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FORCED-AIR, FORCED-DRAFT UNIT HEATER

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2 Sheets-Sheet 1

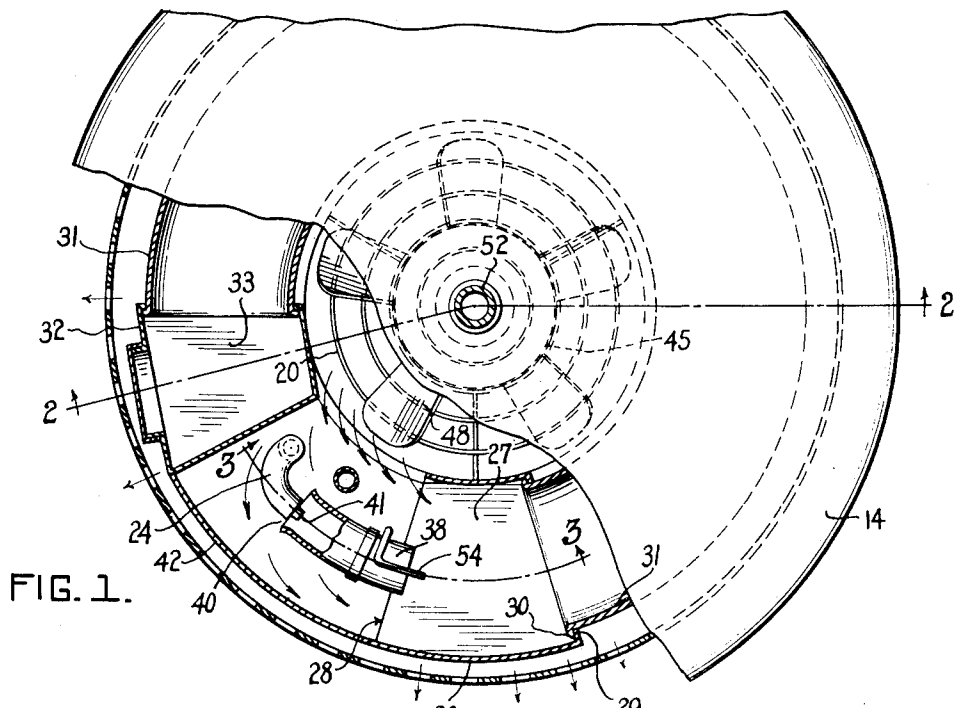


FIG. 1.

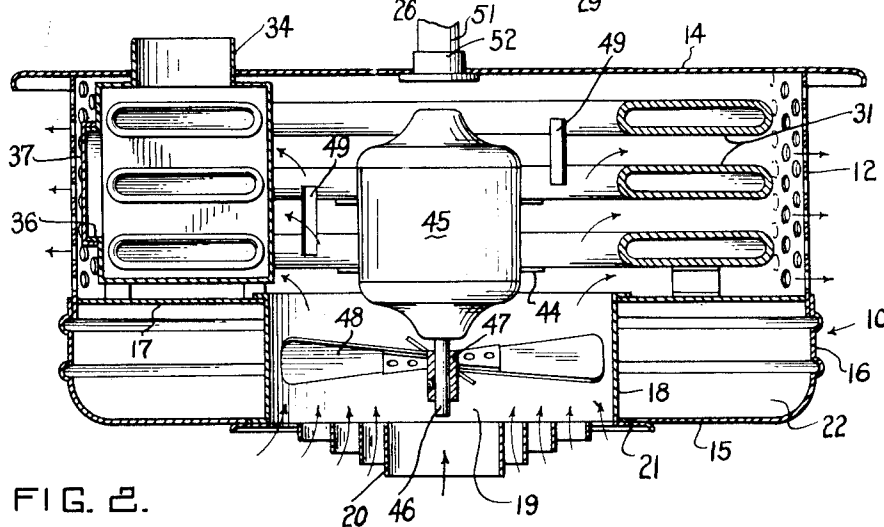


FIG. 2.

