Aug. 22, 1950

E. A. NORMAN, JR
GAS FIRED FORCED DRAFT AND
AIR FLOW UNIT AIR HEATER

2,519,496

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2 Sheets-Sheet 1

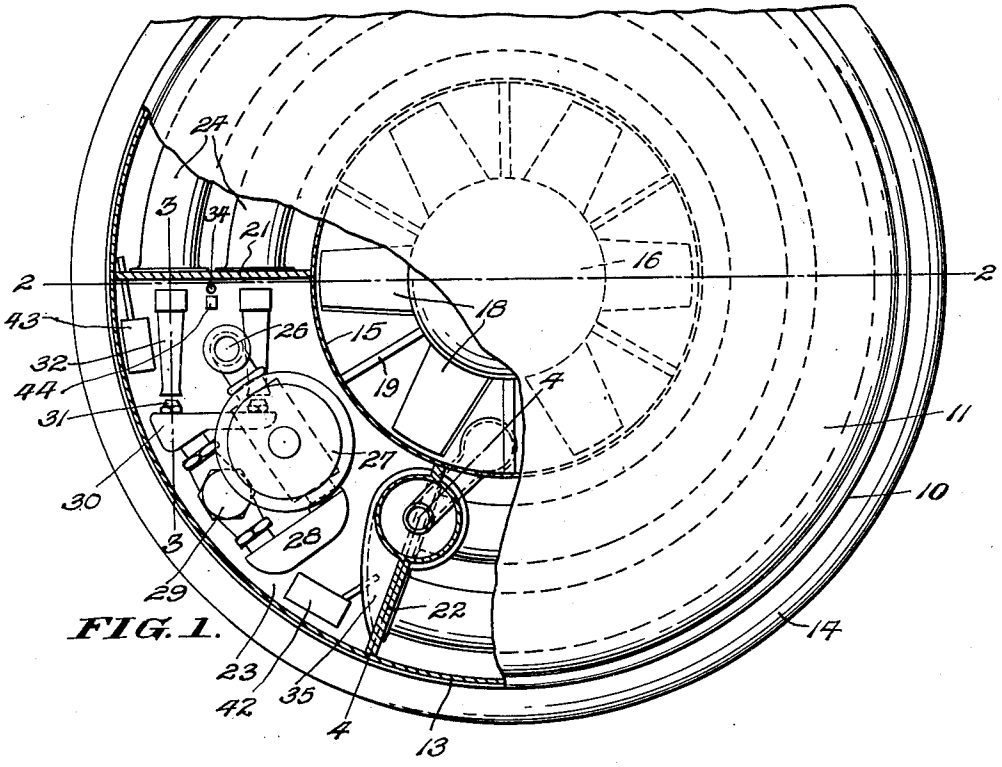


FIG. 1.

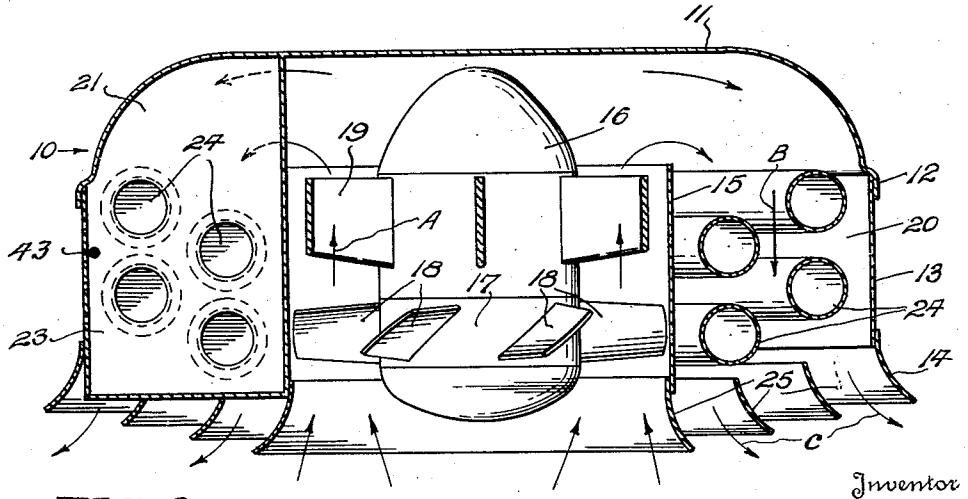


FIG. 2.

