Aug. 24, 1965 P. M. L. JOUARD 3,202,204

RADIANT GAS BURNER

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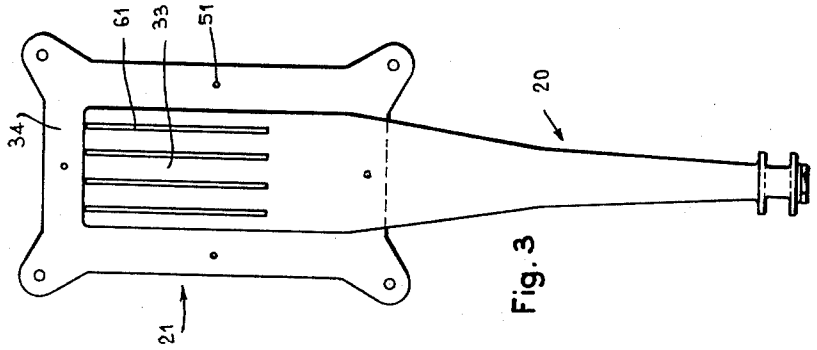


Fig. 3

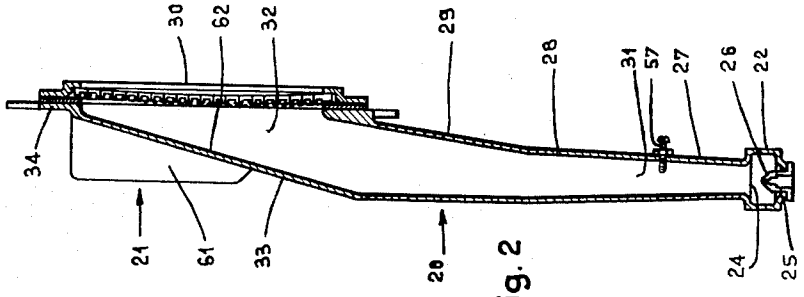


Fig. 2

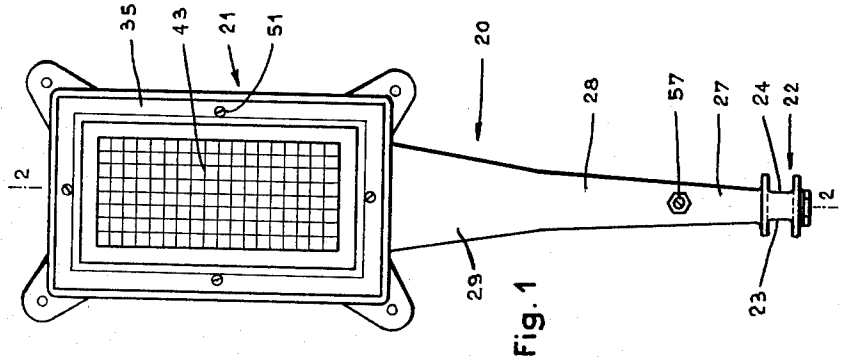


Fig. 1

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Fig.5

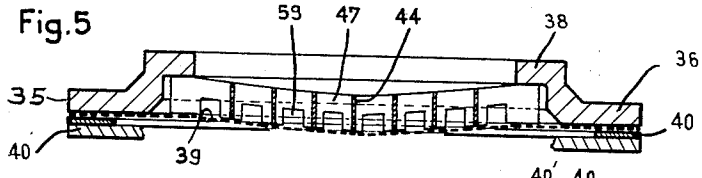


Fig.4

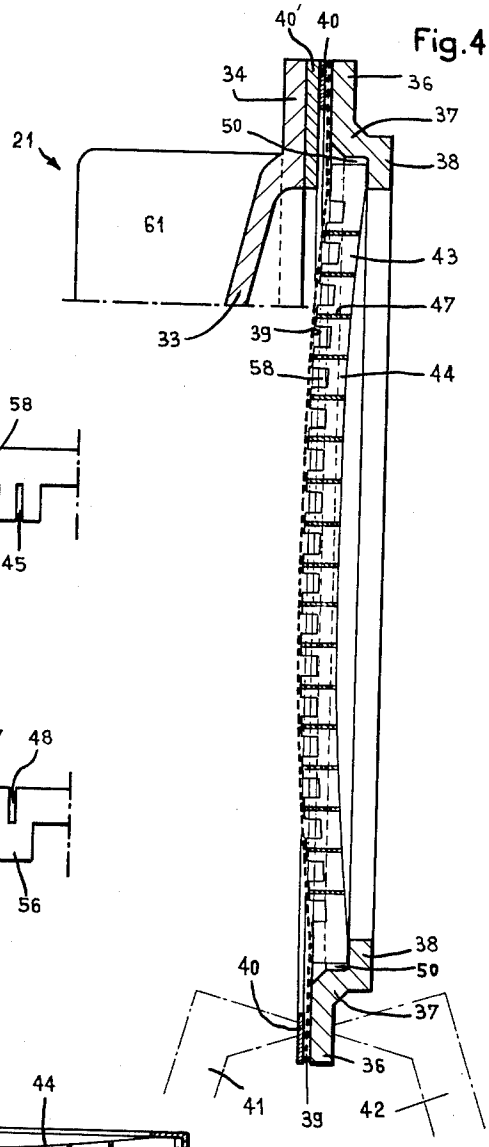


