April 22, 1969 J. HANCOCK ETAL 3,439,997

POST-AERATED GAS JETS

Filed Oct. 13, 1967 Sheet 1 of 2

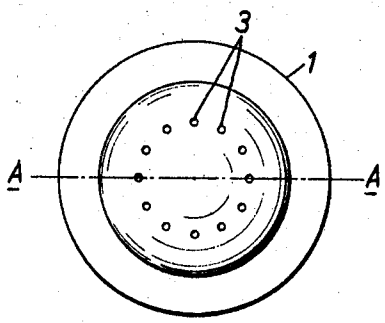


FIG. 1.

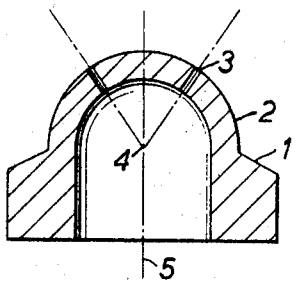


FIG. 2.

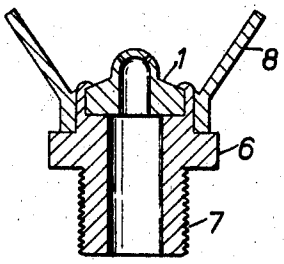


FIG. 3.

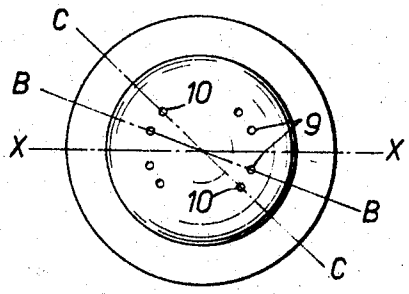


FIG. 4.

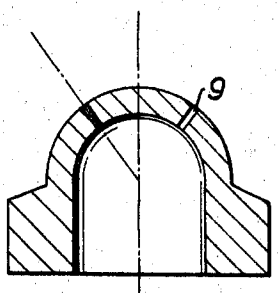


FIG. 5.

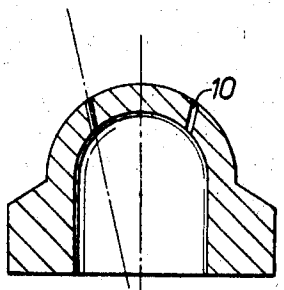


FIG. 6.

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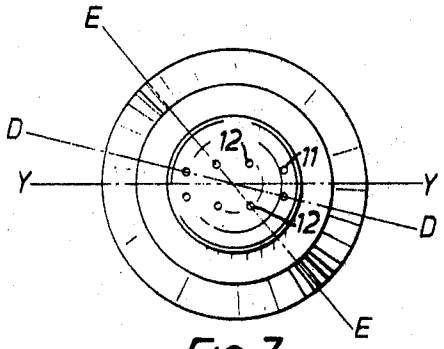


FIG. 7.

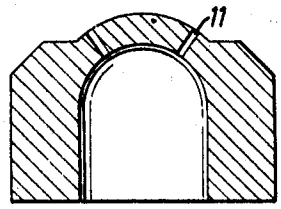


FIG. 8.

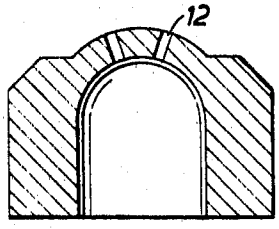


FIG. 9.

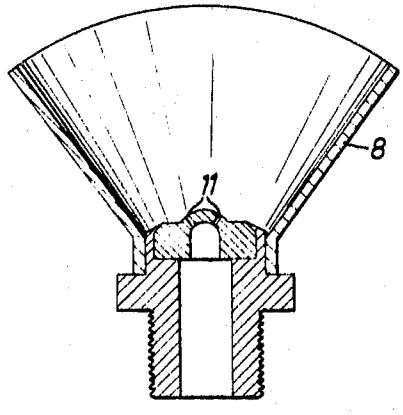


FIG. 10.

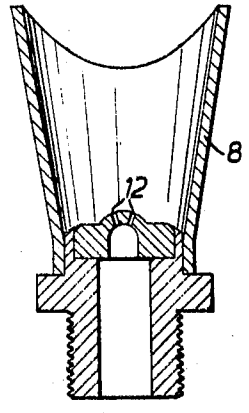


FIG. 11.

