

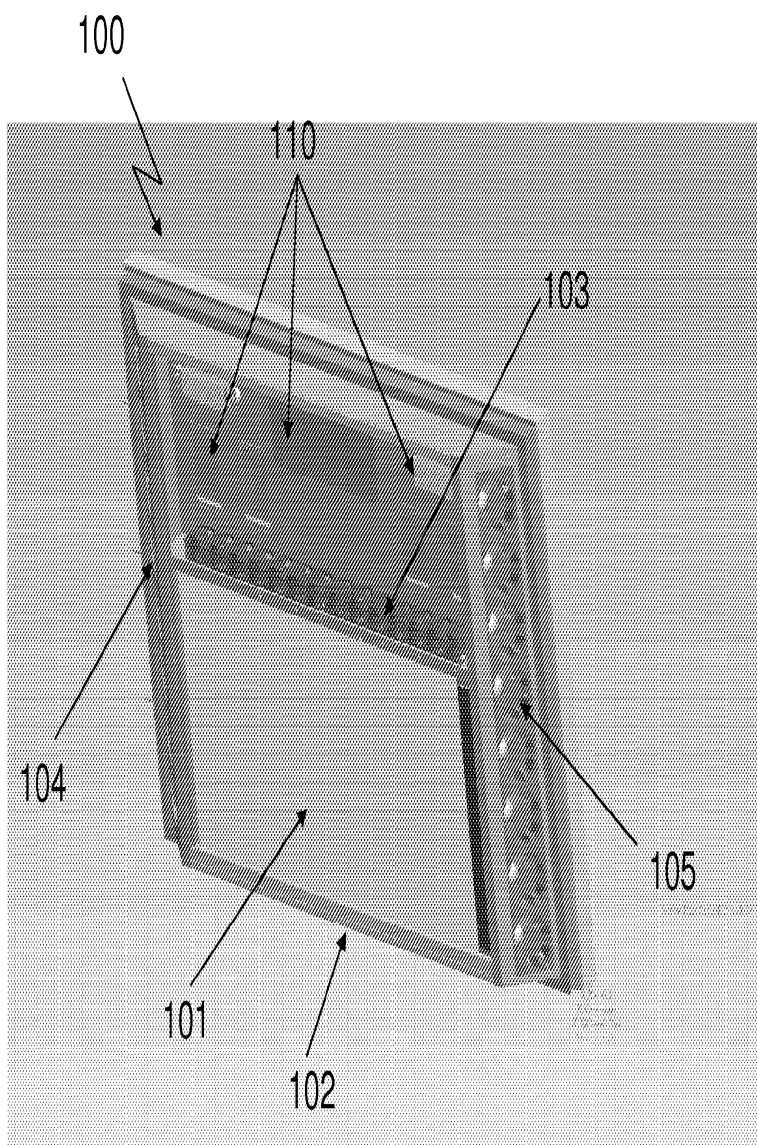


FIG - 9

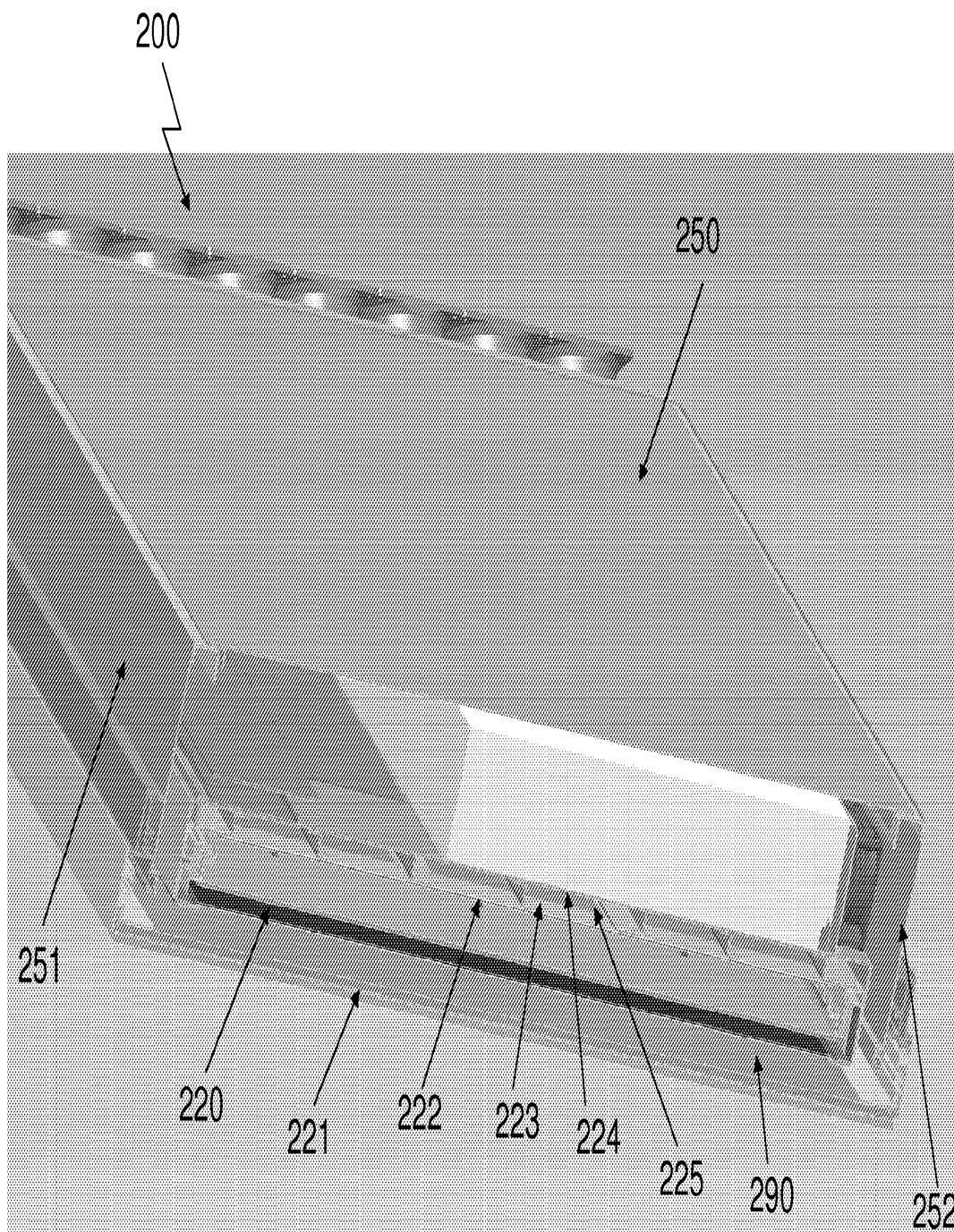
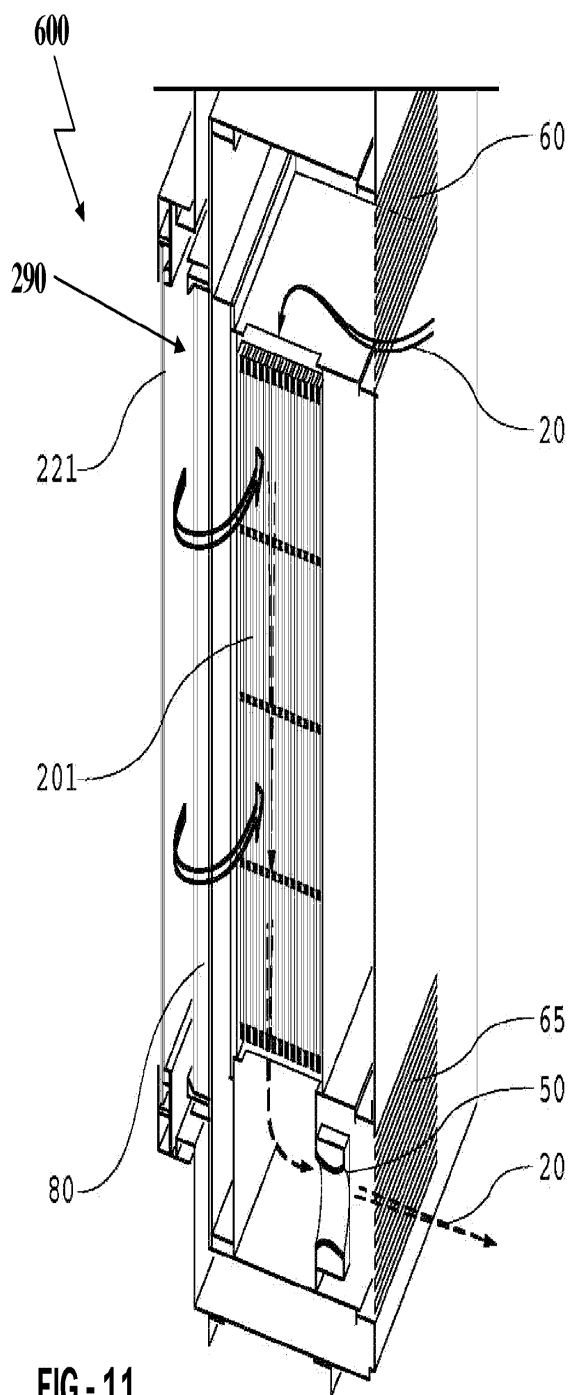
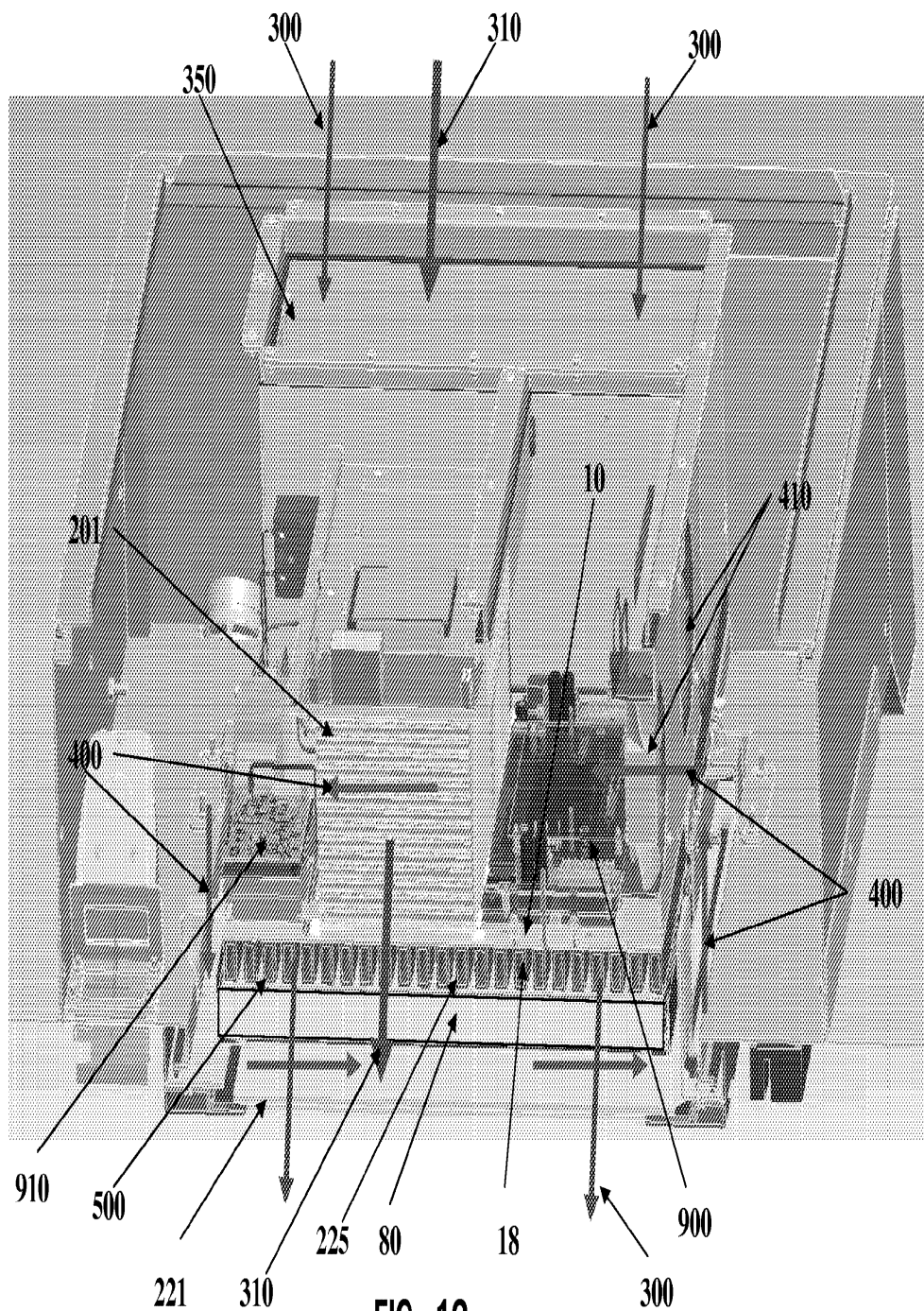


FIG - 10A







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EXPANDED HEAT SINK FOR ELECTRONIC DISPLAYS AND METHOD OF PRODUCING THE SAME

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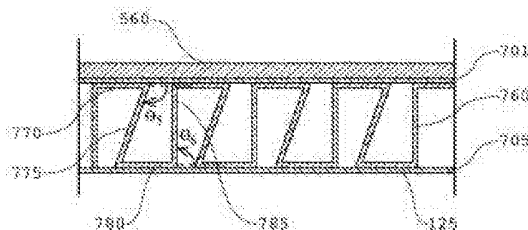
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An expanded heat sink for transferring heat from an electronic display component to a path of cooling air is disclosed. A continuous sheet may define a series of channels where the cooling air is blown through the channels and along the continuous sheet. When viewed along

the path of the cooling air and oriented horizontally, the continuous sheet may define a series of four-sided polygons having top, bottom, left side, and right side portions where either the top or bottom portions are absent from each polygon. The absent top portions may be supplied by a front plate or the rear portion of an electronic display. The absent bottom portions maybe supplied by a rear plate. One or more components of the electronic display may be placed in thermal communication with the sheet and/or front/rear plates to transfer heat from the components to the cooling air.



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[Continued on next page]

(54) Title: EXPANDED HEAT SINK FOR ELECTRONIC DISPLAYS AND METHOD OF PRODUCING THE SAME

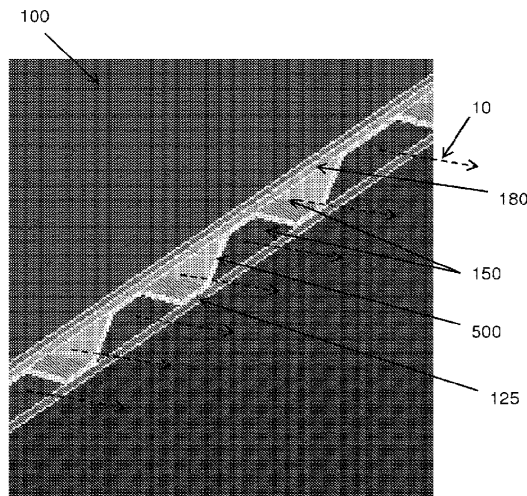


FIG - 1B

(57) Abstract: An expanded heat sink for transferring heat from an electronic display component to a path of cooling air is disclosed. A continuous sheet may define a series of channels where the cooling air is blown through the channels and along the continuous sheet. When viewed along the path of the cooling air and oriented horizontally, the continuous sheet may define a series of four-sided polygons having top, bottom, left side, and right side portions where either the top or bottom portions are absent from each polygon. The absent top portions may be supplied by a front plate or the rear portion of an electronic display. The absent bottom portions may be supplied by a rear plate. One or more components of the electronic display may be placed in thermal communication with the sheet and/or front/rear plates to transfer heat from the components to the cooling air.

