

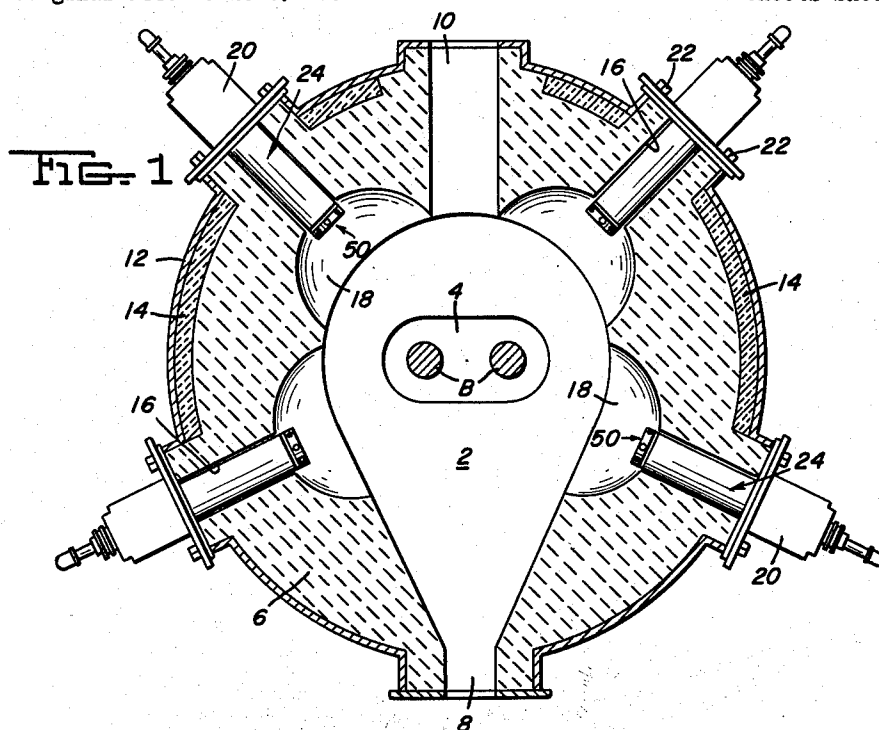
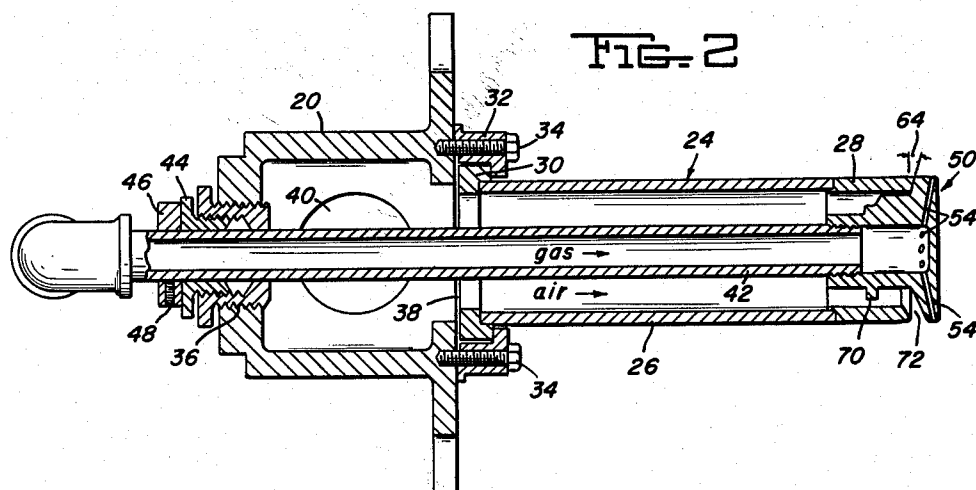
March 23, 1965

