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(54) METHOD OF USING LIGHT-EMITTING DIODE (LED) LIGHTING TO ILLUMINATE THE INTERIOR OF MICROWAVE OVENS

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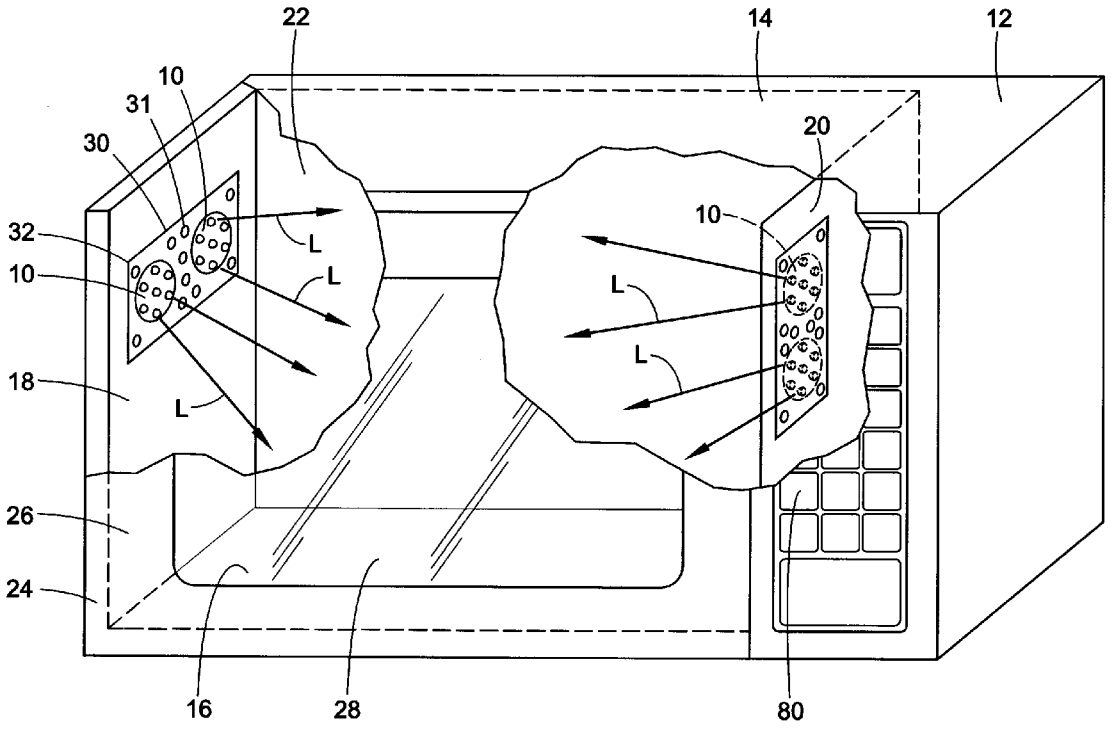
(57) **ABSTRACT**

A Light Emitting Diode light system for a domestic appliance includes a Light Emitting Diode light panel mounted on a first wall of the appliance. Light Emitting Diodes are mounted along a periphery of the panel for emitting light through a first surface of the panel. A second reflective surface is formed opposite the first surface of the panel. A diffuser is provided for diffusing light emitted by the Light Emitting Diodes. A power supply source connected to the Light Emitting Diode panel for providing power to the panel. A method of illuminating the interior of a microwave oven includes providing a first Light Emitting Diode panel mounted on a first wall of the microwave; providing a second Light Emitting Diode panel mounted on the first wall of the microwave; providing a diffuser for diffusing light emitted by the light emitting diodes; and providing a power supply source connected to the Light Emitting Diode panel to provide power to the panel.