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Expanded Heat Sink for Electronic Displays and Method of Producing the Same

Inventors: William Dunn, Bill Swatt, and Tim Hubbard

Cross-Reference to Related Applications

[0001] This application claims priority to U.S. Application No. 61/372,942, filed on August 12, 2010, herein incorporated by reference in its entirety. This application claims priority to U.S. Application No. 13/206,596 filed on August 10, 2011, herein incorporated by reference in its entirety.

Technical Field

[0002] Exemplary embodiments generally relate to cooling systems and in particular to cooling systems for electronic displays.

Background of the Art

[0003] Conductive and convective heat transfer systems for electronic displays generally attempt to remove heat from the electronic components in a display through the sidewalls of the display. Components such as power modules, which are known for producing a large amount of heat may have a 'heat sink' attached to the component which provides an expanded surface area so that heat may be transferred away from the component. These heat sinks have previously been limited to only the size of the power module itself.

[0004] Modern displays have become extremely bright, with some LCD backlights producing 1,000-2,000 nits or more. Sometimes, these illumination levels are necessary because the display is being used outdoors, or in other relatively bright areas where the display illumination must compete with other ambient light. In order to produce this level of brightness, illumination devices (ex. fluorescent lamps, LED, organic LED (OLED), light emitting polymer (LEP), organic electro luminescence (OEL), and plasma assemblies) may produce a relatively large amount of heat. Further, the illumination devices require a relatively large amount of power in order to generate the

required brightness level. This large amount of power is typically supplied through one or more power supplies for the display. These power supplies may also become a significant source of heat for the display.

[0005] Further, previous electronic displays were primarily designed for operation near room temperature. However, it is now desirable to have displays which are capable of withstanding large surrounding environmental temperature variations. For example, some displays are designed for operation at temperatures as low as -22F and as high as 113 F or higher. When surrounding temperatures rise, the cooling of the internal display components can become even more difficult.

[0006] Still further, in some situations radiative heat transfer from the sun through the front portion of the display can also become a source of heat. Furthermore, the market is demanding larger screen sizes for displays. With increased electronic display screen size and corresponding front display surfaces, more heat will be generated and more heat will be transmitted into the displays.

Summary of the Exemplary Embodiments

[0007] Exemplary embodiments relate to a system for cooling various components of an electronic display. The exemplary embodiments may be used to cool the power module(s) or power transformer(s), backlight (if used in the particular display), and other internal components of an electronic display, either alone or in combination. The component(s) may be placed in thermal communication with a continuous conductive sheet which may be placed in the path of cooling air. The heat from the components are distributed throughout the continuous conductive sheet and removed by the cooling air. Some embodiments may place the continuous conductive sheet between a pair of substantially parallel plates (which may also be conductive and may be in thermal communication with the continuous conductive sheet and one or more components).

[0008] In one embodiment where the electronic display is a liquid crystal display, power modules and the display backlight may be placed in thermal communication with the continuous conductive sheet. In this way, a single path of cooling air can be used to cool two of the most heat-producing components of a typical LCD. For example, and not by way of limitation, LED arrays are commonly used as the illumination devices for LCD backlights. It has been found that the optical properties of LEDs (and other illumination devices) can vary depending on temperature. Thus, when an LED is exposed to room temperatures, it may output light with a certain luminance, wavelength, and/or color temperature. However, when the same LED is exposed to high temperatures, the luminance, wavelength, color temperature, and other properties can vary. Thus, when a temperature variation occurs across an LED backlight (some areas are at a higher temperature than others) there can be optical inconsistencies across the backlight which can be visible to the observer. By using the exemplary embodiments herein, heat buildup can be evenly distributed across the continuous conductive sheet and removed from the display. This can prevent any potential 'hot spots' in the backlight which may become visible to the observer because of a change in optical properties of the LEDs.

[0009] The continuous conductive sheet may provide an isolated chamber from the rest of the display so that ambient air can be ingested and used to cool the continuous conductive sheet. This is beneficial for situations where the display is being used in an

outdoor environment and the ingested air may contain contaminants (pollen, dirt, dust, water, smoke, etc.) that would damage the sensitive electronic components of the display.

[0010] The foregoing and other features and advantages will be apparent from the following more detailed description of the particular embodiments of the invention, as illustrated in the accompanying drawings.

Brief Description of the Drawings

[0011] A better understanding of an exemplary embodiment will be obtained from a reading of the following detailed description and the accompanying drawings wherein identical reference characters refer to identical parts and in which:

[0012] **FIGURE 1A** is a front perspective section view of an exemplary embodiment used to cool an LED backlight;

[0013] **FIGURE 1B** is a detailed front perspective section view of insert B from Figure 1A;

[0014] **FIGURE 2** is a rear perspective view of an embodiment using fans to draw cooling air through the channels;

[0015] **FIGURE 3A** is a rear perspective section view of an embodiment where the cooling fans are placed within the continuous conductive sheet and several components are placed within thermal communication with the continuous conductive sheet;

[0016] **FIGURE 3B** is a rear perspective section view of insert B from Figure 3A;

[0017] **FIGURE 4** is a perspective view of one embodiment for the continuous conductive sheet;

[0018] **FIGURE 5A** is a side view of one embodiment for the continuous conductive sheet used within an LED-backlit liquid crystal display;

[0019] **FIGURE 5B** is a side view of another embodiment for the continuous conductive sheet used to cool a backlight as well as other electrical components; and

[0020] **FIGURE 5C** is a side view of another embodiment for the continuous conductive sheet used within an electronic display.

Detailed Description

[0021] The invention is described more fully hereinafter with reference to the accompanying drawings, in which exemplary embodiments of the invention are shown. This invention may, however, be embodied in many different forms and should not be construed as limited to the exemplary embodiments set forth herein. Rather, these embodiments are provided so that this disclosure will be thorough and complete, and will fully convey the scope of the invention to those skilled in the art. In the drawings, the size and relative sizes of layers and regions may be exaggerated for clarity.

[0022] It will be understood that when an element or layer is referred to as being "on" another element or layer, the element or layer can be directly on another element or layer or intervening elements or layers. In contrast, when an element is referred to as being "directly on" another element or layer, there are no intervening elements or layers present. Like numbers refer to like elements throughout. As used herein, the term "and/or" includes any and all combinations of one or more of the associated listed items.

[0023] It will be understood that, although the terms first, second, third, etc., may be used herein to describe various elements, components, regions, layers and/or sections, these elements, components, regions, layers and/or sections should not be limited by these terms. These terms are only used to distinguish one element, component, region, layer or section from another region, layer or section. Thus, a first element, component, region, layer or section discussed below could be termed a second element, component, region, layer or section without departing from the teachings of the present invention.

[0024] The terminology used herein is for the purpose of describing particular embodiments only and is not intended to be limiting of the invention. As used herein, the singular forms "a", "an" and "the" are intended to include the plural forms as well, unless the context clearly indicates otherwise. It will be further understood that the terms "comprises" and/or "comprising," when used in this specification, specify the presence of stated features, integers, steps, operations, elements, and/or components, but do not preclude the presence or addition of one or more other features, integers, steps, operations, elements, components, and/or groups thereof.

[0025] Embodiments of the invention are described herein with reference to cross-section illustrations that are schematic illustrations of idealized embodiments (and intermediate structures) of the invention. As such, variations from the shapes of the illustrations as a result, for example, of manufacturing techniques and/or tolerances, are to be expected. Thus, embodiments of the invention should not be construed as limited to the particular shapes of regions illustrated herein but are to include deviations in shapes that result, for example, from manufacturing.

[0026] For example, an implanted region illustrated as a rectangle will, typically, have rounded or curved features and/or a gradient of implant concentration at its edges rather than a binary change from implanted to non-implanted region. Likewise, a buried region formed by implantation may result in some implantation in the region between the buried region and the surface through which the implantation takes place. Thus, the regions illustrated in the figures are schematic in nature and their shapes are not intended to illustrate the actual shape of a region of a device and are not intended to limit the scope of the invention.

[0027] Unless otherwise defined, all terms (including technical and scientific terms) used herein have the same meaning as commonly understood by one of ordinary skill in the art to which this invention belongs. It will be further understood that terms, such as those defined in commonly used dictionaries, should be interpreted as having a meaning that is consistent with their meaning in the context of the relevant art and will not be interpreted in an idealized or overly formal sense unless expressly so defined herein.

[0029] Herein the terms 'front' and 'rear' may be used to describe the relationship between the various elements shown in the various embodiments. The term 'front' is used herein to denote a direction towards the intended observer of the electronic display. The term 'rear' is used herein to denote a direction away from the intended observer of the electronic display.

[0030] **FIGURE 1A** is a front perspective section view of an exemplary embodiment used to cool an LED backlight 100 (or an LED display). In this embodiment, the continuous conductive sheet 500 is placed adjacent to the LED backlight 100 and used to create a plurality of channels 150. Preferably, the LED backlight 100 is in thermal

communication with the continuous conductive sheet 500. Thus, heat which is generated by the LED backlight 100 is transferred to the continuous conductive sheet 500 and removed by cooling air 10.

[0031] FIGURE 1B is a detailed front perspective section view of insert B from Figure 1A. In this embodiment, the continuous conductive sheet 500 is placed between a front plate 180 and a rear plate 125 in order to create the channels 150. The front plate 180 is preferably in thermal communication with the LED backlight 100 and the continuous conductive sheet 500. The rear plate 125 may also be in thermal communication with the continuous conductive sheet 500. The thermal communication may be conductive, convective, radiative, or any combination of these. Preferably, the thermal communication is at least conductive.

[0032] The LED backlight 100 and front plate 180, front plate 180 and continuous conductive sheet 500, and the continuous conductive sheet 500 and rear plate 125 may be fastened to one another using any number of different techniques, including but not limited to: mechanical fasteners, adhesives, double-sided tape, welding, or other similar techniques. Each component may be attached to one another using similar or different methods. It is preferable that the chosen technique permits thermal communication between the components (if desired). In some embodiments the thermal communication between components may be accomplished by simply placing the components in contact with one-another or in close proximity to one another. Some embodiments may use a combination of the fastening techniques above. Thus, an exemplary embodiment may use both mechanical fasteners as well as an adhesive (preferably a thermally conductive adhesive) or double-sided tape. An exemplary type of double-sided tape would be Very High Bond (VHB™) tape commercially available from 3M™ Saint Paul, MN. www.3M.com An exemplary form of mechanical fasteners would be rivets or screws/bolts.

[0033] FIGURE 2 is a rear perspective view of an embodiment using fans 225 to draw cooling air 10 through the channels 150. Inlet apertures 200 allow the fans 225 to draw cooling air 10 in between the rear plate 125 and front plate 180 and along the channels 150. The cooling air 10 can then be exhausted out of the exit apertures 210. A single fan may be used in some embodiments, while several fans (even more than shown in

Figure 2) could be used in other embodiments. Of course, the fans 225 could instead be placed at the inlet apertures 200 and used to 'push' the cooling air 10 through the channels 150 rather than 'pull' (as shown in Figure 2). Further, fans could be placed at both the inlet apertures 200 and exit apertures 210 to both push and pull the cooling air 10 through the system.

[0034] FIGURE 3A is a rear perspective section view of an embodiment where the cooling fans 300 are placed within the continuous conductive sheet 500 and electronic components 800 are placed in thermal communication with the continuous conductive sheet 500. In this embodiment, cooling air 10 is drawn into the inlet apertures 310 by fans 300 which are placed along the length of the continuous conductive sheet 500. Thus, in this embodiment the fans 300 perform both a 'pull' and 'push' of the cooling air 10 through the channels 150. Electronic components 800 may be placed in thermal communication with the continuous conductive sheet 500 by establishing thermal communication between the electronic components 800 and the rear plate 125 (which is preferably in thermal communication with the continuous conductive sheet 500 in this embodiment).

[0035] The electronic components 800 may be any electronic component used in an electronic display which generates heat. The electronic components 800 are preferably in electrical communication with the electronic display assembly. Some embodiments may use power supplies/modules or power transformers as the electronic components 800.

[0036] FIGURE 3B is a rear perspective section view of insert B from Figure 3A. In this embodiment, the continuous conductive sheet 500 is placed between a front plate 180 and a rear plate 125 in order to create the channels 150. As discussed further below, a front plate 180 may not be necessary in some embodiments. Thus, in some embodiments the continuous conductive sheet 500 may be directly fastened to the rear portion of the LED backlight 100 (or another rear portion of an electronic display, especially an OLED assembly).

[0037] In this embodiment, a portion of the front plate 180 overlaps a portion of the rear plate 125 to create an overlap section 350. Here, heat is permitted to transfer directly between the edges of the rear plate 125 and front plate 180 and allows the

thermal energy to quickly and evenly spread throughout the plates and the continuous conductive sheet 500.

[0038] FIGURE 4 is a perspective view of one embodiment for the continuous conductive sheet 500.

[0039] FIGURE 5A is a side view of one embodiment for the continuous conductive sheet 500 used within an LED-backlit liquid crystal display. In this embodiment, the LED backlight 100 is attached to and in thermal communication with the front plate 180; which is attached to and in thermal communication with the continuous conductive sheet 500. A liquid crystal assembly 550 is placed in front of the LED backlight 100. The liquid crystal assembly 550 may contain several layers and is well known in the art. Typically, the liquid crystal assembly 550 contains two transparent plates with liquid crystal material sandwiched in between the two plates. An electrode of some type is typically used to orient the liquid crystal material. Additional layers may also be used to orient/polarize light, color filter the light, and provide anti-reflective or protective properties. These layers have not been shown as they are well-known in the art and are not critical to these embodiments of the invention.

[0040] Here, the rear plate 125 may not be in thermal communication with the continuous conductive sheet 500 but may only provide structure for the channels and/or structural support to the assembly. Of course, it is preferable that the rear plate 125 and the continuous conductive sheet 500 are in thermal communication so that heat can be more effectively and evenly distributed and removed. Ideally, there should be a low level of thermal resistance between the front and rear sides of the backlight 100. An exemplary embodiment may utilize a metal core PCB with LEDs on the front side and a metallic surface (or otherwise thermally conductive surface) on the rear side.

[0041] Generally, the continuous conductive sheet 500 may be described as four continuous portions, which are generally repeated to create the overall structure. For this embodiment, the first portion 600 runs parallel to and adjacent with the front plate 180. The second portion 610 extends from the first portion 600 at angle Θ_1 towards the rear plate 125. The third portion 620 extends from the second portion 610 and runs parallel to and adjacent with the rear plate 125. The fourth portion 630 extends from the third portion 620 at angle Θ_2 towards the front plate 180. The four portions may

then be repeated to create the continuous conductive sheet 500. Thus, the fourth portion 630 may continue to a second series of portions, starting with another portion similar to the previous first portion 600. In some embodiments, angle Θ_1 may be substantially equal to angle Θ_2 . While in other embodiments, angle Θ_1 may be different than angle Θ_2 .

[0042] In other words, when oriented horizontally and viewed along the direction of the cooling air (the side view shown in Figure 5A) the continuous conductive sheet 500 may be formed to create a series of four-sided polygons, each one having a bottom side (portion 620), left side (portion 610), right side (portion 630), and a top side (in this polygon supplied by front plate 180) where either the top or bottom side is absent from each polygon. For the embodiment shown in Figure 5A, the absent side of the polygon alternates between the top side and bottom side for each adjacent polygon. An exemplary version of the embodiment shown in this figure may be formed of stamped or bent sheet metal.

