US 20060188831A1

(19) United States

(12) Patent Application Publication (10) Pub. No.: US 2006/0188831 A1

Hess et al. (43) Pub. Date: Aug. 24, 2006

(54) FLAME SIMULATING ASSEMBLY INCLUDING AN AIR FILTER

(75) Inventors: **Kristoffer Hess**, Cambridge (CA); **Kelly Stinson**, Kitchener (CA)

Correspondence Address:
VALENTINE A. COTTRILL
SUITE 1020 50 QUEEN STREET NORTH
KITCHENER, ON N2H6M2 (CA)

(73) Assignee: **Dimplex North America Limited**, Cambridge (CA)

(21) Appl. No.: **11/060,398**

(22) Filed: **Feb. 18, 2005**

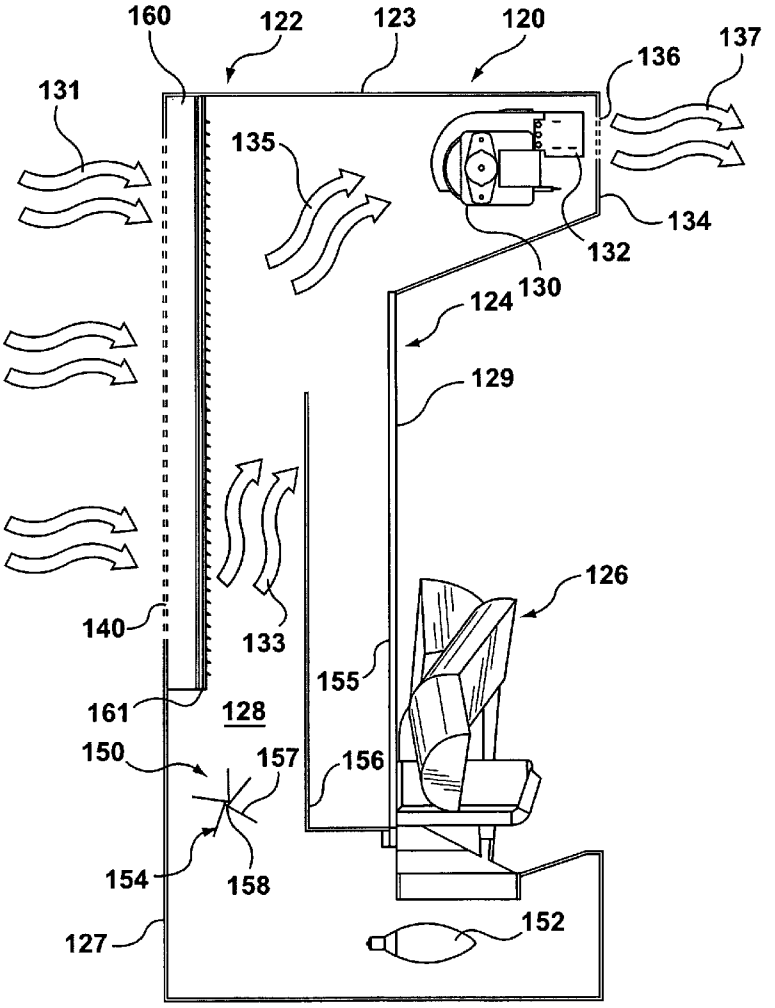
Publication Classification

(51) **Int. Cl.**
F24B 1/191 (2006.01)

(52) **U.S. Cl.** **431/125**; 126/500; 40/428

(57) **ABSTRACT**

A flame simulating assembly having a housing including a top panel, two or more side panels supporting the top panel, a back panel connecting the side panels, and one or more front panels positioned substantially opposite to the back panel. Also, the assembly has a simulated fuel bed, a screen positioned behind the simulated fuel bed, and a flame image subassembly for providing images of flames on the screen, and the screen, the housing and the simulated fuel bed define an internal chamber. The assembly also has a fan positioned to provide an air flow through the chamber from one or more intake apertures to one or more exit apertures, through which said air exits the chamber, and one or more filters for filtering at least a portion of said air in the air flow. The internal chamber is substantially airtight, except for the intake and exit apertures.



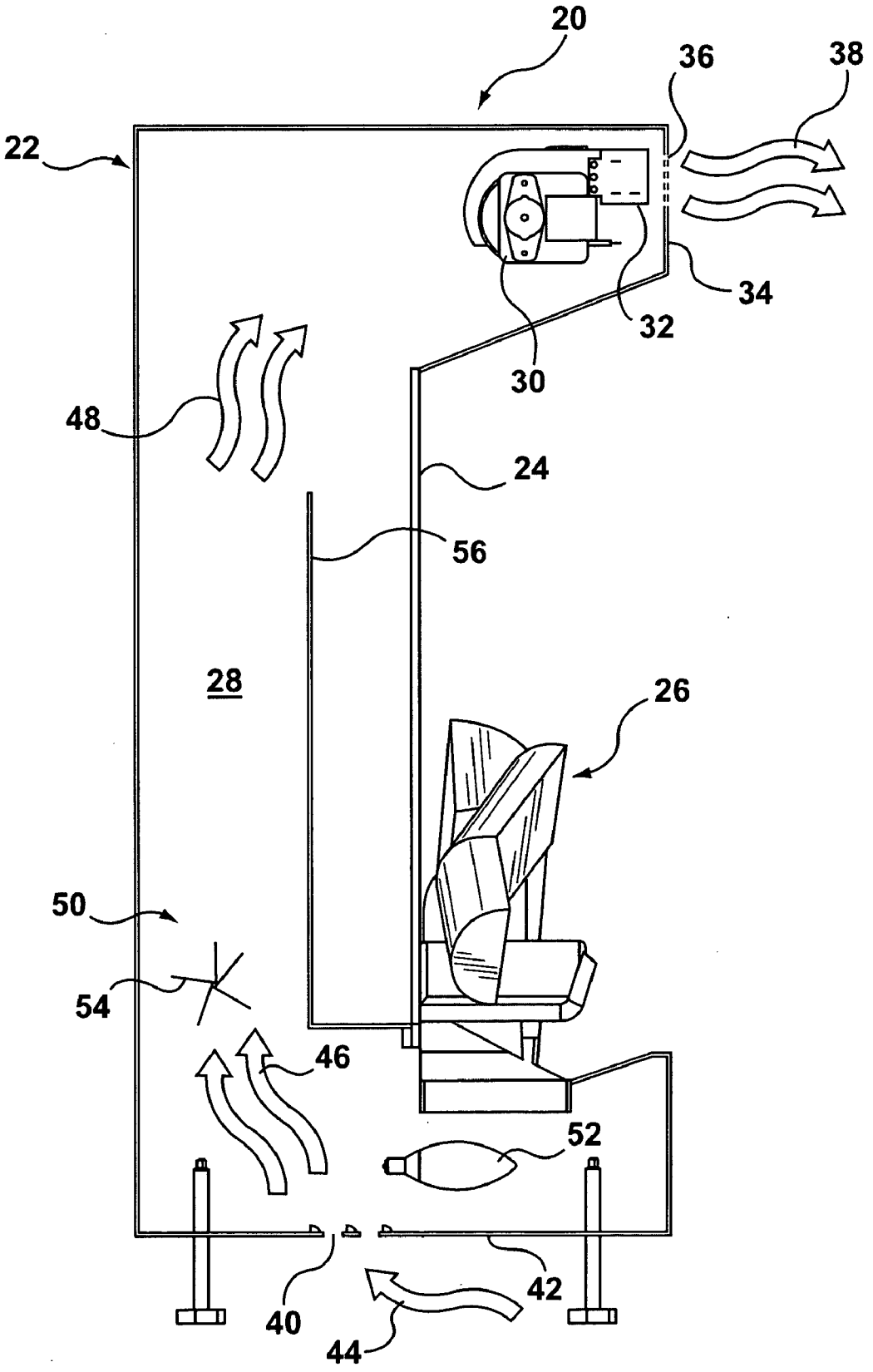


FIG. 1 (PRIOR ART)

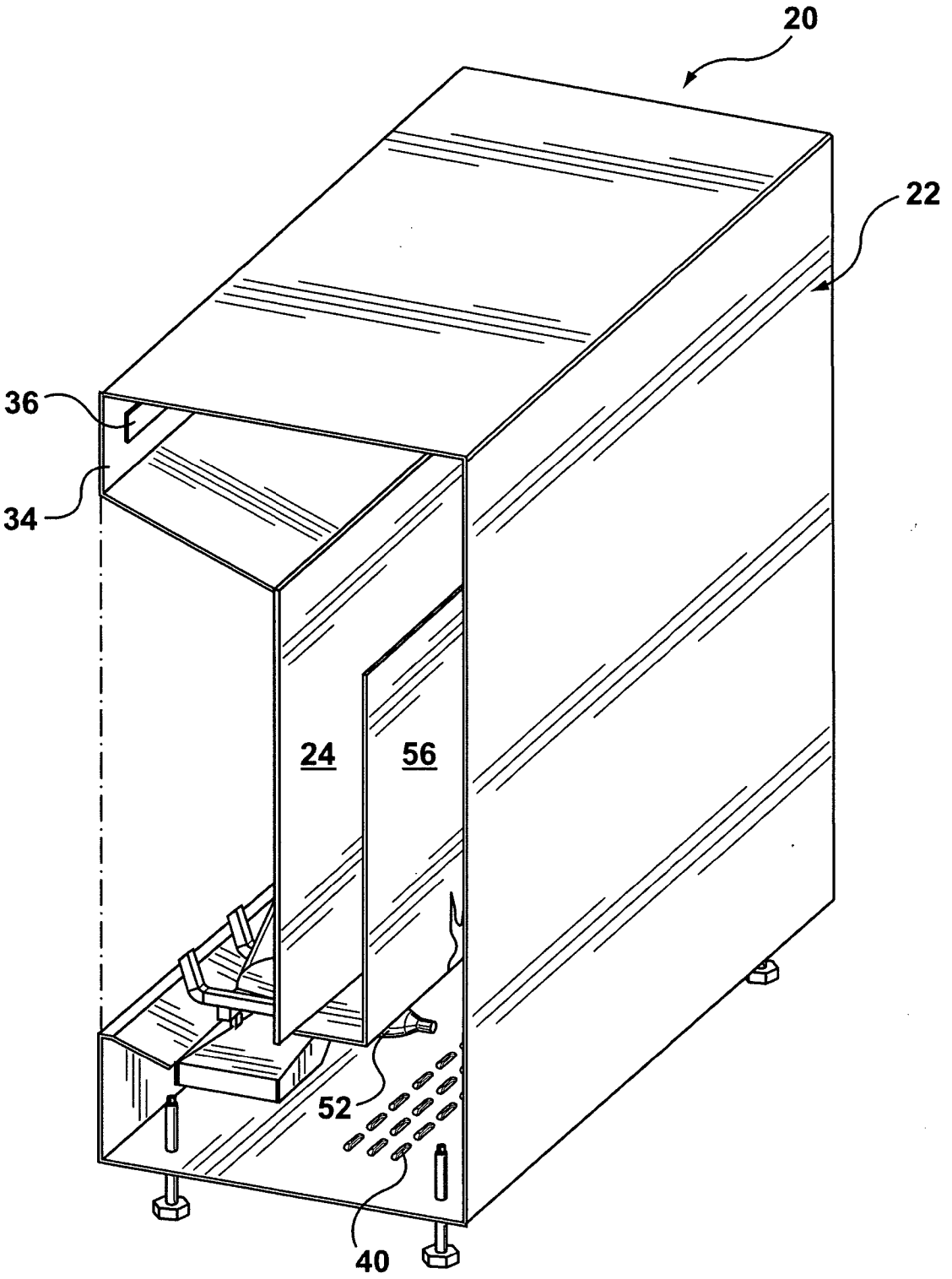
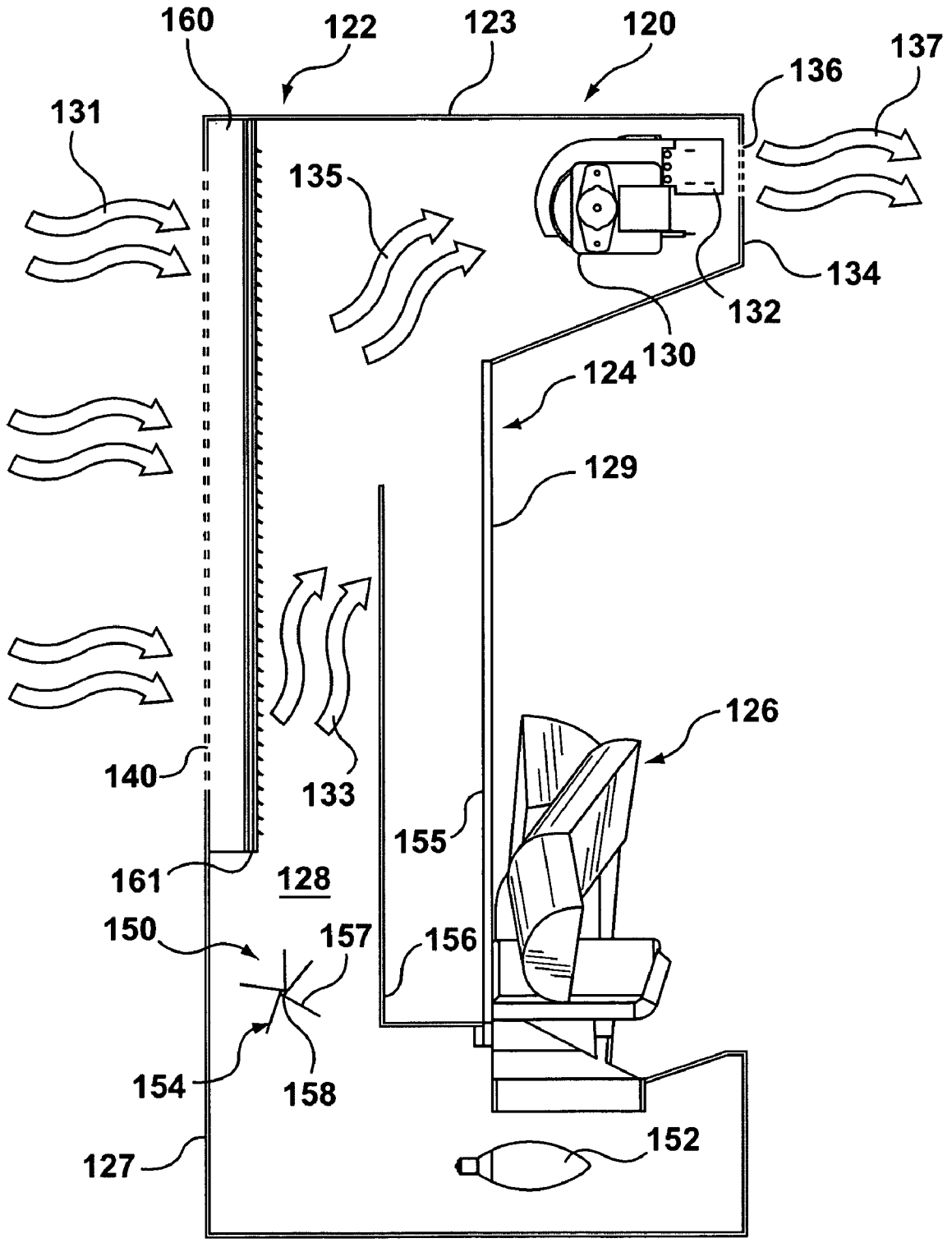


