

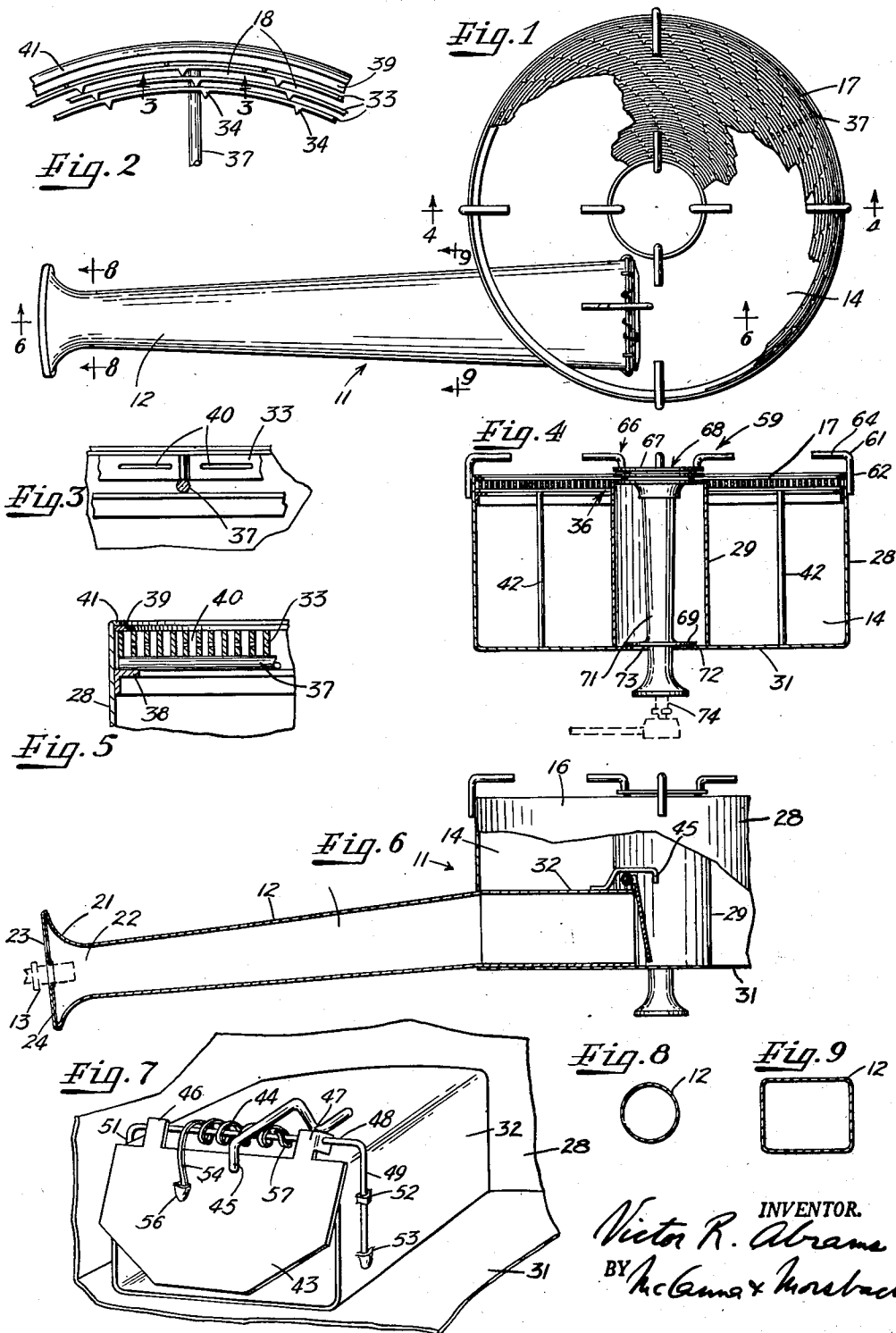
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GRID PORT STRUCTURE FOR GAS BURNERS

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GRID PORT STRUCTURE FOR GAS BURNERS

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This invention relates to a grid port structure for gas burners and more particularly to a grid port structure for gas burners using 100% primary air and operable with either natural or manufactured gas.