[0043] FIGURE 5B is a side view of another embodiment for the continuous conductive sheet 750 used to cool a backlight 700 as well as other electrical components 800. In this embodiment, the continuous conductive sheet 750 is attached to and in thermal communication directly with the backlight 700 (thus, there is no separate front plate used). A liquid crystal assembly 550 is placed in front of the backlight 700, which may be LED driven or may be any other means for illuminating the rear portion of the liquid crystal assembly 550. An additional electrical component 800 is placed in electrical communication with the backlight 700 and/or liquid crystal assembly 550 and is in thermal communication with the rear plate 705. Here, heat which is produced by the electrical component 800 may be transferred to the rear surface 704 of the rear plate 705, where it may then be transferred to the front surface 706 of the rear plate 705. The cooling air can remove the heat from the front surface 706 of the rear plate 705. Additionally, the heat may be transferred from the front surface 706 of the rear plate 705 to the continuous conductive sheet 750 where it may spread throughout the continuous conductive sheet 750 and ultimately removed by the cooling air.

[0044] Again, this embodiment of the continuous conductive sheet 750 may be described as four continuous portions, which are generally repeated to create the overall structure. For this embodiment, the first portion 710 runs parallel to and adjacent with the backlight 700. The second portion 715 extends from the first portion 710 at angle Θ_3 towards the rear plate 705. The third portion 720 extends from the second portion 715 and runs parallel to and adjacent with the rear plate 705. The fourth portion 725 extends from the third portion 720 at angle Θ_4 towards the backlight 700. The four portions may then be repeated to create the continuous conductive sheet 750. Thus, the fourth portion 725 may continue to a second series of portions, starting with another portion similar to the previous first portion 710. In some embodiments, angle Θ_3 may be substantially equal to angle Θ_4 . While in other embodiments, angle Θ_3 may be different than angle Θ_4 . In this particular embodiment, both angles Θ_3 and Θ_4 are near 90 degrees, or perpendicular to the backlight 700 and rear plate 705 and/or first portion 710 and third portion 720.

[0045] In other words, when oriented horizontally and viewed along the direction of the cooling air (the side view shown in Figure 5B) the continuous conductive sheet 750 may be formed to create a series of four-sided polygons, each one having a bottom side (portion 720), left side (portion 715), right side (portion 725), and a top side (in this polygon supplied by backlight 700) where either the top or bottom side is absent from each polygon. For the embodiment shown in Figure 5B, the absent side of the polygon alternates between the top side and bottom side for each adjacent polygon. An exemplary version of the embodiment shown in this figure may be formed of stamped or bent sheet metal.

[0046] **FIGURE 5C** is a side view of another embodiment for the continuous conductive sheet 760 used within an electronic display. Here, the continuous conductive sheet 760 is attached to and in thermal communication with the front plate 701 which is attached to and in thermal communication with an electronic display assembly 560. In this embodiment, the continuous conductive sheet 760 may be used to cool a type of electronic display that does not require a backlight device. Thus, the electronic display assembly 560 could be, but is not limited to any one of the following types of displays: OLED, LED, light emitting polymer (LEP), organic electro

luminescence (OEL), and plasma. The heat which is generated by the electronic display assembly 560 can be transferred to the front plate 701 where it can be transferred to the continuous conductive sheet 760 and removed by the cooling air. Additionally, radiative heat transfer from sunlight can also cause a heat buildup upon the electronic display assembly 560. This heat can also be transferred to the continuous conductive sheet 760 and removed by the cooling air. Here, the rear plate 705 may not be in thermal communication with the continuous conductive sheet 760 but may only provide structure for the channels and/or structural support to the assembly. Of course, it is preferable that the rear plate 705 and the continuous conductive sheet 760 are in thermal communication so that heat can be more effectively and evenly distributed and removed.

[0047] Again, this embodiment of the continuous conductive sheet 760 may be described as four continuous portions, which are generally repeated to create the overall structure. For this embodiment, the first portion 770 runs parallel to and adjacent with the front plate 701. The second portion 775 extends from the first portion 770 at angle Θ_5 towards the rear plate 705. The third portion 780 extends from the second portion 775 and runs parallel to and adjacent with the rear plate 705. The fourth portion 785 extends from the third portion 780 at angle Θ_6 towards the front plate 701. The four portions may then be repeated to create the continuous conductive sheet 760. Thus, the fourth portion 785 may continue to a second series of portions, starting with another portion similar to the previous first portion 770. In some embodiments, angle Θ_5 may be substantially equal to angle Θ_6 . While in other embodiments, angle Θ_5 may be different than angle Θ_6 .

[0048] In other words, when oriented horizontally and viewed along the direction of the cooling air (the side view shown in Figure 5C) the continuous conductive sheet 760 may be formed to create a series of four-sided polygons, each one having a bottom side (portion 780), left side (portion 775), right side (portion 785), and a top side (in this polygon supplied by front plate 701) where either the top or bottom side is absent from each polygon. For the embodiment shown in Figure 5C, the absent side of the polygon alternates between the top side and bottom side for each adjacent polygon. An

exemplary version of the embodiment shown in this figure may be formed of bent sheet metal.

[0049] Electronic displays are produced in a variety of sizes and orientations, including but not limited to both landscape and portrait orientations. Any of the embodiments herein can be used to cool the various types, sizes, and orientations of electronic displays. Further, the channels may be oriented in a vertical manner, and the cooling air may travel from top to bottom or from bottom to top. Still further, the channels may be oriented in a horizontal manner, and the cooling air can travel left to right or right to left.

[0050] While the embodiments of the continuous conductive sheet have been generally described as containing four portions which repeat themselves, other embodiments could use a mixture of different designs. Thus, some embodiments may not repeat the same four portions over and over. Some embodiments could use four portions from the continuous conductive sheet 750 of Figure 5B, followed by four portions from the continuous conductive sheet 500 of Figure 5A. Of course, any number of different combinations could be used, depending on the materials and manufacturing process used to construct the particular continuous conductive sheet.

[0051] It should be noted that the embodiments herein do not require that a singular continuous conductive sheet is used to cool the entire electronic display. A plurality of smaller continuous conductive sheets may be used in order to cool the display. The smaller continuous conductive sheets may be connected to each other and in thermal communication with one another or they may be spaced apart from one another. Thus, as used herein the term 'continuous' does not require that the entire display is cooled with a single conductive sheet. The term 'continuous' as used herein defines a single element that can be placed between two substantially planar objects to create at least two channels.

[0052] Further, the term 'thermal communication' as used herein does not require direct thermal communication, i.e. there may be intermediate devices or layers in-between the two components which are still considered to be in 'thermal communication.' Conductive heat transfer is one type of thermal communication and is preferable with the exemplary embodiments herein. Convective thermal communication

is one type of thermal communication which is preferable between the continuous conductive sheet and the cooling air.

[0053] The continuous conductive sheets have been shown herein with relatively constant cross-sectional thicknesses but this is also not required. Some portions of the continuous conductive sheets may be thicker or thinner than other portions and some may even contain fins or additional extended surface areas for removing the absorbed heat.

[0054] It is preferable that the front plate, rear plate, and continuous conductive sheet are comprised of materials which are thermally conductive. Metals have been found to be exemplary materials for these components. More specifically, sheet metals and even more specifically aluminum sheet metals are preferable. However, many thermally conductive plastics and composite materials can also perform adequately. Specifically, polypropylene sheets would be within the scope of the various embodiments.

[0055] In an exemplary embodiment, the front and rear plates would provide a gaseous and contaminate barrier between the space between them (containing the continuous conductive sheet) and the rest of the display. If the plates provide an adequate barrier, ambient air may be ingested as cooling air 10 and the risk of contaminants entering the portions of the display containing the sensitive electronic components may be reduced or eliminated.

[0056] As noted above, many illumination devices (especially LEDs and OLEDs) may have performance properties which vary depending on temperature. When 'hot spots' are present within a backlight or illumination assembly, these hot spots can result in irregularities in the resulting image which might be visible to the end user. Thus, with the embodiments described herein, the heat which may be generated by the backlight assembly can be distributed (somewhat evenly) throughout the various ribs and thermally-conductive surfaces to remove hot spots and cool the backlight.

[0057] The cooling system may run continuously. However, if desired, temperature sensing devices (not shown) may be incorporated within the electronic display to detect when temperatures have reached a predetermined threshold value. In such a case, the various cooling fans may be selectively engaged when the temperature in the display

reaches a predetermined value. Predetermined thresholds may be selected and the system may be configured to advantageously keep the display within an acceptable temperature range. Typical thermostat assemblies can be used to accomplish this task. Thermocouples may be used as the temperature sensing devices.

[0058] It is to be understood that the spirit and scope of the disclosed embodiments provides for the cooling of many types of displays. By way of example and not by way of limitation, embodiments may be used in conjunction with any of the following: LCD (all types), light emitting diode (LED), organic light emitting diode (OLED), field emitting display (FED), light emitting polymer (LEP), organic electro luminescence (OEL), plasma displays, and any other type of flat panel electronic display. Furthermore, embodiments may be used with displays of other types including those not yet discovered. In particular, it is contemplated that the system may be well suited for use with full color, flat panel OLED displays. Exemplary embodiments may also utilize large (55 inches or more) LED backlit, high definition (1080i or 1080p or greater) liquid crystal displays (LCD). While the embodiments described herein are well suited for outdoor environments, they may also be appropriate for indoor applications (e.g., factory/industrial environments, spas, locker rooms) where thermal stability of the display may be at risk.

[0059] Although fans are shown with some of the embodiments herein, they are not required for all embodiments. While forced convection (using fans) is preferable, natural or un-forced convection (no fans) may also produce acceptable results and is within the scope of the invention.

[0060] The relative sizing of each component shown in the figures is not to be interpreted as a requirement of the invention or that they are accurately drawn to scale. Some components have been enlarged for clarity. Other components have been simplified for clarity.

[0061] Having shown and described preferred embodiments, those skilled in the art will realize that many variations and modifications may be made to affect the described embodiments and still be within the scope of the claimed invention. Additionally, many of the elements indicated above may be altered or replaced by different elements which

will provide the same result and fall within the spirit of the claimed invention. It is the intention, therefore, to limit the invention only as indicated by the scope of the claims.

CLAIMS

1. An expanded heat sink for transferring heat from an electronic display component to a path of cooling air, the expanded heat sink comprising:

a continuous sheet when viewed along the path of the cooling air and oriented horizontally, defines a series of four-sided polygons having top, bottom, left side, and right side portions where either the top or bottom portions are absent from each polygon.

2. The heat sink of claim 1 wherein:

the absent portion of the polygon alternates between the top and bottom portion for each adjacent polygon.

3. The heat sink of claim 1 wherein:

the four-sided polygons are trapezoids.

4. The heat sink of any one of claims 1-3 wherein:

the top and bottom portions are substantially parallel.

5. The heat sink of claim 1 wherein:

the four-sided polygons are rectangles.

6. The heat sink of any claim 1 further comprising:

a front plate placed above the continuous sheet; and

a rear plate placed below the continuous sheet.

7. The heat sink of claim 6 wherein:

the front plate is placed so as to supply the missing top portion of the polygons;
and

the rear plate is placed so as to supply the missing bottom portion of the
polygons.

8. A liquid crystal display (LCD) comprising:

the heat sink of claim 6;

an LED backlight placed above and in thermal communication with the front
plate; and

a liquid crystal assembly placed above the LED backlight.

9. The LCD of claim 8 further comprising:

a fan positioned to draw cooling air between the front plate and rear plate and
along the continuous sheet.

10. The LCD of any one of claims 8-9 wherein:

the LED backlight is placed in conductive thermal communication with the front
plate.

11. An expanded heat sink for transferring heat from an electronic display component to a path of cooling air, the expanded heat sink comprising:

- a substantially planar front plate;
- a substantially planar rear plate placed parallel to the front plate; and
- a continuous sheet placed between the front and rear plates to define a series of channels for accepting the cooling air.

12. The heat sink of claim 11 wherein:

- the continuous sheet contains a series of four portions:
 - the first portion running substantially parallel to the front plate,
 - the second portion extending from the first portion and towards the rear plate at a first angle,
 - the third portion extending from the second portion and substantially parallel to the rear plate, and
 - the fourth portion extending from the third portion and towards the front plate at a second angle.

13. The heat sink of claim 12 wherein:

- the first portions are in contact with the front plate, and
- the third portions are in contact with the rear plate.

14. The heat sink of claim 12 wherein:

- the first and second angles are substantially equal.

15. The heat sink of claim 12 wherein:

the first and second angles are each less than ninety degrees.

16. An electronic display comprising:

the heat sink of claim 11;

an electronic display assembly placed in front of and in thermal communication
with the front plate; and

a fan positioned to draw cooling air through the channels.

17. The electronic display of claim 16 further comprising:

an electrical component in conductive thermal communication with the rear plate.

18. The electronic display of claim 17 wherein:

the electrical component is any one of the following: power module, power
supply, and power transformer.

19. A liquid crystal display (LCD) comprising:

the heat sink of claim 1;

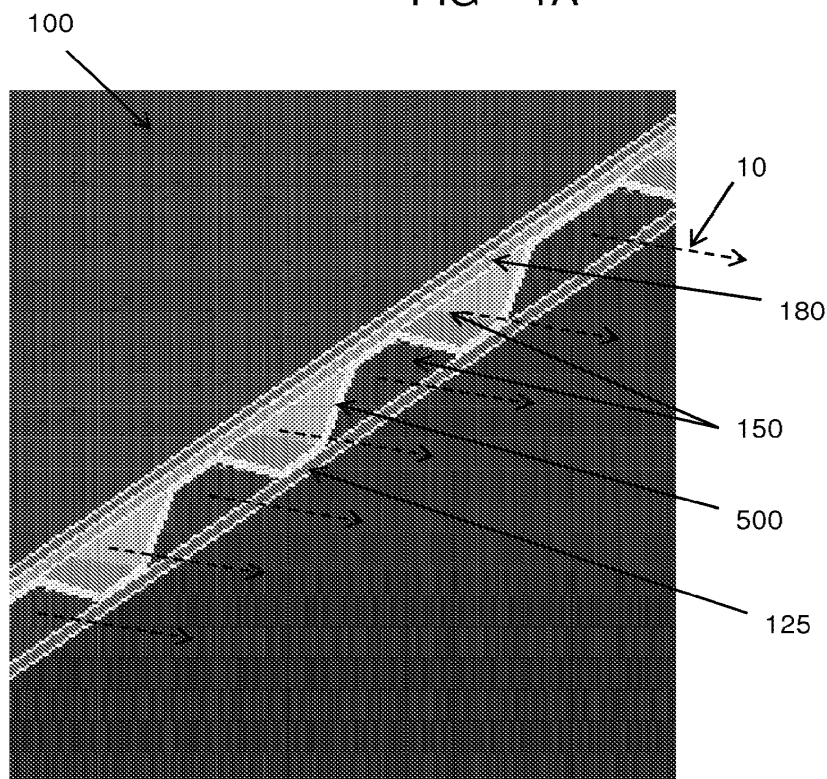
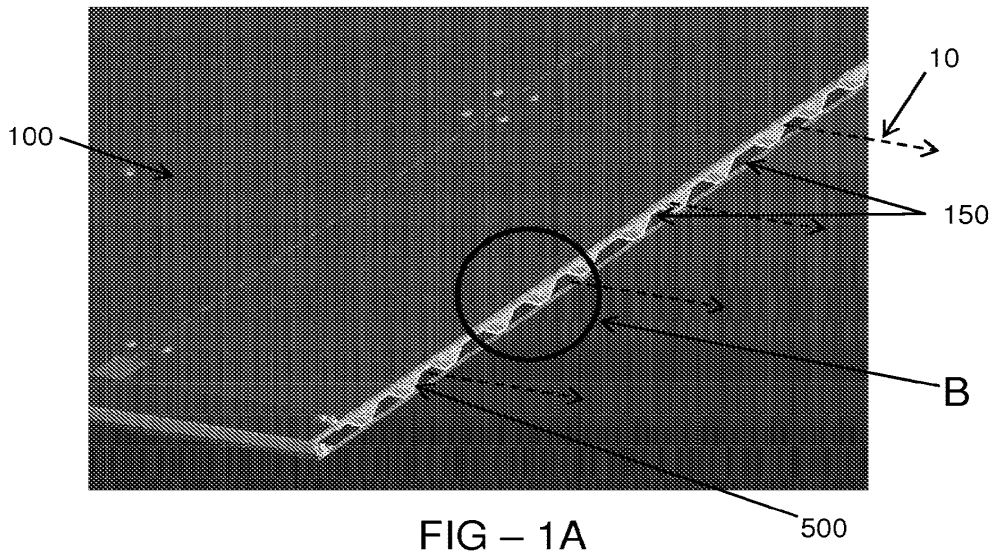
an LED backlight placed above and in thermal communication with the
continuous sheet;

a liquid crystal assembly placed above the LED backlight;

a rear plate placed behind and in thermal communication with the continuous
sheet; and

a fan positioned to draw cooling air between the LED backlight and rear plate
and along the continuous sheet.