A. T. WALSTAD
GAS BURNER ASSEMBLY

3,174,531

Original Filed June 6, 1958

2 Sheets-Sheet 1



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FIG. 4

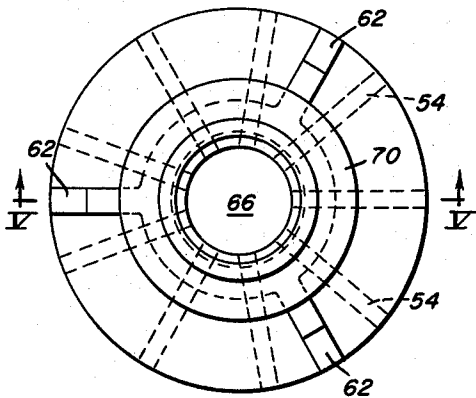


FIG. 3

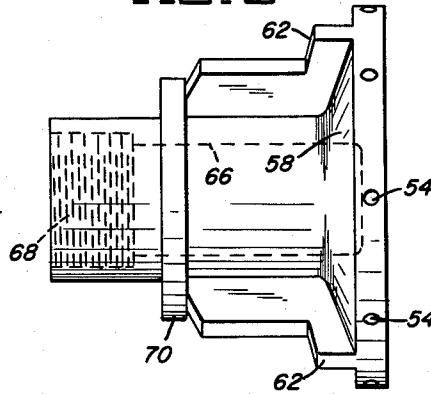


FIG. 5

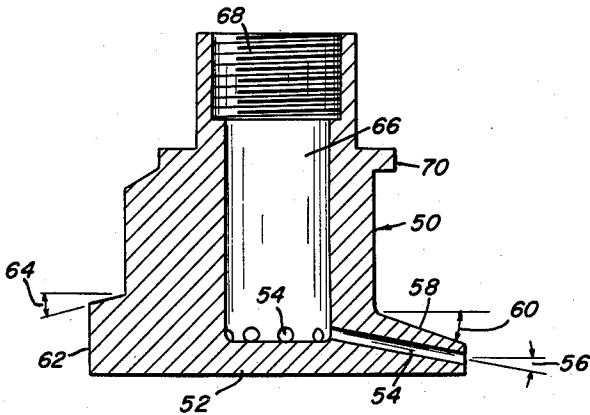
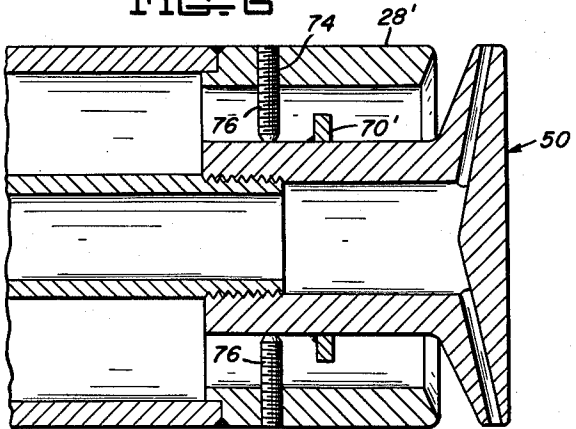


FIG. 6



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3,174,531

GAS BURNER ASSEMBLY

Alvin T. Walstad, Gary, Ind., assignor to United States Steel Corporation, a corporation of New Jersey
Continuation of abandoned application Ser. No. 740,465, June 6, 1958. This application June 20, 1962, Ser. No. 203,825

13 Claims. (Cl. 158—109)

This application which relates to a burner assembly is a continuation of my co-pending application Serial No. 740,465, filed June 6, 1958, now abandoned. The application relates more particularly to a burner assembly for use in the intermediate and late heating stages of billet heating furnaces consisting of a series of barrel type chambers such as shown in Hess Patent No. 2,638,333, dated May 12, 1953. The burners previously used for this purpose are generally of the type shown in Furczyk Patent No. 2,561,793, dated July 24, 1951. The burner tip shown in this patent is subjected to fast cooling and heating and the temperature strains resulting from this change in firing rate distort and crack the burner tips or the supports for the burner tips. This in turn impairs the burner's efficiency and the billet heating ability, thereby requiring excessive repair and maintenance.

It is therefore an object of my invention to provide a nozzle mix radiant type burner which greatly reduces the temperature strains in the burner tip due to changes in firing rates.

Another object is to provide such a burner having improved life and sustained efficiency over a longer period of time than burners previously used, resulting in reduced maintenance cost.

Still another object is to provide a nozzle mix burner of simple design and low initial and replacement cost.

These and other objects will be more apparent after referring to the following specification and attached drawings, in which:

FIGURE 1 is a cross section of a barrel type billet heating furnace with the burner assembly incorporating therein;

FIGURE 2 is a sectional view showing the details of the burner assembly;

FIGURE 3 is an enlarged view showing the burner tip; FIGURE 4 is a view looking to the left of FIGURE 3;

FIGURE 5 is a sectional view taken on the line V—V of FIGURE 4; and

FIGURE 6 is a fragmentary sectional view of a burner assembly showing a modification of the burner tip and forward end of the burner assembly.