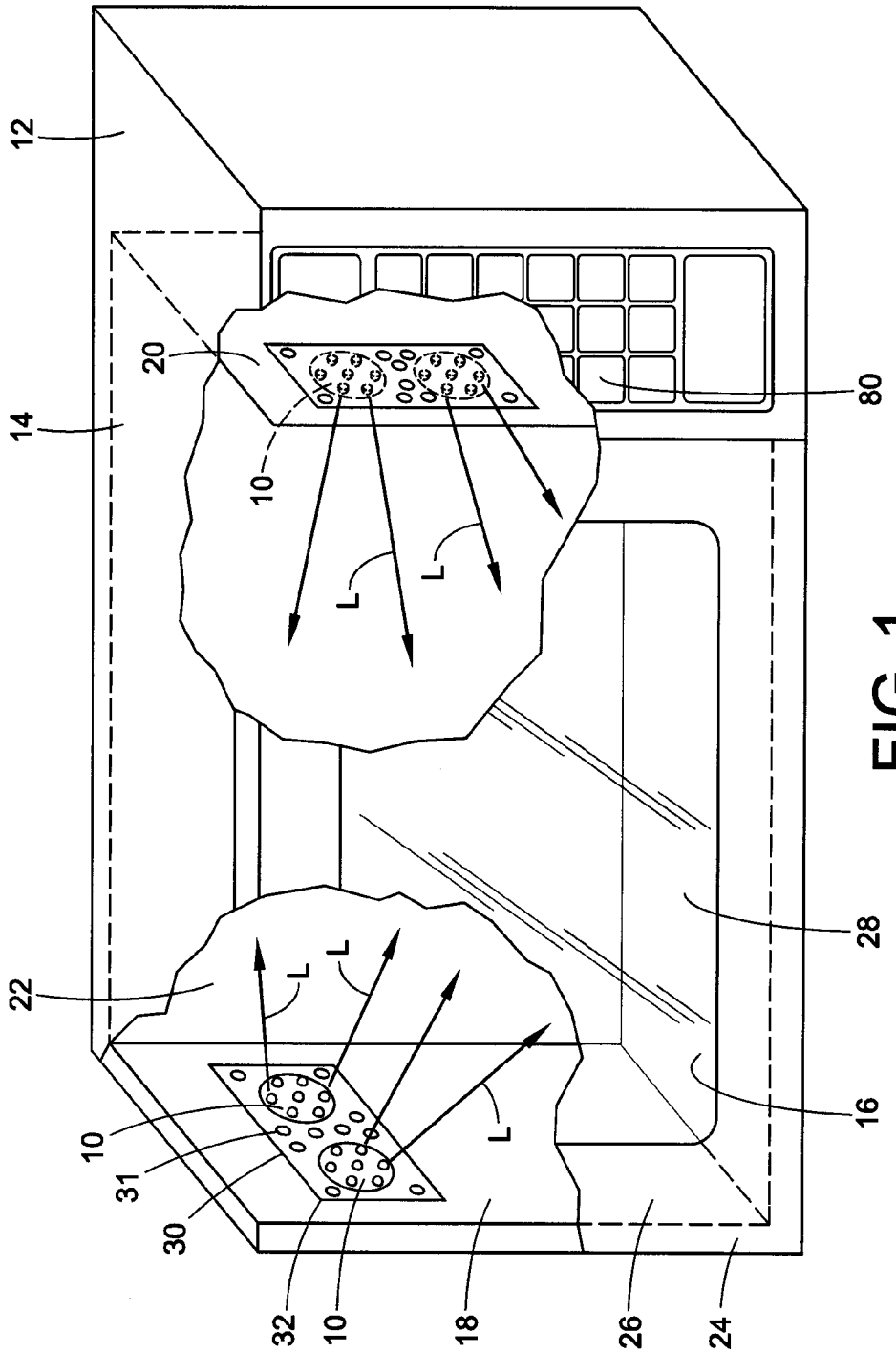


FIG. 1

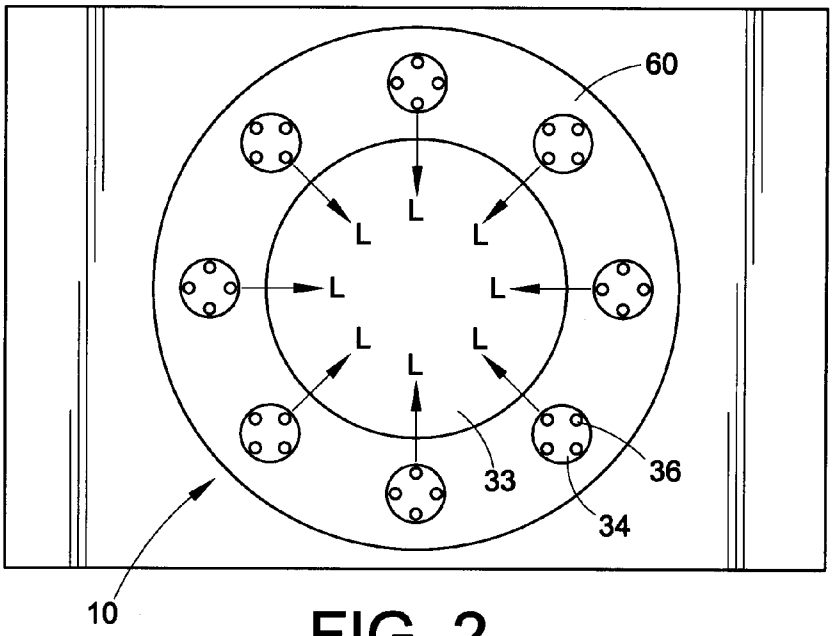


FIG. 2

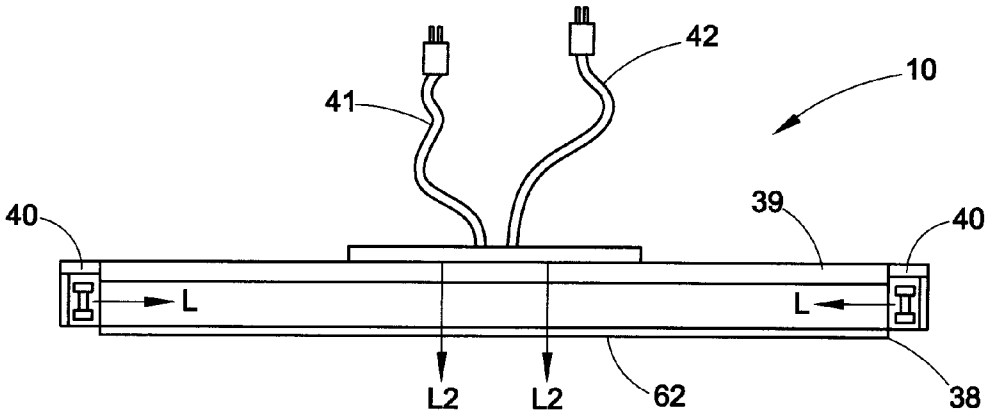


FIG. 2A

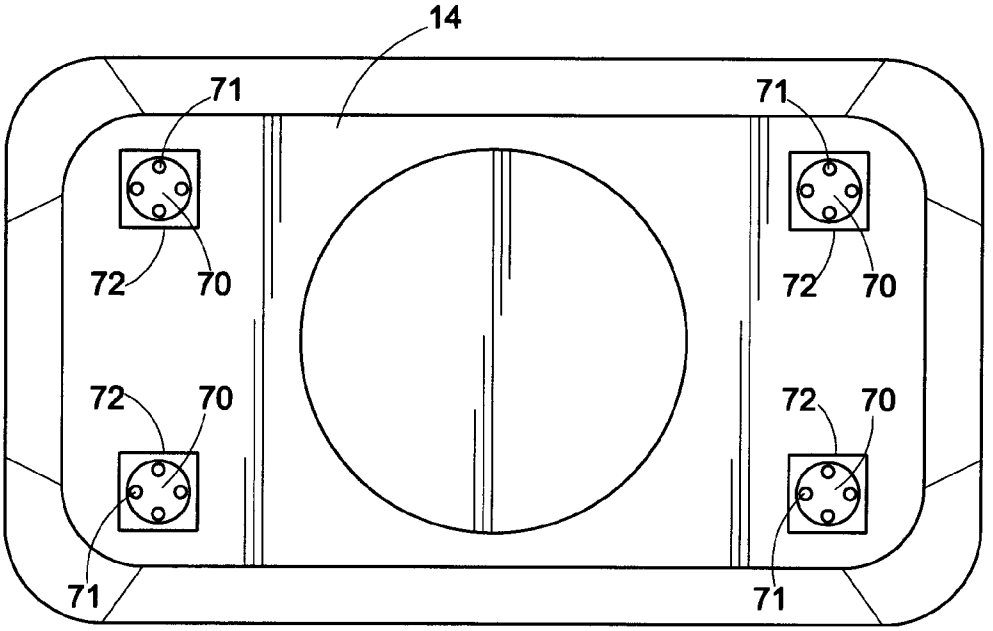


FIG. 3

