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(54) Method and apparatus for visually detecting a burner flame of a gas appliance

(57) An apparatus for detecting the presence of a burner flame of a gas appliance includes a detection element for optically detecting the burner flame. The detection element is positioned adjacent to a location of the burner flame. The apparatus additionally includes a display element positioned remotely from the detection element. The display element is operative in a first mode to indicate the presence of a burner flame and a second mode to indicate the absence of a burner flame. The apparatus further includes a transmission element connecting the detection element and the display element. The transmission element causes the display element to operate in the first mode when the detection element optically detects the burner flame.

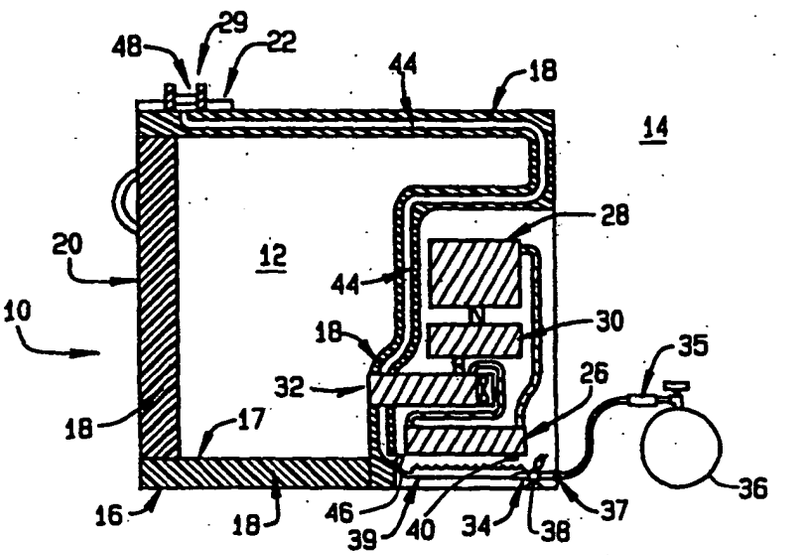

FIG. 1

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Description

CROSS REFERENCE TO RELATED APPLICATION

[0001] This application claims priority to United States Provisional Patent Application No. 60/471,009 filed May 16, 2003 which is hereby expressly incorporated by reference herein in its entirety.

FIELD OF THE INVENTION

[0002] The present invention relates to a method and apparatus for detecting a burner flame of an appliance. More particularly, the present invention relates to a method and apparatus for detecting a flame of an appliance that incorporate a fiber optic element for transmission. More specifically, but without restriction to the particular embodiment and/or use which is shown and described for purposes of illustration, the present invention relates to a method and apparatus for detecting a flame of an appliance, such as an absorption refrigerator, that use a fiber optic element with light filters, light shields, and cable sheathing with indeces which can be designed and optimized for different appliances and applications.

BACKGROUND OF THE INVENTION

[0003] Various appliances are operated with a gas fuel and require a burner flame for operation. Examples of such gas appliances include, but are not limited to ovens, clothes dryers, furnaces, absorption refrigerator and the like. It is frequently desirable to confirm the presence of the burner flame.

[0004] Many known gas appliances employing a fuel burner conventionally include an electronic flame monitor. Unfortunately, the required electronics for electronic flame monitors add complexity and expense to the gas appliance while decreasing reliability and requiring electric power for operation. Other solutions have employed an access hole to view the flame. Such access holes significantly limit the vantage points from which the presence of the burner flame may be confirmed. Accordingly, access to the burner flame is often inconvenient, impractical or even impossible.

[0005] Insofar as the present invention is concerned, absorption refrigerators illustrate some of the disadvantages and/or limitations associated with the conventional detection of burner flames of gas appliances. Such absorption refrigerators are often provided on vehicles, including but not limited to recreational vehicles ("RVs", in the United States and "Caravans" in Europe), tractor trailers, airplanes, boats, trains and the like, for the comfort and convenience of the occupants. For example, recreational vehicle campers often find it convenient, or even necessary, to refrigerate food, drinks, and medicine during their journey and while at their campsites. While many prepared camp sites in parks and commercial campgrounds provide for electrical outlets, many do not. Moreover, many highly desirable camping locations exist outside of these prepared sites. Thus, a popular solution has been to equip the recreational vehicle with an absorption refrigerator.

