April 29, 1952 W. G. CARTTER 2,594,608

FUEL-BURNING PANEL HEATER

Filed Aug. 7, 1948 3 Sheets-Sheet 1

Fig. 1.

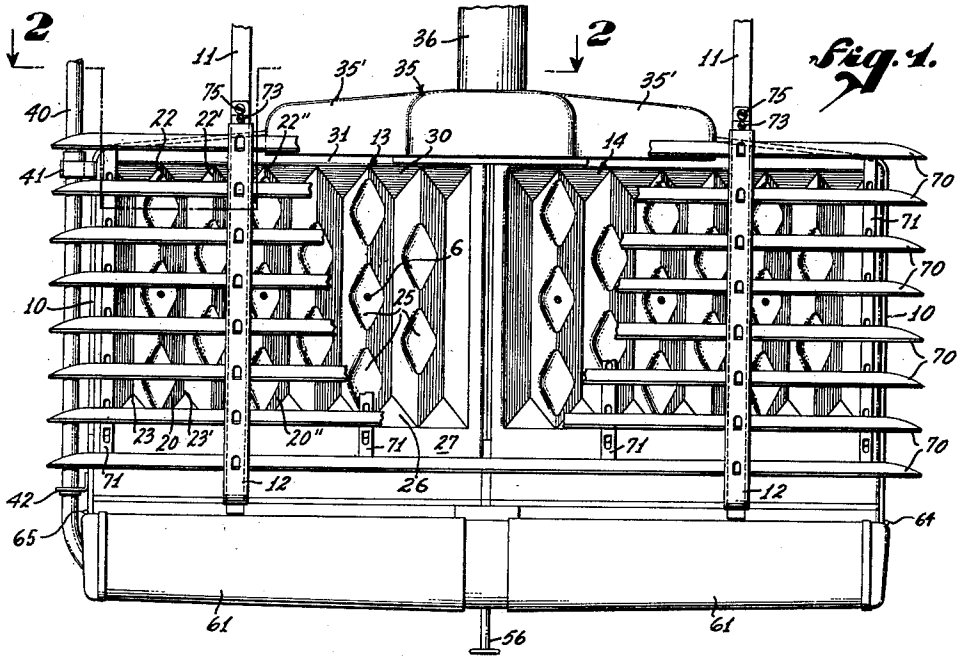


Fig. 2.

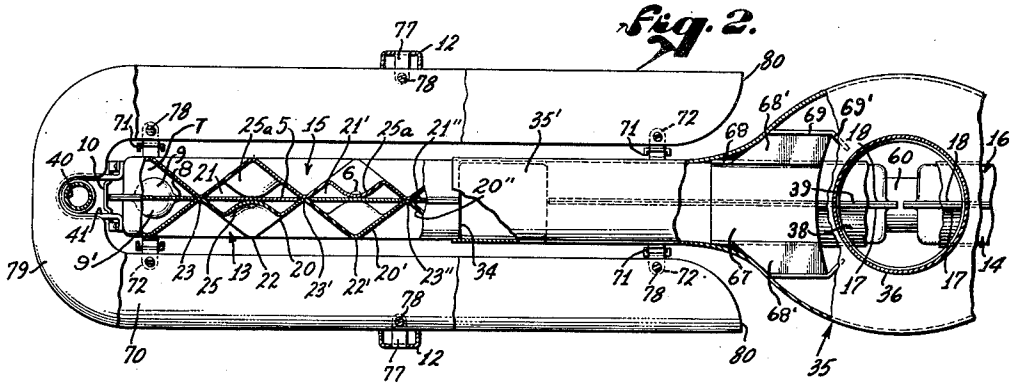
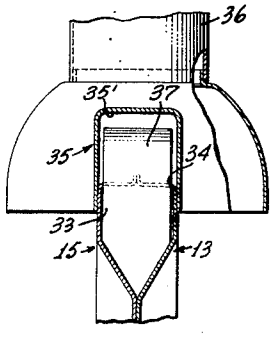


Fig. 3.



