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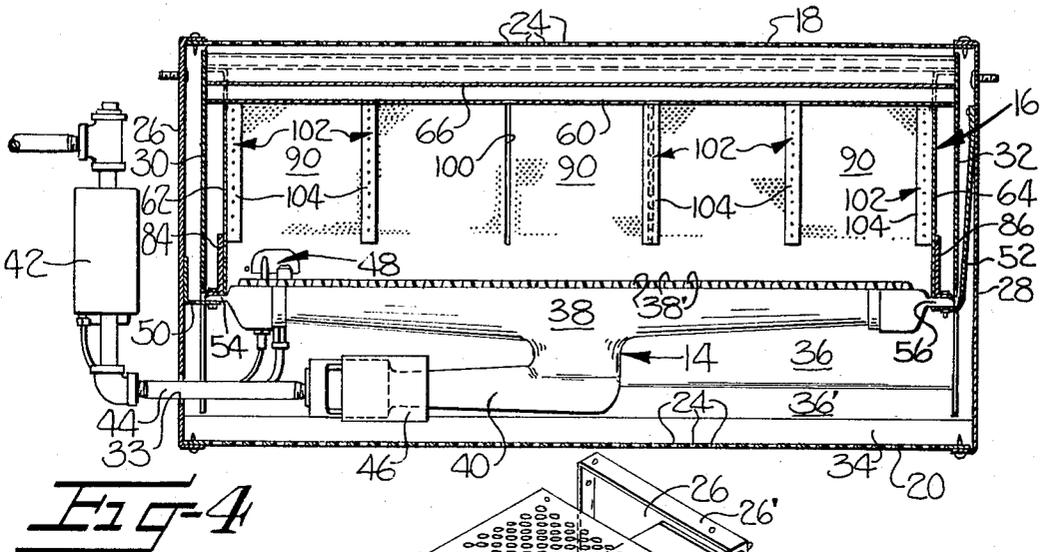
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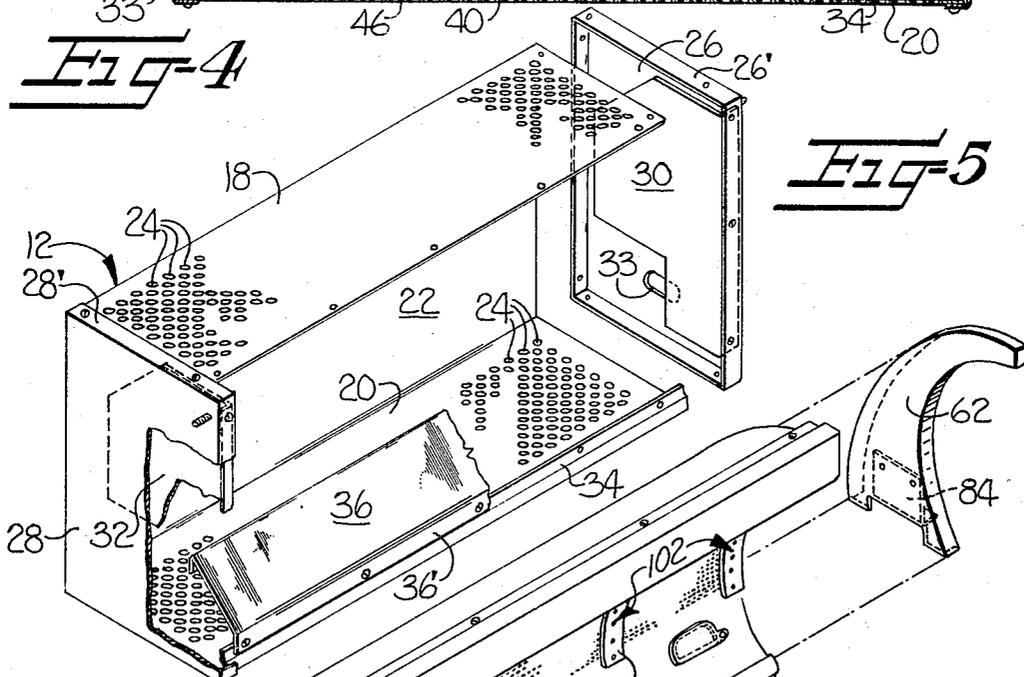
ELONGATE RADIANT GAS HEATER

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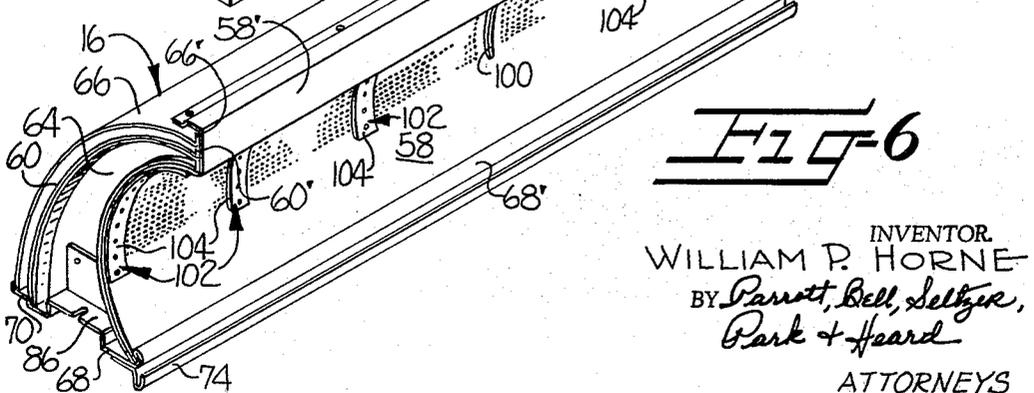
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**Fig-4**



