(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
9 September 2011 (09.09.2011)

PCT

(10) International Publication Number
WO 2011/106824 A1

(51) International Patent Classification:
F23D 14/12 (2006.01) *F23N 5/18* (2006.01)
F23N 5/12 (2006.01)

(21) International Application Number:
PCT/AU2011/000204

(22) International Filing Date:
25 February 2011 (25.02.2011)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
2010900896 3 March 2010 (03.03.2010) AU

(71) Applicant *(for all designated States except US)*: **BROMIC PTY LIMITED** [AU/AU]; 15 Suttor Street, Silverwater, New South Wales 2128 (AU).

(72) Inventors; and
(75) Inventors/Applicants *(for US only)*: **SMITH, Scott** [AU/AU]; 10 Eastview Avenue, North Ryde, New South Wales 2113 (AU). **MICHALOWSKY, Mark** [AU/AU]; 6 Burrabirra Avenue, Vauclause, New South Wales 2030 (AU).

(74) Agent: **PHILLIPS ORMONDE FITZPATRICK**; Level 21, 22 & 23, 367 Collins Street, Melbourne, Victoria 3000 (AU).

(81) Designated States *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PE, PG, PH, PL, PT, RO, RS, RU, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:
— *with international search report (Art. 21(3))*

(54) Title: WIND RESISTANT HEATER

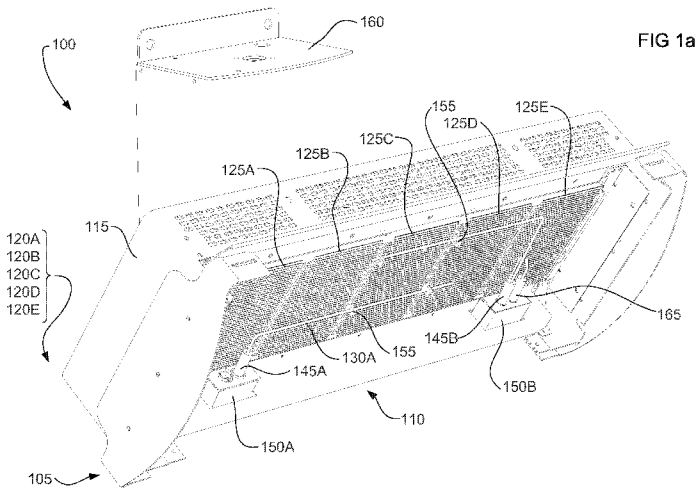


FIG 1a

(57) Abstract: A radiant gas heater is provided which includes one or more gas inlets (105), for receiving gas from a gas supply and one or more air inlets (110). The heater includes one or more gas burners (120A - 120E), in which gas from the one or more gas inlets (105) is burned using oxygen admitted through the one or more air inlets (110). One or more heat emitting elements (125A - 125E) are included, which emit infrared radiation using energy generated by the one or more gas burners (120A - 120E). One or more ionization probes (130A) are provided proximal to two or more of the heat emitting elements (125A - 125E) for detecting the presence or absence of a flame. A housing (115) is also provided which accommodates the one or more gas burners (120A - 120E), the one or more heat emitting elements (125A - 125E) and the one or more ionization probes (130A). One or more control units are also provided which are in electrical communication with the one or more ionization probes (130A) and the one or more gas inlets, the one or more control units operable to shut off the gas supply if the one or more ionization probes (130A) detect the absence of a flame.

WO 2011/106824 A1

WIND RESISTANT HEATER

Field of the Invention

The present invention relates to a radiant gas heater and more particularly to an outdoor radiant gas heater which is operable in windy conditions.

Background of the Invention

Changes in consumer tastes and regulations (i.e. anti-smoking) have resulted in larger usage of outdoor areas both commercially and domestically for eating and entertaining. As a result, the use of radiant gas or outdoor type heaters has increased.

Radiant gas heaters offer an effective source of radiant heat which is essential for outdoor applications. Radiant gas heaters having ceramic tiles are particularly effective. However a problem with this type of heater is that it does not function well in windy conditions since it requires consistent air flow at low speed to function and burn correctly. Wind turbulence will cause the burner to fail.

In an attempt to alleviate this problem, electronically controlled gas valves are used which enable the heater to be shut down in the event of flame failure and operated without manually lighting, re-lighting and extinguishing the burners.

Electronically controlled gas valves typically have a thermocouple and pilot burner arrangement. The thermocouple is used for sensing the presence of a flame and works together with the pilot burner (distant from the main burner so as to be isolated from wind). The pilot burner is typically in an enclosure so as to maintain a constant flame.

A problem with this arrangement is that using a pilot burner to keep the main burner alight in wind is unreliable since the main burner will still extinguish and must re-light from the pilot burner each time it blows out. Inconsistency therefore results as gas control lock out can occur before re-lighting. In the event of a lock out, a full manual re-set is required which may require power to be disconnected and reconnected.

Use of pilot burners can be avoided by using an ionization detector. An ionization detector may be provided directly on the main burner and can

provide quicker lighting and quicker shut down in the event of flame failure. However, a problem with ionization detectors is that they are only suited to indoor applications. Ionization detector arrangements are unsuitable for outdoor applications since the rapid response of the ionization detector prevents their usage on a burner exposed to windy conditions. This arrangement has not been possible in outdoor applications as wind is unavoidable and usage of an ionization system results in the problem of continuous burner “blow out” (failure).

It would therefore be desirable to provide an improved radiant gas heater which alleviates or at least ameliorates the above disadvantages.

It will be appreciated that a reference herein to any matter which is given as prior art is not to be taken as an admission that that matter was, in Australia or elsewhere, known or that the information it contains was part of the common general knowledge as at the priority date of the claims forming part of this specification.

