United States Patent [19]

Cowan

[11] **3,805,763**

[45] **Apr. 23, 1974**

[54] **FLUSH-MOUNTABLE, SELF-COOLING GAS-FIRED HEATER**

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[21] Appl. No.: **282,488**

[52] **U.S. Cl.** ..... **126/92 R,** 431/329, 126/92 B

[51] **Int. Cl.** **F24c 3/04**

[58] **Field of Search** .... 126/92 R, 92 A, 92 B, 92 C; 219/343, 347; 431/328, 329, 351, 352

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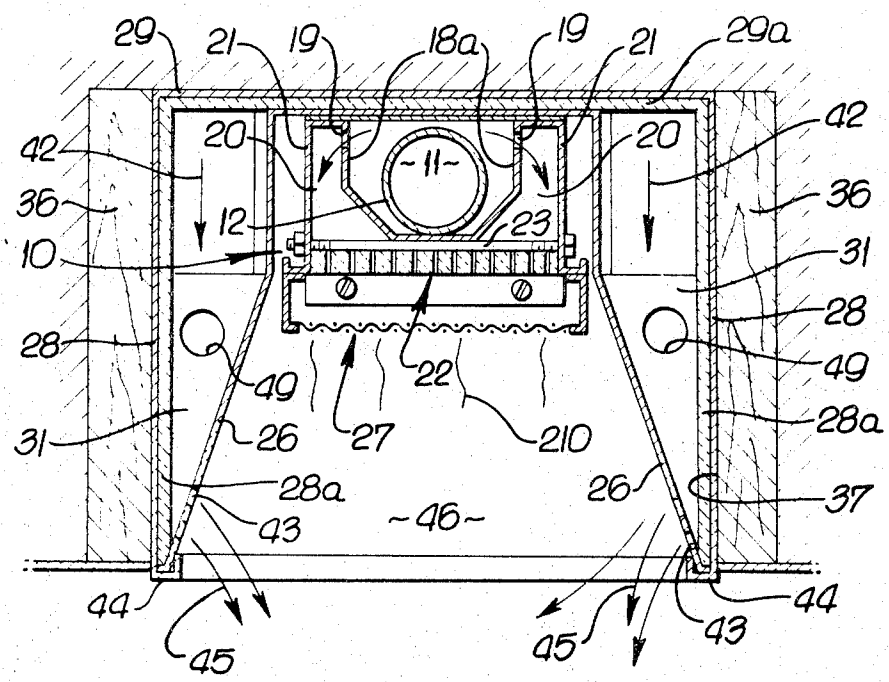
Primary Examiner—Carroll B. Dority, Jr.
Attorney, Agent, or Firm—William W. Haefliger

[57] **ABSTRACT**

A self cooling radiant heater structure for highly efficient infrared heating comprises a heat generator to produce frontwardly directed infrared radiation; and, means including a case for the generator and forming a cooling air flow path or paths extending within the case and about the generator for directing the cooling air to discharge frontwardly and tending to draw hot gas away from the front side of the generator. The heat generator may comprise a gas burner or an electrically energized heating element, and a blowing device may be carried by the case for supplying a stream of cooling air to the described flow path or paths.

8 Claims, 5 Drawing Figures



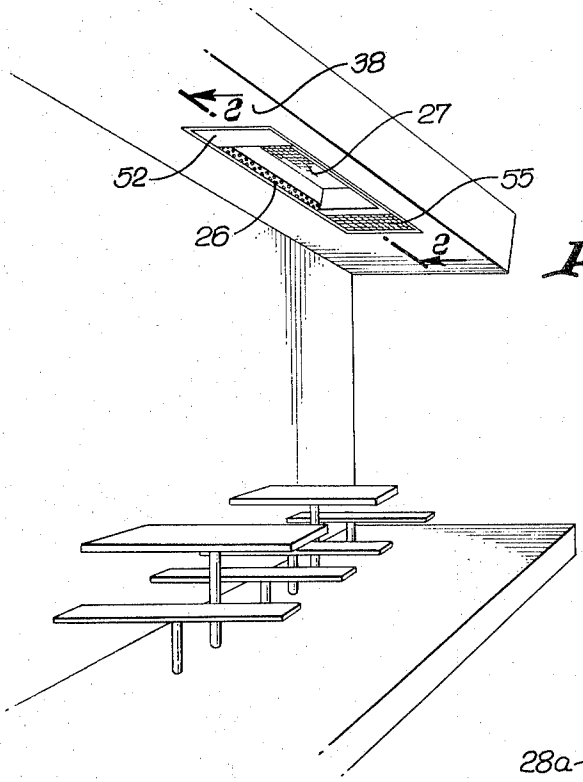


FIG. 1.

