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Braucksiek et al.

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[45] **Aug. 28, 1973**

[54] **DUAL RATE GASEOUS FUEL BURNER ASSEMBLIES**

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[21] Appl. No.: **155,537**

[52] **U.S. Cl.** **431/285,** 434/347

[51] **Int. Cl.** **F23g 9/00**

[58] **Field of Search** 431/42, 80, 284, 431/285, 347, 348; 239/419.5, 425.5

[56] **References Cited**

UNITED STATES PATENTS

1,995,003	3/1935	MacKenzie et al.	239/419.5
2,918,967	12/1959	Hays et al.	239/419.5 X
1,486,668	3/1924	Kielberg	239/425.5
2,526,748	10/1950	Hill	239/425.5 X
3,561,901	2/1971	Jackson et al.	431/284

FOREIGN PATENTS OR APPLICATIONS

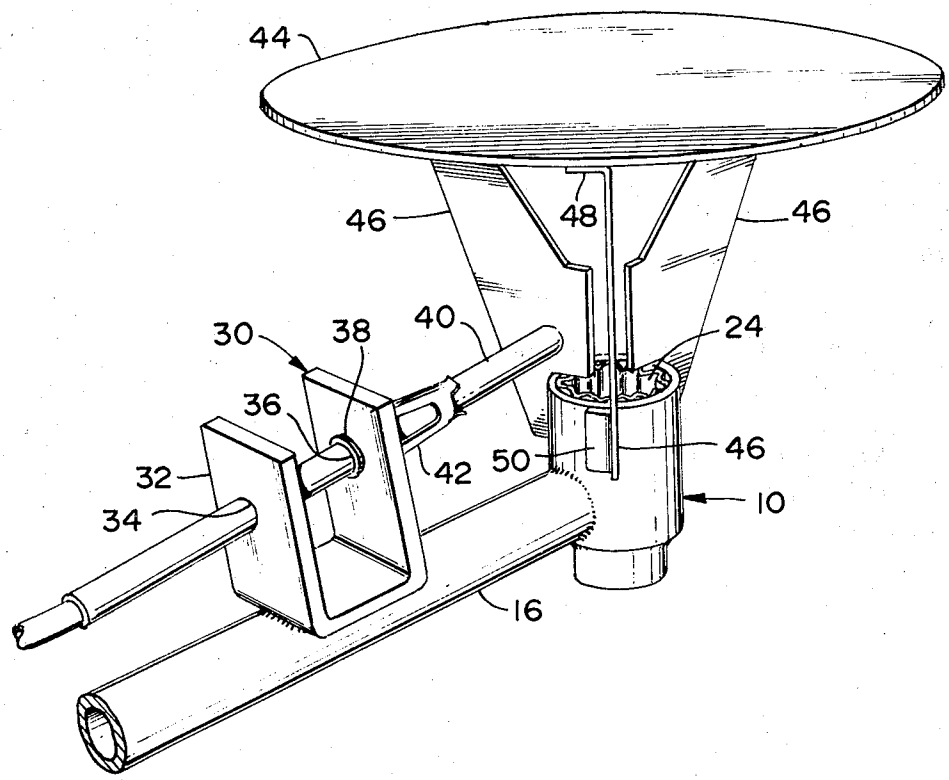
408,842	4/1934	Great Britain	431/42
633,674	1/1962	Canada	431/80

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[57] **ABSTRACT**

Dual rate gaseous fuel burner assemblies wherein a unitary burner is designed to operate at dual rates for full and standby operation in accordance with the fuel flow supplied from a single supply conduit. A flame sensing element is cooperatively disposed upon the burner assemblies such that both the main and standby flame patterns impinge upon the sensing element to provide an effective safety feedback signal for control of the fuel flow to the burner.

