June 9, 1964 C. E. FITZGERALD 3,136,354

RADIANT GAS BURNERS

Filed April 4, 1962 4 Sheets-Sheet 1

FIG. 1

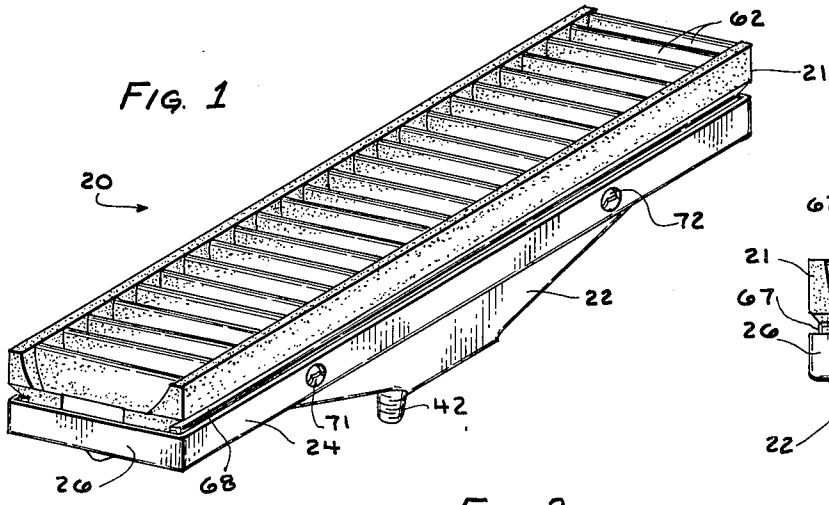


FIG. 5

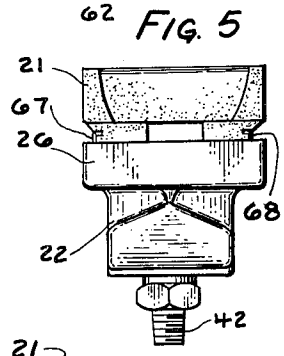


FIG. 2

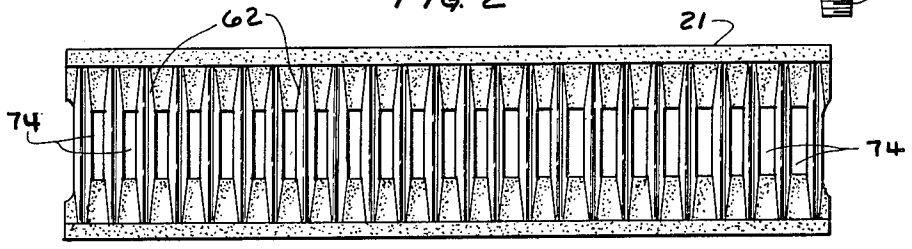
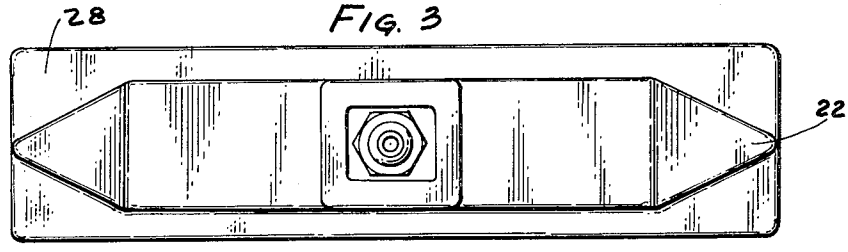