**Fig-5**



**Fig-6**

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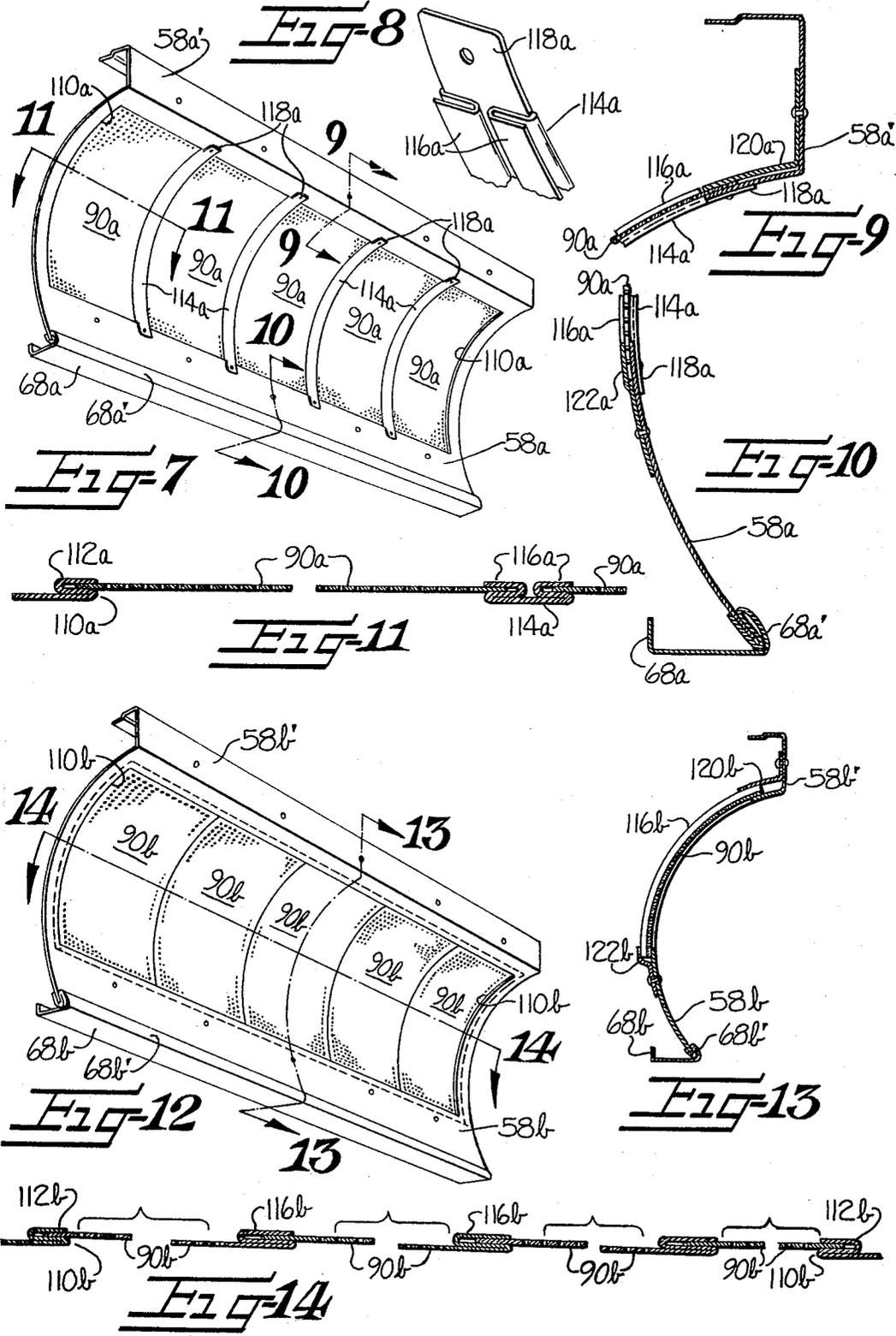
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**ELONGATE RADIANT GAS HEATER**

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 Filed Sept. 3, 1964, Ser. No. 394,294  
 12 Claims. (Cl. 126-92)

This invention relates to gas-fired radiant heaters and, more specifically, to an elongate radiant gas heater particularly adapted for mounting at an elevated location upon the wall of a workshop, hangar or other similar large enclosure for the purpose of radiating heat-energy downwardly toward the floor and occupants thereof.

