United States Patent

[11] **3,540,707**

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[45] Patented **Nov. 17, 1970**

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[54] **GAS BURNER**
12 Claims, 5 Drawing Figs.

[52] **U.S. Cl.** **263/19, 239/426, 431/349**
[51] **Int. Cl.** **F23l 9/04**
[50] **Field of Search** 263/19; 431/347, 348, 349, 171; 239/426, 434, 494

[56] **References Cited**

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3,064,720	11/1962	Keating et al.	431/349X
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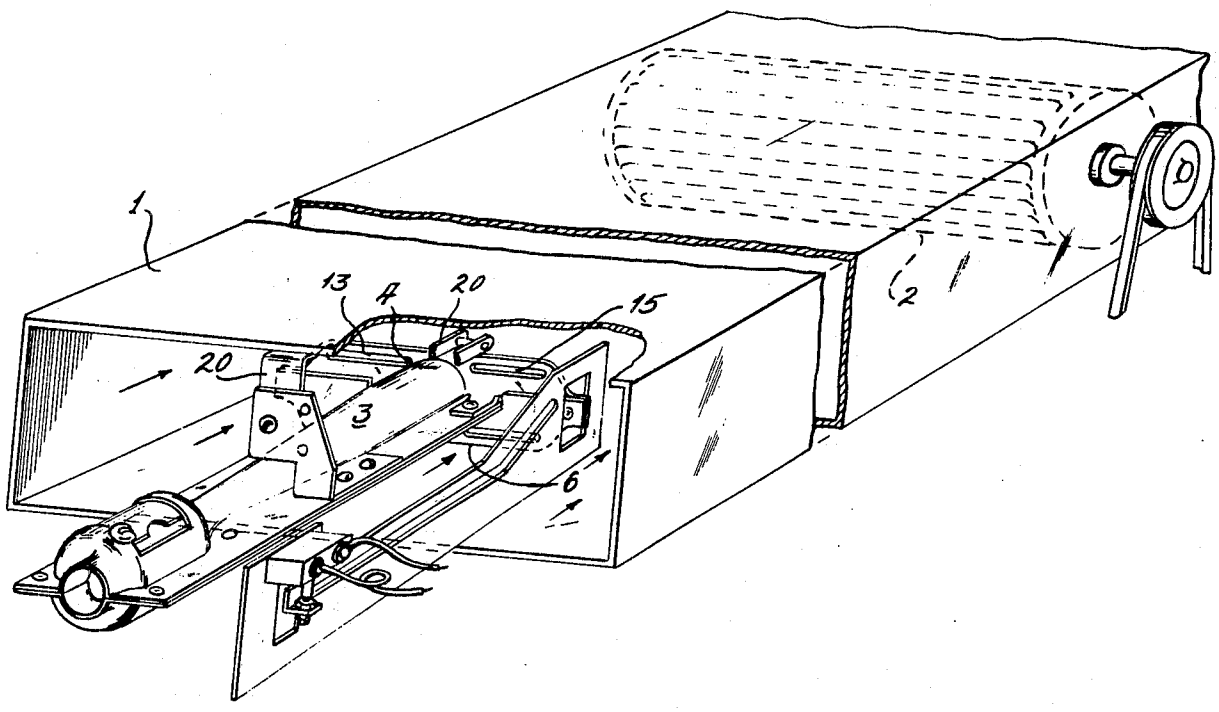
ABSTRACT: Gas burner in which a stream of combustible gas emerging from a tube is deflected radially of the tube and parallel with an open deck, the marginal portions of which are perforated to pass air supporting combustion and to shape the base of the flame.