FIG. 3



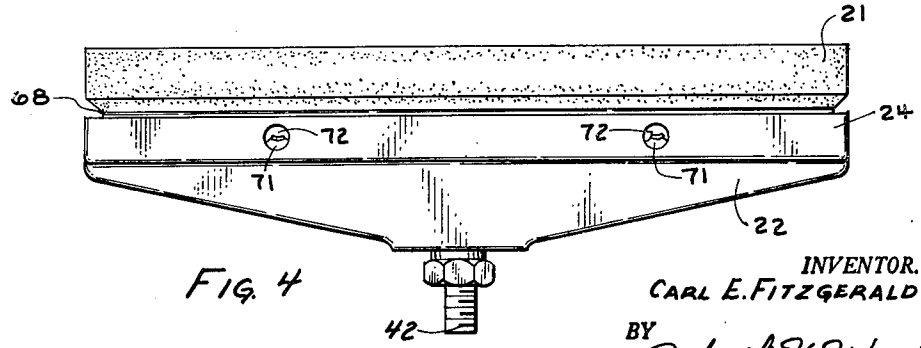


FIG. 4

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RADIANT GAS BURNERS

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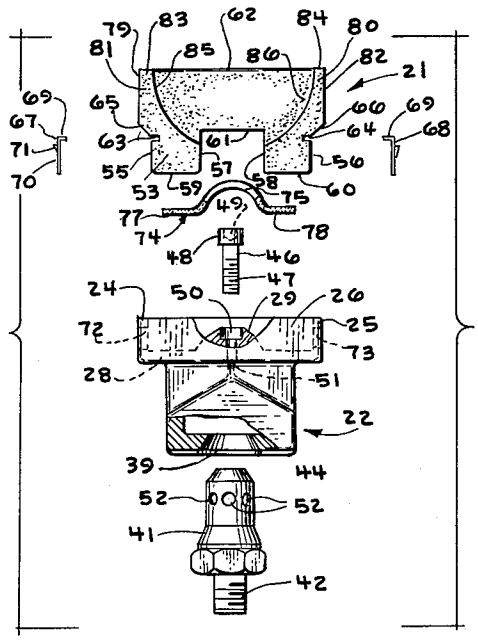

FIG. 6

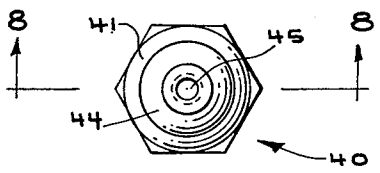

FIG. 7

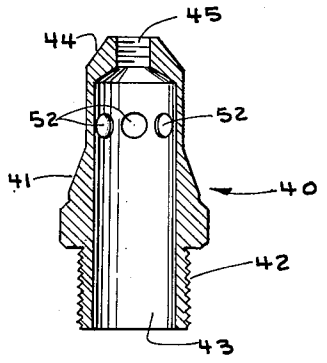

FIG. 8

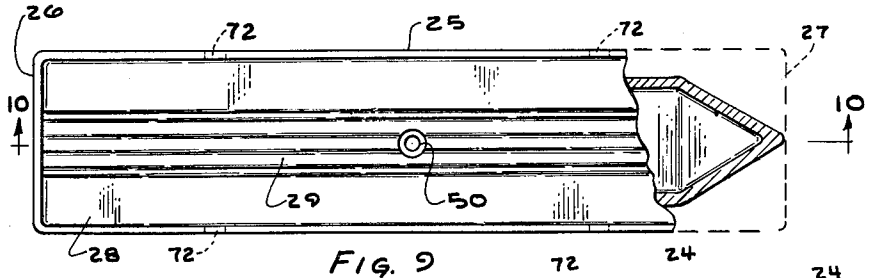

FIG. 9

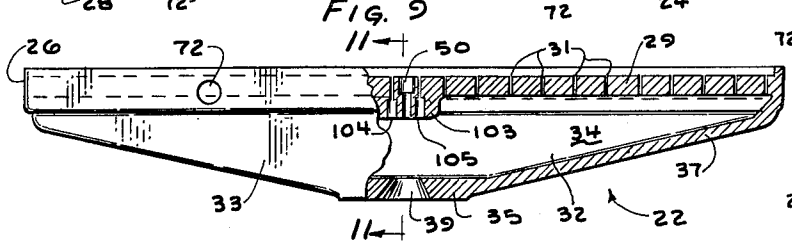

FIG. 10

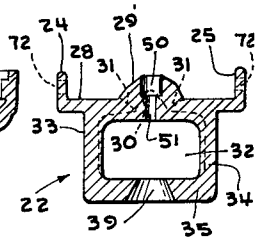

FIG. 11

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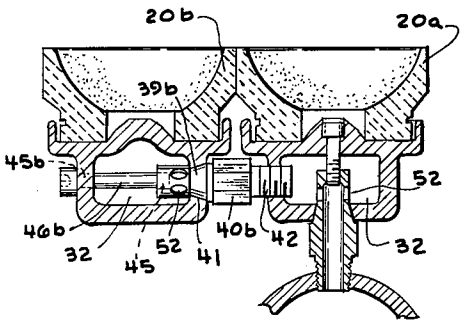