The use of wall-mounted radiant heaters in enclosures of the type mentioned above is often required as floor or ceiling mounted units may impede the intended utilization of the enclosure by interfering with the desired placement of personnel, machinery or equipment and the use of trucks, overhead hoists, cranes and the like. However, while ceiling or floor-mounted heaters may be of a circular design, of which that shown in Patent No. 2,985,137 is illustrative, wall-mounted heaters almost inevitably must be of elongate linear shape due to the necessity of their emitting heat-energy outwardly from a wall. This distinction becomes quite significant in those larger-size heaters intended for use in big enclosures since with elongate heaters suitable for wall mounting, far more so than with the circularly-shaped heaters suitable for floor or ceiling installation, the stresses caused by heating and cooling of components cause serious problems as the size of such components increases. Structural failure due to these stresses has frequently heretofore occurred in heaters of any appreciable length. Apart from and in addition to the problem of structural failure, elongate radiant heaters heretofore proposed for wall mounting generally have not possessed the efficiency of circular floor or ceiling-mounted heaters. The characteristic of substantially unidirectional radiation from generally upright emitter surfaces, necessary in a wall-mounted heater, has been found to be difficult to realize while obtaining maximum radiation emission per each unit of radiation surface area, maintaining the radiation surfaces unobstructed by burners and the like, obtaining maximum heat from the burner gases prior to their escape from the heater, etc.

With the foregoing in mind, a primary object of this invention is the provision of an elongate radiant gas heater suitable for wall-mounting in large enclosures such as hangars, and free from the foregoing disadvantages and deficiencies by reason of its good efficiency and its ability to withstand component expansion and contraction without structural failure.

A related and more specific object of this invention is the provision of an elongate radiant gas heater in which structural failure due to longitudinal expansion and contraction is obviated by, among other things, constructing the radiation-emitting component of the heater in separate modules, each of which is free to undergo independent expansive and contractive movement, upon heating and cooling, without damage to itself or to the entire structure.

Another related and more specific object is the provision in a heater of the type described of a plurality of perforate grid members from which a maximum amount of radiant energy may be realized due to their effective surface areas being totally unobstructed by burners or the like and due to radiation being emitted through the perforations thereof as well as from the solid portions adjacent said perforations.

Another object is the provision of a heater of the type described in which efficient utilization is made of the heat

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content of the gaseous combustion products by passing the same both adjacent the surfaces of and through the radiation-emitting members to be heated prior to their escape into the atmosphere.

5 Still another object is the provision in a heater of the type described of radiation-emitting grid members which are shaped in such a manner as to not only direct the radiation emitted therefrom in a desired direction, but so as to also facilitate the relief of certain stresses imposed thereon and so as to more efficiently utilize the heat content of combustion gases brought into contact therewith.

10 Still other objects and advantages will be in part evident and in part pointed out hereinafter in the following description of an illustrative embodiment of the invention, which should be read in conjunction with the accompanying drawings, in which:

15 FIGURE 1 is a front elevational view of a heater embodying the invention, with the optional front reflector being partially broken away and one of the front wall slot seals not being shown, to better reveal details of construction;

20 FIGURE 2 is an enlarged vertical section taken approximately along the line 2-2 through the heater of FIGURE 1;

25 FIGURE 2A is an enlarged fragmentary horizontal section taken approximately along the line 2A-2A of FIGURE 1;

30 FIGURE 3 is a fragmentary horizontal section taken approximately along the line 3-3 of FIGURE 2;

35 FIGURE 4 is a reduced vertical cross-sectional view taken approximately along the line 4-4 of FIGURE 2 through the housing and combustion chamber means of the heater, but with the gas burner means and associated components being shown in rear elevation;

40 FIGURE 5 is a partially-exploded front perspective view of the housing of the heater shown in FIGURE 1;

45 FIGURE 6 is an enlarged, partially-exploded front perspective view of the combustion chamber means of the heater shown in FIGURE 1;

50 FIGURE 7 is a front perspective view of another embodiment of the front wall of the combustion chamber of the heater;

55 FIGURE 8 is an enlarged rear perspective view of an end of one of the mounting members shown in FIGURE 7;

60 FIGURES 9 and 10 are enlarged vertical sections taken approximately along the lines 9-9 and 10-10 of FIGURE 7, respectively;

65 FIGURE 11 is an enlarged vertical section taken approximately along the line 11-11 of FIGURE 7;

70 FIGURE 12 is a front perspective view of still another embodiment of the front wall of the combustion chamber of the heater;

FIGURE 13 is an enlarged vertical section taken approximately along the line 13-13 of FIGURE 12; and

FIGURE 14 is an enlarged horizontal section taken approximately along the line 14-14 of FIGURE 12.

Referring more specifically to the drawings, the heater shown and identified in its entirety in FIGURE 1 by the numeral 10 consists generally of an elongate housing 12 (see FIGURE 5), burner means 14 (see FIGURE 4) and combustion chamber means 16 (see FIGURE 6). The approximate three-foot length of heater 10 is such as to render it useful for heating large enclosures such as hangars and the like, upon a wall of which it is capable of being mounted, but both the length and the aforesaid intended utilization of heater 10 are subject to variation without departing from the principles of the invention, as will be apparent hereinafter.