[0006] In the case of an absorption refrigerator, a loss of flame results in a corresponding loss of refrigeration and a potential loss of the refrigerator contents. Moreover, if a fuel burner is employed, safety dictates that the fuel supply be shut off in the event of such a failure. Such concerns are associated with other gas appliances. Accordingly, an ability to confirm the presence of a burner flame is important to a gas appliance user.

[0007] It is important to note that space aboard recreational vehicles comes at a premium. Typically, even the couches near the kitchens fold out to provide steeping berths for additional campers. Thus, it is desirable to control light sources during the night for occupant comfort. Otherwise, the occupants may be unable to sleep or may loose their night vision upon waking. The latter is disturbing because part of the enjoyment of camping involves appreciation of the brilliant night skies at remote camping sites. Additionally, at many camp sites, sanitary facilities are provided as part of the permanent facilities (e.g., showers and bathrooms). Upon waking and loosing night vision due to uncontrolled light sources, an occupant desiring to access these permanent facilities may potentially stumble upon exiting the vehicle. Thus, uncontrolled light sources may be inconvenient, or worst yet, hazardous for the occupants. Since the prior art flame detectors function to maximize emitted light, they pose a potential hazard to the users of certain gas appliances, including but not limited to absorption refrigerators.

[0008] It is also important to note that absorption refrigerators are typically positioned against an outside wall of the recreational vehicle. Other gas appliances may be similarly situated within a recreational or other vehicle, or against a stationary wall of a building. As such, direct inspection of the burner flame is often prohibited. Inspection through an access hole is often impractical or unconventional. Accordingly, it remains a need in the pertinent art to provide a method and apparatus detecting a burner flame of a gas appliance that overcomes the disadvantages associated with the prior art, including but not limited to those disadvantages discussed above.

SUMMARY OF THE INVENTION

[0009] The present invention is directed to a method and apparatus for detecting a burner flame of a gas appliance. More particularly, the present invention is directed to a simple, economical and reliable apparatus for detecting a burner flame of a gas appliance and a related method. In one particular application, the apparatus for detecting the presence of a burner flame of a gas appliance includes a detection element for optically

detecting the burner flame. The detection element is positioned adjacent to a location of the burner flame. The apparatus additionally includes a display element positioned remotely from the detection element. The display element is operative in a first mode to indicate the presence of a burner flame and a second mode to indicate the absence of a burner flame. The apparatus further includes a transmission element connecting the detection element and the display element. The transmission element causes the display element to operate in the first mode when the detection element optically detects the burner flame.

[0010] In another particular application, the apparatus for detecting a burner flame of the present invention emits a controlled amount of light, thereby making it suitable for various applications, such as for use in close proximity to the sleeping area of a recreational vehicle. The teachings of the present invention may also be employed to customize a flame detection output for other applications.

[0011] According to one particular aspect, the present invention provides an apparatus for detecting a burner flame of a gas appliance including a fiber optic element or cable. The fiber optic cable has two ends. One of the ends is placed a predetermined distance from the burner flame and couples light from the burner flame location into the fiber optic cable. The other end of the fiber optic cable is routed to a surface of the gas appliance where the user may conveniently view that end of the fiber optic cable. The material, length, cross sectional area, cladding, and distance from the flame of the cable may be chosen such that the viewable end of the fiber optic cable emits no more than a pre-determined amount of light.

[0012] According to another particular aspect, the present invention provides an apparatus having at least one photoelectric panel. The photoelectric panel is disposed adjacent to the location of the burner flame operative to generate electrical energy in response to the presence of the burner flame. This electrical energy is transmitted to a display element which visually indicates the presence of the burner flame at a point remote from the burner flame.

[0013] Further areas of applicability of the present invention will become apparent from the detailed description provided hereinafter. It should be understood that the detailed description and specific examples, while indicating the preferred embodiment of the invention, are intended for purposes of illustration only and are not intended to limit the scope of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

[0014] The present invention will become more fully understood from the detailed description and the accompanying drawings, wherein:

[0015] Figure 1 is a cross-sectional side view of an apparatus for detecting a burner flame of a gas appliance in accordance with a first embodiment of the present invention, the apparatus shown operatively associated with an otherwise conventional gas appliance.