Referring more particularly to the drawings, reference numeral 2 indicates the heating chamber of the furnace. An opening 4 is provided at each end of the furnace chamber 2 through which billets B enter and leave the chamber 2. Chamber 2 is surrounded by a refractory wall 6 having a clean out hole 8 through the bottom thereof and a venting hole 10 through the top thereof. A metal shell 12 surrounds the refractory 6. Insulation 14 may be provided between the metal shell 12 and the refractory 6 where desired. Four burner tunnels 16 extend through the refractory lining 6 and metal shell 12. Cup shaped openings 18 are provided in the inner surface of the refractory lining 6. A tunnel 16 intersects the bottom of each of the cup shaped openings 18. The cup shaped openings 18 are preferably substantially hemispheres. The burner assembly includes a burner body 20 which may be fastened to the metal shell 12 in any suitable manner such as by means of bolts 22. A straight air tube 24 projects into the opening 16 and is fastened to the burner body 20 in any suitable manner. As shown, the air tube 24 is made up of a main tube 26,

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a forward extension 28 and a mounting ring 30 all welded together. An L-shaped clamp 32 receives the mounting ring 30 and is fastened to the body 20 by means of cap screws 34, thus fastening the air tube 24 to the burner body 20. Openings 36 and 38 are provided in the burner body 20 in axial alignment with the air tube 26. Opening 40 is provided in the body 20 through which air is delivered into the air tube 24. A straight imperforate raw fuel gas tube 42 passes through a standard packing gland 44 mounted in the opening 36. A ring 46 is fastened to the tube 42 on the outside of packing gland 44 by means of a set screw 48. A burner tip 50 is threaded on the forward end of gas tube 42. Burner tip 50 is of general T-shape with its head projecting into the cup shaped opening 18. The head end 52 is closed, a plurality of openings 54 extending therethrough with their axes diverging outwardly from the axis of the burner tip. The axes of the openings 54 are arranged at an angle 56 of 10° to a transverse plane through the burner tip. Inner face 58 of the head end 52 is preferably arranged at an angle 60 of 20° with a transverse plane through the burner tip. Three lugs or fins 62 are provided on the inner surface 58. The inner face of each lug 62 is arranged at an angle 64 of 15° with a transverse plane through the burner tip. The forward end of the extension 28 is also arranged at an angle 64 so that the inner face of lugs 62 abut thereagainst. Tip 50 has an axial opening 66 therein which is threaded at 68 for receiving the gas tube 42. An annular ring 70 is provided on the burner tip 50 as shown. Since the air tube 24 is separate from the gas tube 42 and burner tip 50 the gas tube and burner tip can expand axially at the end adjacent the burner tip, with respect to the air tube on thermal changes.

In assembly, the burner tip 50 is held in centered position by means of the lugs 62 and the inner face of the lugs 62 in combination with the ring 46 holds the burner tip 50 in locked position. Air, oxygen or a mixture thereof enters the burner body 20 through opening 40, passes between the air tube 24 and gas tube 42, and out through a slot 72 provided between the end of the air tube extension 28 and the inner face 58 of the burner tip 50. It will be seen that the inner face of the head end of the burner tips slopes radially outwardly toward the forward end of the tip at a lesser angle to the axis of the gas tube than the axes of the openings 54. This provides for better mixing of the gas and air. The ring 70 acts to meter the flow of air through slot 72.

FIGURE 6 shows a slight modification of my invention in which burner tip 50' has a metering ring 70' welded thereto and in which the centering lugs 62 are omitted. To center the burner tip 50' and lock it in position air tube extension 28' is provided with threaded radial holes 74 for receiving set screws 76. The set screws 76 pass through the openings 74 and bear against the burner tip 50'.

While two embodiments of my invention have been shown and described, it will be apparent that other adaptations and modifications may be made without departing from the scope of the following claims.

