March 13, 1934. H. T. BELLAMY 1,950,470

RADIANT BURNER

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Fig. 1.

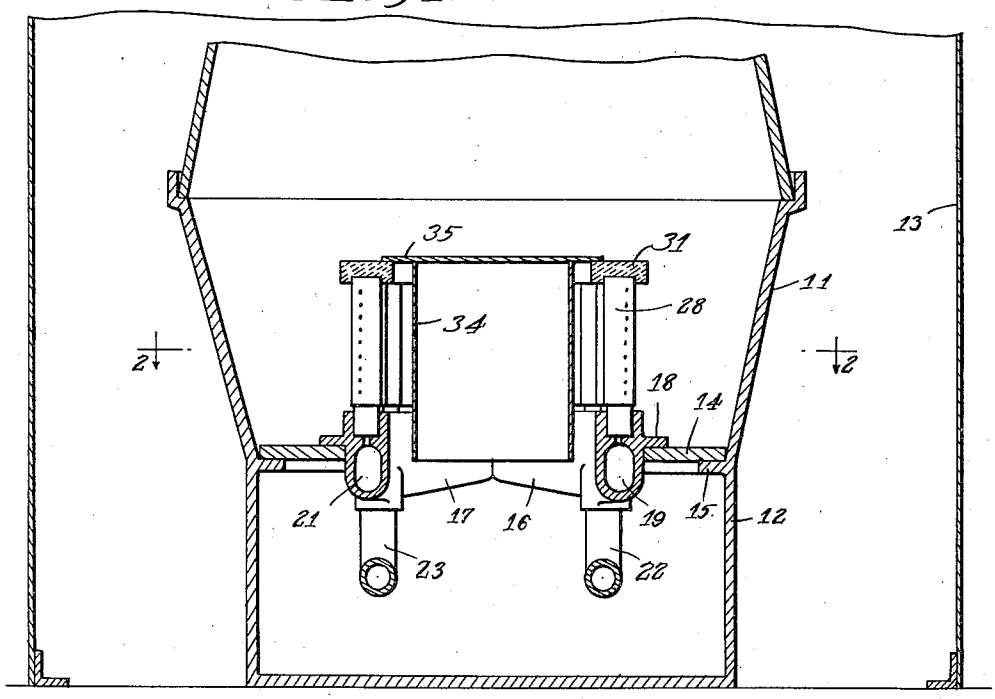
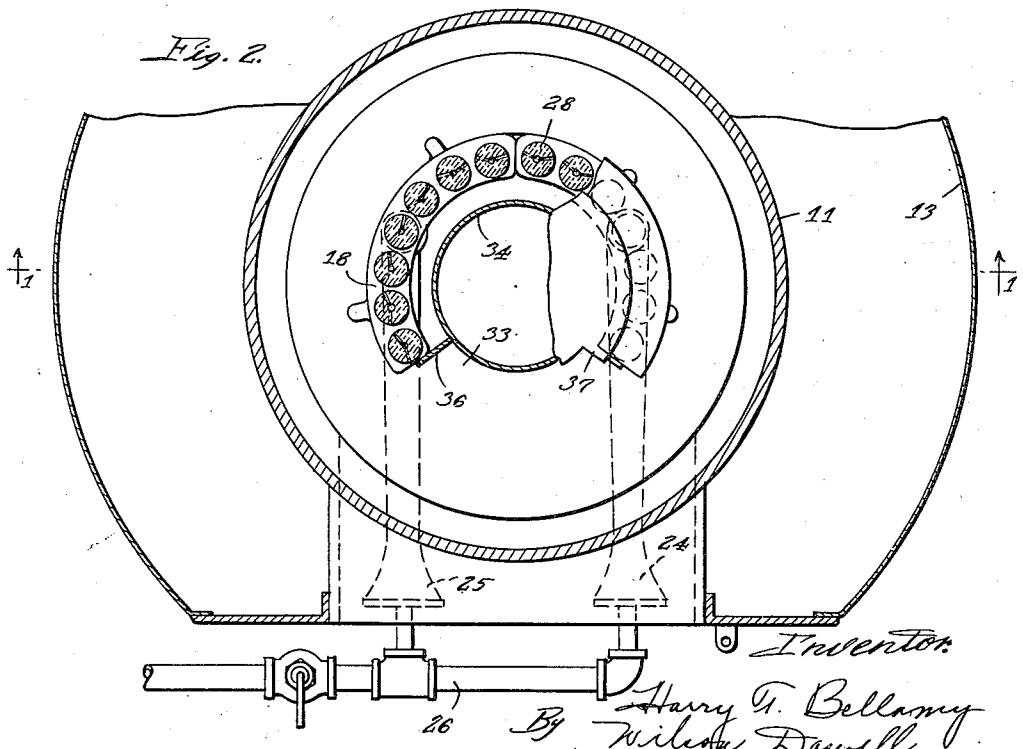


Fig. 2.