United States Patent Office 3,439,997 Patented Apr. 22, 1969

3,439,997

POST-AERATED GAS JETS

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Filed Oct. 13, 1967, Ser. No. 675,101
Claims priority, application Great Britain, Oct. 21, 1966, 47,294/63
Int. Cl. F23d *13/26*; B05b *1/26, 1/14*
U.S. Cl. 431—350 13 Claims

ABSTRACT OF THE DISCLOSURE

A jet suitable for use with all gases of the natural gas family, including such limit gases as propane/air at operating pressures of the order of 8 to 10 inches water gauge. To increase flame stability, the jet is provided with a terminal portion formed with a number of gas orifices which are arranged to ensure that the gas streams are divergent from one another and from the axis of the jet and are separate and distinct both prior to and after ignition. Flame stability is further enhanced by protecting the terminal portion with a shroud which surrounds the gas orifices.

This invention relates to a post-aerated jet for use with natural gas and other gases having similar combustion characteristics.

Our co-pending application No. 45,330/65 describes the construction of a post-aerated jet for use with natural gas which has a stable flame at pressures of 1½ to 3 ins. water gauge as a result of the enhancement of the current of air which flows in a direction counter to that of the gas flow at the base of the flame. In this jet separate streams of gas emerge from each of two slotted orifices in the form of divergent fingers which, on ignition, immediately coalesce to form a flat and substantially fan-shaped flame. The flame is substantially blue in colour when natural gas is being burned but is distinctly yellow when a gas consisting of a mixture of propane and air is used. The latter is used as a limit gas in the testing of appliances designed for use with natural gas. The yellow flame, which can be a danger in some appliances because of soot deposition arises from the fact that the flame is sub-aerated. This under-aeration is due to the relative thickness of the flame, caused by the coalescence of the separate gas streams, and to the gas streams having insufficient momentum.

According to the present invention a shrouded burner for use with natural gas at operating pressures of the order of 8 to 10 inches water gauge comprises in combination a post-aerated gas jet, said jet including a hollow body having an open gas input end and a terminal end formed with a set of gas orifices the longitudinal axes of the orifices having a common point of intersection on the longitudinal axis of the jet, said orifices being so dimensioned and located with respect to each other that in operation, the respective gas flames issuing therefrom are separate and distinct, and a shroud, said shroud surrounding said gas orifices and flaring upwardly and away from said terminal portion of the jet at angle which is less with respect to the longitudinal axis of the jet than is the longitudinal axis of each orifice. The jet may be formed with more than one set of orifices and in such a case the longitudinal axes of each separate set of orifices have a common point of intersection on the longitudinal axis of the jet. Low pressure regions exist in the air surrounding the base of each gas stream and on the axis of the jet in the centre of the divergent gas streams, these low pressure regions being produced by the sudden

expansion of the gas streams emerging from the gas orifices and by their divergence. Air moves into these regions in a direction counter to that of the gas stream and the flames formed on ignition, thus inhibiting the tendency of the latter to lift away from the jet.

The shroud effectively protects the flame base from the upward movement of air produced by convention currents and thereby enhances flame stability. Furthermore, the shroud is open at the top and thereby serves to concentrate the currents air counter to the gas stream and direct them towards the base of the flame. These counter currents of air help to contain within the shroud, that is near the base of each individual flame, the active species produced during combustion. These active species have to be re-entrained into the flames to promote and continue the combustion process and, in the absence of the shroud, would be swept away by the upward movement of air before they had time to be re-entrained.

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

FIGURE 1 shows a diagrammatic plan view of the terminal portion of a first jet,

FIGURE 2 shows a section taken on the line A—A of FIGURE 1,

FIGURE 3 shows a diagrammatic sectional view of a complete burner, incorporating the jet shown in FIGURES 1 and 2,

FIGURE 4 shows a diagrammatic plan view of the terminal portion of a second jet,

FIGURE 5 shows a section taken on the line B—B of FIGURE 4,

FIGURE 6 shows a section taken on the line C—C of FIGURE 4,

FIGURE 7 shows a diagrammatic plan view of the terminal portion of a third jet,

FIGURE 8 shows a section taken on the line D—D of FIGURE 7,

FIGURE 9 shows a section taken on the line E—E of FIGURE 7,

FIGURE 10 shows a diagrammatic sectional view of a complete burner incorporating the jet shown in FIGURES 7 to 9, and

FIGURE 11 shows a further diagrammatic sectional view of the complete burner illustrated in FIGURE 10.