FIG. 2 (PRIOR ART)


160
122
123
120
137
136
131
135
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132
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FIG. 3

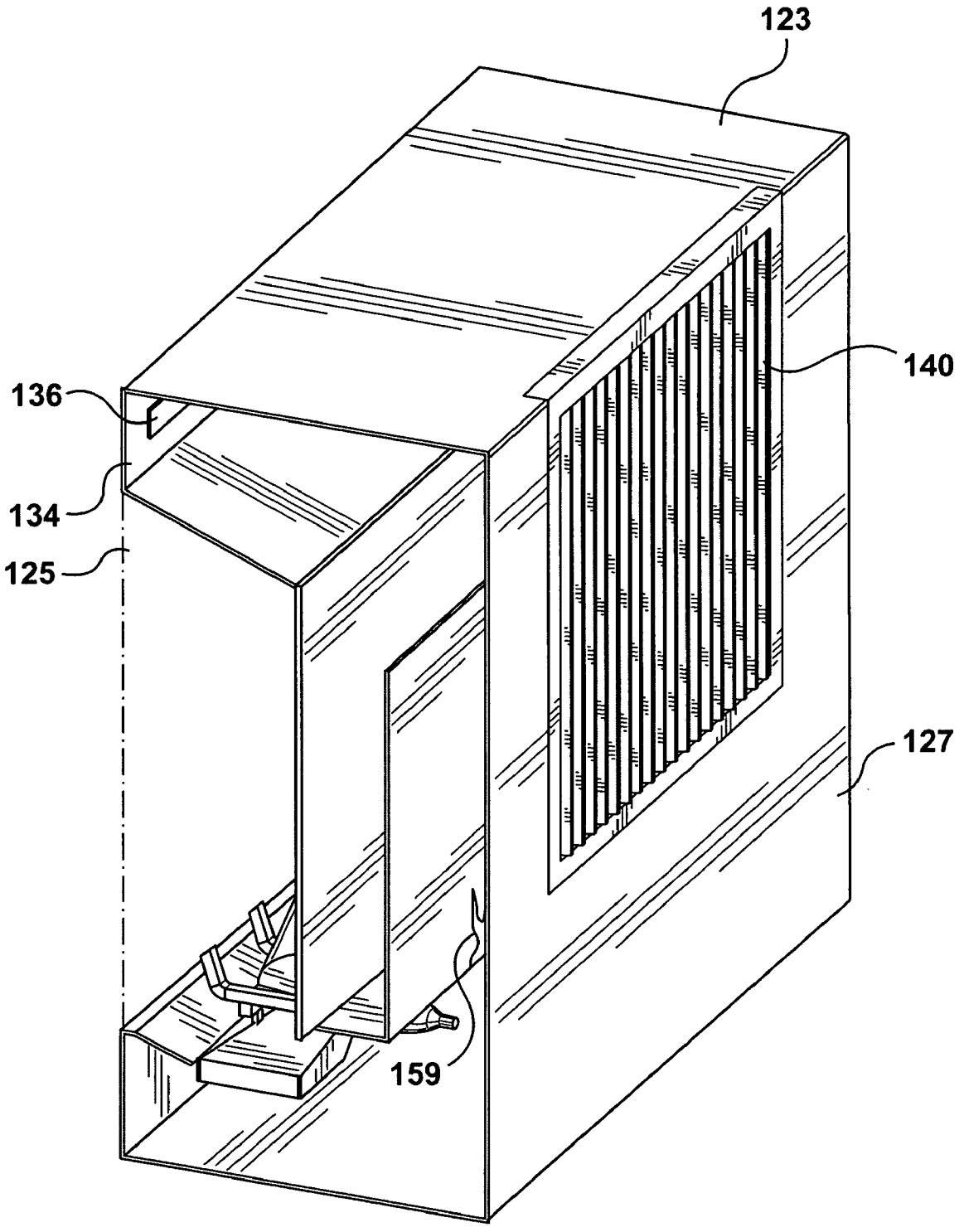


FIG. 4

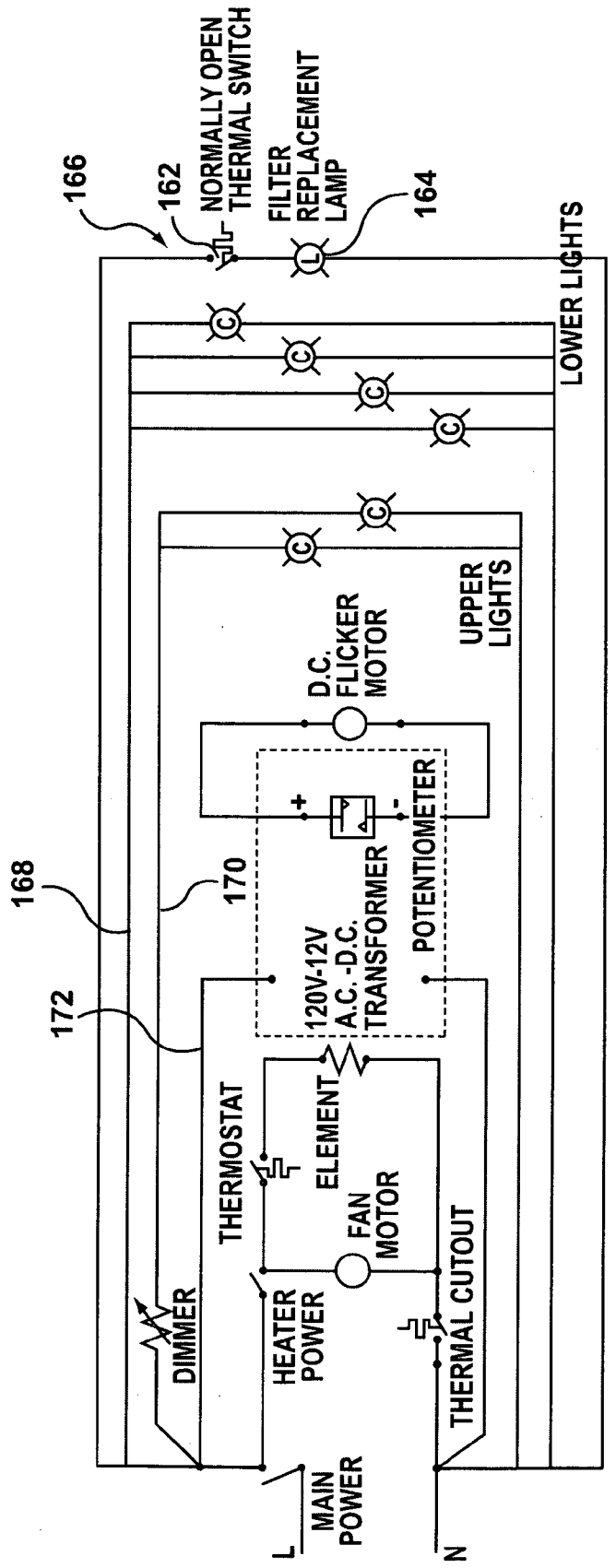
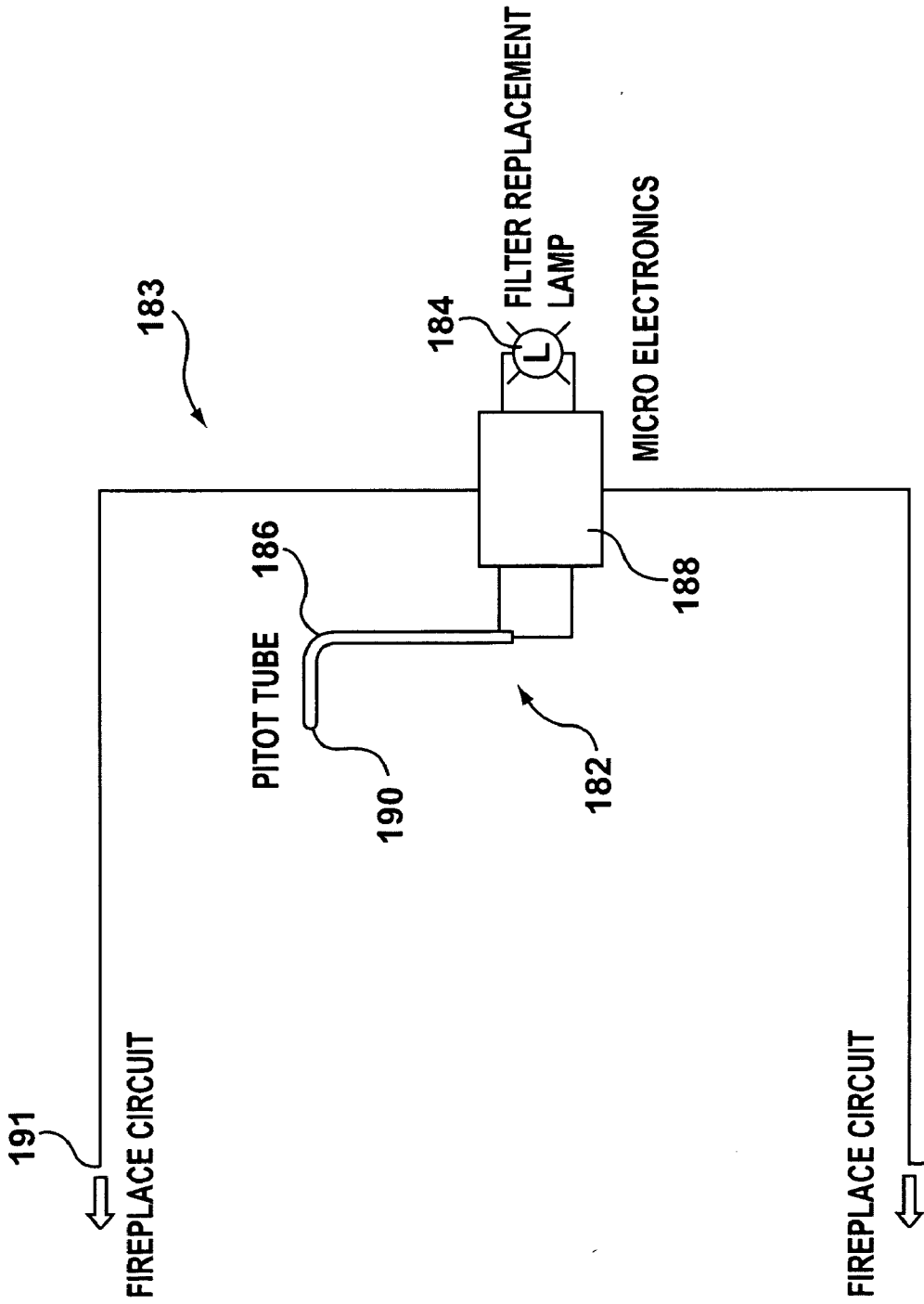

166
162
NORMALLY OPEN THERMAL SWITCH
FILTER REPLACEMENT LAMP
164
LOWER LIGHTS
UPPER LIGHTS
D.C. FLICKER MOTOR
+
-
POTENTIOMETER
168
170
120V-12V A.C. -D.C. TRANSFORMER
172
THERMOSTAT
ELEMENT
FAN MOTOR
DIMMER
HEATER POWER
THERMAL CUTOUT
MAIN POWER
L
N