Fig.6

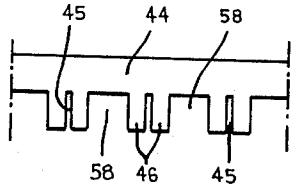


Fig.7

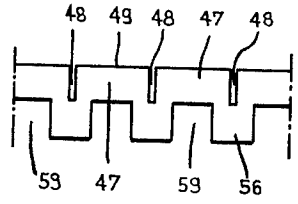
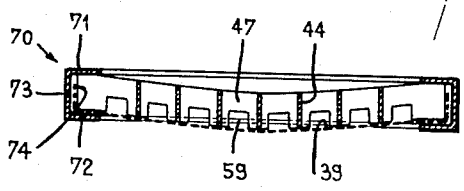


Fig.8



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Fig.10

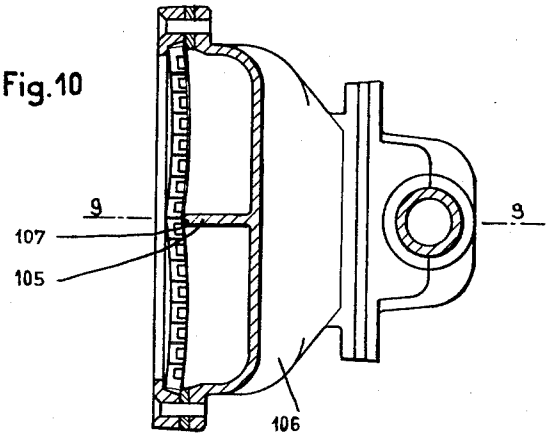


Fig.9

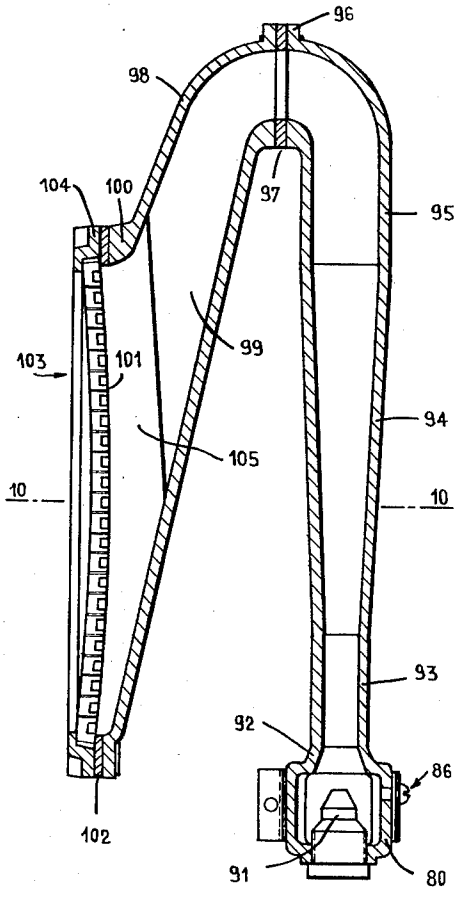


Fig.11

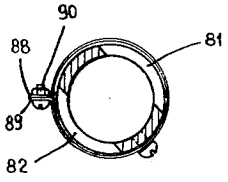
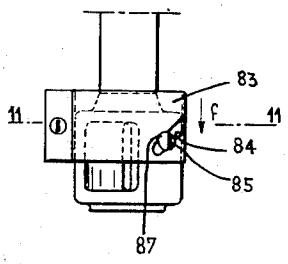


