July 16, 1929. A. L. R. ELLIS 1,721,381

GAS BURNER

Filed Feb. 2, 1928

Fig. 1.

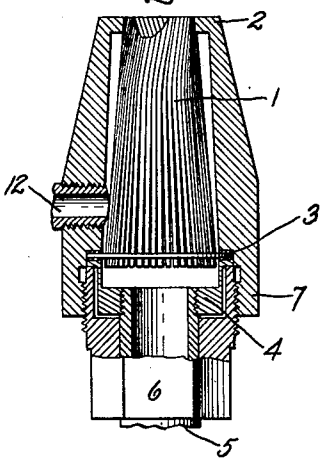


Fig. 2.

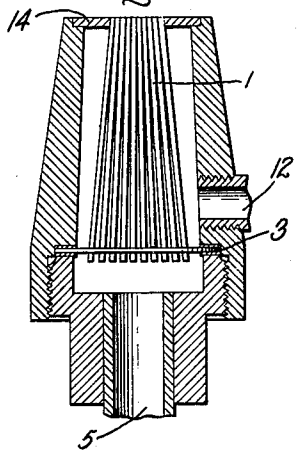


Fig. 3.

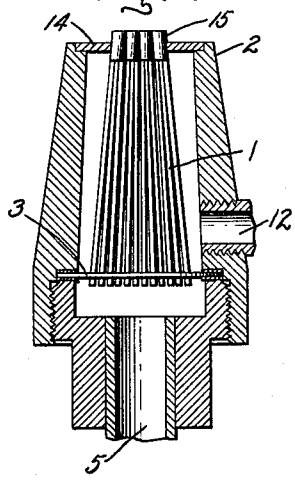


Fig. 5.

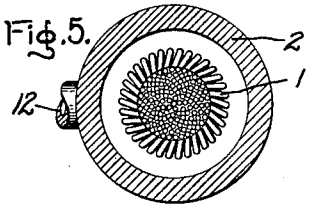


Fig. 6.

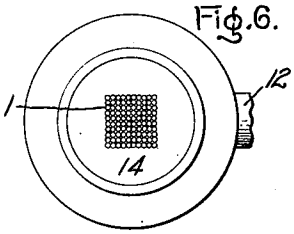


Fig. 7.

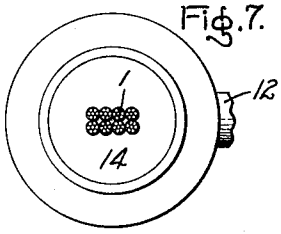


Fig. 9.

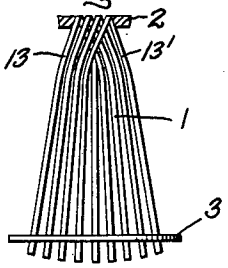


Fig. 4.

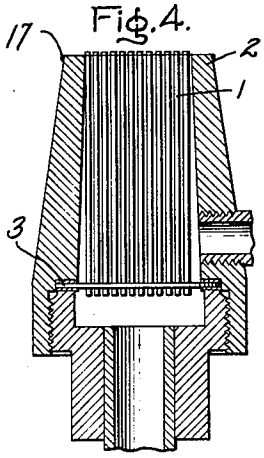


Fig. 8.

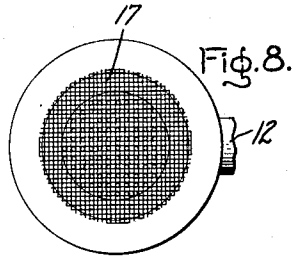


Fig. 10.

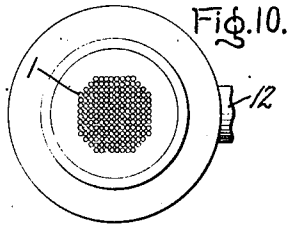


Fig. 11.

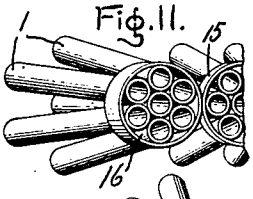


Fig. 12.

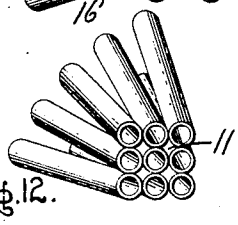
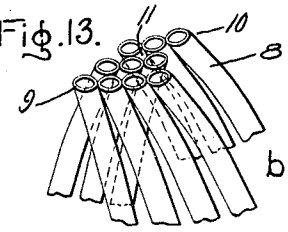


Fig. 13.



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by Charles E. Mullan
His Attorney

Patented July 16, 1929. 1,721,381

UNITED STATES PATENT OFFICE.

ALVARADO L. R. ELLIS, OF SWAMPSCOTT, MASSACHUSETTS, ASSIGNOR TO GENERAL ELECTRIC COMPANY, A CORPORATION OF NEW YORK.

GAS BURNER.

Application filed February 2, 1928. Serial No. 251,442.

The present invention comprises a burner or combustion device which is capable of quiet and efficient operation. A burner embodying my invention, although suitable for any heating purpose, is adapted particularly well for furnishing a sufficiently hot flame to carry out the fusion of silica and the fabrication of silica devices.