20. The LCD of claim 19 further comprising:
an electrical component in conductive thermal communication with the rear plate.



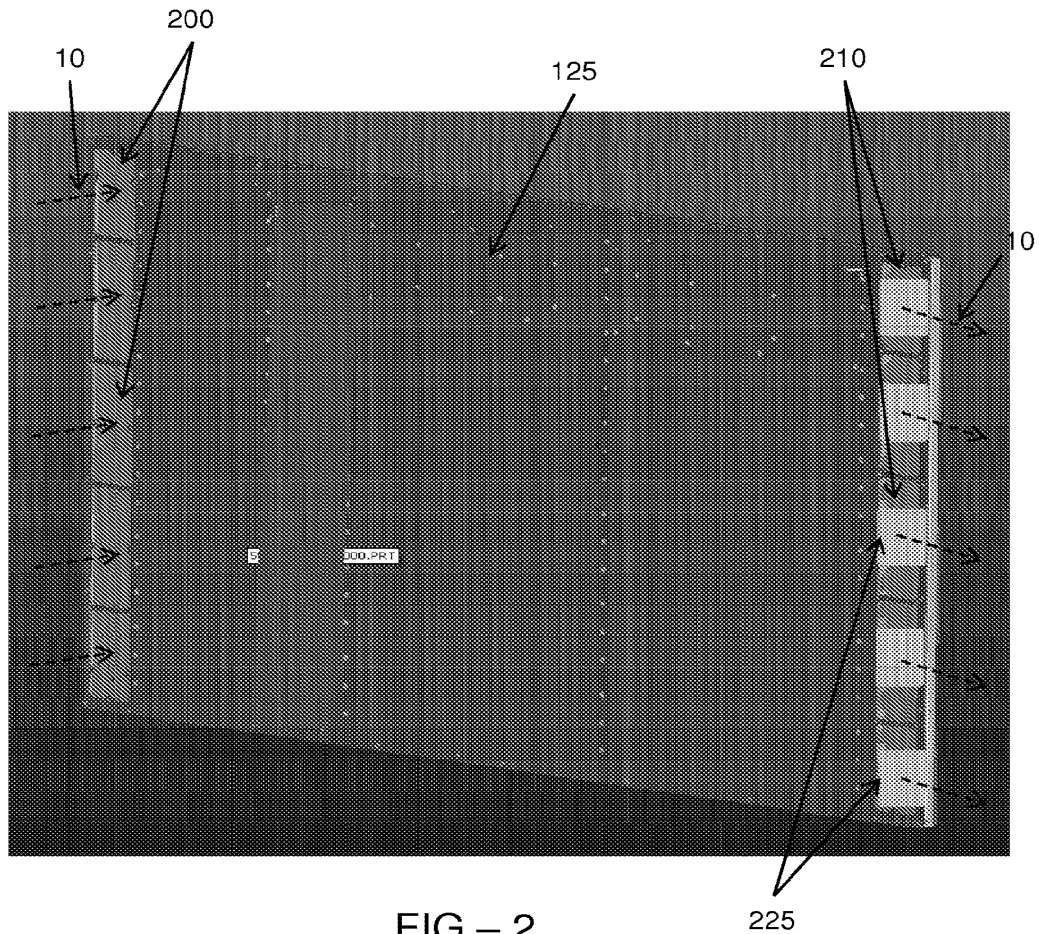
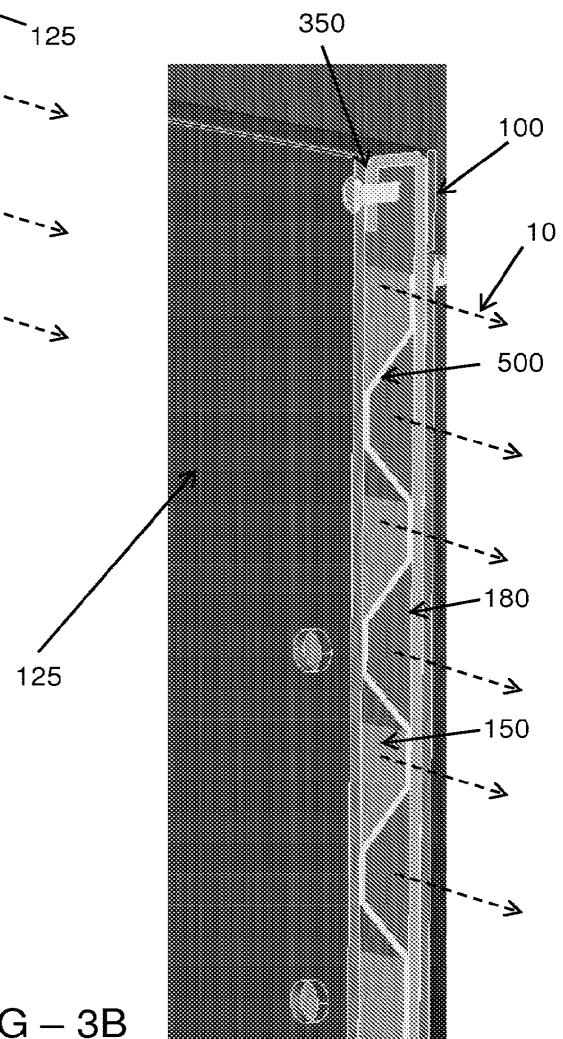
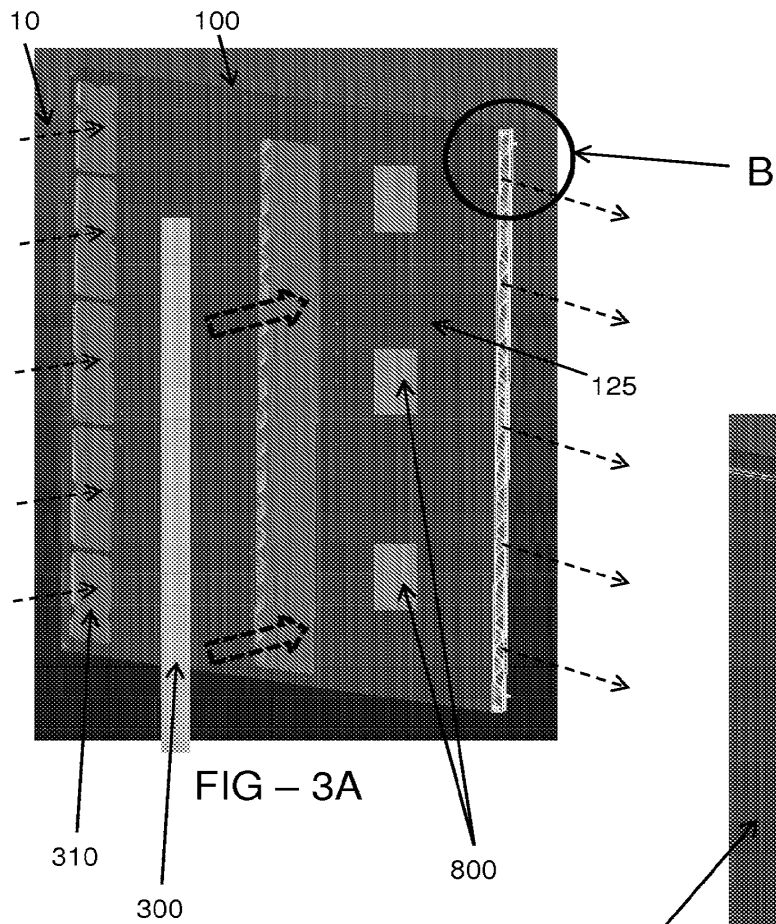


FIG - 2



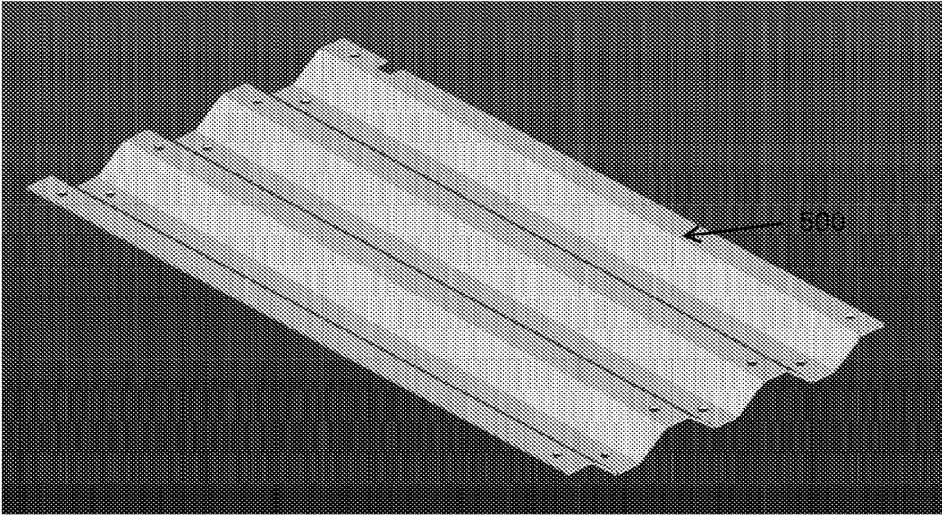
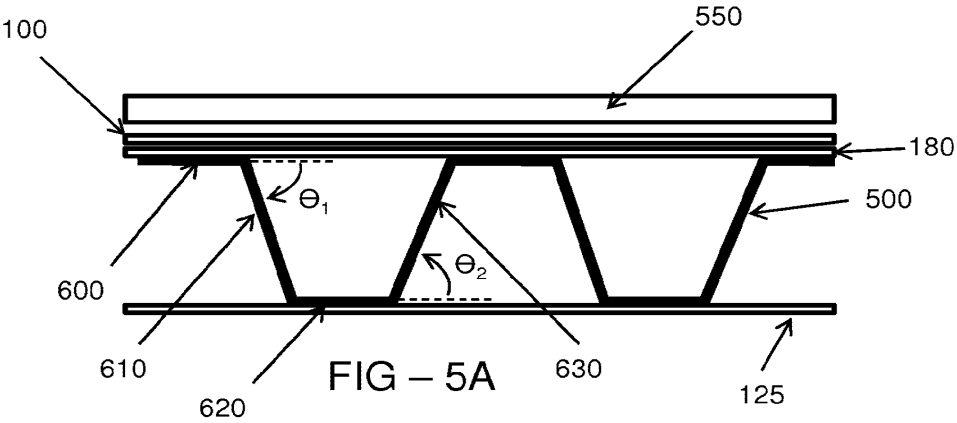
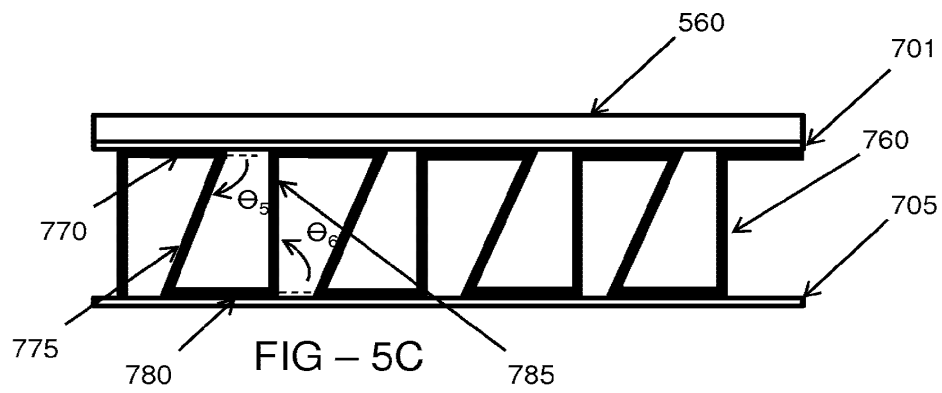
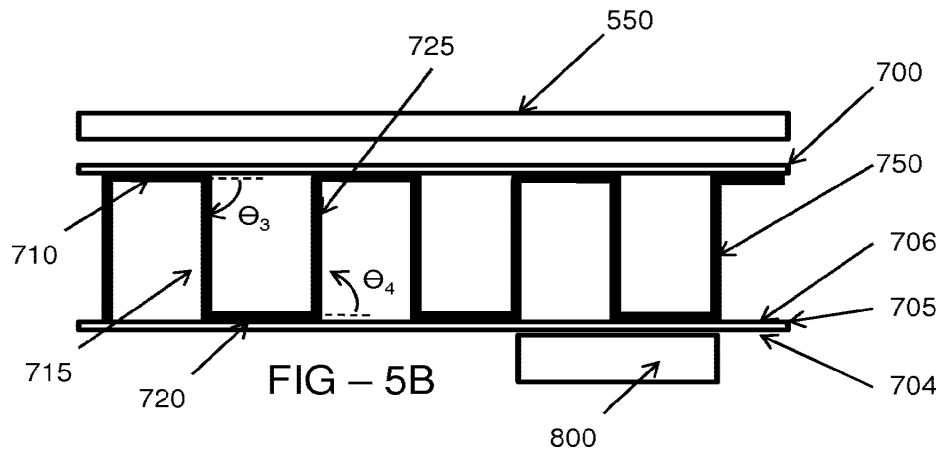


FIG - 4







Espacenet

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BACK PAN COOLING ASSEMBLY FOR ELECTRIC DISPLAY

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Exemplary embodiments disclosed herein provide a back pan cooling assembly for an electronic display having a rear pan. A cooling back pan is preferably positioned behind the rear pan, the space between the cooling back pan and the rear pan defining a gap. A fan is positioned to cause a flow of ambient air through the gap. An electronic component for driving the electronic display may be placed in conductive thermal communication with the cooling back pan. A rear cover can be placed against the cooling back pan to define a sealed compartment which does not permit ambient air to enter. A port can be provided within the rear cover which allows ambient air to travel between the surroundings, the fan, and the gap.