Fig.12



United States Patent Office 3,202,204 Patented Aug. 24, 1965

3,202,204

RADIANT GAS BURNER

Pierre Marie Lucien Jouard, Bellevue, France, assignor to Auguste Emile Boulet, Nice, France

Filed Feb. 20, 1963, Ser. No. 259,993
Claims priority, application France, Feb. 22, 1962, 888,888
6 Claims. (Cl. 158—116)

The present invention relates to an improved gas burner wherein the head of the burner provides, for the outlet of the gases, a flow section substantially greater than the section at the neck, in a ratio of the order of 10/1 to 60/1, so that it offers a negligible resistance to the passage of the gases, and since the flow of the gases may thus take place almost freely, it becomes possible for the fuel gas—whether town gas, butane gas, propane gas or natural gas—to carry along, in the neighbourhood of the injector, a sufficiently large amount of air for the combustion to occur completely, without contribution of secondary air, said combustion taking place in contact with a single wire-gauze or similar member, providing the passages for the gas and topped, in contact therewith, by stack means formed, for instance, by interlaced walls in perpendicular relationship with said wire-gauze.

In such a gas-burner, the partitions constituting the duckboards or interlacings reach a very high temperature, which is higher than that of the wire-gauze or other similar member, the combustion taking place without flame, probably on account of the radiation performed by said partitions on the outer surface of the wire-gauze or other similar member, resulting in a high calorific efficiency which is superior to that of conventional gas burners.

It is an object of the invention to provide a gas burner of this type, which will maintain its operating qualities for long periods of time, in spite of sudden, recurrent, temperature variations due to lighting or extinguishing.

It is another object of the invention to provide such a gas burner which is of a simple and economical construction, designed to operate in a reliable manner and therefore capable of being manufactured in quantities by unskilled labour.

It is a further object of the invention to provide a gas burner operating safely, without back firing or risk of setting fire at the injector, with no need for adjoining additional members, the operating conditions of the burner entirely complying with the safety rules specified for such apparatus under the most exacting circumstances.

Still another object of the invention is the provision of a burner which will reliably operate even in a dust-charged atmosphere.

It is also a general object of the invention to provide a gas burner adapted to satisfy the operating conditions as required in various fields: heating or rooms and, particularly, industrial premises, heating of open-air locations, drying and baking of paint, scouring of paint, heating of stoves and furnaces, cooking of food, especially grilling and roasting.

According to the invention, the close contact between the wire-gauze or similar member, on the surface of which the combustion is taking place, on one hand, and the cell-like partitions, i.e., the internal edge of the partitions defining the chimney means, is insured owing to the contact surface being slightly curved, with the concavity directed outwardly.

Under these conditions, and upon expansion of the wire-gauze due to a temperature rise following the ignition, the general shape of said wire-gauze is thus maintained, i.e. will still form a concave surface, without inflection areas, and since the partition assembly has a

temperature higher than that of the wire-gauze, the temperature increase may result in an increased surface pressure between the wire-gauze and the partitions or lattice and, consequently, in the contact being thus an improvement relative to the cold state.

In a burner according to the invention, all the areas of the partition assembly will be at a high temperature, the wire-gauze being consequently maintained in all its points at a temperature lower than that of the partitions, without areas of higher temperature being produced.

This fact assists in removing any risk of back firing, since the inner portions of the wire-gauze remain, in any one of the areas thereof, at a sufficiently low temperature for the flame not to be able to propagate at the upstream end of the wire-gauze, although the burner presents extremely hot portions at the downstream end, and more particularly the cell forming partitions, in perpendicular relationship to the wire-gauze, on behalf of the intensity of radiation derived from the burner and the calorific efficiency achieved thereby. On account of the intimate contact, on the entire surface, between the partition assembly and the wire-gauze or similar member, the temperature of the latter is uniformly distributed, and an observer facing the burner will see a uniform "colour" on the whole surface, without forming any dark or exceedingly brilliant zones.

