

[54] GAS-FIRED SPACE HEATER MEANS

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[58] Field of Search 126/90, 91, 91 A, 110, 110 B, 126/116, 116 B; 431/181, 182, 190, 350, 351, 352, 353

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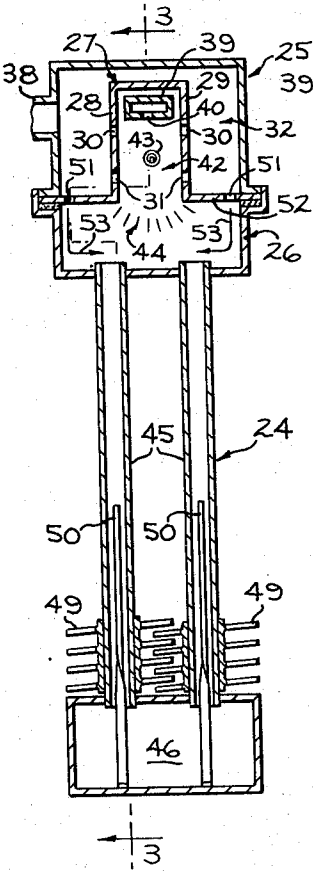
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[57] **ABSTRACT**

This invention provides improved gas-fired heater means for supplying heat to a space, such as a room, house, building or the like. The space heater means include highly efficient heat exchanger means for transferring heat generated by the combustion of a fuel gas-air mixture to an air stream circulated between the heat exchanger means and the space, in combination with pressurized combustor means for mixing fuel gas with pressurized combustion air and igniting that mixture to produce a highly intense heat source flame which is discharged into the heat exchanger means inlet through hollow interconnecting conduit means. The present invention provides novel means for directing a heat-insulating layer of pressurized fluid between the flame and interior surfaces of the interconnecting conduit means such that these conduit surfaces are protected by the fluid layer against adverse heat-fatiguing action by the intensely hot flame.