FIG. 12

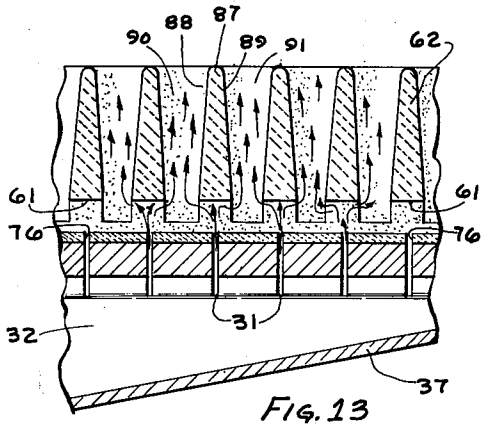

FIG. 13

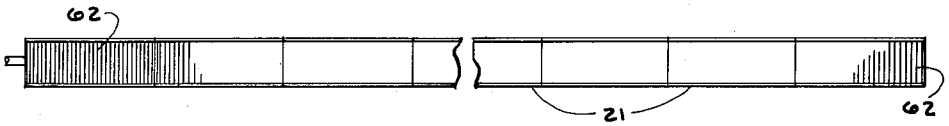

FIG. 15

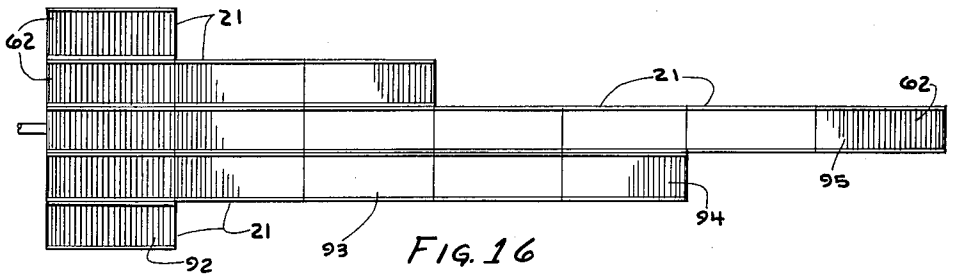

FIG. 16

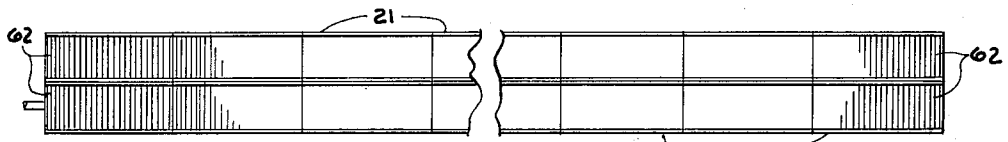

FIG. 17

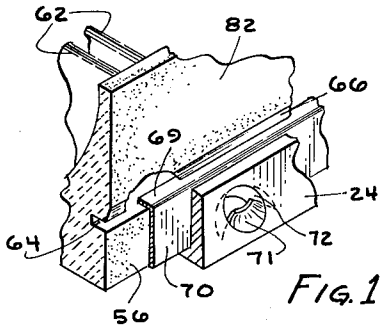

FIG. 14

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RADIANT GAS BURNERS

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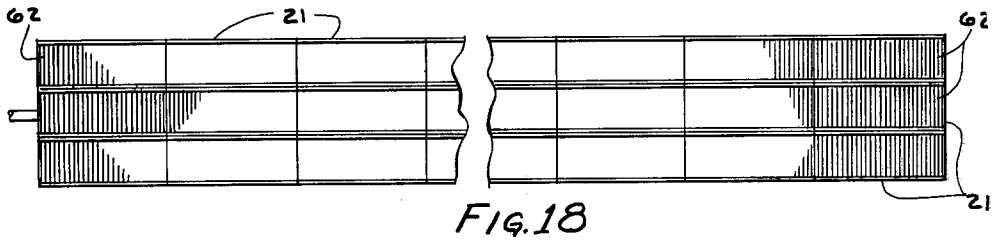