The invention relates also to a method of manufacturing such a gas burner, wherein the incurvation of both the wire-gauze and the partition assembly or lattice associated therewith is achieved, during an operating stage of the burner, by a pressure or a percussion action effected when the wire-gauze and the partition assembly are at a high temperature, when the metallic materials of which they are formed present a high degree of malleability, the manufacturing of the burner being then identical to that of burner having a flat wire-gauze and partition assembly or lattice.

In practice, advantage is taken of the first ignition of the burner, necessary for the adjustment of the air intake, to carry out the incurvation, which remains permanently established and imparts to the burner its particular features according to the invention.

To enable the invention to be more clearly understood and carried into practice, reference is now made to the accompanying drawings, wherein:

FIG. 1 is a front view of the burner, in elevation, according to one embodiment of the invention;

FIG. 2 is a cross-sectional view along line 2—2 of FIG. 1;

FIG. 3 is a rear view of the burner according to the invention;

FIG. 4 is a sectional view, on an enlarged scale, through the front face of the burner;

FIG. 5 is a similar view to that of FIG. 4, but along a cross-section at right angles thereto;

FIG. 6 is a view of a strip forming the partition assembly, or lattice;

FIG. 7 illustrates another type of strip constituting the partition assembly;

FIG. 8 is an alternative embodiment of the arrangement as shown in FIGS. 4 and 5;

FIG. 9 is a longitudinal, sectional view along line 9—9 of FIG. 10, according to an alternative construction of the burner;

FIG. 10 is a cross-sectional view, along line 10—10 of FIG. 9;

FIG. 11 is a cross-sectional view along line 11—11 of FIG. 12;

FIG. 12 is a side elevational view of a portion of the burner in the neighbourhood of the air intake.

Referring first to FIGURES 1 and 2 of the drawing, the burner illustrated generally comprises a body 20 and

a head 21. The body is formed with a neck 22 providing two windows 23 and 24 for the air intake. The fuel gas flows through a nozzle or injector 25 ending in a tapered portion 26 for the leaving jet of fuel gas. The cross-section of body 20 is increasing in the direction of the gas flow. In the illustrated embodiment, the body 20 comprises, beginning with the neck portion 22, a substantially cylindrical portion 27, followed by a portion 28 shaped substantially as a truncated cone, and by a further portion 29 widening up more rapidly into a plane substantially parallel to the exit side 30 of the burner than into a plane perpendicular thereto.

The body 20 of the burner thus provides a duct 31 extending with a chamber 32, also known as a mixing chamber of head 21. Chamber 32 is defined as a mixing clined wall 33, so that the cross-sections of the gaseous flow present a progressively reduced area as the distance from the inlet side of the mixing chamber is increasing. The head is formed with a flange 34 for securing a frame 35. In the illustrated embodiment shown in FIGS. 4 and 5, frame 35 has a substantially Z-shaped cross-section with one branch facing rim or flange 36, another branch substantially perpendicular 37 and a third branch 38. A wire-gauze 39 consisting of wires of a diameter of the order of 0.2 mm. and forming 250 meshes, approximately, per square centimeter, is secured to said frame 35. Although the diameter of the wires of the wire-gauze and the dimensions of the meshes are of importance, the numerical values specified are not limitative. The selection of the sizes and their limits depend, on one hand, on the requirement that the wire-gauze should offer a very low resistance to the passage of the gaseous flow, the pressure difference as measured on both sides of the wire-gauze being of the order of one-tenth of a millimeter of water, and, on the other hand, on the fineness of the wire being sufficient and the meshes being sufficiently closely-woven for the wire-gauze to perform its function as a flame-arrester. Besides the size values mentioned above, satisfactory results have been obtained, according to the nature of the gas utilized, with wires as thin as 0.18 mm. in diameter, and forming about 465 meshes per square centimeter, and also with wires having a diameter of 0.4 mm., forming about 80 meshes per sq. cm.