Summary of the Invention

With this in mind, one aspect of the present invention provides a radiant gas heater including: one or more gas inlets, for receiving gas from a gas supply; one or more air inlets; one or more gas burners, in which gas from the one or more gas inlets is burned using oxygen admitted through the one or more air inlets; one or more heat emitting elements, which emit infrared radiation using energy generated by the one or more gas burners; one or more ionization probes proximal to two or more of the heat emitting elements for detecting the presence or absence of a flame; a housing, which accommodates the one or more gas burners, the one or more heat emitting elements and the one or more ionization probes; one or more control units in electrical communication with the ionization probes and the one or more gas inlets, the control unit operable to shut off the gas supply if the one or more ionization probes detect the absence of a flame.

Advantageously, the use of at least one (or more) ionization probes allows one or more heat emitting elements to extinguish, but provided that the ionization probes is still sensing a flame at one of the heat emitting elements, the gas supply will not be shut off. Advantageously, this results in the radiant

gas heater remaining in operation even in windy conditions while maintaining safety. In a further advantage, the use of only one ionization probe across two or more heat emitting elements reduces the cost while still avoiding the gas supply being shut off unnecessarily.

Preferably, the one or more ionization probes extend across the length of two or more of the heat emitting elements.

In an alternative, two or more ionization probes may be proximal to one or more heat emitting elements for detecting the absence of a flame.

Advantageously, the use of two or more ionization probes allows one or more burners to extinguish, but provided that at least one of the ionization probes is still sensing a flame, the gas supply will not be shut off. Advantageously, this results in the radiant gas heater remaining in operation even in windy conditions while maintaining safety.

The two or more ionization probes may extend across the length of a heat emitting element.

Preferably, the two or more ionization probes extend across the length of two or more of the heat emitting elements.

Preferably, the one or more control units are operable to maintain the gas supply if the one or more ionization probes detect the presence of a flame on at least one of the heat emitting elements.

Advantageously, since the one or more ionization probes can sense if there is a flame present or not at any point across the ionization probe (which may be across a single heat emitting element or across multiple heat emitting elements) this allows the radiant gas heater to be kept on even in the absence of a flame on one or more (but not all) burners. The flame must be strong enough to generate an ionization level sufficient to meet the minimum current requirements in the control unit. Advantageously, this arrangement prevents blow out due to cold spots which can occur around specific segments of the heat emitting elements due to turbulent wind. In a further advantage, the use of multiple ionization probes (or a single ionization probe across multiple heat emitting elements) picks up the presence of a flame across a point along the heat emitting elements (provided the flame is strong enough). Constant gas flow through the heat emitting elements will then ensure that cross lighting continues to occur, thus avoiding total blow out.

Preferably, the one or more control units are operable to shut off the gas supply if the one or more ionization probes detect the absence of a flame on each of the two or more heat emitting elements. Advantageously, if there is a total blow out (i.e. all burners have blown out) the control unit shuts down the gas supply.

The heat emitting elements may be selected from a group including ceramic tiles, compressed metal mesh or metal foam.

Preferably, one or more spacer elements are positioned between the one or more ionization probes and the one or more heat emitting elements.

Advantageously, the spacer elements position the ionization probes so that they are protected from too much heat and at the same time secure the position of the ionization probes and the distance of the ionization probes from the heat emitting elements.

Preferably, the one or more spacer elements are made of a non-conducting material such as ceramics.

Preferably, the two or more ionization probes further include a mount attached to one end of the ionization probe for mounting to the control unit.

Advantageously, the mount prevents the ionisation probes from being earthed over an extended period of use of the radiant gas heater.

Preferably, the mount is made of a non-conducting material such as ceramics.

Preferably, the radiant gas heater further includes a cover attachable to the housing, wherein the cover is formed from ceramic glass. Advantageously, the cover acts to further protect the radiant gas heater from being susceptible to wind.

In an alternative, the radiant gas heater includes a cover attachable to the housing, the cover including a plurality of apertures through which infrared radiation is directed.

Advantageously, the cover acts to further protect the radiant gas heater from being susceptible to wind but with less material than a full cover which reduces manufacturing costs.

Preferably, the cover is formed from a material which is capable of withstanding high temperatures and substantially transparent to infrared radiation.

Preferably, the combined surface area of the plurality of apertures is between 45 to 55% of the total surface area of the cover.

More preferably, the combined surface area of the plurality of apertures is 49 to 51% of the total surface area of the cover.

Advantageously, the apertures may allow heat flow but also act to prevent wind from blowing out the burners. The above surface area of the apertures compared with the total surface area of the cover provides a balance between heat flow and wind resistance.

The following description refers in more detail to the various features and steps of the present invention. To facilitate an understanding of the invention, reference is made in the description to the accompanying drawings where the invention is illustrated in a preferred embodiment. It is to be understood however that the invention is not limited to the preferred embodiment illustrated in the drawings.

In the drawings:

Figure 1a is a perspective view of a radiant gas heater in accordance with an embodiment of the invention;

Figure 1b is a front view of a radiant gas heater of figure 1a;

Figure 2 is a front view of a cover for use with the radiant gas heater of Figures 1a and b; and

Figures 3A to 3G are schematic diagrams of the arrangement of ionization probes of the radiant gas heater of Figures 1a and b.

Detailed Description of Embodiments of the Invention

The radiant gas heater 100 illustrated in Figure 1 includes a gas inlet 105 for receiving gas from a gas supply (not shown), a plurality of air inlets 110 are included in the underside of the housing 115 of the radiant gas heater 100 allowing air to enter and waste gases to escape. The housing 115 also includes a plurality of gas burners 120A-E in which gas from the gas inlet 105 is burned using oxygen in air admitted through the air inlets 110. Waste gases leave the housing 115 through the same air inlets 110 or alternatively separate exhaust outlets (not shown). It will be appreciated that any number of gas burners may be associated with the radiant gas heater 100. A mounting

bracket 160 is attached to the housing 115 for attaching the gas heater 100 to a surface.