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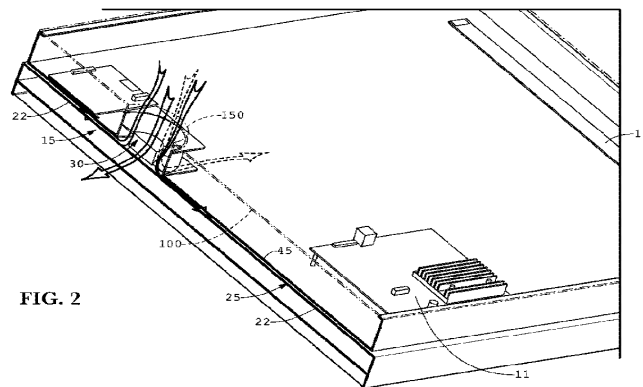


FIG. 2

(57) Abstract: Exemplary embodiments disclosed herein provide a back pan cooling assembly for an electronic display having a rear pan. A cooling back pan is preferably positioned behind the rear pan, the space between the cooling back pan and the rear pan defining a gap. A fan is positioned to cause a flow of ambient air through the gap. An electronic component for driving the electronic display may be placed in conductive thermal communication with the cooling back pan. A rear cover can be placed against the cooling back pan to define a sealed compartment which does not permit ambient air to enter. A port can be provided within the rear cover which allows ambient air to travel between the surroundings, the fan, and the gap.

WO 2014/062815 A1

Back Pan Cooling Assembly for Electronic Display

Cross-Reference to Related Applications

[0001] This application claims priority to US Application No. 61/714,381 filed on October 16, 2012 and is herein incorporated by reference in its entirety.

Technical Field

[0002] Embodiments generally relate to a cooling assembly for the back pan of an electronic display.

Background of the Art

[0003] Electronic displays are now being used for a variety of applications, in addition to the traditional in-home viewing applications. It is now desirable for electronic displays to be used as restaurant menu boards, advertising, and general informational purposes. Each application may require a different set of electronic assemblies, in order to drive the electronic display and provide any ancillary services related to the electronic display and its purpose. Electronic displays are typically manufactured in standard sizes, shapes, and with standard electronic components.

Summary of the Exemplary Embodiments

[0004] One exemplary embodiment provides a cooling back pan that is positioned behind the rear pan of an electronic display, where the space between the cooling back pan and the rear pan defines a gap. A fan is preferably positioned so as to cause a flow of ambient air through the gap, cooling the rear pan and the cooling back pan. Electronic components for operating the electronic display can be mounted to the cooling back pan and preferably are placed in conductive thermal communication with the cooling back pan.

[0005] The foregoing and other features and advantages of the present invention will be apparent from the following more detailed description of the particular embodiments, as illustrated in the accompanying drawings.

Brief Description of the Drawings

[0006] A better understanding of an exemplary embodiment will be obtained from a reading of the following detailed description and the accompanying drawings wherein identical reference characters refer to identical parts and in which:

[0007] FIGURE 1 is a rear perspective view of an exemplary back pan cooling assembly.

[0008] FIGURE 2 is a sectional view of the embodiment shown in Figure 1.

Detailed Description

[0009] The invention is described more fully hereinafter with reference to the accompanying drawings, in which exemplary embodiments of the invention are shown. This invention may, however, be embodied in many different forms and should not be construed as limited to the exemplary embodiments set forth herein. Rather, these embodiments are provided so that this disclosure will be thorough and complete, and will fully convey the scope of the invention to those skilled in the art. In the drawings, the size and relative sizes of layers and regions may be exaggerated for clarity.

[0010] The terminology used herein is for the purpose of describing particular embodiments only and is not intended to be limiting of the invention. As used herein, the singular forms "a", "an" and "the" are intended to include the plural forms as well, unless the context clearly indicates otherwise. It will be further understood that the terms "comprises" and/or "comprising," when used in this specification, specify the presence of stated features, integers, steps, operations, elements, and/or components, but do not preclude the presence or addition of one or more other features, integers, steps, operations, elements, components, and/or groups thereof.

[0011] Embodiments of the invention are described herein with reference to illustrations that are schematic illustrations of idealized embodiments (and intermediate

structures) of the invention. As such, variations from the shapes of the illustrations as a result, for example, of manufacturing techniques and/or tolerances, are to be expected. Thus, embodiments of the invention should not be construed as limited to the particular shapes of regions illustrated herein but are to include deviations in shapes that result, for example, from manufacturing.

[0012] Unless otherwise defined, all terms (including technical and scientific terms) used herein have the same meaning as commonly understood by one of ordinary skill in the art to which this invention belongs. It will be further understood that terms, such as those defined in commonly used dictionaries, should be interpreted as having a meaning that is consistent with their meaning in the context of the relevant art and will not be interpreted in an idealized or overly formal sense unless expressly so defined herein.

[0013] FIGURE 1 is a rear perspective view of an exemplary back pan cooling assembly where the rear cover 100 has been removed. An electronic display 15 is provided on the bottom with an exemplary cooling back pan 45 positioned on the top. The electronic display 15 contains a rear pan 22 on the rear surface of the electronic display 15 (i.e. on the side opposing an intended observer). The rear pan 22 is often a component in mass-manufactured electronic displays and typically provides mounts for electronic subassemblies or housings to go with the electronic display. In some embodiments, the rear pan 22 is metallic. As used herein, the term 'rear pan' does not require that the pan is actually the one that came with the originally mass-manufactured display, as this component may be upgraded from its originally mass-manufactured form by downstream manufacturers.

[0014] Here, electronic components 10 and 11 for driving the electronic display 15 are fastened to the cooling back pan 45. In an exemplary embodiment, the electronic components 10 and 11 may be placed in conductive thermal communication with the cooling back pan 22. The electronic components 10 and 11 may contain any one of the following: timing and control boards (TCON), power supplies, video cards/drivers/players, input/output interfaces, antennas, wireless receivers, modems, local electronic storage, and CPU/microprocessors.

[0015] The space between the rear pan 22 and the exemplary cooling back pan 45 defines an air gap 25. The fan 30 is positioned so as to cause a flow of ambient cooling air through the gap 25, in order to cool both the rear pan 22 and the cooling back pan 45. The fan 30 preferably draws ambient air from around the display housing, without letting the air enter other portions of the display housing, especially the portions of the cooling back pan 45 which contain the electronic components 10 and 11 (i.e. the portions sealed off between the cooling back pan 45 and the rear cover 100). In other words, the fan 30 is preferably placed in sealed gaseous communication with the surrounding ambient air and the gap 25 such that ambient air can pass through the fan 30 and gap 25 without entering the area sealed by the cooling back pan 45 and rear cover 100.

[0016] In at least one embodiment, a port 150 is provided which provides sealed gaseous communication between the ambient air surrounding the display housing and the fan 30. Once forced through the gap 25, the cooling air can exit any portion of the perimeter of the rear pan 22 and cooling back pan 45 assemblies, and eventually is exhausted out of the edges of the display housing. In other words, the gap 25 preferably extends to all four edges of the display housing and allows ambient air to enter/exit the gap 25 along all four edges of the rear pan 22 and cooling back pan 45.

[0017] **FIGURE 2** is a sectional view of the embodiment shown in Figure 1.

[0018] As can be observed, the cooling back pan 45 can be used to mount any number of specialized electrical components 10 and 11 which may be required for the end-use of any electronic display. At the same time, the cooling back pan 45 can help remove heat from the electronic components 10 and 11 as well as the rear pan 22, without exposing the sensitive components to ambient air (which may contain dirt, dust, or contaminants).

[0019] It should be noted that although a single fan 30 is shown, this is not required by any embodiment as there can be multiple fans positioned on the cooling back pan 45 in other embodiments. Also, although an exemplary embodiment uses the fan 30 to push the cooling air into the gap 25, alternative embodiments could also be used to draw air from the edges of the display housing, through the gap 25, and exhaust the air through the port 150. It should also be noted that additional fans may be positioned

within the cooling back pan 45 in order to circulate air around the interior of the cooling back pan 45, without mixing with the ambient air.

[0020] It should also be noted that it is preferable to place the fan 30 near the center of the cooling back pan 45, although this is not required. It may be preferable in some instances to place the fan 30 closer to the horizontal top edge of the cooling back pan 45 (as shown in Figure 2), as the heat generated by the display assembly tends to rise where additional flow rates of cooling air would be beneficial in this area. In most cases, if using only one fan 30, it may be preferable to place the fan near the vertically-drawn centerline of the cooling back pan 45.

[0021] As used herein, the term 'electronic display' is any electronic assembly for generating an image to a viewer. The term specifically includes, but is not limited to: liquid crystal displays (all types), OLED, light emitting diode (LED), field emitting display (FED), light emitting polymer (LEP), organic electro luminescence (OEL), plasma displays, and any other type of thin/flat panel display. In an exemplary embodiment, the electronic display 15 comprises an LED edge lit LCD display where the LED backlight is placed in conductive thermal communication with the rear pan 22. In another exemplary embodiment, the electronic display 15 comprises an LED direct backlit LCD display where the rear pan 22 is provided as the rear surface of the direct LED backlight.

[0022] Having shown and described a preferred embodiment of the invention, those skilled in the art will realize that many variations and modifications may be made to affect the described invention and still be within the scope of the claimed invention. Additionally, many of the elements indicated above may be altered or replaced by different elements which will provide the same result and fall within the spirit of the claimed invention. It is the intention, therefore, to limit the invention only as indicated by the scope of the claims.

CLAIMS

We claim:

1. A back pan cooling assembly for an electronic display having a rear pan, the assembly comprising:
 - a cooling back pan positioned behind the rear pan, the space between the cooling back pan and the rear pan defining a gap;
 - a fan positioned to cause a flow of ambient air through the gap; and
 - an electronic component for driving the electronic display, placed in conductive thermal communication with the cooling back pan.
2. The cooling assembly of claim 1 wherein:
 - the fan is sealed within the cooling back pan such that ambient air is not permitted to contact the electronic component.
3. The cooling assembly of claim 1 wherein:
 - the electronic display is in conductive thermal communication with the rear pan.
4. The cooling assembly of claim 1 further comprising:
 - an LED backlight within the electronic display and placed in thermal communication with the rear pan.
5. The cooling assembly of claim 1 wherein:
 - the rear pan and cooling back pan each contain four perimeter edges which are substantially aligned with one another.
6. The cooling assembly of claim 5 wherein:
 - the gap extends to all four perimeter edges of the rear pan and cooling back pan.
7. The cooling assembly of claim 5 wherein:
 - ambient air is permitted to enter the gap along all four perimeter edges.

8. The cooling assembly of claim 1 wherein:
the rear pan comprises the rear surface of a direct-lit LED backlight.
9. The cooling assembly of claim 1 further comprising:
a port in gaseous communication with the fan such that ambient air is drawn through the port and exhausted out of the gap.
10. The cooling assembly of claim 1 further comprising:
a port in gaseous communication with the fan such that ambient air is drawn through the gap and exhausted out of the port.
11. A back pan cooling assembly for an electronic display having a rear pan, the assembly comprising:
a cooling back pan positioned behind the rear pan, the space between the cooling back pan and the rear pan defining a gap;
a rear cover positioned on the cooling back pan to define a rear compartment which is sealed to prevent ambient air from entering the rear compartment;
a port which accepts ambient gas;
an open loop gaseous pathway defined by gaseous communication between the port, fan, and gap; and
a fan positioned to cause a flow of ambient air through the open loop gaseous pathway.
12. The cooling assembly of claim 11 further comprising:
an electronic component for operating the electronic display, placed within the compartment and mounted to the cooling back pan.
13. The cooling assembly of claim 11 wherein:

the rear pan and cooling back pan each contain four perimeter edges which are substantially aligned with one another.

14. The cooling assembly of claim 13 wherein:

the gap extends to all four perimeter edges of the rear pan and cooling back pan.

15. The cooling assembly of claim 11 wherein:

the fan is oriented such that ambient air is drawn through the port and exhausted out of the gap.

16. The cooling assembly of claim 11 wherein:

the fan is oriented such that ambient air is drawn through the gap and exhausted out of the port.

17. A back pan cooling assembly for an electronic display having a rear pan with a pair of vertical edges and a pair of horizontal edges, the assembly comprising:

a cooling back pan having a pair of vertical edges substantially aligned with the vertical edges of the rear pan and a pair of horizontal edges which are substantially aligned with the horizontal edges of the rear pan;

a gap defined between the cooling back pan and rear pan which extends to each horizontal edge to define a pair of horizontal edge gaps and to each vertical edge to define a pair of vertical edge gaps; and

a fan positioned to cause ambient air to flow through the vertical edge gaps and the horizontal edge gaps.

18. The cooling assembly of claim 17 wherein:

the fan is positioned near a center of the cooling back pan.

19. The cooling assembly of claim 17 further comprising:

an LED backlight within the electronic display which is placed in conductive thermal communication with the rear pan.

20. The cooling assembly of claim 17 further comprising:
- a rear cover positioned on the cooling back pan to define a rear compartment which is sealed to prevent ambient air from entering the rear compartment;
 - a port within the rear cover; and
 - an open loop gaseous pathway defined by gaseous communication between the port, fan, and the edge gaps.