It is an object of this invention to provide a novel grid port structure for gas burners which is of novel construction insuring the proper desired flame port size at the burner.

Another object of this invention is to provide a novel grid port structure for gas burners which is so constructed that large quantities of combustible air-gas mixture may be discharged at a relatively low velocity and which facilitates the operation of the burner as a 100% primary air burner.

Another object of the invention is to provide an improved grid port construction for gas burners so constructed that combustion occurs immediately adjacent to or to some degree in the actual ports so constructed that, though operating at temperatures which cause the port structure to incandesce, flash back is controlled.

Another object of the invention is to provide a novel grid port structure for gas burners which when partially plugged by organic material burns and reduces the same to an ash because of the high air gas ratio and the intense heat at the port structure.

Another object of the invention is to provide a novel grid port structure for gas burners in which the rated port loading is no greater than 1000 B. t. u.'s per square inch per hour.

Other objects and advantages of the invention will become apparent from the following detailed description taken in connection with the accompanying drawings, in which—

Figure 1 is a top view of a burner with a cut-away section embodying my invention;

Fig. 2 is an enlarged fragmentary view of the port structure;

Fig. 3 is a sectional view taken substantially along the line 3—3 of Fig. 2;

Fig. 4 is a transverse vertical sectional view taken substantially along the line 4—4 of Figure 1;

Fig. 5 is an enlarged fragmentary view showing a construction utilized in mounting the port structure in the burner head;

Fig. 6 is a transverse sectional view taken substantially along the line 6—6 of Figure 1;

Fig. 7 is a perspective view showing a discharge end of a mixing tube;

Fig. 8 is a sectional view taken substantially along the line 8—8 of Figure 1, and

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Fig. 9 is a sectional view taken substantially along the line 9—9 of Figure 1.

Referring now to the drawings the invention is shown embodied in a gas burner 11 of the totally aerated type constructed for use in a conventional type gas stove. In general, gas and air for the burner are supplied through an elongated mixing tube 12 connected between a gas supply nozzle 13 and a burner head 16. Upon leaving the mixing tube 12 the air-gas mixture flows into a chamber 14 in the burner head 16 and in turn is subsequently discharged at relatively low head pressure through a port structure 17 covering a relatively larger area, and comprising a plurality of cell like ports 18.

The mixing tube 12 is preferably of a type permitting effective expansion for regain; i. e., change of velocity to pressure energy. The gas initially enters the mixing tube 12 through a bell mouth end 21 and subsequently flows through a relatively large restricted throat portion 22. Herein, the throat size is such as to accommodate approximately 12,500 B. t. u.'s or less per inch of throat area per hour. It is to be understood that this particular B. t. u. per square inch per hour relation is indicative of the order of magnitude and is not intended in any sense to be a limiting value. Simultaneously, air is drawn into the mixing tube 12 through an opening 23 formed in a shutter plate 24 disposed across the bell mouth end 21. The composite air-gas mixture is, after leaving the throat portion 22, expanded in the mixing tube. Herein the mixing tube 12 adjacent the throat in the direction of the flow of the gas stream has a circular cross section (see Fig. 8) of conventional construction. The mixing tube 12 continues to flare outwardly and as shown in Fig. 9 may by transformation take a rectangular or other conveniently shaped cross section. Preferably the mixing tube is dimensioned to provide for an expansion of about 1:10 or more. This is not an absolute ratio but is representative of the order of magnitude contemplated.

The chamber 14 herein is in the form of an annular passage formed by concentrically disposed sleeve members 28 and 29. The sleeve member 28 is of relatively large diameter and is open at its upper end. At its lower end it is closed by a bottom member 31. The sleeve member 29 is of smaller diameter and is secured at its lower end to the bottom member 31 as by welding. The bottom 31 also serves to support the end 32 of the mixing tube projecting through the

sleeve 28 to effect communication with the chamber 14.