[0016] Figure 2 is an enlarged detail view of a portion of the gas appliance of Figure 1.

[0017] Figure 3 is a top view of a control panel of Figure 1.

[0018] Figure 4 is a cross-sectional view taken through a distal end of a fiber optic cable of the apparatus for detecting a burner flame of the preferred embodiment of the present invention.

[0019] Figure 5 is a schematic illustration of an apparatus for detecting a burner flame of a gas appliance in accordance with a second embodiment of the present invention, the apparatus shown operatively associated with an otherwise conventional gas appliance.

DETAILED DESCRIPTION OF THE EMBODIMENTS OF THE INVENTION

[0020] The following description of the embodiments of the invention is merely exemplary in nature and is in no way intended to limit the invention, its application, or uses.

[0021] With initial reference to Figure 1, an apparatus for detecting a burner flame of a gas appliance constructed in accordance with the teachings of a first embodiment of the present invention is illustrated and generally identified at reference character 8. The apparatus 8 is operatively associated with a gas appliance in the form of an absorption refrigerator 10. It will become apparent below to those skilled in the art that the teachings of the present invention have application beyond use with an absorption refrigerator 10. In this regard, it will be understood that the description of the present invention insofar as it is specifically directed to an absorption refrigerator is exemplary in nature.

[0022] Prior to addressing the specific teachings of the present invention, a brief understanding of the exemplary use environment shown in the drawings is warranted. With general reference to the drawings and with particular reference to Figure 1, the absorption refrigerator 10 conventionally includes an interior volume 12 for storing perishables and other items needing cooling. An outer shell 16 provides protection for the various components of the refrigerator 10. The shell 16 also prevents warm air intrusion into the interior 12 and prevents cold air seepage from the interior 12. An insulating layer or insulation 18 (typically a fiberglass or polyurethane foam) limits heat conduction into the interior 12 from the exterior 14. An inner shell 17 provides similar functions as that of the outer shell 16.

[0023] A door 20 allows the user access to the interior 12. The door 20 also includes a portion of the insulation 18. Somewhere on the refrigerator 10 viewable by the user, a control panel 22 is provided so that the user can turn the refrigerator on and off, adjust the temperature of one or more interior sections, and monitor the per-

formance of the refrigerator 10. In the particular embodiment illustrated, controls for these functions are provided such as the on/off switch 23, a temperature indicator 25, and a temperature set point selector 27 as shown in Figure 3. More particularly, the control panel 22 includes a display element or flame indicator 29 to allow the user to determine whether the burner flame driving the refrigeration system is present or absent, as will be discussed more below. The display element 29 is operative in a first mode to indicate the presence of a burner flame and a second mode to indicate the absence of a burner flame. For example, in the first mode the display element 29 may be illuminated and in the second mode the display element is not illuminated.

[0024] It will be appreciated that the flame indicator 29 may be alternatively mounted remote from the control panel. Importantly, the flame indicator 29 is positioned for convenient viewing by the gas appliance user.

[0025] Continuing with specific reference to Figure 1, the refrigerator 10 also includes an absorption refrigeration system 24. The absorption system 24 includes a generator 26, a condenser 28, a receiver 30, and an evaporator 32 arranged in a loop. In the generator 26, the coolant mixture (typically ammonia and water - anhydrous ammonia) absorbs heat thereby preferentially releasing ammonia vapor. From the generator 26, the ammonia vapor flows to the condenser 28.

[0026] In the condenser 28, the ammonia vapor cools and condenses. By gravity, the cool liquid ammonia flows from the condenser 28 and into the receiver 30. From the receiver 30, the liquid ammonia bleeds through an orifice (not shown) into the evaporator 32. In the evaporator 32 the liquid ammonia absorbs heat from the interior 12 thereby cooling the interior 12. In certain applications, the flow of ammonia to the evaporator 32 may be controlled by a control valve rather than the orifice described above, thus providing closed loop control of the temperature in the interior 12 without departing from the spirit and scope of the present invention. The vaporized ammonia then flows from the evaporator 32 to the generator 26 wherein the partially depleted water - ammonia mixture absorbs the ammonia vapor to complete the refrigeration cycle.