FIG. 18

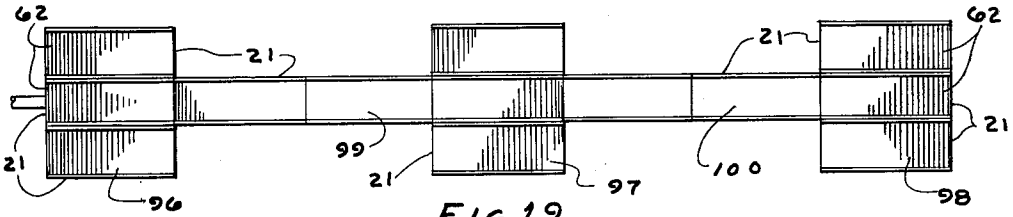

FIG. 19

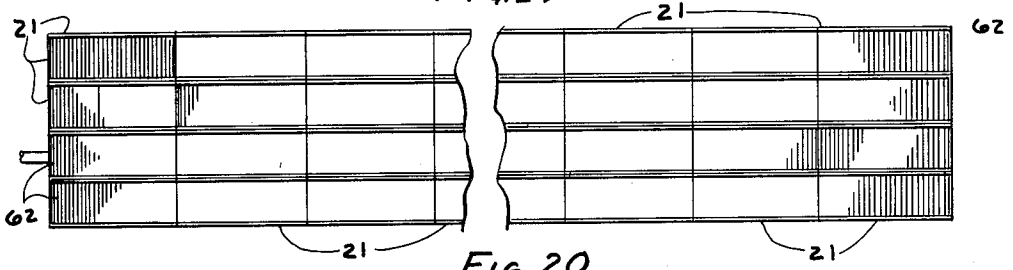

FIG. 20

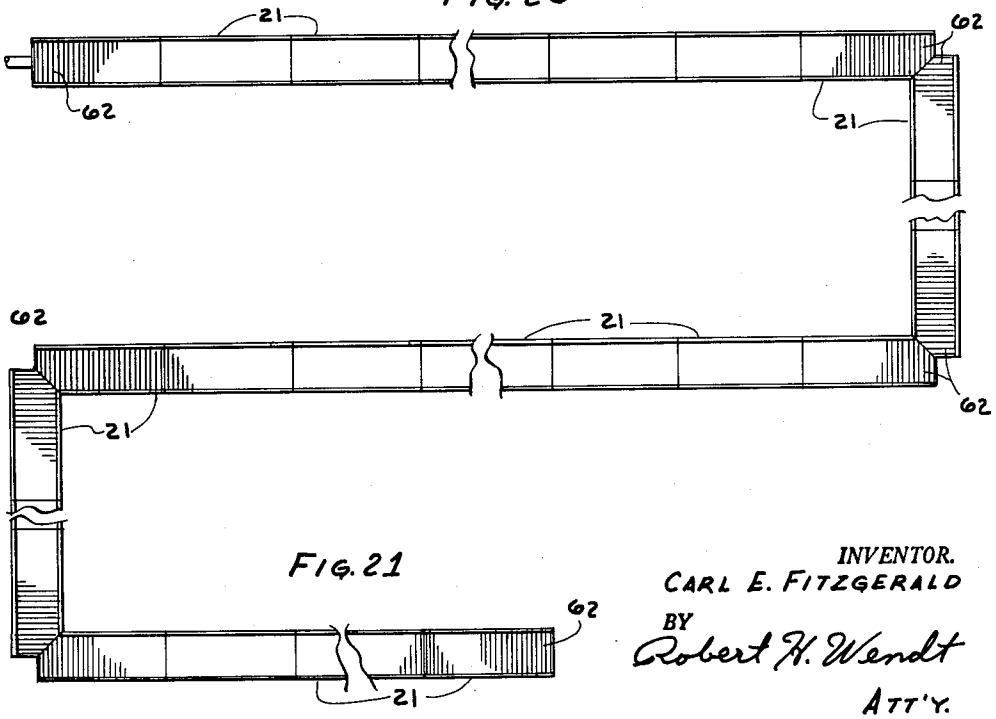

FIG. 21

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United States Patent Office 3,136,354 Patented June 9, 1964

3,136,354

RADIANT GAS BURNERS

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Filed Apr. 4, 1962, Ser. No. 185,104
4 Claims. (Cl. 158—99)

The present invention relates to radiant gas burners, and is particularly concerned with the provision of an improved radiant gas burner of a modular type forming a unit which may be employed to make up gas burner assemblies of many different sizes and shapes since the present burner units may be arranged side by side or end to end to provide a continuous radiant refractory face.