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Fig. 3.

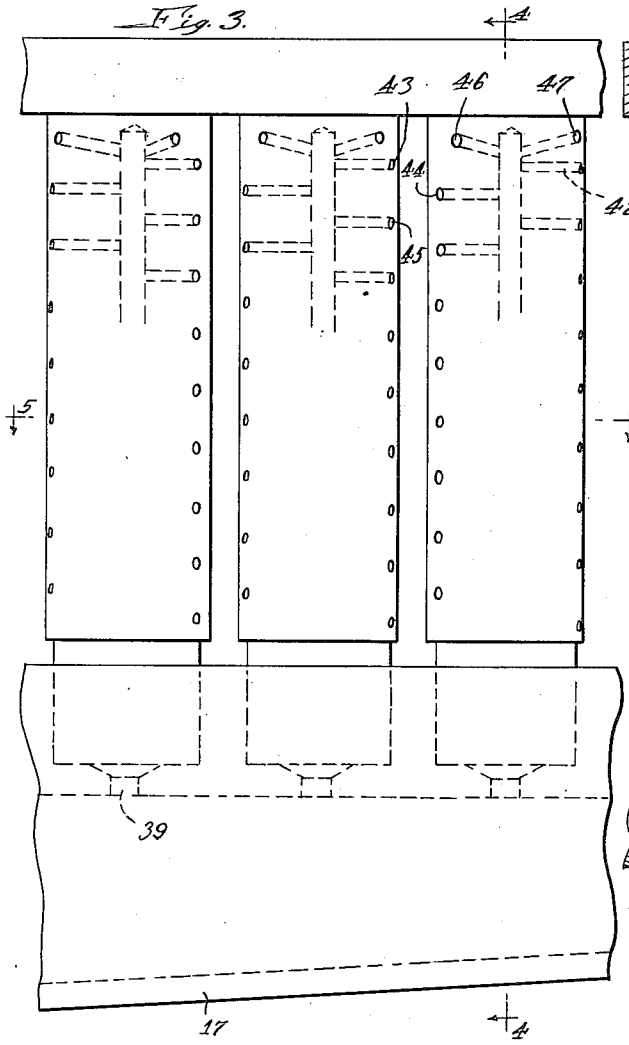


Fig. 4

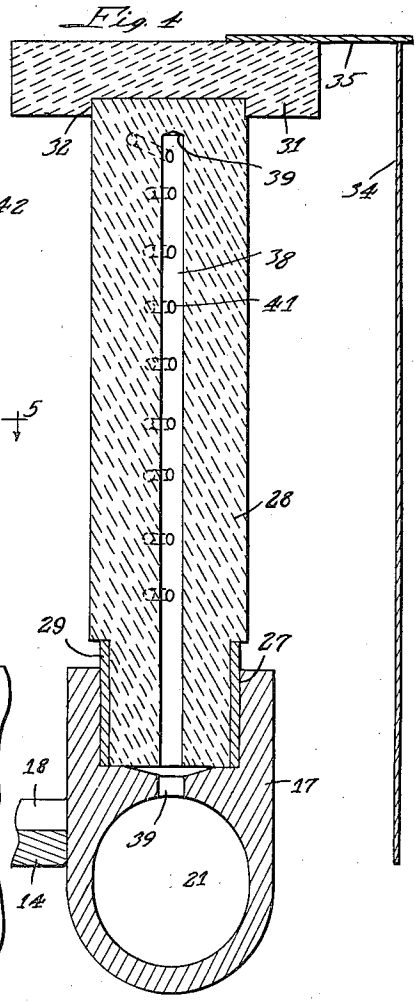
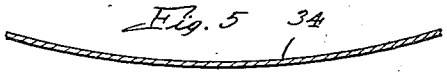
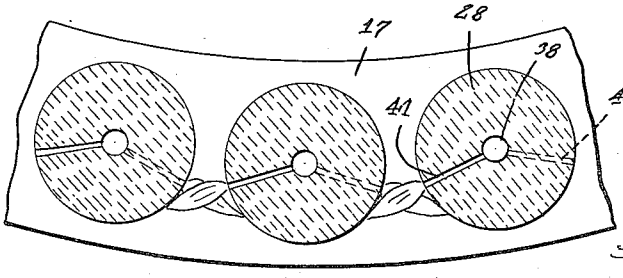