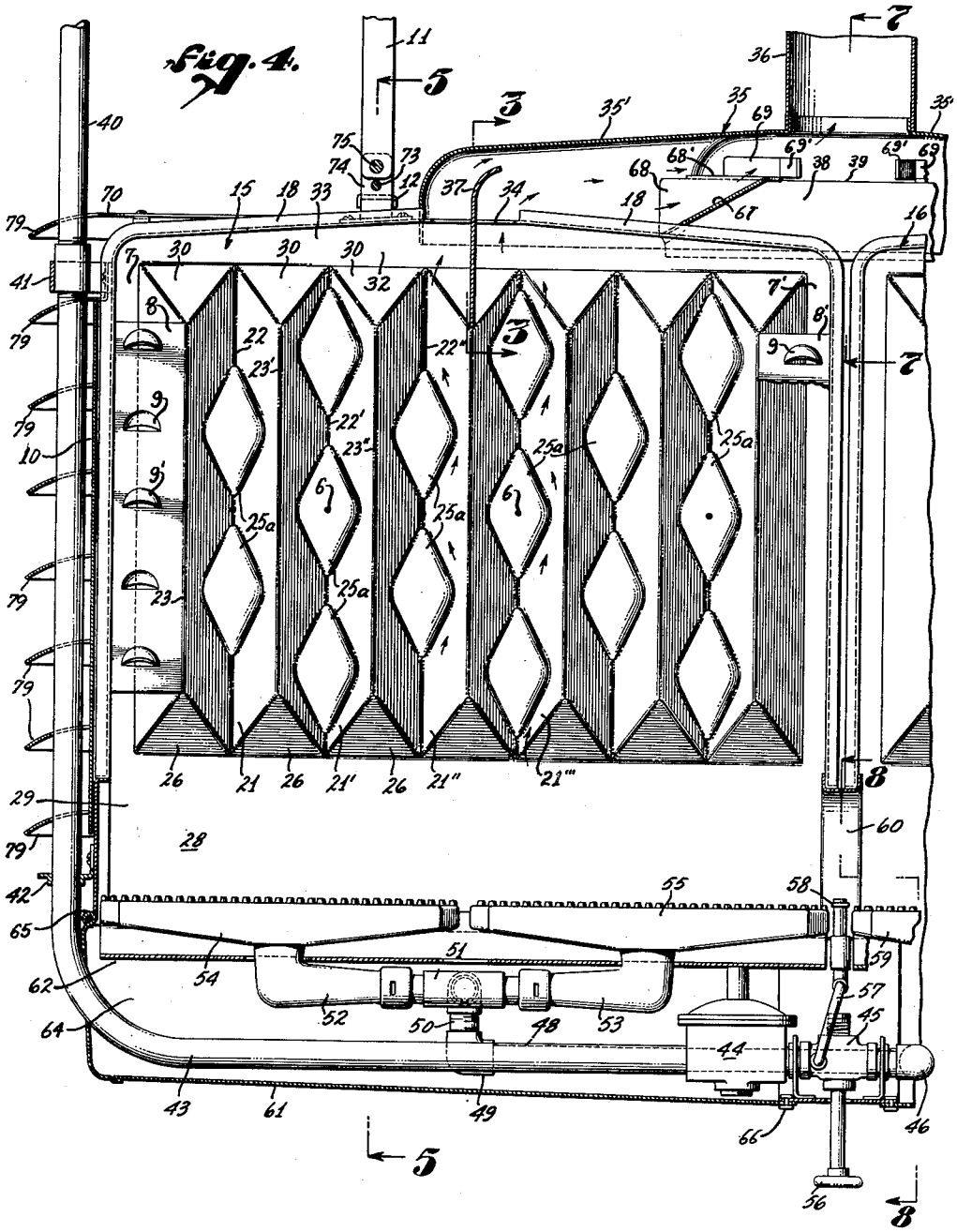
INVENTOR:
WILLIAM G. CARTTER
BY Hulbert, Cualtby & Beecher
ATTORNEYS.

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FUEL-BURNING PANEL HEATER

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Fig. 4.



INVENTOR:
WILLIAM G. CARTTER

BY Huebner, Walkby and Beehler

ATTORNEYS.

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FUEL-BURNING PANEL HEATER

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Fig. 5.

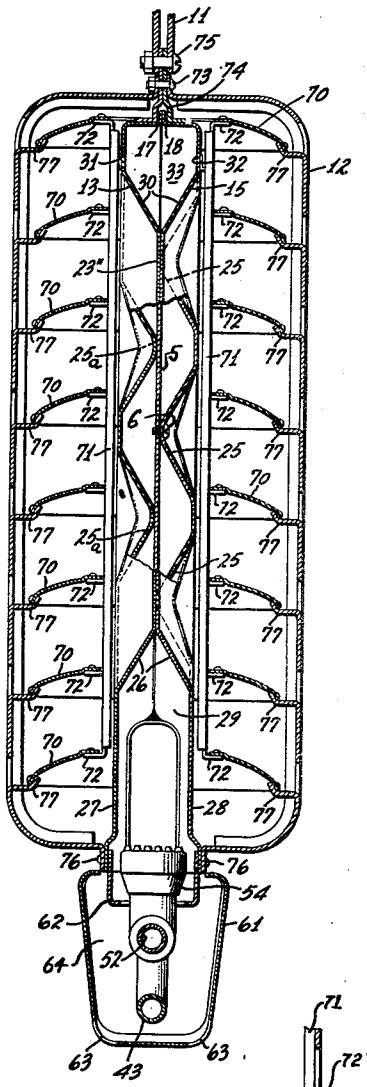


Fig. 7.

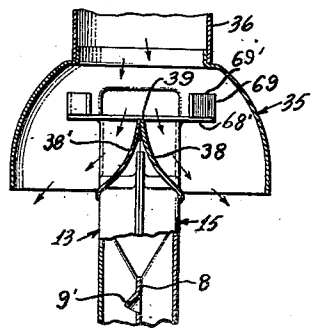


Fig. 6.

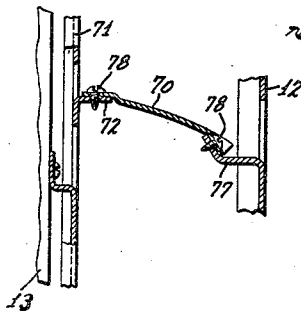


Fig. 8.

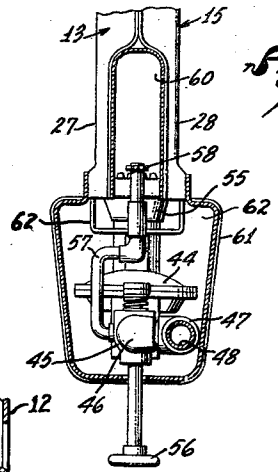
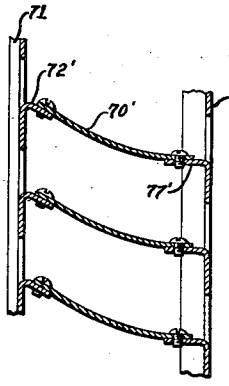


Fig. 9.



INVENTOR:
WILLIAM G. CARTTER
BY Hueboner Wratby and Beecher
ATTORNEYS.