FIG. 5.

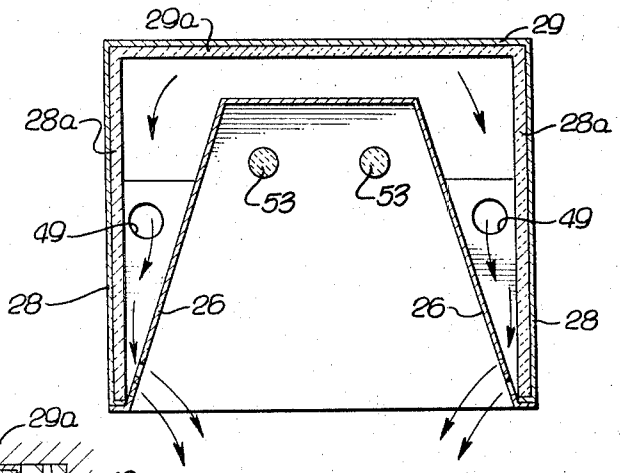
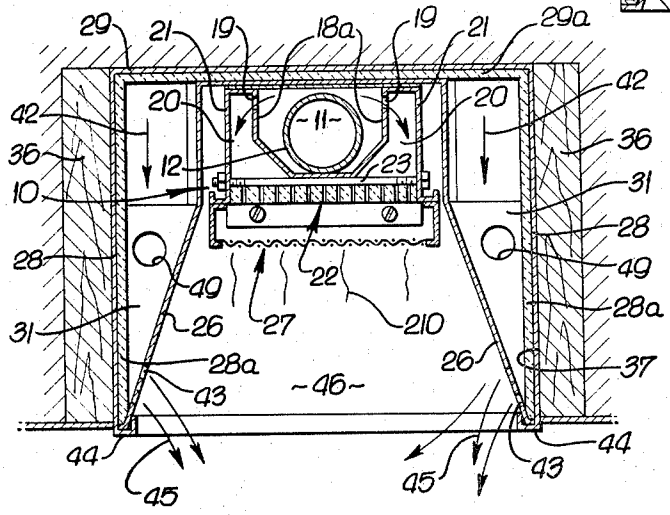


FIG. 4.