In conventional burners the gas supply nozzle and the mixing tube constitute a jet pump for converting the kinetic energy of the gas stream into pressure energy in the burner head, before the gas stream issues through the ports. The dimensional characteristics of these elements in conventional burners have been such that a considerable pressure is developed in the burner head; and, consequently the gas is discharged through the ports at a relatively high velocity. To obtain this high discharge velocity a relatively high static pressure in the head is required. The gas jet and mixer tube assembly which may be considered as the jet pump, is therefore working against a high discharge pressure. Consequently, the amount of air that can be aspirated by the burner is extremely limited. Accordingly, my invention is concerned with a burner grid port construction in which the static pressure in the head is greatly reduced so that large quantities of the air-gas mixture may be aspirated and discharged at a relatively low velocity. This object is facilitated by constructing the port structure 17 so that it has a normal rating at rated burner capacity of approximately one square inch or more of port area or opening per 1000 B. t. u.'s per hour. Conventional burners have somewhere in the neighborhood of $\frac{1}{16}$ square inch of port opening per 1000 B. t. u.'s per hour. It is to be understood that by increasing the port opening the velocity of the gas discharged through the port is decreased. Since the kinetic energy of a moving mass is proportional to the velocity squared, it follows from the above examples that whereas the velocity ratios between the foregoing two constructions is 10:1 the energy ratio is 100:1. A low discharge velocity therefore means decreasing overall energy losses. Thus, a greater total amount of energy is available for aspirating the air.

The grid port structure 17 in the present embodiment of the invention is in the form of a grid structure mounted so as to be disposed at the upper end across the opening in the cylindrical sleeve 28. The port structure is here formed by spiraling a relatively wide ribbon 33 of heat resisting alloy such as Nichrome or the like about a core of substantially the same diameter as the sleeve 28 and building up the structure until the outside diameter is approximately the same as the inside diameter of the sleeve 28 so that the structure can be disposed on the interior thereof. Where required the diameter of the structure should be such that a slight amount of radial displacement is permitted to provide for expansion of the structure; i. e., between the structure and its retaining support, such as caused during operation of the burner. Preferably the ribbon is as thin as possible consistent with mechanical strength requirements. I have found that ribbon of from .008 to .015 inch thick and approximately $\frac{1}{8}$ inch in width gives entirely satisfactory results. These figures are not limiting figures but are indicative of magnitude only. The ribbon is formed with spaced projections 34 of solid cross-section (see Fig. 2) such as can be fashioned by rolling the ribbon 33 between two rollers, coining between dies fashioned to form the projections, or by any other suitable method. The projections 34 herein project outwardly from one side of the ribbon and when in the above grid structure abut against the opposite side of the next ribbon layer so as to maintain

the respective layers in spaced relation. It is to be understood that the projections 34 can be formed on either or both sides of the ribbon 33 as desired.

To maintain the ribbon in a fixed position in the burner, a spider 35 having a plurality of radially extending arms 37 is formed on the underside of the grid structure 17 as shown by dotted lines in Figure 1. It is apparent that the arms 37 could be on the top of the port structure, if desired, or on both the bottom and the top of the ribbon structure. Herein the arms 37 are formed by rods or wire of suitable metal to withstand temperature while at the same time maintaining the integrity of the port structure. The port structure may be supported by the sleeve 28. For this purpose an annular shoulder 38 (see Fig. 5) is provided on the interior of the sleeve 28 adjacent the upper end. The bottom outer peripheral edge of the grid structure rests on this shoulder 38 and a split ring 39 disposed between an annular lip 41 formed by turning the upper end of the sleeve 28 inwardly abuts the top outer peripheral edge of the grid. For purposes of additional support, uprights 42 (see Fig. 4), extending between the bottom 31 and an intermediate portion on the arms 37 of the spider may be included in the assembly.