The radiant gas heater 100 further includes heat emitting elements 125A-125E each of which sit in front of burners 120A-120E. It will be appreciated that there may be one burner for each heat emitting element or there may be one burner for every two heat emitting elements. The heat emitting elements 125A-125E emit infrared radiation using energy generated by the gas burners 120A-120E. Heat is then directed away from the heat emitting elements 125A-125E and through a cover (shown in Figure 2) to provide heat to the outdoor area. Heat emitting elements are preferably ceramic tiles, but may be made from any other suitable material (such as compressed metal mesh or metal foam). In an alternative embodiment, there may be more than one housing 115 which accommodates the burners 120A-E and heat emitting elements 125A-E such that one housing accommodates the gas burners and another housing accommodates the heat emitting elements and so on. The radiant gas heater 100 includes an ignition 165 for lighting or relighting the heat emitting elements 125A-E and further includes two ionization probes 130A, 130B having respective first ends 135A and 135B and second ends 140A and 140B. Ionization probes 130A, 130B are positioned proximal to the heat emitting elements 125A-125E. The first ends 135A and 135B of the ionization probes 130A and 130B include mounts 145A and 145B which are attached to a control unit 150A and 150B mounted on the housing 115. The mounts 145A and 145B are used in order to prevent the ionisation probes from being earthed over an extended period of use of the radiant gas heater 100. Since the ionization probe is a true electrical conductor (a wire in its simplest form), over time, through exposure to heat and the external environment, the surface of the wire will oxidise and therefore build up an insulating layer. The electrical signal will find the quickest path to earth and unless mounts 145A and 145B are used, it will run to earth and the signal will be lost (causing the flame to be extinguished since the ionization circuit is earthed- for safety reasons) This situation will occur if the mounts are metal or even if ceramic rings are used which are held in by metal holders (in between the burners). The ionization probes 130A, 130B are secured at the first ends 135A and 135B by the mounts 145A and 145B and also secured to the heat

emitting elements 125A-125E via spacer elements 155. The spacer elements 155 are preferably located at the second ends 140A and 140B of the ionization probes 130A, 130B and at points in between the first and second end of the ionization probes. Preferably, the spacer elements 155 space the ionization probes 3-4mm away from the heat emitting elements 120A-E. The spacer elements 155 are preferably of a non-conductive material such as ceramics.

The control unit 150A and 150B is in electronic communication with the gas inlet and gas valve (not shown) in order to control operation of the gas to the burners 120A-120E. In operation, the ionization probes 130A and 130B are positioned proximal to one or more of the heat emitting elements 125A-125E. The ionization probes 130A and 130B provide rapid response times in detecting the absence of flame and therefore ensure quicker lighting and quicker shut down in the event of flame failure. Flame failure is typically due to windy conditions which blow out the one or more burners. The operation of the ionization probes will not be described in great detail, since it will be apparent to those skilled in the art. The ionization probes work on the principle that a small current is applied between the ionization probe and earth and the flame creates an ionized path between the ionization probe and earth. In the event that the flame is in an unstable condition (such as flapping due to windy conditions), the ionized path is disturbed which causes interference in the current signal. A control unit will then shut down the gas supply and after a short time, and attempt to restart the system. Since ionisation probes work on the principle that micro current is applied between the rod and ground. The flame acts as an ionisation path, therefore the heater will shut down almost instantly (micro-seconds) in the event both sensors sense the absence of flame.

In the present invention, the provision of two or more ionization probes which extend along the heat emitting elements 125A-125E ensures a consistent and continuous signal sensed by the ionization probes over a larger area of the heat emitting elements 125A-125E. In this way, if heat emitting elements 125A and 125B are being affected by wind which is coming from left to right, the ionization probe 130A may detect an unstable condition and wish to shut down the burners 120A-E via the control unit 150A. However, it may be that heat emitting elements 125 C, D and E have not been extinguished or

are not in an unstable condition. This is determined by the ionization probe 130B. If ionization probe 130B determines that there is no unstable condition, then the burners 120A-E will not be shut down, since even if burner 120A and/or 120B associated with heat emitting element 125A, 125B are extinguished and leaking gas, the heat emitting elements 125 C, D and E will be able to safely re-light heat emitting element 125B and 125A after a short period of time (due to their proximity). Advantageously, this results in the radiant gas heater 100 remaining in operation even in windy conditions while maintaining safety.

In the event that ionization probes 130A and 130B both detect that the burners 120A-E are off, then the control unit 150A, 150B shuts off the gas supply.

It will be appreciated that two or more ionization probes can be positioned in any arrangement extending across the surface area of one or more of the heat emitting elements 125A-125E. This is shown in Figure 3A-3F.

Further, it will be appreciated, as shown in Figure 3G, that one ionization probe may be positioned in any arrangement extending across the surface area of two or more of the heat emitting elements 125A-125E. Advantageously, the use of one ionization probe allows, for example, heat emitting element 125A to extinguish, but provided that the ionization probe is still sensing a flame at another heat emitting element 125B, the gas supply will not be shut off. Advantageously, this results in the radiant gas heater remaining in operation even in windy conditions while maintaining safety. In a further advantage, the use of only one ionization probe across two or more heat emitting elements reduces the cost while still avoiding the gas supply being shut off unnecessarily.

Figure 2 shows a cover 200 which may be placed over the housing 115. The cover 200 includes a plurality of apertures 205 each of which is preferably substantially circular in shape. The apertures may alternatively be square or oval. Apertures with a continuous edge (i.e. round or oval) have been found to perform best as a wind diffuser when receiving wind from a number of different directions onto the heat emitting elements (i.e. in different X and Y planes). Advantageously, the provision of a cover 200 over the housing 115 acts to

further assist the radiant gas heater 100 from being susceptible to wind. The apertures 205 allow heat flow but also act to prevent wind from blowing out the burners 120A-E. The arrangement of the apertures 205 and in particular the surface area of the apertures compared with the total surface area of the cover 200 may provide a balance between heat flow and wind resistance.

Preferably the combined surface area of the plurality of apertures is between 45 to 55% of the total surface area of the cover. More preferably, the combined surface area of the plurality of apertures is 49 to 51% of the total surface area of the cover. The 45% - 55% area also impacts the size and pattern of the apertures 205. The preferred size is approximately 7mm – 12mm in diameter.