Fig. 5





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Fig. 6

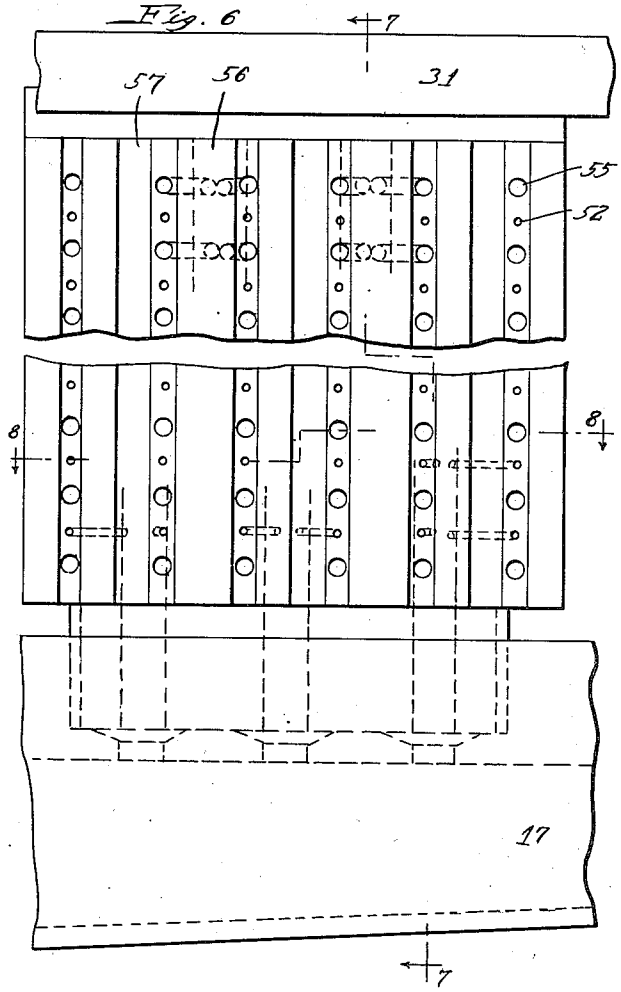


Fig. 7.

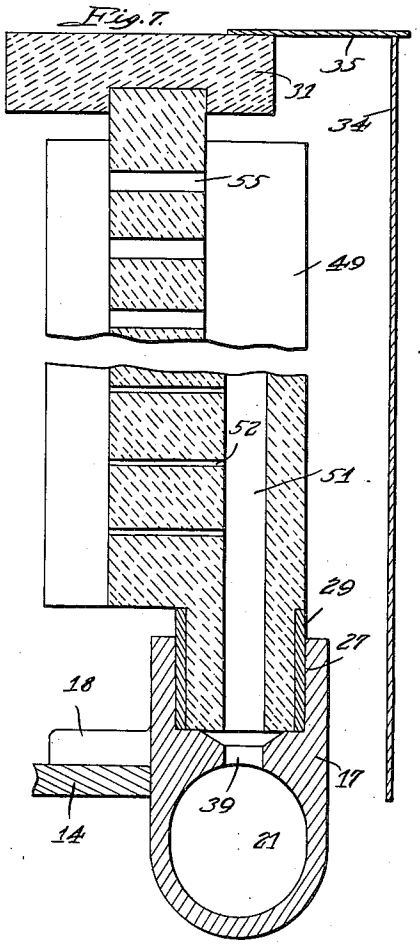
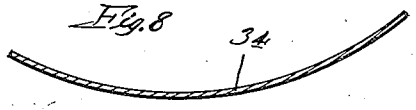
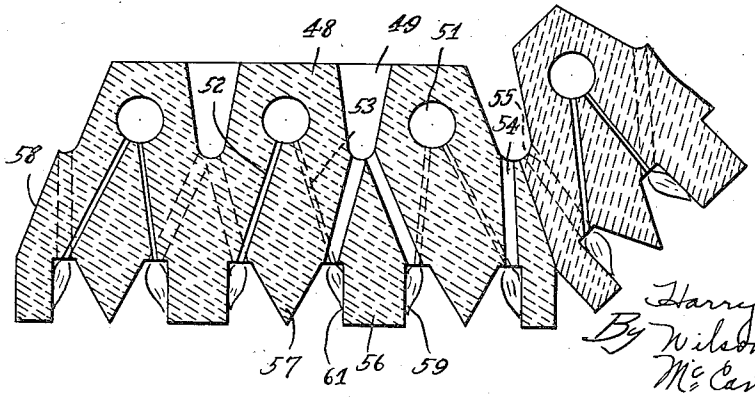