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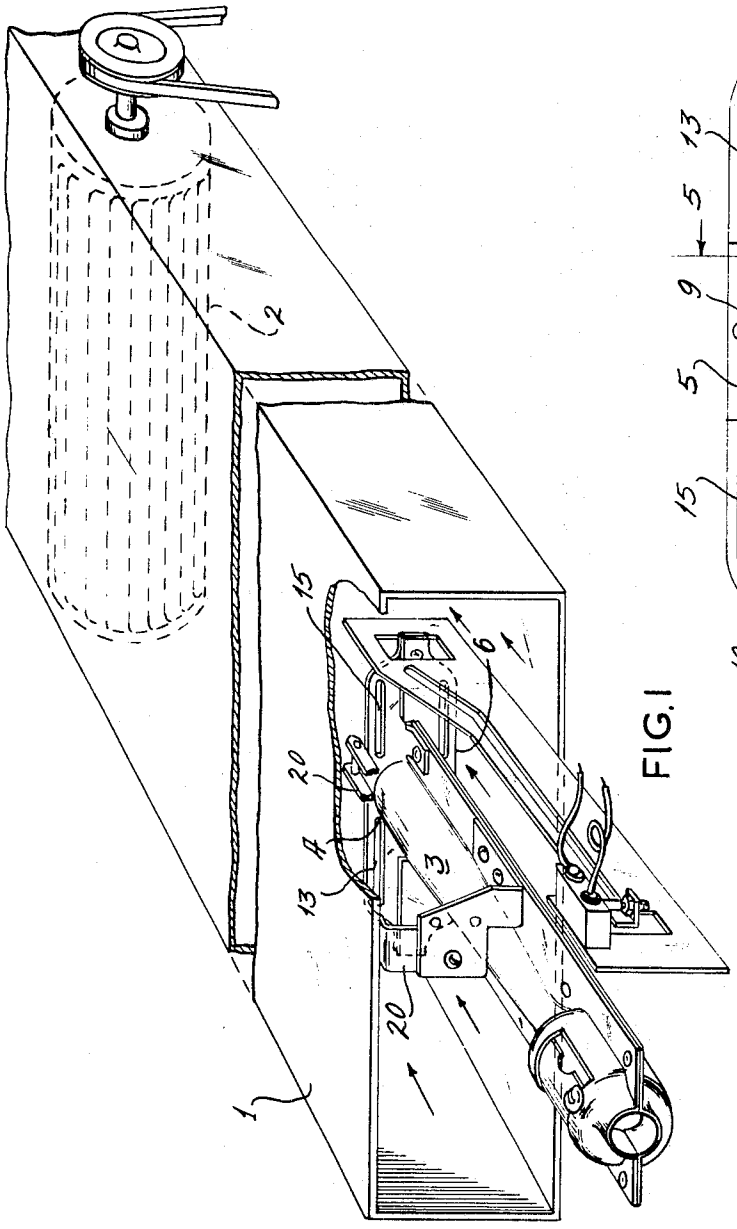

FIG. 1

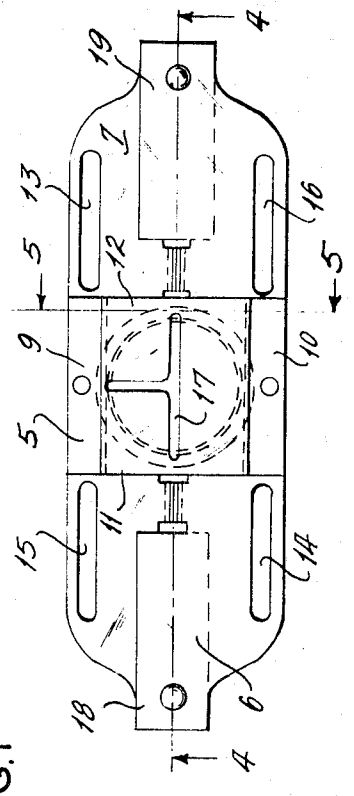

FIG. 3

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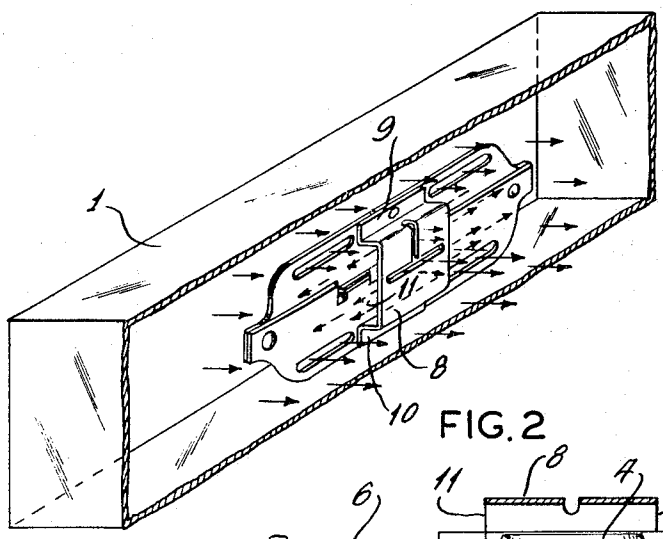