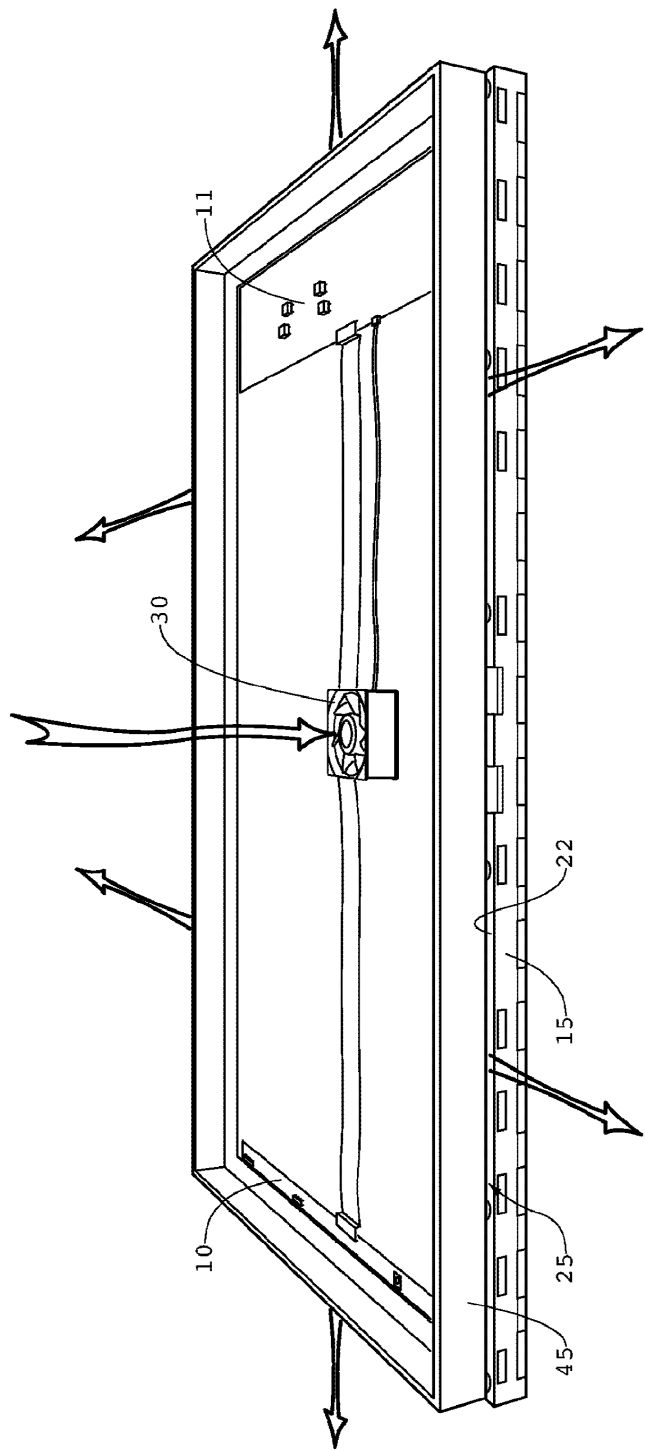


FIG. 1

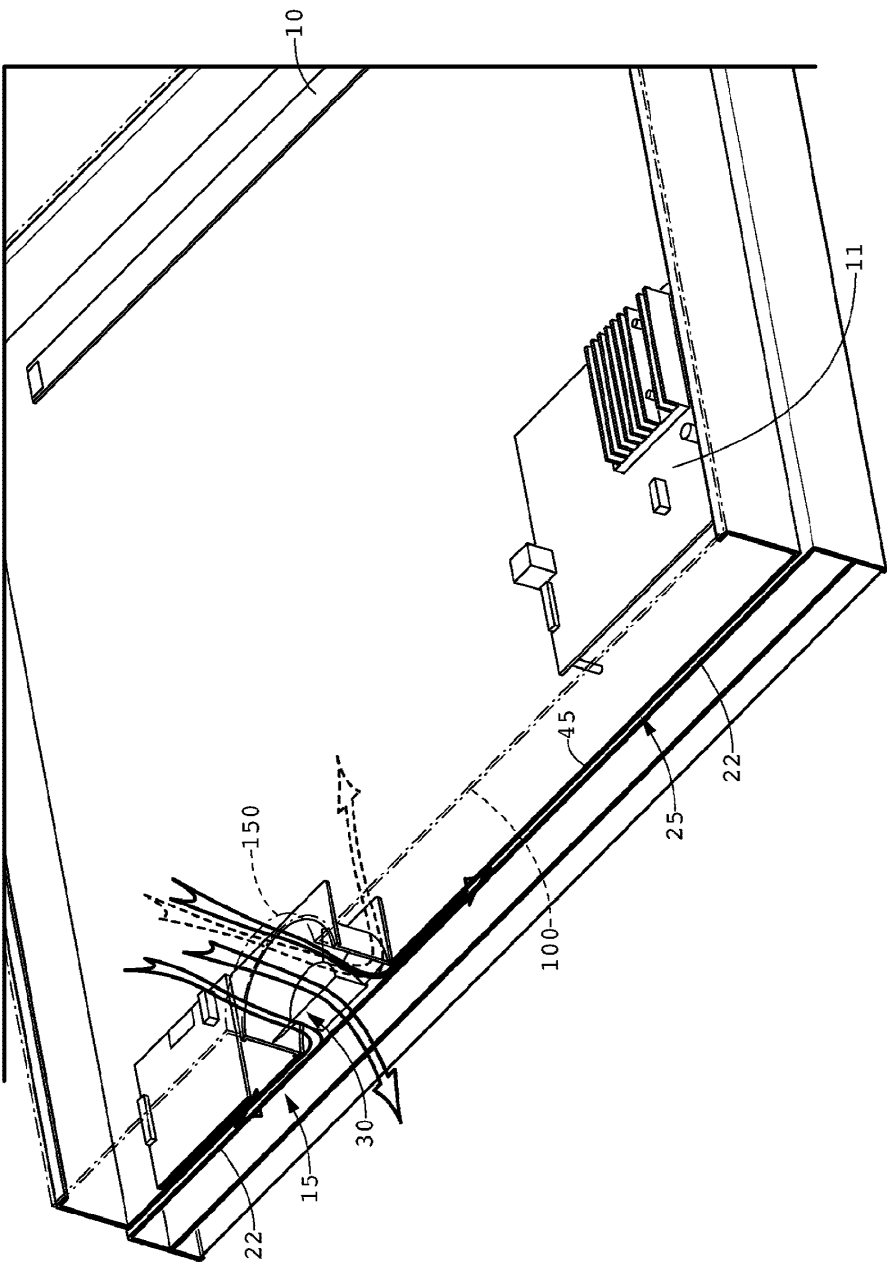


FIG. 2

INTERNATIONAL SEARCH REPORT

International application No.

PCT/US2013/065264

A. CLASSIFICATION OF SUBJECT MATTER IPC(8) - G09F 9/00 (2014.01) USPC - 362/612 According to International Patent Classification (IPC) or to both national classification and IPC		
B. FIELDS SEARCHED Minimum documentation searched (classification system followed by classification symbols) IPC(8) - F21V 29/00; G09F 9/00; G09G 3/20, 5/00, 5/10; H01J 17/28; H05K 7/20 (2014.01) USPC - 174/547; 345/55, 87, 204; 361/692, 695, 697; 362/97.3, 612 Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched CPC - F21V 29/00; G09F 9/00; G09G 3/20, 5/00, 5/10; H01J 17/28; H05K 7/20 (2014.01) Electronic data base consulted during the international search (name of data base and, where practicable, search terms used) Orbit, Google Patents, Google, Google Scholar		
C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	JP 11296094 A (IRIE et al) 29 October 1999 (29.10.1999) entire document	1, 3, 5-7, 9, 10, 17, 18
Y		2, 4, 8, 11-16, 19, 20
Y	US 2012/0020114 A1 (MIYAMOTO et al) 26 January 2012 (26.12.2012) entire document	2, 4, 8, 11-16, 19, 20
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Name and mailing address of the ISA/US Mail Stop PCT, Attn: ISA/US, Commissioner for Patents P.O. Box 1450, Alexandria, Virginia 22313-1450 Facsimile No. 571-273-3201		Authorized officer: Blaine R. Copenheaver PCT Helpdesk: 571-272-4300 PCT OSP: 571-272-7774



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FIGURE EIGHT CLOSED LOOP COOLING SYSTEM FOR ELECTRONIC DISPLAY

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The exemplary embodiments herein provide a figure eight closed loop of circulating gas pathways wrapping around an electronic display. One or more open loop ambient air pathways may pass through the figure eight but do not allow the circulating gas and the ambient air to mix. In some embodiments, the open loop ambient air pathway travels along a rear surface of the electronic display. In some embodiments, the circulating gas pathways contain a front channel placed in front of the electronic display, a rear channel placed behind the electronic display, and a center channel placed between the front and rear channels. Pass-through apertures may be placed within the path of the circulating gas and/or the ambient air to allow the paths of the two gaseous matters to cross without allowing them to mix with one another.

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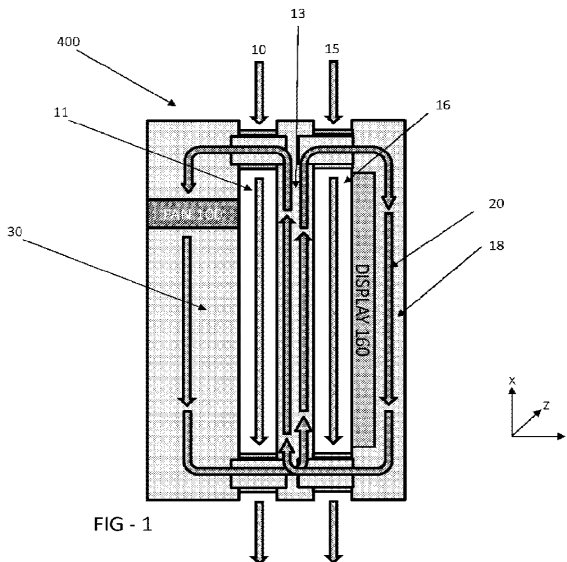
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[Continued on next page]

(54) Title: FIGURE EIGHT CLOSED LOOP COOLING SYSTEM FOR ELECTRONIC DISPLAY



(57) Abstract: The exemplary embodiments herein provide a figure eight closed loop of circulating gas pathways wrapping around an electronic display. One or more open loop ambient air pathways may pass through the figure eight but do not allow the circulating gas and the ambient air to mix. In some embodiments, the open loop ambient air pathway travels along a rear surface of the electronic display. In some embodiments, the circulating gas pathways contain a front channel placed in front of the electronic display, a rear channel placed behind the electronic display, and a center channel placed between the front and rear channels. Pass-through apertures may be placed within the path of the circulating gas and/or the ambient air to allow the paths of the two gaseous matters to cross without allowing them to mix with one another.

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FIGURE EIGHT CLOSED LOOP COOLING SYSTEM FOR ELECTRONIC DISPLAY

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Cross-Reference to Related Applications

[0001] This application claims priority to US Provisional Application No. 61/843,706 filed on July 8, 2013 which is herein incorporated by reference in its entirety.

Technical Field

[0002] Embodiments generally relate to cooling systems for electronic displays.

Background of the Art

[0003] Electronic displays are sometimes used in outdoor environments or other areas where the surrounding temperatures may be high or there may be other sources of heat such as solar loading causing the temperatures within the display to rise. However, some portions of the display can be difficult to cool as simply ingesting ambient air into some portions of the display can introduce dust and contaminants into sensitive portions of the display, which can lead to premature failures.

Summary of the Exemplary Embodiments

[0004] Exemplary embodiments provide a figure eight closed loop circulating gas path which defines a center channel for the closed loop of circulating gas. A pair of open loop ambient air channels may be placed on opposite sides of the center channel, in order to remove heat from at least the center channel and the closed loop circulating

gas. One or more open loop ambient air pathways may pass through the figure eight but do not allow the circulating gas and the ambient air to mix. In some embodiments, the open loop ambient air pathway travels along a rear surface of the electronic display. In some embodiments, the circulating gas pathways contain a front channel placed in front of the electronic display, a rear channel placed behind the electronic display, and a center channel placed between the front and rear channels. Pass-through apertures may be placed within the path of the circulating gas and/or the ambient air to allow the paths of the two gaseous matters to cross without allowing them to mix with one another.

[0005] The foregoing and other features and advantages of the present invention will be apparent from the following more detailed description of the particular embodiments, as illustrated in the accompanying drawings.

Brief Description of the Drawings

[0006] A better understanding of an exemplary embodiment will be obtained from a reading of the following detailed description and the accompanying drawings wherein identical reference characters refer to identical parts and in which:

[0007] FIGURE 1 is a simplified illustration of an exemplary embodiment of the figure eight closed loop cooling system.

[0008] FIGURE 2 is a side rear perspective view showing the overall assembly of the display with the rear cover removed and indicating the section line 3-3.

[0009] FIGURE 3 is a perspective section view taken from the section line 3-3 and indicating the locations for Detail 4 and Detail 5.

- [0010] **FIGURE 4** is a detailed perspective section view of Detail 4.
- [0011] **FIGURE 5** is a detailed perspective section view of Detail 5.
- [0012] **FIGURE 6** is a bottom rear perspective view showing the overall assembly of the display and indicating the section line 7-7.
- [0013] **FIGURE 7** is a perspective section view taken from the section line 7-7.

Detailed Description

[0014] The invention is described more fully hereinafter with reference to the accompanying drawings, in which exemplary embodiments of the invention are shown. This invention may, however, be embodied in many different forms and should not be construed as limited to the exemplary embodiments set forth herein. Rather, these embodiments are provided so that this disclosure will be thorough and complete, and will fully convey the scope of the invention to those skilled in the art. In the drawings, the size and relative sizes of layers and regions may be exaggerated for clarity.

[0015] The terminology used herein is for the purpose of describing particular embodiments only and is not intended to be limiting of the invention. As used herein, the singular forms "a", "an" and "the" are intended to include the plural forms as well, unless the context clearly indicates otherwise. It will be further understood that the terms "comprises" and/or "comprising," when used in this specification, specify the presence of stated features, integers, steps, operations, elements, and/or components, but do not preclude the presence or addition of one or more other features, integers, steps, operations, elements, components, and/or groups thereof.

[0016] Embodiments of the invention are described herein with reference to illustrations that are schematic illustrations of idealized embodiments (and intermediate structures) of the invention. As such, variations from the shapes of the illustrations as a result, for example, of manufacturing techniques and/or tolerances, are to be expected. Thus, embodiments of the invention should not be construed as limited to the particular shapes of regions illustrated herein but are to include deviations in shapes that result, for example, from manufacturing.

[0017] Unless otherwise defined, all terms (including technical and scientific terms) used herein have the same meaning as commonly understood by one of ordinary skill in the art to which this invention belongs. It will be further understood that terms, such as those defined in commonly used dictionaries, should be interpreted as having a meaning that is consistent with their meaning in the context of the relevant art and will not be interpreted in an idealized or overly formal sense unless expressly so defined herein.

[0018] **FIGURE 1** is a simplified illustration of an exemplary embodiment of the figure eight closed loop cooling system 400. This exemplary embodiment contains a plurality of channels in the assembly. The front channel 18 is placed in front of the display 160 and preferably allows closed loop circulating gas 20 to remove heat from the front of the display 160. The front open loop channel 16 is positioned behind the display 160 and preferably allows open loop air 15 to pass behind the display 160, removing heat at least from the rear portion of the display 160 and the center channel 13. The center channel 13 is preferably positioned between the front open loop channel 16 and the rear open loop channel 11 and allows closed loop circulating gas 20 to cross paths with itself

(creating the figure eight) and to cross paths with the open loop air 10 and 15 without allowing the closed loop circulating gas and open loop air to mix.

[0019] The rear open loop channel 11 is preferably positioned immediately adjacent to the center channel 13, and allows open loop air 10 to flow through, thereby removing heat from the center channel 13 (and/or the closed loop circulating gas 13 contained within) and the rear channel 30. The rear channel 30 is positioned near the rear of the display and may contain various electronic components 35 for operating the overall display assembly, fans, or the display 160 itself.

[0020] In an exemplary embodiment, the front channel 18, center channel 13, and rear channel 30 are in sealed gaseous communication with each other. In other words, these channels do not permit closed loop circulating gas 20 to substantially escape or to allow ambient air or open loop air to enter these channels. Also in an exemplary embodiment, open loop air 10 and 15 is simply ambient air surrounding the display assembly. However, in some embodiments the open loop air 10 and 15 may be treated in some way (ex. filtered, air conditioned, or pre-cooled in some way) prior to being ingested into the display assembly. In this particular embodiment, the closed loop fan 100 is positioned within the rear channel 30, although this is not required. All that is required is that the closed loop fan 100 is positioned to force the closed loop circulating gas 20 through the front channel 18, center channel 13, and rear channel 30. The closed loop circulating gas 20 can be any gaseous matter that preferably does not contain large amounts of particulate. However, it does not have to be pure gas of any type; simple clean air works fine with the exemplary embodiments.

[0021] FIGURE 2 is a side rear perspective view showing the overall assembly of the display with the rear cover removed and indicating the section line 3-3. In this particular embodiment, the display assembly is designed for a portrait orientation with the closed loop fans 100 positioned at the top of the assembly and the open loop fans 200 positioned at the bottom of the assembly. This is of course not required however, as the embodiments herein can be flipped or oriented for a landscape orientation if desired. Further, the open loop fans 200 do not have to be placed at the bottom of the assembly, but could be positioned anywhere so that the open loop air travels in the paths specified in these exemplary embodiments. It of course goes without saying that additional fans could also be used to increase flow rates and/or pressure.

[0022] FIGURE 3 is a perspective section view taken from the section line 3-3 and indicating the locations for Detail 4 and Detail 5. Here, the front channel 18 is defined between the front transparent plate 150 and the electronic display 160. In an exemplary embodiment the electronic display 160 may be an LED backlit liquid crystal display (LCD), but this is not required. Alternative embodiments may utilize any type of flat panel electronic display, including but not limited to plasma, OLED, electroluminescent polymers, or similar. In some embodiments, the various electrical components 35 (power supplies, printed circuit boards, microprocessors, electronic storage, etc.) may be attached and in thermal communication with a plate 31 which may form the rear portion of channel 11 for open loop air 10. In this way, heat that is generated by the electrical components 35 may be transferred to the plate 31, where it can be removed by open loop air 10.