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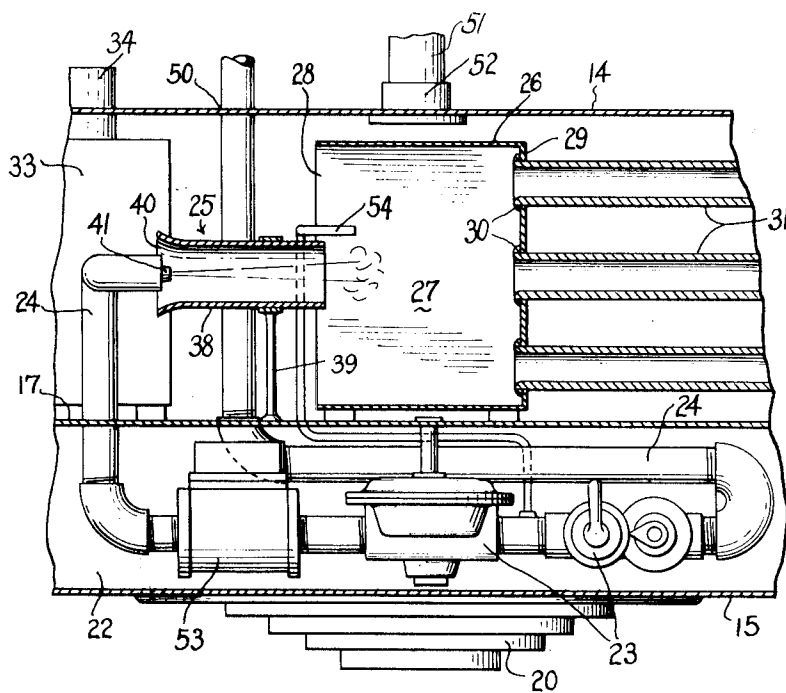


FIG. 3.

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FORCED-AIR, FORCED-DRAFT UNIT HEATER

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3 Claims. (Cl. 126—110)

The present invention relates generally to heating apparatus, and more specifically to an improved heating apparatus of the type known commercially as a unit heater and adapted to be suspended from a wall or ceiling to provide heat for an associated room, factory, or other enclosure.

In the past, various types of so-called unit heaters have been proposed which embodied in general an outer casing structure housing a bank-type heat exchanger communicating with a combustion chamber which, in turn, embodied a fluid fuel burner arranged to burn fuels generally below the heat exchanger, with the heat exchanger comprising a multiplicity of tubes or passageways acting as flue gas outlets from the combustion chamber, and wherein a motor-driven air displacement fan was employed to circulate air across the elements of the heat exchanger and thence to the zone to be heated by the apparatus. In previously known unit heaters of this general type, the heat exchanger was located in a substantially vertical plane above the fuel burner to receive the hot products of combustion emanating from such burner by normal convectional flow, primary combustion air being supplied to the fuel burner and to the combustion chamber at atmospheric pressures. While such unit heaters operated satisfactorily, the same, of necessity, due to the vertical arrangement of the heat exchanger unit, did not make the most efficient use of the heat energy of fuels by reason of the relatively fast travel of hot gases through the heat exchanger passages and outwardly through an associated vertically arranged flue outlet.

It follows, therefore, that the primary object of the present invention is to generally improve on previously known, patented, and described unit heaters through the provision of a forced draft heating apparatus embodying a heat exchanger comprising a plurality of relatively vertically spaced and horizontally disposed tubes or conduits arranged in a generally annular pattern, and communicating, respectively, with a combustion chamber and a flue gas outlet manifold, and wherein combustion air for an associated burner is forcibly introduced to the combustion chamber and through the heat exchanger tubes or conduits to provide forced draft circulation within the combustion area of the apparatus, and to thereby cause a forced circulation of combustion products in a generally horizontal plane through the heat exchanger tubes to obtain a more efficient exchange of heat between the products of combustion and the heating elements of the associated unit heater.

It is another object of the present invention to provide a relatively compact unit heater comprised of few and simple parts, and which embodies but a single air-displacement unit comprising an electric motor and an associated fan or blower operable to effect a forced draft circulation through the combustion area of the heater, and the forced circulation of air in and across the heat exchanger tubes and thence outwardly into the zone being heated by the apparatus.

A still further object of the invention is to provide a unit heater of generally circular or annular design whose width or diametrical dimensions are considerably in excess of its height dimensions, and wherein an air displacement unit is entirely enclosed within the unit heater casing and functions to draw air first inwardly in an upward vertical direction into the unit heater and to discharge such air radially outwardly through the periphery of the heater casing.