One of the objects of the invention is the provision of a radiant gas burner which has a minimum number of parts, which is simple in construction, which may be manufactured very economically, which provides a continuous refractory face, acting as a radiant surface, and which is adapted to convert efficiently the energy of the gaseous fuel into radiant heat.

Another object of the invention is the provision of a radiant gas burner of the class described which has a lower rectangular metal body provided with an inner manifold chamber and upper refractory supporting box separated by a partition having a longitudinally extending ridge provided with a multiplicity of transverse milled slots acting as burner vents; and the slots are located directly beneath a multiplicity of upper refractory vanes separated by parallel slots.

Another object of the invention is the provision of an improved mode of anchoring a refractory radiant body to a lower gas manifold by metal strips having securing flanges extending into grooves in the lower part of the refractory body and having deformed portions anchoring the strips to the lower gas manifold below the face of the refractory.

Another object of the invention is the provision of an improved radiant gas burner and lower gas manifold, the latter having a multiplicity of milled slots in a longitudinally extending ridge, feeding gas to the lower side of a refractory burner in which a refractory apron is provided, covering the longitudinally extending ridge and provided with registering slots so that the entire face of the gas burner is provided with a refractory covering to increase the radiant heat characteristics of the burner.

Other objects and advantages of the invention will be apparent from the following description and the accompanying drawings, in which similar characters of reference indicate similar parts throughout the several views.

Referring to the drawings of which there are four sheets,

FIG. 1 is a view in perspective of a radiant gas burner assembly embodying the invention;

FIG. 2 is a top plan view of the burner;

FIG. 3 is a bottom plan view;

FIG. 4 is a side elevational view;

FIG. 5 is an end elevational view;

FIG. 6 is an exploded view of the component parts of the burner assembly;

FIG. 7 is a top plan view of the adapter;

FIG. 8 is a sectional view taken on the plane of the line 8—8 of FIG. 7, looking in the direction of the arrows;

FIG. 9 is a top plan view of the metal gas manifold body;

FIG. 10 is a side elevational view of the gas manifold body in partial section on the plane of the line 10—10 of FIG. 9, looking in the direction of the arrows;

FIG. 11 is a sectional view taken on the plane of the line 11—11 of FIG. 10, looking in the direction of the arrows;

FIG. 12 is a fragmentary sectional view taken through

a plurality of the burner units, showing two different ways of utilizing the adapter;

FIG. 13 is a fragmentary sectional view of the end portion of one of the burner units, showing the course of the fuel and combustion gases through the burner;

FIG. 14 is a fragmentary side view of one of the apertures of the casting, also showing in dotted lines the manner of punching the metal strip for anchoring the refractory in the casting;

FIGS. 15–21 are diagrams showing the different modes of assembling burner units to accomplish various results.

Referring to FIGS. 1–5, 20 indicates in its entirety one of the radiant gas burner units embodying the invention; and this includes an upper ceramic body 21 and a lower metal supporting body 22.

The lower body 22 is provided with an upper box-like formation having a pair of parallel side walls 24, 25 and a pair of end walls 26, 27.

Referring to FIGS. 9–11, the metal supporting body is formed with an upper wall 28 extending to the walls of the box. This upper wall is provided with a longitudinally extending convex ridge 29 centrally located in the box and also located directed above an inverted V shaped groove 30 in the lower side of the upper wall 28.

The upper wall 28 is provided with a multiplicity of transverse milled thin or narrow slots 31 regularly spaced from each other throughout the length of the lower supporting body and forming gas discharging vents. The slots may be made of different length, depending on the volume of gas to be discharged; and the length is determined by the depth of the cut into the V-shaped groove 30.

The lower supporting body 22 is formed with an integral closed gas chamber 32 extending from end to end of the supporting body and defined by the upper wall 28, a pair of parallel side walls 33, 34, a parallel bottom wall 35, and a pair of sloping bottom walls 36, 37, all integrally joined to the top wall 28.

The bottom wall 35 is provided with a gas inlet 39; but in some embodiments the gas inlet may be provided in either of the side walls 33 or 34. The gas inlet 39 is preferably a frusto-conical tapered bore tapering inwardly for receiving an adapter 40, which has a complementary frusto-conical outer surface 41.