FIG. 5A


183
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FILTER REPLACEMENT LAMP
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MICRO ELECTRONICS
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PITOT TUBE
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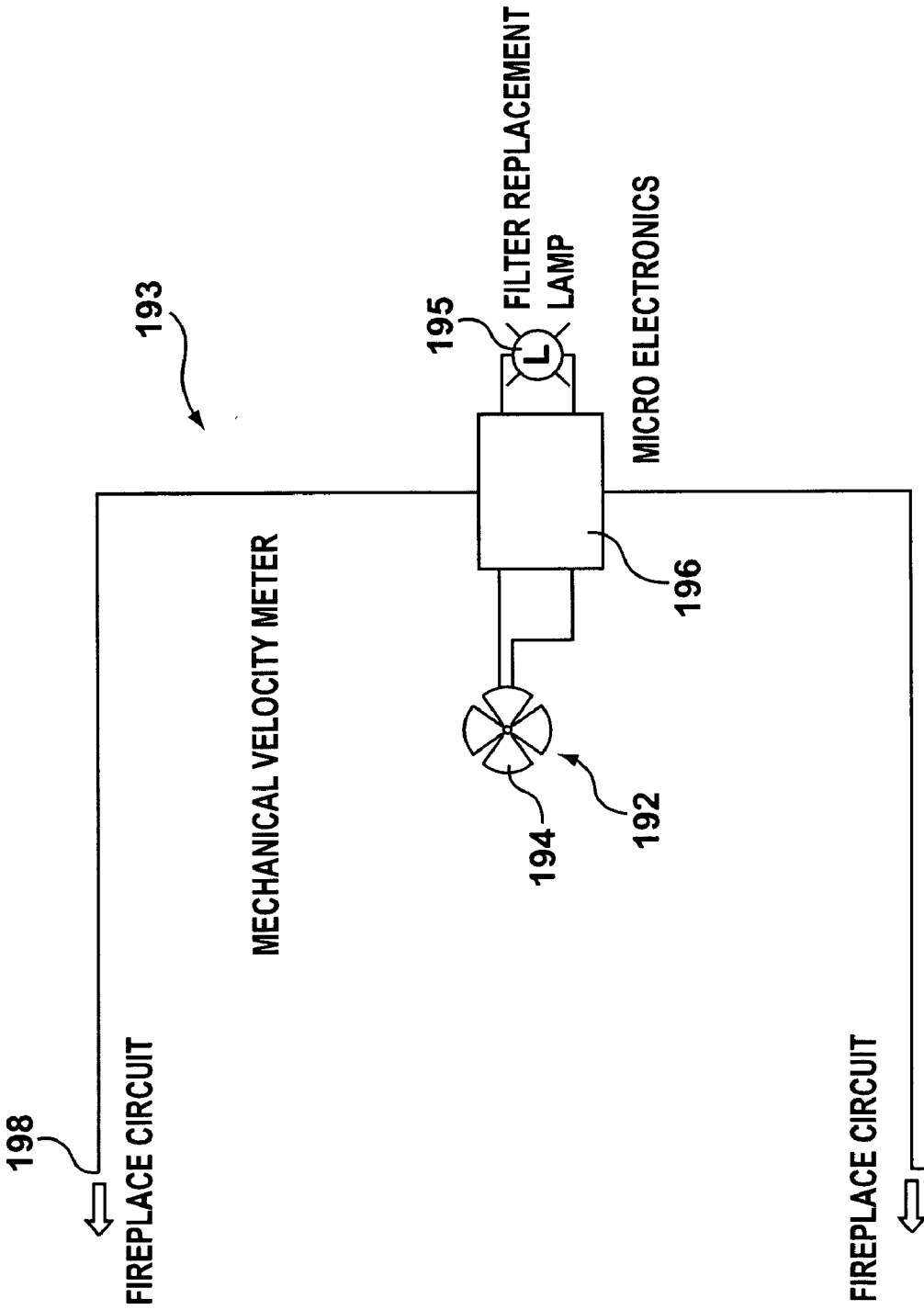
FIREPLACE CIRCUIT
191
FIREPLACE CIRCUIT

FIG. 5B


193
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FILTER REPLACEMENT LAMP
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MICRO ELECTRONICS
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MECHANICAL VELOCITY METER
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192
198
FIREPLACE CIRCUIT
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FIREPLACE CIRCUIT

FIG. 5C

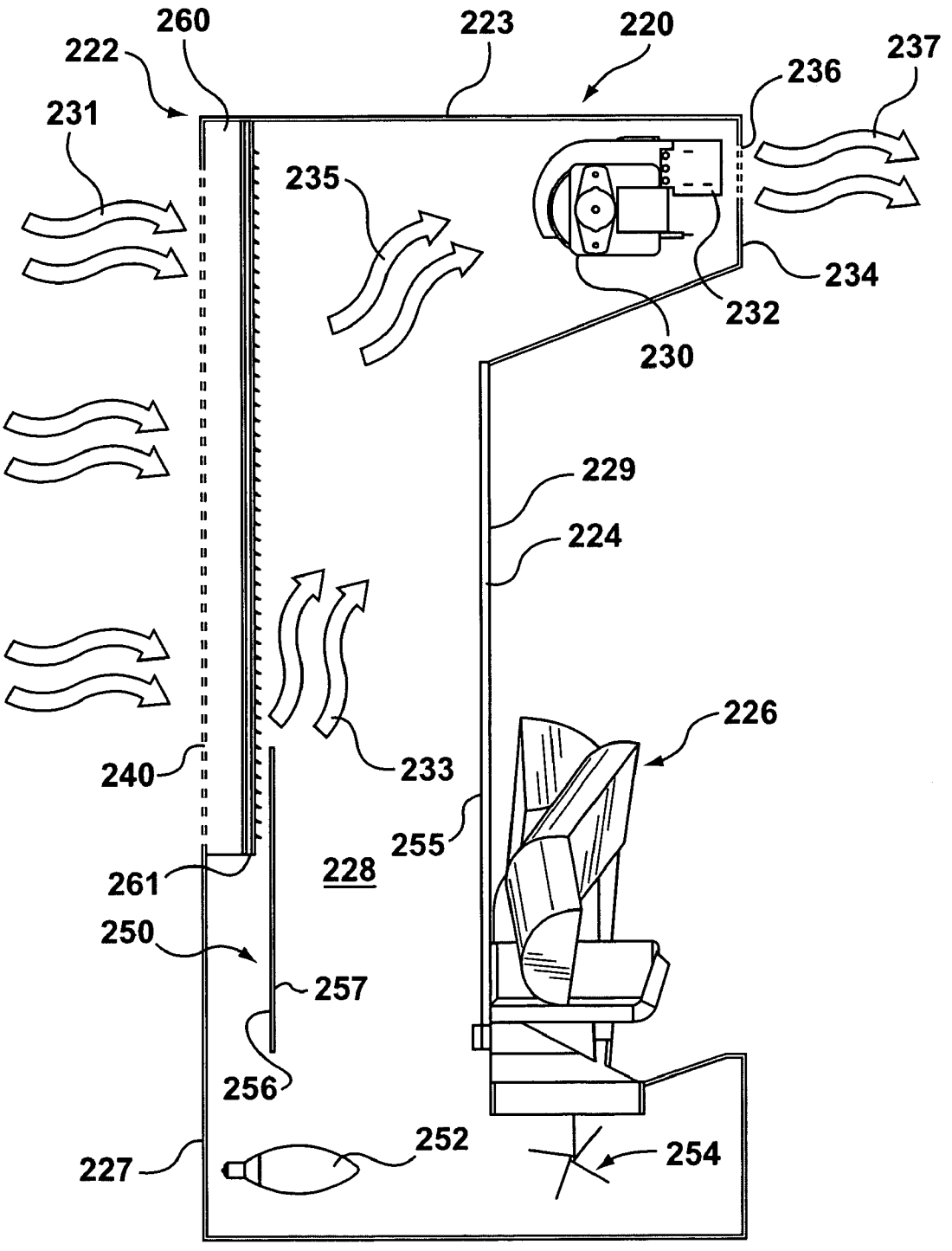
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FIG. 6

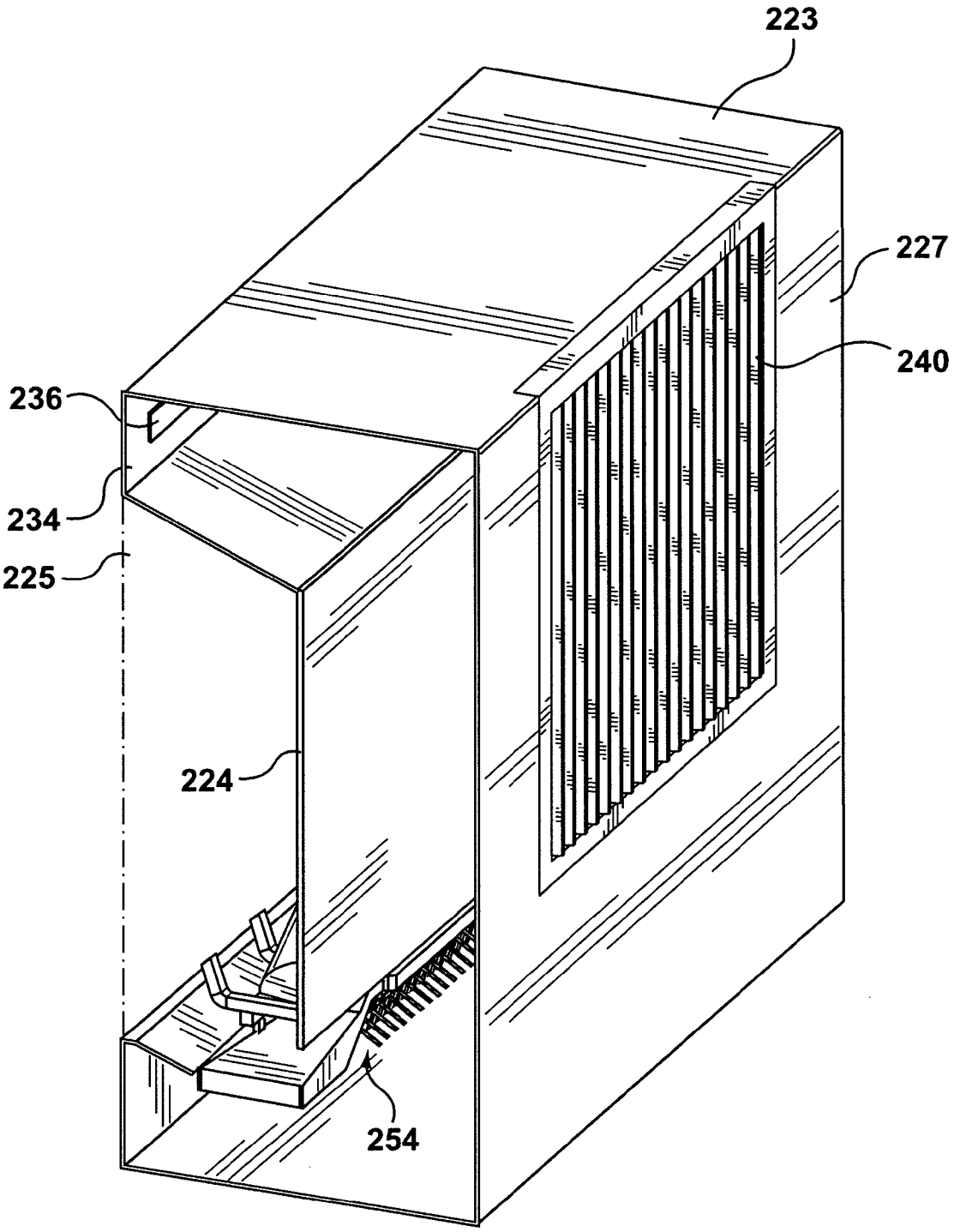

FIG. 7

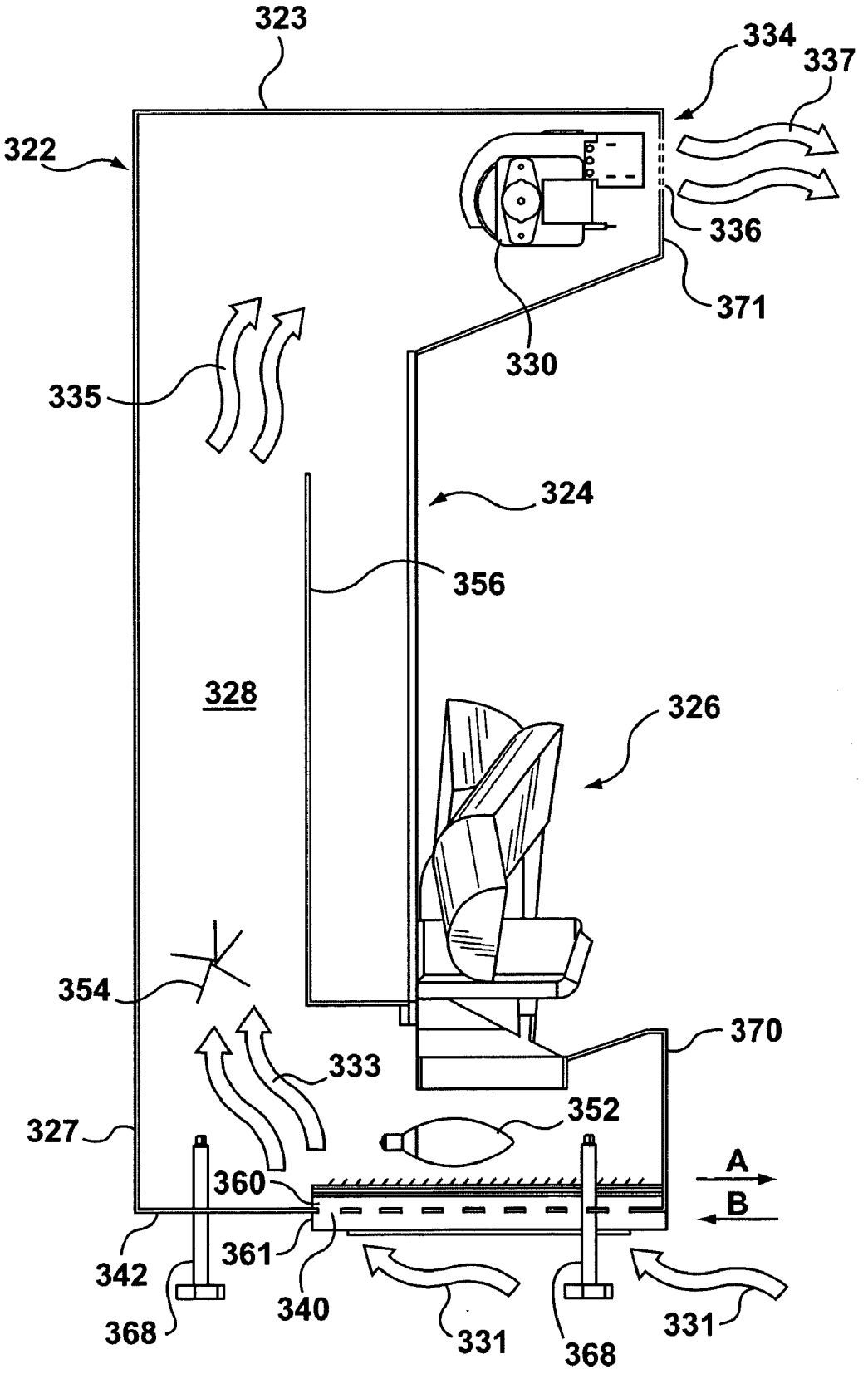
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FIG. 8

