

United States Patent

Reich

[15] 3,689,040

[45] Sept. 5, 1972

[54] **PORTABLE SPACE HEATER AND GAS BURNER FOR THE SAME**

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[22] Filed: **Nov. 30, 1970**

[21] Appl. No.: **93,765**

[52] U.S. Cl. **263/19 A, 431/353**

[51] Int. Cl. **F23I 9/04**

[58] Field of Search **263/19 A; 126/21 A; 431/351, 431/352, 353**

[56] **References Cited**

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[57] **ABSTRACT**

A gas burner to be swept by a high velocity air stream has a cup-shaped primary combustion chamber opening forwardly to a coaxial, annular, radially outwardly opening secondary combustion chamber. The primary combustion chamber has a gas inlet in its closed rear end and air inlets in its cylindrical side wall. The secondary combustion chamber is defined by a large annular flange on the front of the primary combustion chamber and a smaller coaxial baffle disc spaced forwardly of the flange.

5 Claims, 5 Drawing Figures

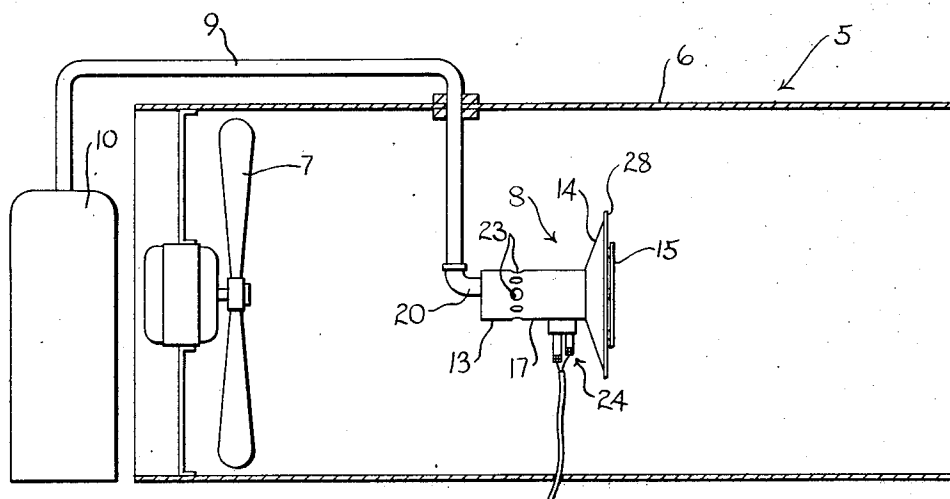


FIG. 1.