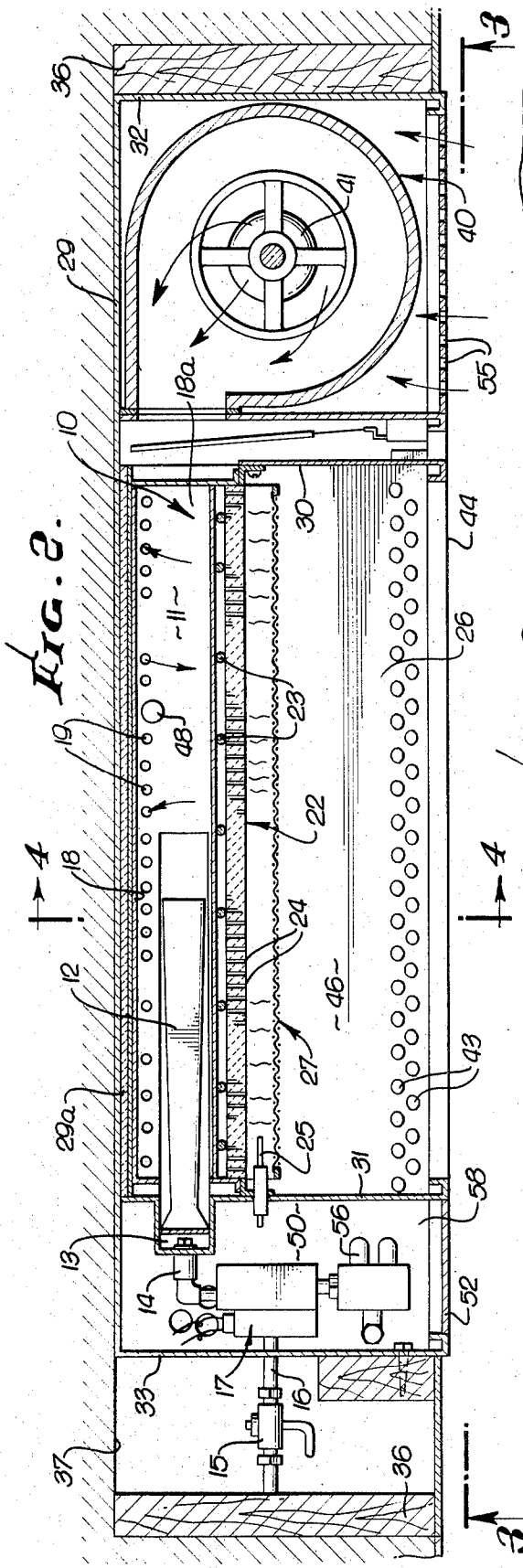

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Fig. 2.

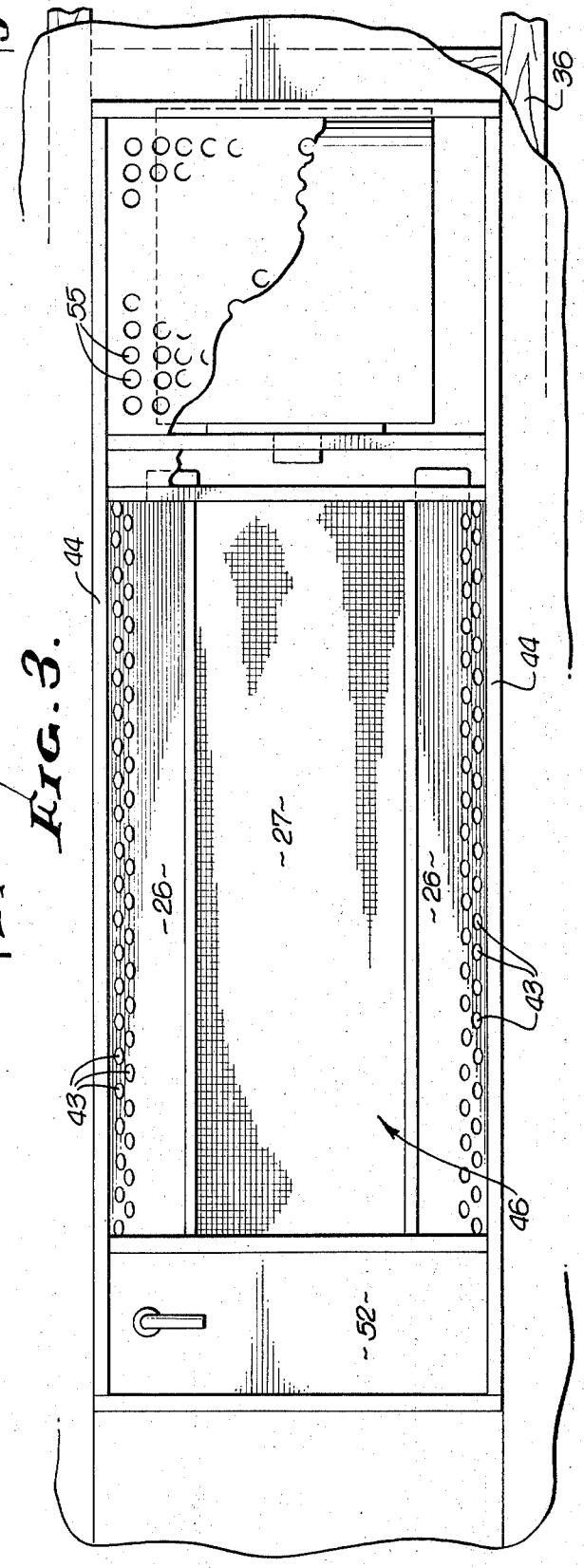
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Fig. 3.