20 Claims, 3 Drawing Figures



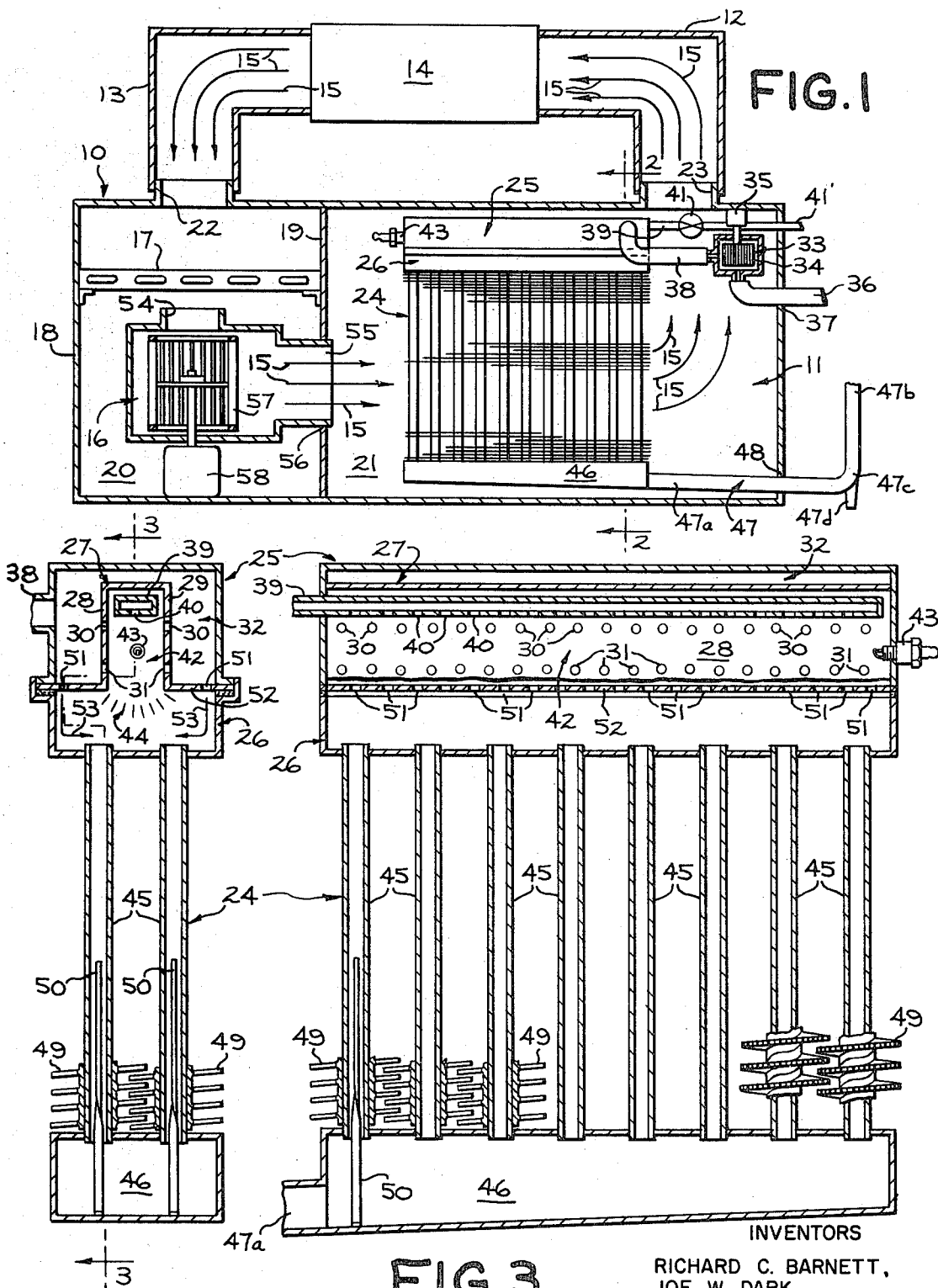


FIG. 2

FIG. 3

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GAS-FIRED SPACE HEATER MEANS

CROSS-REFERENCE TO RELATED APPLICATIONS

The present invention is directed to further improvement of those described in detail in copending, commonly assigned U.S. Pat. applications Ser. No. 47,433, filed June 18, 1970 by Roy W. Abbott, Ser. No. 66,800, filed Aug. 25, 1970 by James D. Boucher and Ser. No. 71,007, filed Sept. 10, 1970, by Richard C. Barnett.

BACKGROUND OF THE INVENTION

This invention relates to means for supplying heat to a space such as a room, house, building or the like, and more particularly, to improved gas-fired heater means for supplying such heat.

Heretofore, conventional gas-fired space heater or furnace means have most frequently employed rather crude cast iron or steel heat exchanger means having the general shape of a hollow box or clam shell to transfer heat generated by the combustion of a combustible gas-air mixture to an air stream circulated between the heat exchanger means and the space to be heated. And, these conventional heat exchanger means have usually been combined with similarly unsophisticated combustor or burner means which have been very much like those used in gas cooking ranges and wherein the combustion air that is mixed with the fuel gas is supplied to the combustor means at atmospheric conditions. In these conventional space heater means, the atmospheric combustor means is located beneath the heat exchanger and the combustion products rise upwardly by natural convection through the heat exchanger and are discharged to the atmosphere via an exhaust vent or flue that is connected to the top of the heat exchanger.

The aforementioned copending, commonly assigned patent applications described gas-fired space heater means which are superior to the aforescribed conventional heater means in that they permit considerable weight and volume reduction in heat exchanger means material by employing a combination of highly efficient heat exchanger means for transferring heat to an air stream circulated between the heat exchanger means and the space to be heated, and pressurized high intensity combustor means for mixing fuel gas with pressurized combustion air to produce and ignite the combustible gas-air mixture.