[0027] Not shown, for clarity, is the insulation around evaporator 32 required to maximize the efficiency of the evaporator 32. Nor are the air registers and duct work to route air from the interior 12, through the evaporator 32, and back to the interior 12 shown in the figures. Instead, evaporator 32 is shown protruding into the interior 12 to signify that the air in the interior 12 and the cooling surfaces of evaporator 32 are in thermal communication. Other arrangements of the evaporator 32 may be provided without departing from the spirit and scope of the present invention.

[0028] Referring particularly now to Figure 1 and 2, heat is required to preferentially vaporize the ammonia in the ammonia - water mixture. The heat source may be an electrical heater or a fire. Where a flame 42 is employed (for example, to reduce the need for electricity at remote camp sites), a fuel system is included in the refrigerator 10. The fuel system includes a fuel pipe, or source 34, a fuel shutoff valve 38 (shown with control wires), and a connection 37 for an external fuel bottle 36. Since propane is a commonly available fuel, propane is frequently used for the fuel. Though other fuels, solid, liquid, or gaseous, could be employed without departing from the spirit or scope of the present invention.

[0029] An igniter 40 is also provided to ignite the fuel from a burner 39 and create the burner flame 42 as required. In the embodiment illustrated, the igniter 40 is shown as a spark igniter with electrical wires. A number of causes may extinguish the flame 42. For example, either the fuel may run out or the flow of fresh air to the flame 42 could be interrupted. Additionally, if exposed to the weather or drafts, wind could blow out the flame 42 or precipitation could quench the flame 42. No matter what the reason for the flame 42 failing, the user needs to know that a problem has occurred so that corrective action can be taken before the interior 12 warms too much.

[0030] The generator 26 may incorporate the burner 39 as an integral component along with a fan and duct work to move fresh air into, and exhaust gases out of, the generator 26. For clarity, the burner 39 is shown external to the generator 26 and the duct work and fans are omitted from the figures. Even where the burner 39 is not integral with the generator 26 it will typically be at the rear of the refrigerator 10 enclosed within the refrigerator 10. Accordingly, the flame 42 will not be visible to the user.

[0031] The description of the absorption refrigerator 10 heretofore provided will again be understood to be exemplary. Moreover, the details of the absorption refrigerator 10 heretofore provided will be understood to be conventional insofar as the present invention is concerned. It will be appreciated that various features of the absorption refrigerator 10 can be modified within the scope of the present invention. Of significance is the fact that the burner flame is positioned remotely from the flame indicator.

[0032] With continued reference to Figures 1-4 of the drawings, the apparatus 8 of the present invention will now be described in detail. The apparatus 8 of the present invention is shown to generally include a fiber optic element, or cable 44. The fiber optic cable 44 has a proximal end 46 and a distal end 48. The proximal end 46 is placed a predetermined distance "d" from the location of the burner flame 42. In one application, the distance "d" is approximately 1mm. The proximal end 46 is polished and shaped so that it couples light into the fiber optic cable 44. The proximal end 46 serves as a detection element for optically detecting the burner flame 42.

[0033] The fiber optic cable 44 is routed from the proximate vicinity of the flame 42 behind (or through) the insulation 18 and to the control panel 22. That is, the fiber

optic cable 44 is located on the exterior side of the insulation 18 so that the cable 44 does not act as a heat conductor from the flame 42 to the interior 12. Though, low thermal conductivity cables could be routed along the inside of the insulation 18 to minimize heat conduction into the interior. Thus, the fiber optic cable 44 serves as a transmission member that provides a transmission path for the light from the flame 42 to the control panel 22.

[0034] Like the proximal end 46, the distal end 48 is also polished and shaped but for the purpose of emitting the light of the flame 42 from the distal end 48. As shown in Figure 4, the proximal end 48 is shown in relation to the flame indicator 29. In addition it should be noted that the fiber optic cable 44 may be composed of a core 45, a cladding 47, and a jacket 51.

[0035] Each of the components of the cable 44 serves a specific purpose. The jacket 51 provides mechanical protection for the cladding 47 and core 45. The core 45 is also known as a light guide, and it is the degree of transparency of the core 45 which allows the light to pass through the cable 44. The cladding 47 also aids in optimal transmission of light through the cable 44. When the cladding 47 has an index of refraction lower than that of the core 45, the cladding 47 reflects light which strays from the core 45 back into the core 45.