FLUSH-MOUNTABLE, SELF-COOLING GAS-FIRED HEATER

BACKGROUND OF THE INVENTION

This invention relates generally to radiant heaters, and more specifically concerns the use of self cooling radiant heater structure for highly efficient infrared heating. Apparatus embodying the invention is particularly suited to infrared heaters of the type requiring protection from wind and rain and also those heaters requiring recessing in a combustible ceiling or wall in such a manner that the heater may be safely operated without causing a fire hazard condition.

In the past, ceramic plate type gas infrared heaters have been used for space heating and in process heating environments. Such burners and heaters using these burners have been considered highly advantageous because they emit infrared radiant energy at a high temperature level; however, gas operated units as well as electric units suffer a disadvantage when exposed to wind and water which can disrupt the operation of the heating element and cause a reduced flame efficiency or burner outage. The exposed heating element type infrared heater is generally the most efficient because it radiates energy directly from the heating element to the object to be warmed. As explained, use of such a heating element under windy conditions cause a reduction in the radiant output. Further, a portion of the heat from the heating element travels upward by convection necessitating the heater to be placed a considerable distance below combustible material to minimize the fire hazard. This requirement has not been considered generally acceptable to the architect who considers the aesthetics of the building, and often times would prefer to see such heating devices installed flush to a ceiling rather than hanging a distance of two or three feet below.

SUMMARY OF THE INVENTION

It is a major object of the invention to provide self cooling heating apparatus overcoming the above disadvantages.

Basically, the apparatus comprises a heat generator to produce frontwardly directed infrared radiation; and, means including a case for the generator, and forming a cooling air flow path or paths extending within the case and about the generator for directing the cooling air to discharge frontwardly and tending to draw hot gas away from the front side of the generator. As will be seen, the heat generator may comprise a gas burner or an electrically energized heating element, and a blower may be carried by the case for supplying a stream of cooling air to he described flow path or paths.

Further, the case may define a frontwardly opening recess at the front side of the heat generator, there being panel structure, as for example frontwardly diverging reflector panels, facing the recess at the side or sides thereof, the panel or panels forming a discharge opening or multiple openings for directing the cooling air to discharge in a forwardly and laterally angled direction across the front of the recess. Typically, oppositely directed discharge cooling air streams impinge frontwardly of the heating element to draw hot gas away from the latter preventing hot gas build-up and thereby minimizing the fire hazard. The pressurized air from the blower may optionally be used to power air into the burner to increase its burning rate or the burner can also operate by low pressure injection of air into the gas stream by the gas pressure itself. In the electric version, the blower may be used to cool the enclosing casing and eject the heated air away from the area of the electric heating element maintaining the casing at a relatively low temperature.

The air pressure from the blower therefore serves a multipurpose, in that such air cools the casing or cabinet in which the burner or heating element is located, and it also ejects the hot gases away from the unit, as these gases must be drawn away from the heating element so that newly combusted gases can burn properly. The jets of air discharging from the heater function as an anti-wind force to oppose drafts and winds from the outdoor weather conditions. This serves to prevent outside wind from reaching the heating element itself in that the pressurized jets of air from the blower push away from the element outside air pressure and cuase a steady state burning condition or atmosphere to surround the heating element itself. An additional use of blower assembly is to supply pressurized air to the inlet of the burner enabling burning of gas at a higher rate and at a more intense temperature than would be otherwise possible under normal low pressure gas injection.