The combustor means described in these aforementioned copending, commonly assigned patent applications include a trough having an imperforate base wall and long side walls that are pierced by a plurality of pressurized combustion air inlet apertures, and a fuel gas supply conduit which extends generally longitudinally through the trough. The fuel gas supply conduit has a long surface that is pierced by a plurality of apertures through which fuel gas enters the trough and is turbulently mixed with the pressurized combustion air in a fuel gas-air mixing area that is defined by the apertured trough side walls and the apertured fuel gas supply conduit surface. This turbulent mixture of fuel gas and pressurized combustion air is ignited within the combustor fuel gas-air mixing area to produce an extremely intense heat source flame that is discharged to the inlet end of the heat exchanger means through hollow interconnecting conduit means. Typically, the intensity of this flame is at least 300,000 BTU of heat per hour per cubic foot of the interconnecting conduit means.

While the gas-fire space heater means described in the aforementioned copending, commonly assigned Abbott, Boucher and Barnett patent applications are superior to the aforescribed conventional gas-fired space heaters, it has been found in accordance with the present invention that they can be still further improved by providing novel means for directing a heat-insulating layer of pressurized fluid between the heat source flame and interior surfaces of the hollow conduit means which fluid-connects the combustor trough discharge to the heat exchanger inlet, such that these surfaces will be protected by the fluid layer against adverse heat-fatiguing action by the intensely hot flame.

SUMMARY OF THE INVENTION

This invention provides gas-fired space heater means for supplying heat to a space, such as a room, house, building or the like. The space heater means include highly efficient heat exchanger means for transferring heat generated by the combustion of a fuel gas-air mixture to an air stream circulated between the heat exchanger means and the space, in combination with pressurized combustor means for mixing fuel gas with pressurized combustion air and igniting that mixture to produce a highly intense heat source flame which is discharged into the heat exchanger means inlet through hollow interconnecting conduit means. The present invention provides novel means for directing a heat-insulating layer of pressurized fluid between the flame and interior surfaces of the interconnecting conduit means such that these conduit surfaces are protected by the fluid layer against adverse heat-fatiguing action by the intensely hot flame.

Preferably, although not necessarily, the fluid which forms the layer for protecting the interior surfaces of the interconnecting conduit means from the heat source flame is air and is derived from the same source as is the pressurized combustion air that is mixed with the fuel gas in the combustor means fuel gas-air mixing area.

BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 is a somewhat schematic, partly sectioned, front elevational view of a space air-conditioning unit incorporating a presently preferred form of the improved gas-fired space heater means of the present invention;

FIG. 2 is a greatly enlarged fragmentary sectional view taken along line 2—2 of FIG. 1; and

FIG. 3 is a partly broken fragmentary sectional view taken along line 3—3 of FIG. 2.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now to the drawing and, more particularly, to FIG. 1 thereof, there is illustrated, somewhat schematically, an air-conditioning unit 10 incorporating a presently preferred form of improved gas-fired space heater means 11 that are provided in accordance with the present invention. The air-conditioning unit 10 is fluid-connected by right and left hollow conduit means 12 and 13 to a space 14 (shown in block), such as a room, house, building or the like, so as to condition air contained within the space 14, as by supplying heat to or removing heat from an air stream, indicated by arrows 15, that is circulated between the space 14 and the air-conditioning unit 10 through the conduit means 12 and 13 by space air blower means 16. As shown, the air-conditioning unit 10 employs the improved gas-fired space heater means 11 to supply heat to the air stream 15 in combination with cooling means, including an evaporator section 17, to remove heat from the air stream 15.

As illustrated in FIG. 1, the air-conditioning unit 10 includes a generally rectangular hollow box-like cabinet 18 that is subdivided by a vertically arranged partition 19 into a left compartment 20 and a right compartment 21. The cabinet left compartment 20 has an air inlet opening 22 in its upper wall that is fluid connected to the space 14 by the left conduit means 13 while the upper wall of the cabinet right compartment 21 has an air outlet opening 23 that is fluid-connected to the space 14 by the right conduit means 12. The cabinet left compartment 20 houses the cooling means evaporator section 17 and the space air blower means 16, while the cabinet right compartment 21 houses presently preferred forms of heat exchanger means 24 and pressurized combustor means 25 that are combined in accordance with the present invention to produce the improved gas-fired heater means 11.