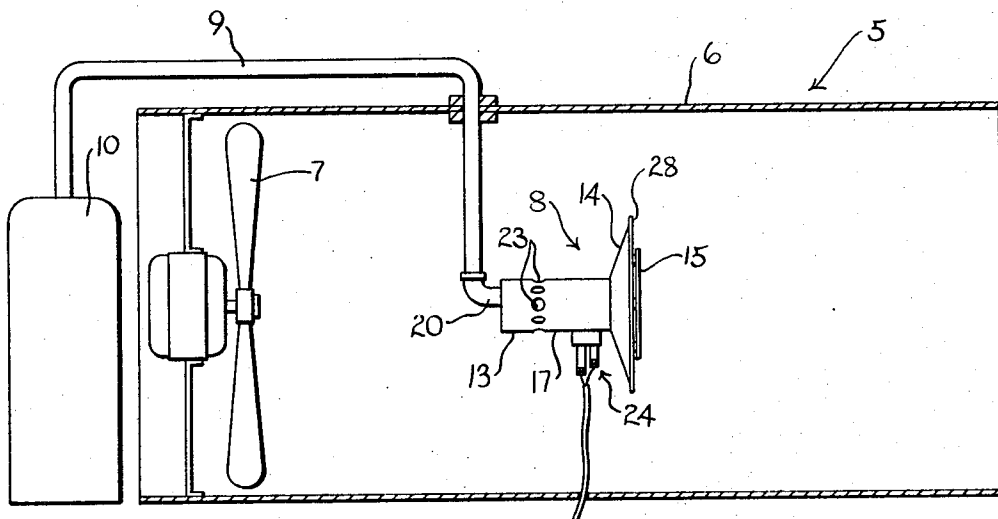
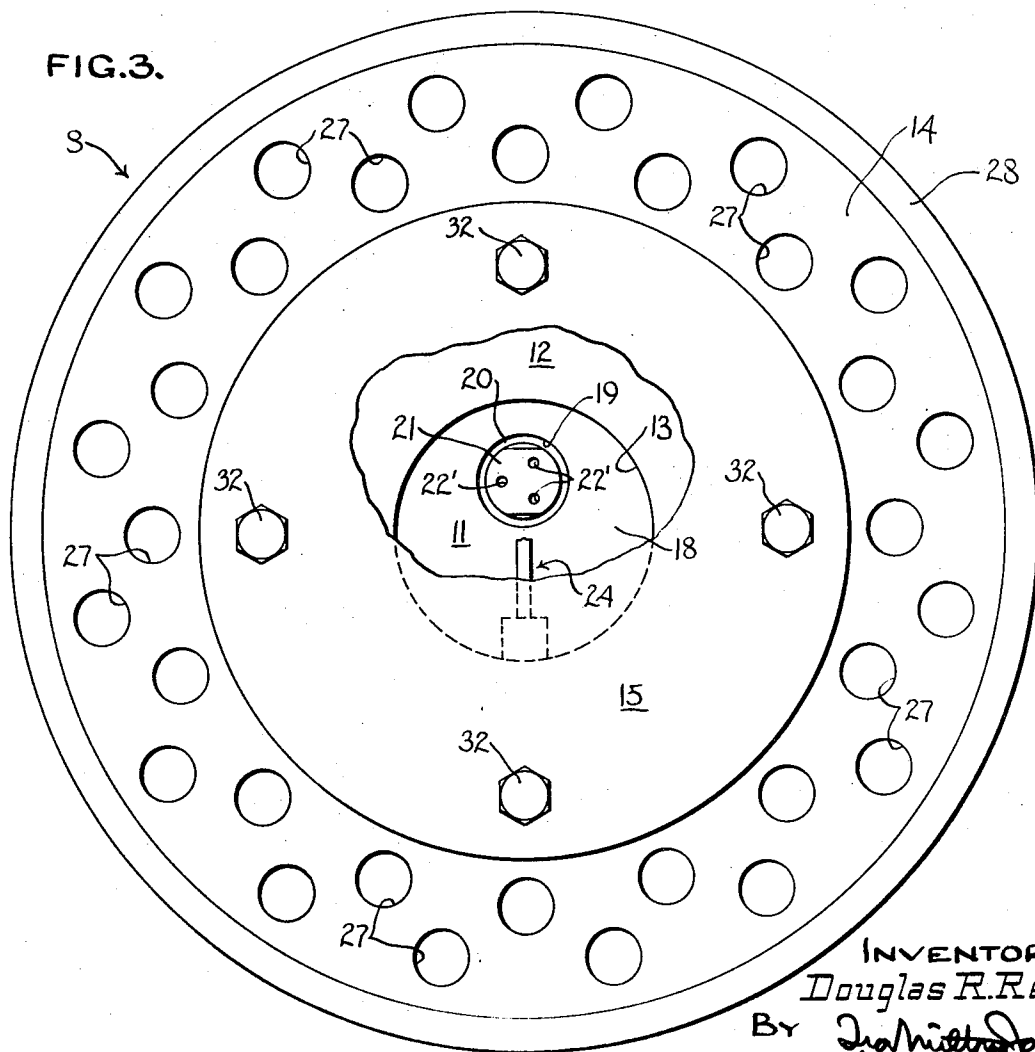


FIG. 3.



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FIG. 2.