Referring now primarily to FIGURE 5, housing 12 of heater 10 is of generally rectangular shape and is pref-

erably of sheet-metal construction, including parallel, horizontally extending top and bottom walls 18, 20, respectively, which extend normal to and may be integral with rear wall 22. A plurality of holes 24 are provided in top and bottom walls 18, 20 of housing 12 to permit circulation of air therethrough. The opposite ends of housing 12 are closed by end walls 26, 28, each of which is provided with an inwardly directed peripheral flange 26', 28', respectively, for the purpose of facilitating its attachment to walls 18, 20 and 22. Such attachment may be by any convenient means, as by spot-welding, rivets or sheet-metal screws. Flanges 26', 28' also serve as supports for panels 30, 32 which are attached thereto in parallel, spaced relation to end walls 26, 28, respectively, for reasons which will be subsequently apparent. Panels 30, 32 are formed of material that is a good reflector of radiant heat, such as polished aluminum, and the lower-rear portions thereof are both cut away in the manner shown in FIGURE 5 relative to the panel 30. The forward edge of bottom wall 20 of housing 12 is provided with a relatively short, upwardly extending flange 34. Secured, as by means of sheet-metal screws, to flange 34 is one downwardly-extending leg 36' of a panel 36 running substantially the entire length of housing 12. In a transverse direction (see FIGURES 2 and 5), the major area of panel 36 extends rearwardly and upwardly within the interior of housing 12 and at an angle of approximately 45 degrees to the horizontal, terminating within the forward half of housing 12 at another integral, downwardly-extending leg 36''. That portion of the front of housing 12 lying above panel 36 is left open for reception of the combustion chamber means 16 to be subsequently described.

Detachably connected to housing 12 for optional use when desired is an arcuate reflector member 35 formed of polished aluminum or the like (see FIGURES 1 and 2). As is shown in FIGURE 2, the inner or rearward edge of reflector 35 is spaced from the plane of the forward face of housing 12, defining an elongate gap or passage-way 37 between the reflector and housing.

Referring now primarily to FIGURE 4, burner means 14 of heater 10 is of conventional design and cast-iron construction, including an elongate plenum portion 38 provided along its entire length with a plurality of individual burner ports 38' and extending horizontally below and generally parallel to the central longitudinal axis of housing 12 throughout substantially the entire length of the housing, and further including a throat portion 40 formed integral with and extending downwardly from the center of plenum portion 38. Fuel gas is supplied to ports 38' of burner means 14 from a conventional source and through a conventional valve mechanism 42 disposed exteriorly of housing 12 by a pipe 44 connected to the latter and extending through a hole 33 in end wall 26 of the housing and through the cut-away portion of panel 30. That end of pipe 44 disposed within housing 12 communicates with and is connected to a conventional sleeve mechanism 46 carried by throat portion 40, which sleeve mechanism is adjustable so as to introduce desired amounts of primary air into the fuel gas conducted through pipe 44 and throat 40 to the burner ports 38' of plenum portion 38. The gas-air mixture thus supplied to ports 38' is regulated and ignited by any suitable pilot mechanism, indicated generally by the numeral 48.

Burner means 14 is secured to and mounted within housing 12 by generally L-shaped bracket members 50, 52, best shown in FIGURE 4. The horizontal leg of bracket 50 is bolted to a horizontally extending ear 54 provided integral with that end of plenum 38 adjacent end wall 26 of the housing, while the vertical leg of bracket 50 is rigidly secured to end wall 26. As is shown, the horizontal and vertical legs of bracket 50 may be of approximately the same relatively short length, and the former may pass through the same previously-mentioned cut-away portion of panel 30 through which pipe 44 also

extends. The horizontal leg of the other bracket, 52, is secured to a comparable ear 56 integral with that end of plenum portion 38 adjacent end wall 28 of the housing, and extends toward such end wall through the cut-away portion provided in panel 32. Unlike bracket 50, however, the horizontal leg of bracket 52 terminates short of the adjacent end wall of the housing (see FIGURE 3), and the vertical leg of the bracket is of considerably greater length than the horizontal leg, extending upwardly and angularly outwardly from the horizontal leg to a point of attachment at its uppermost end to end wall 28. By reason of the length of the free portion of its vertical leg, bracket 52 possesses a resiliency capable of compensating for any relative expansion and contraction experienced by burner means 14 and housing 12 during use of heater 10. Thus, if heat-expansion of burner 14 should cause movement of ear 56 toward end wall 28 during use of the heater, bracket 52 permits such movement to transpire without damage to or structural failure of either the burner means or the housing, and similarly permits movement in the opposite direction if contraction should occur upon cooling of burner means 14 when heater 10 is extinguished.

For the same reasons as those set forth above, bracket 50 might be constructed and arranged in the same way as bracket 52, rather than as shown and as previously described. In most instances, however, such would be unnecessary since the expansive and contractive movement of burner means 14 relative to the housing is most pronounced at that end distal from its fixed gas supply connections including pipe 44; i.e., at that end of burner means 14 adjacent end wall 28 of the housing to which it has a fixed attachment.