As shown in FIGS. 1-3, the improved gas-fired space heater means 11 of the present invention are generally similar in form to those described in the aforementioned Boucher patent application with the combustor means 25 being inverted and having its outlet fluid-connected to the inlet at the top of the heat ex-

hanger means 24 via hollow box-like interconnecting conduit means 26. However, in accordance with a particular aspect of the present invention which will be described in detail hereinafter, means are provided for directing a heat-insulating layer of fluid along interior surfaces of the interconnecting conduit means 26.

The combustor means 25 includes an inverted, generally horizontally arranged elongate trough 27 having opposed, generally vertically arranged, spaced apart downwardly extending long side walls 28 and 29 that are provided with a plurality of apertures along their upper and lower portions to respectively define primary combustion air inlet apertures 30 and secondary combustion air inlet apertures 31. The upper surfaces of the inverted trough 27 are surrounded by a combustion air supply plenum 32 that is fluid-connected to a source of pressurized combustion air, such as a combustion air supply blower 33. The combustion air supply blower 33 includes an impeller 34 that is rotated by electric motor 35 and is housed in the upper right hand corner of the cabinet right compartment 21 with its inlet connected to a combustion air intake conduit 36 which extends outwardly from the cabinet through an opening 37 provided in the right side wall thereof. The combustion air supply blower 33 has its outlet connected via a combustion air supply blower discharge conduit 38 to the combustion air supply plenum 32. A generally horizontally disposed gas supply conduit 39 extends longitudinally through the inverted trough 27 and is provided with plural gas inlet apertures 40 located above the primary combustion air inlet apertures 30. The inlet of the gas supply conduit 39 is connected via an electric control valve 41 of a well-known type to a source (not shown) of pressurized fuel gas, such as natural gas, propane, or the like, that is delivered to the valve by a fuel gas source conduit 41'. The fuel gas inlet apertures 40 are arranged such that the fuel gas enters the inverted trough 27 generally parallel to the downwardly extending trough long side walls 28 and 29 and is turbulently mixed with the combustion air in a fuel gas-air mixing area 42 that is defined by the apertured lower surface of the gas supply conduit 39 and the downwardly extending apertured trough side walls 28 and 29.

The rich combustible fuel gas-air mixture which results from the turbulent mixing of the pressurized fuel gas that is discharged from the fuel gas inlet apertures 40 with the pressurized combustion air that enters the fuel gas-air mixing area 42 via the trough primary combustion air inlet apertures 30 moves downwardly through the mixing area 42 and is ignited by a high voltage spark produced in a well-known manner by igniter means, such as an electric spark plug 43, that is generally horizontally arranged at the left end of the mixing area 42 at a point vertically spaced between the primary combustion air inlet apertures 30 and the secondary combustion air inlet apertures 31. This ignited mixture of fuel gas and primary combustion air is then further turbulently mixed with the pressurized combustion air which enters the fuel gas-air mixing area 42 through the generally horizontal secondary combustion air inlet apertures 30 provided along the lower portion of downwardly extending long side walls 28 and 29 of the inverted trough 27 and produces a generally downwardly extending, extremely high intensity heat source flame 44.

The highly intense heat and the products of combustion from the flame 44 are now discharged from the open lower or outlet end of the inverted trough 27 and into the upper or inlet end of the heat exchangers means 24 through the hollow box-like interconnecting conduit means 26. The intensity of the heat source flame 44 that is produced by the high intensity pressurized combustor means 25 is generally similar to that produced by the combustor means described in the aforementioned Abbott and Boucher patent applications and is typically at least 300,000 BTU of heat per hour per cubic foot of the interconnecting conduit means, an intensity level far exceeding any previously achieved with the aforescribed prior-art atmospheric combustor or burner means which have heretofore been commonly employed in conventional gas-fired space heaters.