While the exposed flame type ceramic infrared heater has been marketed in this country for approximately two decades, to date no heater of this design has apparently been able to meet the national certification requirements of the American Gas Association. These requirements state that the appliance must operate without burner flame outage in a 15 mile an hour wind and that it must ignite at that wind velocity. Because the latter would normally draw the flame off an exposed flame type ceramic surface, no exposed flame type appliance has previously been able to pass these requirements. By the use of the opposing air jets emanating from the heating unit described herein, an anti-wind force is created, acting against the exposure to outdoor wind conditions which protects the exposed flame atmosphere from the ravaging effects of outdoor wind. The disclosed device has been tested and found to offer a surprisingly successful solution to the problem of operating an exposed flame type ceramic infrared heater in wind velocities well exceeding 15 miles an hour. Further, the jets of air discharging from the unit are most useful prior to discharge in cooling the enclosing cabinet as well as in pressurizing the actual burner inlet. All of the air so used can be discharged in such a manner as to oppose outdoor wind conditions as well as enable the appliance to be recessed in a ceiling with only the radiant surface exposed for heating by radiation downward.

In order to burn the combustible gases in a gas operated unit, at least 100 percent of the air required for complete combustion must be introduced as primary air. The heating capacity of a given area of ceramic surface can be greatly increased by introducing a greater supply of air and gas through the inlet mixing chamber with pressurized air. Even though this device can be operated with unpressurized inlet burner air, the addition of air pressure to the inlet side of a gas burner does allow for an increased volume of gas to be burned with the resulting of higher radiant surface temperature of the ceramics. Inasmuch as the efficiency of the heating unit increases in a relationship to the fourth power of

its absolute temperature, such an increase in surface temperature is highly beneficial to increased operating efficiency of the burner itself.

These and other objects and advantages of the invention as well as the details of illustrative embodiments, will be more fully understood from the following detailed descriptions of the drawings, in which:

DRAWING DESCRIPTION

FIG. 1 is a perspective showing of an installation of one heating unit incorporating the invention;

FIG. 2 is a sectional side view taken along lines 2—2 of FIG. 1;

FIG. 3 shows the bottom view taken on line 3—3 of FIG. 2;

FIG. 4 is a section taken on line 4—4 of FIG. 2; and

FIG. 5 is a view like FIG. 4, but showing a modified form of the invention.

DESCRIPTION OF PREFERRED EMBODIMENTS

Referring first to FIGS. 1 – 4, heat radiating apparatus embodying the invention includes a heat generator to produce frontwardly directed infrared radiation, one such generator comprising a gas burner **10.** The latter may for example receive a gas air mixture into the mixing chamber **11** via a mixer tube **12,** air and gas entering that tube via air inlet **13** and gas inlet **14,** respectively. A gas inlet control valve is shown at **15** controlling gas flow to inlet **14** via tubing **16** and pressure regulating means **17.** The gas-air mixture is distributed along the length of the burner as by means of an internal baffle **18** within which the burner is received. The opposite side panels **18***a* of the elongated baffle contain a lengthwise series of perforations or outlet openings **19** passing the mixture into the elongated chamber **20** passed between panels **21** and **18***a*. This structure allows the gas-air mixture to be substantially uniformly distributed along the length of chamber **20** and to the rear side of ported ceramic plaques **22,** which are also part of the heat generator structure, and may be considered to define a burner head.

The plaques may be supported in series as seen in FIGS. 2 and 4 between panels **21,** fasteners **23** extending between the latter providing clamping force. The gas-air mixture escapes to the front side of the plaques via a multiplicity of burner through ports **24.** Typically, the ports may be less than one-sixteenth inch in diameter, there normally being more than 150 such ports per square inch of burner head surface. The thickness of the plaques may in general be between one-fourth and three-fourths inch.

The gas-air mixture may be ignited at the front surface of the plaques by a spark igniter or pilot indicated at **25,** when gas inlet control valve **15** is open. The resultant flames lie very close and over to the front surfaces of the plaques, and typically do not project more than one-fourth inch from such surfaces. Accordingly, the latter are typically heated to a glowing condition in the temperature range 1,500° to 1,800° F. The radiant surface at this temperature emits heat rays traveling at the speed of light pursuant to a highly efficient heat transfer rate according to the Stephen-Boltzman radiation formula, that formula specifies that the rate of radiation is directly proportional to the fourth power of the absolute temperature difference between the radiating surface and the receiving surface. Reflectors or panels **26** are used to direct the heat rays forwardly in a fixed pattern and to concentrate the heat rays within the desired pattern. A stainless steel or Inconel metal screen **27** having at least 50 percent open area can be used directly in front of the glowing ceramic plaques with a spacing of one-fourth to 1 inch away from the plaques. The effect of the screen is to increase the radiation efficiency of the ceramic plaques themselves by causing a re-radiation of heat energy back to the surface of the plaques, intensifying their surface temperature and thus increasing the overall efficiency of radiation. The Inconel or metal screen device can be optionally used.