For a further and more complete understanding of the

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present invention and the various additional objects and advantages realized therefrom, reference is made to the following description and the appended drawings, wherein:

5 Fig. 1 is a top plan view, partially in horizontal section, showing a unit heater constructed in accordance with the present invention;

Fig. 2 is a detailed vertical sectional view taken along the line 2—2 of Fig. 1;

10 Fig. 3 is an enlarged fragmentary vertical sectional view taken along the line 3—3 of Fig. 1.

Referring to the drawings, the numeral 10 designates generally the outer casing of the present unit heater which comprises an annular perforate side wall 12, a flat top wall 14 whose marginal edge region slightly overhangs the side wall 12, and an annular bottom wall 15. As shown particularly in Fig. 2 of the drawings, the bottom wall 15 is turned upwardly in its outer edge regions to provide a relatively shallow and imperforate side wall portion 16, and extending intermediately between the ends of the outer casing in vertically spaced relation to the bottom wall 15 is an annular intermediate division wall 17. The inner surfaces of the bottom wall 15 and the intermediate division wall 17 define a pair of vertically aligned circular openings, and advantageously, as shown in Fig. 2, there is provided a vertically arranged and annular inner side wall 18 which extends through the openings formed in the bottom and intermediate walls and defines a circular air intake opening 19 extending vertically upwardly from the bottom wall 15 of the casing into the interior chamber defined by the perforate side wall 12, the intermediate wall 17, and the top wall 14. Preferably, the intake opening 19, at the lower end thereof, is covered by an open grillework 20 comprising a plurality of concentrically spaced and annular bands having a radially extending attachment flange 21 secured along the inner edge portion of the bottom wall 15, as by welding.

The bottom wall 15 with its upturned outer edge portion 16, together with the divisional wall 17 and the inner side wall 18, defines a substantially enclosed annular chamber 22 which, as shown particularly in Fig. 3 of the drawings, houses the fuel flow control valves 23 and the fuel supply conduits 24 associated with a single port gaseous fuel burner 25.

45 Positioned within the casing 10 above the divisional wall 17, and in spaced concentric relation to the perforate outer side wall 12, is an open-mouthed combustion case 26, the side walls of which are curved to define a generally arcuate combustion chamber 27. The combustion case 26 is open at one end, as at 28, and carries at its opposite end a substantially vertically arranged back wall 29. Connected with the back wall 29, as at 30, are a plurality of relatively vertically spaced and horizontally arranged annular flat tubes or conduits 31 which are disposed in concentric spaced relation adjacent to the perforate outer wall 12 of the casing, and which extend through approximately three-fourths of the perimeter of the outer casing 10. The opposite ends of the tubes 31 are connected with and supported by an end wall of a substantially rectangular casing 32 which defines, at the opposite ends of the tubes 31, an enclosed exhaust manifold chamber 33. Preferably, the upper wall of the exhaust case 32 is formed to constitute a vertically arranged flue outlet 34 which projects upwardly through an opening formed in the roof or top wall 14 of the outer casing 10. Alternatively, the outer side wall of the exhaust case 32 may be formed with a laterally projecting flue gas outlet 36 which is shown as being capped, as at 37, when it is desirable to use the top opening outlet 34. However, it will be understood that in locations where it is impractical to lead a remotely extending flue pipe, not shown, vertically outwardly from the casing, the laterally projecting side opening 36 may be used with the top outlet 34 capped.

75 Referring to Fig. 1, it will be seen that the combustion case 26 is disposed in perimetrical spaced relation to the outer end wall of the exhaust manifold case 32 by a distance sufficient to accommodate a generally arcuate single port mixing conduit 38 which is open at either end, and which is supported in axial alignment with the combustion chamber 27 by a bracket 39 extending

upwardly from the intermediate division wall 17. The tube 30 is tapered outwardly at its inner end to provide a partial Venturi inlet 40 into which extends the outlet nozzle 41 carried at the outer end of the fuel supply conduit 24. The outer end of the burner extends slightly inwardly of the combustion chamber 21 to project a flame inwardly of the combustion chamber in axial alignment with the open-ended heat exchanger tubes 31. The space occupied by the burner tube 36 and the outlet portion of the fuel supply conduit 24 is closed on the side thereof adjacent to the perforate outer side wall 12, as by means of the arcuate segmental side wall 42, while the inner side of such space opens radially inwardly toward the axis of the heater.