Patented Apr. 29, 1952

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UNITED STATES PATENT OFFICE

2,594,608

FUEL-BURNING PANEL HEATER

William G. Cartter, Monrovia, Calif., assignor, by mesne assignments, to Affiliated Gas Equipment, Inc., Cleveland, Ohio, a corporation of Delaware

Application August 7, 1948, Serial No. 43,038

14 Claims. (Cl. 126—91)

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The application refers to space heaters of a type which rely chiefly upon the effect of radiated heat to provide the necessary heating effect. The particular heater here involved is one commonly designated as an overhead heater and because of its construction is more generally adapted to use for heating large spaces like factories, waiting rooms and other large quarters where floor space is at a premium, where a large volume of heat is required and where there is ample space overhead in which to locate the necessary heating equipment.

Considerable attention has devoted during recent years to the provision of space heaters commonly designated as unit heaters, the units of which are adapted to be spotted in advantageous locations overhead within the space which is to be heated. In making use of space heaters for heating quarters of very large volume, a variety of means has been resorted to for the distribution of heat. The usual type of heater employed for such purposes has not depended so much upon radiation as upon convection and has more frequently resorted to forced air circulation by use of fans. Although forced air heating units are capable of disseminating a substantial amount of heat into spaces of large volume because of the fact that there is a strong draft induced necessary to circulate the air, they are more often than not a source of considerable discomfort to persons within the space. Persons located too near the source of heating find that the air in that quarter is overheated. Persons remote from the source of heat, though not suffering an overheated effect, nevertheless are troubled by the rather strong circulation of air about them even though the air is warmed to a comfortable temperature.

Those space heaters depending in part at least upon radiant heat have been constructed in such a way that there is a very limited dissipation of radiant heat and because of the compact construction of overhead heaters previously utilized, the effect of radiant heat is carried to only a limited area around the heating unit. Often when a sufficient number of those units were provided to heat all of a floor area by the use of radiant heat, the cost of equipment and the space required for the installation may not be warranted by the results experienced.

It is therefore among the objects of the invention to provide a new and improved overhead heater which is so constructed that it provides substantially a maximum amount of heating surface at the source of heat thereby raising the efficiency of the unit to a very high degree.

Another object of the invention is to provide an overhead radiant type heater having radiating surfaces which extend substantially throughout the entire area of the source of heat, thereby

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utilizing virtually all of the space within the heater as a source of radiating heat energy.

Still another object of the invention is to provide a new and improved overhead radiant type unit heater which is so constructed that it is capable of directing virtually all of the radiant heat generated in the heater most advantageously over an area to be heated and wherein substantially a maximum share of heat generated by the heater is directed by radiation rather than convection into the space to be heated.

A further object of the invention is to provide in a radiant type heater a new and improved heating element or heating source which has the form of plates back to back, the entire areas of which provide means from which radiant heat may be emanated in an extremely efficient manner.

Still further among the objects of the invention is to provide a new and improved unit type overhead radiant heater which is relatively low in manufacturing cost in proportion to the square foot area of heating surfaces, which makes multiple use of certain elements of the device thereby greatly minimizing the quantity of materials used in the heater and the cost of assembling the same without imparing the ovarall heating efficiency.

Included also among the objects of the invention is the provision of a unit type radiant heater so constructed that the quantity of heat may be controlled with relative ease, which can be built inexpensively in multiple units so as to be accommodated to spaces varying greatly in size, and which because of its new and improved construction is capable of spreading a very wide pattern of radiant heat uniformly in every direction from the heating source.

With these and other objects in view, the invention consists in the construction, arrangement and conbination of the various parts of the device whereby the objects contemplated are attained, as hereinafter set forth, pointed out in the appended claims and illustrated in the accompanying drawings.

In the drawings:

Figure 1 is a side elevational view partly broken away showing one unit of the radiant heater.

Figure 2 is a plan view partially in section showing one of the complementary sides of the radiant heater taken on the line 2—2 of Figure 1 and drawn to a larger scale.

Figure 3 is a fragmentary vertical sectional view taken on the line 3—3 of Figure 4.

Figure 4 is a vertical sectional view of one of the complementary sides of the heater.

Figure 5 is a vertical sectional view of one side of the heater taken at right angles to the view shown in Figure 4 and on the line 5—5 of Figure 4.

Figure 6 is a fragmentary vertical sectional view showing the vane construction and mounting.

Figure 7 is a fragmentary vertical sectional view taken on the line 7—7 of Figure 4.

Figure 8 is a vertical sectional view taken on the line 8—8 of Figure 4.

Figure 9 is a vertical fragmentary sectional view of another type of vane structure.

In the embodiment chosen to illustrate the invention there has been selected an overhead unit type heater constructed in a manner which permits it to be readily suspended at virtually any height from a ceiling so that it can be adjusted to proper relationship with the floor of the space which is to be heated. It will also become apparent as the description proceeds that almost any number of units of the type illustrated can be located, end to end or otherwise, thereby to service a very substantial area where the space to be heated is large. In order, however, to simplify the description, a single unit is here illustrated in detail.

In the unit selected there is no framework as such but instead the various elements cooperating together stiffen the assembly sufficiently to dispense with a separate frame. There are straps, however, attached to the unit which serve to support the unit upon beams of the ceiling or other portions of the building structure. Because excessive weight has been avoided in the unit, straps 11 need not be of especially heavy construction. Additional support may be provided by vertical strips 12 which extend along opposite sides of the unit.