Fig. 8





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Patented Mar. 13, 1934

1,950,470

UNITED STATES PATENT OFFICE

1,950,470

RADIANT BURNER

Harry T. Bellamy, Belvidere, Ill.

Application February 14, 1931, Serial No. 515,690

19 Claims. (Cl. 158—104)

This invention relates to radiant gas burners for use in portable heaters, fire places, furnaces, boilers, and the like.

In the past, in the construction of heaters of this character, it has been customary to provide more or less vertical surfaces of refractory material and a plurality of gas ports at the bottom of these vertical surfaces positioned in such a manner that the flames from said ports sweep upward over the surfaces, heating them to a certain degree of radiance. This type of construction is subject to a number of serious limitations. One of the objections to such a construction is that the radiant surfaces are so far removed from the ports that they are heated but slowly and to a relatively low temperature and, therefore, to an imperfect radiating heat. This has been necessarily so, since the gas must be distributed over the entire surface of the refractory from points near the lower edge thereof, and the surface area of the refractory must be sufficient to bring about the desired heating effect. Furthermore, because of the relatively large diameter of the ports it has been necessary to place the refractory a sufficient distance away from the ports to prevent backfiring into the manifold. In that construction the ports must be relatively large because of the large amount of gas to be liberated and because of the great length of the flame desired.

A further limitation of the constructions of the prior art is the fact that in order to obtain the maximum radiating efficiency of the burner it was necessary to place a plurality of baffles in the vertical path of the flame whereby the flame is caused to take a tortuous path, thereby coming in contact with the baffles and heating them. Under these conditions the burned gases from lower part of the flame are carried upward with the flame along the surface of the refractory and thereby serve to dilute the gas mixture toward the upper edge of the refractory, thereby reducing the rate of combustion and lowering the flame temperature. In this type of construction air cannot be introduced to any great extent along the surface of the refractory, that is, between the refractory and the flame, because it tends to sweep the flame away from the surface and thereby reduce the temperature of the refractory to a point so low as to materially interfere with radiation. Furthermore, the burner must always be used in a vertical position.

Another serious limitation to the construction of the prior art is, that the refractory material cannot be so placed with respect to the flame as to obtain the maximum radiating efficiency of the gas being burned. In other words, the highest temperature of a gas flame lies just beyond the tip of the blue cone and consequently the highest radiating efficiency will be obtained when the radiant or heated refractory surface is placed so that this point of the flame impinges thereon.

Therefore, one of the objects of my invention is to provide a radiant gas burner having a higher radiating efficiency than has heretofore been possible.

A further object of my invention is the provision of a radiant gas burner having a face provided with a plurality of small gas ports and means for supplying secondary air near each of the ports.

A still further object of the invention is the provision of a radiant gas burner having a radiating area provided with surfaces against which a plurality of small flames are adapted to impinge at substantially their hottest point for the purpose of heating the surface and radiating the heat of the flames.

Other objects and attendant advantages will become apparent to those skilled in the art from the following description and the accompanying drawings in which—

Figure 1 is a vertical section through a domestic furnace provided with one form of my improved burner;

Fig. 2 is a section on the line 2—2 of Fig. 1;

Fig. 3 is a fragmentary face view of the form of my improved burner shown in Fig. 1, as supplied to a domestic furnace;

Fig. 4 is a section on the line 4—4 of Fig. 3;

Fig. 5 is a section on the line 5—5 of Fig. 3;

Fig. 6 is a fragmentary face view of a modified form of burner as applied to a domestic furnace;

Fig. 7 is a section on the line 7—7 of Fig. 6; and

Fig. 8 is a section on the line 8—8 of Fig. 6.