10 Claims, 7 Drawing Figures



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2 Sheets-Sheet 1

FIG. 1

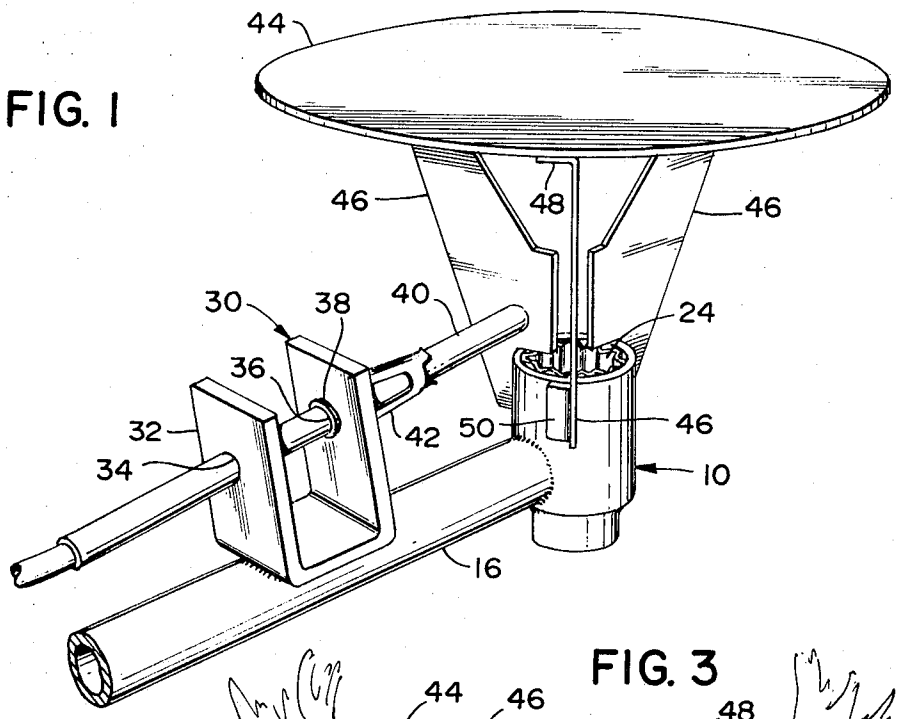


FIG. 3

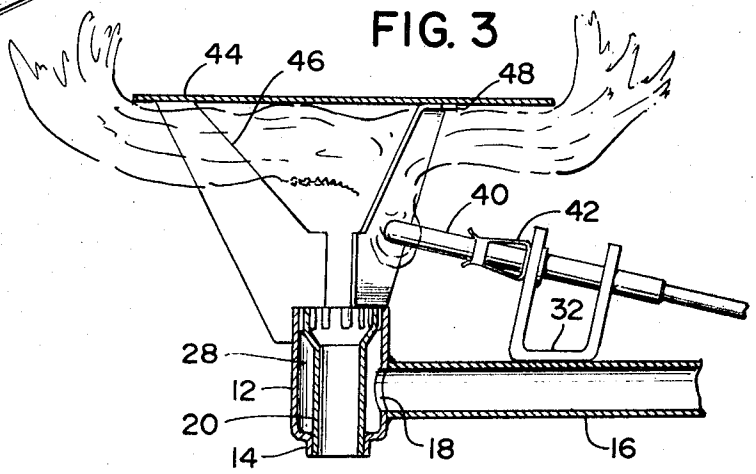


FIG. 2

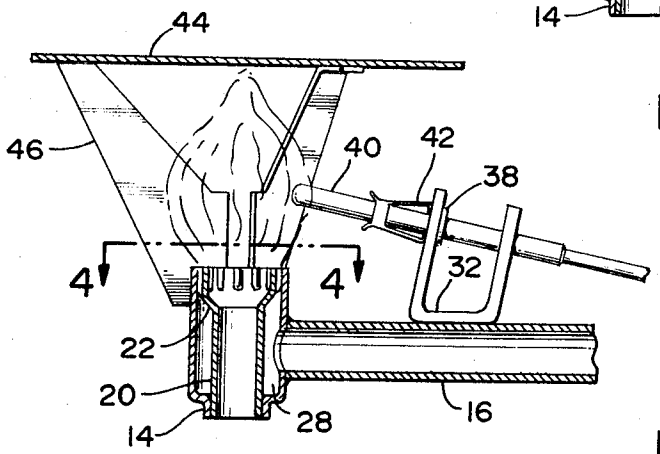
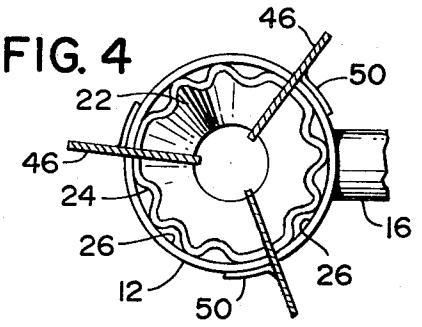