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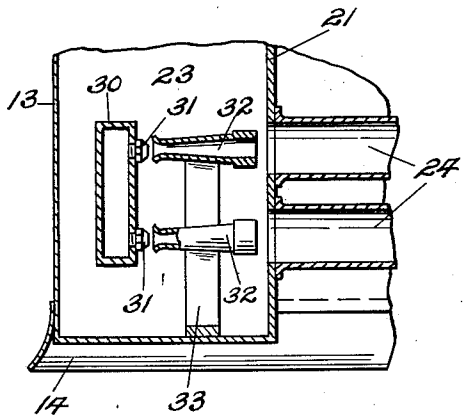
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FIG. 3.



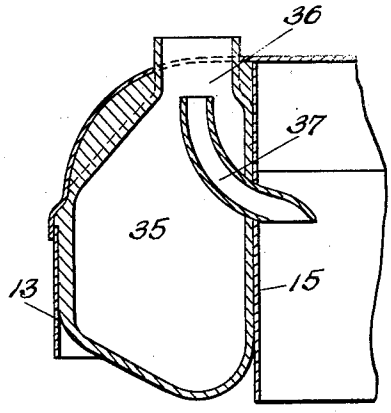


FIG. 4.

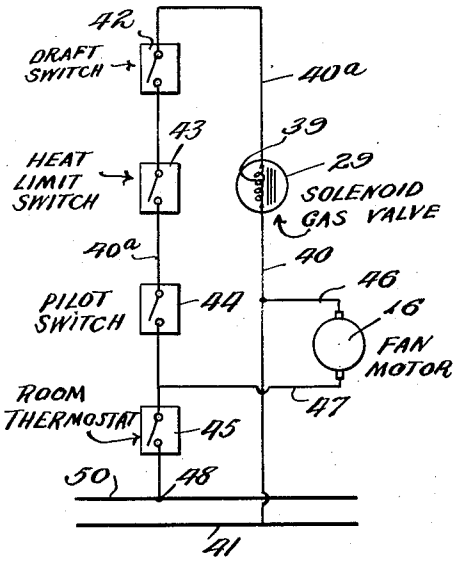


FIG. 5.

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GAS-FIRED FORCED DRAFT AND AIR FLOW UNIT AIR HEATER

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3 Claims. (Cl. 126—110)

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This invention relates to room-heating appliances, having particular reference to gas-fired unit heaters of the type adapted for mounting in relatively elevated positions in rooms or other enclosed areas to be heated, and wherein the heaters are of such construction that air, under forced flow produced by motor-driven air-displacing means, is advanced over the outer surfaces of internally heated heat-transferring tubes and thereafter directed downwardly and outwardly into the room or other space undergoing heating.

The conventional gas-fired unit heaters hitherto and now in general use employ vertical heat-exchanging tubes with the gas burners located below these tubes, so that the flames and combustion gases travel vertically upwardly through the tubes. A motor driven fan or blower is located behind this bank of vertical tubes so that air is blown over the tubes and discharged either horizontally and outwardly from the heater or, by means of controllable louvers or shutters, directed downwardly at an angle toward the room floor.

The rectangular shape of the casing of such a conventional unit heater provides an air tunnel around the heat-exchanging tubes which is also of rectangular form. Due to this shape, the efficiency of the fan is considerably impaired and areas known as "dead spots" (no air circulation) occur in the four corners as well as in the center of the heat exchanger, causing hot spots or locally over-heated areas in the heat-exchanging tubes. It may also be noted that these units must be suspended vertically from the ceiling of the space to be heated, and as the height above the floor is usually in excess of 8 feet, plus the fact that the air discharged must be at an angle to the floor, necessitates the use of relatively large fans operating at high speed in order to force the heated air down to and across the floor. Also, such heaters generally use natural draft for ventilating to the atmosphere the products of combustion issuing from the heat-exchanging tubes. Inasmuch as many of such unit heaters are installed in one-story buildings located adjacent to taller structures, there is a high prevalence of "down draft" which tends to choke off combustion in heat exchanging tubes or to cause condensation and other factors interfering with combustion and the desired rate of flow of the heated products of combustion through the heat exchanging tubes.

To overcome these and other objections, it is an object of the present invention to provide a

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unit heater possessing generally a circular formation, and which, in use, is adapted to be disposed in a substantially horizontal plane adjacent the ceiling of a room, the construction of the heater being such that heated air is discharged therefrom in a generally downward direction to provide for a more uniform and even distribution of heat than is obtainable with conventionally constructed and arranged unit heaters.