FIG. 2

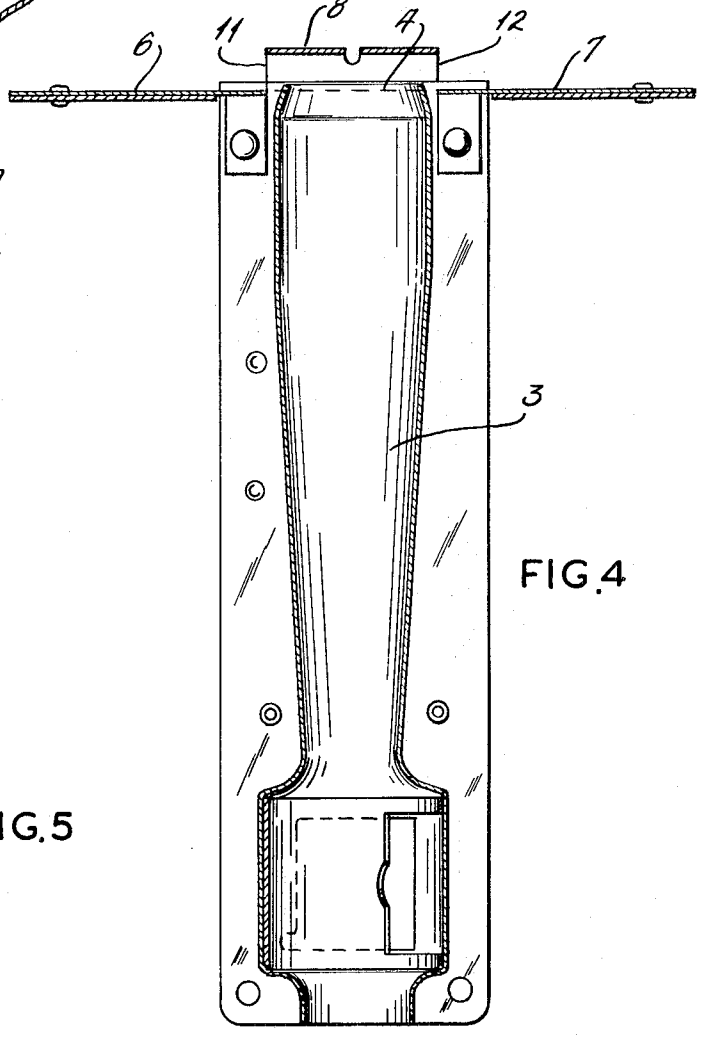

FIG. 4

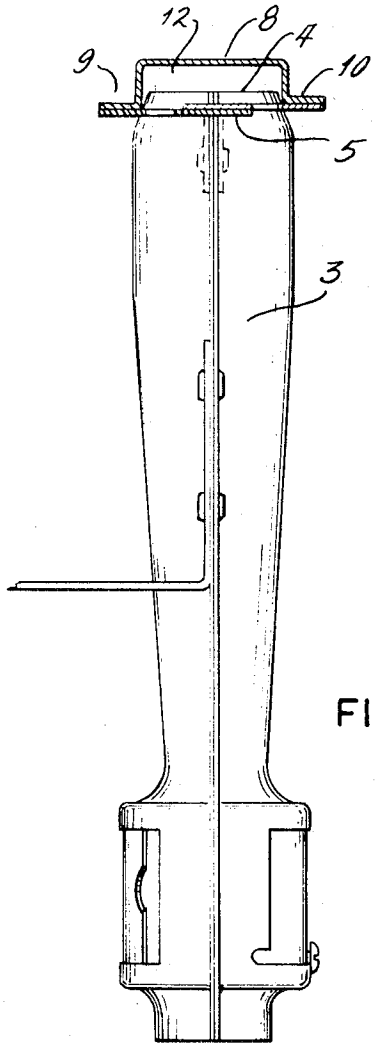

FIG. 5

GAS BURNER

This invention relates generally to gas burners, and particularly to controlling the shape, magnitude and direction of flame from a gas burner.