I claim:

1. A nozzle mix radiant burner assembly comprising a burner body, a straight air tube fastened to said burner body, a straight imperforate gas raw fuel tube extending through said body into said air tube, and a one piece generally T-shaped burner tip mounted on the inner end of said gas tube in axial alignment therewith and with its head end projecting radially beyond the opening of said air tube, the head end of said burner tip being closed with a plurality of elongated and enclosed gas openings therethrough having their axes diverging out-

wardly from the axis of said burner tip toward the discharge end of the burner, said gas openings being spaced apart a distance substantially greater than the transverse section thereof, the inner face of the head end of said burner tip sloping radially outwardly toward the forward end of said tip and being spaced from the forward end of said air tube to define an air slot therebetween, said air tube being separate from the gas tube and burner tip at the end adjacent the burner tip so that said gas tube and burner tip are free to expand axially with respect to said air tube on thermal changes.

2. A nozzle mix radiant burner assembly comprising a burner body, a straight air tube fastened to said burner body, a straight imperforate gas raw fuel tube extending through said body into said air tube, a one piece generally T-shaped burner tip mounted on the inner end of said gas tube in axial alignment therewith and with its head end projecting radially beyond the opening of said air tube, the head end of said burner tip being closed with a plurality of elongated and enclosed gas openings therethrough having their axes diverging outwardly from the axis of said burner tip toward the discharge end of the burner, said gas openings being spaced apart a distance substantially greater than the transverse section thereof, and means extending between said burner tip and said air tube to position said burner tip in centered position within said air tube, the inner face of the head end of said burner tip sloping radially outwardly toward the forward end of said tip and being spaced from the forward end of said air tube to define an air slot therebetween, said air tube being separate from the gas tube and burner tip at the end adjacent the burner tip so that said gas tube and burner tip are free to expand axially with respect to said air tube on thermal changes.

3. A nozzle mix radiant burner assembly comprising a burner body, a straight air tube fastened to said burner body, a straight imperforate gas raw fuel tube extending through said body into said air tube, a one piece generally T-shaped burner tip mounted on the inner end of said gas tube in axial alignment therewith and with its head end projecting radially beyond the opening of said air tube, the head end of said burner tip being closed with a plurality of elongated and enclosed gas openings therethrough having their axes diverging outwardly from the axis of said burner tip toward the discharge end of the burner, said gas openings being spaced apart a distance substantially greater than the transverse section thereof, the inner face of the head end of said burner tip sloping radially outwardly toward the forward end of said tip and being spaced from the forward end of said air tube to define an air slot therebetween, and an air metering ring between said burner tip and the inside of said air tube, said air tube being separate from the gas tube and burner tip at the end adjacent the burner tip so that said gas tube and burner tip are free to expand axially with respect to said air tube on thermal changes.

4. A nozzle mix radiant burner assembly comprising a burner body, a straight air tube fastened to said burner body, a straight imperforate gas raw fuel tube extending through said body into said air tube, a one piece generally T-shaped burner tip mounted on the inner end of said gas tube in axial alignment therewith and with its head end projecting radially beyond the opening of said air tube, the head end of said burner tip being closed with a plurality of elongated and enclosed gas openings therethrough having their axes diverging outwardly from the axis of said burner tip toward the discharge end of the burner, said gas openings being spaced apart a distance substantially greater than the transverse section thereof, means extending between said burner tip and said air tube to position said burner tip in centered position within said air tube, the inner face of the head end of said burner tip sloping radially outwardly toward the forward end of said tip and being spaced from the forward end of said air tube to define an air

slot therebetween, and an air metering ring between said burner tip and the inside of said air tube, said air tube being separate from the gas tube and burner tip at the end adjacent the burner tip so that said gas tube and burner tip are free to expand axially with respect to said air tube on thermal changes.

5. A nozzle mix radiant burner assembly comprising a burner body, a straight air tube fastened to said burner body, a straight imperforate gas raw fuel tube extending through said body into said air tube, a one piece generally T-shaped burner tip mounted on the inner end of said gas tube in axial alignment therewith and with its head end projecting radially beyond the opening of said air tube, the head end of said burner tip being closed with a plurality of elongated and enclosed gas openings therethrough having their axes diverging outwardly from the axis of said burner tip toward the discharge end of the burner, said gas openings being spaced apart a distance substantially greater than the transverse section thereof, and means extending between said burner tip and said air tube to position said burner tip in centered position within said air tube, the inner face of the head end of said burner tip sloping radially outwardly toward the forward end of said tip and being spaced from the forward end of said air tube to define an air slot therebetween, the axes of said openings in said burner tip being at a greater angle to the axis of said gas tube than the inner face of the head end of said burner tip, said air tube being separate from the gas tube and burner tip at the end adjacent the burner tip so that said gas tube and burner tip are free to expand axially with respect to said air tube on thermal changes.