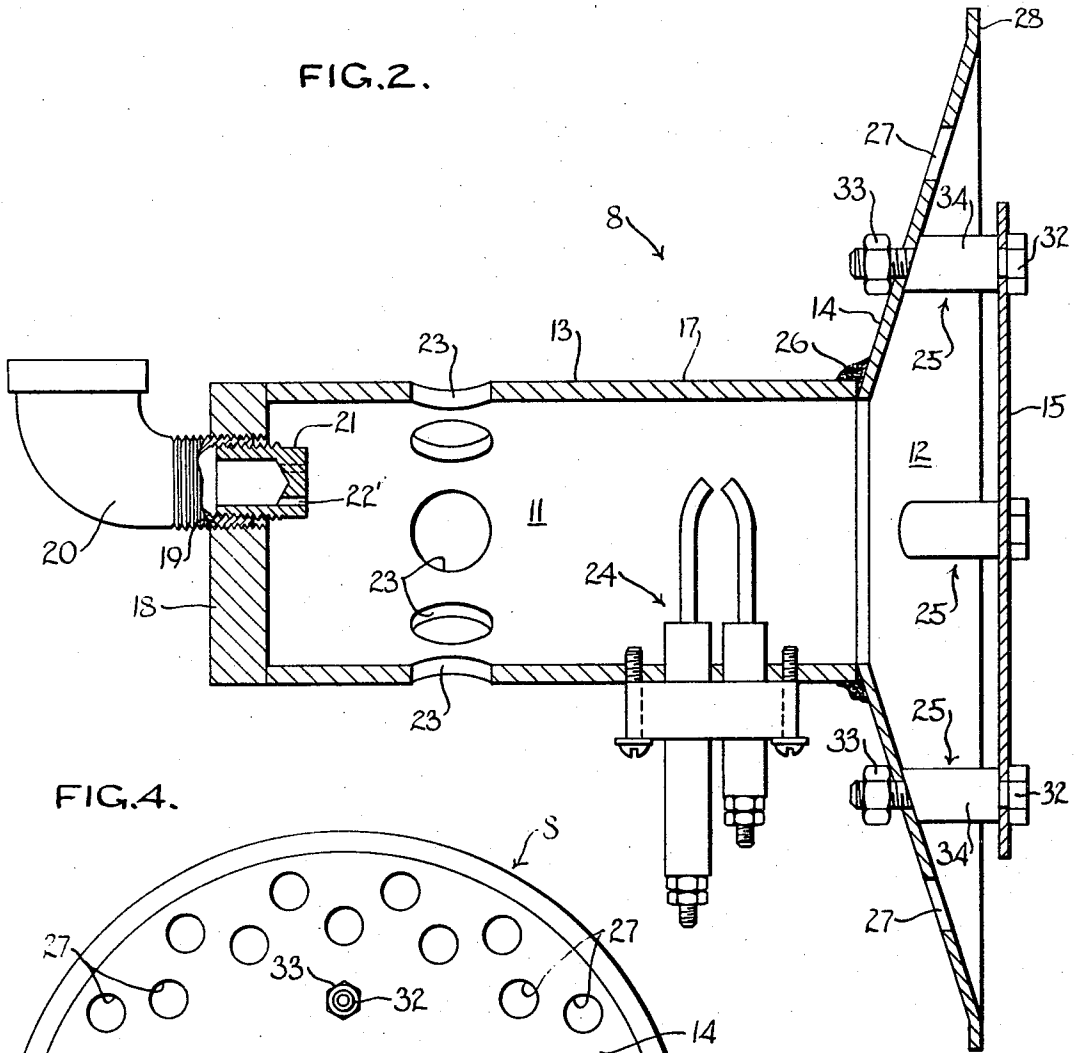
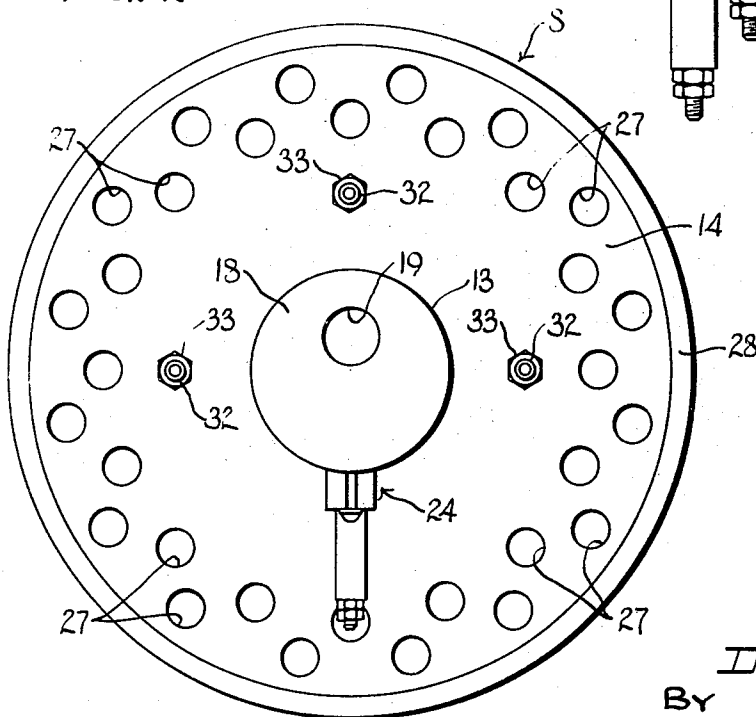