It will be recognized by those skilled in the art that the grid port structure of the present invention may as readily be employed in a rectangular assembly of the ribbons 33, since the principles of construction of the grid port structure of the present invention do not limit it to the particular spiral assembly illustrated in the drawing. Likewise, it is to be understood that different arrangements, other than that described above, may be adopted for holding the ribbon assembly of the grid port structure in assembled relation.

I have found that best operation results are obtained when the projections 34 are dimensioned such that the distance between two parallel sides of each cell in the grid, that is, the distance between the layers of ribbon is approximately .015-.035 of an inch. With a spacing of from .015 to .021 inch either natural or manufactured gas can be used. When the spacing is less than .015 inch, in some instances the burner will function properly and in others it will not operate. When the spacing is increased so that the distance is greater than .021 inch the same phenomenon is noted with manufactured gas; that is, in some instances satisfactory results are obtained and in others the burner will not function at all. Natural gas can be used with the spacing increased to approximately .035 inch before faulty operation occurs. Due to the wide variety of gas utilized it is evident that these spacing figures are representative of the magnitude of the ports spacing and are not in themselves limiting values. It is to be understood also that although the port spacings below .015 inch can be utilized, the resistance offered by port structure is such that in order to get enough individual ports to permit passage of the gas stream, the size of the burner becomes impractical. With ports of the above dimensions, tests showed that at rated capacity the port loadings were as low as 500-700 B. t. u.'s per square inch per hour compared to conventional loadings of 6000-10,000 B. t. u.'s per hour. On turn down the port loading can be reduced to as low as 50-70 B. t. u.'s per square inch per hour. Because of the low port loadings the noises of combustion, attendant with conventional burners operated

with high primary air being aspirated, are eliminated. With the above port construction the head pressure in chamber 14 measures approximately .005 inch of water or less when the burner is in operation and with an average gas line pressure. The available energy from a gas stream issued from an orifice or jet nozzle is dependent upon the initial pressure of the gas system. It is well known in the art that the pressure in commercial gas systems varies considerably. Variations occur both as to the type of gas; that is, whether it is natural or manufactured and also as to the specific type of gas. Moreover, the pressure varies as to the locality of the gas. Thus, under conditions in which the pressure of the gas system is extremely high the burner may be designed for head pressures up to as much as .010 inch of water or to even .015 inch of water in some cases. The foregoing figures are indicative of magnitude only and are not to be limiting figures due to the many variables connected with the initial gas pressure, type of gas, the purpose to which the burner is to be applied, and the like.

Combustion takes place adjacent to or actually in the outer portion of the port exit passage. Despite the fact that the port structure 17 is composed of a large number of individual ports 18 of a predetermined size as hereinbefore described, the flame from each port merges with the flames of all the other ports so that in effect only one flame is visible, rising above the surface of the structure. Although shown as a burner in which the flame is directed in an upward direction, the burner is capable of being operated in an inverted position. It is estimated that the port temperatures in the zone of combustion may approximate 1400 to 1500 degrees Fahrenheit. Flash back is controlled by maintaining primary air in excess of the air-gas mixture which produces the most rapid flame propagation and also by providing individual port openings small enough and deep enough to give high cooling or flame arrestor action. As a further aid in the control of flash back, in some instances, I form successive slits 40 (see Fig. 3) in the ribbon 33 which in effect divide the ribbon into an upper portion and a lower portion joined together by narrowed portions between adjacent slits. Because of the break in the metal ribbon the conduction of heat from the upper portion of the ribbon is minimized and consequently, the lower part of the grid structure is at a lower head temperature than the upper part. This is advantageous in that there is less heating, and of course less expansion, of the gases flowing through the individual ports 18. Because the heat is partly prevented from being conducted to the bottom of the ribbon 33 the top of the ports become hotter and consequently more radiant heat is available for heating purposes.