For preparing the wire-gauze to be fixed onto the frame, the invention provides the application of the spot welding method, according to an embodiment now to be described. The wire-gauze 39 is cut up along a contour corresponding to that of the frame, and the frame is then placed on said wire-gauze (the elements being, for this purpose, placed horizontally), or, inversely, the wire-gauze is placed on the frame, and a metal strip or strap 40 is placed in front of branch 36. Branch 36, the edge portion of wire-gauze 39 and strip 40 are clamped between the electrodes 41 and 42 of a welding machine (not shown) and the welding spots set up at a convenient distance from one another. The wire-gauze is thus successively secured to the four edges of the frame, which may be rectangularly shaped, for instance, as in the example illustrated. After securing the first side of the wire-gauze, the lattice or partition assembly 43 is introduced. The assembly is formed of strips or laminations, which are, partly disposed longitudinally and in parallel relationship to a pair of the frame sides, and partly, transversally and in parallel relationship to the other pair of frame sides. The strips 44, which are longitudinally disposed (FIG. 6) are formed with uniformly spaced notches or slots 45 on one of the longitudinal edges thereof, for instance the inner edge 46. Similarly, the strips of the other set, transversally disposed 47 (FIG. 7) are formed with notches 48 on the opposite edges thereof, i.e. on the external edge 49. The two sets of strips are assembled by overlapping, thus providing the lattice or partition assembly 43 defining square-shaped cell structures. This lattice assembly, having generally a rectangular contour, is placed between the wire-gauze 39 and an outside mounted frame defining branches 38. A small gap is formed between an edge of this lattice, as shown at 50, and branch 37 to allow for play due to expansion. The lattice or partition assembly 43 provides thus square-shaped cell or compartment structures, the height of the strips, and therefore that of the lattice, between substantially equal to the side of the square. Satisfactory results have been obtained with a lattice structure forming square chimneys having one side of 8 mm. and a height of 8 mm. These sizes are however not critical, although the network must be sufficiently open for the partitions forming the lattice, placed edgewise, not to oppose a substantial resistance to the flow of the gaseous fluid. The thickness of the strips forming the two-way lattice assembly is selected to be small for the same reason, but sufficiently large for the strips to present the necessary mechanical strength for the operation of the burner, under high temperatures. The frame thus established is applied with its surface carrying the sheet 40, with interposition of an asbestos or similar gasket 40', against edge 34, and the assembly is then fitted together by any convenient meanss, such as by screws 51, for instance

Upon the burner being lighted for the first time or times, and when the wire-gauze 39 and the lattice assembly 43 have reached the operating temperature, a slight pressure is exerted on the external face of the lattice by means of a small drum fitted on a shaft, or by performing slight percussions by means of hammer with a rounded off claw. This operation will impart both the lattice assembly and the wire-gauze, which is clamped on its periphery, an incurvation both in the longitudinal and in the transversal direction, resulting in the wire-gauze, initially flat shaped, assuming a concave form, both in the plane directed in parallel relationship with the large sides 52 and 53 of the frame, and in a plane directed in parallel relationship with the small sides 54 and 55 thereof. This distortion corresponds exactly to the distortion of the lattice assembly, since it is this latter assembly which is determining it, so that a perfectly continuous application of the inner edges 46 and 56 of strips 44 and 47 against the wire-gauze is thus achieved, from one end of the strips to the other. This distortion, which takes advantage of the malleability of said strips and of the wire-gauze at the operating temperature, remains permanently set after the extinction of the burner. Subsequently, the distortions of the wire-gauze instead of occurring in a haphazard manner, i.e. resulting in incurvations directed randomly and would thus bring about spacings, in certain spots, between the wire-gauze and the lattice, maintain the first in its curved shape, the distortions of the lattice, moreover, resulting in an increase of the close contact between the inner edges of the lattice and the wire-gauze. This shaping of the wire-gauze and the partition assembly may be performed during the initial adjustment operation of the air intake of the burner, by means of a turbulence screw, for instance such as shown in 57.