I have shown in the drawings a type of burner adapted to be employed in a domestic furnace. It will be seen, however, that the principles of the invention are equally applicable to burners for other purposes and I do not intend to limit myself to this particular type. By slight alterations, easily within the ability of those skilled in the art, the same principles may be applied to all types of radiant heaters.

Referring to Figs. 1 and 2 the numeral 11 designates the fire pot of a conventional domestic furnace and the numeral 12 designates the walls of the ash pit, both of which are surrounded by the customary furnace casing 13. A circular

plate 14 is positioned upon flanges 15 and serves to separate the fire pot from the ash pit. A manifold, which may advantageously be formed of two integral sections 16 and 17, is positioned within the opening in the plate 14 by means of a flange 18 on the periphery of the manifold. The manifold sections 16 and 17 are provided with gas chambers 19 and 21 adapted to receive gas through injecting tubes 22 and 23 which are provided at their outer ends with the usual Venturi tubes 24 and 25 for making the proper mixture of gas and primary air. Gas is supplied to the injecting tubes from a gas supply line 26.

The manifold is provided with a plurality of sockets 27 arranged in spaced relation and adapted to receive rods 28 of refractory material. In order to provide a gas tight joint at these points a bushing 29 may be cemented to the refractory rod 28, or any other suitable means may be provided. A ring 31 of refractory material is provided with recesses 32 to receive the upper ends of the refractory rods 28, the ring resting upon the rods for the purpose of maintaining the upper ends thereof in position. Since the heat of the burner is not utilized to the best of advantage when directed against the door of the furnace, I have made the manifold and the ring 31 in the form of about three-fourths of a circle leaving the opening in the circle opposite the door of the furnace, in which instance the plate 14 is caused to extend inward across the ends of the manifold as shown at 33.

A cylinder 34 which may advantageously be formed of sheet metal, is positioned within the cylinder formed by the manifold and the rods 28 and partially rests at its lower edge upon the section 33 of the plate 14. A top 35, is supported on the ring 31 and completely closes the upper end of the cylinder formed by the manifold and the rods 28, the cylinder 24 being secured thereto at its upper end. Flanges 36 and 37 are secured to the cylinder 34 and extend outward against the ends of the manifold and vertically between the section 33 and the top 35. Thus the air moving upward is required to pass through the space between the manifold and the cylinder 34 and outward between the spaced rods 28, the air so moving constituting the sole supply of secondary air to the burner.

Referring now more particularly to Figs. 3, 4 and 5, the refractory rods 28 are formed of a refractory material preferably having high heat insulating qualities in order that the heat may not be too readily conducted through the rod and thereby facilitate flash-back difficulties. One of such materials which may be satisfactorily employed for the purpose is described in my copending application, Serial No. 436,254, filed March 15, 1930. Each of the rods 28 is provided with a relatively small gas chamber 38 which may advantageously be axially positioned in the rod and should not extend the full length of the rod as shown at 39. The lower end of the chamber 38 connects with an opening 39 in the manifold through which the mixture of gas and primary air may pass from the manifold chambers 19 or 21 into the chambers 38. Two rows of channels 41 and 42 of small diameter extend from the outer surface of the rod 28 into the chamber 38 and serve to conduct the mixture of gas and primary air to the surface of the rod 28 at which points the gas is caused to burn in a plurality of small flames. The channels 41 and 42 are vertically spaced in an alternate fashion and are positioned at such an angle with respect to each other that the flames resulting from the burning gas of two adjacent channels will strike the surface of the rods 28 spaced at each side of the rod in question at a different elevation. The rods 28 are so spaced that the flames from the channels 41 and 42 will impinge on the adjacent rod at substantially the hottest point of the flame, that is, slightly beyond the tip of the cone. As indicated in Fig. 5, the channels of the two series are ordinarily advantageously disposed when they diverge at an angle of approximately 160°.

Referring now to Fig. 3, it will be seen that because of the staggered relation between the channels 41 and 42, the flame at the port marked 43, for example, will strike the adjacent rod 28 slightly above the port marked 44, while the flame from the port 44 will likewise strike the rod 28 in which the port 43 is located slightly below this port. Likewise the flame of the port 45 will strike the rod 28 in which the port 44 is located slightly below the port 44. Therefore, the flames issuing from adjacent rods 28 will lie in vertically alternately spaced relationship. If desired, the upper channels 46 and 47 of the rows 41 and 42 may be inclined slightly upward so that the flame will be directed to the lower surface of the ring 31 to aid in flashing the fire between the various rows when the burner is lighted.