Referring to FIGURES 1 and 2, a ceramic or metal tip or terminal portion **1** for a gas jet, is formed with a hemispherical portion **2** which is provided with a set of circular gas orifices **3**. The latter are formed in a circular arrangement and their longitudinal axes intersect at a common point **4** on the longitudinal axis **5** of the tip. The gas streams issuing from each orifice diverge away from one another and also from the longitudinal axis of the tip. The stability and aeration of the flames is controlled by the angles of divergence and in practice it has been found desirable for the angle between adjacent flames to be 20–45° and that between the axis of the jet and the flames to be 30–45°.

A complete burner is shown in FIGURE 3 in which the tip **1** is mounted in a holder **6** which is provided with a screw thread **7** which provides the means of attachment to a gas pipe, not shown, and is surrounded by a shroud **8** which takes the form of a metal cup attached to the holder **6**. Although, as described above, the holder is provided with a screw thread it will be understood that any other suitable means of attachment to the gas-pipe may be employed. Furthermore, it will be evident that the metal cup may be formed integrally with the holder. The walls of the cup are of generally circular section and flare away from the tip at an angle appropriate to the disposition of the flames. Thus, as will be seen from FIG-

URE 3 the inclination of the side walls of the shroud **8** to the longitudinal axis of the jet is slightly less than the inclination of the longitudinal axis of each orifice to the longitudinal axis of the jet.

The overall circular flame pattern produced by this jet makes it suitable for use with such appliances as water heaters and central heating boilers which have open combustion chambers, but for radiant fires and other appliances which have long and narrow combustion chambers the flames should be approximate to that of the fan-shaped flame produced by the well known forms of post-aerated town gas jets.

The construction of a jet giving in plan view an elliptical shaped flame is shown in FIGURE 4 and in FIGURES 5 and 6.

A first set of circular orifices **9** on either side of the plane X—X in FIGURE 4 are formed as shown in FIGURE 5 at a greater angle to the axis of the jet than a second set circular orifices **10** which are more remote from the plane X—X as shown in FIGURE 6. The set of orifices **10** produce flames which are more vertically disposed than those emanating from the set of orifices **9** and the result is a flame in plan view of elliptical section with its major axis in the plane X—X of the tip **1**. It has been found desirable in the interests of flame stability and aeration for the set of orifices **9** to be formed at an angle of 30–45° to the axis of the jet and for the set of orifices **10** at an angle of 15–25°. When the tip is mounted in a holder with an accompanying shroud (both not shown), the complete burner will have a form similar to that shown in FIGURE 3. However, in this case, it is necessary for the latter to have walls which are of generally elliptical section, again flaring away from the jet at an angle determined by the angular disposition of the flames. Thus, the inclination of the walls of the shroud to the longitudinal axis of the jet will be made slightly less than the inclination of the longitudinal axis of each orifice to the longitudinal axis of the jet.

Another form of jet producing an elliptical flame in plan view is illustrated in FIGURES 7 to 11. The main difference between this jet and the one shown in FIGURES 4 to 6 is that all eight orifices **11**, **12** emanate from a common point on the axis of the jet whereas, as shown in FIGURES 5 and 6 the orifices **9** and **10** have different origins. The orifices **11** and **12** are circular and are also normal to the surface of the jet, that is their origin is the centre of the sphere in which they are formed. The orifices **11** are formed in the plane D—D which is at an angle of 10–20° from the plane Y—Y, which is the major axis of the flame, as a whole, and the orifices **12** in the plane E—E are at an angle of 40–60° from the plane Y—Y. In FIGURE 8, which is a section through D—D, the orifices **11** are shown to be inclined at 15–20° to the axis of the tip and in FIGURE 9, a section through E—E, the orifices **12** are at 30–40° to the axis of the jet.

A complete burner incorporating the jet illustrated in FIGURES 7 to 9 is shown in FIGURES 10 and 11. As will be seen from FIGURES 10 and 11 the walls of the shroud **8** are of generally elliptical section and flare away from the jet at an angle corresponding to the angular disposition of the orifices. Furthermore, the inclination of the side wall of the shroud is always slightly less with respect to the longitudinal axis of the jet than is the longitudinal axis of each orifice.