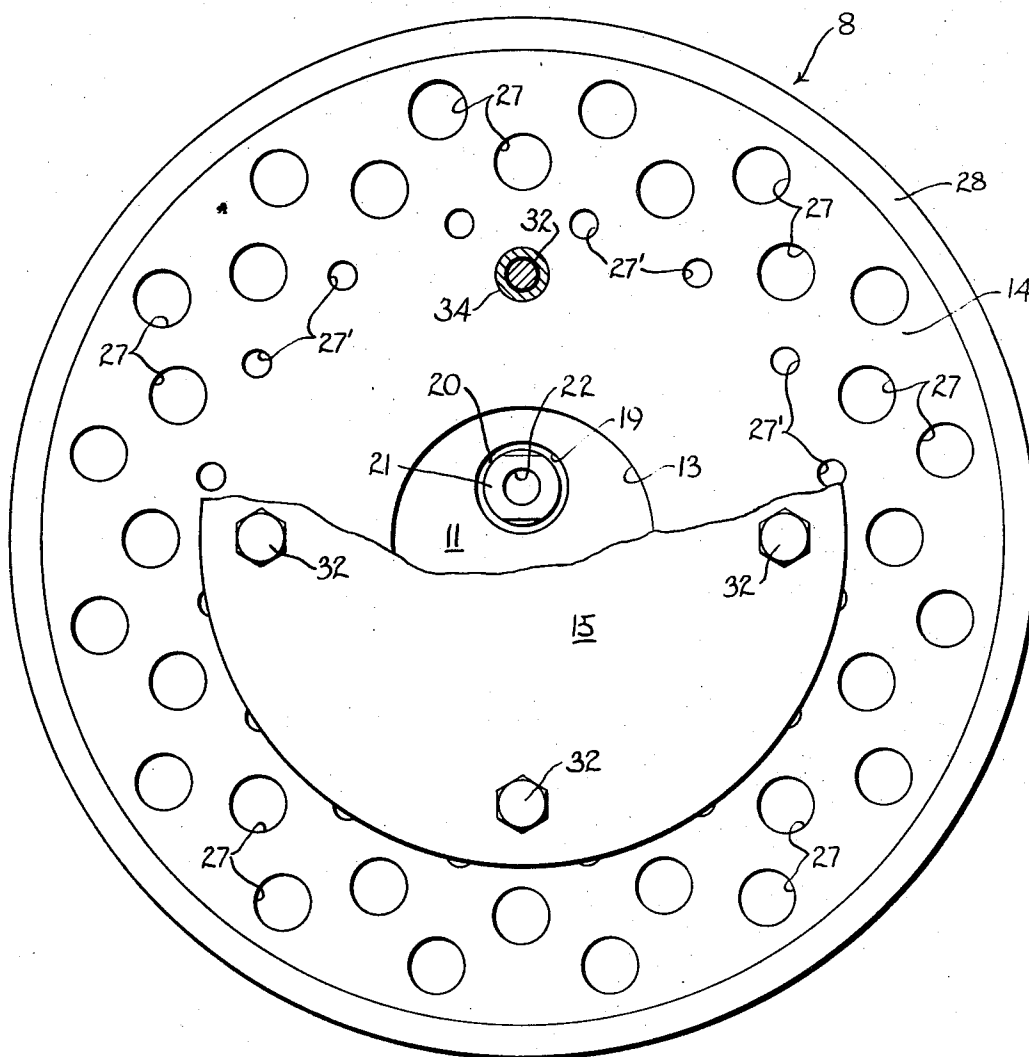