An important part of the unit is embodied in the plate panels which provide a source of radiant heat. In the selected embodiment four panels 13, 14, 15 and 16 are utilized, all of the panels being visible in Figure 2. These panels are of special construction and are matched so that, for example, panels 13 and 15 are adapted to fit together back to back and are provided with stiffening flanges 17 and 18 extending around the sides and the top, thereby closing the edges of the panels 13 and 15 on all sides except the bottom. The panels 14 and 16 are similarly constructed. Because of the fact that each side of the unit here illustrated is substantially identical, a detailed description will be given for only one side.

Each of the panels 13 and 15 as illustrated in considerable detail in Figures 2, 4 and 5 has its central portion stamped out in a very particular pattern. The stamping process provides in the panel 13 a series of walls 20, 20', 20'' forming portions of heater channels or tubes 21, 21', 21''. As here illustrated the walls 20 form a series of outwardly extending triangular channels having outer ridges 22, 22', 22'' and having inner ridges 23, 23', 23''. Along the ridges 22, 22', 22'' of the heater channels 21, 21', 21'' respectively, except the channels at the outermost edges, there are provided depressions or recesses 25 which extend inwardly a distance approximately meeting a baffle plate 5 retained by a single screw 6 at the center of each channel. The recesses are alternated in adjacent heater channels of the plate panel 13, for example, so that they present a staggered pattern, thereby appearing uniformly over the entire central portion of the plate panel.

As most readily seen in Figure 2 the angles formed between the outside surface of vertical walls of adjoining heater channels are not less than 90°. For example, the angle at the ridge 23' formed by adjoining wall 20 of the channel 21 and adjoining wall 20' of the channel 21' will

be found to be something greater than 90°. By giving the panel this shape, heat radiated from the surface of the walls will at no time be reflected from any of the other walls before passing out into space. In other words, secondary reflection of radiant heat is avoided.

In the vertical channels 7 and 7' adjacent the outer limits of the heater, baffles 8 and 8' are employed to obtain a tortuous path in place of depressions heretofore described in connection with the other vertical channels. The baffle plates 8 and 8' are disposed vertically between the plate panels 13 and 15 and are formed with outwardly turned ears 9 and 9', said ears being turned outwardly in opposite directions in staggered relation.

The plate panel 15 is constructed similar to plate panel 13 as will be apparent from an examination of Figures 2 and 5 with the exception that the recesses 25a are staggered with relation to the recesses 25 of the walls 20, 20', 20'' of the plate panel 13. The staggered relationship is more readily apparent in Figure 5. By thus arranging the recesses in each of the heater channels there is provided a tortuous passage for the products of combustion as they pass upwardly within the space between the oppositely positioned plate panels 13 and 15. It will further be apparent that the entire space between the plate panels 13 and 15 is occupied by the series of parallel adjacent and vertically positioned heater channels 21 formed between corresponding wall portions 20, 20', 20'' of the oppositely disposed plate panels. Along the edges 23 the respective heater channels are closed and at the outer edges the outermost heater channels are closed by a junction of the flanges 17 and 18.

Near the bottom of the respective walls 20, 20', 20'' forming the heater channels are outwardly extending triangular segments 26 by which construction the lower portions of the plate panels identified by the reference characters 27 and 28 form an enlarged common combustion chamber 29. The combustion chamber 29 communicates uniformly with all of the heater channels 21, 21', 21''. Similarly triangular segments 30 at the tops of the walls 20, 20', 20'' extend outwardly to portions 31 and 32 of the respective plate panels, thereby forming a common flue chamber 33 which is in communication with the tops of all of the heater channels 21, 21', 21''. The flue chamber 33 communicates through an opening 34 with a vent manifold 35 from the central hood through which the flue gases are conducted to an outlet vent 36. Extensions 35' of the vent manifold are located on opposite sides, the extension 35' on the right being a duplicate of the extension 35' on the left. To improve the venting operation a baffle 37 may be provided extending from a location intermediate channels 21'' and 21''', as best seen in Figures 3 and 4, upwardly through the opening 34. Flow is improved by curving the top of the baffle toward the vent 36.

To eliminate backdraft or downdraft through the panels the central hood of the vent manifold 35 is made substantially wider than the width of the combined plate panels. The proportion of the width of the vent manifold or hood to the width of the plate panels is best illustrated in Figures 3 and 7.

To insure the effectiveness of both the venting process and the elimination of downdrafts, a structure of special design may be included be-

neath the vent manifold 35 and immediately adjacent the entrance to the vent 36.

Beneath the vent there is provided an inverted V-shaped structure having opposite sides 38 and 38' which join along a line 39 at the top. The shape of the structure can best be seen in Figure 7 whereas the length of the structure is more readily discernible in Figure 4. At each end of the structure there are provided draft deflectors for directing flue gases entering the manifold 35 in a path toward the vent 36. One of these draft deflectors, namely, the deflector for the left panel is illustrated in Figures 2 and 4. The draft deflector consists of a flat sloping plate 67 provided with wings 68, the upper edges of which are turned outwardly to form flat horizontal portions 68'. At the outer edges of the sections 68' are walls 69 having end edges 69' directed inwardly, as shown in Figure 2.

By this arrangement, if there should be a sudden downdraft or backdraft through the vent 36, it will be deflected into the atmosphere at a point adjacent the junction of one set of plate panels with the other which is a location removed from the opening 34 by a distance roughly equal to one-half of the overall width of the plate panels. Consequently there is no tendency for a backdraft or downdraft to travel through the vent manifold 35 and opening 34 into the heater channels and from there pass downwardly to the combustion chamber to a position where it would be apt to snuff out the pilot light.