It will be seen from the structure just described, that the face of the burner is provided with a multiplicity of small gas ports distributed along the surface thereof, the gas issuing from each port being adapted to burn with a small flame. The refractory material and the flames are so arranged that the flame will impinge upon the former substantially at its point of highest temperature thereby heating the refractory substantially to the highest temperature of the flame, whereby maximum radiating efficiency is had from the burner. The flames are each projected across the space between adjacent refractory rods and the secondary air is supplied from the rear of the rods and moves outward through these spaces. The various advantages of this construction will presently be set forth.

Referring to Figs. 6, 7 and 8, I have shown a body structure wherein the members are considerably larger than the rods 28 of the body structure just described. In this instance a block 48 of refractory material is provided with vertical grooves 49 and with vertical gas chambers 51. Channels 52 and 53 extend from the gas chambers 51 to the surface of the burner and are arranged in vertically spaced relation to provide vertical rows of gas orifices. Channels 54 and 55 extend from the grooves 49 to the face of the burner adjacent to the ports formed by the channels 52 and 53. Vertical ribs 56 and 57 are positioned on the face of the burner in alternate spaced relation, the ribs 56 being rectangular in shape and the ribs 57 triangular as shown in Fig. 8. The blocks 48 are adapted to be positioned edgewise in the manifold and the edges 58 of the blocks may be slightly beveled as shown in Fig. 8 to permit them to be placed in a general circular position. The chambers 51 are arranged to communicate with the manifold chambers 19 and 21 through the opening 39 as previously described. In like manner the ring 31 is arranged to receive the upper edges of the blocks 48 to secure them in position. Viewing Fig. 1, it will be seen that the construction just described provides vertical rows of alternate air ports and gas ports emerging in the grooves between the ribs 56 and 57. The channels 52 and 53 extend outward from the chambers

51 in such a manner that each chamber provides gas for two rows of ports, the channels 52 and 53 lying at an angle with respect to each other and with respect to the faces 59 and 61 of the ribs 56. This angle is such as to cause the flames from the ports to be directed obliquely against the surfaces 59 and 61, so that the hottest portion of each flame impinges on these surfaces. The channels 52 and 53 are relatively small in diameter whereby to provide a relatively small flame on the face of the burner and the channels 54 and 55 are sufficiently large to provide secondary air for completely oxidizing the gas mixture. It will thus be seen that in this modification also the secondary air is supplied at the base of the flame and between the body of the burner and the flame.

It will be obvious that the present invention brings about a number of highly advantageous results. For example, the flame temperature is substantially higher than that obtained in other burners of like nature. This is partly due to the fact that a plurality of small flames are employed and means are provided for supplying the necessary secondary air to each of these flames at the face of the burner, thereby materially increasing the speed of combustion. This is because the speed of combustion of the primary reaction products with secondary air is almost entirely dependent on the rate of diffusion of the combustible gases left after the reaction with primary air. These products must diffuse to find sufficient oxygen for complete combustion, thereby producing what has been termed a wandering flame. In my improved construction the secondary air is supplied directly to each small flame and in the direction of travel of the flame, so that very little diffusion is required for complete oxidation.

Another reason for the increased rate of combustion is the fact that the hottest portion of the flames is directed against a radiant surface of insulating refractory material by which a very highly heated porous surface is produced. This highly heated surface acts as a catalyst for the oxidation reaction and thereby materially increases the rate of combustion.

A further reason for the increased rate of combustion is the fact that secondary air is introduced directly at each flame in sufficient quantity to provide the oxygen necessary for this increased rate of oxidation, and the direction of movement of the secondary air is such that the products of combustion, that is, the burned gases, are almost immediately removed from the flame zone. It will be obvious that the movement of gas at the face of the burner is away from the surface because of the introduction of the gas and air from the rear of the burner. For this reason, the burned gases need only pass through the thin layer of the flame zone. On the other hand, with the prior art constructions in which the gas is passed parallel to the face of the burner, the products of combustion of the gas burning at the lower edge of the burner are commingled with the unburned gases and with the secondary air thereby diluting them and reducing the rate of oxidation because of the decreased concentration of inflammable gases. Furthermore, as a result of this construction there is little or no opportunity for the gas to be chilled below its kindling point before sufficient air is provided for the oxidation of the combustible gases. This substantially prevents the escape of carbon monoxide from the burner.