Although the invention has been described in relation to a single jet, it will be understood that it is also applicable to the so-called ribbon burners in which the orifices are formed in projections on the upper face of a continuous metal channel. In applying the invention to such burners, hemispherical projections are formed on the upper face of the channel at centres which allow air flow between the flames formed on each projection, and which are also such as to allow interlighting of the flames one from another. A metal shroud of section appropriate to the flames is placed around each projection in which the set or sets of orifices are formed.

Furthermore, it will be understood that the part of the tip in which the set or sets of orifices are formed may take forms other than hemispherical, for example conical or frusto-conical. Again although the invention has only been described in relation to jets producing flames of circular or elliptical cross-section it will be understood that various other flame shapes can be produced by suitable arrangement of each set of orifices. Moreover, it will be evident that the number of sets of orifices used in any particular jet can be more than the one or two used in the embodiments described above.

It will be seen that the embodiments described above have the following advantages. Aeration of the burner flames is enhanced and the jet is therefore suitable for use with all gases of the natural gas family, including such limit gases as propane/air. The stability of the flames is increased so that they are stable when operating with natural gas at 8 ins. water gauge pressure.

We claim:

1. A shrouded burner for use with natural gas at operating pressures of the order of 8 to 10 inches water gauge comprising in combination a post-aerated gas jet, said jet including a hollow body having an open gas input end and a terminal end formed with a set of gas orifices the longitudinal axes of the orifices having a common point of intersection on the longitudinal axis of the jet, said orifices being so dimensioned and located with respect to each other that in operation, the respective gas flames issuing therefrom are separate and distinct, and a shroud, said shroud surrounding said gas orifices and flaring upwardly and away from said terminal portion of the jet at angle which is less with respect to the longitudinal axis of the jet than is the longitudinal axis of each orifice.

2. A burner as claimed in claim **1** in which all of said orifices lie on a common circle.

3. A burner as claimed in claim **2** in which the angle between the longitudinal axes of adjacent orifices is of the order of 20 to 45° and that between the longitudinal axis of each orifice and the longitudinal axis of the jet is of the order of 30 to 45°.

4. A burner as claimed in claim **3** in which the walls of the shroud are generally circular.

5. A burner as claimed in claim **1** in which the terminal end of said jet is formed with more than one set of orifices, the longitudinal axes of each separate set of orifices having a common point of intersection on the longitudinal axis of the jet.

6. A burner as claimed in claim **5** in which all of said orifices lie on a common ellipse.

7. A burner as claimed in claim **6** in which two sets of orifices are provided the longitudinal axes of the orifices in each set having a different common point of intersection on the longitudinal axis of the jet.

8. A burner as claimed in claim **7** in which the longitudinal axis of each orifice of one of the said sets lies at an angle of the order of 30 to 45° to the longitudinal axis of the jet, and the longitudinal axis of each orifice of the other of the said sets lies at an angle of the order of 15 to 25° to the longitudinal axis of the jet.

9. A burner as claimed in claim **8** in which the walls of the shroud are generally elliptical.

10. A burner as claimed in claim **6** in which two sets of orifices are provided the longitudinal axes of the orifices in each of said sets having a common point of intersection on the longitudinal axis of the jet.

11. A burner as claimed in claim **10** in which the longitudinal axis of each orifice of one of the said sets lies at an angle of the order of 15 to 20° to the longitudinal axis of the jet, and the longitudinal axis of each orifice of the other of said sets lies at angle of the order of 30 to 40° to the longitudinal axis of the jet.

12. A burner as claimed in claim **11** in which the walls of the shroud are generally elliptical.

13. A burner as claimed in claim **1** in which that part of the terminal portion of said jet in which said orifices are formed is spherically contoured.

References Cited

UNITED STATES PATENTS

1,405,100	1/1922	Cornwell et al.	
2,499,556	3/1950	Zink	239—416.5
2,513,087	6/1950	Ferrel	431—354 XR
2,840,152	6/1958	Reed	431—350 XR
3,205,933	9/1965	Morris	431—349 XR

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U.S. Cl. X.R.

239—499, 556, 601