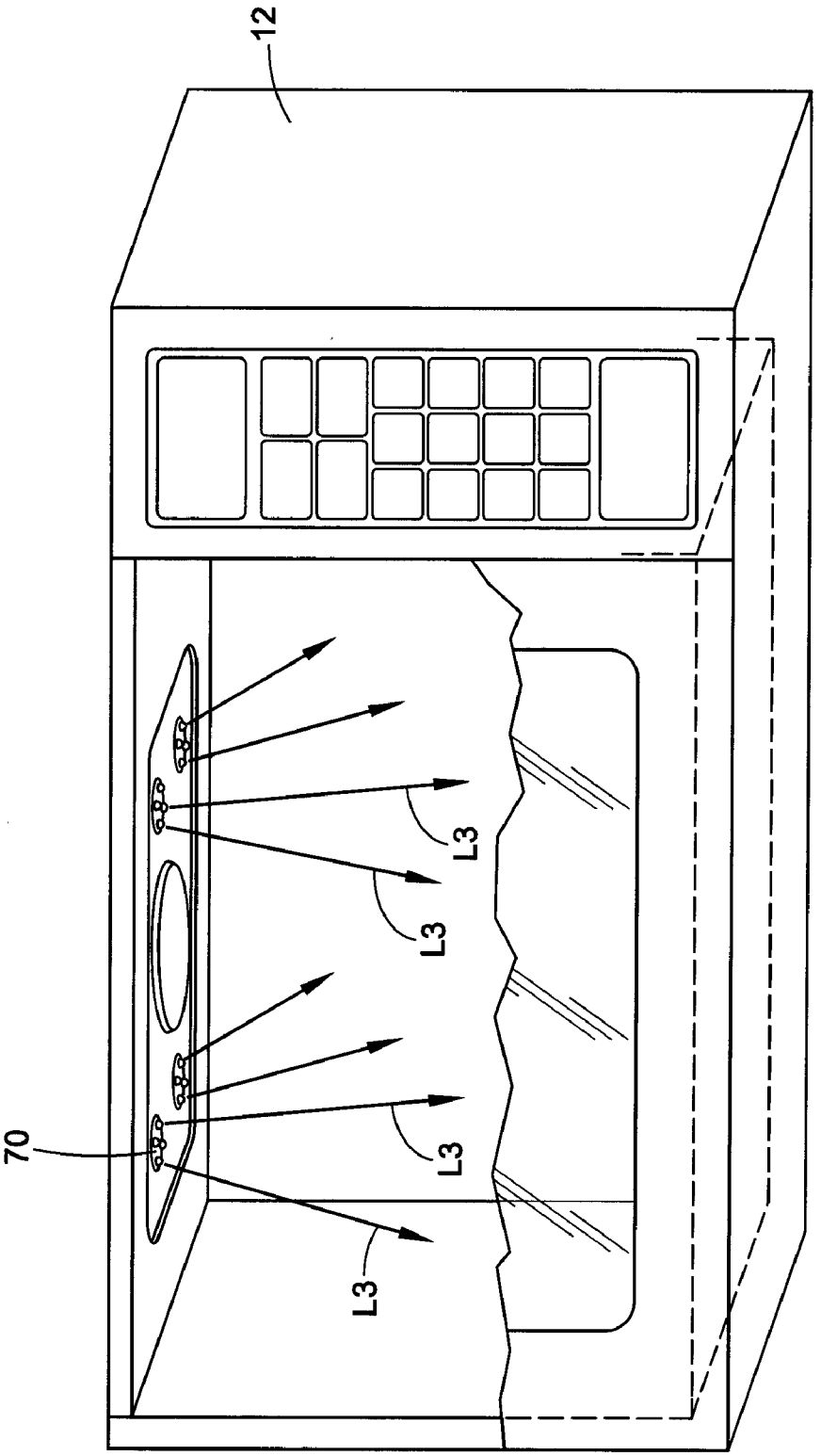


FIG. 4

METHOD OF USING LIGHT-EMITTING DIODE (LED) LIGHTING TO ILLUMINATE THE INTERIOR OF MICROWAVE OVENS

BACKGROUND OF THE DISCLOSURE

[0001] The present disclosure relates to a method and apparatus for improved lighting of the interior of microwave ovens. More particularly, it relates to the use of light-emitting diodes (LEDs) to illuminate the interior of microwave ovens.