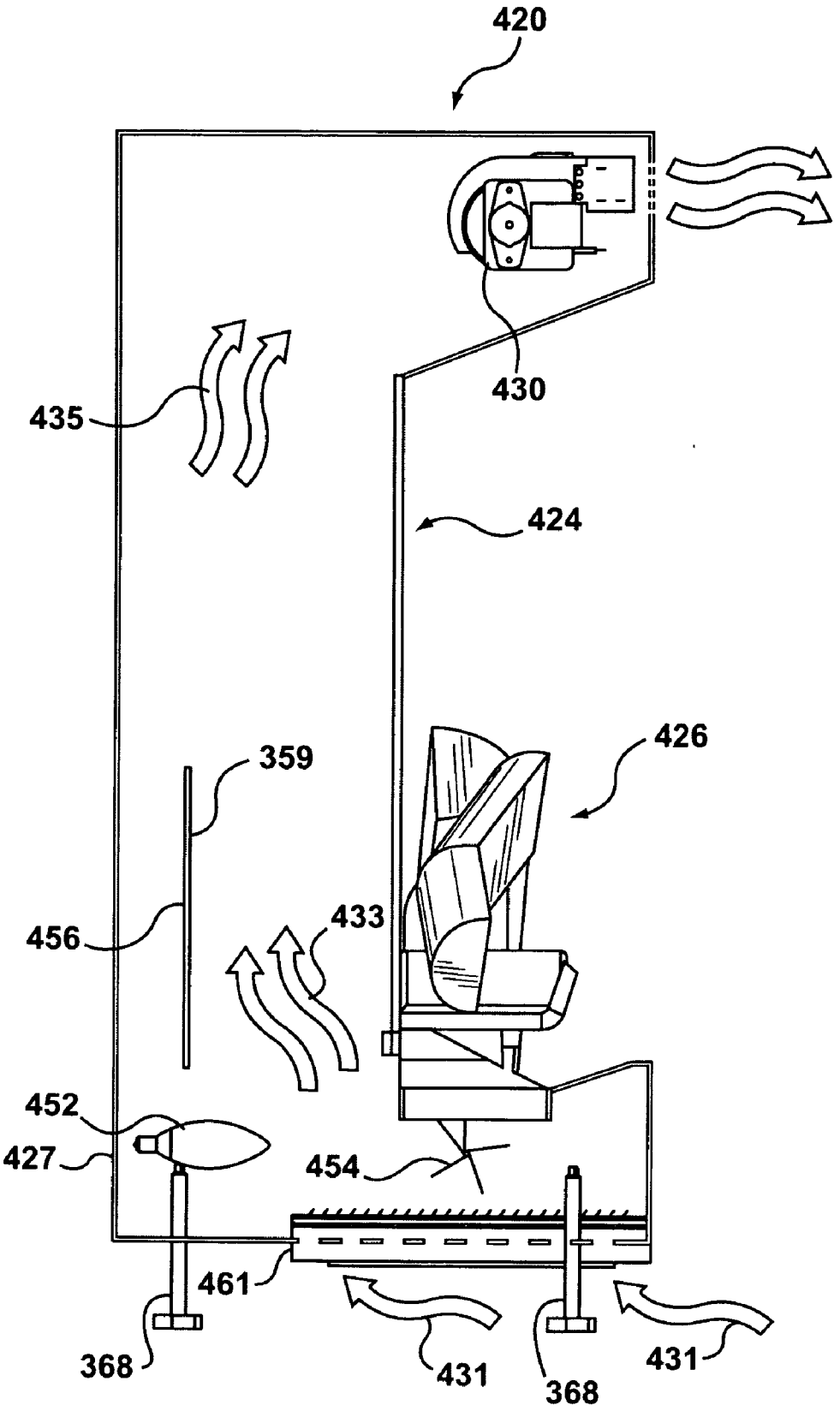

FIG. 9

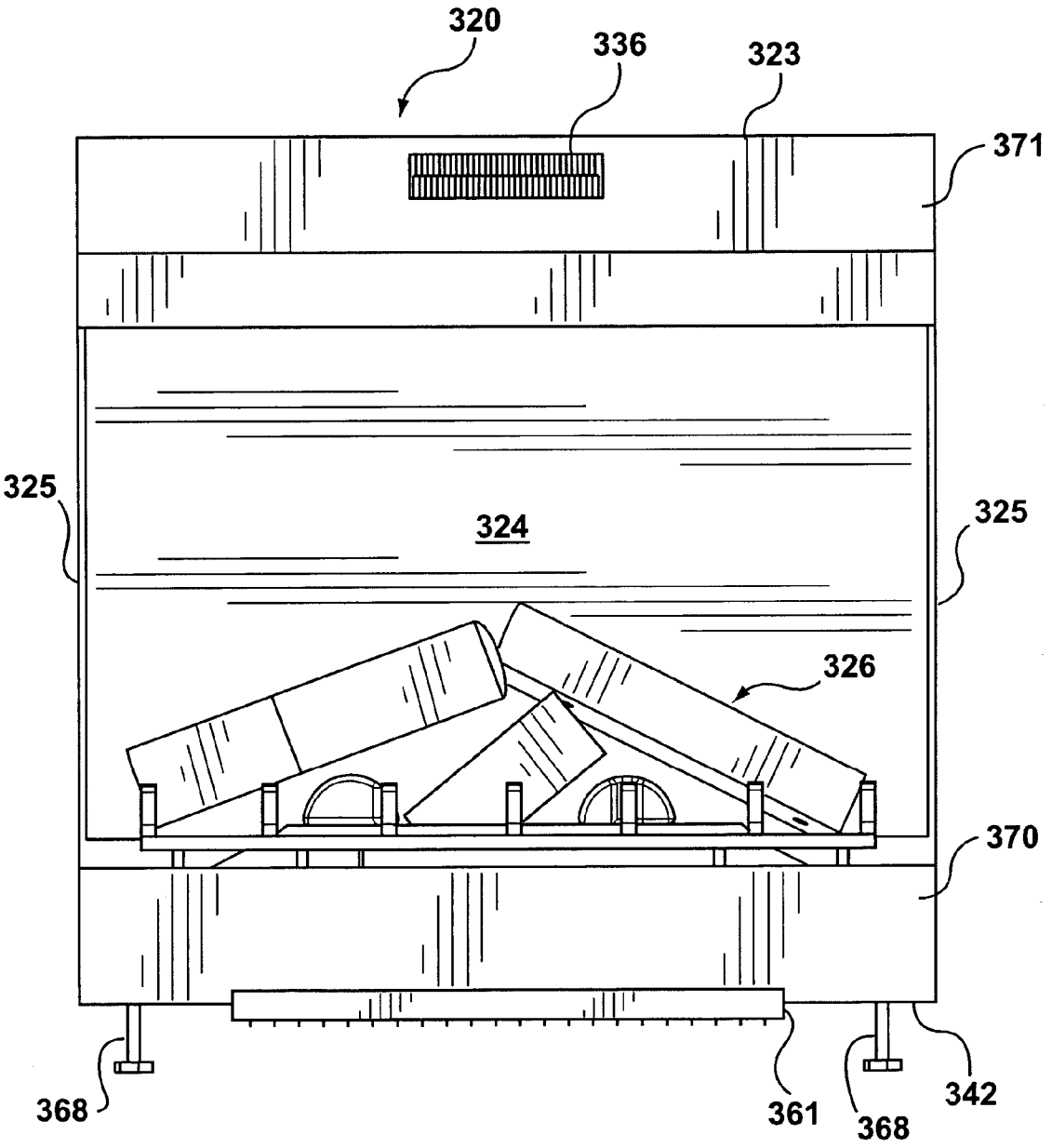

FIG. 10

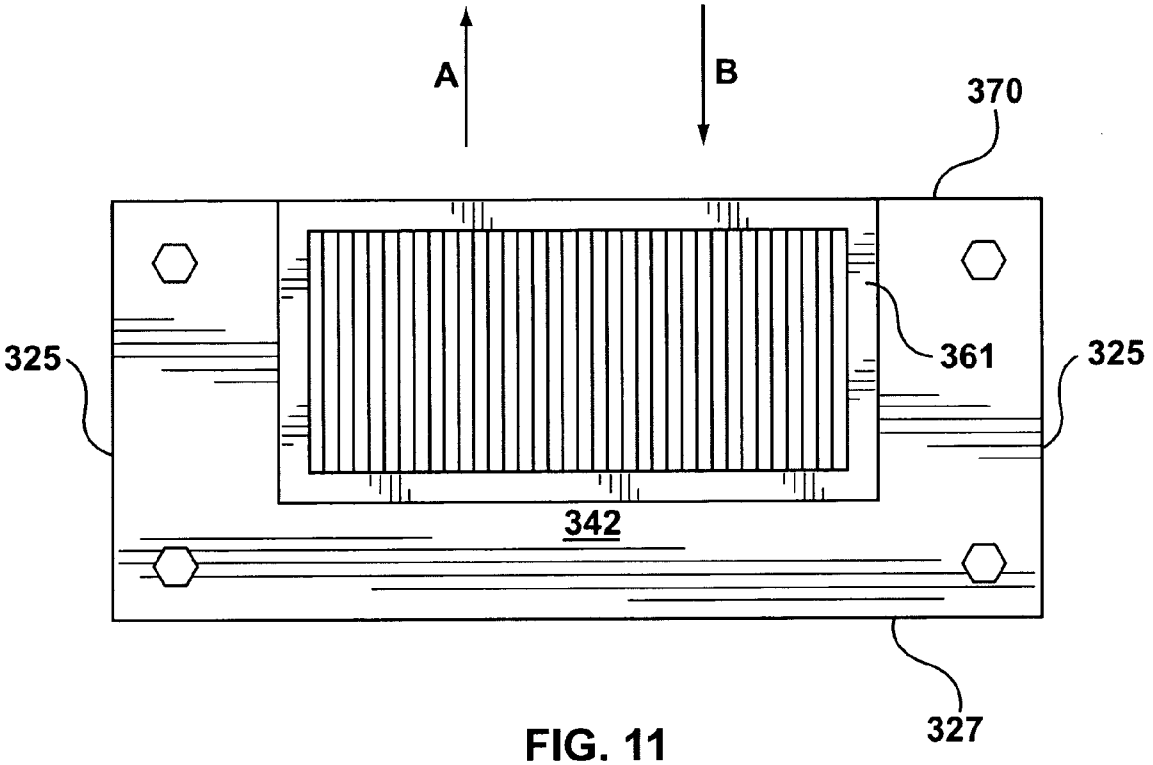

FIG. 11

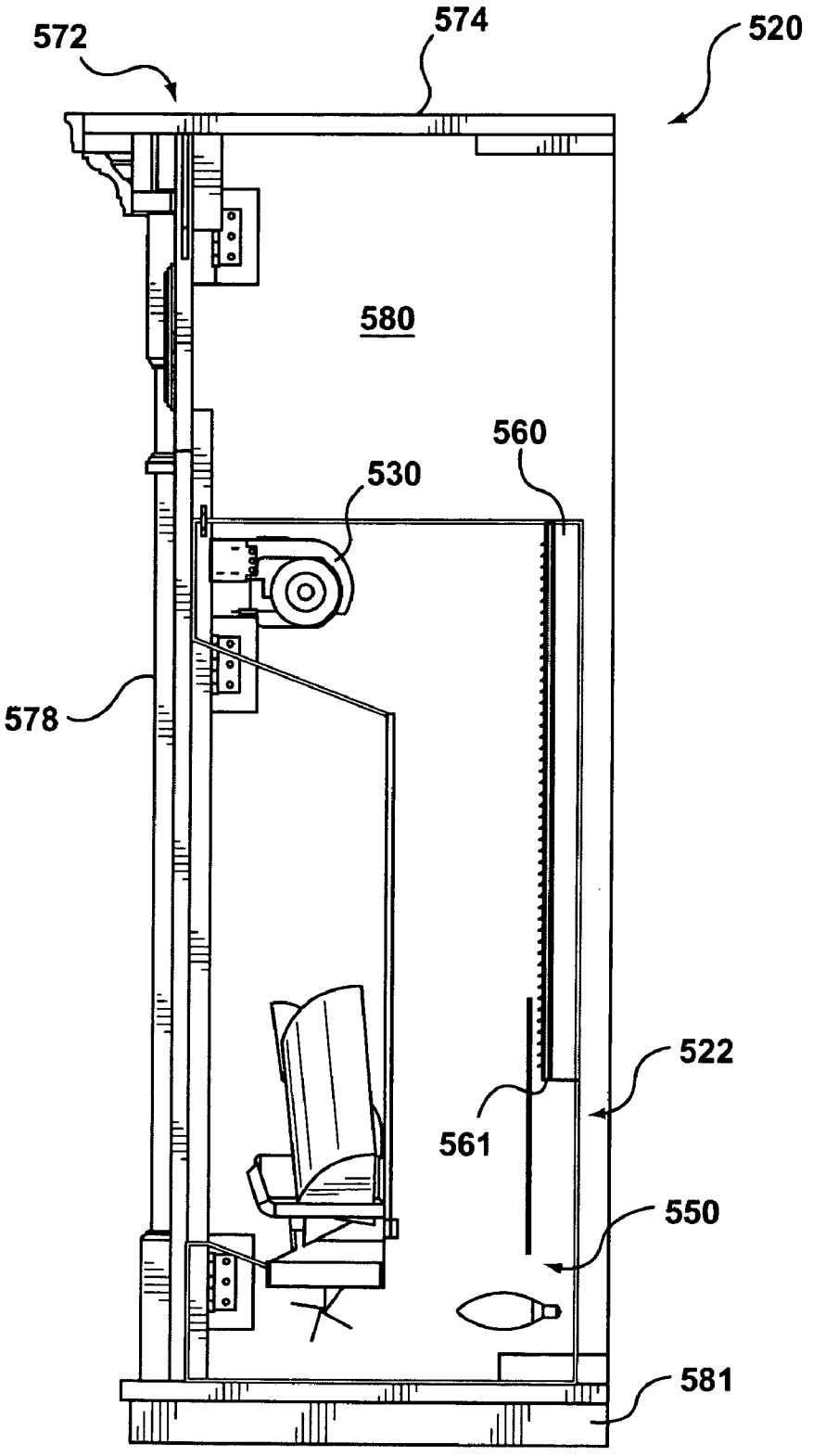

FIG. 12

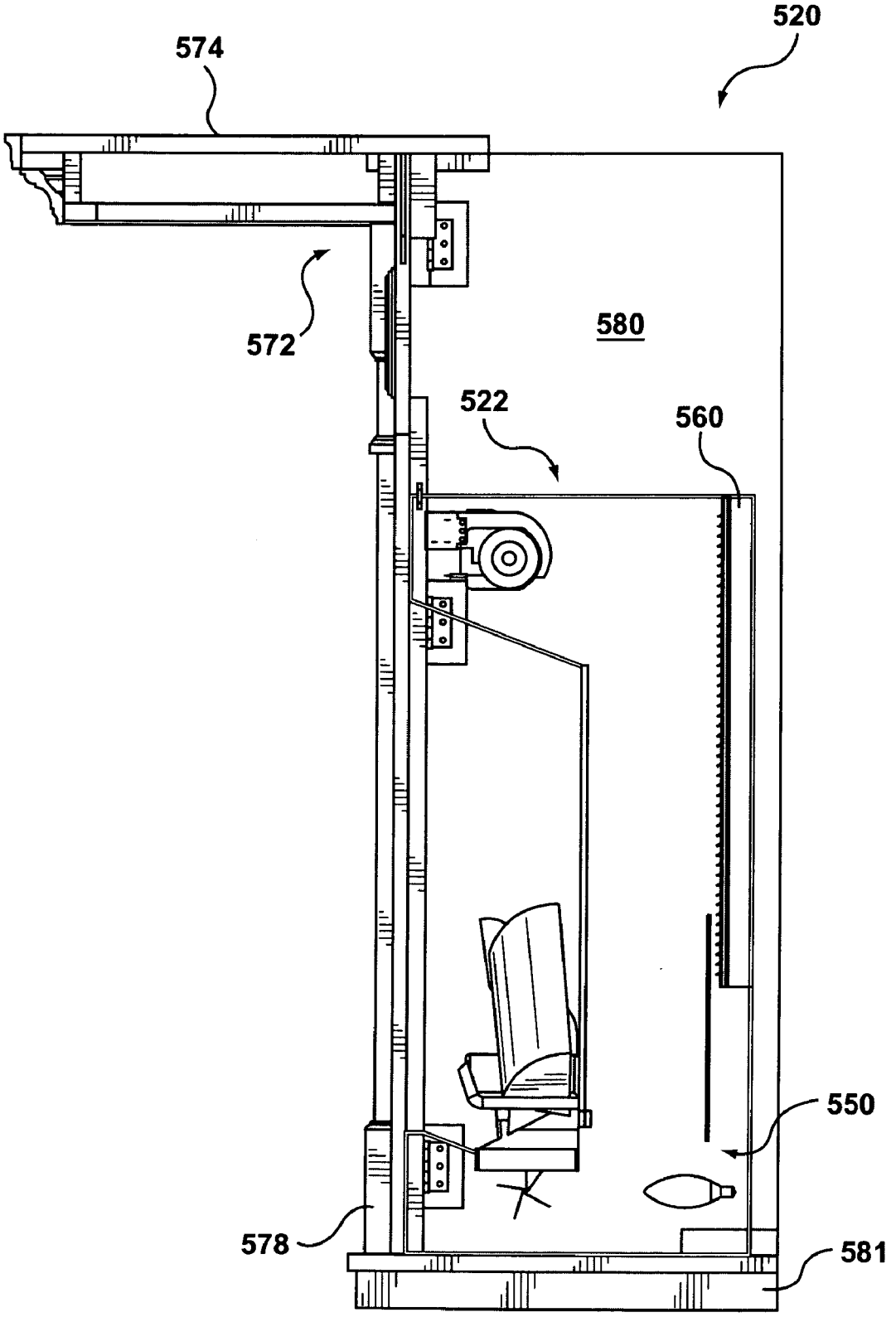

FIG. 13

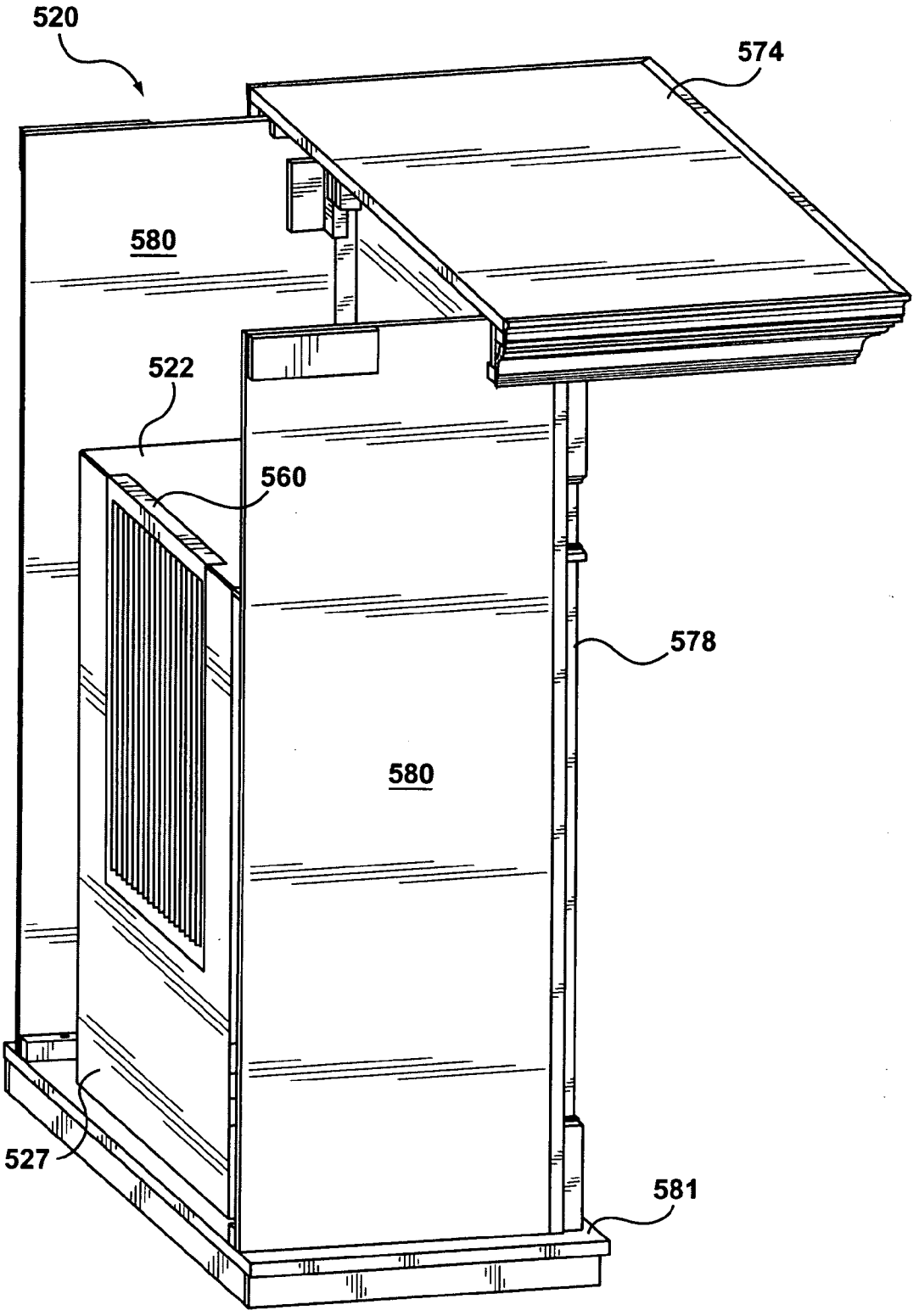

FIG. 14

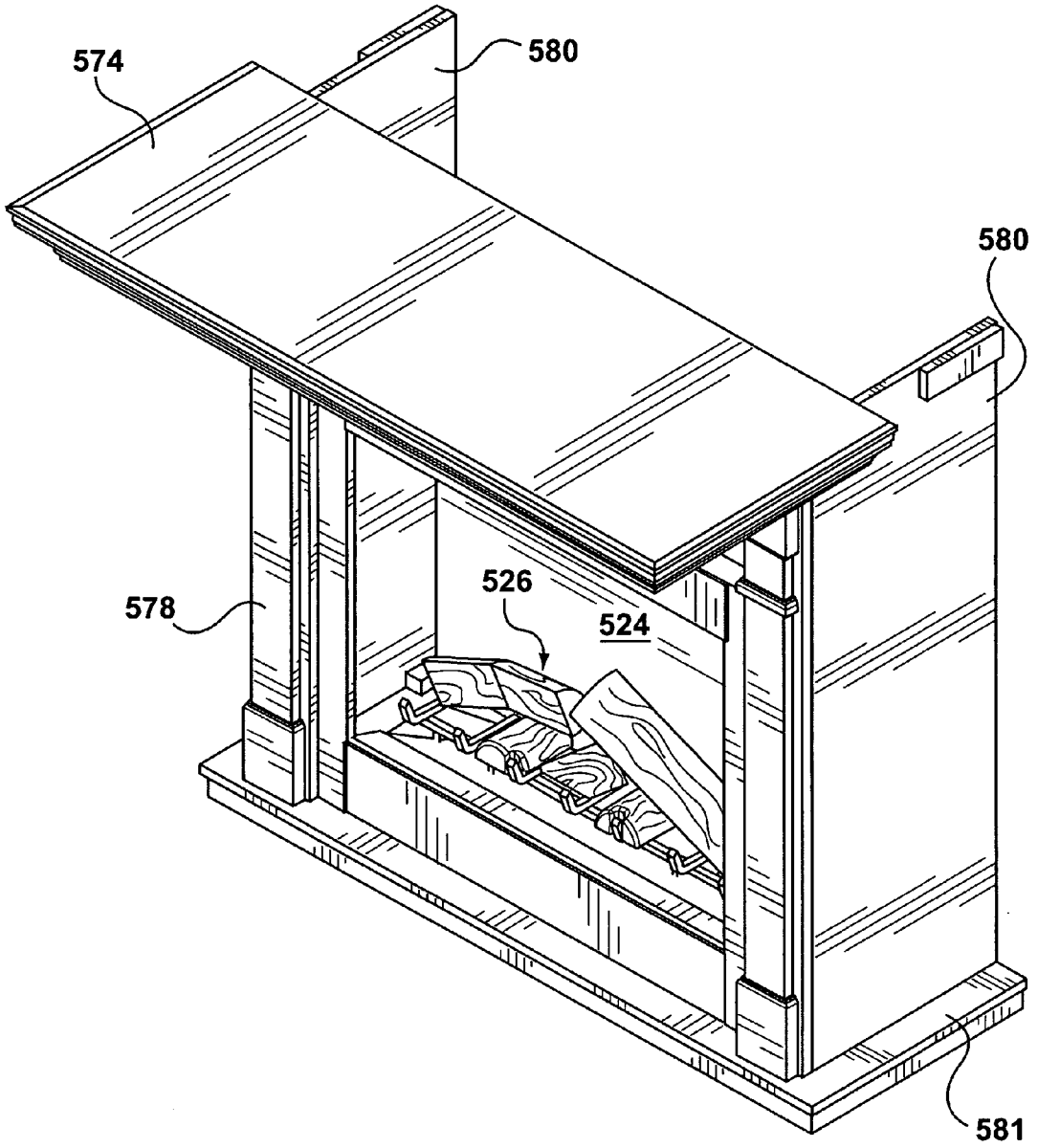

FIG. 15

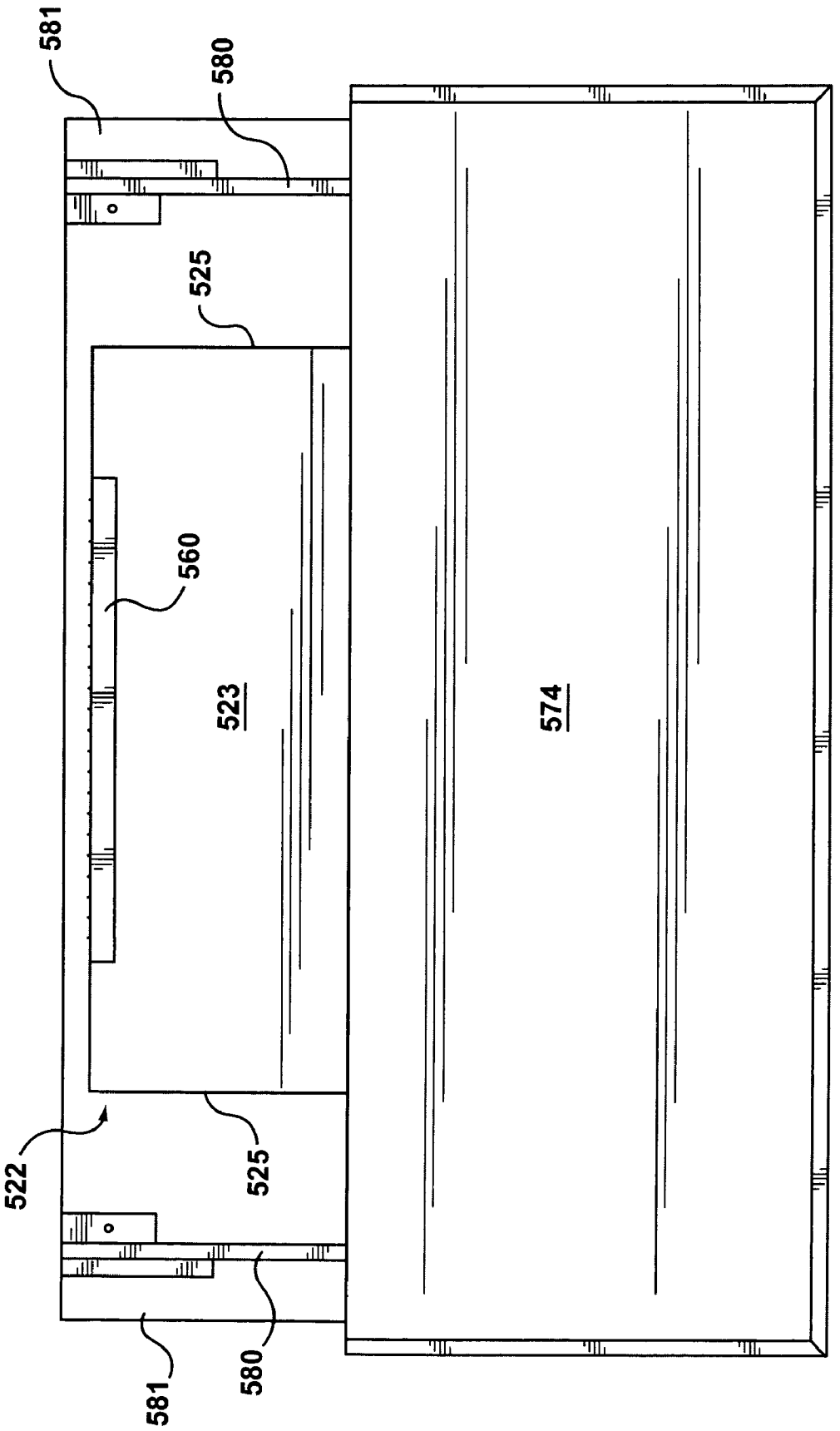

FIG. 16

FLAME SIMULATING ASSEMBLY INCLUDING AN AIR FILTER

FIELD OF THE INVENTION

[0001] This invention is related to flame simulating assemblies.

BACKGROUND OF THE INVENTION

[0002] Various types of flame simulating assemblies are known. One type of known flame simulating assembly (shown in **FIGS. 1 and 2**) typically includes a simulated fuel bed, one or more light sources, a screen disposed behind the simulated fuel bed for diffusing and transmitting light from the light source, and a flicker element for causing light from the light source to fluctuate, or flicker, to simulate flames. Images of flames are provided by fluctuating light from the light source which is transmitted through the screen. Typically, the known electric flame simulating assembly also includes a flames effect element winch configures fluctuating light from the light source to form the images of flames which are transmitted through the screen. An example of this type of flame simulating assembly is disclosed in U.S. Pat. No. 5,642,580 (Hess et al.).

[0003] In another type of flame simulating assembly, strips of colored cloth ribbons are suspended behind a screen. The ribbons are moved by a forced stream of air from a fan, and illuminated to simulate flames, when viewed through the screen. An example of this type of flame simulating assembly is disclosed in U.S. Pat. No. 4,965,707 (Butterfield).

[0004] In a third type of known flame simulating assembly, a series of pictorial images of flames are shown on a display panel adapted to show such images. For example, in GB 2 242 737 (Shute), an artificial fire unit is disclosed which includes a television set and a video recorder for playing recordings of fires on the television set. The artificial fire unit is positioned in a cabinet so that it appears to be "a conventional domestic fire unit" (p. 2, at lines 19-20).

[0005] The typical flame simulating assembly is sold with a trim package according to the purchaser's preference. For example, most flame simulating assemblies are sold with a trim package which, upon assembly, resembles a natural fireplace hearth and mantel and associated woodwork. However, flame simulating assemblies positioned inside simulated stoves (e.g. cabinets which resemble wood-burning stoves) are also popular. For the purposes hereof, it will be understood that a flame simulating assembly includes a device for simulating flames, regardless of whether, for example, the device is installed in a simulated stove or fireplace.

[0006] As shown in **FIG. 1**, a flame simulating assembly **20** of the prior art includes a housing **22**, a screen **24**, and a simulated fuel bed **26** positioned in the housing **22**, in front of the screen **24**. The housing **22**, the screen **24**, and the simulated fuel bed **26** define an internal chamber **28**, through which air is drawn by a fan **30**. Typically, the flame simulating assembly **20** also includes a heater with one or more heating elements **32**. A front part **34** of the housing **22** includes holes **36** to permit air which has been warmed by the heating elements **32** to exit into the premises in which the flame simulating assembly **20** is located, as schematically indicated by arrows **38** in **FIG. 1**. In many known flame simulating assemblies, holes **40** may be located in a bottom wall **42** of the housing **22** so that air is drawn through the holes **40** by the fan **30** from outside the chamber **28** (as schematically indicated by arrow **44**) through the chamber **28** (as schematically indicated by arrows **46**, **48**). However, intake holes **40** are sometimes located in side panels of the housing (not shown) in prior art flame simulating assemblies, or in other parts of the housing **22**.

[0007] The flame simulating assembly **20** illustrated is the type of flame simulating assembly described in U.S. Pat. No. 5,642,580 (Hess et al.), referred to above. The flame simulating assembly **20** has a flame image subassembly **50** which includes the simulated fuel bed **26**, the screen **24** positioned behind the simulated fuel bed **26**, one or more light sources **52**, a flicker element **54**, and a flame effect element **56**. The flame image subassembly **50** may include a variety of components in various configurations, and is adapted to provide one or more images of flames on the screen **24**, so that the images of flames appear to be emanating from the simulated fuel bed **26**. Because some heat is generated by the light source **52**, the holes **40** are usually located in the vicinity of the light source **52**, so that heat generated by the light source **52** is drawn away and dissipated by the air flow through the holes **40** towards the holes **36**, which air flow is generated by the fan **30**.