The efficiency of my improved burner is substantially higher than that of the burners in the prior art. This is believed to be due to the higher rate of combustion and the higher flame temperature and also to the manner in which the flames are directed against the radiant surface whereby a greater portion of the heat of the flame is converted into radiant energy.

The danger of flash-back is practically eliminated by my improved construction. This results from two factors, first the channels or ports may be made so small that flame propagation therethrough is practically impossible. The rate of flame propagation decreases with the size of the channel and it has been stated that flame propagation is impossible in tubes of less than .08 inches in diameter. Furthermore, the refractory material is possessed of high insulating properties and the heat will, therefore, not penetrate to an excessive amount through the body of the burner.

In the old type of burner, there is substantially no draft away from the surface of the burner and, therefore, there is a grave tendency for the upper part of the flame to be smothered with the products of combustion, thereby diffusing the flame and producing carbon monoxide.

In my improved construction it is not necessary to provide overhanging portions such as common in radiant heaters of the prior art, since gas is not permitted to stream up along the surface but instead is positively caused to impinge and burn in a small flame on the face of the burner. This permits the design to be such that the burned gases may be expelled freely from the flame zone along the face of the burner.

Because the secondary air is introduced from the rear of the burner face and in the direction of the flames, the hot burned gases are moved horizontally outward from the face of the burner, thereby providing heated gases between the face of the burner and the object to be heated whereby the efficiency of heating is further increased.

While I have described, throughout the specification the movement and effect of the secondary air it will be seen that my improvement possesses all of the described advantages when all of the air necessary for the burning of the gas is introduced as primary air. In that case the movement of secondary air from the ash pit may be cut off if desired.

Furthermore, while I have described these radiant burners as operating in a substantially vertical position, the radiating surface may be horizontal to direct the heat up or at any angle between that and the vertical with satisfactory intake of secondary air, and the radiating surface may be in any position when all air necessary for combustion is introduced with the gas. To be sure, various changes in the construction of the burner results from such use, but these are within the contemplated scope of the invention.

While I have thus described and illustrated a specific embodiment of my invention I am aware that numerous alterations and changes may be made therein without departing from the spirit of the invention or the scope of the appended claims in which—

I claim:

1. A radiant burner comprising a plurality of refractory burner members each having means for producing a plurality of relatively small flames, each member having a radiant surface positioned substantially at the hottest points of the flames of the next adjacent member, whereby to receive and radiate the heat thereof.

2. In a radiant heater, series of radiant members having surfaces against which small flames are adapted to impinge for the purpose of radiating the heat of the flames, and individual ports for each radiating surface, the ports of each member being located in such proximity to surfaces of the adjacent members as to cause the hottest portion of said flames to impinge thereagainst.

3. In a radiant heater, radiant members of refractory material against the surfaces of which small flames are adapted to impinge for the purpose of radiating the heat of the flames, individual gas ports for each radiating surface located in such proximity to said surfaces as to cause the hottest portion of said flames to impinge thereagainst, and individual air ports for each of said gas ports to supply secondary air thereto.

4. In a radiant burner, a radiant member of refractory material, a plurality of relatively small ports in the surface thereof, means for causing a flow of gas through said ports to burn thereon in a plurality of small flames, means for causing secondary air to flow to said flames in the same general direction as the products of combustion whereby the gas emerging from said ports is caused to burn in a plurality of cones, and refractory material positioned at substantially the hottest part of said flames adapted to radiate energy away from said member.

5. A radiant burner comprising a radiant of refractory material, a plurality of gas ports distributed on the surface of said radiant, means for supplying secondary air to each of said ports whereby the gas from said ports is caused to burn with a plurality of small flames, and radiant material positioned in the region of the hottest portion of said flames to be heated to substantially the highest temperature of said flames whereby to radiate a maximum proportion of the heat generated by said flames.

6. In a radiant heater, a body structure of refractory heat insulating material arranged to radiate heat from the face thereof, a plurality of ports in said body structure through which a gas mixture may be forced from behind the face of said structure, means for supplying secondary air from behind the face of said structure to the gas mixture liberated from said ports whereby said gas mixture is caused to burn in a plurality of cones, and a refractory material positioned opposite said portion at such distance that the portions of the flames beyond their cones will impinge on said material.