Figures 3A-F are schematic diagrams of possible arrangements of the two or more ionization probes according to the invention. Figure 3G is a schematic diagram showing one of any number of possible arrangements where one ionization probe is positioned in any arrangement extending across the surface area of two or more of the heat emitting elements 125A-125E. Figure 3A illustrates a radiant gas heater 100 having three heat emitting elements 125A, 125B and 125C. Each heat emitting element 125A, 125B and 125C has two ionization probes 305, 310; 315, 320; and 325, 330 to detect the presence or absence of a flame on heating elements 125A, 125B and 125C. In the event that ionization probe 305, 310; 315, 320; and 325, 330 detects an unstable condition on 125A, 125B and 125C then it will shut down burners associated with 125A, 125B and 125C via a control unit 150A. However, it may be that one (or even two) of heat emitting elements 125A, 125B and 125C have not been extinguished or are not in an unstable condition. This is determined by the ionization probes 305, 310; 315, 320; and 325,330. If ionization probe 305, 310; 315, 320; and 325,330 determines that there is no unstable condition, then the burners associated with heating elements 125A, 125B and 125C will not be shut down, since even if, for example burners associated with heat emitting element 125A, 125B are extinguished and leaking gas, heat emitting element 125C will be able to safely re-light heat emitting element 125B and 125A after a short period of time (due to their proximity). Advantageously, this results in the radiant gas heater 100 remaining in operation even in windy conditions while maintaining safety.

Figure 3B illustrates a radiant gas heater 100 having three heat emitting elements 125A, 125B and 125C. Heat emitting element 125A and 125C has an ionization probe 335, 340. Ionization probe 335 extends across heat emitting elements 125A and 125B while ionization probe 340 extends across heat emitting elements 125C and 125B to detect the presence or absence of a flame.

Figure 3C illustrates a radiant gas heater 100 having three heat emitting elements 125A, 125B and 125C. Each heat emitting element 125A, 125B and 125C has two ionization probes 345, 350; 355, 360; and 365, 370 positioned at an inclined angle to detect the presence or absence of a flame.

Figure 3D illustrates a radiant gas heater 100 having three heat emitting elements 125A, 125B and 125C. Heat emitting elements 125A and 125C has an ionization probe 375, 380. Ionization probe 375 extends at an inclined angle across heat emitting elements 125A and 125B while ionization probe 340 extends at an inclined angle across heat emitting elements 125C and 125B to detect the presence or absence of a flame.

Figure 3E illustrates a radiant gas heater 100 having three heat emitting elements 125A, 125B and 125C. Heat emitting element 125A and 125C has an ionization probe 385, 390. Ionization probe 385 extends across heat emitting elements 125A, 125B and 125C, while ionization probe 390 extends across heat emitting elements 125C, 125B and 125A to detect the presence or absence of a flame.

Figure 3F illustrates a radiant gas heater 100 having three heat emitting elements 125A, 125B and 125C. Each heat emitting element 125A, 125B and 125C has three ionization probes 395, 400, 405; 410, 415, 420; and 425, 430, 435 to detect the presence or absence of a flame.

Figure 3G illustrates a radiant gas heater 100 having three heat emitting elements 125A, 125B and 125C. Heat emitting element 125A has an ionization probe 440. Ionization probe 440 extends across heat emitting elements 125A, 125B and 125C to detect the presence or absence of a flame on heating elements 125A, 125B and 125C. In the event that ionization probe 440 detects an unstable condition on 125A, 125B and 125C then it will shut down burners associated with 125A, 125B and 125C via a control unit 150A.

However, it may be that one (or even two) of heat emitting elements 125A, 125B and 125C have not been extinguished or are not in an unstable condition. This is determined by the ionization probe 440. If ionization probe 440 determines that there is no unstable condition, then the burners associated with heating elements 125A, 125B and 125C will not be shut down, since even if burners associated with heat emitting element 125A, 125B are extinguished and leaking gas, heat emitting element 125C will be able to safely re-light heat emitting element 125B and 125A after a short period of time (due to their proximity). Advantageously, this results in the radiant gas heater 100 remaining in operation even in windy conditions while maintaining safety.

Although the exemplary embodiments of the invention have been disclosed for illustrative purposes, those skilled in the art will appreciate that various modifications, additions and substitutions are possible without departing from the scope of the present invention. Therefore, the present invention is not limited to the above-described embodiments but is defined by the following claims.

CLAIMS:

1. A radiant gas heater including:

one or more gas inlets, for receiving gas from a gas supply;

one or more air inlets;

one or more gas burners, in which gas from the one or more gas inlets is burned using oxygen admitted through the one or more air inlets;

one or more heat emitting elements, which emit infrared radiation using energy generated by the one or more gas burners;

one or more ionization probes proximal to two or more of the heat emitting elements for detecting the presence or absence of a flame;

a housing, which accommodates the one or more gas burners, the one or more heat emitting elements and the one or more ionization probes;

one or more control units in electrical communication with the ionization probes and the one or more gas inlets, the one or more control units operable to shut off the gas supply if the one or more ionization probes detect the absence of a flame.

2. The radiant gas heater of claim 1, wherein the one or more ionization probes extend across the length of two or more of the heat emitting elements.

3. The method of claim 1, wherein two or more ionization probes are proximal to the one or more heat emitting elements for detecting the absence of a flame.

4. The radiant gas heater of claim 3, wherein the two or more ionization probes extend across the length of a heat emitting element.

5. The radiant gas heater of claim 4, wherein the two or more ionization probes extend across the length of two or more of the heat emitting elements.

6. The radiant gas heater of claim 1, wherein the one or more control units are operable to maintain the gas supply if the one or more ionization probes detect the presence of a flame on at least one of the heat emitting elements.

7. The radiant gas heater of claim 1, wherein the one or more control units are operable to shut off the gas supply if the one or more ionization probes detect the absence of a flame on each of the two or more heat emitting elements.

8. The radiant gas heater of any one of the preceding claims, wherein the heat emitting elements are selected from a group including ceramic tiles, compressed metal mesh or metal foam.

9. The radiant gas heater of any one of the preceding claims, further including one or more spacer elements positioned between the one or more ionization probes and the one or more heat emitting elements.