[0008] Most known flame simulating assemblies do not include air filtration systems. In addition, known flame simulating assemblies are not of airtight (whether substantially airtight or otherwise) construction, so ambient air enters into the internal chamber through many cracks, holes, and small openings in the housing, and, for example, between the screen and the housing, between the screen and the simulated fuel bed, and between the simulated fuel bed and the housing. In the typical known flame simulating assembly **20**, therefore, airborne contaminants such as dust and other materials (i.e., not only particles) which are in the ambient air are drawn into the internal chamber **28**, and then sent back out into the premises without any filtration. In particular, over an extended time period, dust accumulates in the internal chamber. The air which exits the chamber **28** through the holes **36** therefore typically includes as much dust as the ambient air, and can include more on occasion if, for example, some of the dust in the chamber is picked up by the air flow through the chamber.

[0009] Filtering the air drawn through the intake holes **40** is somewhat difficult, as the holes **40** are relatively small, even when considered in the aggregate. In general, in order to ensure that smaller particles are caught in an air filter, the filter typically has relatively small holes in it. As is known in the art, for an air filter with relatively small holes in it, a relatively high pressure differential across the air filter is required to draw the air through the filter. However, a fan capable of providing the relatively high volume required and a relatively high pressure differential is relatively expensive. Furthermore, because the known flame simulating assemblies are not of airtight construction, known filtering systems are of limited effectiveness.

[0010] Therefore, there is a need for an improved flame simulating assembly which overcomes or mitigates at least one of the disadvantages of the prior art.

SUMMARY OF THE INVENTION

[0011] In its broad aspect, the invention provides a flame simulating assembly having a housing, a simulated fuel bed disposed in the housing, a screen positioned behind the simulated fuel bed, and a flame image subassembly for providing images of flames on a front surface of the screen positioned adjacent to the simulated fuel bed. The housing includes a top panel, two or more side panels supporting the top panel, a back panel connecting said at least two side panels, and at least one or more front panels positioned substantially opposite to the back panel. The screen, the housing and the simulated fuel bed delimit an internal chamber. The flame simulating assembly also includes a fan positioned to provide an air flow through the internal chamber from one or more intake apertures, through which air is drawn into the internal chamber, to one or more exit apertures, through which the air in the air flow exits the internal chamber. In addition, the flame simulating assembly includes one or more air filters for filtering at least a portion of the air in the air flow, the air filter being positioned to filter contaminants out of the air in the air flow. The internal chamber is substantially airtight, except for the intake and exit apertures.

[0012] In another aspect, the flame simulating assembly additionally includes one or more heating elements for heating the air in the air flow.

[0013] In yet another aspect, the invention also includes a thermal switch positioned proximal to the heating elements. The thermal switch is adapted to cause one or more alerting devices to be energized upon the thermal switch reaching a predetermined temperature. The increase in the temperature of the air surrounding the thermal switch up to the predetermined temperature (and beyond) results from at least partial obstruction of the air filter.

[0014] In another aspect, the alerting device is an electric lamp.

[0015] In another of its aspects, the invention provides intake apertures disposed in the back panel, and the air filter is positioned adjacent to the intake apertures.

[0016] In yet another aspect, the invention additionally includes a mantel portion positionable substantially above the air filter, the mantel portion being movable to provide access to the air filter for removal thereof.

[0017] In another of its aspects, the housing includes a bottom panel connecting the side panels and the back panel, and the intake aperture(s) is (or are) positioned in the bottom panel. The air filter is positioned adjacent to the intake aperture(s).

[0018] In yet another aspect, the invention additionally includes a front exterior portion positionable in front of the air filter, the front exterior portion being removable to provide access to the air filter for removal thereof.