The exchanger means 24 comprises a plurality of generally vertically arranged hollow tubes 45. The tubes 45 have their upper ends fluid-connected in parallel to the lower end of the hollow interconnecting conduit means 26 and the top of the heat exchanger means 24, while their lower ends are fluid-connected in parallel to an exhaust plenum 46 which directs the waste products of combustion to the atmosphere via exhaust vent means which include an elbow-shaped vent pipe 47 having an inlet leg 47a and an outlet leg 47b. The vent pipe inlet leg 47a is connected to the exhaust plenum 46 and extends outwardly from the air-conditioning unit cabinet 18 through an opening 48 provided at the lower end of the cabinet right side wall, while the vent pipe outlet leg 47b extends upwardly outside the cabinet 18. The vent pipe inlet leg 47a is sloped downwardly toward its intersection or elbow 47c with its upwardly extending outlet leg 47b, and liquid drain means 47d is provided at its lowest point, as at the bottom of the vent pipe elbow 47c.

Also, as in the case of the aforementioned Abbott and Boucher applications, the outer surfaces of the heat exchanger tubes 45 are provided with fin means 49 of the so-called "spine-fin type" that are generally similar to those described in detail in commonly-assigned prior-art U.S. Pat. No. 2,983,300, except that the tubes 45 and the fins 49 for the heat exchanger 24 are preferably formed of a ferrous metal, such as steel, rather than of a non-ferrous aluminum or copper as in the air-cooling exchanger described in U.S. Pat. No. 2,983,300. And, as further shown in FIGS. 2 and 3, twisted ribbon-like turbulence promoters 50 are provided in the lower or exit ends of each of the heat exchanger tubes 45 in order to provide a balance of heat transfer between the finned outer surfaces and the bare inner surfaces of the tubes 45.

The pressurized gas-fired space heater means described in the aforementioned copending, commonly assigned patent application are superior to the aforescribed conventional atmospheric gas-fired space heater means in that they permit considerable weight and volume reduction in heat exchanger means material by employing the combination of highly efficient heat exchanger means, such as the heat exchanger means 24, and pressurized high intensity combustor means, such as the combustor means 25. However, the extreme intensity of the heat source flame 44 produced thereby has, until now, presented certain problems which were not previously encountered with the conventional atmospheric combustor means. More specifically, this intensely hot flame 44 has caused rapid thermal-fatiguing of the hollow box-like conduit means 26 which interconnect the combustor means 25 and the heat exchanger means 24.

Heretofore, various schemes have been employed in an attempt to overcome this heat fatiguing problem, such as coating interior surfaces of the interconnecting conduit means 26 with high temperature refractory insulative materials, such as asbestos, etc. However, these have been costly.

In particular accordance with the present invention, it has been found that the aforementioned problems of heat-fatiguing of the interconnecting conduit means 26 by the highly intense heat source flame 44 can be inexpensively greatly mitigated by providing novel means for directing a heat-insulating layer of pressurized fluid between the flame 44 and interior surfaces of the interconnecting conduit means 26 such that these conduit surfaces are protected by the fluid layer against adverse heat-fatiguing action by the intensely hot flame 44. Preferably, although not necessarily, the fluid which forms the layer for protecting the interior surfaces of the interconnecting conduit means 26 from the heat source flame 44 is air and is derived from the same source (blower 33) as the pressurized combustion air that is mixed with the fuel gas in the fuel gas-air mixing area 42 of the combustor means 25.