Combustion chamber means 16 of heater 10, best shown in FIGURES 2 and 6, consists generally of arcuate front and rear walls 58, 60, respectively, side walls 62, 64, and arcuate shield 66 extending behind rear wall 60 in spaced, generally parallel relation thereto, and a bottom wall defined by elongate irregularly-shaped channel members 68, 70. With the exception of shield member 66, which is formed of heat-reflecting material such as polished aluminum, all of the various aforementioned components of duct means 16 are formed of refractory metal possessing a low coefficient of expansion and capable of good emissivity of radiant heat. Ferritic stainless steel, after development of a dark oxide film following exposure for a brief period of time to gas flame, is a preferred material possessing these qualities.

The channel members 68, 70 defining the bottom wall of combustion chamber 16 extend longitudinally for substantially the entire length of housing 12 in parallel, spaced relationship to each other so as to provide therebetween an elongate opening 72 (see FIGURE 2) through the bottom wall of the chamber. Secured to and preferably co-extensive in length with the under surface of channel member 68 is a substantially flat bracket member 74 having a generally hook-shaped extension 74' integral with and extending downwardly from its forward edge. Hook-shaped extension 74' receives leg 36'' of panel 36, thereby mounting channel member 68 closely adjacent and substantially parallel to the uppermost edge of panel 36.

A generally U-shaped extension 68' provided integral with the forward edge of channel member 68 receives and supports, but is not rigidly connected to, the bottom edge of front wall 58 of combustion chamber 16. Front wall 58 is substantially co-extensive in length with channel member 68, extending longitudinally almost the entire length of housing 12, and in a transverse direction curves upwardly from channel member 68 first rearwardly and then forwardly relative to such channel member and to the housing. The aforesaid curved portion of front wall 58 terminates at the front of housing 12, adjacent but spaced from the top thereof, in right-angularly bent extension 58' having a vertical leg projecting upwardly in the plane of the front of housing 12 and a hori-

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zontal leg projecting rearwardly therefrom to a point of attachment with top wall 18 of the housing.

Rear wall 60 of combustion chamber means 16 is approximately of the same size and shape and extends generally, but not exactly, in parallel spaced relation to the curved portion of front wall 58. The lower edge of bottom wall 60 is supported by channel member 70, bearing against an up-turned shoulder provided on such channel member, while its upper edge is provided with an integral up-turned flange 60' which is spot-welded or otherwise secured to the vertical leg of extension 58' of front wall 58. As is apparent from FIGURE 2, front and rear walls 58, 60 of chamber 16 are not precisely parallel to each other, but rather converge as they extend upwardly so as to define therebetween a space having roughly the shape of a truncated crescent and possessing an upwardly-decreasing cross-sectional area.

As noted previously, arcuate shield 66 of chamber means 16 is positioned behind rear wall 60 and extends in spaced parallel relation thereto, defining between itself and the rear wall a dead-air space 82 which may, if desired, be filled with insulating material (not shown). The lower edge of shield 66 is supported by channel member 70 of chamber 16 by a shoulder similar to that supporting the lower edge of rear wall 60, and the upper edge of shield 66 is secured to the vertical leg of extension 58' of front wall 58 by means of a flange 66' integral with such upper edge, also generally in keeping with the mounting of rear wall 60.

The opposite sides of chamber 16 are closed by and terminate at side walls 62, 64. Side walls 62, 64 each are of a shape corresponding generally to the truncated-crescent shape of chamber 16 (see FIGURE 6), and are substantially flat except for each being provided with peripheral flanges to facilitate their connection, as by spot-welding, to front and rear walls 58, 60 of the chamber. Rigidly secured to the outer surfaces of side walls 62, 64 are L-shaped bracket members 84, 86, respectively, each of which is provided with an elongate slot in its horizontally extending leg. The slots of members 84, 86 loosely receive the bolts extending upwardly from ears 54, 56 and of burner means 14 and employed to secure bracket members 50, 52 thereto, thus interconnecting combustion chamber means 16 and burner means 14 but still permitting longitudinal expansive and contractive movement therebetween. When thus interconnected, plenum portion 38 of burner means 14 extends substantially the entire length of the opening 72 provided within the bottom wall of chamber 16, and projects upwardly through said opening to such an extent that the individual burner ports 38' are disposed within the combustion chamber. As is shown in FIGURE 2, the width of opening 72 is sufficiently greater than the width of the plenum portion 38 projecting therethrough as to provide gaps or air passageways 72', 72'', respectively, between opposite sides of plenum portion 38 and the adjacent channel members 68, 70. For reasons subsequently made apparent the mounting of burner means 14 and combustion chamber 16 is such as to render the gap or air passageway 72'' of a larger width than that of passageway 72'.