FIG. 4.



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FIG. 5.



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PORTABLE SPACE HEATER AND GAS BURNER FOR THE SAME

This invention relates to gas fired portable heating units such as are used for heating buildings that are under construction, and the invention relates more particularly to a gas burner for such a unit that is capable of high heat output with substantially no production of carbon monoxide.

In order not to delay construction work during the cold weather season, it has become a practice to use portable heating units to heat the interiors of unfinished buildings, thus enabling the construction crews to do their work comfortably and efficiently and also making it possible to apply certain materials, such as plaster and paint, that cannot be used at temperatures at or near the freezing level.

In most cases the heating units employed for this purpose are fired with a gaseous fuel. Because such heaters must be readily transportable from one building site to another, they cannot be connected with chimneys or the like, and therefore they are usually so constructed and arranged that they discharge products of combustion into the enclosure to be heated. It will be immediately apparent that any such heater must therefore provide for very complete combustion of its fuel, for otherwise the products of combustion that it discharges will include carbon monoxide, which is not only extremely toxic but is colorless and odorless and therefore gives no warning of its presence.

For best efficiency a stream of air should be forced across the gas burner or combustion chamber of such a heater, to effect the best possible distribution of heat within the space to be heated. At least for the larger heating units used for projects such as theaters, shopping center malls and the like, the gas burner is usually mounted in a tubular housing, and air is circulated through the housing by means of a fan mounted near one end of it. If heat output is high, there must be a correspondingly high volume of air circulated through the tubular housing per unit time, and this requires that the air move through the housing at a high velocity. But with prior gas burners, a high velocity air flow over and around the burner interfered with combustion and thus caused the burner to produce carbon monoxide, or even prevented the burner from operating by literally blowing out its flame.

With the above stated considerations in mind, it is a general object of the present invention to provide a burner for gaseous fuel that is capable of achieving complete combustion even when it is mounted in a very high velocity airstream.

It follows that it is also an object of this invention to provide a gas fueled portable space heater that is especially well suited for heating very large enclosures by reason of its having a high capacity fan and a burner that is capable of high heat output with complete combustion, even in the presence of the high velocity air stream generated by the fan.

A further object of this invention is to provide a space heater of the type comprising a tubular housing, a fan mounted in the housing to move air therethrough, and a burner for gaseous fuel, also mounted in the housing, which heater is capable of heat outputs on the order of 750,000 Btu/hr. and, by reason of high rates of air flow through its housing, insures that the heat which it produces will be adequately circulated throughout a large enclosure.

Another and very important object of this invention is to provide a portable space heater and a gas burner therefor that are capable of high heat output and good distribution of the generated heat, all without production of such an amount of carbon monoxide as is measurable with the usually employed detecting instruments.

With these observations and objectives in mind, the manner in which the invention achieves its purpose will be appreciated from the following description and the accompanying drawings, which exemplify the invention, it being understood that such changes may be made in the specific apparatus disclosed herein as come within the scope of the appended claims.

The accompanying drawings illustrate two complete examples of the embodiments of the invention constructed according to the best modes so far devised for the practical application of the principles thereof, and in which:

FIG. 1 is a more or less diagrammatic longitudinal sectional view of a gas fired portable heating unit embodying the principles of this invention;

FIG. 2 is a longitudinal sectional view through the gas burner of the heating unit of this invention;

FIG. 3 is a view in front elevation of the gas burner, with portions of the baffle broken away;

FIG. 4 shows the gas burner in rear elevation; and

FIG. 5 is a view generally similar to FIG. 3 but illustrating a modified embodiment of the burner, adapted to burn a different kind of gas.

Referring now to the accompanying drawings, the numeral 5 designates generally a portable space heater which embodies the principles of this invention and which comprises, in general, a tubular housing 6, a fan 7 that is mounted in the housing, and a burner 8 for gaseous fuel, connected by means of a duct 9 with a source of such fuel, illustrated as a pressure vessel 10.

In order to achieve a high heat output, the burner 8 must consume a large volume of gas per unit time; and in order to afford adequate circulation of the heat produced, as well as to provide sufficient air for complete combustion of the gas, the fan 7 must have a high capacity. For compactness of the unit, as well as for efficiency, the diameter of the housing 6 must be limited, and therefore the necessary rate of air flow must be obtained by having the fan force the air through the housing in a high velocity stream. The burner 8 is capable of achieving complete combustion even under the unfavorable conditions created by such high speed air flow around it.

Unlike most prior gas burners, which had only a single combustion chamber, the burner 8 of this invention has both a primary combustion chamber 11 and a secondary combustion chamber 12.