[0036] However, in accordance with the present invention, these components of the cable 44 may be tuned to attenuate, rather than maximize, light transmission for the cable 44. For instance, core 45 may be made of a partially transparent material. The cladding 47 material may be chosen to have a higher index of refraction, relative to the core, than is typical of fiber optic cables. Note that the index of refraction of the cladding 47 does not have to exceed the index of refraction of the core 45.

[0037] Employing a relatively high index of refraction for the cladding 47 allows a portion of the light from the core 45 to pass through the cladding 47 and be absorbed by the jacket 51. Thus, only a portion of the light from the flame 42 would be transmitted all the way to the proximal end 48. As indicated, the color and reflectivity of the jacket 51 may also be tailored to attenuate light straying from the core 45. Additionally, one or both ends 46 or 48 may not be polished to optical perfection. Rather, the surface of the ends could be left with some roughness to provide less than optimal light coupling into and out of the cable 44.

[0038] Which ever combination of these properties is used, the cable 44 is designed to limit or otherwise control the amount of light which might otherwise be emitted from the proximal end 48. incorporation of an optimized cable sized to accomplish the same low level of emitted light will be understood to be also included in the present invention.

[0039] As noted earlier, light sources in the interior of a recreational vehicle must be controlled for occupant comfort and safety (for example, at night). Thus, according to the present invention, the distance "d" between the proximal end 46 and the flame 42; the shape, cross sectional area, and polish of the distal end 46; the cladding, core, and jacket materials, the cross sectional area, and the length of the fiber optic cable 44; and the shape, cross sectional area, and polish of the distal end 48 are chosen so that for the expected intensity of the light from the flame 42, a predetermined amount of light is emitted from the distal end 48. In short, the light transmission characteristics of the fiber optic cable 44 are preferably chosen to limit or otherwise control the amount of light transmitted by the fiber optic cable 44.

[0040] Now, note is made of the anatomy of the human eye so that further understanding of the present invention may be imparted. In particular, the human eye has two sets of light sensitive cells: rods and cones. The cones respond to bright light while the rods respond to less intense light. When the luminance of the field is (less than) 0.01 fL (footlamberts), as at night, seeing is due to the rods only and is called scotopic vision. At higher levels, with the cones primarily involved, seeing is called photopic vision. There is an intermediate region called mesopic vision. (See MARK'S STANDARD HANDBOOK FOR MECHANICAL ENGINEERS page 12-117 (Theodore Baumeister, Eugene A. Avallone, and Theodore Baumeister III eds., 8th ed. 1979).

[0041] Thus, the anatomy of the human eye gives rise to the phenomena known colloquially as "night vision" (scotopic vision) and "day vision" (photopic) with a region in which the eyes adjust between scotopic and photopic vision.

[0042] It should also be noted that the human eye does not respond instantly to changes in the intensity of light. Rather a matter of seconds or minutes may occur during which the cornea adjusts the size of the pupil to sudden and persistent changes in the intensity of light. Thus, momentary fluctuations in light level do not cause significant loss of night vision.

[0043] Accordingly, by limiting the average light being emitted from the distal end 48 of the fiber optic cable 44 to a level that does not significantly cause photopic vision, a flame detector may be created that both detects the flame and does not disturb the vision of the night time occupants (e.g., sleeping campers) of a recreational vehicle. Another preferred embodiment further limits the emitted light so that the flame detector does not even cause mesopic vision (e.g., only scotopic vision is caused).

[0044] Thus, the intensity of the light being emitted from the proximal end 48 may be computed that would correspond to the approximate 0.01 fL limit for scotopic vision for a room of any given area. Take for example a large recreational vehicle, of approximately 6.5 feet by (nominally) 55 feet, the luminance of 0.01 fL corresponds to a single light source of approximately 3.575 lumens. For a single room of a large vehicle (or the entire area of a smaller vehicle) of approximately 6.5 feet by (nominally) 12 feet, the luminance level of 0.01 fL corresponds to a single light source of approximately 0.78

lumens. Thus, preferred embodiments include fiber optic flame detectors designed to provide a distal end 48 emitting less than approximately 3.575 lumens, and more particularly less than about 0.78 lumens.