[0002] The interior of existing microwave ovens are typically illuminated by a small, tungsten filament appliance lightbulb, typically of 25 watts, radiating 200 lumens, and having a life expectancy of about 200 hours. Unfortunately, such bulbs are vulnerable to microwaves, because the filament can receive microwave energy which will heat the filament to destructive levels. High oven temperatures, when added to the heating effects of the microwaves in addition to the heating effects of the AC current supply, can quickly raise the filament temperature above its rated value, thus quickly burning out the bulb.

[0003] One existing way of minimizing damage to the light bulb is to locate the lightbulb in one of the interior side walls of the oven and to cover the bulb with a screen to prevent microwave energy from reaching the bulb filament. A problem with this solution is such a placement of the bulb results in a significant reduction in the amount of available light for the cavity of the oven.

[0004] To increase illumination using existing incandescent lighting, lightbulbs of at least 750 watts or more would have to be used. However, this would not be effective in view of the limited power available for existing microwave ovens. Microwave ovens typically are limited to 1,620 watts (13.5 amps) and any power used by the lightbulb reduces the power needed for cooking.

[0005] The use of light emitting diode (LED) technology provides lighting capabilities at far greater efficiency than are provided by incandescent bulbs. Recent improvements have raised the brightness and lighting quality of light emitting diode light fixtures up to the standards of incandescent bulbs. However, light emitting diodes in the light emitting diode lighting panels used in lighting devices of various types can be susceptible to overheating. When overheating occurs, the efficiency and lifetime of the light emitting diodes is decreased and can result in LED failure.

[0006] Thus, there is a need for improved lighting for the interior of microwave ovens using Light Emitting Diode (LED) lights which overcome the above mentioned deficiencies while providing better and more advantageous overall results.

SUMMARY OF THE DISCLOSURE

[0007] The present disclosure provides a high-intensity light-emitting diode (LED) light within the cooking cavity of a microwave oven, so that the contents of the oven are fully illuminated with an intensity sufficient to provide a good contrast ratio for viewing the contents through the access window.

[0008] A Light Emitting Diode light system for a domestic appliance includes a first Light Emitting Diode light panel mounted on a first wall of the appliance. Light Emitting Diodes are mounted along a periphery of the circular light panel for emitting light through a first surface of the panel.

[0009] A second reflective surface is formed on the light panel opposite the first surface. A diffuser is provided for diffusing light emitted by the Light Emitting Diodes. A power supply source is connected to the Light Emitting Diode panel for providing power to the panel.

[0010] A method of illuminating the interior of a microwave oven includes: providing a first Light Emitting Diode panel mounted on a first wall of the microwave; providing a second Light Emitting Diode panel mounted on the first wall of the microwave; providing a diffuser for diffusing light emitted by said light emitting diodes and providing a power supply source connected to the Light Emitting Diode panel to provide power to the panel.

[0011] One aspect of the present disclosure is to provide an improved microwave oven light source which will greatly increase the available illumination within the oven cavity without reducing the power available for the cooking operation of the oven.

[0012] Another aspect of the disclosure is that the LED light can be placed in the path of the cooking microwaves without being damaged.

[0013] The advantages to using LEDs over incandescent lighting is that LEDs offer considerable power savings, illuminate much quicker than incandescents, have a very long life (partly due to its solid state technology), can illuminate with a color closer to white (as opposed to the yellowish light that incandescent give off), as well as present a visual appeal to the consumer.

[0014] LEDs consume very low power and do not add significant energy usage to the appliance, thus reserving most of the energy for cooking.

[0015] Still other aspects of the disclosure will become apparent upon a reading and understanding of the following detailed description.