The adapter is a tubular metal member having a threaded end 42 provided with pipe threads for attachment to a gas supply pipe. The adapter has an internal cylindrical bore 43 and a closed upper end 44, which is provided with a threaded bore 45 for receiving the threaded end of a securing bolt 46.

The securing bolt 46 has a threaded shank 47 and a small head 48 with a non-circular socket 49. The upper wall 28 has an enlarged bore 50 between two of its slots or midway between its ends, above the inlet 39; and the bore 50 is adapted to receive the head 48 of the securing bolt 46.

The enlarged bore 50 communicates with a smaller bore 51, which engages below the head; and the threaded shank 47 may be threaded into the threaded bore 45 of the adapter to secure the adapter in the inlet 39.

When the bolt 46 is drawn up with a wrench extending into the socket 49, the frusto-conical surface 41 engages in the frusto-conical inlet 39, effecting a gas-tight joint; and the burner unit may not only be supplied with gas through the adapter 40, but it may also be supported by the adapter.

At its upper end the adapter has a plurality of radially extending apertures 52 discharging gas into the gas chamber 32, which acts as a gas manifold, distributing the gas to all of the milled slots 31 uniformly.

The present gas burners are adapted to be used with a gas supply comprising a pre-mixed amount of fuel and

air at a predetermined pressure so that all burner slots receive the fuel at substantially the same pressure.

Referring to FIG. 12, this is a diagrammatic view showing a plurality of burner units connected to the gas supply by the same type of adapter employed in several different ways.

For example, the burner unit 20*a* is connected in the manner already described, while the burner unit 20*b* is supplied with gas by an adapter 40*b*, which has its threaded end 42 extending into the gas chamber 32 at one side in a threaded bore.

The adapter 40*b* has its frusto-conical portion 41 extending into a frusto-conical bore 39*b* in the side of the gas chamber 32 of the burner 20*b*.

A screw bolt 46*b* extends through a bore 45*b* in the other side of the gas chamber 32 of burner 20*b*; and the bolt is threaded into the threaded bore 45 in the adapter, drawing the unit 20*b* over against the unit 20*a*, and at the same time drawing the adapter into the conical bore 39*b*.

Referring to FIG. 6, the refractory burner member 21 is shown in end elevation; and it comprises an integral ceramic molded member having a pair of downwardly projecting elongated rectangular supporting ribs 53, 54 provided with plane side surfaces 55, 56, plane inner surfaces 57, 58, and plane bottom surfaces 59, 60.

These supporting bodies 53 and 54 fit loosely into the box-like formation on top of the metal body 22, which box is formed by the side walls 24, 25 and the end walls 26, 27 upon the upper wall 28.

The central groove is formed by the inner surfaces 57, 58 and an upper wall 61, which represents the bottom of each of a multiplicity of integral transverse vanes 62.

The ceramic body 21 is provided with a pair of parallel walled slots 63, 64 in its side surfaces 55, 56; and above the slots the body has an outwardly sloping surface 65, 66 on each side. The slots 63, 64 are adapted to receive a pair of elongated metal anchoring strips 67, 68, which are identical in construction and may comprise stainless steel strips, each having an inwardly turned securing flange 69 and a flat body 70, which has a plurality of tabs 71 punched outward and deformed to engage in circular openings 72, 73 in the box-like formation side walls 24, 25.

The tabs 71 are punched on a larger radius than the openings 72 in the casting wall, as shown in FIG. 14; and the tabs extend upwardly and permit the ceramic and the retaining strips to be pushed into the box.

The upper edge of each tab 71 is then accessible to a punch or awl inserted through the aperture 72 at its top; and when the tabs are deformed outwardly and downwardly by the tool in the aperture 72, the tabs expand into the aperture and engage the sides of the aperture below its horizontal diameter, retaining the strip and ceramic in the casting.

The longitudinally extending convex ridge 29 may be cylindrical or hexagonal; and this ridge and a portion of the wall 28 are covered by a ceramic sheet insert or apron (FIG. 6) which comprises a rectangular ceramic sheet of "Fibrafax," a sheet insulating material which is also heat resistive, made of silica fiber and formed on a die and having slots cut when dried.

This ceramic insert or apron 74 is upwardly convex and downwardly concave and partially cylindrical; and its central portion 75 fits over the ridge 29 and is provided with registering milled slots 76.