FIG. 4



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FIG. 5

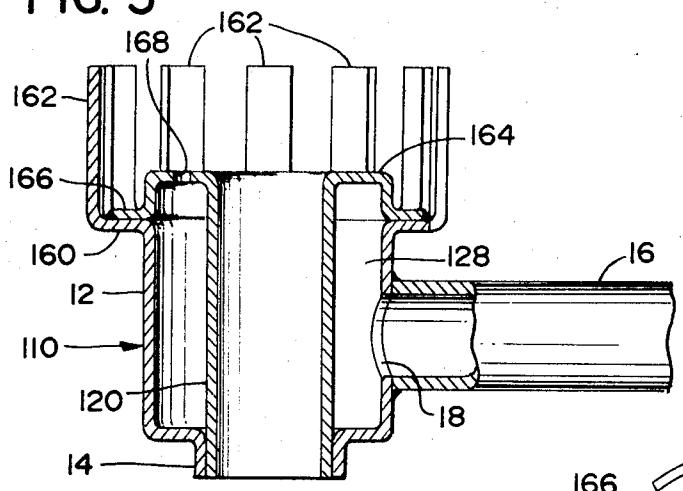


FIG. 6

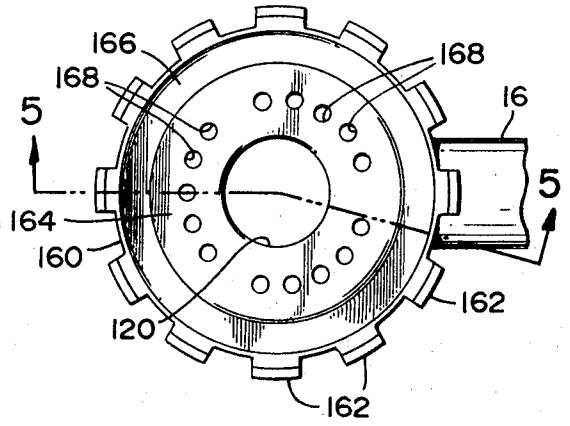
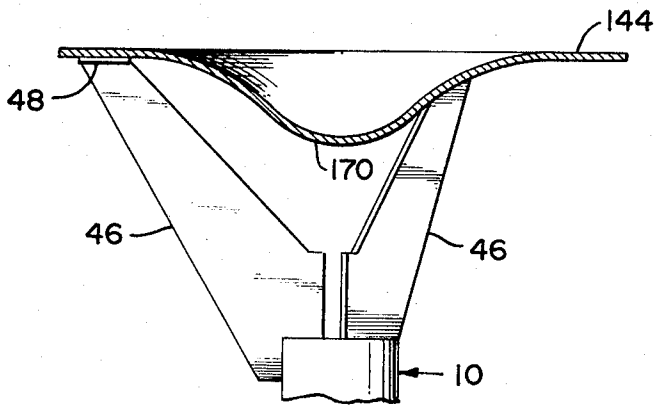


FIG. 7



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DUAL RATE GASEOUS FUEL BURNER ASSEMBLIES

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to fuel burner systems and, more particularly, to dual rate gaseous fuel burner assemblies for use in such systems.