10. The radiant gas heater of any one of the preceding claims, wherein the one or more spacer elements are made of a non-conducting material such as ceramics.

11. The radiant gas heater of any one of the preceding claims, wherein the two or more ionization probes further include a mount attached to one end of the ionization probe for mounting to the control unit.

12. The radiant gas heater of any one of the preceding claims, wherein the mount is made of a non-conducting material such as ceramics.

13. The radiant gas heater of any one of the preceding claims, further including a cover attachable to the housing, wherein the cover is formed from ceramic glass.

14. The radiant gas heater of any one of claims 1 to 12, further including a cover attachable to the housing, the cover including a plurality of apertures through which infrared radiation is directed.

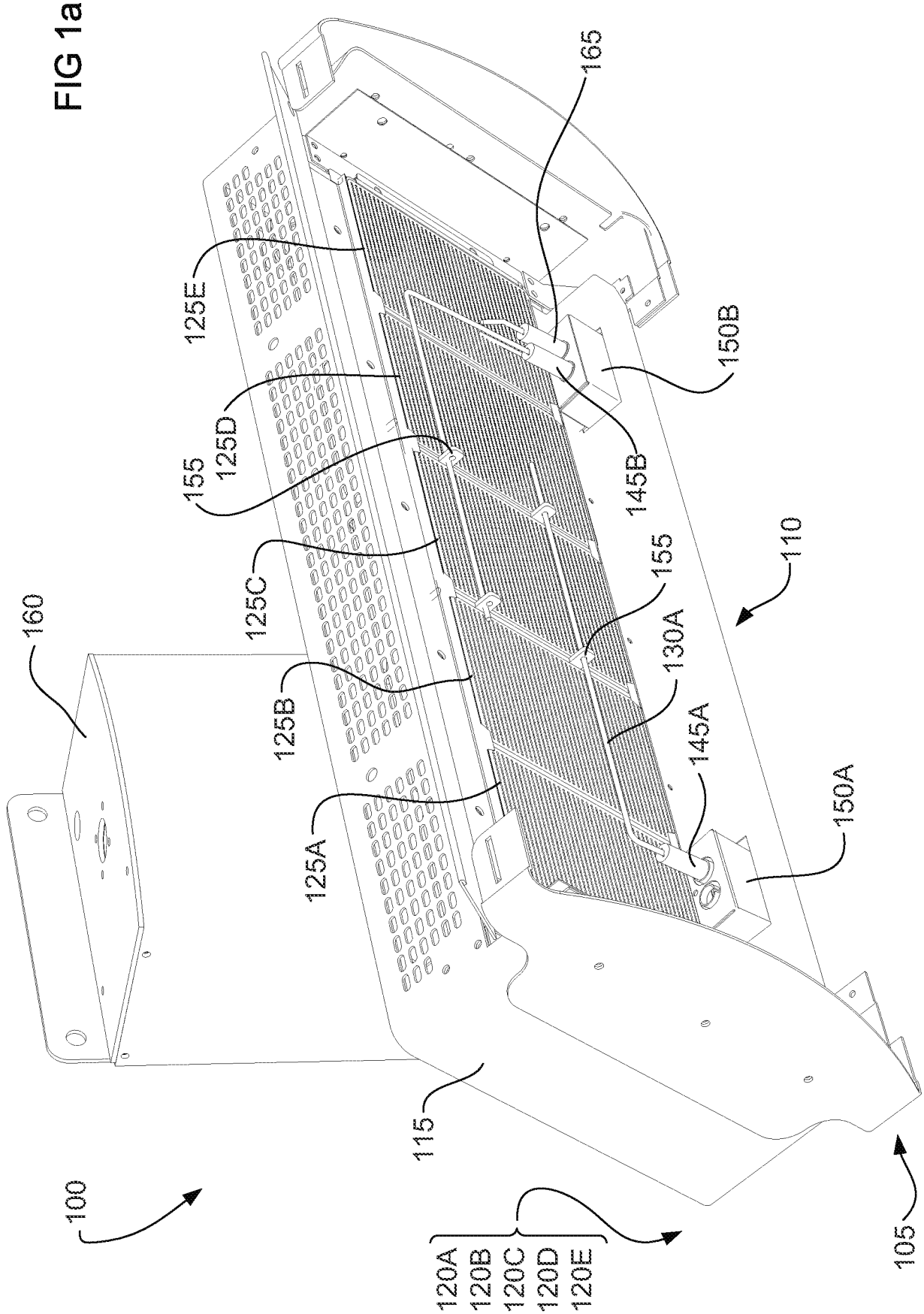
15. The radiant gas heater of claim 14, wherein the cover is formed from a material which is capable of withstanding high temperatures and substantially transparent to infrared radiation.

16. The radiant gas heater of claim 14 or 15, wherein the combined surface area of the plurality of apertures is between 45 to 55% of the total surface area of the cover.

17. The radiant gas heater of any one of claims 14 to 16, wherein the combined surface area of the plurality of apertures is 49 to 51% of the total surface area of the cover.