Spaced across substantially the entire length of the curved portion of front wall 58 are a plurality of generally rectangular, perforate grid members 90. Each grid member 90 extends vertically along approximately the upper two-thirds of the curved portion of front wall 58 and may be formed, as shown in FIGURES 1-6, integrally with the latter by directly perforating the same. Also provided through the curved portion of front wall 58 are a plurality of expansion slots 100 (one being clearly shown in FIGURES 1, 4 and 6), there being one such slot between each pair of adjacent grid members 90 and at each end of the horizontally-extending series of grid members. Slots 100 are approximately equal in length and parallel to the height of grid members 90, and are each provided with sealing means 102 to prohibit flow of

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gases therethrough. As is best shown in FIGURE 2A, such sealing means may comprise a pair of cover strips 104 secured in spaced parallel relationship to each other against opposite faces of front wall 58 by double-headed rivets 106 extending through the slots 100. When thus constructed, sealing members 102 in no way impede the function of slots 100 in permitting independent expansion and contraction of grid members 90.

In the case of the approximately three-foot long heater shown in the drawings, a minimum of five or six grid members 90 of equal size should be provided. The precise number will vary, however, depending on the length of the heater and the conditions under which it is to operate, the desideratum in any given case being to provide a sufficient number of grid members that each can accommodate without structural failure its own proportionate share of the total expansive and contractive stresses—particularly those directed longitudinally of the heater—to which front wall 58 is subjected due to its periodic heating and cooling. By thus providing a plurality of relatively small, spaced grid members 90 separated by expansion slots 100, rather than a single continuous grid member equal in length to front wall 58, the structural front wall failures that would otherwise occur have been found to be prevented. This is believed to be due, as noted previously, to a distribution and accommodation of the front wall expansive and contractive stresses among and by the various grid members, which stresses would in the case of a single unitary and continuous grid all tend to concentrate and produce structural failure at its weakest area.

When heater 10 is in operation, the combustion of the gas-primary air mixture passing through ports 38' of burner means 14 produces a flame extending upwardly from and along substantially the entire length of plenum portion 38, and also causes ambient, secondary air to flow into the housing 12, the secondary air entering the housing through the holes 24 thereof and then passing into combustion chamber 16 through the gaps 72', 72'' between the chamber bottom wall and plenum portion 38 of burner means 14. In addition to facilitating more complete combustion of the gas-primary air mixture passing from ports 38', the secondary air flowing into chamber means 16 is also utilized to assist in concentrating the heat realized by such combustion upon the chamber's front wall 58, rather than upon its rear wall 60. This desirable heat-concentration is attributable in part merely to the greater volume of the air passing through the gap 72'' adjacent rear wall 60, due to its being, as noted previously, of a larger size than the gap 72' adjacent front wall 58. Another contributing factor is that the forwardly-extending curvature of rear wall 60 causes its front face to be continuously contacted or swept by the secondary air passing through gap 72'' and ascending in chamber means 16, while the curvature of front wall 58 is in a direction away from the ascending secondary air entering through gap 72'. Still another contributing factor in this regard is that the greater flow of air passing through gap 72'' causes the flame extending upwardly from plenum portion 38 to be deflected in a forward direction, i.e., toward front wall 58 and away from rear wall 60.

As is shown in FIGURE 2, the lower edges of grid members 90 are at an elevation directly adjacent the upper, more intense portion of the flame extending upwardly and somewhat forwardly from plenum portion 38. As the heated gases and products of combustion ascend from this flame, a portion thereof passes immediately from chamber 16 through the lower perforations in grid members 90. The greater, remaining portion of the heated gases passes more or less uniformly during its ascendancy through the intermediate and upper perforations of grid members 90, and those gases reaching the uppermost extremity of chamber 16 are actually forced downwardly through the uppermost perforations of grid mem-

bers 90 by the "stack effect" existing within chamber 16 and by the counterflow of that portion of the gap 72" secondary air reaching the uppermost part of the chamber after completing its travel along the inner face of rear wall 60. Build-up of heated gases within the upper part of chamber 16 is discouraged by the chamber's upwardly-decreasing cross-sectional area, which tends to maintain the velocity of the gases and thereby minimize heating of the upper portions of grid members 90 to a greater extent than their lower portions.

The gaseous combustion products exiting as described from chamber means 16 not only heat those particular areas of grid members 90 containing the perforations through which they pass, but also lessen loss of heat from the remaining areas of the grid members lying thereabove. Thus, due to the forwardly extending curvature of front wall 58, the heated gases passing through the lowermost perforations of grid members 90 remain in contact with the front faces of the grid members while ascending and until their final escape through the passageway 37 between reflector 35 and extension 58' of front wall 58. The effect of these gases is to shield grid members 90 from the cooler ambient air, and in so doing to lessen heat losses from the former to the latter and thereby increase the overall efficiency of heater 10.

Once heated to a sufficient temperature, front wall 58 begins to emit radiant heat and continue to emit for so long as heater 10 remains in operation. The major portion of such radiant heat energy originates from grid members 90, these being at a higher temperature due to their more intimate contact with the heated combustion products. However, since rear wall 60 of chamber 16 and the solid portions of front wall 58 adjacent grids 90 are also heated to some extent, radiant energy is also emitted from these sources. Due to the curvature of rear wall 60 and the presence of reflecting shield member 66 therebehind, radiant energy emitted therefrom is directed toward front wall 58. That portion of this radiant energy striking the solid parts of front wall 58 and its grid members 90 further increases the temperature of these solid parts, while the remaining portion of the radiant energy emitted from rear wall 60 passes through the perforations of grid members 90 and the open front face of housing 12. There is therefore realized not only good utilization of the radiant energy emitted from rear wall 60, but also radiation emission from 100 percent of the projected surface area of the arcuate portion of front wall 58, notwithstanding the fact that an appreciable part of this area is open due to the perforations of grid members 90.