The primary combustion chamber is defined by a substantially cylindrical cup-shaped member 13 that is mounted with its axis generally parallel to the direction of air flow through the housing 6 and with its closed rear end upstream with respect to said direction. The secondary combustion chamber 12, to which the primary combustion chamber opens at its front end, extends generally in a radially outward direction from the primary combustion chamber and is defined by an annular flange 14 on the front end of the cup-shaped member and a coaxial disc-like baffle 15 that is spaced forwardly of the flange.

The cup-shaped member 13 can have its cylindrical side wall 17 formed from a length of steel tube, and its end closure or end wall 18 can be provided by a steel plug or disc welded to the rear end of the tube. A tapped hole 19 in the end wall 18 receives a conventional elbow or nipple 20 that is connectable with the duct 9 through which fuel gas is delivered into the burner.

The elbow or nipple 20 is in turn internally threaded to receive an inlet nozzle 21 which meters gas into the combustion chamber and by which the gas is guided for flow into the chamber in a forward direction generally parallel to the axis thereof. Note, however, that the gas inlet is spaced to one side of the axis of the cup-shaped member. It has been found that such eccentric location of the gas inlet is considerably more favorable to complete combustion than a coaxial position of the nozzle, apparently because the eccentric inlet encourages turbulence in the incoming stream of gas and thus promotes a more thorough mixing of the gas with combustion air. Alternatively, if the nozzle is located concentrically to the cup-shaped member, it can be arranged to direct gas into it at an oblique angle to its axis, although this arrangement is less desirable in most cases because it tends to complicate construction of the burner.

It has also been found that best results with natural gas are obtained with a single relatively large orifice 22 in the nozzle, as shown in FIG. 5, whereas for propane the nozzle should have a plurality of smaller, spaced apart apertures 22', as illustrated in FIG. 3. Apparently the heavier propane mixes better with the combustion air if it is injected into the combustion chamber in several narrow streams.

Air is drawn into the primary combustion chamber through a number of primary air inlets 23 in its cylindrical side wall in a zone that is intermediate the front and rear ends thereof. As shown, the primary air inlets comprise a row of holes extending circumferentially around the cup-shaped member.

Between the zone of the air inlet holes 23 and the front end of the cup-shaped member, an igniter 24 projects into the primary combustion chamber from the side wall thereof. The igniter is a conventional electrical one and has its electrodes substantially on the axis of the cup-shaped member.

The baffle 15 is supported in forwardly spaced relation to the cup-shaped member and the annular flange 14 by means of short rods or bars 25 that extend forwardly from the flange. As illustrated, these comprise bolts 32 that extend through aligned holes in the flange and disc and are secured by nuts 33, and a spacer sleeve 34 surrounding each bolt.

The diameter of the baffle is substantially greater than that of the primary combustion chamber but substantially less than that of the annular flange 14. The flange is substantially conical and is inclined forwardly and radially outwardly; or, stated another way, it is dished and forwardly concave. It can be secured to the front edge of the cup-shaped member as by a weldment 26. The flange has numerous apertures 27 therethrough, in annular radially outermost zone thereof, to provide inlets for secondary combustion air. In the case of a burner intended to be used with propane, the inner boundary of the zone of the second-

dary air inlet holes 27 is on a radius approximately equal to that of the baffle disc. In a burner intended for natural gas, there is preferably provided an additional row of smaller secondary air inlet holes 27', centered on a circle of approximately the radius last mentioned.

The outer marginal edge portion of the flange comprises a narrow flared rim 28 that lies in a plane parallel to that of the baffle disc.

When the burner is in operation, gas is of course introduced into the primary combustion chamber 11 from the inlet nozzle 21, and air is drawn into the primary air inlets 23 to be mixed with the gas. The combustible mixture is ignited by the igniter 24, and combustion is seen to take place through most of the length of the primary combustion chamber, as far back as a zone spaced a little distance behind the primary air inlet holes 23. The only exit for the combusting gases is through the open front end of the primary combustion chamber, into the secondary combustion chamber, where the gases impinge against the baffle 15 and are deflected radially outwardly by it. Note that in their radially outward flow through the secondary combustion chamber the combusting gases are accelerated, owing to the convergence of the walls of that chamber that is afforded by the forwardly dished configuration of the flange 14.

