a reduction in pressure extending back through the holder 12, orifice 26, and inclined passages 20 will reduce the pressure in the T-fitting 33 and communicating injector throat 40 so that subatmospheric pressure will exist in these regions. This negative pressure will considerably increase the flow of induced air through the primary air openings 66 and it will also have a tendency to only slightly increase the flow of fuel gas from the gas cock 46 through the orifice 65. However, the preponderance of increased air flowing, the burner will be such that the orifice 65 cannot possibly supply the quantity of fuel gas necessary for proper stoichiometric combustion or flame conditions and, as a result, a lean flame would ordinarily issue from the nozzle orifice 26 were it not for the provisions of the present invention whereby additional fuel gas may be supplied to the T-fitting 33 from the zero-governor 86 at a region adjacent the wide end of the venturi throat 42 where the presence of such sub-atmospheric pressure will be "felt," so to speak, and where it will be effective to draw additional gas into the system and in a quantity sufficient to produce stoichiometrical conditions at the burner nozzle orifice 26 by compensating for the increased volume of air which will be induced into the system through the primary air openings 66. By such an arrangement, stoichiometrical conditions at the burner nozzle orifice will not be upset, especially since no provision whatsoever is made in the system for the introduction of secondary air to the burner.

Under these circumstances, the subatmospheric pressure which is created within the T-fitting is reflected to the discharge chamber 118 and the zero-governor will allow a quantity of fuel gas to be drawn therefrom at approximately the proper rate to offset the excess air which is drawn through the primary air openings 66. By such an arrangement, the proper or stoichiometric condition which obtains at the burner nozzle 22 will result in the issuance of a torch-like flame from the nozzle orifice 26. Due to the increased volume of air and gas undergoing combustion within the holder 12, considerable turbulence is developed and the flame is thus maintained in intimate contact with the metal holder so that a good ground condition is established for operatin of the flame failure system.

There has been illustrated and described herein a practical embodiment of the invention, proven efficient in actual practice. No further attempts have been made herein to illustrate other modifications and adaptations which are contemplated, for example, adaptations of the present system to atmospheric burners other than the pilot burner selected for illustration. It is believed, however, that the disclosure made herein will enable those skilled in the art to embody or adapt the invention in whatever environments may suggest themselves.

The invention is not to be understood as restricted to the details set forth since these may be modified within the scope of the appended claim without departing from the spirit and scope of the invention.

Having thus described the invention what we claim as new and desire to secure by Letters Patent is:

In a draft compensating burner system of the character described, an atmospheric burner assembly including a cup-shaped combustion member having an open ended passage therethrough one end of which is designed for

communication with the combustion chamber of a furnace or the like, a burner nozzle in communication with the other end of said passage, a T-fitting having aligned inlet and discharge legs respectively and a lateral leg, the discharge leg of said T-fitting communicating with said nozzle, a venturi conversion sleeve establishing a forwardly and outwardly flared gas and air mixing chamber, said conversion sleeve having its forward enlarged end in communication with the inlet leg of said T-fitting, the reduced rear end of said conversion sleeve being provided with an inlet for primary induced air, the reduced end of the conversion sleeve also being provided with an inlet for primary gas, a gas cock for regularly controlling the introduction of air into the gas and air mixing chamber through said inlet for primary gas, a source of gas, a conduit operatively connecting said source to the inlet for

primary gas, and a zero governor having its inlet side connected to said source of gas and having its discharge side operatively connected to the lateral leg of said T-fitting, said zero governor being operable to admit gas to said T-fitting only when sub-atmospheric conditions of pressure within the T-fitting obtain.

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