As the gas issues from the ports 18 it becomes heated and expanded due to its passage through the burner body 16, the port passages 12, and the flame zone. This added volume entails higher velocity per unit of mass through the ports 18 and thereby leaves additional residual energy in the discharged stream. The residual energy is proportional to the velocity squared of the gas. The ports may operate at incandescence, so that the exit velocity through the individual ports 18 may in fact increase several times. In accordance with illustrated embodiment of the present invention there is provided a burner constructed by which the flame port resistance is made a

relatively uninfluential part of the total system resistance so that the temperature increase of the port structure 17 has a comparatively minor appreciable effect on the operation of the burner.

Following the principles hereinbefore set forth for constructing the mixing tube 12, the burner body 16, and the port structure 17 it is possible to produce a burner, capable when cold, of aspirating air in excess of 150 percent of that required for combustion. To obtain a desired mixture a conventional shutter, such as the shutter 24, may be added ahead of the bell mouth of the mixing tube 12. This acts as a throttling means and introduces a lump resistance to air flow which is a large part of overall system resistance of the burner after its addition. Preferably the throttling mechanism, herein in the form of the shutter 24, is placed at the inlet end 21 of the mixing tube 12 and thus positioned at a cold area so as to handle primary air which has not been materially affected by variations of burner temperatures and thus preserves a relative uniform resistance to flow irrespective of burner temperature. Thus, a constant fluid flow within required limits irrespective of the burner port temperatures tends to be assured. Since the port structures 17, the burner head 16, and the mixing tube 12 have relatively low resistance losses, their change in resistance with changing burner head temperatures induces changed systemic resistances compatible with practical operation of the burner.

This control factor by the lumped resistance in the form of the shutter 24 may be illustrated by an example.

Assume that the

Shutter resistance is .025" water

Mixer throat resistance is .002" water

Port resistance is .005" water

Due to heat, assume that the port resistance doubles to .010". In first case, the total resistance is .032"; and in the second case, .037".

Since flow varies as to square root of head, flow ratios will be as

$$\frac{\sqrt{.032}}{\sqrt{.037}} = \frac{.1785}{.192} = 93\%$$

or a 7% decrease in flow due to increased port resistance. Actually in practice, as flow decreases, there will be a corresponding decrease in shutter and other system resistances so that actual overall change in flow will be less than above indicated.

The shutter is also important from a standpoint of constructing certain types of burners. However, in many instances, for example with a constant pressure gas system gas burners having the novel grid port structure of the present invention, constructed in accordance with the principles set forth herein, do not require the shutter. Therefore it is to be understood that the grid port structure of the present invention is in no way limited to use in a burner assembly which includes the shutter. Due to the fact that in the field, however, pressures for gas systems are not the same for different localities and for different types of gases, it is sometimes desirable to have a substantially universal burner of the type herein disclosed to provide means for varying the air intake in accordance with the pressure of the gas system and with the type of gas used. The shutter disclosed herein may be used for this purpose. By constructing the burner so that over 150% of the air required for combustion

is supplied without the shutter 24 in position, it is evident that a considerable range of adjustment is possible with the shutter 24 mounted as shown in the drawings. By way of example, only, the shutter 24 permits adjustment of the flow of air whereby it is possible to provide all primary air for combustion to a burner rated at 9000 B. t. u.'s and operating with gas system pressure ranging from 10 inches of water to 4 inches of water from rated capacity to a 7:1 turn-down.