In numerous industrial and domestic devices for drying, baking, or otherwise heat treating, the product being treated is heated by the circulation thereabout of hot or warm air in mixture with the gaseous products of the combustion which heated the air. Such devices are illustrated by household gas-fired clothes driers, and by industrial ovens and tunnel driers. In such devices, it is customary to provide a duct system which receives air at ambient temperature and conducts it to the environs of the product to be heated. Somewhere between the intake and exhaust ends of the duct system, there is provided a blower, or other means of forcing the stream of air from the intake location to the exhaust location; and also a source of heat which is usually a fire. The fire's products of combustion may be, and frequently are, delivered into and moved with the draft of air through the duct system. Where frequently, as in the case of clothes driers, it is imperative that the stream of air be kept clean, the fire is usually fueled by gas, and it is to the latter situations that the present invention relates.

It is important in such situations that combustion of the fuel be complete, that is to say, that there be a minimum of non-gaseous products of combustion. It is also important in such situations that the flame be of a shape and size, and be so directed as to obtain the most efficient and uniform heat transfer between the flame and its products of combustion, on the one hand, and the incoming air, on the other hand, all without overheating the duct or the blower, and without creating a condition under which the environs of the flame are likely to carbonize.

Accordingly, it is an object of the present invention to provide a gas burner wherein the shape, magnitude and direction of the flame are controlled to best advantage, and the flame is protected against being blown out by the draft of air being forced past it.

This objective, as well as other desirable results, are achieved in accordance with the present invention by the provision of a burner including a tube having an open end spaced from a baffle or tunnel (which may be vented) to divert most of the gas emerging from the open end of the tube in a direction substantially at right angles to the direction in which it traveled through the tube, and, preferably, at right angles to the general direction of any forced stream of air traveling past the burner. The baffle, tunnel, or other diverting means, lying athwart the direction of the movement of the fuel gas through the open end of the tube, has one or more portals disposed substantially perpendicular to a radius of the open end of the tube through which the fuel gas emerges; and the sum of the areas of such portal or portals is no greater than, and preferably less than, the area of the open end of the tube through which the gas emerged.

To control the shape of the base of the flame, each such portal is equipped with an open deck projecting outwardly therefrom so as to be substantially tangent with the stream of fuel gas emerging from the portal, and on the side of such stream opposite that at which the flame burns. Such deck or decks are preferably wider than the width of the tunnel portals, and in the marginal portions of each deck which extend widthwise beyond the tunnel portals, it is preferable to provide air vents. The shape of the combined decks, and particularly the portions thereof lying within the contour delineated by the air vents in the decks, controls the shape of the base of the flame.

The aforesaid vents in the deck are preferably proportioned to pass sufficient air to support substantial combustion of the stream of gas emerging from the open end of the inlet tube, but any deficiency of air to support complete combustion is supplied by the air which flows around the exterior of the decks. Preferably, the combined area of the vents in the margins of the decks is between 10 percent and 20 percent of the combined area of the decks.

As mentioned previously, the tunnel or baffle member may be vented, but the area of such a vent in the tunnel or baffle is preferably a small percentage, say about 5 percent, and no greater than about 30 percent, of the combined area of all portals (in the case of a tunnel; or the equivalent in the case of a baffle plate). Thus, only a relatively small amount of the fuel gas can flow through the tunnel vent. Such a tunnel vent is provided primarily for facilitating ignition, particularly electrical ignition which is accomplished by an electrical spark or series thereof where the performance is best assured by the delivery of a relatively small stream of gas aimed accurately at the spark producing electrodes.

The burner of the invention is peculiarly adapted for use in duct systems of the character previously described where the burner is disposed within a duct which conveys a forced draft of air past the burner and into a chamber which contains the products to be heated. Such a duct is usually of rectangular cross section, but may be square, round, or any other shape dictated by the circumstances of use. Depending upon the cross-sectional configuration of such a duct, the deck portions of the burner of the present invention may be shaped in substantial geometrical similarity, so that they, and the flame produced thereon, are most efficiently spaced from the surrounding walls of the duct, yet provide a sufficient obstruction (*e.g.*, **17—27** percent of the duct cross section) therein that the forced draft of air is accelerated adjacent such decks, thereby confining the base of the flame substantially to the outline of the decks, and, at the same time, creating a turbulence which completely mixes air with unburned gas, and intermixes the cold air with the warm, as well as with the gaseous products of combustion.