[0045] In particular, red light triggers the least day vision response from the human eye. Thus, placing a red filter 50 at any place along the light path, from the flame 42 to the user's eye, may be of benefit to the user. As shown in Figure 4, the red filter 50 is optically coupled to the distal end 48. Alternatively, the present invention may incorporate filters of different colors.

[0046] Likewise, sharp differences in intensity (i.e. contrast) may be irritating to the human eye. Thus, placing a light diffuser 52 between the user and the distal end 48 may enhance the beneficial effects of the present invention. In the alternative the distal end 48 may point up so that the emitted light strikes the ceiling of the recreational vehicle and diffuses accordingly.

[0047] For use during the day, a shield 49 may be placed around the flame indicator 29 to provide contrast for the low light level being emitted by the distal end 48. The shield 29 may extend vertically above the surface of the distal end 48, the filter 50, and the diffuser 52 to provide additional contrast.

[0048] It should also be noted that enclosure in an inside space does not limit the spirit nor the scope of the present invention. For example, the refrigerator 10 could be a free standing unit set atop a picnic table and illuminating, at a low level, its surroundings (the picnic table, trees, bushes, recreational vehicles, tents, fog, rain, etc.). Nor does the exact value 0.01 fL (and those derived from it: e.g. 3.575 lumens and 0.78 lumens) limit the spirit or the scope of the present invention, for the difference between day and night vision is not a sharp line. Rather, luminance within the mesopic region is also included within the present invention.

[0049] In an alternative embodiment, not shown, a fiber optic splitter allows the proximal end 46 to transmit light to two distal ends 46. One distal end can then be tailored to protect night vision. While the other proximal end is optimized for light transmission, thereby being suitable for driving an optoelectronic alarm system.

[0050] As illustrated the present invention provides a superior flame detector for a gas appliance such as an absorption refrigerator. Since the flame detector is a fiber optic cable it is passive with few failure modes. Accordingly, reliability is enhanced. Moreover, the simplicity and ease of installation contribute to an affordable gas appliance. The present invention also preserves the night vision of campers so that they may enjoy the night sky or sleep soundly according to their choosing. Additionally, by preserving night vision, the present invention enhances occupant safety onboard dark, crowded recreational vehicles.

[0051] Turning to Figure 5, a schematic view of a refrigerator 100 constructed to include an apparatus 102 for detecting the presence of a burner flame according to a second embodiment of the present invention is illustrated. As with the first embodiment, the gas appliance 100 is an absorption refrigerator. It will be understood, however, that the teachings of the second embodiment also have application for other gas appliances.

[0052] The apparatus 102 is generally illustrated to include a detection element in the form of at least one photoelectric panel 104. For certain applications, it may be desirable to incorporate multiple photoelectric panels 104. The photoelectric panel 104 is positioned adjacent the location of the burner flame 42 and operative for optically detecting the presence of the burner flame 42. Insofar as the present invention is concerned, the photoelectric panel 104 will be understood to be conventional in construction. The panel 104 senses the light from the burner flame 42 and converts this light to electrical energy.

[0053] The apparatus 102 is additionally shown to generally include a transmission element in the form of an electrical wire 106. The transmission element 106 functions to transmit the electrical energy to the display element 29. Transmission of the electrical energy by the transmission element 106 to the display element 29 causes the display element 29 to operate in the second mode *(i.e.*, to illuminate). Such illumination occurs when the detection element 104 optically detects the burner flame 42. The display element 29 may be a liquid crystal display, a light diode display or any other known type of display powered by electrical energy.

[0054] The description of the invention is merely exemplary in nature and, thus, variations that do not depart from the gist of the invention are intended to be within the scope of the invention. Such variations are not to be regarded as a departure from the spirit and scope of the invention.

Claims

1. An apparatus for detecting the presence of a burner flame of a gas appliance in combination with the gas appliance, the apparatus comprising:

a detection element for optically detecting the burner flame, the detection element positioned adjacent to a location of the burner flame;
a display element positioned remotely from the detection element, the display element operative in a first mode to indicate the presence of a burner flame and a second mode to indicate the absence of a burner flame; and
a transmission element connecting the detection element and the display element, such that the transmission element causes the display element to operate in the first mode when the detection element optically detects the burner flame.