In accordance with an important aspect of the invention, means including a case for the heat generator is provided, to form a cooling air flow path extending within the case and about the heat generator for directing cooling air to discharge frontwardly of the generator. The construction is such that the frontward discharge of cooling air tends to draw hot gas (such as air) directly at the front of the generator forwardly away from the generator, preventing overheating of the equipment. In the FIG. 1 – 4 example, a box-like elongated case is defined by side walls **28,** rear wall **29,** opposite inner end walls **30** and **31,** and outer end walls **32** and **33.** Insulative lining for the walls may be provided as at **28***a* and **29***a*. The case may be set into a recess formed by a building wall or ceiling and receiving the major extend of the case, as in the drawings. For example, wooden structure **36** associated with the building wall or ceiling may define a recess **37** receiving the case, and without danger of overheating due to the novel construction of the apparatus. FIG. **1** shows the apparatus built into the ceiling **38** of an outdoor eating establishment.

A blower or fan assembly **40** is driven by a motor **41** to discharge pressurized cooling air to circulate via flow paths at **42** between the outer case as described and the interior surfaces of the reflector panels **26.** The reflectors can be of one-piece U-shaped construction as shown so as to totally protect the burner flames from any stray air currents. The air thus introduced between the casing and the reflector is normally at ambient temperature and will minimize any rise in temperature of the case which might otherwise occur due to the heated gases exhausting from the surface of the burner as well as heat conducted from the reflectors **26.** The circulating air exits near the outer edges of the reflectors through a series of perforations or holes **43** which are adjacent to the discharge bottom or outer surface **44** of the heating unit. It should be noted that the discharged air jets **45** are directed downwardly and away from the heating unit at such an angle as to draw the hot combusted gases **210** downward and away from the burner and recess **46** formed between panels **26,** and with such velocity that the hot gases will mix with the discharged air jets as the mixture is carried a foot or more away from the heater and the surrounding possibly combustible ceiling **38.** In this regard, national standards applicable to heaters require that a combustible surface may not reach a temperature exceeding 90°F above that of the surrounding room air.

To provide increased safety in operation of the appliance, a limit control **48** may be installed to shut off the gas valve **17** to the burner should the blower fail to operate, or should the motor burn out. Such a limit control may operate to shut off the burner within a few sec-

onds after it has ignited if there if no air supply to cool the cabinet. An air opening **49** can be made in the case inner end wall **31** so that some pressurized air may be used to pressurize the control compartment **50.** Such air can then flow to the air inlet **13** of the mixer tube **12** causing a pressurized mixture of air with gas. Note that this pressurized mixture exits from the ported ceramic plaques **22** and becomes discharged between the outwardly diverging reflectors **26,** and therefore can be ejected from the appliance by means of the discharge air jets **45.** Normally gas pressure is delivered from the gas mains in the pressure range of 3 to 9 inches of water column. This gas pressure is sufficient to inject a good volume of air into the mixer tube **12** by virtue of the normal gas pressure alone. However, the burning rate at the burner ports **24** can be increased by using a portion of the pressurized air just described to increase the flow of air with the use of a larger measured portion of gas, resulting in an increased surface temperature of the exterior surface of the ported ceramic plaques **22.** If the burner mixer tube is not pressurized, an air opening can be formed in wall **52** to being air through the control compartment **50** to the mixer air inlet **13.** If pressurized air is utilized through air openings **49,** then no inlet air openings in wall **52** would be required.