The radiant energy passing from and through front wall 58 and leaving heater 10 is directed downwardly toward the floor of the enclosure within which the heater is mounted at a median angle of approximately 30 degrees. This directing of the radiant energy to the desired location is achieved to some extent by panels 30, 32 and reflector 35, but primarily by the arcuate shapes of front and rear walls 58, 60 of combustion chamber 16.

In addition to the foregoing benefit, the arcuate shape of the grid members 90 forming a part of front wall 58 further serves to alleviate the effect of the vertically-directed stresses to which these members, in particular, are subjected upon heating and cooling. Thus, by virtue of their already possessing an arcuate curvature, the vertically-directed expansive and contractive stresses to which the grid members are subjected tend to cause merely an increase or decrease in the amount of such curvature, rather than structural failure. Vertically directed stresses in the remainder of front wall 58 are similarly alleviated to some extent, and are also alleviated by reason of the lower edge of the front wall being capable of limited expansive and contractive movement relative to the supporting U-shaped extension 68' of channel member 68. As noted previously, structural failure due to relative longitudinal expansion and contraction between burner means 14 and housing 12 is prevented by the resiliency of interconnect-

ing bracket 52, and structural failure of front wall 58 due to longitudinally-directed expansive and contractive stresses is prevented by the provision of a sufficient number of grid members 90 and expansion slots 100.

In the latter connection, it is not essential that grid members 90 be integrally formed with front wall 58 by direct perforation thereof, as illustrated in FIGURES 1-6. Rather, the grid members may be separate panels suitably carried by the front wall. FIGURES 7-11 and 12-14 illustrate two alternative embodiments of this latter construction.

The front wall 58a of FIGURE 7 corresponds in all essential particulars to wall 58 of FIGURES 1-6, except for the provision of an opening 110a extending across substantially the entire length and the upper two-thirds of the height of its curved portion. The opposite side edges of opening 110a are each provided with U-shaped flanges 112a, one of which is shown in FIGURE 11. A plurality of mounting members 114a, each having a pair of oppositely-facing U-shaped flanges 116a, are secured in spaced parallel relation between the upper and lower edges of opening 110a, as by rivets extending through ears 118a provided at opposite ends thereof. Grid members 90a are comprised of five separate, suitably perforated panels. As is shown in FIGURE 11, one side edge of each end grid 90a is loosely received within the adjacent side-edge flange 112a of opening 110a, and the opposite side edge of the grid loosely received within one of the flanges 116a of the adjacent mounting member 114a. Both side edges of the three intermediate grids 90a are loosely received within flanges 116a of mounting members 114a. Above the upper edge of opening 110a, a bracket 120a (see FIGURE 9) is mounted in spaced relation to the inner face of that portion of front wall 58a bordering the opening so as to define therewith a slot which loosely receives the upper edges of grids 90a. The lower edges of the grids are similarly received within a slot defined by a bracket 122a and by the inner face of that portion of wall 58a adjacent the lower edge of opening 110a (see FIGURE 10), the bracket 122a being secured to said face. It will be appreciated that the described mounting of grids 90a permits them to accommodate expansive and contractive stresses directed longitudinally of front wall 58a by movement of their side edges within flanges 116a and, in the case of the endmost grids, 112a. The result achieved in this regard is comparable to that realized in the FIGURES 1-6 embodiment through the use of expansion slots 100 on opposite sides of the grid members 90. With respect to vertically-directed expansive and contractive stresses, the grids 90a of the FIGURES 7-11 embodiment are capable of accommodating the same even more readily than the grids 90 of FIGURES 1-6. This is because the accommodation of such stresses by grids 90a may be not only by a variation in their arcuate shape, but also by movement of their upper and lower edges within the slots defined by brackets 120a, 122a and the inner face of the front wall.

The construction shown in the FIGURES 12-14 embodiment is basically the same as that of the FIGURES 7-11 embodiment, including an opening 110b, flanges 112b, and brackets 120b, 122b. In the FIGURES 12-14 embodiment, however, mounting members such as those identified by the numeral 114a in FIGURES 7-11 are not provided. Rather, four of the five grids 90b of FIGURES 12-14 are each provided along one side edge with an integral U-shaped flange 116b which, as shown in FIGURE 14, loosely receives the side edge of an adjacent grid. The fifth panel 90b, which is the rightmost one shown in FIGURES 12 and 14, need not be provided with a flange 116b and may be identical to the grids 90a of FIGURES 7-11.