18. A radiant gas heater, substantially as herein described with reference to the accompanying drawings.

FIG 1a


165
125E
150B
155
125D
145B
125C
155
110
160
130A
125B
145A
150A
125A
115
100
105
120A
120B
120C
120D
120E

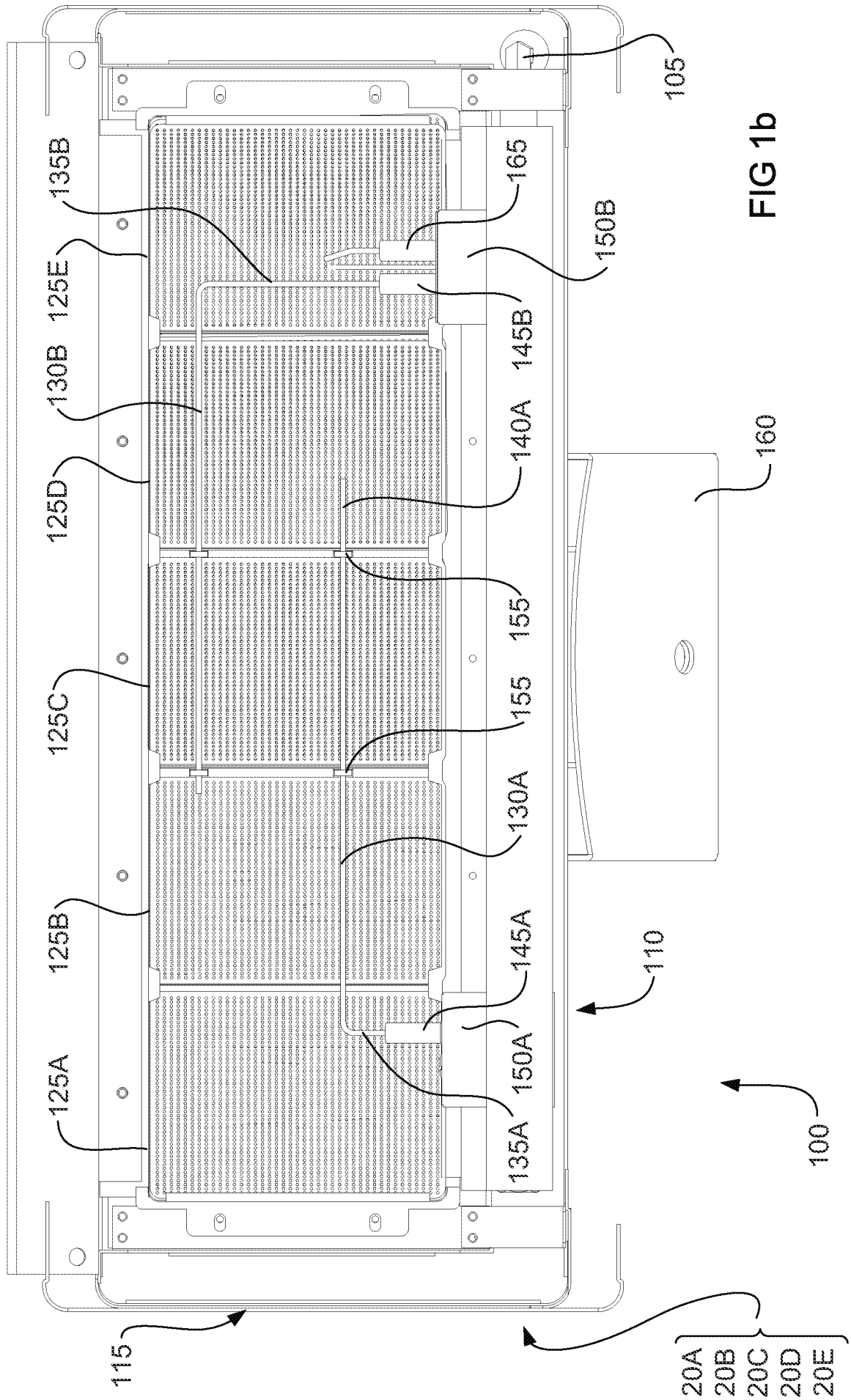

105
135B
165
150B
125E
145B
130B
140A
160
125D
155
125C
155
130A
125B
145A
110
125A
150A
135A
100
115
120A
120B
120C
120D
120E