Arranged centrally and axially within the casing 10, and supported on brackets 44, is an electric motor 45 having a drive shaft 46 projecting downwardly from one end thereof along the axis of the casing. Drivably connected with the drive shaft 46 is the hub 47 of a blower fan 48. The fan 48 is positioned within and occupies the inlet opening 19, and the blades thereof are pitched so as to force atmospheric air upwardly through the interstices of the grille 20, the opening 19, and into the central portion of the casing to be thereafter deflected radially outwardly through the perforate side wall 12 between the intermediate division wall 17 and the top wall 14 of the casing. At the same time, the air is forced over and between the vertically spaced annular heat exchanger tubes 31. Preferably, the cross-sectional configuration of the tubes 31 is substantially an elongated oval disposed in parallel relation to the radial axis of the casing in order to present a major portion of their outer surfaces to air being circulated radially outwardly through the perforate side walls of the casing. However, if desired, the tubes 31 may be of any suitable shape, and may possess a generally annular cross section and may be arranged in radially spaced and staggered order to present a plurality of banks of tubes adjacent the perforate side wall. Also, the individual tubes 31 are joined with one another at spaced intervals throughout their lengths, as by means of supporting straps 49 which are welded at their respective ends to the inner sides of the individual tubes to provide a composite removable heat exchanger unit.

As shown in detail in Fig. 3, the fuel supply conduit 24 is arranged so as to extend first downwardly through the top wall 14 of the outer casing, as at 50, vertically through the space occupied by the burner tube 38, then through an opening in the intermediate division wall 17 and into the lower annular chamber 22 for connection with the valves 23. In this manner, the fuel supply conduit 24 may be connected with a remotely extending supply conduit, not shown, which may be carried in the ceiling or wall of a room to eliminate unsightly and relatively long exposed lengths of piping extending to the unit heater. In the same manner, the present heater may advantageously be suspended by means of a single vertically and axially arranged supporting post 51 which is connected at its outer end, as at 52, with the center of the top wall 14, and which, at its inner end, may be joined with a fixture bracket bolted, or otherwise suitably secured, to the ceiling of a room.

It will be understood that any suitable electric or mechanical control circuit and apparatus may be used in combination with the present unit heater to control the opening and closing of a fuel flow control valve associated with the burner 38 in response to the ambient temperatures of the zone being heated by the apparatus in the usual and well known manner. In Fig. 3 there is shown a solenoid-actuated flow control valve 53 of a type common to many gaseous fuel heating systems in present day use, and whose operation may be controlled in response to the opening and closing of an associated room temperature-responsive thermostatic switch, not shown. Likewise, the energization of the fan-actuating motor 45 may be made responsive to various conditions, and in this connection, it has been found advantageous to employ a control circuit which provides for the initial operation of the blower prior to the opening of the fuel flow control valve, and which functions to continue the operation of the blower after closure of such valve, in order to efficiently dissipate heat built up within the heat exchanger tubes 31. In this connection, it should be understood that the present invention is concerned primarily with the structure comprising the unit heater per se,

and that such heater may be operated either manually or automatically without departing from the spirit of the present invention.

In operation, the fan or blower 48, when driven upon energization of the motor 45, circulates air upwardly through the opening 19 and inwardly of the outer casing 10, and thereafter radially outwardly between and across the separate heat exchanger tubes 31 and thence outwardly through the perforations of the outer wall 12. Upon opening of the fuel flow control valve and the ignition of fuel at the burner tube 36, as by means of a pilot burner shown at 54, flames are projected inwardly of the combustion chamber 21, thence horizontally through the passages provided by the tubes 31, and into the exhaust manifold chamber 33. Combustion air is furnished the burner under forced draft of the fan 48, such combustion air being directed radially outwardly into the space occupied by the tube 38 through and around the partial Venturi opening 40 of the tube for admixture with fuel discharged through the nozzle 41, and additionally, around the outer surface of the tube 38 into the combustion chamber 27. This circulation of air is caused by the arcuate side wall 42 which acts as a shield to deflect a portion of the air circulated by the fan 48 into the open mouth of the combustion chamber 27 to force gaseous products of combustion through the tubes 31 and thence outwardly into the exhaust manifold chamber 33 and into a remotely extending flue outlet, not shown, which is arranged to be connected with either of the outlets 34 or 36.

In view of the foregoing, it will be seen that the present invention provides an efficient and compact unit heater construction in which fluid fuels are burned under forced draft and circulated in a substantially horizontal plane through heat exchanger tubes across which air is circulated to be heated by contact with the outer surfaces of such tubes and thereafter discharged in the zone to be heated. Due to the annular and horizontal disposition of the heat exchanger of the present invention, the same may be arranged in a compact and relatively shallow casing, whereby the heater may occupy but little space adjacent the ceiling or a wall of a room or other enclosure.

While a single preferred form of the invention has been disclosed in detail in the foregoing specification and drawings, it will be manifest that various modifications may be resorted to without departing from the spirit of the invention or the scope of the following claims.