Specific embodiments of the present invention are illustrated in the accompanying drawings, in which:

FIG. **1** is a perspective view of a section of duct system equipped with a burner of the present invention adjacent the open end shown;

FIG. **2** is a perspective view of a portion of the duct system shown in FIG. **1**, but showing the flame side of the burner;

FIG. **3** is an end view of the burner shown in FIGS. **1** and **2** taken from the flame side thereof;

FIG. **4** is a sectional view taken along line **4–4** of FIG. **3**; and

FIG. **5** is a sectional view taken along line **5–5** of FIG. **3**.

In the environment shown in FIG. **1**, the burner of the invention is situated adjacent the intake end of a duct system **1**, having a blower **2**, of any suitable type, disposed to draw air in through the open end of the duct system, as shown by the arrows in FIG. **1**, and to force that air toward a heating chamber not shown. In the environment shown, the burner of the invention is disposed on the upstream side of the blower in a domestic laundry dryer; the duct has a rectangular cross section of 3 inches by 10 inches; the volume of air drawn into the duct is 100—125 cubic feet per minute; the burner delivers about 20,000 BTU per hour; and the burner, with its accessories, locally obstructs about **22** percent of the duct cross section.

As best shown in FIGS. **3**, **4** and **5**, the burner shown in FIG. **1** comprises a tubular member **3**, of construction corresponding substantially to that disclosed in U.S. Pat. No. 3,259,170. The tubular member **3** has an open end **4**. Mounted on the open end of the tube **3**, there is a burner plate **5** consisting of an open deck **6**, an opposite open deck **7**, and a tunnel member **8**. In the embodiment shown, the decks **6** and **7** are formed of two identical pieces integrated together in centrally overlapping relationship to define a circular hole of somewhat greater diameter than that of the open end **4** of tube **3**, so as to receive and pass the end portion of tube **3** for a short distance. The tunnel member **8** is an inverted U-shaped structure having side flanges **9** and **10**, which are secured to the deck structure **6—7** outwardly of the end opening **4**, as clearly shown in FIG. **5**.

Adjacent the tube **3**, the members which constitute the decks **6** and **7** form the floor of a tunnel whose sides and roof are defined by the U-shaped portion of the tunnel member,

thereby leaving open portals **11** and **12** addressed at right angles to the flanges **9** and **10**, so that the roof of the tunnel acts as a baffle to divert fuel gas emerging from open end **4** through portals **11** and **12** in a direction substantially at right angles to the direction in which the gas flowed through tube **3**, that is to say, as two streams flowing substantially tangent with the respective decks **6** and **7**.

As shown clearly in FIG. **3**, the decks **6** and **7** are wider than the portals **11** and **12**, and in the marginal portions of the respective decks which lie outwardly of the portals **11** and **12**, there are elongated perforations **13**, **14** in deck **6**, and **15**, **16** in deck **7**. These perforations permit air to pass through the deck adjacent the outer limits of the stream of fuel gas sweeping across the respective decks from their corresponding portals, and their disposition outwardly of the streams of fuel gas serves not only to confine the shape of the base of the flame to substantially that of the decks, but also to direct the flame.

As indicated previously, the roof of the tunnel member **8** may be vented. In the form shown in FIGS. **3**, **4** and **5**, such a vent **17** is an inverted T-shaped slit whose open area for the passage of gas is about 24 percent of the combined area of the portals **11** and **12**. The vent **17** is optional, but when provided, its open area can be of any desired magnitude, provided it does not exceed about 30 percent of either the area of open end **4** or the combined area of the two portals **11** and **12**. In the embodiment shown, the combined areas of portals **11**, **12** and vent **17** are approximately 95 percent of the area of open end **4** of tube **3**. The vent **17** in the roof of tunnel **8** is shown as an inverted T-shaped slit. Such shape is preferable when the igniter for the burner is of the type which has its igniting element, such as the electrodes of a spark gap, disposed centrally of and above the locus of the flame, as shown, for example in U.S. Pat. No. 3,191,660. Such an igniter is illustrated diagrammatically at **20** in FIG. **1**. WIth other types of igniting devices, the vent in the roof of the tunnel may be so shaped as to best serve the associated igniter, or may be dispensed with.

In the form shown in the drawings, each of the open decks **6** and **7** terminates in an ear **18** and **19**, respectively. Such ears are optional, but are provided in the embodiment illustrated in order to accommodate a thermoresponsive element of the character disclosed in U.S. Pat. No. 3,191,660 which, at its heat-exposed end, is provided with a window; and it is contemplated that, as desired, one or the other of ears **18** and **19** project through the window of such a thermosensing device.