FIG 1b

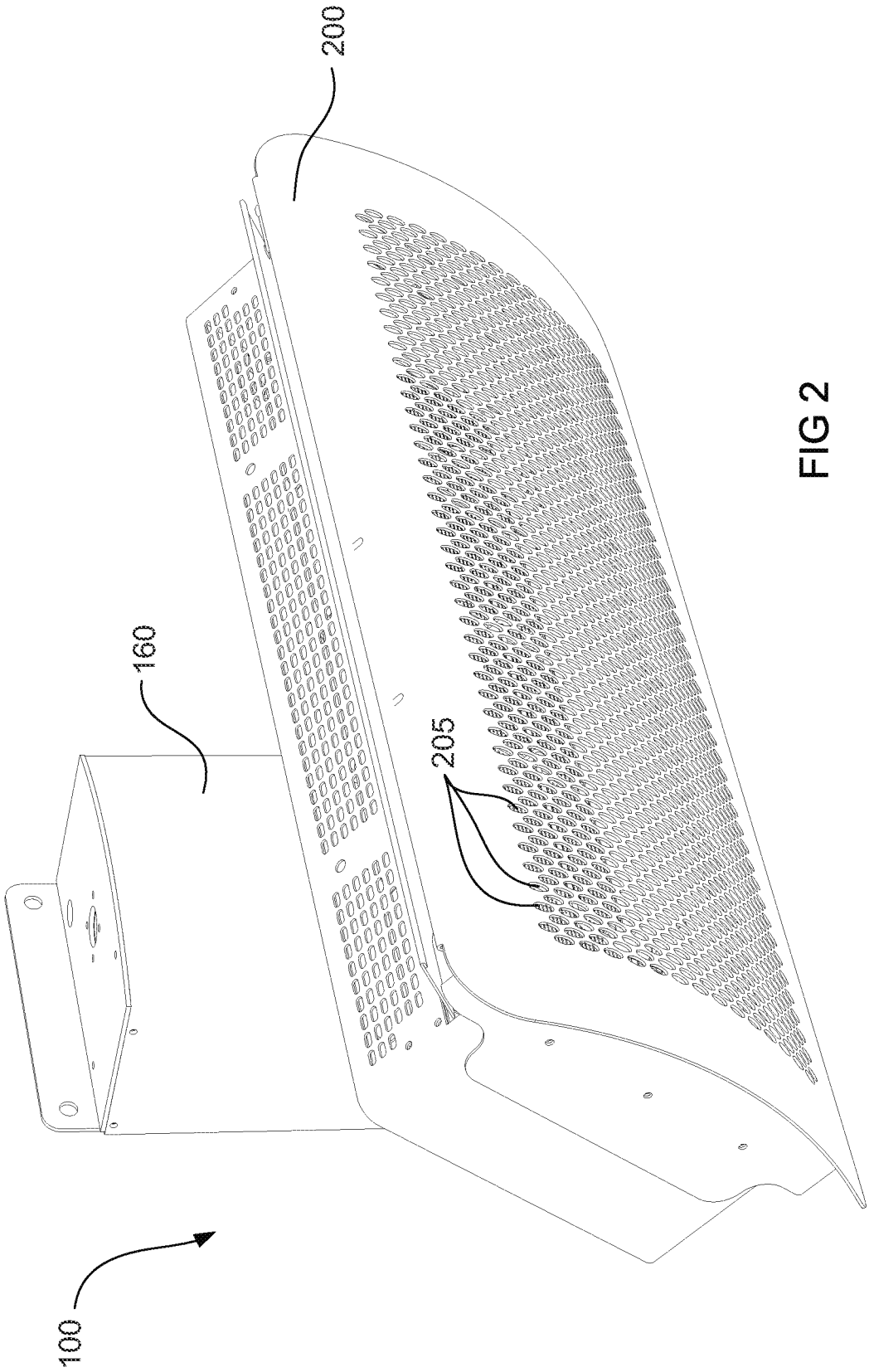


FIG 2

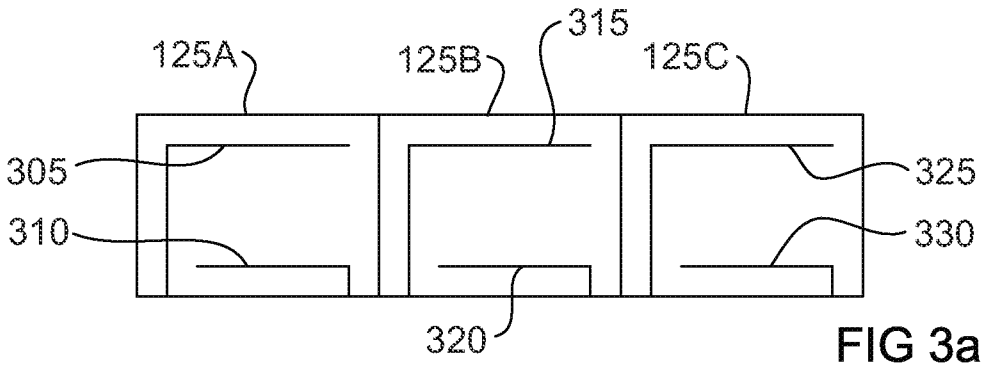


FIG 3a

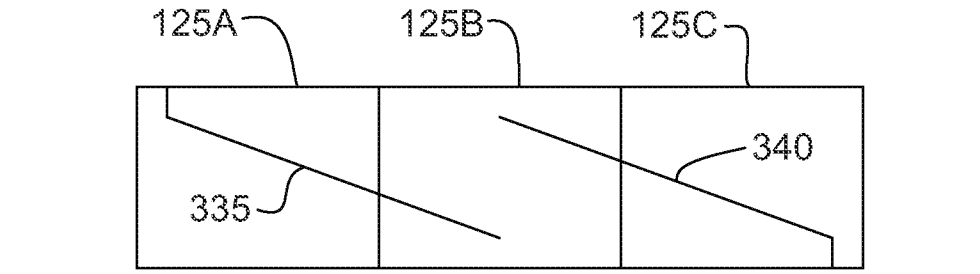


FIG 3b

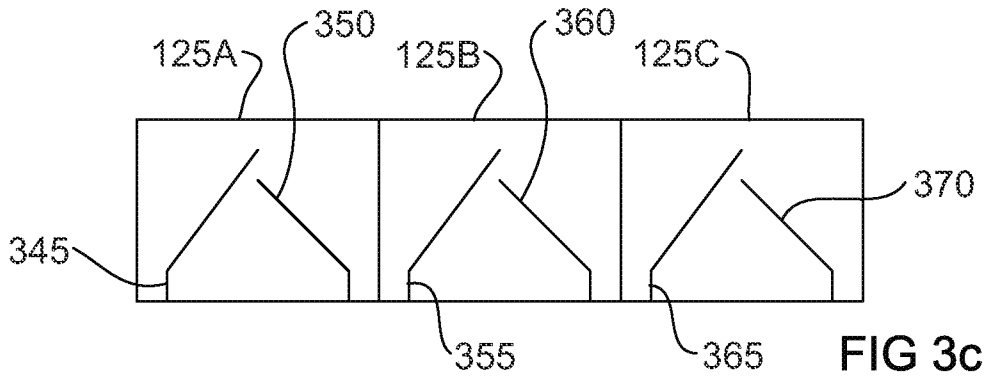


FIG 3c

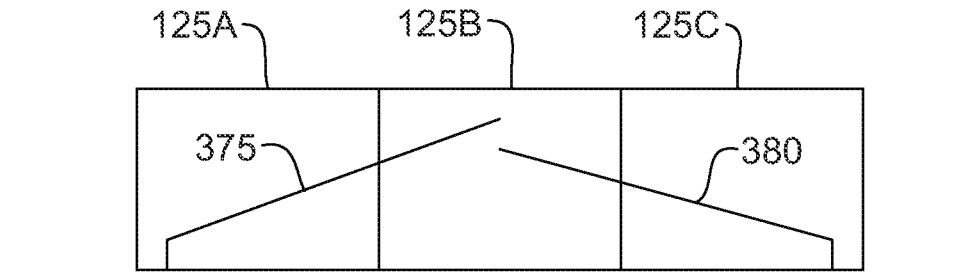


FIG 3d

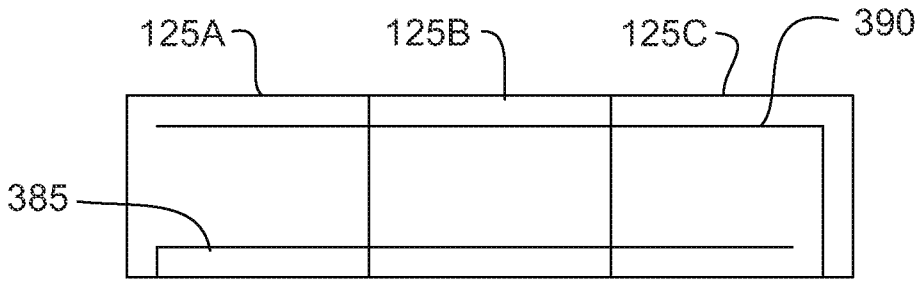


FIG 3e

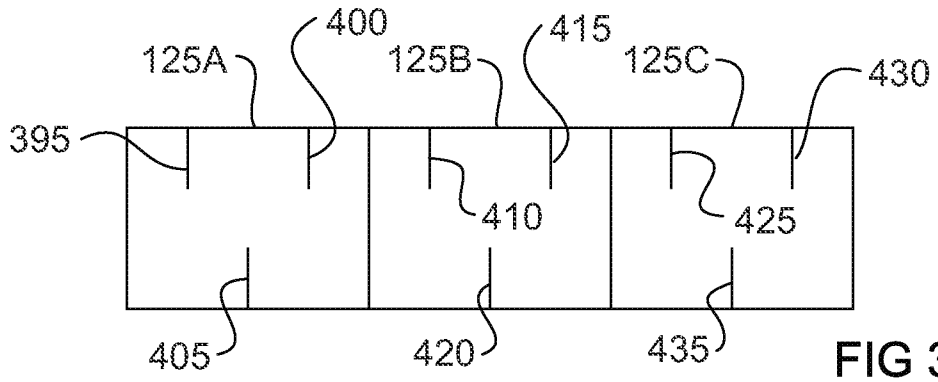


FIG 3f

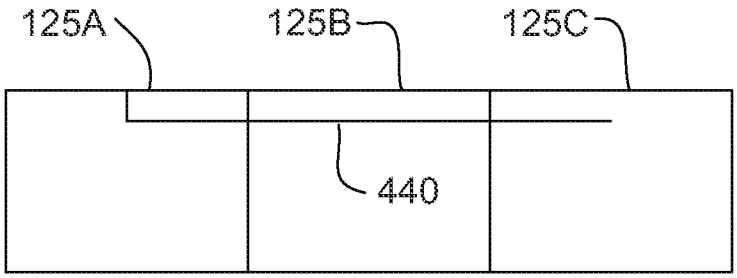


FIG 3g

INTERNATIONAL SEARCH REPORT

International application No.
PCT/AU2011/000204

A. CLASSIFICATION OF SUBJECT MATTER

Int. Cl.

F23D 14/12 (2006.01) ***F23N 5/12*** (2006.01) ***F23N 5/18*** (2006.01)

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
WPI, EPODOC databases (EPOQUE) Keywords, IPC: (RADIANT 3D HEATER) OR (+INFRA_RED 3D HEATER); (BURNER OR GAS); (OUTDOOR+ OR WINDY OR TURBULEN+ OR OUTSIDE OR SIDE_WALK); ION+; THERMO_SENSITIVE OR IONI[Z,S]ATION; (BURNER OR HEATER); (PATIO OR TAVERN? OR CAFE OR CAFETERIA OR SIDE_WALK OR OUTDOOR OR PORTABLE OR OUTSIDE OR RESTAURANT); (EC/IC F24D OR F24C OR F23D OR F23N)
www.google.com/patents and Keyword(s): (patio radiant heater control sensor), (radiant heater OR burner probe OR sensor OR detector ionization control), and similar terms
esp@cenet Keyword(s): ("radiant heater" control), (ionization and F23D14/12), and similar terms.

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 5099822 A (CRAMER et al.) 31 March 1992. See abstract; figures 1 and 2; column 1, lines 6- 12; column 2, line 18- column 4, line 68; and claims.	
A	US 2009/0241942 A1 (SCHWANK et al.) 1 October 2009. See abstract; figures 1, 2 and 15; paragraphs [0006]-[0012], and [0031]-[0035]; and claims.	

[X] Further documents are listed in the continuation of Box C [X] See patent family annex

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier application or patent but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
02 June 2011	6 JUN 2011
Name and mailing address of the ISA/AU AUSTRALIAN PATENT OFFICE PO BOX 200, WODEN ACT 2606, AUSTRALIA E-mail address: pct@ipaustralia.gov.au Facsimile No. +61 2 6283 7999	Authorized officer **PETER ELLIS** AUSTRALIAN PATENT OFFICE (ISO 9001 Quality Certified Service) Telephone No : (02) 6225 6106