One of the purposes of the structure just described is to divorce conditions in the vent pipe from operation of the burners and the heating portion of the appliance. This is for the purpose of maintaining normal combustion and flue gas escape, release of vent conditions such as a strong updraft, a blocked vent pipe or a strong backdraft. The path defined by the structure just described for flue gases will be found one tending to confine the flow of flue gases to the center portion of the vent manifold and to direct those gases directly to the bottom entrance of the vent 36. By making the vent manifold relatively wide around that portion of the manifold immediately adjacent the vent pipe, draft conditions may be maintained in a manner not materially affecting burner conditions.

The gas burning features and appropriate mechanism are located largely beneath the plate panels. The gas burning mechanism is fed through the supply pipe 40 located at the left of the unit as viewed in Figure 1. The supply pipe is retained against the frame by brackets 41 and 42 and is curved so that a lower portion 43 of the supply pipe lies in a horizontal position at the bottom of the unit. A plate 10 prevents some of the heat from the baffles reaching and overheating the supply pipe 40. The supply pipe leads to a gas pressure regulator 44 and gas from the pressure regulator passes to a shut-off valve 45 and from there through an elbow 46 to a T 47 shown in Figure 8. From the T a pipe 48 conducts the gas to burners in the portion of the unit on the left side as viewed in Figure 1 which is the portion made the subject matter of this description. The pipe 48 is led into an L 49 and a nipple 50 conducts gas through a T 51 from which Venturi tubes 52 and 53 supply left and right hand burners 54 and 55, respectively. As clearly shown in Figures 4 and 5 the burners are relatively narrow and also long so that two of them extend throughout the entire breadth of the plate panels. A somewhat V-shaped guard 62

beneath the burners serves as a flash-out baffle when the burners are being lit.

For operating the gas burning equipment there is provided a handle 56 for turning the shut-off valve 45 off and on. A pilot line 57 is fed from the inlet side of the shut-off valve and supplies a pilot burner 58 which is located adjacent the burner 55 and also adjacent a burner 59 which is one of those used on the right-hand side of the unit as viewed in Figures 1 and 4. With the pilot burner located in the center of the heater and the main burners extending a relatively great distance upwardly on each side in the embodiment herein described, there is a momentary delay in full burner ignition due to the time required for flame propagation. The time delay means that a quantity of unburned gas escapes into the spaces around the burners before ignition. When ignited the gas expands rapidly and would flash out dangerously except for the interposition of the flash-out baffle 62.

As previously indicated, the lower portions of the plates 13 and 15 form the combustion chamber 29 and it should be noted that a vestibule 60 forms a junction between the combustion chambers on the opposite sides of the unit, the pilot burner being located within the vestibule. A separate casing 61 is formed about the gas burning mechanism and houses a pre-combustion chamber 64 beneath but communicating with the combustion chamber 29. Air is admitted into the pre-combustion chamber through openings 63. The casing is made removable by providing a hinge 65 at the left end of the left panel as viewed in Figure 4 and a snap fastener 66' at the right-hand end of that panel. The right panel is similarly equipped.

By reason of the pattern of the faces of the plates 13, 14, 15 and 16, a very effective overall source of heat radiation is provided. Because of the angular relationship of the walls forming the heater channels and the presence of the recesses with faces pitched so that they face in various directions, there is an especially well-defined spread of radiated heat in all directions from the unit and also to some extent in a downward direction.

To be effective, however, the radiated heat or at least the larger portion of it must be directed toward the floor area of the space to be heated inasmuch as this is the portion of the room occupied by workers or other persons using the space which benefits most by the radiant heat. To accomplish this there is provided a series of baffles, vanes or louvers disposed in the path of radiated heat emanating from the unit. The vanes selected for this purpose are preferably as thin as can be made commensurate with suitable strength so that they will interfere as little as possible with the distribution of the radiated heat. The purpose of the vanes, which dictates the character of the structure selected, is to reflect or deflect the heat radiating from the unit downwardly over the desired area of floor space. In this connection it should be noted that it is desirable to deflect a substantial quantity of heat at an angle between 30° and 40° from horizontal which is an area ordinarily difficult to reach in use of overhead heaters. In this manner substantially all of the radiant heat will be utilized to best advantage.

In one of the embodiments selected for the purpose of illustration, deflectors or vanes 70 are arranged in parallel relationship and disposed horizontally. Eight vanes are shown on each side

of the device but the precise number is not material so long as there are a sufficient number of vanes having breadth great enough to catch radiant heat which may start in an upward direction from the respective plate and preventing little, if any, radiant heat having an upward path from passing undisturbed toward the ceiling of the space. It will be appreciated that the number of vanes will bear a relation to the breadth in order to trap all of the radiant heat and deflect and spread it to the extent desired. At the same time it will become clear that for practical reasons as well the breadth of the vanes cannot be excessively great while at the same time providing a compact and efficient heater unit.

In one modification shown, the vanes are curved slightly and directed outwardly and downwardly. This is for the purpose of spreading virtually all of the radiant heat toward the floor well outwardly from the unit. The amount of tilt or downward pitch of the vanes may also be varied, depending upon the height of the unit above the floor and the floor area which is needed to be heated. The latter element may vary to some extent depending upon outside temperatures or, on the other hand, depending upon the desired inside temperature. The vanes may, for more efficient operation, be of etched aluminum on the lower sides and painted black on the upper sides.

For securing the vanes in place there are provided inside strips 71 having lugs 72 extending outwardly therefrom for engagement with the vanes 70. The lugs 72 are uniformly spaced apart distances determined by the desired spacing of the vanes 70.

The vertical strips 12 previously referred to are anchored at their top ends by means of bolts 73 to brackets 74 and the brackets in turn are secured by bolts 75 to the straps 11. The brackets, incidentally, are attached to the tops of the plate panels. At the bottom ends the strips 12 are attached by screws 76 to the lower edges of the plate panels at which point the casing 61 is also attached. By this arrangement the strips 12 may be said to form part of the frame.