2. Description of the Prior Art

The prior art, as exemplified by U.S. Pat. Nos. 1,763,295, No. 2,155,339, No. 2,220,247, No. 2,474,547, No. 2,531,316, No. 2,840,152, No. 3,164,200, No. 3,405,999 and No. 3,516,773, is generally cognizant of various types of burner apparatus wherein a main flame is selectively ignited by means of a standby or pilot flame. These prior art patents are representative of conventional approaches in the design of fuel burner systems which are capable of providing plural flame patterns, with a flame or heat sensing element responsive to only a single flame pattern for safety purposes. Systems of this general type have been found to be disadvantageous in that incomplete safety characteristics are exhibited thereby and, further, that the various burner assemblies used therein are unduly complicated in design and construction rendering them economically unsatisfactory in many instances.

SUMMARY OF THE INVENTION

The present invention is summarized in a dual rate burner including a housing defining a closed annular chamber surrounding an open vertical air passage, a single fuel inlet port supplying fuel to the housing at high and low rates, a flame spreader carried by the housing in spaced superposition therewith, and outlets defining burner orifices in the top of the annular chamber for supporting high and low rate flame patterns and for directing such flame patterns upwardly of the housing developing an updraft through the open air passage.

It is an object of the present invention to simply and economically construct a burner assembly capable of developing plural flame patterns dependent upon the flow rate of fuel supplied thereto.

Another object of this invention is to construct a unitary burner having a single inlet port and producing plural flame patterns.

This invention has another object in that a heat sensing element is carried by burner apparatus in such a manner that main and standby flame patterns produced thereat always impinge on the heat sensing element.

A further object of the present invention is to construct a dual rate gaseous fuel burner supplied by a single conduit so as to eliminate the need for standby or pilot gas conduits.

Other objects and advantages of the present invention will become apparent from the following description of the preferred embodiments when taken in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a perspective view of a preferred embodiment of a dual rate gaseous fuel burner assembly according to the present invention;

FIG. 2 is a cross-sectional view of the assembly of FIG. 1 showing the burner apparatus operating under a low-rate flame condition;

FIG. 3 is a cross-sectional view similar to FIG. 2 and showing the burner apparatus operating under a high-rate flame condition;

FIG. 4 is a sectional view taken along line 4—4 of FIG. 2;

FIG. 5 is a partial sectional view of a modification of the burner apparatus of FIG. 1;

FIG. 6 is a top plan view of the burner apparatus of FIG. 5; and

FIG. 7 is a partial sectional view of the burner assembly of FIG. 1 illustrating a modified flame spreader according to the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

As illustrated in FIGS. 1–4, the present invention is embodied in a gaseous fuel burner assembly including a burner, indicated generally at **10**, having a cylindrical housing **12** which is open at both ends and, at its lower end, is deformed to define a concentric, smaller diameter cylindrical neck portion **14**. A single inlet conduit **16** communicates with the interior of housing **12** via inlet port **18** which is defined by a wall of the housing intermediate its ends.

A cylindrical tube **20** having an outer diameter equal to the inner diameter of neck portion **14** of housing **12** is concentrically disposed within the housing **12** as shown in FIGS. **2** and **3** with the lower end of tube **20** seam welded or otherwise suitably attached to the housing so as to provide an air-tight seal therebetween. Tube **20** has, at its upper end, an outwardly flared, frustro-conical portion **22** which is contiguously formed with a fluted cylindrical end portion **24** having an outer diameter equal to the inner diameter of housing **12**. As can be seen in FIG. **4**, fluted portion **24** of cylindrical tube **20** cooperates with housing **12** to define a plurality of circumferentially spaced outlet ports **26** for the burner. Referring to FIGS. **2** and **3**, the concentric arrangement of housing **12** and cylindrical tube **20** provides a hollow space therebetween which defines a generally cylindrical, annular chamber **28** for receiving a flow of gas from inlet conduit **16**, with chamber **28** surrounding an open vertical air passage defined by tube **20**.

Mounted upon inlet conduit **16** is a flame sensing assembly, indicated generally at **30**, including a generally U-shaped upright mounting bracket **32** which is affixed to conduit **16** in any suitable manner such as by welding. The upright legs of bracket **32** are aligned in parallel and are obliquely disposed with respect to the base thereof, as can be seen in FIGS. **2** and **3**. Each of the legs of bracket **32** defines an axially aligned aperture **34** and **36**, respectively, with an annular collar **38** of a retaining clip disposed adjacent the periphery of aperture **36**. A thermocouple **40** is mounted through apertures **34** and **36**, and a suitable fastener such as the retaining clip **42** is inserted in the aperture **36** so as to secure the thermocouple **40** to the burner assembly.