[0019] In yet another aspect, the invention includes one or more electric lamps, and a control device operatively connected to the lamp(s) for activating and de-activating the lamp(s). The control device includes one or more sensors for sensing a temperature of the air in the air flow. The invention also includes a control circuit operatively connecting the sensor to the lamp for activating the lamp when the temperature of the air is at a predetermined temperature or higher. The sensor is positioned proximal to the heating element so that when the air filter is obstructed to a predetermined extent, the lamp is energized, indicating that the air filter is due for replacement.

BRIEF DESCRIPTION OF THE DRAWINGS

[0020] The invention will be better understood with reference to the drawings, in which:

[0021] **FIG. 1** (also described previously) is a cross-section of a flame simulating assembly of the prior art of a first version of a flame simulating assembly of the prior art;

[0022] **FIG. 2** (also described previously) is an isometric view of the flame simulating assembly of the prior art of **FIG. 1**, drawn at a smaller scale;

[0023] **FIG. 3** is a cross-section of a preferred embodiment of a flame simulating assembly of the invention, drawn at a larger scale;

[0024] **FIG. 4** is an isometric view of the flame simulating assembly of **FIG. 3**, drawn at a smaller scale;

[0025] **FIG. 5A** is a schematic diagram of a preferred embodiment of a control circuit for providing an indication that a filter is obstructed to a predetermined extent;

[0026] **FIG. 5B** is a schematic diagram of an alternative embodiment of a control circuit for providing an indication that a filter is obstructed to a predetermined extent;

[0027] **FIG. 5C** is a schematic diagram of another alternative embodiment of a control circuit for providing an indication that a filter is obstructed to a predetermined extent;

[0028] **FIG. 6** is a cross-section of an alternative embodiment of the flame simulating assembly of the invention;

[0029] **FIG. 7** is an isometric view of the flame simulating assembly of **FIG. 6**, drawn at a smaller scale;

[0030] **FIG. 8** is a cross-section of an alternative embodiment of the flame simulating assembly of the invention, drawn at a larger scale;

[0031] **FIG. 9** is a cross-section of another alternative embodiment of the flame simulating assembly of the invention;

[0032] **FIG. 10** is a front view of the alternative embodiments of the invention shown in **FIGS. 8 and 9**, drawn at a smaller scale;

[0033] **FIG. 11** is a bottom view of the alternative embodiments of the invention shown in **FIGS. 8 and 9**;

[0034] **FIG. 12** is a cross-section of another alternative embodiment of the flame simulating assembly of the invention, in which a mantel portion of the flame simulating assembly is in a closed position, drawn at a smaller scale;

[0035] **FIG. 13** is a cross-section of the flame simulating assembly in which the mantel portion is in an open position,

[0036] **FIG. 14** is an isometric view of the flame simulating assembly of **FIG. 13**, drawn at a smaller scale;

[0037] **FIG. 15** is another isometric view of the flame simulating assembly of **FIG. 13**, drawn at a smaller scale; and

[0038] **FIG. 16** is a top view of the flame simulating assembly of **FIG. 13**, drawn at a larger scale.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT(S)

[0039] Reference is first made to **FIGS. 3-5** to describe a preferred embodiment of a flame simulating assembly in accordance with the invention indicated generally by the numeral **120**. The flame simulating assembly **120** preferably includes a housing **122** with a top panel **123**, two or more side panels **125** supporting the top panel **123**, a back panel **127** connecting the side panels **125**, and one or more front panels **134** positioned substantially opposite to the back panel **127**. As can be seen in **FIGS. 3 and 4**, the flame simulating assembly also includes a simulated fuel bed **126** disposed in the housing **122** and a screen **124** positioned behind the simulated fuel bed **126**, and the screen **124** has a front surface **129** disposed adjacent to the simulated fuel bed. The flame simulating assembly **120** additionally includes a flame image subassembly **150** for providing images of flames on the front surface **129** of the screen **124**, as will be described. As can be seen in **FIG. 3**, the screen **124**, the housing **122** and the simulated fuel bed **126** delimit an internal chamber **128**. The flame simulating assembly **120** also includes a fan **130** positioned to generate an air flow through the chamber **128** from one or more intake apertures **140**, through which air is drawn into the chamber **128**, to one or more exit apertures **136**, through which the air exits the chamber **128**. In the preferred embodiment, the flame simulating assembly **120** also includes one or more air filters **160** for filtering at least part of the air in the air flow through the internal chamber **128**. Preferably, the air filter **160** is positioned to filter the air in the air flow before the air enters the chamber **128**.