BRIEF DESCRIPTION OF THE DRAWINGS

[0016] The foregoing, and additional aspects of the present disclosure will become apparent to those of skill in the art from the following detailed consideration of preferred embodiments thereof, taken in conjunction with the accompanying drawing, in which:

[0017] FIG. **1** is a perspective view of a microwave oven illustrating a cut-away of an internal cavity with Light Emitting Diodes (LED) panels installed on side walls therein in accordance with a first embodiment of the present disclosure;

[0018] FIG. **2** is an enlarged plan view of one of the circular LED panels of FIG. **1**;

[0019] FIG. **2**A is a side view of a circular LED panel with a lens;

[0020] FIG. **3** is a top plan view of the top wall of the cavity of a microwave oven illustrating LEDs mounted to a top wall of the cavity in accordance with a second embodiment of the present disclosure; and

[0021] FIG. **4** is a perspective view of a microwave oven with LED panels mounted on a top wall.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0022] A conventional microwave oven has a front door, a rear wall, interior side walls and a floor or bottom wall forming an interior chamber or cavity of the oven. In existing microwaves, a standard appliance-type tungsten filament lamp is positioned in a chamber or panel within one or more

of the side walls. The lamp is positioned to be out of the path of microwaves within the cavity. In addition, a screen covers the lamp within the chamber or panel.

[0023] In addition to a reduced amount of light being available from the incandescent lamp because of its location in the chamber, the screen reduces the available light by another 50 percent or so, so that a 25 watt bulb effectively delivers only about 4% of its emitted light to the oven cavity in a conventional microwave oven. In addition, the location of the chamber is generally on a side wall of the oven so that the contents of the oven are lit only from the sides, so much of the incident light is not directed toward the oven door, where the viewing window is normally located.

[0024] As used herein, the term "LED" or "LED device" is to be understood to encompass bare semiconductor chips of inorganic or organic LEDs, encapsulated semiconductor chips of inorganic or organic LEDs, LED chip "packages" in which the LED chip is mounted on one or more intermediate elements such as a sub-mount, a lead-frame, a surface mount support, semiconductor chips of inorganic or organic LEDs that include a wavelength-converting phosphor coating with or without an encapsulant (for example, an ultraviolet or violet or blue LED chip coated with a yellow, white or other phosphor designed to cooperatively produce white light), multi-chip inorganic or organic LED devices (for example, a white LED device including three LED chips emitting red, green, and blue light, respectively, so as to collectively generate white light).

[0025] Thus, in accordance with the present disclosure, as shown in FIGS. **1-3**, the incandescent lamp is removed from chamber, and instead a plurality of Light Emitting Diode (LED) light panels **10** are mounted to the interior side walls of the interior cavity of a microwave oven **12**. As illustrated in FIG. **1**, microwave oven **12** includes top and bottom cavity walls **14**, **16** and opposed side cavity walls **18**, **20**, a rear cavity wall **22** and a front cavity wall **24**, with an access door **26** having a viewing window **28** formed therein. A recess or cavity **32** is formed on each side wall **18**, **20**, and preferably near the top wall **14**. A lamp shield or cover **30** which is configured to prevent microwave energy from passing through as is known in the art is provided to cover each cavity **32**. The cover includes ventilation holes **31** for preventing overheating of the LED lights. The location of the panels directs light L downwardly and inwardly toward the center of the open cavity, illuminating the interior as well as the contents of the oven.

[0026] The shield or cover **30** may be formed as an integral part of the interior wall of the oven, or can be a separate element which is secured in the oven by suitable adhesives, screws or other fasteners (not shown) for easy access and replacement. A pair of Light Emitting Diode (LED) light panels **10** is secured within each of the side panels in cavities **32** in side walls **18**, **20**.

[0027] FIGS. **2** and **2**A show an enlarged view of a circular LED light panel **10**. The LED panel is created by wrapping a disk-shaped light guide panel **33** with a strip **34** of light emitting diodes **36**. The light emitting diodes **36** emit light L that enters the light guide panel at its edge **38** in a radially inward direction.