[0023] FIGURE 4 is a detailed perspective section view of Detail 4. Closed loop circulating gas 20 is permitted to pass through the rear open loop channel 11 without mixing with the open loop air 10 by use of pass-through apertures 200, which provide sealed gaseous communication between the rear channel 30 and the center channel 13, without permitting open loop air 10 to enter the channels 30 and 13. In an exemplary embodiment, rear open loop channel 11 may also contain cooling fins 400 for distributing heat from the adjacent channels (30 and 13) and/or electronic components 35 in order to be efficiently removed by the open loop air 10. Similarly, front open loop channel 16 may also contain cooling fins 450 for distributing heat from the adjacent channels (30 and 18) and/or the rear surface of the display 160 in order to be efficiently removed by the open loop air 15. In an exemplary embodiment, the display 160 contains a direct lit LED backlight where the cooling fins 450 are placed in thermal communication with the LED backlight. The cooling fins 450 and 400 may be comprised of any thermally conductive material, but would preferably be comprised of metal and in an exemplary embodiment would be a thin sheet (or multiple thin sheets) of metal.

[0024] FIGURE 5 is a detailed perspective section view of Detail 5. Closed loop circulating gas 20 is permitted to pass through the front open loop channel 16 without mixing with the open loop air 15 by use of pass-through apertures 205, which provide sealed gaseous communication between the front channel 18 and the center channel 13, without permitting open loop air 15 to enter the channels 18 and 13.

[0025] FIGURE 6 is a bottom rear perspective view showing the overall assembly of the display and indicating the section line 7-7.

[0026] **FIGURE 7** is a perspective section view taken from the section line 7-7. The center channel 13 is preferably divided into a plurality of subchannels 300 and 305. On this end of the overall assembly, subchannels 300 are in gaseous communication with the pass-through apertures 200 (which connects the subchannel 300 with the rear channel 30) while subchannels 305 are in gaseous communication with the pass-through apertures 205 (which connects the subchannel 305 with the front channel 18). However, on the opposite end of the assembly (see Figure 3) subchannels 300 are in gaseous communication with the pass-through apertures 205 (which connects the subchannel 300 with the front channel 18) while subchannels 305 are in gaseous communication with the pass-through apertures 200 (which connects the subchannel 305 with the rear channel 30). In this way, the closed loop of circulating gas 20 travels through the front channel 18, through a pass-through aperture to travel along subchannel 305, through another pass-through aperture to travel along the rear channel 30, through another pass-through aperture to travel along the subchannel 300, and finally through another pass-through aperture to return to the front channel 18. In this way, the closed loop of circulating gas 20 performs the 'figure eight' through the assembly, as it weaves its way across the front channel 18, through the center channel 13, across the rear channel 30, again through the center channel 13, and returning to the front channel 18.

[0027] It should be noted that subchannels 300 and 305 may not be required in some embodiments as the center channel 13 could be completely open. It should also be noted that other embodiments may use the subchannels 300 and 305 but would not allow a single subchannel to communicate gaseously with both the front channel 18 and

the rear channel 30. In other words, when viewing the end of the assembly as shown in Figure 7, the opposing end of the assembly would be substantially similar. Thus, subchannels 300 would only communicate with pass-through apertures 200 and the rear channel 30, while the subchannels 305 would only communicate with pass-through apertures 205 and front channel 18. Thus, in this embodiment there would be two separate closed loops.

[0028] Although there is preferably gaseous communication throughout the figure eight, subchannel 300 directs the flow of closed loop circulating gas 20 through rear channel 30 and center channel 13 while subchannel 305 directs the flow of closed loop circulating gas 20 through the center channel 13 and front channel 18. In this preferred embodiment, the subchannels 300 and 305 allow separate flow paths for closed loop circulating gas 20 within the center channel 13, without requiring additional fans. These separate flow paths which cross through the center and loop around the display in a single continuous flow, define the figure eight path for the closed loop circulating gas 20 (seen also in Figure 1). Further, in this preferred embodiment, the flow direction of closed loop circulating gas 20 through the center channel 13 is opposite the flow direction of open loop air 15 and 10, creating a counter-flow heat exchanger between the center channel 13 and the front/rear open loop channels 11 and 16. However, this is not required, as a parallel flow or a cross flow design would work as well.

[0029] In an exemplary embodiment, the rear channel 30 would share a plate with the rear open loop channel 11, such that one side of the plate would be within the rear channel 30 while the opposing side of the plate would be within the rear open loop channel 11. This arrangement is illustrated in Figure 3 with the rear plate 31. Similarly,

it may be preferable for the center channel 13 and the rear open loop 11 to share a plate, such that one side of the plate is within the center channel 13 while the other side of the plate is within the rear open loop 11. Similarly, it may be preferable for the center channel 13 and the front open loop 16 to share a plate. Finally, it may also be preferable for the rear surface of the display 160 to form the front wall of the front open loop 16, such that open loop ambient air 15 can remove heat from the electronic display 160. In some embodiments the rear surface of the display 160 would be the rear surface of a metallic PCB holding a plurality of LEDs for the backlight.

[0030] Having shown and described a preferred embodiment of the invention, those skilled in the art will realize that many variations and modifications may be made to affect the described invention and still be within the scope of the claimed invention. Additionally, many of the elements indicated above may be altered or replaced by different elements which will provide the same result and fall within the spirit of the claimed invention. It is the intention, therefore, to limit the invention only as indicated by the scope of the claims.

CLAIMS

We claim:

1. A cooling assembly for an electronic display comprising:
 - a figure eight closed loop of circulating gas pathways wrapping around the electronic display; and
 - an open loop ambient air pathway passing through the figure eight which does not allow circulating gas to mix with ambient gas.
2. The cooling assembly of claim 1 further comprising:
 - a front channel defined between a front surface of the electronic display and a transparent plate;
 - wherein the figure eight closed loop of circulating gas pathways includes the front channel.
3. The cooling assembly of claim 2 further comprising:
 - a rear channel containing electronic components which are mounted to a rear plate;
 - wherein the figure eight closed loop of circulating gas pathways includes the rear channel.
4. The cooling assembly of claim 3 further comprising:
 - a center channel placed between the front channel and rear channel;

wherein the figure eight closed loop of circulating gas pathways includes the center channel.

5. The cooling assembly of claim 1 wherein:

the open loop ambient air pathway travels along a rear surface of the electronic display.

6. The cooling assembly of claim 3 wherein:

the open loop ambient air pathway travels along a side of the rear plate which is opposite the side containing the electronic components.

7. The cooling assembly of claim 1 further comprising:

a plurality of pass-through apertures placed within the figure eight closed loop of circulating gas pathways.

8. The cooling assembly of claim 7 wherein:

the pass-through apertures are arranged such that the circulating gas travels through the center of the aperture while the open loop ambient air passes around the aperture.

9. The cooling assembly of claim 7 wherein:

the pass-through apertures are arranged to prevent the circulating gas from mixing with the open loop ambient air.

10. A cooling assembly for an electronic display comprising:
- a closed loop of gas pathways for circulating gas comprising
 - a front channel placed in front of the electronic display,
 - a rear channel placed behind the electronic display, and
 - a center channel placed between the front and rear channels;
 - a first open loop pathway for ambient air positioned between the electronic display and the center channel; and
 - a second open loop pathway for ambient air positioned between the center channel and the rear channel.
11. The cooling assembly of claim 10 further comprising:
- a closed loop fan positioned to force circulating gas through the closed loop of gas pathways; and
 - an open loop fan positioned to force ambient air through the first and second open loop pathways.
12. The cooling assembly of claim 10 further comprising:
- a rear plate having a posterior and anterior side and placed within the rear channel;
 - a plurality of electronic components attached to the posterior side of the rear plate; and
 - wherein the anterior side of the rear plate forms a portion of the second open loop pathway.

13. The cooling assembly of claim 10 further comprising:
a plurality of pass-through apertures positioned within the first open loop pathway.
14. The cooling assembly of claim 13 wherein:
the pass-through apertures contain a hole in the center and are arranged such that the circulating gas travels through the hole in the center while the ambient air travels around the pass-through aperture.
15. The cooling assembly of claim 10 wherein:
the second open loop pathway and the rear channel share a plate such that a side of the plate is within the rear channel while an opposing side of the plate is within the second open loop pathway.
16. The cooling assembly of claim 10 wherein:
the center channel is placed between the first and second open loop pathways.
17. A cooling assembly for an electronic display comprising:
a front channel defined by the space between a front surface of the electronic display and a transparent plate;
a first open loop pathway defined by the space between a rear surface of the electronic display and a front plate;

a rear plate positioned behind the electronic display and having a first side forming part of a rear channel and an opposing side forming part of a second open loop pathway;

a center channel placed between the first and second open loop pathways;

a closed loop fan positioned to force circulating gas through the front channel, rear channel, and center channel; and

an open loop fan positioned to force ambient air through the first and second open loop pathways.

18. The cooling assembly of claim 17 further comprising:

a plurality of pass-through apertures placed within the path of the circulating gas.

19. The cooling assembly of claim 17 further comprising:

a plurality of electronic components attached to the side of the rear plate forming part of the rear channel.

20. The cooling assembly of claim 17 further comprising:

a plurality of cooling fins placed within the first and second open loop pathways.