7. In a radiant heater, means for producing a radiating area comprising at least one radiant member having a passageway constituting a source of supply of mixed gas and air and having a multiplicity of small ports on the surface thereof at which said gas is adapted to burn in small flames and means for supplying secondary air to said flames at the base thereof.

8. A radiant burner comprising at least one member of refractory material constituting a radiant and provided with a plurality of gas chambers, a plurality of gas channels leading from said chambers to the surface of said member to provide gas ports at which a gas mixture emerging therefrom is adapted to burn with a small flame, and means for supplying secondary air adjacent to each of said ports.

9. A radiant burner comprising at least one member of refractory material provided with a plurality of vertical gas chambers, a plurality of gas channels leading from said chambers to the surface of said member to provide gas ports at which a gas mixture emerging therefrom is adapted to burn with a small flame, means for supplying secondary air adjacent to each of said ports, and radiating surfaces of refractory material in such proximity to each of said ports that the flames therefrom impinge upon said surfaces to heat the latter and radiate the heat of said flame.

10. A radiant burner comprising a gas manifold, means for supplying a mixture of gas and primary air to said manifold, at least one member of refractory material constituting a radiant provided with a plurality of gas mixture chambers connecting with said manifold, a plurality of gas channels leading from said chambers to the surface of said member to provide gas ports at which a gas mixture emerging therefrom is adapted to burn with a small flame, and means for delivering secondary air adjacent to each of said ports individually.

11. A radiant heater comprising at least one body of refractory material provided with series of channels extending therethrough and opening on the same surface thereof, means for supplying a gas mixture to the channels of one series to burn against said surface, and means for supplying air to the channels of the other series to provide secondary air for the burning of said gas.

12. A radiant heater comprising a plurality of spaced rods of refractory material each having a gas chamber and a plurality of spaced channels leading therefrom to the surface of each rod to provide ports at which gas is adapted to be burned in small flames, said ports being positioned to caust the hottest portions of said flames to impinge the surface of adjacent refractory rods to heat the same and radiate the heat of said flame.

13. A radiant heater comprising a plurality of spaced rods of refractory material each having a gas chamber and a plurality of spaced channels leading therefrom to the surface of each rod to provide ports at which gas is adapted to burn in small flames, and means for supplying secondary air to the space between said rods, said ports being positioned to cause the hottest portions of said flames to impinge the surface of adjacent refractory rods to heat the same and radiate the heat of said flame.

14. A radiant heater comprising at least two spaced radiant members each having a gas chamber and a plurality of channels leading therefrom to the surface of said member to provide a plurality of gas ports and small flames, said ports being positioned to direct the hottest portions of said flames against the adjacent member whereby to heat said member and radiate the heat from said flames, and means for supplying secondary air to the space between said members.

15. A radiant heater comprising at least two spaced radiant members each having a gas chamber and a plurality of channels leading therefrom to the surface of said member to provide a plurality of gas ports and small flames, said ports being positioned to direct the hottest portions of said flames against the adjacent member whereby to heat said member and radiate the heat from said flames.

16. A radiant heater comprising a plurality of parallel spaced rods of refractory material each having a gas chamber and a plurality of channels leading therefrom to the surface of the rod adapted to conduct a gas mixture and positioned to tangentially direct the hottest portions of said flames against the adjacent rod whereby to heat said member and radiate the heat from said

flames, and means for supplying secondary air to the space between said rods.

17. A radiant burner member of refractory material having a fuel mixture chamber therein and passageways extending from said chamber through the wall of said member, the outer openings of said passageways being disposed in two series longitudinally of said member for the purpose set forth, said member also having other passageways communicating with a source of air supply and opening close to the fuel mixture openings aforesaid.

18. A radiant burner member of refractory material having a fuel mixture chamber therein, grooves extending longitudinally thereof in one wall thereof, and passageways opening into said grooves, said passageways extending from said chamber towards one wall of said grooves, said member also having passageways from a source of air supply and opening into said grooves adjacent to said first mentioned passageways respectively.

19. In a radiant heater, a plurality of radiant members each having a multiplicity of small spaced gas mixture ports, each member being positioned at substantially the hottest point of flames from the ports of the next adjacent member whereby it is adapted to be heated thereby to radiate the heat of said flames.

HARRY T. BELLAMY.