While one complete embodiment of the invention has been described in detail, it is to be understood that the principle of the invention is not limited to elements of the shape and magnitudes herein described and illustrated, but, on the contrary, such elements may be enlarged or diminished in magnitude while maintaining substantially equal relative proportions; and in accordance with the invention, when applied to ducts which are square, round, or of any other desired cross-sectional configuration, the decks **6** and **7** are preferably contoured generally in accordance with the cross-sectional contour of the duct, so as to leave an unobstructed space about the periphery of the burner plate within the parameters hereinbefore stated.

From the foregoing description, those skilled in the art should readily understand the construction and operation of the invention, and realize that it accomplishes its objects, in not only controlling the shape of the base of the flame, but its direction, and, by virtue of the obstruction which the decks **6** and **7** provide in the cross section of the associated duct, creates a venturi condition, the throat of which is represented by the space between the margins of the decks **6** and **7** and the side margins of tunnel **8**, on the one hand, and the interior walls of duct **1** on the other hand. Such venturi condition accelerates the flow of air past the burner plate, creating a negative pressure which tends to suck the flame on the burner plate toward the outer margins thereof, and there to become intermixed with air to support combustion of such increments of the fuel gas as have not been supplied with air to support the combustion through the elongated slots **13**—**16**. At the same time, the venturi action creates a turbulence which thoroughly mixes the products of combustion with the incoming air.

I Claim:

1. A gas burner duct comprising:

a. a tubular member for conducting gas to the approximate locus of combustion, said tubular member having an orifice addressed lengthwise of said duct;

b. means surrounding said orifice for spreading flame crosswise of said duct, said means including:

i. a tunnel extending athwart said orifice in spaced relationship thereto, said tunnel having oppositely addressed portals each addressed substantially at right angles to the address of said orifice, and a floor surrounding said orifice and subtending each portal;

ii. an open deck projecting radially outward of said tubular member from each portal substantially in alinement with said floor, said deck having a width substantially greater than the parallel dimension of said portals, said deck having an elongated vent adjacent opposite margins thereof and addressed substantially parallel with the address of said orifice.

2. The burner of claim **1** wherein said vents are located, at least in substantial part, in the portions of said decks which are wider than said portals.

3. The burner of claim **1** in which said tunnel has a vent addressed substantially perpendicular to the address of said portals.

4. The burner of claim **1** wherein the tunnel has two oppositely addressed portals, and two open decks respectively projecting in opposite directions from the oppositely addressed portals.

5. The burner of claim **1** wherein said vents occupy between about 10 percent and about 20 percent of the surface area of the decks.

6. The burner of claim **3** wherein said tunnel vent has an area of about 5 to about 30 percent of the combined area of said portals.

7. The burner of claim **3** wherein said tunnel vent is a T-shaped slit.

8. The burner of claim **2** wherein the combined area of said portals and said tunnel vent is less than the area of said orifice.

9. The combination with an open ended duct of means for forcing a stream of air through said duct, and a gas burner having an orifice located within said duct, said gas burner having a plate projecting in substantially radially alined relationship with the plane of said orifice, said plate being so oriented in said duct that the surface thereof is substantially normal to the direction of draft through said duct; means for diverting gas, emerging axially from said orifice, in opposite directions radially of said orifice along the downstream surface of said plate; said means comprising: a baffle substantially parallel with the plane of said of said orifice and spaced therefrom to define, relative to said plate, oppositely addressed portals whose width (parallel with a diameter of said orifice) is at least as great as the diameter of said orifice and whose height (parallel with the axis of said orifice) is substantially less than their width.

10. The combination of claim **9** wherein the area of said plate surface is at least about one-third of the cross-sectional area of said duct.

11. The combination of claim **9** wherein said surface of said plate has perforations at opposite margins thereof, opposite ones of said perforations being so located that at least a substantial part of each perforation is remote from the opposite perforation a distance greater than the parallel dimension of said orifice.

12. A gas burner comprising, a tubular member for conducting combustible gas and discharging it through an orifice, a substantially planar plate projecting in substantially radially

alined relationship with the plane of said orifice, means for diverting gas. emerging axially from said orifice, in opposite directions radially of said orifice along a surface of said plate, said means comprising, a baffle substantially parallel with the

plane of said orifice and spaced therefrom to define, relative to said plate, oppositely addressed portals whose width is at least as great as the diameter of said orifice.