As they issue from behind the baffle 15, flowing rapidly outwardly along the radially outermost portion of the annular flange 14, the gases pick up additional combustion air through the secondary air inlets 27. At the same time, the flange protects the combusting gases from the main force of the airstream that is blown forwardly over the burner by the fan 7, thus enabling such secondary combustion air to be used for complete combustion.

Careful measurements with conventional carbon monoxide testing devices have revealed no detectable output of carbon monoxide from a properly designed burner of this invention. In designing a burner embodying the principles herein disclosed, as with every new gas burner, some experimentation may be needed to adjust the sizes of air and gas inlets, the spacing of the baffle disc relative to the flange, and other such variables, in order to achieve optimum combustion conditions. However, once the parameters for a burner intended for a particular fuel gas have been established, that burner will produce complete combustion over a relatively wide range of gas input rates; hence the heat output of the burner can be regulated to some extent by the mere adjustment of the rate of fuel gas flow into the burner.

To aid those skilled in the art in the design of particular burners embodying the principles of this invention, the following information is given concerning the dimensions of a heating unit found to be successful in use with propane gas and capable of heat outputs of about 350,000 to 750,000 Btu/hr.

Housing: Length 48 in.; diameter 21 1/2 in.

Fan: Located near inlet end of housing. Motor: 1/3 H.P., 1,725 rpm; blade diameter: 20 inches; capacity: 5,000 cfm.

Burner: Primary combustion chamber: 2 1/2 in. I.D., 5 3/4 in. long; 3/4 in. tapped hole for conventional pipe elbow in rear wall, having its center spaced one-half in. to one side of the chamber axis; inlet nozzle: 3 holes,

equispaced, each about one-sixteenth in. diam., on 5/32 in. radius circle; primary air inlet: 8 holes, each eleven-sixteenth in. diam., on circumferentially equispaced centers about 1 1/8 in. forward of the rear wall. Baffle disc: 3 in. radius, 304 stainless steel, spaced about 1 1/4 in. from front of primary combustion chamber. Flange: 4 3/4 in. radius, 304 stainless steel, spaced five-eighths in. rearward of baffle disc at the edge of the latter; 1/4 in. outer marginal rim, flared to have its front surface lie in a plane parallel to baffle disc and about one-eighth in. behind its rear surface; two rows of 16 circumferentially equispaced 1/2 in. diameter holes, one row centered on a 3 3/8 in. radius circle, one on a 3-5/16 in. radius circle.

Igniter: Fenwall (Div. of Walter Kidde & Co.) catalogue 05-100000-144.

A burner for natural gas, capable of generating 230,000 to 440,000 Btu/hr., has the same specifications except that its gas inlet nozzle has a single 5/16 in. diameter bore and its flange has a third row of 16 holes, each about five-sixteenth in. in diameter, circumferentially equispaced and centered on a circle of 2 7/8 in. radius.

From the foregoing description taken with the accompanying drawings it will be apparent that this invention provides a burner for gaseous fuel which is capable of generating large amounts of heat without production of carbon monoxide, even in the presence of a high velocity airstream sweeping across it, and which is thus well adapted for incorporation in a portable gas fired space heater such as is used for buildings under construction.

Those skilled in the art will appreciate that the invention can be embodied in forms other than as herein disclosed for purposes of illustration.

The invention is defined by the following claims:

I claim:

1. A portable heating unit for use with gaseous fuel, comprising:
 - A. a tubular housing having an air inlet at a rear end thereof and an outlet at its front end for heated air and combustion products;
 - B. a fan in said housing for moving air therethrough at a substantially high velocity; and
 - C. a burner in the housing, adapted to burn gaseous fuel substantially without production of carbon monoxide despite high velocity of air flowing past it, said burner comprising
 1. a generally cylindrical primary combustion chamber having its axis substantially parallel to that of the housing, said primary combustion chamber having a rear end wall but being open at its front end, and having a cylindrical side wall that is apertured for admission of primary combustion air in a circumferential zone which is spaced from its front and rear ends,
 2. an eccentric fuel gas inlet in said rear end wall, communicable with a source of fuel gas,
 3. an igniter for the combustion chamber, intermediate its front end and said zone,
 4. a flat disc-like baffle having a radius substantially greater than that of the primary combustion chamber, fixed in forwardly spaced coaxial relation to the open front end of the primary combustion chamber and providing a sur-

face normal to the axis thereof against which combusting gases impinge and by which they are deflected radially outwardly as they issue from the primary combustion chamber, and