More specifically, as best shown in FIGS. 2 and 3, the fluid directing means that are provided in accordance with the presently preferred form of the present invention comprise a plurality of apertures 51 which fluid-connect the combustion air supply plenum 32 with the hollow interconnecting conduit means 26. In this illustrated form of the present invention, the

fluid directing means or apertures 51 surround and pierce the outer periphery of a generally horizontally arranged wall 52 which forms the bottom wall of the combustion air plenum 32 and the top wall of the interconnecting conduit means 26 and has its center connected to the outlet of the inverted trough 27. As shown, the axial centers of the fluid directing apertures 51 are generally vertically arranged parallel and adjacent to, but slightly inward of, the generally vertically arranged interior side surfaces of the generally rectangular, hollow box-like interconnecting means 26.

With this arrangement, energization of the combustion air supply blower means 33 (FIG. 1) will supply pressurized air to the combustion air plenum 32 (FIGS. 2 and 3). Part of this air will, of course, be distributed into the fuel gas-air mixing area 42 of the inverted trough 27 via the combustion air inlet apertures 30 and 31 and be mixed and ignited with the fuel gas, while the balance of this air of fluid will be directed generally downwardly through fluid directing apertures 51 to provide a heat-insulating layer of fluid or air, indicated by arrows 53 (FIG. 2), over the interior surfaces of the interconnecting conduit means 26 and between the flame 44 and these surfaces such that these surfaces are protected by the fluid or air layer against adverse heat-fatiguing action of the intensely hot flame 44. Ultimately, the air forming this protective fluid layer 53 will be combined with the waste products of combustion from the flame 44 and will pass downwardly along with these products through the heat exchanger means 24 and be exhausted to the atmosphere via the exhaust plenum 46 and atmospheric exhaust vent pipe 47.

As shown in FIGS. 1-3 the remaining structure comprising the air-conditioning unit 10 is generally similar to that described in the aforementioned copending, commonly assigned Boucher patent application. As illustrated in FIG. 1, the space air blower 16 has its inlet 54 aligned with the air inlet opening 22 for the cabinet left compartment 20 and has its discharge 55 fluid-connected to the cabinet right compartment 21 via an opening 56 that is provided in the partition 19 and is arranged such that rotation of its impeller 57 by its electric motor 58 will cause the air stream 15 to be circulated between the space 14 and the finned exteriors of the heat exchanger tubes 45. Hence, during operation of the combustor means 25 of the improved gas-fired space heater means 11, the right conduit means 12 serves as means for directing heated air from the air-conditioning unit cabinet 18 to the space 14 or as the so-called warm air conduit means, the left conduit means serves as means for returning air from the space 14 to the cabinet 18 for the reception of heat or as the so-called return air conduit means, and the space air blower 16 serves as means for circulating air between the space 14 and the gas-fired space heater means 11.

Thus, during operation of the combustor means 25 of the improved gas-fired heater means 11, the combustion products resulting from the ignition of the pressurized fuel gas and combustion air that are mixed in the fuel gas-air mixing area 42 of the inverted trough 27 produce the extremely intense heat source flame 44 and they and the heat generated thereby are forced downwardly under pressure provided by the combustion air supply blower 33 through the interconnecting conduit means 26 where they mix with the protective air layer stream 53 and, thence, downwardly through the tubes 45 of the heat exchanger 24, with the heat therefrom being transferred by combustion, convection, and radiation, first to the interiors of the tubes 45, then to the finned exteriors of the tubes 45 and finally to the space air stream 15 that is circulated across the finned exterior of the tubes 45 by the space air blower 16. And, the waste products of combustion are forced from the lower ends of the heat exchanger tubes 45 and into the exhaust plenum 46 at the bottom of the heat exchanger 24, then outwardly and downwardly through the vent pipe inlet leg 47a and, finally, upwardly to the atmosphere via the vent pipe outlet leg 47b by the pressurized air that is supplied by the combustion air supply blower 33. The rate of heat transfer to the air stream 16 that can be accomplished by the heat

exchanger means 24 is similar to that of the heat exchanger means described in detail in the aforementioned Abbott and Boucher patent applications, and is typically at least 3,500 BTU of heat per hour per pound of material that is used in the tubes and the fins, a rate far exceeding any previously achieved with the rather crude prior art box-like or clam shell-shaped heat exchangers which have heretofore been commonly employed in the aforescribed conventional gas fired space heaters.