The modification in FIG. **5** illustrates electric heating elements **53** which can be used in place of the described gas burner, the remainder of the appliance construction remaining the same. There exists a good measure advantage to the use of the pressurized blower with an electric heating element to prevent outside winds from blowing against the electric heating element and cooling the temperature of the latter. It will be recalled that any lowering of the surface temperature of the heating element will greatly reduce the efficiency of the heating apparatus. The anti-wind force of the discharge air jets **45** serves also to minimize air velocity in the area adjacent to the burner flames described above, or the area of the electric heating elements **53.** Further, some convected heat is created by the electric heating elements, which must be removed by the blower to maintain the temperature of the cabinet sufficiently low that it will not create a fire hazard to the adjacent possibly combustible surfaces **38.**

It will be appreciated that this invention provides a device which prevents a reduction in the radiant efficiency of a heating element due to indoor or outdoor wind or breeze conditions in the area of the heating unit. It should be noted that the basic design permits the cabinet top sides, and ends to be entirely sealed and thus provides complete protection against the elements such as rain entering the unit from its top side when installed as shown. It should be further noted that no vent or venting system is required above the heating unit, as all combusted gases and circulating heat are ejected downward and away from the unit itself. This construction enables the entire cabinet to be recessed in combustible material with only the heater face exposed to view. A flanged surface can be attached to the periphery of the bottom of the heating unit when the unit is recessed in a ceiling with only the heater face exposed. If it is desired to install the unit with the cabinet top against or in contact with a combustible ceiling, the flanged surface could be removed from the heater.

Blower air inlet openings **55** may be provided for the introduction of cooling room temperature air. An electrical inlet **56** and a gas inlet may be installed in the control compartment through the cabinet wall portion **58.**

I claim:

1. In heat radiating apparatus, the combination comprising

a. a heat generator including a fuel gas burner to produce downwardly directed infrared radiation, the burner facing downwardly and comprising ceramic structure defining a large number of relatively small through ports communicating between the rear and front sides of the burner to pass the gas-air mixture for controlled combustion at the front side of the burner,

b. means including a case for said generator, and forming a cooling air flow path extending within the case and about the generator for directing the cooling air to discharge frontwardly and downwardly of the generator, the case defining a frontwardly opening recess at the front side of the burner and said means including panel structure facing said recess at the lateral side thereof and forming at least one discharge opening directing said cooling air to discharge in a downwardly and laterally angled direction across the front of the recess, and

c. a blowing device carried by the case for supplying a stream of cooling air to the flow path to discharge downwardly at the front of the recess with sufficient velocity to carry hot exhaust gases downwardly away from the burner.

2. The combination of claim **1** wherein said distributor includes a mixer tube extending generally parallel to said ceramic structure, and baffle means extending between the tube and ceramic structure and containing ports spaced lengthwise of the tube to pass the mixture to said rear side of the ceramic structure.

3. The combination of claim **1** wherein said panel structure includes a pair of panels extending downwardly in diverging relation away from zones at opposite sides of the burner, each panel forming multiple cooling air discharge openings, as defined, and at laterally opposed locations so that discharged cooling air streams impinge forwardly and downwardly of the heat generator.

4. The combination of claim **3** wherein said case and burner are longitudinally elongated, and the blower is located endwise of the burner.

5. The combination of claim **4** wherein the heat generator includes a gas-air mixture distributor at the rear of the burner with a gas-air mixture inlet at the end of the case opposite the blower.

6. The combination of claim **1** including a metallic screen closely spaced from the burner at the front side thereof to pass heat radiation forwardly and to become heated by the burner and re-radiate heat back to the burner for intensifying the burner surface temperature.

7. The combination of claim **1** including a building wall forming a recess receiving the major extent of the case with the burner exposed to the front exterior of the building wall.

8. The combination of claim **1** including a path for communicating pressurized air from the blower to the gas burner inlet.

* * * * *

UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,805,763 Dated April 23, 1974

Inventor(s) Edwin J. Cowan

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Column 6, line 32; " 2. The combination of claim 1 wherein said distribu- " should read -- 2. The combination of claim 7 wherein said distribu- --

Signed and sealed this 19th day of November 1974.

(SEAL)
Attest:

McCOY M. GIBSON JR.
Attesting Officer

C. MARSHALL DANN
Commissioner of Patents

FORM PO-1050 (10-69)

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