2. The apparatus for detecting the presence of a burner flame of a gas appliance of claim 1, further comprising a fiber optic element having a distal end and a proximal end, the proximal end positioned adjacent to a location of the burner flame, the distal end positioned remotely from the proximal end for detection of the burner flame.

3. The apparatus for detecting the presence of a burner flame of a gas appliance of claim 2, further comprising means for customizing a flame detection output of the fiber optic element.

4. The apparatus for detecting the presence of a burner flame of a gas appliance of claim 3, wherein the means for customizing the flame detection output of the fiber optic element is operative to restrict output frequencies of the flame detection output.

5. The apparatus for detecting the presence of a burner flame of a gas appliance of claim 1, wherein the means for customizing the flame detection output of the fiber optic element includes at least one of a light filter, a light shield and a cable sheathing with predetermined indeces of refraction.

6. The apparatus for detecting the presence of a burner flame of a gas appliance of claim 1, wherein the fiber optic element is a fiber optic cable operative to limit the amount of light transmitted from the proximal end to the distal end.

7. The apparatus for detecting the presence of a burner flame of a gas appliance of claim 1, wherein the gas appliance is an absorption refrigerator.

8. The apparatus for detecting the presence of a burner flame of a gas appliance of claim 1, which the detection element comprises at least one photoelectric panel.

9. The apparatus for detecting the presence of a burner flame of a gas appliance of claim 8, further comprising a transparent panel disposed between the burner flame and the at least one photoelectric panel to protect the at least one photoelectric panel from heat.

10. The apparatus for detecting the presence of a burner flame of a gas appliance of claim 7, wherein the display element is a liquid crystal display.

11. The apparatus for detecting the presence of a burner flame of a gas appliance of claim 7, wherein the display element is a light diode display.