The operation of high temperature burners such as used heretofore for working quartz has been accompanied by so loud a roar that ordinary conversation in their vicinity has been impossible and the hearing of workmen has been injured thereby. This loud roar has been believed to be inevitable and to be due to the high pressure of gas required for such a burner.

I have discovered that in order to secure a sufficiently hot but quiet flame it is necessary that a substantially constant flow of gases which are thoroughly mixed for combustion should be provided. The tremendous roar of oxy-hydrogen burners, suitable in size for working quartz, is due not so much to the pressure and consequent high velocity of gas emission from the burner, as to the great variation in the mixture of the two gases at various points in the cross section of the flame a short distance from the burner. The velocity of flame propagation in different parts of the emission stream varies enormously, due to the variation in the mixture, with the result that at points it has an explosive character. At these points the flame darts toward the burner until it meets a region where the flame propagation is slower than the velocity of the gas flow, and as a consequence is carried farther from the burner. These events rapidly recurring in different parts of the flame are responsible for the roar of the former type of burner.

As a consequence of my invention, I have provided an improved burner whereby a quiet flame of high calorific value may be secured. In accordance with my invention, one of the gases for the combustion is delivered through a plurality of thin-walled tubes and a second combustion gas is delivered through the spaces between such tubes. In accordance with one modification of my invention groups of tubes are arranged to deliver gas streams at an angle to one another thereby producing turbulence of gases in the flame which promotes mixing and hence uniform combustion of the gases.

My invention will be pointed out with greater particularity in the appended claims. For a complete understanding of my invention, reference may be had to the accompanying drawing taken in connection with the following description.

In the drawing, Figs. 1, 2, 3 and 4 are longitudinal sections of different forms of burners embodying my invention; Figs. 5, 6, 7 and 8 are end views respectively of the burners shown in Figs. 1, 2, 3 and 4; Fig. 9 is a fragmental view of a simplified form of a burner embodying my invention; Fig. 10 is an end view of a modified arrangement of the burner shown in Figs. 5 and 6; and Figs. 11, 12 and 13 are enlarged fragmental views illustrating the spacing of the gas delivery tubes of different burners.

The burner shown in Figs. 1 and 5 comprises a bundle of thin-walled tubes 1 consisting of nickel, copper, Monel metal, or other suitable material, which terminate at their delivery end in the head of a nozzle casing 2 and which pass at their receiving end through a plate 3 to which they are joined hermetically by soldering, brazing, or otherwise. This plate 3 is secured in a recess of the nozzle head 2 by a ring 4 which is screw-threaded to the end of the gas delivery conduit 5, suitable washers being provided to make a gas-tight joint. The ring 4 is held into position by a nut 6, the flange of which is screw-threaded and engages with screw-threads of the flange 7 of the nozzle head 2.

The delivery ends of the tubes 1 are given a twist or rotative displacement in successive rows with respect to one another to produce turbulence of the gases in the flame. As best observable in Figs. 1 and 13, the outer ends of the row of tubes 8 are bent at an angle to the adjacent rows 9 and 10 at the gas delivery end of the nozzle head. The individual tubes are so spaced that openings 11 are left between the tubes for the delivery of a gas which is supplied by a conduit 12.

In the arrangement shown in Figs. 1 and 5 the ends of the tubes 1 in successive concentric rows of tubes are given a twist in opposite directions as illustrated in Fig. 13 to produce the desired turbulence in the gases issuing from the nozzle. It is not always necessary that a concentric arrangement should be adopted. For example, in Fig. 9 a simplified embodiment of my invention is shown in which a single row of tubes is provided

which separate into groups 13 and 13′ near the proximity of the nozzle head 2, the ends of the respective groups being bent so that they overlie one another at an angle at the orifices in the nozzle casing 2. The arrangement of the tubes illustrated in Figs. 1, 5 and 13 is such that a maximum space is left between the tubes. It will be observed that if lines were drawn between the centers of tubes groups about such diamond-shaped openings 11 that the resulting figure would be a square. Such arrangement, therefore, will be referred to as a square packed grouping. The conduits 5 and 12 are supplied with a combustible gas, such as hydrogen or fuel gas, and a combustion-supporting gas, such as oxygen and air, the combustible gas preferably being supplied to the conduit 5 and from it to the tubes 1.

In the modification of my invention shown in Figs. 2 and 6, the desired spacing between the tubes 1 is secured by a different square-packed arrangement. The opening through the nozzle head 14 is rectangular in shape, as shown in Fig. 6. The various tubes are arranged in rows through the rectangular opening (see also Fig. 12). The rectangular shape of the opening prevents succeeding rows of tubes from becoming more closely packed, that is from moving into the spacing between the preceding row in such a way as to produce a triangular packing which would unduly reduce the area of the opening between the tubes. The spacing of the holes in the plate 3 through which the tubes 1 pass is sufficiently far apart to prevent undue obstacles in the delivery of the gases received by the conduit 12. The fall of pressure occurs almost entirely at or adjacent to the nozzle head. This insures a uniform delivery of the gases.