Despite the fact that the resistance of the port structure 17 and the mixing tube 12 is relatively low compared to the resistance of the shutter 24, at cold conditions the burner may aspirate more air than will permit ignition or support combustion. Accordingly in the burner assembly illustrated in the drawing, I utilize a choke 43 (see Fig. 7) disposed in the air-gas stream for controlling the flow thereof through the ports 18 and operated by a thermal element 44, responsive to the port structure and burner temperature. Thus, at cold burner temperature the amount of air admitted by the burner is restricted, yet when the burner is hot the correct amount of air will be aspirated. The choke 43 herein is in the form of a vane hinged by ears 46 and 47 to a shaft 48. The latter is formed by a U-shaped rod, the ends 49 and 51 of which are supported by lugs 52 and 53 on opposite sides of the end 32 of the mixing tube. An intermediate portion of the U-shaped rod overlies the end 32 of the tube in the head to form the shaft 48. The thermally responsive element 44 is fashioned from a bi-metallic ribbon helically wound in spaced relation about the shaft 48. One end 54 of the wire is attached to the vane 43 as by being inserted in a pocket 56 formed on the vane 43. An opposite end 57 of the wire is pinched around the shaft 48 in elastic frictional contact. This latter construction in effect provides a load limit friction clutch. The thermally responsive element 44 is in spaced relation with and below the port structure 17. Thus, the temperatures of the burner and the port structure influence the temperature of the thermal element and cause the latter to operate. When the temperature of the port structure 17 and burner increases as during operation of the burner the helically wound bi-metallic ribbon 44 tends to increase or decrease the number and diameter of its convolutions. Since one end 57 of the ribbon frictionally engages the shaft 48, with drag greater than the drag of the vane 43, the opposite end 54; i. e., the end secured to the vane 43 is caused to swing about the shaft 48 with a spring like action. The rotation of the end 54 of ribbon secured to the vane 43 causes the latter to be raised until it engages a stop 45 herein secured to the burner overlying the end 32 thereof disposed in the chamber 14. Upon continued action of the ribbon 44 the end 57 frictionally engaged with the shaft 48 moves relative to the shaft, permitting slippage between the respective parts. When the port structure 17 cools as when the burner is turned off, the reverse action takes place. The end of the ribbon 57 pinched over the shaft 48 frictionally engages the latter and the end 54 of the ribbon engaging the vane 43 rotates with a spring like action in a direction to return the vane 43 to its original position restricting the flow of gas through the mixing tube 12 away from engagement with the stop 45.

Thus, at cold temperatures the vane 43 will restrict the quantity of air gas flowing to the port structure 17, yet when the burner is at an

operating temperature the vane 43 will be fully raised so that the correct amount of air and gas will flow to the port structure 17.

Frequently in utilizing burners of this type liquid contents from a pot or pan will boil over and spill on the port structure. Some of the liquid passes through the port structure 17 and will be retained in the lower portion of the chamber 14. To insure that the latter is drained from the chamber I incline the mixing tube 12 at a slight angle with respect to the plane of the bottom portion as shown in Fig. 6. Thus, any liquid caught in the bottom of the cylindrical head will be drained from the chamber 14 through the mixing tube 12.

As shown in Figures 1 and 4 the head of the burner is constructed for use on a gas range. To insure that a plane surface is formed on which the pots, pans, and the like may be supported, a rack 59 is provided. In the present instance this is formed by right angle brackets 61 mounted so that one portion 62 is rigid with the outer periphery of the sleeve 28 and the other portion 64 overlies the port structure 17. In a similar manner right angle brackets 66 are affixed to a top disc 67 of a simmer burner 68. The respective brackets are in alinement as shown in Figure 1 and are disposed in a common plane in spaced relation above the port structure 17. If desired, the burner may be burned under a plate with relatively low clearances in the order of $\frac{1}{4}$ to $\frac{1}{8}$ of an inch.

This burner construction does not have an inherent turn-down ratio sufficient to meet simmer burner requirements. Consequently, when utilized as a top burner in a stove it is necessary to employ a simmer burner. As shown in Fig. 4 the simmer burner is of the type disclosed in my copending application, Serial No. 731,704, filed October 23, 1947. The latter is disposed within the sleeve member 29 and is supported by a collar 69 attached to a mixing tube 71 of the simmer burner and resting on a land 72 on the bottom 31 about the opening 73 through which the mixing tube projects for connection to a gas supply nozzle 74.