Another object is to provide a gas-fired unit heater for wall or ceiling mounting having a circular heat exchanger over which air is advanced positively, by fan operation in a manner eliminating "dead spots" in the air tunnel of the heater and thereby preventing localized overheating of the heat exchanging tubes.

A further object is to provide a unit heater formed with a heat exchanger composed of arcuate open-ended tubes suitably supported in a circular casing structure, gas burners being arranged to introduce burning gases into adjoining ends of said tubes and a venting manifold being arranged at the opposite ends of said tubes to vent the gaseous products of combustion issuing therefrom to the atmosphere.

An additional object is to provide a gas-fired unit heater having the characteristics set forth and wherein the venting manifold is formed with a Venturi throat leading to the atmosphere, and wherein air under positive flow of the heater fan is introduced into said throat in a manner producing negative pressure conditions in the heat exchanger tubes to facilitate travel of burner gases therethrough and positive pressures in the vent leading to the atmosphere to expel such gases in a manner precluding down drafts through the venting system under normal operating conditions.

It is still a further object of the invention to provide a unit heater in which smaller and less expensive motor driven fans may be employed for obtaining a given circulation of air than is feasible with the use of conventional vertically disposed and rectangular unit heaters.

For a further understanding of the invention, and additional objects and advantages thereof, reference is to be had to the following description and the accompanying drawings, wherein:

Fig. 1 is a top plan view of a gas-fired unit heater formed in accordance with the present invention, parts of the heater being broken away to disclose underlying structure;

Fig. 2 is a vertical transverse cross-sectional

view taken through the heater on the plane indicated by the line 2—2 of Fig. 1;

Fig. 3 is a fragmentary vertical sectional view on the plane disclosed on the line 3—3 of Fig. 1, illustrating the gas burner construction for introducing burning gases into the inlet ends of the heat-exchanging tubes;

Fig. 4 is a similar view on the line 4—4 of Fig. 1, disclosing the gas outlet manifold for venting combustion gases to the atmosphere and the air-injecting tube associated with said manifold.

Fig. 5 is a diagrammatic view disclosing the electrical wiring circuit employed in the automatic control system for the heater.

Referring more particularly to the drawings, the numeral 10 designates the circular outer shell or casing of my improved unit heater. Advantageously, the same may be formed from sheet metal, although other materials may be employed. In this instance, the shell or casing has been shown as embodying a top section 11 having an offset bottom flange 12 to which is welded or otherwise secured a circular intermediate section 13, and to the lower edge of this intermediate section, there is stationarily applied in any suitable manner an annular deflector ring or louver 14, the latter being substantially arcuate in cross section, as shown more particularly in Fig. 2.

Disposed concentrically within the outer shell or casing is an inner shell 15 which may also be formed from sheet metal. Within the inner shell, there is supported an electric motor 16, the armature shaft of which drives a fan hub 17 which, as shown, forms a symmetrical continuation of the stationary housing of the motor at its lower end. Radiating from the hub 17 are a plurality of air-displacing blades 18 which, when the motor is in operation, draw air from the room in which the heater is disposed and advance the same positively in a generally upward direction through the inner shell 15, as indicated by the arrows A of Fig. 2. Spaced spider arms 19 extend from the housing of the motor 16 to the inner shell for the purpose of supporting the motor in its operating position within the heater.

The upper edge of the inner shell 15 is spaced substantially below the top section 11 of the outer shell 10, so that air displaced by the fan blades 18 will flow over the upper edges of the inner shell, as indicated by the arrows B, and thence downwardly as at C through a generally circular chamber 20 formed between the inner and outer shells of the casing, the chamber 20 being provided with spaced vertical end walls 21 and 22, which define between them a segmental burner control chamber 23. Carried by the end walls 21 and 22, and disposed within the chamber 20, are a plurality of segmental heat-exchanging tubes or flues 24. Burning gases, or the hot gases resulting from the combustion of gaseous fuels, pass through the tubes or flues 24 to heat the heat-transmitting walls thereof, so that air flowing downwardly through the chamber 20 will sweep over the heated outer surfaces of these tubes or flues and thereby attain a temperature suitable for room-heating purposes. The heated air outlet at the bottom of the chamber 20 may contain a plurality of spaced deflector rings or louvers 25 disposed within and in concentric relation to the outer ring or louver 14. The arcuate curvature of these louvers or rings serves to direct the heated air downwardly and outwardly in the room area to be heated. While the rings or louvers have been shown as comprising stationary annular members, it will be appreciated that the same may be adjustably mounted on the heater casing to regulate or vary the direction of air travel therethrough.