A flat, flame spreading plate **44** is mounted upon three equally spaced support legs **46** over burner **10** and is attached by any suitable means such as spot welding to a bent tab **48** formed at the upper end of each leg. Each of the legs **46** extends partially across the radius of housing **12** (FIG. **5**) and has an arcuate tab **50** at a lower end thereof to facilitate attachment to the housing **12** by welding or any other suitable means. It is noted that the apertures **26** defined by

fluted cylindrical portion 24 of tube 20 are located in three equal segments or arcs about the periphery of housing 12, and the aforementioned legs 46 are oriented so as to be positioned above the spaces formed between the three segments whereby the burner flame does not directly impinge upon the legs.

In operation, the dual rate burner assembly of FIGS. 1–4 is designed to be used in cooperation with a control device (not shown) having a single outlet and adapted to provide dual rates of gas flow in accordance with preselected standby or main burner modes of operation. Such a control device may also include an electromagnetic safety holding device, of conventional design, which is connected to receive the generated thermoelectric potential from thermocouple 40 when heated by the flame from burner apparatus 10. The holding device operates a safety valve for the gas such that in the event no flame impinges upon the thermocouple 40, the holding device will release the valve and safely cut-off the flow of fuel to the burner.

To initiate burner operation, the control device is set to its low-rate position and the holding device is manually held in its reset position whereupon a low-rate flow of gas is fed to single inlet conduit 16 of the burner 10. The incoming gas enters chamber 28 of housing 12 under low pressure and escapes upwardly through ports 26. Since tube 20 is hollow and is open at both ends, the gas escaping upwardly from ports 26, when ignited, causes an updraft of air through tube 20 whereby the standby or low-rate flame pattern illustrated in FIG. 2 is produced by burner 10. It is noted that the thermocouple 40 is supported by bracket 32 in a slightly inclined position with the tip or flame responsive end thereof disposed for impingement by the standby flame. Thus, after establishment of the standby flame, the thermocouple 40 will be heated so as to produce a sufficient energizing voltage for the electromagnetic holding device in the gas control assembly (not shown) whereupon the holding device may be released with the safety shut-off valve held in its open position.

After release of the holding device, the control assembly is then set to its main or "on" position whereupon a hiGh-rate gas flow is established for the burner. The low-rate flame pattern at the burner 10 is therefore transformed to a high-rate pattern, as shown in FIG. 3, with the BTU capacity of the burner determined primarily by the depth of the flutes in the top portion 24 of tube 20. Since the gas from ports 26 is flowing at a much higher velocity than during standby operation, the flame cannot propagate down to the top of the burner and is spread outwardly by the flame spreader 44. At this point, even though the gas velocity is much greater than during standby and even though the flame produced during full or main operation is spaced from the top surface of the burner, as illustrated, the disposition of thermocouple 40 is such that the tip thereof extends into the gas stream so as to disturb the fuel flow in the vicinity of the thermocouple. The turbulence caused by the thermocouple tip slows down the gas sufficiently to enable the flame to propagate downwardly so as to burn directly about the thermocouple as illustrated, whereupon the presence or absence of a high-rate flame can be safely and effectively monitored.

Once the demand for heating ceases, a low-rate flow of gas is reestablished to the burner 10 whereupon the standby flame pattern of FIG. 2 is produced at the burner and may be maintained until the demand for heat is once again developed. The dual rate burner 10 thus is capable of continued cyclic operation between its high and low flames under thermostatic control in response to the rate of flow of gas supplied thereto. In the event that the flame at the dual rate burner should be extinguished for any reason, when in either its high or low flame mode, the thermocouple 40 will cool and the holding device (not shown) will be deenergized causing the release of the safety shut-off valve to its "off" position thereby precluding raw fuel leakage.