The ceramic insert has a pair of lateral flanges 77, 78 which engage the bottom 28 and are in turn engaged by the bottom surfaces 59 and 60 of the refractory burner body. The insert 74 is made of thin refractory or ceramic material; and it covers all the exposed metal parts of the ridge 29 except the slots 31, which register with the slots 76 of the insert.

The function of the ceramic sheet insert is that it is—

(1) Adapted to become radiant, increasing the radiant output.

(2) It forms a combustion chamber which is covered with ceramic throughout.

(3) It insulates the casting from the high temperature zone.

(4) It serves as a gasket between the refractory body and the casting.

This gives the burner a complete refractory face, the parts of which become incandescent and radiant. The refractory body 21 is provided with a pair of upwardly extending side walls 79, 80, which have plane outer surfaces 81, 82, plane upper edges 83, 84, and concave cylindrical inner surfaces 85, 86 between the integral vanes 62.

The vanes 62 terminate at upper rounded edges and are tapered upwardly, having the side surfaces 88, 89 extending upwardly from their lower edges 61. The lower edges of the vanes are located directly above the slots 31 in the metal body 22 and registering slots 76 in the ceramic insert; and the gas issuing from these slots impinges on the plane surfaces 61 at the bottom of the vanes 62.

Referring to FIG. 10, the casting has an inner enlargement 103 at the point where the securing bolt 46 is located in the bore 51, having its head in the enlarged bore 50. The adjacent slots 31 would be blocked by this enlargement 103; but this is remedied by drilling through the conical aperture 39 and forming a pair of drilled bores 104, 105 feeding the slots 31 which are adjacent the central bolt.

Referring to FIGS. 1, 2, 4, and 5, it will be seen that the ceramic burner body extends to a point flush with or slightly beyond the end of the casting in each case. This leaves half the space which is located between each one of the vanes 62 open at each end of the ceramic body.

When two burner bodies are joined end to end, this leaves an opening into the combustion chamber which is below the lower edge 61 of the vanes and which communicates with any end to end refractory body. This is useful for permitting ignition from one ceramic body to another when arranged end to end.

Referring to FIG. 13, this is a diagram showing the course of the gas and combustion gases in the burner; and the arrows show the gas coming from the gas manifold 32 through the slots 31 in the top of the manifold and through the slots 76 in the ceramic insert and impinging against the bottom surface 61 of the vanes 62.

Combustion begins at the exit from the slots 31 and continues as the combustion gases move up the spaces 90, 91 between the vanes 62; and due to the spread of the slots 31 and 76 the combustion gases spread outward and occupy the entire width of the burner at its top, causing the entire upper part of the ceramic body to become a radiant incandescent radiator of heat.

The operation of the radiant gas burner is as follows:

The gas-air mixture is completely consumed by burning within the confines of the refractory vanes. No flame is discernible leaving the upper surface of the burner refractory. No secondary air for cooling or combustion is required.

Complete combustion is effected in the burner, since all oxygen required for complete burning of the gas fuel is previously mixed with the gas fuel in the proper ratio. Complete combustion occurs throughout the entire operating range of the burner or burner system, whether it be operating wide open or turned down.

The burners can be pointed in any direction, upward, sidewise, downward, or diagonally, and can be used as a furnace wall without requiring any additional supply of oxygen; and their operation will not be affected by the presence of inert atmospheres.

The burner capacity range can be varied by increasing or decreasing the size and number of discharge orifices; and either holes or milled slots may be used in the casting. The capacity may also be varied by varying the inlet and discharge apertures of the adapter, and in any case by varying the pressure of the gas-air feeding system.

The burner capacity under normal conditions may be

varied from a low of 5,000 B.t.u. per burner per hour to a high of 30,000 B.t.u. per hour per burner. The normal operating manifold pressures may vary from 0.5 inch of water column up to 10 inches of water column. An extreme range of operating manifold pressures may be from 0.2 inch of water column low to a high of 36 inches water column.

Regardless of the input pressure, the burner does not blow itself out, but has perfect flame retention and propagation of combustion between burners end to end.

Referring to FIGS. 15–21, these are diagrams showing the arrangement of this modular burner unit in a multiplicity of different installations.

FIG. 15 shows a plurality of burners arranged end to end;

FIG. 16 shows a concentration of transverse burner units extending transversely at the left end and indicated by the numeral 92, while the heating effect diminishes toward the right by providing a plurality of burners extending lengthwise at 93 adjoined by a lesser number extending toward the right 94 and single units extending toward the right at 95.