[0028] A top surface of the LED panel has a mirrored edge **39** that reflects light emitted by the light emitting diodes **36** of the LED panel. The mirrored edge has a coating of a reflective material such as a metal. The mirrored edge is preferably completely opaque and reflective to the light L emitted by the light emitting diodes **36**. Light L emitted by the light emitting diodes is reflected from the mirrored edge and leaves the LED panel through a bottom surface **40** of the LED panel to provide light L**2** below the LED panel.

[0029] As shown in FIG. **2**A, the LED panel has two or more connectors **41**, **42** for connecting the LED panel to an external power source (not shown). The connectors of the LED panel are connected to the panel in conventional fashion (not shown).

[0030] As shown in FIG. **2**, the configuration of the LED lights on the panel is in a circular pattern, located on a printed circuit board **60**. Constant direct current (DC) is used to drive the LEDs so that each LED has the same lighting intensity, regardless of the voltage tolerances of the LED itself. The number of LEDs can vary from one to up to eight LEDs as shown. Also, a diffuser such as a lens **62** is used to help diffuse the light inside the interior of the microwave oven. Power for the printed circuit board can be either tapped off an existing transformer, or a separate DC voltage power supply (not shown) may be created for this purpose. The board would need to be harnessed to the control board of the microwave oven.

[0031] Specifically, lens **62** distributes or disperses the light L**2** exiting the LED panel as it exits the panel through the bottom surface of the panel. The lens distributes the light emitted by the LED panel to light interior spaces more efficiently.

[0032] A pair of LED panels are positioned within the cavities on opposite interior side walls of the microwave cavity. FIG. **1** illustrates the light L which is dispersed from the LED panels to illuminate the interior cavity of the oven from opposite sides of the oven.

[0033] The color of the LEDs is preferably matched as closely as possible to white or a suitable color that would not affect the perceived color of the foods cooking inside. A Color Rendering Index (CRI) is used to help quantitatively measure the "color" of the light.

[0034] Referring to FIGS. **3** and **4**, an alternate embodiment of the present disclosure is shown in which the LED light panels are placed on the top wall **14** of the interior cavity. LED panels **70** including a plurality of LED lights **71** and a shield **72** known in the art configured to minimize exposure of the LED lights to microwave energy are located at the top of the interior cavity of the microwave oven. As shown in FIG. **4**, light L**3** of the LEDs shine directly down into the interior cavity of the oven.

[0035] Considerations with the use of LED panels inside of a microwave oven include where the LEDs are mounted and placed. The preferable locations for the LED panels are at the top of the interior cavity or the side walls of the interior cavity of the oven. However, other locations for the LED panels within the oven are contemplated by the disclosure. Heat dissipation of the LEDs is also a concern to ensure that the heat is properly distributed away from the LEDs to protect the LEDs from early failure. It is important to protect the LEDs from the ambient oven environment due to microwave energy, temperature, humidity, grease, etc. The implementation of the LEDs should be cost effective and ensure evenness/uniformity of light. The LEDs should make the food inside the oven appear similar to its normal color, appearance and texture. The LEDs can be electrically connected together in parallel or in series, such as by a constant current method, or by a constant/regulated voltage with a limiting resistor. Heat dissipation would be a concern, as the interior of a microwave

can get hot and the LEDs themselves would need passive or active heatsinking to dissipate the heat generated.

[0036] For passive heat sinking, the general principle is to attach the LEDs to a component or assembly with a much larger surface area than the LED in order to transfer the higher temperature heat from the LED through the component or assembly into a lower temperature fluid medium (such as air). The heat sink material can be made from a variety of materials such as, but not limited to, aluminum, aluminum alloy, or copper. Active heat sinking uses the same principle as passive heat sinking, except the addition of a fan is used to blow air over or through the component or assembly (heat sink) in order to further increase the efficiency of the heat transfer. Design considerations for passive and active heat sink design are known to those skilled in the art.

[0037] The disclosure has been described with reference to the preferred embodiments. Obviously, modifications and alterations will occur to others upon reading and understanding the preceding detailed description. It is intended that the disclosure be construed as including all such modifications and alterations.