Bent inwardly from the strips 12 is a series of lugs 77 which are spaced the same distance apart as the lugs 72. In the present embodiment, however, the lugs 77 are off-set downwardly to a slight extent from the position of lugs 72. As shown, the vanes 70 are supported by the lugs 72 along one edge and the lugs 77 along the opposite edge to which they may be secured by suitable screws 78, details of which are best illustrated in Figure 6.

A better idea of the character of the vanes or louvers can be gained from an inspection of Figure 2. As is shown it will be apparent that the vanes 70 include a portion 79 which extends around the end edges of the units. The topmost vane in each instance may be cut off at an end 80 so as not to interfere with the outward spread of the vent manifold 35. The remaining vanes, however, may extend clear across the face of each side of the unit heater.

The selection and shape of the heat deflecting vanes depends to a large extent upon how it is desired to disperse radiant heat over the floor area. Improved dispersion over a larger area may be accomplished by vanes of the character illustrated in Figure 9. As there shown vanes 70' are curved outwardly with the convex side downwardly. These vanes may be attached to strips 12 and 71 by the same means as previously described. In this case, however, lugs 72' may be

tilted downwardly to a slight extent and lugs 77' extended horizontally inwardly for the better accommodation of the vanes. Vanes of the type of vanes 70' may be more numerous and located closer together if desired.

In use the unit heater is adapted as previously mentioned to be suspended near the ceiling level of a space to be heated. One or more of the units may be used as occasion may require. The size of the unit will be selected in conformance with the volume of the space to be heated and the floor area as well as the particular shape of the floor area. Also taken into consideration is the ceiling height and the distance of the heater unit above the floor. These circumstances will dictate to some extent the number of heaters used and also the size of the units utilized as well as the pitch of the deflector vanes.

In operation gas is piped to the valve 45 and pilot burner 58 which is lit and remains lit. Whenever the burners are to be lighted it is necessary only to turn the valve handle 56 to "open" position for the shut-off valve 55. In this position gas will flow to the burners 54, 55, 59, etc. As soon as gas reaches the ends of the burners 55 and 59, respectively, adjacent the pilot burner 58, the gas will be ignited and the flame will trail across all of the burners until all jets in the burners are ignited. The flame at the burners may be turned up or down at will. As the burners continue to burn they draw fresh air through the apertures 63 and the hot products of combustion pass upwardly through the several heater channels 25 within which a tortuous path is followed. During passage the greater part of the heat of the products of combustion is absorbed by the walls of the plate panels so that the products of combustion greatly reduced in temperature pass around the baffles 37 and thence through the vent passage 34, the vent manifold 35 and upwardly through the vent 36. The plates at this point become extremely hot throughout practically their entire surfaces and become a source of radiant heat of considerable area. Because of the large area of the plate panels there is a markedly less tendency for overheating at any particular place and at the same time there is emanated from the plates a very large volume of radiant heat. Radiant heat is in turn reflected outwardly and downwardly by the vanes 70 or the vanes 70'. Some convection may also assist in the distribution of the heat as air rises in the vicinity of the heater units and after being heated continues to rise toward the ceiling. The great percentage of heat, however, is dissipated as radiant heat. The detrimental effect of downdrafts or backdrafts is minimized or, in fact, eliminated as previously noted. When the space has been sufficiently heated it is necessary only to turn off the shut-off valve 45 at which point all of the burners are turned off and only the pilot continues to burn.

By providing combustion chambers interconnected by the vestibule 60 a reasonably uniform temperature is maintained in the combustion chambers adjacent the burners. The interconnection of the vent passages is likewise helpful in maintaining a uniformity of heat delivery throughout the entire area of the unit. In functioning as described, the heater unit provides highly desirable radiant heat sufficient to heat a given area entirely in the absence of undesirable and objectionable drafts.

While I have herein shown and described my invention in what I have conceived to be the

most practical and preferred embodiment, it is recognized that departures may be made therefrom within the scope of my invention, which is not to be limited to the details disclosed herein but is to be accorded the full scope of the claims so as to embrace any and all equivalent devices.

Having described my invention, what I claim as new and desire to secure by Letters Patent is.

1. A radiant-type gas burning heater adapted for installation in the upper limits of a room comprising in combination fuel combustion means; means for collecting the products of combustion produced by said fuel combustion means disposed superadjacent said combustion means and having an opening in the top thereof; a hollow heat exchange unit having a lower open end communicating with said fuel combustion means and an upper flue outlet communicating with said collecting means, and comprising means defining a plurality of vertically disposed tortuous gas passages adapted to duct said products of combustion upwardly and to radiate heat produced thereby; and means for reflecting heat radiated by said heat exchange unit downwardly towards the floor of said room, said means comprising a plurality of vertically spaced longitudinally horizontal reflector vanes circumscribing in spaced relation said heat exchange unit, the lower surfaces of said vanes being finished so as to be predominantly reflective, the upper surfaces of said vanes being darkened so as to be predominantly absorptive.

2. A radiant-type heater having fuel combustion means and a hollow heat exchange unit having an open lower end and an upper flue outlet, said unit being disposed superadjacent and communicating with said combustion means, thereby being adapted to duct products of combustion upwardly and to radiate heat generated by said fuel combustion means into the space surrounding said heater, said heat exchange unit comprising a pair of sheet metal panels disposed vertically in back-to-back relation having opposite edges joined together, each of said panels being formed with a plurality of inwardly directed grooves defining parallel vertically disposed gas passages and having a ridge between each of said respective grooves, each of said ridges being formed with a plurality of inwardly depressed sections in staggered relation with the corresponding inwardly depressed sections of the opposite panel, each of said grooves being formed by side walls having a surface configuration such that a line normal to the surface at any point extends outwardly into said space uninterruptedly.