As shown in Figure 1, the mixing tube 12 is disposed to discharge the air gas stream into the chamber 14 in a manner to produce controlled tangential flow. Thus, the gas will circulate about the chamber 14 and will be discharged through the port structure 17 in a stream having vortex characteristics. This is desirable from an operating standpoint since a low pressure area will tend to be created on the interior of the vortex which counteracts a normally high pressure condition created by resistance in the passageway formed by the top area of the port structure and a vessel or plate on the burner. By placing the simmer burner 68 as shown in the drawings it is located in this compensated pressure area; thus, the simmer burner does not have to operate in a high pressure area and as a result its operation is stabilized.

Where desired the burner may be utilized as an intermediate burner in a flash ignition system, such as shown in application Serial No. 105,545 of Peter I. Hollman, filed July 19, 1949. In such instances it is to be understood that the burner operates as a 100% primary air burner, with the gas mixture at the burner being utilized to propagate flame through a flash tube without requiring the aspiration of secondary air, as in conventional burners.

While I have shown a particular burner em-

bodying the grid port structure of my invention, it is to be understood that I do not wish to be limited thereto since the grid port structure of the present invention may be used in other and different burner assemblies and it is therefore contemplated by the appended claims to cover any such modifications as fall within the true spirit and scope of my invention.

I claim:

1. In a gas burner, a port structure comprising a gridwork having a plurality of cells in closely spaced relation, said grid work being fashioned so that said structure comprises an upper portion, a lower portion and connecting portions integral with said upper and lower portions, said connecting portions being of relatively small cross section whereby to minimize the heat conducted through said connecting portions between a higher temperature side of the port structure and a lower temperature side of the port structure.

2. In a gas burner, a flame port structure formed by a plurality of ribbon segments of heat-resistant material in spaced side-by-side relation, each said ribbon segment being formed at one side with a plurality of transverse protrusions of solid cross-section extending down that side of the ribbon segment and spaced relatively far apart lengthwise of the ribbon segment and abutting against the adjacent side of the next ribbon segment to space apart the ribbon segments and define a cellular construction of the assembled ribbon segments, said protrusions and the adjacent sides of adjacent ribbon segments defining a plurality of upwardly-extending recesses which are elongated lengthwise of the ribbon segments and which provide a relatively short separation between adjacent ribbon segments.

3. The structure of claim 2, wherein the separation between adjacent ribbon segments is from .015 inch to .035 inch and the thickness of each ribbon segments is less than the separation between adjacent ribbons.

4. In a gas burner, a flame port structure formed by a plurality of ribbon segments of heat-resistant metal in spaced side-by-side relation, each said ribbon being formed with a plurality of triangular transverse protrusions of solid cross-section extending entirely down that side of the ribbon segment and spaced relatively far apart lengthwise of the ribbon segment and abutting against the adjacent side of the next ribbon

segment to space apart the adjacent ribbon segments and to define a plurality of four-sided upwardly-extending fuel passages which are open above and below the ribbon assembly, each said fuel passage defined by said protrusions and the adjacent spaced sides of adjacent ribbon segments being elongated lengthwise of the ribbon segments and defining a relatively short separation between adjacent ribbon segments.

5. The structure of claim 4, wherein the separation between adjacent ribbon segments is from .015 inch to .035 inch and the thickness of each ribbon segment is less than the separation between adjacent ribbons.

6. In a totally aerated gas burner, a burner head, and a flame port structure mounted on said head, said flame port structure including a plurality of ribbon segments of heat resistant material in spaced side-by-side relation, each said ribbon segment being provided at one side with a plurality of spaced transverse protrusions of solid cross-section extending the entire height of the ribbon and spaced relatively far apart lengthwise of the ribbon segment and abutting against the adjacent side of the next ribbon segment to space apart the ribbon segments and define a cellular construction of the assembled ribbon segments, said protrusions and the adjacent sides of adjacent ribbon segments defining a plurality of upwardly-extending recesses which are elongated lengthwise of the ribbon segments and which provide a relatively short separation between adjacent ribbon segments.

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