What is claimed is:

1. A Light Emitting Diode light system for a domestic appliance, comprising:
- a first Light Emitting Diode light panel mounted on a first wall of said appliance,
- wherein Light Emitting Diodes are mounted along a periphery of said light panel for emitting light through a first surface of said panel;
- a second reflective surface formed on said panel opposite said first surface;
- a diffuser provided on said panel for diffusing light emitting by said Light Emitting Diodes; and
- a power supply source connected to said Light Emitting Diode panel for providing power to said panel.

2. The Light Emitting Diode light system of claim **1**, further comprising a second Light Emitting Diode light panel mounted on a second wall of said appliance opposite said first wall.

3. The Light Emitting Diode light system of claim **2**, further comprising a third Light Emitting Diode panel mounted on said first side wall of said appliance.

4. The Light Emitting Diode light system of claim **3**, further comprising a fourth Light Emitting Diode panel mounted on said second side wall of said appliance.

5. The Light Emitting Diode light panel of claim **1**, wherein said diffuser comprises a lens.

6. The Light Emitting Diode light panel of claim **1**, wherein said first Light Emitting Diode panel is mounted within a cavity formed in said first wall.

7. The Light Emitting Diode light panel of claim **2**, wherein said second Light Emitting Diode panel is mounted within a cavity formed in said second wall.

8. The Light Emitting Diode light of claim **3**, wherein said third Light Emitting Diode system panel is mounted within a cavity formed in said first wall.

9. The Light Emitting Diode light system of claim **4**, wherein said fourth Light Emitting Diode panel is mounted within a cavity in said second wall.

10. The Light Emitting Diode light system of claim **1**, wherein a shield is mounted over said first Light Emitting Diode panel.

11. The Light Emitting Diode light system of claim **2**, wherein a shield is mounted over said second Light Emitting Diode panel.

12. The Light Emitting Diode light system of claim **3**, wherein a shield is mounted over said third Light Emitting Diode panel.

13. The Light Emitting Diode light system of claim **4**, wherein a shield is mounted over said fourth Light Emitting Diode panel.

14. The Light Emitting Diode light system of claim **1**, wherein said power supply source supplies a Direct Current to power said Light Emitting Diode panel.

15. The Light Emitting diode light system of claim **1**, wherein said power supply source supplies an Alternating Current to power said Light Emitting Diode panel.

16. The Light Emitting Diode light system of claim **1**, wherein said appliance comprises a microwave oven.

17. The Light Emitting Diode light system of claim **1**, wherein said appliance comprises a wall-mounted microwave oven.

18. The Light Emitting Diode light system of claim **1**, wherein said appliance comprises an over-the-range microwave oven.

19. A method of illuminating the interior of a microwave oven, comprising:
- providing a first Light Emitting Diode panel mounted on a first wall of said microwave oven;
- providing a second Light Emitting Diode panel mounted on said first wall of said microwave oven spaced apart from said first Light Emitting Diode panel;
- providing a diffuser for each of said first and second Light Emitting Diode panels for diffusing light emitted by said light emitting diodes; and
- providing a power supply source connected to each of said first and second Light Emitting Diode panels to provide power to said panels.

20. The method of claim **19**, further comprising the step of providing a shield for said first Light Emitting Diode panel and a shield for said second Light Emitting Diode panel.

21. The method of claim **19**, wherein said step of providing a diffuser comprises providing a lens.

22. The method of claim **19**, wherein said step of providing a power supply source comprises providing a Direct Current source.

23. The method of claim **19**, wherein said step of providing a power supply source comprises providing an Alternating Current source.

24. The method of claim **19**, wherein said first Light Emitting Diode panel and said second Light Emitting Diode panel are provided on a top wall of said microwave.

25. The method of claim **19**, wherein said first Light Emitting Diode panel and said second Light Emitting Diode panel are provided on a bottom wall of said microwave oven.

26. The method of claim **19**, wherein said first Light Emitting Diode panel and said second Light Emitting Diode panel are provided on an interior side wall of said microwave oven.

27. The method of claim **19**, wherein said first Light Emitting Diode panel and said second Light Emitting Diode panel are provided on a rear cavity wall of said microwave oven.

28. The method of claim **19**, wherein said first Light Emitting Diode panel and said second Light Emitting Diode panel are provided on the door of said microwave oven.

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