3. A radiant-type heater having fuel combustion means and a hollow heat exchange unit having a lower open end and an upper flue outlet, said unit being disposed superadjacent and communicating with said combustion means, thereby being adapted to duct products of combustion upwardly and to radiate heat generated by said fuel combustion means into the space surrounding said heater, said heat exchange unit comprising a pair of sheet metal panels disposed vertically in back-to-back relation having opposite edges joined together, each of said panels being formed with a plurality of inwardly depressed V-shaped grooves defining parallel vertically disposed gas passages and having a ridge between each of said respective grooves, each of said ridges being formed with a plurality of inwardly depressed sections spaced in staggered relation with the corresponding inwardly depressed sections of the opposite panel, each of said grooves having side walls disposed at greater than 90° with respect to each other.

4. A radiant-type heater having fuel combustion means, a hollow heat exchange unit having a lower open end and an upper flue outlet, said unit being disposed superadjacent and communicating with said combustion means, thereby being adapted to duct products of combustion upwardly and to radiate heat generated by said fuel combustion means into the space surrounding said heater, said heat exchange unit comprising a pair of sheet metal panels disposed vertically in back-to-back relation having opposite edges joined together, each of said panels being formed with a plurality of inwardly depressed V-shaped grooves defining parallel vertically disposed gas passages and having a ridge between each of said respective grooves, each of said ridges being formed with a plurality of inwardly depressed sections spaced in staggered relation with the corresponding inwardly depressed sections of the opposite panel, each of said grooves having side walls disposed at greater than 90° with respect to each other, and means for reflecting the radiant heat downwardly, said means comprising a plurality of spaced parallel horizontally disposed reflector vanes circumscribing said heat exchange unit in spaced relation therefrom adapted to reflect downwardly heat radiated by said heat exchange unit.

5. A radiant-type heater having fuel combustion means and a hollow heat exchange unit having an open lower end and an upper flue outlet, said unit being disposed superadjacent and communicating with said combustion means, thereby being adapted to duct products of combustion upwardly and to radiate heat generated by said fuel combustion means into the space surrounding said heater, said heat exchange unit comprising a pair of panels disposed vertically in spaced relation having opposite edges joined together, each of said panels being formed with a plurality of inwardly directed grooves defining parallel vertically disposed gas passages and having a ridge between each of said respective grooves, each of said ridges being formed with a plurality of inwardly depressed sections in staggered relation with the corresponding inwardly depressed sections of the opposite panel.

6. A radiant-type heater having fuel combustion means, a hollow heat exchange unit having an open lower end and an upper flue outlet, said unit being disposed superadjacent and communicating with said combustion means, thereby being adapted to duct products of combustion upwardly and to radiate heat generated by said fuel combustion means into the space surrounding said heater, said heat exchange unit comprising a pair of panels disposed vertically in spaced relation having opposite edges joined together, each of said panels being formed with a plurality of inwardly directed grooves defining parallel vertically disposed gas passages and having a ridge between each of said respective grooves, each of said ridges being formed with a plurality of inwardly depressed sections in staggered relation with the corresponding inwardly depressed sections of the opposite panel, and means for reflecting the radiant heat downwardly, said means comprising a plurality of spaced parallel horizontally disposed reflector vanes circumscribing said heat exchange unit in spaced relation therefrom.

7. A radiant-type heater comprising fuel com-

bustion means, collector means positioned superadjacent said combustion means for collecting products of combustion, said collector means being open at the top thereof, a hollow heat exchange unit having a lower open end communicating with said combustion means and an upper flue outlet in communication with and disposed subjacent said collector means adapted to duct the products of combustion upwardly and to radiate heat generated by said fuel combustion means into the space surrounding said heater, said heat exchange unit comprising a pair of sheet metal panels positioned back-to-back and having a vertical partition therebetween, each of said panels being formed corrugated, thereby defining in cooperation with said partition parallel vertical gas passages, each of the corrugations having a ridge formed with inwardly depressed segments extending into said gas passage and being in staggered relation with the corresponding inwardly depressed segments of the oppositely disposed panel, thereby causing said products of combustion to follow a sinuous path upwardly, each of said gas passages being open at the top thereof.

8. A radiant-type heater comprising fuel combustion means, collector means positioned superadjacent said combustion means for collecting products of combustion, said collector means being open at the top thereof, a hollow heat exchange unit having an open lower end communicating with said combustion means and an upper flue outlet in communication with and disposed subjacent said collector means adapted to duct the products of combustion upwardly and to radiate heat generated by said fuel combustion means into the space surrounding said heater, said heat exchange unit comprising a pair of sheet metal panels positioned back-to-back and having a vertical partition therebetween, each of said panels being formed corrugated, thereby defining in cooperation with said partition parallel vetrical gas passages, each of the corrugations having a ridge formed with inwardly depressed segments extending into said gas passage and being in staggered relation with the corresponding inwardly depressed segments of the oppositely disposed panel, thereby causing said products of combustion to follow a sinuous path upwardly, the outer surface of each of said corrugations being so formed that a line normal to the surface thereof passes into the space surrounding said heater without interruption, each of said gas passages being open at the top thereof.