It should be apparent to those skilled in the art that while there has been describe what, at present, is considered to be a presently preferred embodiment of this invention in accordance with the Patent Statutes, changes may be made to the disclosed apparatus without actually departing from the true spirit and scope of this invention. It is therefore, intended that the appended claims shall cover such modifications and applications that do not depart from the true spirit and scope of the invention.

What is claimed is:

1. Improved gas-fired space heater means, comprising:
 - a. heat exchanger means for transferring heat generated by the combustion of a combustible gas-air mixture to an air stream circulated between said heat exchanger means and the space to be heated;
 - b. combustor means for mixing fuel gas with pressurized air to provide said combustible gas-air mixture and igniting said mixture to produce a highly intense heat source flame;
 - c. hollow conduit means for interconnecting said combustor means and said heat exchanger means to discharge the products of combustion from said heat source flame into said heat exchanger means; and
 - d. means for directing a heat-insulating layer of pressurized fluid between said heat source flame and interior surfaces of said interconnecting conduit means such that said surfaces are protected by said fluid layer against adverse heat-fatiguing action by said heat source flame.
2. The invention of claim 1, wherein said fluid is air.
3. The invention of claim 2, wherein said heat source flame has an intensity of at least 300,000 BTU of heat per hour per cubic foot of said interconnecting conduit means.
4. The invention of claim 1, wherein said heat source flame has an intensity of at least 300,000 BTU of heat per hour per cubic foot of said interconnecting conduit means.
5. The invention of claim 1, wherein said combustor means includes:
 - a. means defining an area for mixing fuel gas and pressurized air; and
 - b. means for supplying pressurized air to said mixing area.
6. The invention of claim 5, further including means for fluid-connecting said air supplying means to said fluid directing means.
7. The invention of claim 6, wherein:
 - a. said mixing area defining means comprises a trough; and
 - b. said trough is surrounded by a plenum that is fluid-connected to said air supplying means and said mixing means.
8. The invention of claim 7, wherein said trough is inverted.
9. The invention of claim 7, wherein said fluid directing means and said plenum are fluid-connected.
10. The invention of claim 9, wherein said fluid directing means comprises a plurality of apertures piercing a wall between said plenum and said interconnecting conduit means.
11. The invention of claim 10, wherein said apertures have their axial centers arranged generally parallel to said interior surfaces of said interconnecting conduit means.
12. The invention of claim 11, wherein:
 - a. said interconnecting conduit means has the shape of a generally rectangular hollow box including generally vertically arranged interior side surfaces; and
 - b. said apertures have their axial centers generally vertically arranged adjacent said generally vertically arranged interior side surfaces of said interconnecting conduit means.

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13. The invention of claim 12, wherein said trough is inverted.

14. The invention of claim 9, wherein said heat source flame has an intensity of at least 300,000 BTU of heat per hour per cubic foot of said interconnecting conduit means.

15. The invention of claim 14, wherein said trough is inverted.

16. The invention of claim 9, wherein said trough is inverted.

17. The invention of claim 10, wherein:

a. said trough is inverted; and

b. said wall that is pierced by said apertures forms a bottom wall of said plenum and a top wall of said interconnecting conduit means.

18. The invention of claim 17, wherein:

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a. said interconnecting conduit means has the shape of a generally rectangular box including generally vertically arranged interior side surfaces; and

b. said apertures have their axial centers generally vertically arranged adjacent said generally vertically arranged interior side surfaces of said interconnecting conduit means.

19. The invention of claim 18, wherein said heat source flame has an intensity of at least 300,000 BTU of heat per hour per cubic foot of said interconnecting conduit means.

20. The invention of claim 12, wherein said heat source flame has an intensity of at least 300,000 BTU of heat per hour per cubic foot of said interconnecting conduit means.

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