6. A nozzle mix radiant burner assembly comprising a refractory wall having a cup shaped opening in its inner surface and a generally cylindrical opening therethrough intersecting the bottom of said cup shaped opening, a straight air tube extending through said cylindrical opening, a burner body mounted adjacent the outer end of said cylindrical opening, means for fastening said air tube to said burner body, a straight imperforate gas raw fuel tube extending through said body into said air tube, and a one piece generally T-shaped burner tip mounted on the inner end of said gas tube in axial alignment therewith and with its head end projecting into said cup shaped opening and radially beyond the opening of said air tube, the head end of said burner tip being closed with a plurality of elongated and enclosed gas openings therethrough having their axes diverging outwardly from the axis of said burner tip toward the discharge end of the burner, said gas openings being spaced apart a distance substantially greater than the transverse section thereof, the inner face of the head end of said burner tip sloping radially outwardly toward the forward end of said tip and being spaced from the forward end of said air tube to define an air slot therebetween, said air tube being separate from the gas tube and burner tip at the end adjacent the burner tip so that said gas tube and burner tip are free to expand axially with respect to said air tube on thermal changes.

7. A nozzle mix radiant burner assembly comprising a refractory wall having a cup shaped opening in its inner surface and a generally cylindrical opening therethrough intersecting the bottom of said cup shaped opening, a straight air tube extending through said cylindrical opening, a burner body mounted adjacent the outer end of said cylindrical opening, means for fastening said air tube to said burner body, a straight imperforate gas raw fuel tube extending through said body into said air tube, and a one piece generally T-shaped burner tip mounted on the inner end of said gas tube in axial alignment therewith and with its head end projecting into said cup shaped opening and radially beyond the opening of said air tube, the head end of said burner tip being closed with a plurality of elongated and enclosed gas openings therethrough having their axes di-

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verging outwardly from the axis of said burner tip toward the discharge end of the burner, said gas openings being spaced apart a distance substantially greater than the transverse section thereof, means extending between said burner tip and said air tube to position said burner tip in centered position within said air tube, the inner face of the head end of said burner tip sloping radially outwardly toward the forward end of said tip and being spaced from the forward end of said air tube to define an air slot therebetween, said air tube being separate from the gas tube and burner tip at the end adjacent the burner tip so that said gas tube and burner tip are free to expand axially with respect to said air tube on thermal changes.

8. A nozzle mix radiant burner assembly comprising a refractory wall having a cup shaped opening in its inner surface and a generally cylindrical opening therethrough intersecting the bottom of said cup shaped opening, a straight air tube extending through said cylindrical opening, a burner body mounted adjacent the outer end of said cylindrical opening, means for fastening said air tube to said burner body, a straight imperforate gas raw fuel tube extending through said body into said air tube, a one piece generally T-shaped burner tip mounted on the inner end of said gas tube in axial alignment therewith and with its head end projecting into said cup shaped opening and radially beyond the opening of said air tube, the head end of said burner tip being closed with a plurality of elongated and enclosed gas openings therethrough having their axes diverging outwardly from the axis of said burner tip toward the discharge end of the burner, said gas openings being spaced apart a distance substantially greater than the transverse section thereof, the inner face of the head end of said burner tip sloping radially outwardly toward the forward end of said tip and being spaced from the forward end of said air tube to define an air slot therebetween, and an air metering ring between said burner tip and the inside of said air tube, said air tube being separate from the gas tube and burner tip at the end adjacent the burner tip so that said gas tube and burner tip are free to expand axially with respect to said air tube on thermal changes.

9. A nozzle mix radiant burner assembly comprising a refractory wall having a cup shaped opening in its inner surface and a generally cylindrical opening therethrough intersecting the bottom of said cup shaped opening, a straight air tube extending through said cylindrical opening, a burner body mounted adjacent the outer end of said cylindrical opening, means for fastening said air tube to said burner body, a straight imperforate gas raw fuel tube extending through said body into said air tube, a one piece generally T-shaped burner tip mounted on the inner end of said gas tube in axial alignment therewith and with its head end projecting into said cup shaped opening and radially beyond the opening of said air tube, the head end of said burner tip being closed with a plurality of elongated and enclosed gas openings therethrough having their axes diverging outwardly from the axis of said burner tip toward the discharge end of the burner, said gas openings being spaced apart a distance substantially greater than the transverse section thereof, means extending between said burner tip and said air tube to position said burner tip in centered position within said air tube, the inner face of the head end of said burner tip sloping radially outwardly toward the forward end of said tip and being spaced from the forward end of said air tube to define an air slot therebetween, and an air metering ring between said burner tip and the inside of said air tube, said air tube being separate from the gas tube and burner tip at the end adjacent the burner tip so that said gas tube and burner tip are free to expand axially with respect to said air tube on thermal changes.