Preferably the heater is of the gas-fired type, and a gas inlet is indicated by the numeral 26, this inlet being adapted for attachment with the gas-supplying pipes of a building. As shown in Fig. 1, the inlet 26 extends to a standard pressure regulator 27, and the gas issuing from the outlet of the regulator travels by way of the return bend, shown at 28, to a gas flow-controlling valve 29, the outlet of the valve being connected with a header 30. As shown in Fig. 3, the header is formed with a plurality of orifice plugs 31, which are arranged in spaced relation from a plurality of Venturi tubes 32, the latter being supported, as at 33, in the chamber 23, with the outlets of the tubes spaced from the inlet ends of the tubes or flues 24. A pilot is shown at 34 and is so arranged as to produce combustion of gas issuing from the tubes 32. Such combustion produces jetted flames which are projected into the inlet ends of the tubes or flues 24 so that the flames, and the heated products of combustion developed thereby, will pass through said tubes or flues, heating the relatively thin heat-transmitting walls thereof to temperatures sufficient to heat the air passing therethrough to a requisite degree for house or room-heating purposes. After the heated gases have traversed the full lengths of the tubes, the same are received in a venting manifold 35 arranged in the chamber 20 adjacent to the end wall 22 thereof. This manifold is formed with a throat 36 which is directed upwardly for connection with an outlet flue, not shown, leading to the atmosphere. In this instance, the heater has been shown as being provided with an aspirator tube 37, the lower open end of which extends through the inner shell 15 into the fan chamber, so that a portion of the air moving upwardly through said chamber, as a result of the action of the rotating fan blades 18, will be advanced through the tube 37 for delivery to the throat 36. This construction tends to produce negative pressures in the tubes or flues 24 in order to provide for positive flow of the hot gases therethrough. At the same time the tube 37, by discharging air into the throat 36, produces positive pressures on the escaping flue gases to cause their forced travel into the atmosphere, thereby overcoming down drafts or other forces tending to interfere with the fuel combustion and efficient operation on the part of the heater.

In connection with the apparatus disclosed, I also utilize automatic controls for assuring safety and efficient operation on the part of the heater. Thus, as illustrated in Fig. 5, the gas-controlling valve 29 is preferably of the solenoid actuated type. The field coil 39 of this valve is connected with a conduit 40 leading to a trunk conduit 41. From the opposite side of the coil 39, a conduit 40*a* extends to a draft controlling switch 42, thence to a heat limit controlling switch 43, a pilot switch 44 and a room positioned thermostatic switch 45. The fan motor 16 is connected with the conduit 40 by a lead 46 and with the conduit 40*a*, between the pilot switch 44 and the thermostatic switch 45, by a second lead 47. The conduit 40*a* is joined, as at 48, to a return trunk conduit 50.

Through the provision of the electrically oper-

ated solenoid gas valve 29, provision is made for controlling the supply of gas flowing to the main burner, and this supply is normally regulated by the thermostatic switch 45, subject to the safety control associated with the circuit. The fan motor 16 provides the means for controlling the circulation of heated air, and is turned on by the room positioned thermostatic switch 45. The fan controlled by the motor 16 also provides for induced draft through the combustion chamber and the associated tubes 24. The thermostatic switch 45 closes when the temperature of the room in which it is located falls below the desired temperature as determined by the setting of the usual dial, not shown, of such a switch. When the thermostatic switch is closed, the circuit to the fan motor and the solenoid gas valve is complete, providing the three safety controls, shown at 42, 43 and 44, are also closed. The unit heater will then operate to supply heat until the room temperature reaches the thermostatic setting, at which time the switch 45 will open to break the operating circuit.

Since the heater operates on the principle of induced draft, the safety draft controlling switch 42 has been provided, which completes the solenoid gas valve circuit when a predetermined minimum draft has been established by the operation of the fan. Should this draft fall below the minimum for any reason, the operating circuit will be opened, or remain open, and the gas supply to the burner turned off. The limit control switch 43 is normally closed and opens only when the ambient temperature of the heat-exchanging tubes reaches a predetermined safe maximum. Any temperature in excess of this maximum will cause the switch 43 to open, thereby interrupting the operating circuit.