In Figs. 3 and 7 another modification is shown in which the tubes 1 are maintained in bundles properly spaced. As shown in Fig. 11 groups or bundles of seven tubes are held in position by larger encompassing bands or cylinders 15 so that in each bundle six tubes are spaced about a centrally located seventh tube. In this case a triangular packing is so arranged that the spaces 16 between and about the tubes and within the band 15 are adequate for the delivery of the gas which coacts with the gas delivered by the tubes themselves to produce a flame.

The desired spacing between the tubes may also be obtained by arranging a wire screen or mesh 17 adjacent the burner orifice as shown in Figs. 4 and 8, and causing the ends of the gas delivery tubes 1 to project through alternate openings in the wire mesh. The combustion supporting gases pass through the intervening spaces. Such an arrangement is suited particularly for burning illuminating gas with air.

An arrangement such as shown in Figs. 2 and 6 can be modified to produce a burner orifice of desired geometric shape. For example, in the end view of a burner as shown in Fig. 10 the tubes are arranged in the form of an octagon, thereby approximating a circular burner opening, the tubes being kept in the desired spaced condition by the regularity and arrangement of the rows.

In any of the constructions here illustrated embodying different modifications of my invention, the relative cross-sectional areas of the combined tube orifices and the combined spaces between the tubes are so chosen that the combustible gas and the combustion supporting gas flow from the burner at approximately the same velocities. For example, in the case of a burner in which the flame is produced by the combustion of hydrogen and oxygen the cross-sectional area of the orifices delivering the hydrogen gas should be approximately double the area of the orifices delivering the oxygen. When air is used as the combustion-supporting gas larger orifices must be provided.

The complete mixture of the gases afforded by the number and spacing of the delivery orifices produces a burner which is quiet in operation, making no more noise than an ordinary Bunsen burner and in which the danger of a flash-back of the combustion into the delivery conduits is absent and which may be constructed to provide for the delivery of any desired combustion of gases. It will be observed that the size and shape of the flame produced by my improved burner may be varied by simply adding additional gas delivery tubes in a desired manner and, therefore, the flame may be made as large as desired without loss of flame temperature.

What I claim as new and desire to secure by Letters Patent of the United States, is:

1. A burner comprising a bundle of tubes held in compact relation, means for feeding a gas through said tubes, means for feeding a second gas which is capable of combining with the first gas through spaces between said tubes, the combined cross-sectional areas of the tube orifices being chosen relative to the combined cross-sectional areas of said spaces that said gases may be delivered thereby at approximately equal velocities in a ratio adapted to produce a quiet flame.

2. A gas burner comprising a nozzle casing, a partition extending across said casing and forming two chambers therein, a plurality of tubes extending from one of said chambers through the other chamber to the orifice of said casing leaving spaces for the escape of a gas between said tubes and means for delivering combustion gases to said respective chambers, the combined cross-sectional areas of the tube orifices being chosen relative to the combined cross-sectional areas of said spaces that said gases may be delivered thereby at approximately equal ve-

locities in a ratio adapted to produce a quiet flame.

3. A gas burner comprising a nozzle, a casing having an opening, a plurality of tubes passing through said casing and terminating at said opening, said tubes being bent at their ends and arranged at an angle with respect to one another, means for delivering a gas to said tubes, and means for delivering a second gas capable of producing a flame to the first gas through the openings between said tubes, the combined cross-sectional areas of the tube orifices being chosen relative to the combined cross-sectional areas of said spaces that said gases may be delivered thereby at approximately equal velocities in a ratio adapted to produce a quiet flame.

4. A gas burner comprising a nozzle casing having an opening, a plurality of tubes projecting through said casing and terminating at said opening, said tubes being arranged in square-packed relation, and means for delivering flame producing gases respectively through said tubes and through the spaces between said tubes, the combined cross-sectional areas of the tube orifices being chosen relative to the combined cross-sectional areas of said spaces that said gases may be delivered thereby at approximately equal velocities in a ratio adapted to produce a quiet flame.

5. A gas burner comprising a nozzle casing, a plurality of tubes extending through said casing, a wire mesh supported adjacent the orifice of said casing and arranged to hold said tubes in desired relation with respect to one another and said casing, the combined cross sectional areas of the spaces between said tubes having such relation to the combined cross sectional areas of said tubes as to permit of the delivery therethrough of a sufficient volume of combustion-supporting gas to completely burn with a quiet flame a combustible gas delivered through said tubes at the same rate of flow as said former gas, and means for feeding said gases respectively through said tubes and through the spaces between said tubes.

6. A gas burner comprising a casing provided with an opening having straight sides, a plurality of thin-walled tubes having their orifices arranged in square packed relation in said opening, the combined cross-sectional areas of said orifices being chosen relative to the combined cross-sectional areas of spaces between said tubes to permit flame-producing gases to be separately delivered at substantially equal velocities by said tubes and spaces respectively in a ratio required for quiet combustion and means for supplying said gases separately to said tubes and the spaces therebetween.

In witness whereof, I have hereunto set my hand this 31st day of January, 1928.

ALVARADO L. R. ELLIS.