During the cycling of the dual rate burner, it automatically changes between its high and low flame patterns in accordance with the high and low rates of fuel flow to the burner inlet 16. It should be noted that during both high and low rates, the flame impinges directly on the flame responsive element 40; furthermore, the contrary to conventional burner apparatus, during low input conditions (FIG. 2) as well as high input conditions (FIG. 3), the fuel flow exits from the single set of outlet ports 26. Such an arrangement eliminates the necessity of a separate pilot or standby burner resulting in substantial cost reduction in manufacture and assembly. Additional cost reduction is apparent from the use of a single conduit 16 which delivers fuel to burner 10 at both the high and low rates of flow; thus, there is no need for a separate "pilot" conduit and no need for the accompanying fittings which are used to fasten such a separate conduit to the burner and the control device. Furthermore, the burner 10 itself results in significant savings in view of the extremely simplified nature of its design which permits fast and economical manufacture with reduced labor costs.

A modification of the dual rate burner assembly of FIGS. 1-4 is illustrated in FIGS. 5 and 6, and only the structure which differs from that of FIGS. 1–4 is being described in detail for the sake of brevity. Accordingly, the same reference numerals are being utilized for those elements previously described in connection with FIGS. 1–4, and similar reference numbers with 100 added thereto are being utilized to identify elements similar to those previously described.

As is shown in FIG. 5, housing 12 of burner apparatus 110 is offset at its upper end to define a flat annular shoulder or support ring 160 having a plurality of upstanding tabs 162 spaced about the periphery thereof so as to protect the low-rate or standby flame from drafts.

A cylindrical tube 120 having an outer diameter equal to the inner diameter of neck portion 14 of housing 12 is concentrically disposed within the housing and has an inverted annular channel 164 contiguously formed at its upper end as shown in FIG. 5. Channel 164 has a generally U-shaped cross-section and has an outer diameter equal to that of housing 12. An annular flange 166 on the outer periphery of channel 164 is sealably affixed as by welding to shoulder 160 of housing 12, as is the lower end of tube 120 and neck portion 14 of the housing. Tube 120 and housing 12 thus form a hollow space which defines a generally cylindrical, annular chamber 128 which receives a flow of gas from inlet 18. A plurality of circumferentially spaced outlet ports 168 are defined by the upper wall or floor of annular channel 164, with the ports 168 disposed in three equally spaced groups about the burner to prevent direct flame impingement upon legs 46 of the flame spreader 44 as described in connection with the structure of FIGS. 1–4.

The operation of the burner **110** of FIGS. **5** and **6** is substantially identical with that of the burner **10** of FIG. **1** and thus will not be described again for the sake of brevity. It is noted that while the outlet ports of the embodiment of FIGS. **5** and **6** are in the form of spaced apertures **168**, as compared with the fluted construction of burner **10** of FIG. **1**, the standby and main flame patterns produced by burners **10** and **110** are substantially the same and, in both embodiments, the high and low flames impinge directly upon thermocouple **40** to enable full-cycle flame detection and control. It is also noted that the tabs or baffles **162** (FIG. **5**) serve to prevent undesired flame outage as may be caused by drafts.

A modification of the flame spreader **44** of FIG. **1** is shown in FIG. **7**. Flame spreader **144** of FIG. **7** is substantially similar to that of FIG. **1** with the exception that the central portion thereof is deformed to provide a smooth, radially symmetrical bulge **170** which faces the top of the burner **10**. The deformed shape of flame spreader **144** illustrated in FIG. **7** produces a modification in the high-rate or main flame pattern of the burner apparatus and may be used in those applications where such a modified flame pattern may be desired without in any way detracting from the operation of the dual rate burner assemblies of the present invention.