We claim:

1. A forced-draft, forced-air unit heater comprising a substantially flat cylindrical casing formed with an annular and perforate side wall, an imperforate top wall, and a bottom wall having an axially disposed air intake opening, said side, top, and bottom walls defining in said casing a cylindrical chamber communicating with the intake opening and the perforations of said side wall; a combustion case positioned in the chamber of said casing adjacent to the side wall thereof and having at one end thereof an air inlet opening into the chamber of said casing; a fluid fuel burner having a fuel-projecting orifice, a mixing conduit into one end of which fuel discharged from said fuel-projecting orifice is received, said conduit extending into one end of said combustion case and having a primary air inlet adjacent said burner orifice; a plurality of horizontally arranged, vertically spaced, arcuate heat exchanger tubes positioned in the chamber of said casing in concentric relation to the perforate side wall thereof, said tubes extending throughout a major portion of the periphery of said chamber adjacent to the perforate side wall and communicating with the end of said combustion case opposite that into which said mixing conduit extends to receive gaseous products of combustion emanating from the discharge end of the mixing conduit of said burner; an exhaust manifold case positioned in the chamber of said casing and communicating with the opposite ends of said tubes for receiving gaseous products of combustion conducted by said tubes, said exhaust manifold case being spaced circumferentially from the air inlet end of said combustion case and defining therewith an open slot communicating radially with the central portion of said chamber; an arcuately curved wall extending between said combustion case and said manifold case on the side thereof opposite said slot for directing air flowing radially outwardly from the said

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central portion of said chamber into the air inlet end of said combustion case; and air-circulating means positioned within said casing and arranged to forcibly circulate air first inwardly of the air intake opening of the bottom wall of said casing, and then generally radially and outwardly across said tubes and through the perforations of said side wall and simultaneously radially through the slot formed between said combustion case and said manifold case, and thence axially through said tubes.

2. In a gas-fired unit heater; an outer cylindrical casing of greater diameter than axial length and having an annular side wall provided with air outlet openings, a top wall, and a bottom wall formed with an air intake opening and defining an internal chamber; a plurality of relatively spaced, arcuately curved, substantially horizontally arranged heat exchanger tubes mounted in the chamber of said casing adjacent and in concentric spaced relation to the side wall thereof; a combustion case carried in said casing and communicating at one end with one end of each of said tubes, said combustion case being open at the end thereof opposite to that communicating with said tubes; a gaseous fuel burner provided at one end with a fuel-projecting orifice; a mixing conduit receiving fuel discharged from said orifice and having a discharge end arranged to project fuel generally horizontally into the open end of said combustion case, said conduit being provided at its fuel-receiving end with a primary air inlet; an exhaust manifold case positioned at and communicating with the opposite ends of said tubes and having an outlet therein through which gaseous products of combustion emanating from said burner and conducted through said tubes may pass exteriorly of said casing, said manifold case being spaced circumferentially from the open end of said combustion case and defining therewith an open slot communicating radially with the central portion of the internal chamber of said casing; an electric motor-driven blower carried within said casing and arranged to draw air inwardly through the air intake opening of said bottom wall and thence to force the same radially and outwardly of the chamber of said casing across said tubes and thence through the perforations of said side wall and simultaneously through the open slot between said manifold case and the open

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end of said combustion case; and a vertically arranged imperforate wall extending between said manifold case and the open end of said combustion case on the side thereof opposite said open slot for directing air forced radially through said slot by said blower into the open end of said combustion case and axially through said tubes.

3. In a forced-air, forced-draft heater; a plurality of vertically spaced, substantially horizontally arranged, and arcuately curved, flat heat exchanger tubes defining a major segment of a circle; means defining an open-mouth combustion case at one end of said tubes; an exhaust manifold case communicating with the opposite ends of said tubes and spaced circumferentially from the open mouth of said combustion case; a fluid fuel burner having a fuel-projecting orifice; a mixing conduit into which fuel is projected from said orifice, said mixing conduit being formed at one end with a primary air inlet opening into the space between said manifold case and said combustion case and arranged to project a combustible fuel mixture into said combustion case and said heat-exchanger tubes; single air displacement means arranged to forcibly circulate air generally radially and outwardly across and between said heat-exchanger tubes throughout their entire length and thence outwardly into the atmosphere to be heated, said displacing means serving simultaneously to force a part of the air displaced thereby into the space between said combustion case and said manifold case; and an imperforate wall extending between said combustion case and said manifold case for directing air forced radially therein into the open mouth of said combustion case and axially of said tubes.

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