The inner edges 46 and 56 of the strips are cut out along notches 58 and 59, respectively, so that each cell 60 of the lattice communicates by means of four notches with four adjacent cells, thus ensuring that the lighting effected at a single point propagates to the whole surface of the burner. Thus, a stable operation of the burner is rapidly achieved. The notches formed on the inner edge of the lattice partitions also facilitate the incurvation of the lattice assembly during the initial shaping operation.

When igniting the burner, for instance by means of a match, the flame produced at the cell or at the point of ignition is propagating nearly instantaneously to all the cells of the structure. The combustion occurs first with small blue flames which quickly fade away and progressively and completely disappear along with the increase of the temperature: on observing the head of the burner, the red hues show that the strips constituting the lattice

assembly are at a higher temperature than the external face of the wire-gauze. The combustion continues without any flame, the lattice assembly being brought to a temperature of the order of 700° to 1000° C., the combustion area being limited by the screen provided by the wire-gauze. The very small resistance offered to the flow of the gas over its whole circulating path, including the passage through the wire-gauze, enables the jet of the fuel gas to carry along a sufficient amount of air to ensure a complete combustion. It is even possible, by means of the adjusting screw **57**, to obtain the entrainment of an air volume greater than that corresponding to the complete combustion, in order to achieve an oxidizing combustion. A reducing combustion may also be obtained by limiting the entrained air. The radiation issued from the partitions brought to a high temperature substantially accelerates the combustion rate of the mixture leaving the wire-gauze—the intervention of the temperature being in accordance with an exponential law—and thus explains the absence of the flame. The close and continuous contact between the internal edges of the partition strips and the wire-gauze favours the obtaining of a high temperature for the strips, as well the maintaining of a lesser temperature at the surface of the external portions—or downstream—of the fine wires constituting the wire-gauze, the internal portions—or upstream—being at a lower temperature because of these being cooled down by the fuel gas mixture. The wire-gauze thus performs in a perfect manner its part as a flame arrester, in spite of the comparatively high temperature of the adjacent strips. No firing occurs at the injector, even in the long run of the burner.

The shape of chamber **32** ensures, without requiring any kind of baffles, the feeding of all portions of the burner, which provides a uniform combustion on the surface, in spite of the comparatively low pressure applied for moving the fluid mass.

Should a dust particle carried along by the fluid up to the wire-gauze, it will be destroyed when it will enter a mesh on account of the high temperature to which it is submitted. Any risk of blocking the grid is thus eliminated, thus enabling the use of the burner in a polluted atmosphere such as met with frequently in industrial locations.

According to the embodiment illustrated in FIGS. 2 and 3, the burner and its head is of cast iron, fitted with cooling ribs or fins such as **61**, for the cooling of the rear portion, the inner surface **62** (FIG. 2) of chamber **32** assisting in maintaining a low temperature for the internal parts of the wire-gauze.

When the burner is used with its wire-gauze placed in a vertical or quasi-vertical plane, as shown in FIGS. 2 and 3, the adjacent fins **61** play a similar part as that of a chimney, the air sweeping achieved assisting in the cooling.

A burner of this type may also be used with the head disposed horizontally, either directed upwardly, or downwardly.

Referring now to FIG. 8, it will be noted that in the embodiment illustrated the wire-gauze **39** and the lattice **43** are maintained by means of a U-shaped frame **70**, formed with two parallel branches **71** and **72** connected by a branch **73**. The wire-gauze is bent on its periphery so as to form a flange **74**; one of the four sides of the frame, at first open to allow the establishment of the lattice assembly, is then bent over for blocking purposes. Such a frame may be treated so as to produce the incurvation of the wire-gauze and its lattice assembly, as previously shown.

Referring now to FIGS. 9 through 12 of the drawing, there is shown a lantern **80** forming two large diametrally opposed air intakes **81** and **82**. On this lantern is slidingly engaged an adjusting ring **83** for the air admission. This ring is formed with a button-hole **84** inclined with respect to the axis and cooperating with the shank **85** of a screw **86** with head **87**. The ring **83** is open and is

formed with two flanges **88** and **89** facing each other, providing a passage for a locking screw **90**. FIG. 12 shows the ring at a maximum opening. By causing the ring to slide in the direction of the arrow *f*, after loosening the screw **90**, the opening for the air intake is reduced; the cooperation of the screw **86** and the button-hole **84** enables an accurate adjustment to be achieved.