10. A nozzle mix radiant burner assembly comprising a burner body, said body having an axial opening there-

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through, a straight air tube in axial alignment with said axial opening, means detachably fastening said air tube to said burner body around the exit end of said axial opening, a straight imperforate raw gas fuel tube extending through said axial opening into said air tube coaxially therewith, a packing gland mounted in the entry end of said axial opening for slidably supporting said fuel gas tube, means for introducing air into said body around said fuel gas tube, a unitary generally T-shaped in section burner tip, means mounting said burner tip on the exit end of said fuel gas tube, said T-shaped burner tip having an axial opening extending from the entry end toward the head end thereof, the head end of said burner tip having a diameter greater than the inner diameter of said air tube, the inner face of the head end of said burner tip sloping radially outwardly toward the forward end of said tip and being spaced from the forward end of said air tube to define an air slot therebetween, the head end of said burner tip being closed with a plurality of elongated and enclosed gas openings therethrough having their axes diverging outwardly from the axis of said burner tip toward the discharge end of the burner, said gas openings being spaced apart a distance substantially greater than the transverse section thereof, the axes of said openings in said burner tip being at a greater angle to the axis of said gas tube than the inner face of the head end of said burner tip, and longitudinal centering lugs on said burner tip extending to the inner wall of said air tube to position said burner tip in centered position within said air tube.

11. A nozzle mix radiant burner assembly according to claim 10 including a refractory wall having a cup shaped opening in its inner surface and a generally cylindrical opening therethrough intersecting the bottom of said cup shaped opening, said air tube extending through said cylindrical opening and said burner body being mounted adjacent the outer end of said cylindrical opening, the head end of said burner tip projecting into said cup shaped opening.

12. A nozzle mix burner assembly comprising a burner body, said body having an axial opening therethrough, a straight air tube in axial alignment with said axial opening, the exit end of the wall of said air tube being beveled and extending outwardly at an angle from its inlet end, means detachably fastening said air tube to said burner body around the exit end of said axial opening, said last named means including a mounting ring attached to the entry end of said air tube, said mounting ring having an outside diameter greater than the outside diameter of said air tube, an L-shaped clamp surrounding said mounting ring with one leg thereof extending toward said air tube and abutting said mounting ring and means attaching said L-shaped clamp to said body, a straight imperforate raw gas fuel tube extending through said axial opening into said air tube coaxially therewith, a packing gland mounted in the entry end of said axial opening for slidably supporting said fuel gas tube, means for introducing air into said body around said fuel gas tube, male threads on the exit end of said fuel gas tube, a unitary generally T-shaped in section burner tip threaded on said male threads in axial alignment with said fuel gas tube, said T-shaped burner tip having an axial opening extending from the entry end toward the head end thereof, the head end of said burner tip having a diameter greater than the inner diameter of said air tube, the inner face of the head end of said burner tip sloping radially outwardly toward the forward end of said tip and being spaced from the forward end of said air tube to define an air slot therebetween, the head end of said burner tip being closed with a plurality of elongated and enclosed gas openings therethrough having their axes diverging outwardly from the axis of said burner tip toward the discharge end of the burner, said gas openings being spaced apart a distance substantially greater than the transverse section

thereof, the axes of said openings in said burner tip being at a greater angle to the axis of said gas tube than the inner face of the head end of said burner tip, longitudinal centering lugs on said burner tip arranged to position said burner tip in centered position within said air tube, said centering lugs having a portion thereof arranged at a bevel and bearing against the exit end of said air tube, and a circumferential metering ring surrounding said burner tip on the inlet side of said lugs.

13. A nozzle mix radiant burner assembly according to claim 12 including a refractory wall having a cup shaped opening in its inner surface and a generally cylindrical opening therethrough intersecting the bottom of said cup shaped opening, said air tube extending through said cylindrical opening and said burner body being mounted adjacent the outer end of said cylindrical

opening, the head end of said burner tip projecting into said cup shaped opening.

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