FIG. 17 shows two rows of burner units arranged end to end to provide a concentration of heating units amounting to 5,000 B.t.u. per square inch of burner face per hour.

FIG. 18 shows a heating assembly of uniform but narrower width.

FIG. 19 shows a diagram in which there are three assemblies 96, 97, 98 of transversely extending burner units joined by two assemblies 99, 100 of longitudinally extending burner units.

FIG. 20 shows an assembly of burner units extending longitudinally, comprising four rows of burner units, each of which may produce 2500 B.t.u. per square inch of burner face per hour.

FIG. 21 shows a serpentine diagram of the burner units arranged end to end.

It will be observed that I have invented a radiant gas burner which is highly efficient, economical in the use of gas fuel, and adapted to be economically manufactured and installed or replaced.

While I have illustrated a preferred embodiment of my invention, many modifications may be made without departing from the spirit of the invention, and I do not wish to be limited to the precise details of construction set forth, but desire to avail myself of all changes within the scope of the appended claims.

Having thus described by invention, what I claim as new and desire to secure by Letters Patent of the United States, is:

1. A radiant gas burner comprising a cast metal member having a rectangular burner body in plan, said body having an upper rectangular wall with an integral upwardly extending flange extending about all sides of said wall forming a rectangular tray, said body having a depending integral container forming a gas manifold and having parallel sides walls and a bottom wall and provided with a central inlet port, said bottom wall comprising two parts sloping upwardly toward both ends to distribute gas uniformly to the upper wall and said upper wall having an upwardly convex ridge provided with a multiplicity of centrally located transverse narrow milled burner slots located in said upwardly convex ridge in the tray above an inverted V-shaped groove in the lower side of the upper wall, the depth of cut into the V-shaped groove below the upper wall varying the length of the slots to determine the volume of gas discharged, and a ceramic radiant body having a lower rectangular base receivable in said tray and having a pair of longitudinally extending side walls joined by a plurality of integral transverse vanes extending from side to side of said side walls, each vane tapering upwardly to an elongated transverse ridge at the top and the vanes being separated at the bottom by a rectangular aperture between the bottoms of the vanes and each vane having a flat bottom wall located directly and centrally above a burner slot in the upper wall of the burner body, the bottom walls of said vanes being spaced from the burner slots to deflect the gases laterally in both directions and said radiant body having a longitudinally extending downwardly open rectangular groove, open at both ends to effect ignition of all burner slots from adjacent burner slots.

2. A radiant gas burner according to claim 1, in which the burner is provided with a thin upwardly convex and downwardly concave elongated rectangular refractory apron, fitting over the ridge on the upper wall of the burner body and provided with slots registering with the slots in the burner body, said refractory apron extending laterally on each side of the said ridge on the upper wall of the burner body and being confined between the radiant body and the upper wall of the burner body, the said refractory apron and said refractory radiant body providing a full upper refractory face for the radiant gas burner.

3. A radiant gas burner according to claim 2, in which the ceramic body has an inwarding extending, parallel-walled, lateral groove extending along each side of the ceramic body, and the burner has a metal holder for each side of the ceramic body, said metal holder comprising a sheet metal angle member having a transverse flange extending over its full length and extending into the lateral groove in each side of the ceramic body, and the holder has a longitudinal body flange fitting in the box of the burner body between the upwardly extending flange of the burner body, and the ceramic body, the said upwardly extending flange of the burner body having a plurality of apertures, and the longitudinally extending flange of the holder having a deformed tab pressed into each said aperture to secure the ceramic body in the burner body.

4. A radiant gas burner according to claim 3, in which the inlet port comprises an inwardly tapered frusto conical opening, and the burner body has an opposing body portion provided with an concentric bore, and the burner includes an adapter to connect the manifold to a source of gas under pressure, said adapter having a threaded end outside the burner body, said adapter comprising a tubular member having an internally threaded bore at its other end, and a threaded member having a head received in said concentric bore, said threaded member extending into said threaded bore of said adapter, said adapter having a frusto conical surface intermediate its ends, and said threaded member drawing said adapater into said inlet port and drawing the said frusto conical surfaces on the adapter and in the inlet port into fitting engagement, the said adapter having radial apertures in its tubular body in said manifold discharging gas into said manifold.

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