The lantern **80** which accommodates the fuel gas injector **91** continues with a convergent portion **92**, followed by a cylindrical portion **93** and a divergent portion **94**, the latter comprising a curved part **95** ending in a flange **96** adapted to facilitate its assembly, through the interposition of a gasket **97**, with the burner head **98**. This head includes an inner chamber **99**, the cross-section of which increases up to the flange **100** used for fixing in position, in the manner described with reference to the embodiment illustrated in FIGS. 1 through 7, of a wire-gauze **101**, with interposition of a gasket **102**, on the top of which, and in contact therewith, there is mounted a cell-like lattice assembly **103**, the wire-gauze and the lattice being maintained by a frame **104** secured together by means of screws or bolts inserted in the oppositely provided holes.

According to this embodiment, the assembly comprising the wire-gauze **101** and the lattice **103** rests, in the central portion thereof, against a rib or fin cast in one piece with the body **106** of the burner head and arranged in parallel relationship with the large sides of the rectangle defining the openings formed therein.

During the incurvation operation, the wire-gauze **101** is caused to rest against the blunt edge **107** of the rib **105** and the wire-gauze and lattice assembly thus presents a concavity on both sides of the central part, as clearly shown in FIG. 10, the two halves being also concave in the perpendicular direction as illustrated in this figure.

What I claim is:

1. A gas burner comprising a body defining a mixing chamber having a terminal head, said head having an outlet opening, frame means bounding said opening, a covering for said outlet opening including a wire-gauze, and a cellular partition on the wire-gauze on a side thereof opposite the mixing chamber, said cellular partition being formed of intersecting strips, the wire-gauze and the partition being rigidly secured peripherally by said frame means, said partition being incurved toward the interior of the chamber and being applied with pressure against the wire-gauze to which is imparted a complementary incurved shape.

2. A gas burner head having an outlet opening and comprising an inner frame structure and an outer frame structure, a wire-gauze covering the outlet opening and peripherally engaged between the inner frame structure and the outer frame structure, a cellular partition constituted by intersecting strips substantially perpendicular to the wire-gauze, said partition being peripherally engaged between said frame structures and being curved inwardly in said head so as to be concave toward the outside and to impart to the wire-gauze a stretched configuration in which the wire-gauze is in pressure contact with the partition over the entire length of the strips.

3. A burner head according to claim **2**, wherein the strips have edges which are notched for reciprocal engagement, the inner edges of the strips proximate the gauze having cut outs between the notches.

4. A gas burner head comprising rectangular frame means bounding an outlet opening for the gas mixture, covering means for said opening comprising, an inner wire-gauze and a partition formed of intersecting strips substantially perpendicular to the wire-gauze, said covering means being stretched and peripherally engaged by said frame means, a central support rib integral with the frame means, said covering means forming a first portion curved inwardly toward the interior between one of the edges of the frame means and said rib and a second portion curved inwardly toward the interior between the op-

posite edge of the frame means and said rib, the wire-gauze and the cellular partition being engaged in pressure contact in both said portions of the covering means.

5. In a process of manufacturing a burner having a head with a frame bounding an opening and provided with an assembly formed of a wire-gauze surmounted by a cellular partition covering said opening, said assembly being peripherally engaged by the frame and stretched therein, the steps comprising firing the burner, leaving the burner ignited until the head reaches its operating temperature, exerting on the outer surface of the partition a pressure force acting transversely to said partition to cause incurving of the latter and stressing of the gauze under tension by contact with the wire-gauze of the incurved inner edges of the strips of said partition.

6. In a process of manufacturing a burner having a head with a frame bounding an opening and provided with an assembly formed of a wire-gauze surmounted by a cellular partition covering said opening, said assembly being peripherally engaged by the frame and stretched therein, the steps comprising firing the burner, leaving the burner

ignited until the head reaches its operating temperature, subjecting the outer face of said partition to a cylindering parallel to one of the edges of the frame thus curving the partition inwardly against the gauze to place the gauze under tension in engagement with the incurved inner edges of the strips of said partition.

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