Any suitable fixtures or hangers (not shown) may be employed for mounting heater 10 upon the wall of an enclosure. Due to the presence of shield member 66

and dead-air space 82, among other factors, rear wall 22 of housing 12 is maintained at a sufficiently low temperature to permit its mounting in close proximity to the wall of the enclosure, if desired, without damage to the latter.

It will thus be seen that there has been provided a highly efficient and long-lasting radiant gas heater eminently suitable for wall-mounting within and the heating of large enclosures and which possesses the advantages and realizes the objects hereinbefore set forth. While specific embodiments of the invention have been shown and described, it will be understood that this was by way of illustration only, and not by way of limitation, and that there might be made various changes and modifications without departing from the scope of the invention as set forth in the following claims.

That which is claimed is:

1. An elongate radiant gas heater adapted for substantially unidirectional heating, comprising:

- (a) elongate, generally horizontally-extending gas burner means adapted to produce heated gases;
- (b) a plurality of perforate, arcuate grid members mounted for independent expansive and contractive movement in spaced side-by-side relation to each other adjacent one side and along the length of said burner means, said grid members being formed of material capable of a high radiation emissivity and curving upwardly and forwardly away from said burner means;
- (c) means for directing the heated gases produced by said burner means along and through said perforate grid members for heating said grid members; and
- (d) said grid members being adapted after heating to emit radiant heat energy in a predominantly forward and downward direction.

2. An elongate radiant gas heater adapted for substantially unidirectional heating, comprising:

- (a) elongate, generally horizontally extending gas burner means adapted to produce heated gases;
- (b) combustion chamber means extending above and longitudinally of said burner means for reception of the heated gases produced thereby, said chamber means having an upwardly-decreasing cross-sectional area and including an arcuate front wall formed of material capable of a high radiation emissivity and curving upwardly and forwardly away from said burner means; and
- (c) said front wall of said chamber means including a plurality of longitudinally-spaced perforate grid members mounted for independent expansive and contractive movement, said grid members being adapted to pass and be heated by said gases and to thereafter emit radiant heat energy in a predominantly forward and downward direction.

3. A heater as in claim 2, wherein said chamber means further includes an opening through which ambient air is admitted therein for concentrating the heat of said gases upon said front wall thereof.

4. A heater as in claim 2, wherein said chamber means further includes a rear wall formed of material capable of a high radiation emissivity and extending generally parallel to said front wall, whereby radiant heat energy emitted by said rear wall is transmitted through said perforate grid members of said front wall in substantially the same direction as the radiant heat energy emitted by said grid members.

5. An elongate radiant gas heater adapted for substantially unidirectional heating, comprising:

- (a) elongate, generally horizontally-extending gas burner means adapted to produce heated gases;
- (b) combustion chamber means extending above and longitudinally of said burner means for reception of the heated gases produced thereby, said chamber

means including arcuate front and rear walls curving upwardly and forwardly in spaced converging relation to each other and formed of material capable of a high radiation emissivity, and said front wall including a plurality of longitudinally-spaced perforate grid members mounted for independent expansive and contractive movement and adapted to pass and be heated by said gases;

(c) said grid members being adapted after heating to emit and transmit radiant heat energy in a predominantly forward and downward direction.

6. A heater as in claim 5, wherein said chamber means further includes an opening through which ambient air is admitted therein for concentrating the heat of said gases upon said front wall thereof.

7. A heater as in claim 6, wherein said grid members are integrally formed with said front wall, and wherein said front wall includes a plurality of expansion slots extending therethrough intermediate said grid members.

8. An elongate radiant gas heater adapted for substantially unidirectional heating, comprising:

(a) an elongate housing adapted to be mounted in a generally horizontally-extending position upon the wall of an enclosure or the like and having a forwardly-facing opening through which radiant heat energy is adapted to be emitted in a predominantly forward and downward direction;

(b) gas burner means extending longitudinally within said housing and adapted to produce heated gases;

(c) combustion chamber means extending longitudinally within said housing above said gas burner means for reception of the ascending heated gases produced thereby, said chamber means including arcuate front and rear walls curving upwardly and forwardly within said housing in spaced converging relation to each other and formed of material capable of a high radiation emissivity, said front wall being disposed adjacent said opening of said housing and including a plurality of longitudinally-spaced perforate grid members mounted for independent expansive and contractive movement and adapted to pass and be uniformly heated by said gases; and

(d) said grid members being adapted to emit and transmit radiant heat energy through said opening of said housing in a predominantly forward and downward direction.

9. A heater as in claim 8, wherein said combustion chamber means further includes an opening through which ambient air is admitted therein for concentrating the heat of said gases upon said front wall thereof.

10. A heater as in claim 8, and further including resilient bracket means mounting said burner means within said housing and permitting relative expansive and contractive movement therebetween.

11. A heater as in claim 8, and further including an arcuate reflector detachably connected to and extending forwardly of said housing above said opening thereof for downwardly reflecting stray radiant heat energy passing through said opening and impinging thereagainst.

12. A heater as in claim 8, wherein said combustion chamber means further includes reflective shield means mounted rearwardly of and in spaced, substantially parallel relationship to said rear wall, and defining with said rear wall a dead-air space.

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