5. a forwardly concave conical flange on the front of the primary combustion chamber having a radius larger than that of the baffle and opposing the same, said flange being spaced rearwardly from the baffle to cooperate therewith in defining a radially outwardly opening circumferentially extending secondary combustion chamber, said flange having circumferentially spaced secondary combustion air apertures therethrough in an annular zone in its radially outermost portion.
2. The portable heating unit of claim 1, further characterized by:
 - the fuel gas inlet having its axis substantially parallel to that of the primary combustion chamber but spaced to one side thereof.
3. A gaseous fuel burner for a portable heating unit of the type comprising a tubular housing in which the burner is mounted and a fan in the housing for moving air forwardly therethrough at a high velocity, said gaseous fuel burner comprising:
 - A. a primary combustion chamber defined by a generally cup-shaped member having a rear end wall, an open front and a substantially cylindrical side wall through which there are primary combustion air inlets in a zone spaced from its front and rear ends;
 - B. an eccentric inlet for gaseous fuel in the rear end wall of said cup-shaped member;
 - C. an igniter for said cup-shaped member, intermediate said zone and its front end; and
 - D. means defining a concentric secondary combustion chamber into which the primary combustion chamber opens at its front, the last named means comprising
 1. a radially outwardly projecting, forwardly concave, conical annular flange coaxially fixed on the front end of the cup-shaped member, said flange having a radius which is substantially larger than that of the cup-shaped member and having secondary combustion air inlets therethrough in a radially outer annular zone thereof;
 2. a flat baffle disc having a radius greater than that of the cup-shaped member but less than that of said flange, and
 3. means fixing the baffle disc in forwardly spaced coaxial relation to the flange and the cup shaped member, with a rear surface of the baffle disc normal to the axis of the cup-shaped member.
4. A gaseous fuel burner adapted to operate in a stream of fast moving air, comprising:
 - A. a primary combustion chamber defined by a generally cup-shaped member having a closed rear end, an open front end, and a side wall that has air inlet apertures therethrough, spaced at intervals therearound in a zone between its front and rear ends, said cup-shaped member being adapted for mounting with its axis generally parallel to an air stream and with its rear end upstream;

- B. a gaseous fuel inlet opening eccentrically into the cup shaped member through its closed rear end, said inlet being connectable with a source of fuel gas under pressure and arranged to expel gas forwardly into the cup-shaped member; 5
- C. igniter means spaced forwardly of said zone, for initiating combustion of mixed air and fuel gas in the primary combustion chamber; and
- D. an annular substantially radially extending and radially outwardly opening secondary combustion chamber into which the front end of the cup-shaped member opens, said secondary combustion chamber being defined by 10
1. a flat baffle disc concentric and normal to the axis of the cup-shaped member and spaced forwardly from the front end thereof, the radius of said baffle disc being larger than that of the cup-shaped member, and 15
 2. a radially outwardly projecting annular flange on the front end of the cup-shaped member having a radius substantially larger than that of the baffle disc and having secondary air inlet apertures through its portion that lies radially outward of the baffle disc, said flange being substantially conical, with a forward and radially outward inclination, but being spaced from the edge of the baffle disc. 20 25
5. A gas burner of the character described, comprising:
- A. means defining an elongated primary combustion 30

- chamber that is open at a front end thereof, closed at its rear end, and has primary combustion air inlets between its ends;
- B. means providing an eccentric fuel gas inlet near the rear end of the primary combustion chamber;
- C. means for igniting mixed fuel gas and air in the primary combustion chamber; and
- D. means defining a concentric secondary combustion chamber into which the primary combustion chamber opens at its front end, the last mentioned means comprising a pair of opposing spaced apart wall elements extending in a direction generally transverse to the length of the primary combustion chamber means but being convergent in said direction,
1. one of said wall elements being a flat concentric disc spaced forwardly beyond the front end of the primary combustion chamber means and extending entirely across the same, and
 2. the other of said wall elements being concentric, conical and forwardly divergent from the front end of the primary combustion chamber means and having a substantially larger radius than said disc, said other wall element having secondary air inlets therethrough in a circumferential zone thereof that extends radially beyond said disc and is spaced radially from the primary combustion chamber means.

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