9. A radiant-type heater comprising fuel combustion means, collector means positioned superadjacent said combustion means for collecting products of combustion, said collector means being open at the top thereof, a hollow heat exchange unit having a lower open end communicating with said combustion means and an upper flue outlet in communication with and disposed subjacent said collector means adapted to duct the products of combustion upwardly and to radiate heat generated by said fuel combustion means into the space surrounding said heater, said heat exchange unit comprising a pair of sheet metal panels positioned back-to-back and having a vertical flat partition there-between, each of said panels being formed with substantially V-shaped corrugations, thereby defining in cooperation with said partition parallel vertical gas passages, each of said corrugations having a ridge formed with inwardly depressed segments extending into said gas passage and being in staggered relation with the corresponding inwardly depressed segments of the oppositely disposed panel, thereby causing said products of combustion to follow a sinuous path upwardly, the angle between adjacent walls of said V-shaped corrugations being greater than 90°, each of said gas passages being open at the top thereof.

10. A radiant-type heater comprising fuel combustion means, collector means positioned superadjacent said combustion means for collecting products of combustion, said collector means being open at the top thereof, a hollow heat exchange unit having a lower open end communicating with said combustion means and an upper flue outlet in communication with and disposed subjacent said collector means adapted to duct the products of combustion upwardly and to radiate heat generated by said fuel combustion means into the space surrounding said heater, said heat exchange unit comprising a pair of sheet metal panels positioned back-to-back and having a vertical flat partition therebetween, each of said panels being formed with substantially V-shaped corrugations, thereby defining in cooperation with said partition parallel vertical gas passages, each of said corrugations having a ridge formed with inwardly depressed segments extending into said gas passage and being in staggered relation with the corresponding inwardly depressed segments of the oppositely disposed panel, thereby causing said products of combustion to follow a sinuous path upwardly, the angle between adjacent walls of said V-shaped corrugations being greater than 90°, each of said gas passages being open at the top thereof, and means for reflecting said radiant heat downwardly, said means comprising a plurality of spaced parallel horizontally disposed reflector vanes circumscribing said heat exchange unit in spaced relation therefrom.

11. A radiant-type heater comprising fuel combustion means, collector means positioned superadjacent said combustion means for collecting products of combustion, said collector means being open at the top thereof, a hollow heat exchange unit having a lower open end communicating with said combustion means and an upper flue outlet in communication with and disposed subjacent said collector means adapted to duct the products of combustion upwardly and to radiate heat generated by said fuel combustion means into the space surrounding said heater, said heat exchange unit comprising a pair of sheet metal panels positioned back-to-back and having a vertical flat partition therebetween, each of said panels being formed with substantially V-shaped corrugations, thereby defining in cooperation with said partition parallel vertical triangular-shaped gas passages, each of said corrugations having a ridge formed with inwardly depressed segments extending into said gas passage and being in staggered relation with the corresponding inwardly depressed segments of the oppositely disposed panel, thereby causing said products of combustion to follow a sinuous path upwardly, each of said gas passages being open at the top thereof.

12. A radiant-type heater comprising fuel combustion means, collector means positioned superadjacent said combustion means for collecting products of combustion, said collector means being open at the top thereof, a hollow heat exchange unit having a lower open end communicating with said combustion means and an upper flue outlet in communication with and disposed subjacent said collector means adapted

to duct the products of combustion upwardly and to radiate heat generated by said fuel combustion means into the space surrounding said heater, said heat exchange unit comprising a pair of sheet metal panels positioned back-to-back and having a vertical flat partition therebetween, each of said panels being formed with substantially V-shaped corrugations, thereby defining in cooperation with said partition parallel vertical triangular-shaped gas passages, each of said corrugations having a ridge formed with inwardly depressed segments extending into said gas passage and being in staggered relation with the corresponding inwardly depressed segments of the oppositely disposed panel, thereby causing said products of combustion to follow a sinuous path upwardly, each of said gas passages being open at the top thereof, and means for reflecting said radiant heat downwardly, said means comprising a plurality of spaced parallel horizontally disposed reflector vanes circumscribing said heat exchange unit in spaced relation therefrom.

13. In a heater adapted to be suspended from a room ceiling, the combination of fuel combustion means, a generally flat, hollow heat exchange unit superjacent and communicating with said combustion means to pass products of combustion upwardly therethrough, a plurality of vertically disposed first straps secured to and disposed adjacent the flat sides of said unit, a plurality of reflector vanes vertically spaced around said unit, the inner edges of said vanes being disposed horizontally and secured to said first straps, and a plurality of vertically disposed second straps secured to said vanes at the outer edges thereof, each vane slanting downward and outward so that the outer edge thereof lies in a lower plane than the inner edge, the under surfaces of said vanes being finished so as to be predominantly reflective, the upper surfaces of said vanes being darkened so as to be predominantly absorptive.

14. An overhead gas burning radiant type heater comprising: a substantially flat, hollow heat exchange element formed with a plurality of vertical, partially obstructed passages for hot gases, the outer surfaces of said element being adapted to radiate heat in a generally horizontal outward direction, means forming a combustion chamber subjacent said heat exchange element and in communication with the lower portion thereof, burner means in said chamber whereby products of combustion from said burner means will travel upwardly into said element, gas collection means superjacent said heat exchange element and in communication with the upper portion thereof, a vent connected to said gas collection means to convey away the products of combustion, a plurality of longitudinally horizontal reflector vanes vertically spaced on both sides of said heat exchange element with the inner edges of said vanes parallel and adjacent to said heat exchange element, said vanes being inclined downwardly and outwardly whereby heat radiated from said heat exchange element will be reflected downwardly and outwardly, and means adapted to suspend said heat exchange element, combustion chamber means, burner means, gas collection means, and vanes, as a unitary structure of assembly, from a ceiling.

WILLIAM G. CARTTER.

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