In accordance with the present invention, the unitary dual rate burner exhibits desired performance characteristics at two levels of operation, main flame and standby flame, thereby solving a long standing problem; namely, how to obviate the need for a pilot burner in a gas burner system. The significance of such performance becomes apparent when comparing the increase of the input rate of gas from the low rate maintaining the standby flame to the high rate maintaining the main flame. For example, a typical pilot burner would have an input rate of 750 to 1000 BTU per hour at a particular pressure generally measured in inches of a water column and such a pilot burner could be operated between two flame levels such as is shown in U. S. Pat. No. 3,405,999. However, in prior art devices of this type, the increase in the input rate is usually limited to a multiplier of approximately three. Since the input rate is proportional to the square root of the gas pressure, an increase in the input rate in such a conventional pilot burner to the rate normally desired for a main flame, which is considerably greater than the standby or pilot rate, would result in a relatively high gas pressure which creates a number of serious problems such as blowing most if not all of the flame away from the flame sensing thermocouple and even blowing the entire flame out. Thus, a conventional pilot burner lacks the capability of operating at the relatively high input rate necessary to sustain a main flame. The present invention, on the other hand, has the particular advantage of a single burner capable of operating at a standby flame level as well as at a main flame level and further capable of maintaining direct flame impingement on a flame sensing device at both levels.

Inasmuch as the present invention is subject to many variations, modifications and changes in detail, it is intended that all matter contained in the foregoing description or shown in the accompanying drawings shall be interpreted as illustrative and not in a limiting sense.

What is claimed is:

1. A dual rate gas burner comprising

burner housing means defining a closed annular chamber surrounding an open vertical air passage,

said burner housing means including a cylindrical housing member and a cylindrical, hollow tube concentrically disposed within said housing member and affixed therein to define said annular chamber therebetween,

a single fuel inlet port for said housing means supplying fuel thereto at high and low rates,

flame spreading means carried by said housing means, said flame spreading means being disposed in spaced super-position with said housing means for spreading a flame issuing therefrom when a high rate of fuel flow is supplied to said housing means, and

outlet means in said housing means defining burner orifice means in the top of said annular chamber for supporting high and low rate flame patterns in accordance with the rate of fuel supplied thereto and for directing both of such flame patterns upwardly of said housing means developing an updraft through said open air passage,

said cylindrical housing member having annular shoulder on an upper end thereof and a plurality of upstanding tabs spaced about the periphery of said flange.

2. The invention as recited in claim **1** wherein said cylindrical tube has an outwardly flared, fluted upper end cooperating with said housing member to define a plurality of burner outlet ports comprising said burner orifice means, and wherein the lower end of said tube is sealingly secured to the lower end of said housing member.

3. The invention as recited in claim **1** wherein said hollow tube has an inverted annular channel contiguously formed on an upper end thereof, and wherein said burner orifice means comprises a plurality of spaced burner outlet ports in the floor of said channel.

4. The invention as recited in claim **3** wherein said hollow tube has an annular flange on the periphery of said channel, and wherein said flange is sealingly secured with said shoulder of said housing member.

5. The invention as recited in claim **1** wherein said flame spreading means comprises a flat plate supported upon a plurality of legs affixed to said housing means.

6. The invention as recited in claim **5** wherein said flat plate is centrally deformed to define a smooth, radially symmetrical bulge over said burner orifice means.

7. A multiple rate gas burner and flame sensor combination comprising

a multiple rate burner having a single inlet port adapted to be connected with a source of gas, and outlet means establishing a small standby flame directly adjacent said outlet means and the same said outlet means alternately establishing a larger main flame spaced from said outlet means by the velocity of gas issuing therefrom,

a flame sensor, and

means for locating said flame sensor proximate to said multiple rate burner adjacent said outlet means such that said small standby flame directly impinges upon said flame sensor and said larger main flame projects beyond said flame sensor,

said flame sensor being disposed in a position to develop a decreased-velocity turbulence in the gas flow issuing from said outlet means when said larger main flame is established whereby a portion

of said main flame propagates back toward said outlet means to surround said flame sensor.

8. The invention as recited in claim **7** wherein said multiple rate burner includes housing means defining a closed annular chamber surrounding an open vertical air passage and an inlet conduit connected with said housing means at said single inlet port and extending radially from said annular chamber.

9. The invention as recited in claim **8** wherein said locating means includes attaching means carried upon said inlet conduit, and wherein said flame sensor is obliquely supported upon said attaching means.

10. The invention as recited in claim **7** including flame spreading means mounted in superposition with said multiple rate burner for spreading the larger main flame from said outlet means.

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