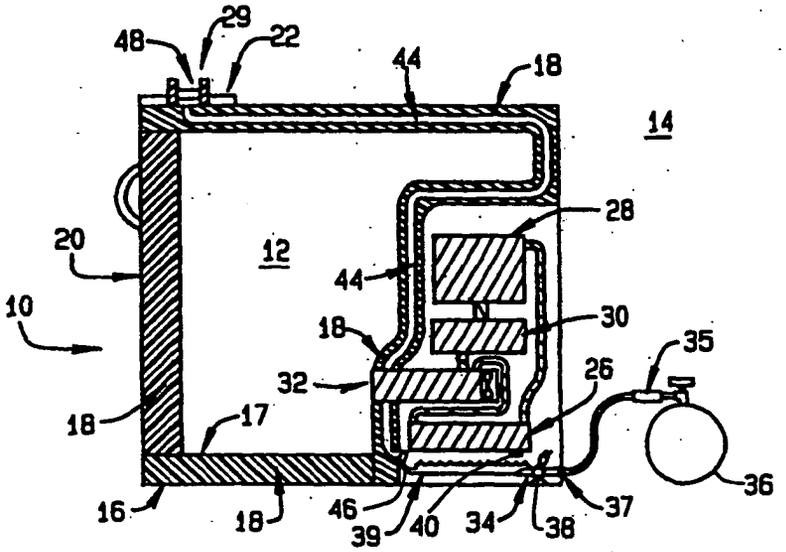

FIG. 1

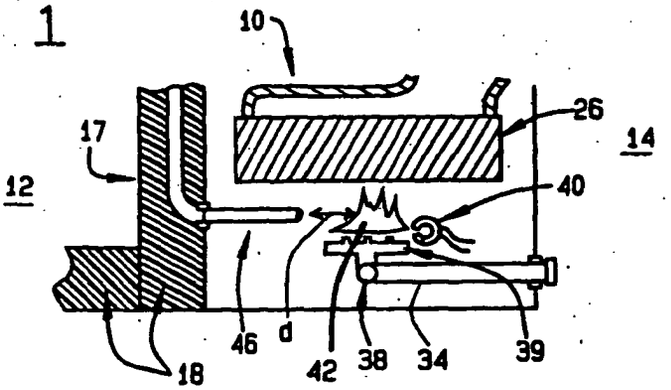

FIG. 2

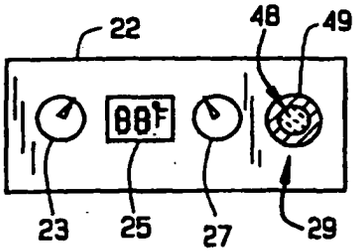

FIG. 3

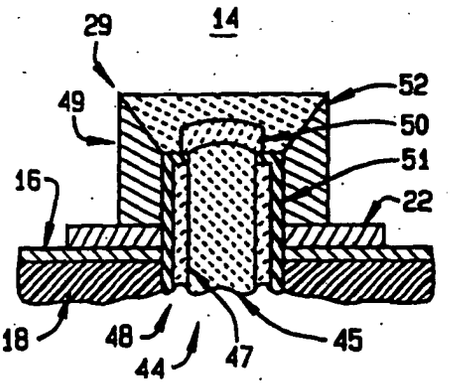

FIG. 4

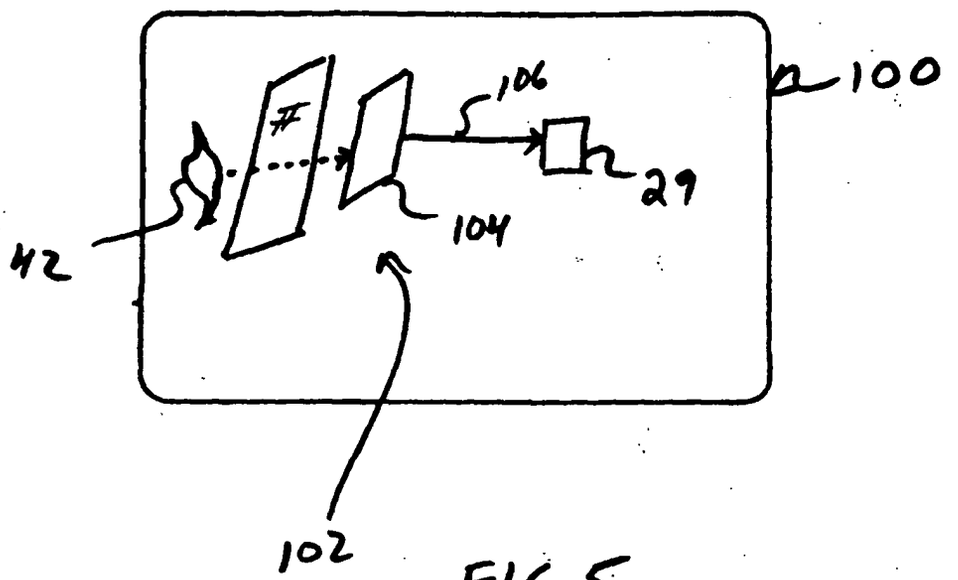

FIG. 5

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 04 01 1603

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
X	US 5 470 223 A (MCCOY HUGH W) 28 November 1995 (1995-11-28) * column 1, line 15 - column 9, line 53; figures 1A,1B *	1-4,6,8, 11	F23N5/24
X	GB 2 219 115 A (BAXI PARTNERSHIP LTD) 29 November 1989 (1989-11-29) * page 2, paragraph 5 - page 3, line 5; figure *	1,2,6	
X	WO 02/070953 A (RICHTER PETER ; VESPER THOMAS (DE); TIEDTKE DIRK (DE); WINTRICH FRANZ) 12 September 2002 (2002-09-12) * page 5, line 15 - page 13, line 28; figures 1-10 *	1-6,8	
A	US 5 748 090 A (LAWRENCE ROBERT M ET AL) 5 May 1998 (1998-05-05) * the whole document *	1	
A	US 5 670 074 A (KASS CARL F ET AL) 23 September 1997 (1997-09-23) * the whole document *	1	TECHNICAL FIELDS SEARCHED (Int.Cl.7) F23N F23D
A	DE 197 10 206 A (SIEMENS AG) 17 September 1998 (1998-09-17)		

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	2 July 2004	Theis, G

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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E : earlier patent document, but published on, or after the filing date
D : document cited in the application
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