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 2008/0152329 A1 (SAUNDERS et al.) 26 June 2008. See abstract; figures 1-3, 5, 9 and 11; paragraphs [0007]-[0034], and [0036]-[0043]; and claims.	
A	WO 2008/142531 A2 (WORGAS- BRUCIATORI- S.R.L [IT]) 27 November 2008. See whole document.	
A	EP 1422475 A1 (4E [FR]) 26 May 2004. English Translation retrieved from Esp@cenet database. See <URL: http://translationgateway.epo.org/emtp/gw?ACTION=description-retrieval&COUNTRY=EP&FORMAT=docdb&KIND=A1&LOCALE=en_EP&NUMBER=1422475&OPS=ops.epo.org	

INTERNATIONAL SEARCH REPORT

International application No.
PCT/AU2011/000204

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☒ Claims Nos.: **18**
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

This claim does not comply with Rule 6.2(a) because it relies on references to the description and/or drawings.

3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a)

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.
2. ☐ As all searchable claims could be searched without effort justifying additional fees, this Authority did not invite payment of additional fees.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:

4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.

☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.

☐ No protest accompanied the payment of additional search fees.

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.
PCT/AU2011/000204

This Annex lists the known "A" publication level patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent Document Cited in Search Report		Patent Family Member					
US	5099822	ES	2027143	FR	2657950	GB	2240841
		IT	9022098	JP	5026443		
US	2009241942	CA	2657147	US	7874835		
US	2008152329	NONE					
WO	2008142531	EP	2167876	IT	MO20070167	US	2010227285
EP	1422475	FR	2847660				

Due to data integration issues this family listing may not include 10 digit Australian applications filed since May 2001.

END OF ANNEX