[0040] As shown in **FIG. 3**, in the preferred embodiment, the flame simulating assembly **120** additionally includes one or more heating elements **132** for heating the air in the air flow before the air exits the chamber **128**.

[0041] The exit apertures **136** are preferably located in the front panel **134**, also as shown in **FIG. 3**. In addition, the intake apertures **140** are preferably positioned in the back panel **127**. As shown in **FIG. 3**, the air filter **160** is positioned immediately in front of the intake apertures **140** in the preferred embodiment. The air filter **160** is preferably mounted in a frame **161** therefor which is positioned on the back panel **127**. As is known in the art a seal (not shown) is provided between the air filter **160** and the frame **161**, to provide a substantially airtight seal. As is known in the art, a seal, or sealing element, could be positioned in the frame **161** and/or included in the filter **160**. **FIG. 3** shows that ambient air (schematically represented by arrows **131**) is drawn towards the intake apertures **140**, through the air filter **160**, and through the chamber **128** (as represented schematically by arrows **133** and **135**). The air flow generated by the fan **130** results in the air in the air flow exiting the chamber **128** through exit apertures **136**, as represented schematically by arrows **137**.

[0042] The air filter **160** is for removing contaminants in the air flow from the air. As is known in the art, more than one air filter may be used together. For example, a charcoal filter (for odors) may be used with a pre-filter (to remove larger particles), and a filter with smaller holes in it to remove smaller particles. Further, and as is also known in the art, air filtration systems can include chemical and other systems for filtering air, as well as particulate filtration systems. For the purposes hereof, references to the "air filter" will be understood to include a single filter and any of the foregoing types of air filtration systems.

[0043] As is known in the art, the housing is preferably constructed of panels of sheet metal which are fastened together using any suitable means. However, because the housing is used to form part of a plenum (i.e., the internal chamber **128**), the housing is manufactured to be substantially airtight (i.e., except for the intake and exit apertures), at least in the portions of the housing which delimit part of the internal chamber **128**. In addition, the other components of the flame simulating assembly **120** which also delimit the internal chamber **128**, i.e., the screen **124** and tho simulated fuel bed **126**, are preferably mounted in the housing **122** so that substantially airtight seals are formed between the housing, the screen **124** and the simulated fuel bed **126**. Such sealing can be effected by any suitable means, including caulking with a suitable sealant, or using gaskets. The function of the sealing elements is to direct, or guide, the air in the air flow so that, in the preferred embodiment, virtually all of the air in the air flow is directed through the filter (i.e., the air filtration system). To the extent that there is leakage around the filter (i.e., around the internal chamber), however, airborne contaminants (and especially dust) in the ambient air will get into the air in the air flow, which is undesirable. It will be understood that, although the sealing of the internal chamber (i.e., excluding the intake and exit apertures) should be substantially airtight, some leakage around the sealing elements can be permitted, for acceptable functioning of the filtering system.

[0044] In the preferred embodiment, the fan **130** is positioned proximal to the top panel **123** and the front panel **134**, so that the air flow which is generated through the internal chamber **128** exits the internal chamber **128** above the screen **124**, though the exit apertures **136** in the front panel **134**.

[0045] Preferably, the air filter **160** (i.e., the operational area of the filter) is as large as possible, in order to facilitate efficient filtering of the air which passes through the filter **160**. Because the filter **160** covers a relatively large area, the filter **160** can have a plurality of relatively small holes in it through which the air is drawn, however, with a relatively low pressure gradient across the filter **160**. For example, the air filter **160** is preferably a standard size particle filtering system, such as a filter 20 inches in height by approximately 20 inches in width by approximately one inch in thickness. In the preferred embodiment, the air filter **160** is an electrostatically charged filter, because an electrostatically charged filter operating with a relatively lower pressure drop across the filter is nevertheless generally as effective as a non-electrostatic filter operating with a higher pressure drop across it. It is generally preferred that the holes in the air filter **160** are relatively small, so that the filter can accumulate relatively small particulates. The intake apertures **140** are preferably distributed over an area of the back panel **127** which has approximately the same dimensions overall as the operative part of the air filter **160**.

[0046] The filter **160** tends to become obstructed after usage over a period of time, as particulates accumulate on

the filter **160** and gradually build up to obstruct or close the holes in the filter **160**. Because of this, the filter **160** has to be removed from the flame simulating assembly **120** from time to time, for maintenance. For example, depending on the type of filter, the air filter may be replaced by a new air filter. However, if the air filter is of a type which is to be cleaned, rather than replaced, then the air filter is cleaned.

[**0047**] The flame simulating assembly **120** preferably includes a thermal switch (or control device) **162** (**FIG. 5**) positioned proximal to the heating element **132** (**FIG. 3**). The thermal switch **162** is adapted to cause an alerting device (preferably, an electric lamp) **164** to be energized upon the thermal switch sensing a predetermined temperature (or a higher temperature) in the air in the air flow. In the preferred embodiment, as shown in **FIG. 5**, thermal switch **162** and the electric lamp **164** are connected in series in a control circuit **166**. Preferably, the circuit **166** is connected (in parallel) to other circuits **168**, **170**, **172** included in the flame simulating assembly **120**, also as shown in **FIG. 5**. The other circuits **168**, **170**, and **172** are required for the operation of other aspects of the flame simulating assembly **120**, as is known in the art.

[**0048**] As is known in the art, the thermal switch (or control device) **162** includes one or more sensors for sensing (i.e., measuring) a temperature of the air in the air flow as the air exits the heating elements **132**. The control circuit **166** operatively connects the sensors to the lamp for activating the lamp **164** when the measured temperature of the air in the air flow is at the predetermined temperature, or at a temperature greater than the predetermined temperature. When the air filter **160** is sufficiently obstructed, the rate of flow of the air through the heating elements **132** decreases. When that happens, the temperature of the air exiting the heating elements **132** quickly rises, becoming much hotter than the temperature of the air exiting the heating elements **132** under normal operating conditions. The thermal switch **162**, which (in the preferred embodiment) is normally open, closes when the predetermined temperature is reached, thereby completing the control circuit **166**, and causing current to flow through the electric lamp **164**. As is known in the art, the thermal switch remains closed until a reset button is operated, regardless of the temperature of the air in the air flow after the thermal switch has closed.

[**0049**] The electric lamp **164** preferably is mounted in a position where it is easily viewed by a user (not shown), such as in a control panel (not shown) mounted on the flame simulating assembly. Accordingly, upon activation of the electric lamp **164**, the user is thereby alerted that the air filter **160** should be replaced. It will be appreciated that, instead of the electric lamp **164**, any other suitable alerting device, such as a device for emitting an audible warning, could be used.

[**0050**] It will be understood that, alternatively, other control devices could be used to determine whether the air filter **160** is obstructed to a predetermined extent. For example, instead of the thermal switch, the control device can include an air flow meter (**FIGS. 5B and 5C**) included in an alternative embodiment of the control circuit. Although the embodiments shown in **FIGS. 5B and 5C** have the advantage that a sensor is monitoring the flow rate of the air flow in the absence of operation of the heating elements, this embodiment has the disadvantage (relative to the thermal switch) that the air flow meter components are slightly more complex than the components used in the thermal switch embodiment.

[**0051**] As will be described, an air flow meter **182** is adapted to sense a flow rate of the air flow and is included in a control circuit **183** (**FIG. 5B**). The control circuit **183** preferably includes an alerting device **184** to which the air flow meter **182** is operatively connected, so that a decrease in the flow rate of the air flow to a predetermined flow rate (or below) results in activation of the alerting device **184**. Preferably, the air flow meter **182** includes a Pitot tube **186** which is operatively connected to the alerting device **184** by a microelectronic component (or components) **188**, as is known in the art. As is also known in the art, the Pitot tube has an inner tube (not shown) and an outer tube (not shown) bent into an L shape, and the inner tube is open at an end **190** directed upstream. Accordingly, the end **190** of the Pitot tube **186** is positioned appropriately in the air flow, so that the flow rate of the air flow is sensed by the Pitot tube **186**. Preferably, the control circuit **183** is electrically connected to the fireplace circuits (not shown in **FIG. 5B**) at terminals **191** of the control circuit **183**, as is known in the art.

[**0052**] An alternative air flow meter **192**, included in another alternative embodiment of a control circuit **193**, is schematically illustrated in **FIG. 5C**. The air flow meter **192** includes a mechanical velocity meter **194** and an alerting device **195**, the mechanical meter **194** and the alerting device **195** being operatively connected by a microelectronic component (or components) **196**, as is known in the art. The mechanical meter **194** is positioned in the air flow, and is adapted to sense the rate of flow of the air flow. If the rate of flow decreases to a predetermined flow rate (or below), the alerting device **195** is activated. Preferably, the alerting device **195** is an electric lamp. It is also preferable that the control circuit **193** is electrically connected to the fireplace circuit(s) at terminals **198**.

[**0053**] In the preferred embodiment, the flame image subassembly **150** includes one or more light sources **152**, a flicker element **154**, and a flame effect element **156** (**FIG. 3**). Preferably, the arrangement of the flame image subassembly **150** and its operation are generally as described in U.S. Pat. No. 5,642,580 (Hess et al.), the entire specification of which is hereby incorporated herein by reference. It will be understood that the structures supporting and positioning the light source **152** and the flicker element **154** are known, and not included in **FIG. 3** for clarity of illustration.

[**0054**] Light from the light source **152** is reflected by the flicker element **154** towards a back surface **155** of the screen **124**. The reflected light which is thus directed is also caused to flicker by the flicker element **154** because the flicker element **154** includes a plurality of reflective strips **157** which are rotated about an axis **158**. The reflective strips **157** are arranged so that they appear to reflect light from the light source **152** intermittently, to mimic the flickering light produced by a fire. The flame effect element **154** is preferably made of sheet metal, with an outline of flames **159** (**FIG. 4**) cut out of the sheet metal. Preferably, the flame effect element **154** is positioned between the flicker element **152** and the back surface **155** of the screen **124**. The flickering light which is directed towards the back surface **155** of the screen **124** is configured by the flame effect element **154** so that the images of flames are directed onto

the back surface **155** of the screen **124**. The structure of the screen **124** is preferably as described in U.S. Pat. No. 5,642,580 (Hess et al.), or as described in U.S. Pat. No. 6,363,636 (Hess et al.), the entire specification of which is hereby incorporated herein by reference. Accordingly, one or more images of flames is provided at the front surface **129** of the screen **124** by the flame image subassembly **150**. Due to the position of the front surface **129** immediately behind the simulated fuel bed **126**, the images of flames provided by the flame image subassembly **150** appear to an observer (not shown) to be emanating from the simulated fuel bed **126**. The illusion is enhanced when the front surface **129** is at least partially specularly reflective, as described in U.S. Pat. No. 5,642,580 (Hess et al.).

[**0055**] It will be understood that the images of flames could be provided by other known flame image subassemblies. For example, the flame simulating assembly included in the flame simulating assembly **150** could include the components needed to provide images of flames in accordance with any of the various methods disclosed in U.S. Pat. No. 4,965,707 (Butterfield) or in GB 2 242 737 (Shute). Or, the images of flames could be provided via motion pictures of flames, as disclosed in co-pending U.S. patent application Ser. No. 11/038,118 filed on Jan. 21, 2005, the entire specification of which is hereby incorporated herein by reference.

[**0056**] It will also be understood that different components which are known in the art could be substituted for various components in the preferred embodiment of the flame image subassembly described above. For instance, although a preferred embodiment of a flicker element has been described, it will be appreciated by those skilled in the art that different ways of causing light from the light source **152** to flicker, or fluctuate, could be used.

[**0057**] In use, ambient air is drawn by the fan **130** from the premises in which the flame simulating assembly **120** is located into the internal chamber **128** through the inlet apertures **140**, as indicated by arrows **131** (**FIG. 3**). The air is drawn through the internal chamber (as indicated by arrows **133** and **135**) and through the fan **130** and the heating elements **132**, to exit the internal chamber **128** through the exit apertures **136** (as indicated by arrows **137**). As is known in the art, in the preferred embodiment, the fan **130** can be operated independently of the heating elements **132**. It will be understood that the fan **130** could "pull" or "push" the air in the air flow.

[**0058**] When, as in the preferred embodiment, the air filter is mounted in the back panel, the air filter can have a relatively large operational area. This enables the filter to filter the air in the air flow relatively efficiently (i.e., at a relatively high flow rate) a relatively low pressure drop is provided across the filter.

[**0059**] Additional embodiments of the invention are shown in **FIGS. 6-16**. In **FIGS. 6-16**, elements are numbered so as to correspond to like elements shown in **FIGS. 3 and 4**.

[**0060**] An alternative embodiment of a flame simulating assembly **220** is shown in **FIGS. 6 and 7**. The flame simulating assembly **220** includes a flame image subassembly **250** which differs from the flame image subassembly **150** shown in **FIG. 3**. In the flame image subassembly **250**, light from a light source **252** is reflected by a flicker element **254** towards a flame effect element **256** which has, on a front surface **257** thereof, an outline of flames in a reflective material or finish (not shown) which reflects the flickering light towards a back surface **255** of a screen **224**, to provide an image of flames at a front surface of the screen **224**. The flame simulating assembly **220** additionally includes a simulated fuel bed **226** which is positioned adjacent to the front surface **229** of the screen **224**, so that the images of flames produced by the flame image subassembly **250** appear to be emanating from the simulated fuel bed **226**.