The pilot switch, shown at 44, is normally closed by the heat of the pilot flame at the pilot burner shown at 34. If the pilot flame should be extinguished for any reason, the switch will open the circuit to the solenoid gas valve, thus turning off the gas in the main burner. Through the provision of these controls, the operation of the heater will be automatically regulated to provide for efficient and safe performance thereof.

I claim:

1. A gas-fired unit heater comprising: a substantially circular casing embodying a closed top, an outer annular side wall and a substantially open bottom; a stationary inner ring member disposed within said casing in concentric relation thereto, said member having an upper edge which throughout the major part of its periphery is spaced from said top so that an air passageway is provided thereover enabling air to flow upwardly through said ring member over the upper edge of the ring member and below said top and generally downwardly through a heat-exchanging space provided in said casing between said ring member and said outer annular wall; relatively spaced transversely extending supporting walls stationarily positioned in said casing between said ring member and the outer annular wall of said casing to provide a segmental burner and gas-control chamber substantially separated from said heat-exchanging space; a plurality of substantially arcuate heating tubes supported in said space, said tubes extending from one of said supporting walls to the other and having open fuel-receiving ends communicating with said chamber; valve-controlled burner means positioned in said chamber in registration with the open fuel-receiving ends of said tubes; a venting manifold connected with the ends of said tubes opposite to those in registration with said burner means; and motor-driven air-displacing means positioned in said casing for effecting a positive movement of atmospheric air upwardly through said ring member, over the upper edges of the ring member and downwardly through said heat-exchanging space for discharge from the open bottom of said casing.

2. A gas-fired unit heater comprising: a casing embodying a closed top, an outer side wall, and a substantially open bottom; an inner ring member positioned within said casing in spaced concentric relation to said outer side wall and throughout a major portion of its periphery in vertically spaced relation to the closed top of said casing and defining with the top and side wall of said casing an air passage extending upwardly from the bottom of said casing through said inner ring, laterally across the closed top, and downwardly between the outer side wall and inner ring; motor-driven air-displacing means positioned in said casing and operative to effect a positive movement of air upwardly through said ring member, thence laterally toward the outer side wall and downwardly through the space formed between said ring member and the outer side wall of said casing for discharge in a generally downward direction through the open bottom of said casing; a plurality of circumferentially spaced vertically arranged supporting walls carried in said casing between said ring member and said outer wall and extending vertically upwardly to the closed top of said casing; a plurality of substantially arcuate heating tubes having open ends carried by said supporting walls, said tubes being arranged between said ring member and said outer casing wall in the path of air moving downwardly through said casing under the influence of said air-displacing means; valve-controlled burner means positioned in said casing between said supporting walls and arranged to project combustible gases into one end of said tubes; and means communicating with the opposite ends of said tubes and positioned between said supporting walls for venting gases discharged from said tubes.

3. A gas-fired unit heater comprising: a casing embodying a closed top, an outer side wall, and a substantially open bottom; an inner ring member positioned within said casing in spaced concentric relation to said outer side wall and throughout a major portion of its periphery in vertically spaced relation to the closed top of said casing and defining with the top and side wall of said casing an air passage extending upwardly from the bottom of said casing through said inner ring, laterally across the closed top, and downwardly between the outer side wall and inner ring; motor-driven air-displacing means positioned in said casing and operative to effect a positive movement of air upwardly through said ring member, thence laterally toward the outer side wall and downwardly through the space formed between said ring member and the outer side wall of said casing for discharge in a generally downward direction through the open bottom of said casing; a plurality of circumferentially spaced vertically arranged supporting walls carried in said casing between said ring member and said outer wall and extending vertically upwardly to the closed top of said casing; a plurality of substantially arcuate heating tubes having open ends carried by said sup-

porting walls, said tubes being arranged between said ring member and said outer casing wall in the path of air moving downwardly through said casing under the influence of said air-displacing means; valve-controlled burner means positioned in said casing between said supporting walls and arranged to project combustible gases into one end of said tubes; means communicating with the opposite ends of said tubes and positioned between said supporting walls for venting gases discharged from said tubes; and means extending between said inner ring member and said venting means for diverting a portion of the air moving upwardly through said ring member from general flow through said casing and introducing such diverted air in the form of a jet into said

venting means to induce positive flow of burner gases through said tubes.

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