[**0061**] The flame simulating assembly **220** includes a housing **222** with a top panel **223**, two or more side panels **225** supporting the top panel **223**, a back panel **227** connecting the side panels **225**, and one or more front panels **234** positioned substantially opposite to the basic panel **227**. As can be seen in **FIG. 6**, the screen **224**, the housing **222** and the simulated fuel bed **226** delimit an internal chamber **228**. The flame simulating assembly **220** also includes a fan **230** positioned to provide an air flow through the chamber **228** from one or more intake apertures **240**, through which air is drawn into the chamber **228**, to one or more exit apertures **236**, through which the air exits the chamber **228**. The flame simulating assembly additionally includes an air filter chamber **260** for filtering at least part of the air in the air flow through the internal chamber **228**. The air filter **260** is positioned to filter the air in the air flow before the air exits the chamber **228**. It is also preferred that the flame simulating assembly **220** includes one or more heating elements **232** for heating the air in the air flow before the air exits the chamber **228**.

[**0062**] As can be seen in **FIGS. 6 and 7**, the intake apertures **240** are positioned in the back panel **227**, and the exit apertures **236** are positioned in the front panel **234**. The air filter **260** is positioned immediately in front of the intake apertures **240**, mounted in a frame **261** therefor. Ambient air (schematically represented by arrows **231**) is drawn towards the intake apertures **240** and, through the air filter **260**, and through the chamber **228** (as represented schematically by arrows **233** and **235**). The air flow generated by the fan **130** results in the air in the air flow exiting the chamber **228** through the exit apertures **236**, as represented schematically by arrows **237**.

[**0063**] An alternative embodiment of a flame simulating assembly **320** of the invention is disclosed in **FIGS. 8, 10**, and **11**. As can be seen in **FIG. 8**, in the flame simulating assembly **320**, an air filter **360** is mounted on a bottom panel **342** of a housing **322** in a frame **361**. The frame **361** preferably extends below the bottom panel **342** because it is necessary to allow space inside the flame simulating assembly **320** for components of a flame image subassembly **350** (i.e., a light source **352**) above the bottom panel **342** and below a screen **324** and a simulated ember bed **326**.

[**0064**] The flame simulating assembly **320** includes a housing **322** which includes the bottom panel **342**, a back panel **327** extending upwardly from the bottom panel **342**, side panels **325** (**FIG. 10**) connected to each other by the bottom panel **342** and the back wall **327**, a top panel **323** at the top of the side panels **325**, and one or more front parts **334** positioned opposite to the back panel **327**. As can be seen in **FIG. 8**, the front parts **334** include a lower front part **370** positioned proximal to the bottom panel **342** and an

upper front part **371** positioned proximal to the top panel **323**. An internal chamber **328** is delimited by the housing **322**, the screen **324**, and the simulated fuel bed **326**. As shown in **FIG. 8**, the housing **322** also preferably includes feet **368** to support the bottom panel **342** above the floor (not shown), so that ambient air can flow into the internal chamber **328** from the premises.

[**0065**] Because the air filter **361** is positioned partly below the bottom panel **342**, the bottom panel **342** has one or more intake apertures **340** positioned in it through which air is drawn by a fan **330** from the premises in which the flame simulating assembly **320** is located (schematically represented by arrows **331**). Alternatively, the frame **361** for the filter **360** can be positioned substantially in an aperture **340** in the bottom panel **342**. The fan **330** also drawn the air through the internal chamber **328** (as represented by arrows **333**, **335**) towards the fan **330**, and the air is subsequently pushed by the fan **330** through exit apertures **336** out of the internal chamber **328**.

[**0066**] As shown in **FIGS. 8 and 10**, the air filter frame **361** preferably extends to the lower front part **370**. Preferably, this permits relatively easy removal of the air filter **360** from the frame **361**, by sliding the filter **360** forwardly (i.e., in the direction of arrow "A" in **FIG. 8**). The filter **360** can be placed in the frame **361** by pushing the filter backwardly (i.e., in the direction of arrow "B" in **FIG. 8**). The filter **360** is preferably securely positioned in the frame **361** by a latching mechanism or any other suitable mechanism, as is known in the art.

[**0067**] The frame **361** is also shown in **FIG. 11** to extend to the front panel **371**. For convenience, arrows "A" and "B" are also shown in **FIG. 11**, to indicate the direction in which the filter **360** is moved when it is to be removed and the direction in which the filter **360** is moved when it is to be installed, respectively.

[**0068**] As can be seen in **FIGS. 8, 10**, and **11**, the access from the front which is provided in the flame simulating assembly **320** is generally more convenient than the access to the filter which is provided in the embodiments of the flame simulating assembly (**120**, **220**) in which the air filter (**160**, **260**) is mounted on the back panel (**127**, **227**). However, due to space constraints, the air filter **360** is generally not as large as the air filter which is positioned in the back panel. For example, the bottom-mounted filter is typically a size such as approximately 20 inches by approximately 10 inches by 1 inch which is standard, and readily available from a variety of manufacturers. As described above, a larger operative area of an air filter is generally advantageous because a relatively large air flow volume can be provided through relatively small holes in the filter with a relatively low pressure differential across the filter. However, as shown in **FIGS. 8 and 10**, access to the bottom-mounted filter is relatively convenient.

[**0069**] As shown in **FIG. 9**, another alternative embodiment of a flame simulating assembly **420** includes a bottom-mounted filter **460** and a flame image subassembly **450** similar to the flame image subassembly **250**. In particular, the flame image subassembly **450** includes a flame effect element **456** with a reflective portion **459** shaped to resemble flames, similar to the flame effect element **256** shown in **FIG. 6**.

[**0070**] It will be understood that a front elevation view of the flame simulating assembly **420** also would be as shown in **FIG. 10**. For clarity, however, **FIG. 10** is an illustration of a front elevation view of the flame simulating assembly **320** also shown in **FIG. 8**. Also, a bottom elevation view of me flame simulating assembly **420** would be as shown in **FIG. 11**.

[**0071**] Another alternative embodiment **520** of a flame simulating assembly is shown in **FIGS. 12-16**. As can be seen in **FIGS. 12 and 13**, the flame simulating assembly **520** includes an exterior subassembly **572** enclosing at least a portion of a housing **522** and generally including a mantel portion **574**, a front portion **578**, and side walls **580** (**FIGS. 14, 15**). The flame simulating assembly **520** also includes a bottom portion **581** (**FIG. 12**). The exterior subassembly **572** comprises a "trim" package resembling a mantel and other decorative parts of an actual fireplace, which is provided to enhance the simulation effect of the flame simulating assembly. For example, the exterior subassembly **572** can be made of wood, wood veneer, or any other suitable material, and provided with a suitable finish. Preferably, the exterior subassembly **572** does not include a back wall, unless needed in a particular application.

[**0072**] In the flame simulating assembly **520**, the mantel portion **574** is movable relative to the housing **522** between a closed position (**FIG. 12**), in which an air filter **560** is inaccessible because it is covered by the mantel portion **574**, and an open position (**FIGS. 13-16**), in which the air filter **560** is accessible because the mantel portion **574** has been moved forwardly. In this way, access to the air filter is provided when the air filter is mounted in or on the back panel, to enable the user to remove the air filter **560** from a frame **561** for replacement or repair or cleaning of the filter **560**, as appropriate.

[**0073**] It will be appreciated by those skilled in the art that the invention can take many forms, and that such forms are within the scope of the invention as claimed. Therefore, the spirit and scope of the appended claims should not be limited to the descriptions of the preferred versions contained herein.

We claim:

1. A flame simulating assembly having:

a housing including:

a top panel;

at least two side panels supporting the top panel;

a back panel connecting said at least two side panels;

at least one front panel positioned substantially opposite to the back panel;

a simulated fuel bed disposed in the housing;

a screen positioned behind the simulated fuel bed, the screen having a front surface disposed adjacent to the simulated fuel bed;

a flame image subassembly for providing images of flames on the front surface of the screen;

the screen, the housing and the simulated fuel bed delimiting an internal chamber;

a fan positioned to generate an air flow through the internal chamber from at least one intake aperture, through which air is drawn into the internal chamber, to

at least one exit aperture, through which said air in the air flow exits the internal chamber;

the internal chamber being substantially airtight, except for said at least one intake aperture and said at least one exit aperture; and

at least one air filter for filtering at least a portion of said air in the air flow, said at least one air filter being positioned to filter said air in the air flow.

2. A flame simulating assembly according to claim 1 additionally including at least one heating element for heating said air in the air flow.

3. A flame simulating assembly according to claim 2 additionally including a thermal switch positioned proximal to said at least one heating element and in the air flow, the thermal switch being operatively connected to at least one alerting device such that the thermal switch causes said at least one alerting device to be energized upon the thermal switch sensing that the air in the air flow reaches at least a predetermined temperature.

4. A flame simulating assembly according to claim 3 in which said at least one alerting device is an electric lamp.

5. A flame simulating assembly according to claim 1 additionally including a control device for measuring a flow rate of the air flow, the control device being operatively connected to an alerting device such that, upon the flow rate of the air flow falling below a preselected flow rate, the control device causes the alerting device to be energized.

6. A flame simulating assembly according to claim 1 in which said at least one exit aperture is located in said at least one front panel.

7. A flame simulating assembly according to claim 1 in which said at least one intake aperture is disposed in the back panel and said at least one air filter is positioned adjacent to said at least one intake aperture.

8. A flame simulating assembly according to claim 7 additionally including a mantel portion positionable substantially above said at least one air filter, the mantel portion being movable to provide access to said at least one air filter for removal thereof.

9. A flame simulating assembly according to claim 7 in which the fan is positioned proximal to the top panel and said at least one front panel, for generating the air flow through the internal chamber.

10. A flame simulating assembly according to claim 6 in which said at least one air filter is approximately 20 inches in height by approximately 20 inches in width by approximately 1 inch in thickness and said at least one intake aperture is approximately 20 inches in width and approximately 20 inches in height.

11. A flame simulating assembly according to claim 1 in which:

the housing includes a bottom panel connecting said at least two side panels and the back panel;

the bottom panel includes said at least one intake aperture; and

said at least one air filter is positioned adjacent to said at least one intake aperture.

12. A flame simulating assembly according to claim 11 additionally including a front exterior portion positionable in front of said at least one air filter, the front exterior portion being removable to provide access to said at least one air filter for removal thereof.

13. A flame simulating assembly according to claim 11 in which the fan is positioned proximal to the top panel and said at least one front panel, for generating the air flow through the chamber.

14. A flame simulating assembly according to claim 11 in which said at least one air filter is approximately 20 inches in height by approximately 10 inches in width by approximately 1 inch in thickness.

15. A flame simulating assembly having:

a housing including:

at least two side panels;

a bottom panel positioned substantially orthogonal to said at least two side panels;

a back panel positioned substantially orthogonal to said at least two side panels;

a top panel positioned substantially orthogonal to said at least two side panels;

at least one front panel positioned substantially orthogonal to the top panel;

a simulated fuel bed disposed in the housing;

a screen positioned in the housing behind the simulated fuel bed;

the screen, the simulated fuel bed, and the housing defining an internal chamber;

a flame image subassembly for providing images of flames on the screen;

an air flow generator, for providing for generating an air flow through at least a portion of the chamber from at least one input aperture to at least one exit aperture; and

at least one filter for filtering at least a portion of said air in the air flow.

16. A flame simulating assembly according to claim 14 in which the internal chamber is substantially airtight, except for said at least one intake aperture and said at least one exit aperture.

17. A flame simulating assembly according to claim 16 additionally including at least one heating element for heating said air in the air flow before said air exits the chamber.

18. A flame simulating assembly according to claim 16 additionally including:

at least one lamp;

a control device operatively connected to said at least one lamp for activating and de-activating said at least one lamp; and

the control device including at least one sensor for sensing a temperature of said air in the air flow; and

a control circuit operatively connecting said at least one sensor to said at least one lamp for activating said at least one lamp when the temperature of said air is at a predetermined temperature or higher, said at least one sensor being positioned proximal to said at least one heating element such that when said at least one air filter is obstructed to a predetermined extent, said at least one lamp is energized.

19. A flame simulating assembly according to claim 16 additionally including a control device for measuring a flow rate of the air flow, the control device being operatively connected to an alerting device such that, upon the flow rate of the air flow falling below a preselected flow rate, the control device causes the alerting device to be energized.

20. A flame simulating assembly according to claim 15 in which said at least one exit aperture is located in said at least one front panel.

21. A flame simulating assembly according to claim 15 in which said at least one intake aperture is disposed in the back panel and said at least one air filter is positioned adjacent to said at least one intake aperture.

22. A flame simulating assembly according to claim 18 additionally including a mantel portion positionable substantially above said at least one air filter, the mantel portion being removable to provide access to said at least one air filter for removal thereof.

23. A flame simulating assembly according to claim 21 in which the fan is positioned proximal to the top panel and said at least one front panel, for generating the air flow through the chamber.

24. A flame simulating assembly according to claim 21 in which said at least one air filter is approximately 20 inches in height by approximately 20 inches in width by approximately 1 inch in thickness and said at least one intake aperture is approximately 20 inches in width and approximately 20 inches in height.

25. A flame simulating assembly according to claim 15 in which:

the housing includes a bottom panel connecting said at least two side panels and the back panel;

the bottom panel includes said at least one intake aperture; and

said at least one air filter is positioned adjacent to said at least one intake aperture.

26. A flame simulating assembly according to claim 25 additionally including a front exterior portion positionable in front of said at least one air filter, the front exterior portion being removable to provide access to said at least one air filter for removal thereof.

27. A flame simulating assembly according to claim 25 in which the fan is positioned proximal to the top panel and said at least one front panel, for generating the air flow through the chamber.

28. A flame simulating assembly according to claim 25 in which said at least one air filter is approximately 20 inches in a first dimension by approximately 10 inches in a second dimension by approximately 1 inch in thickness.

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