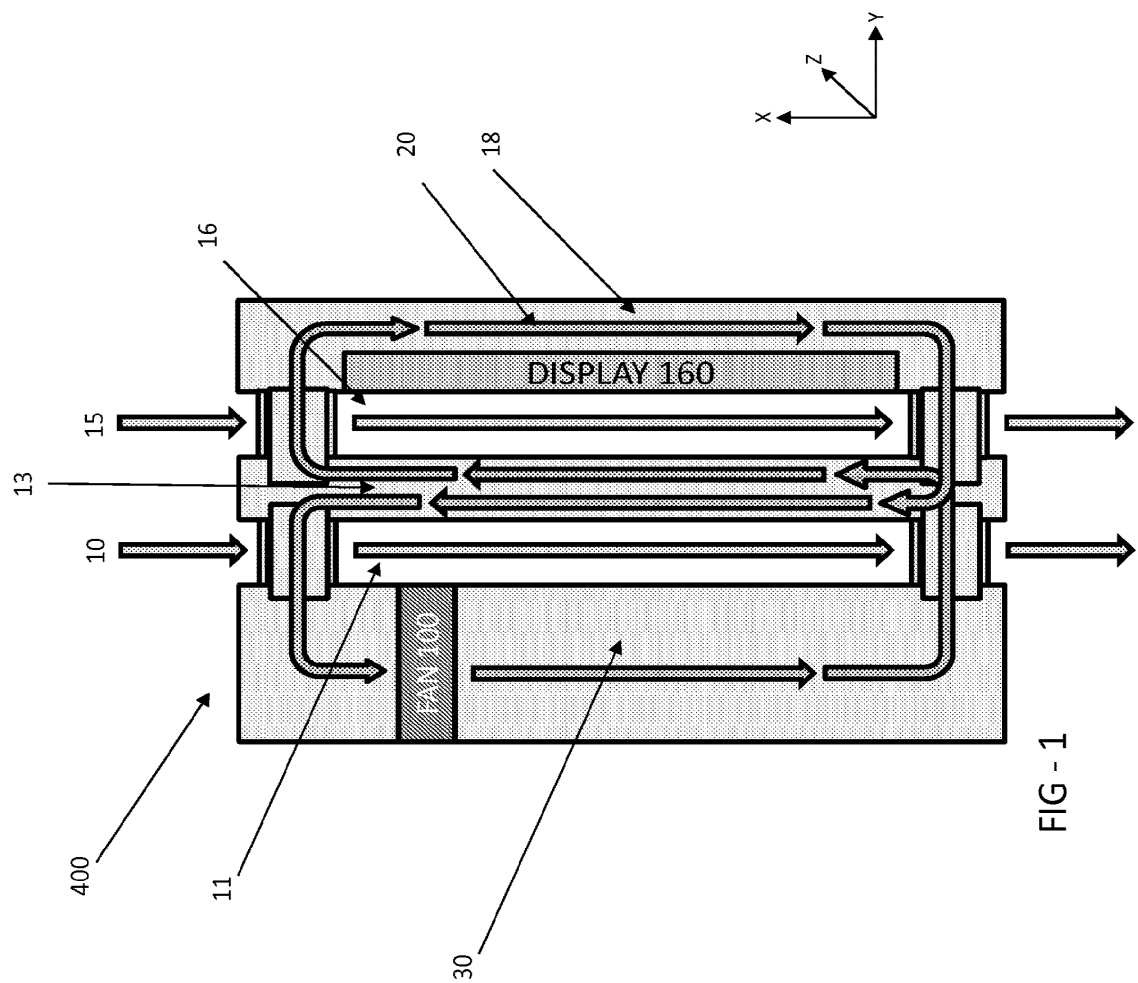


FIG - 1

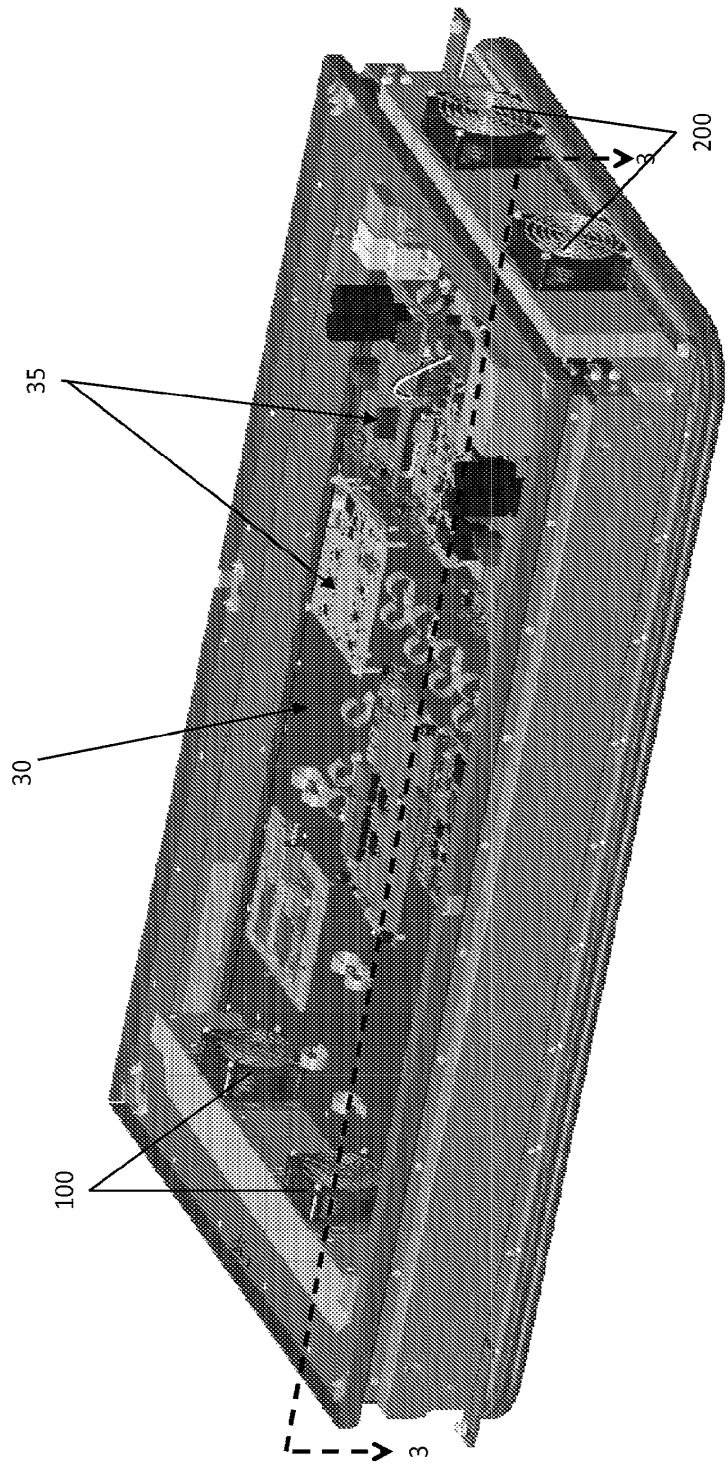


FIG - 2

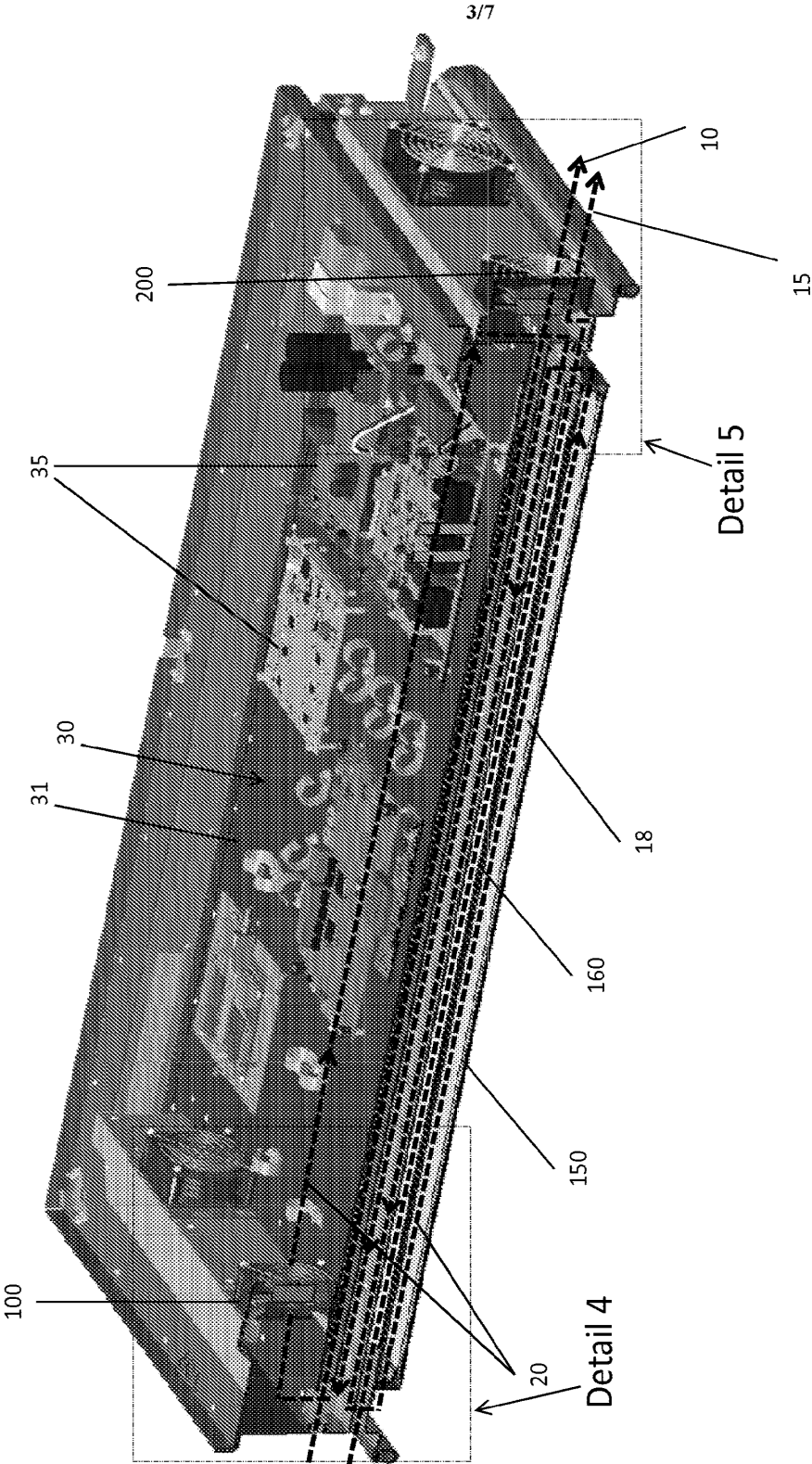


FIG - 3

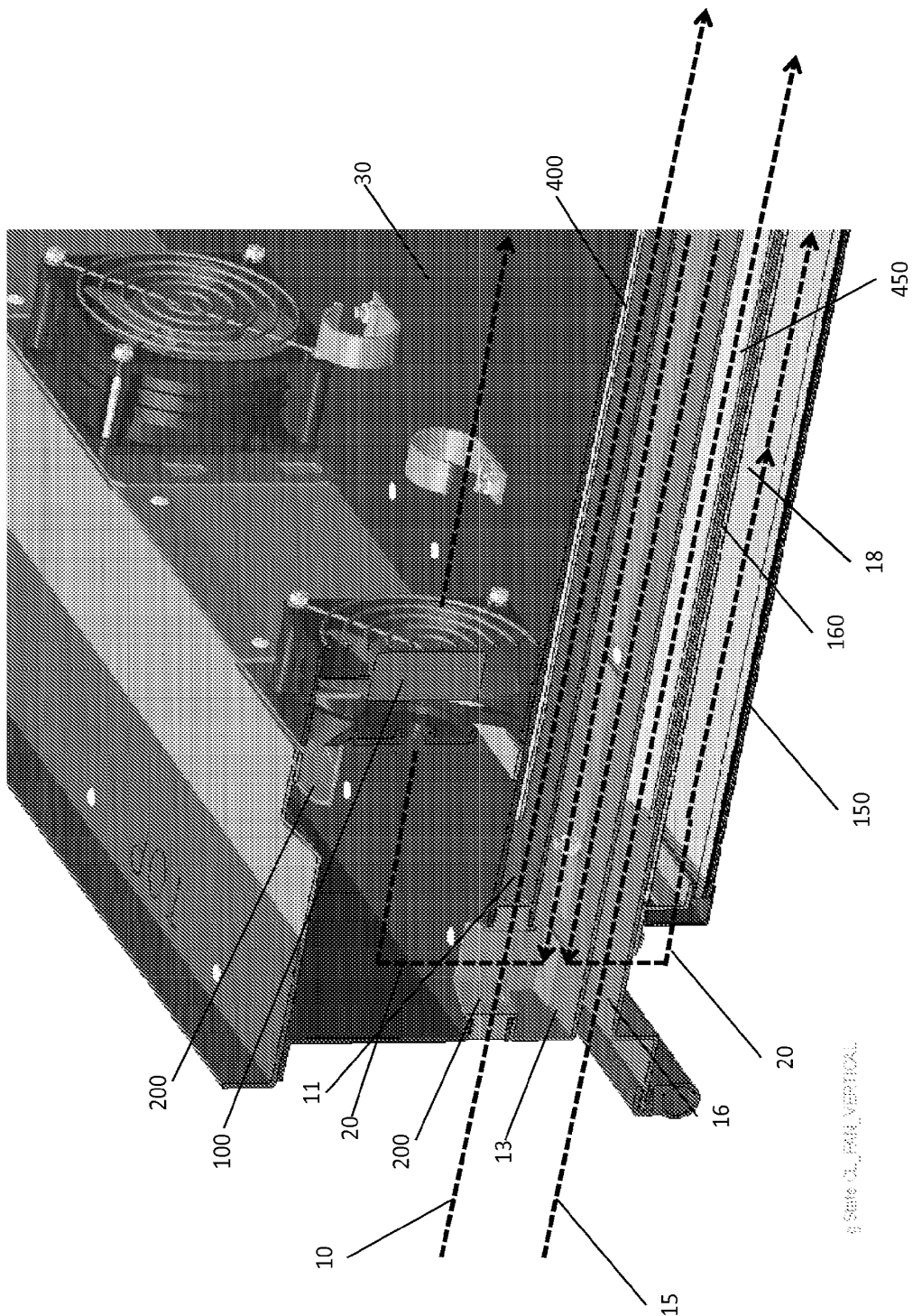


FIG - 4

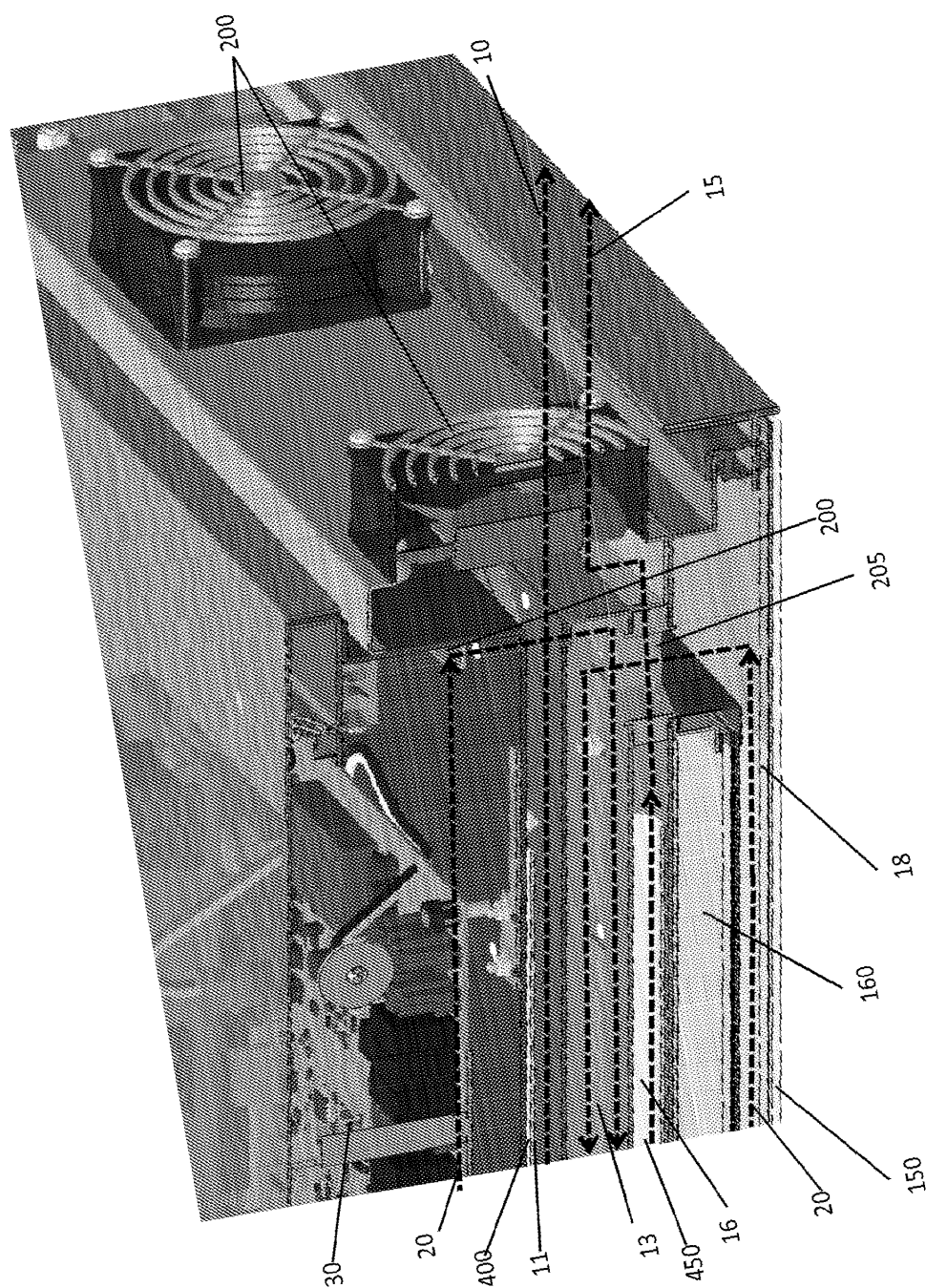


FIG - 5

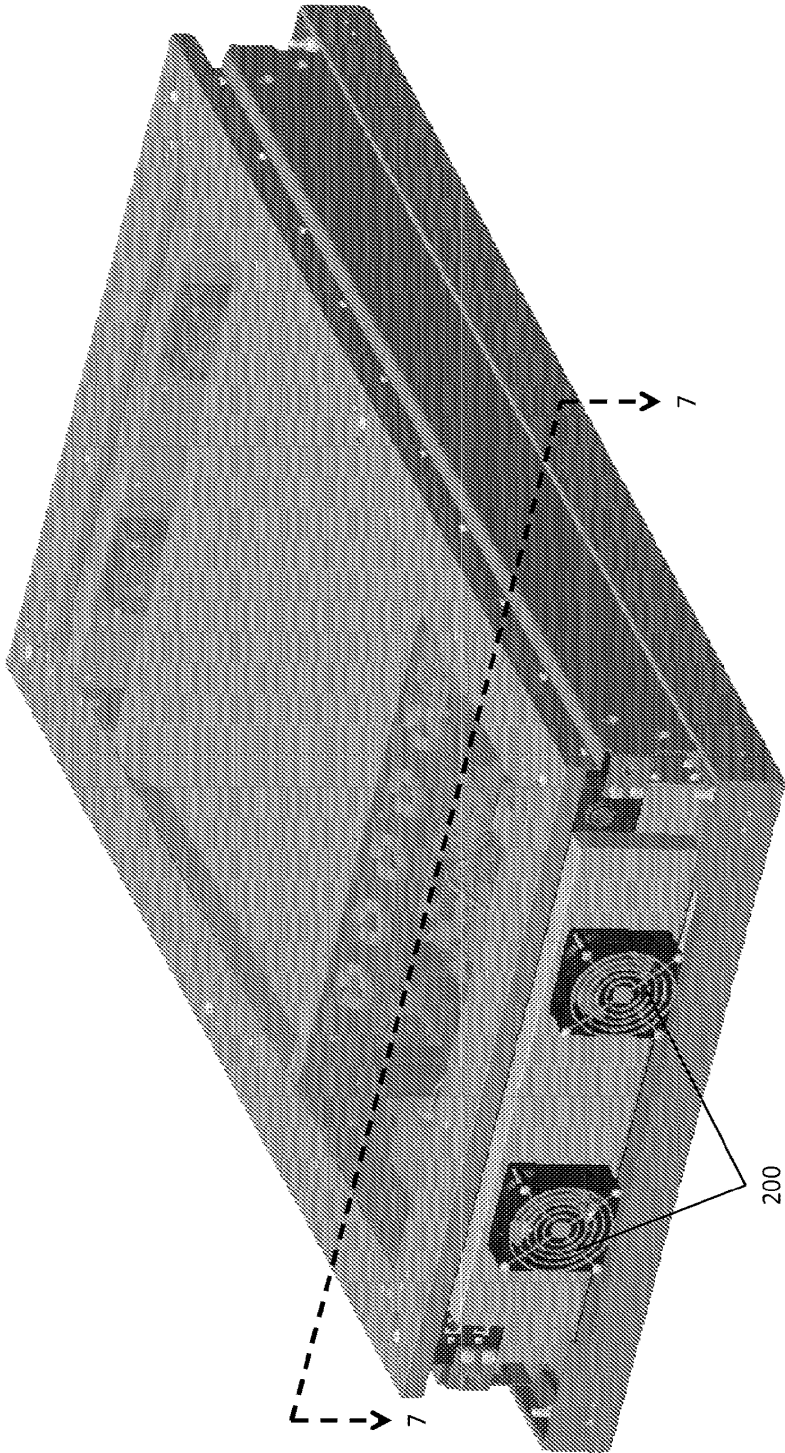


FIG - 6

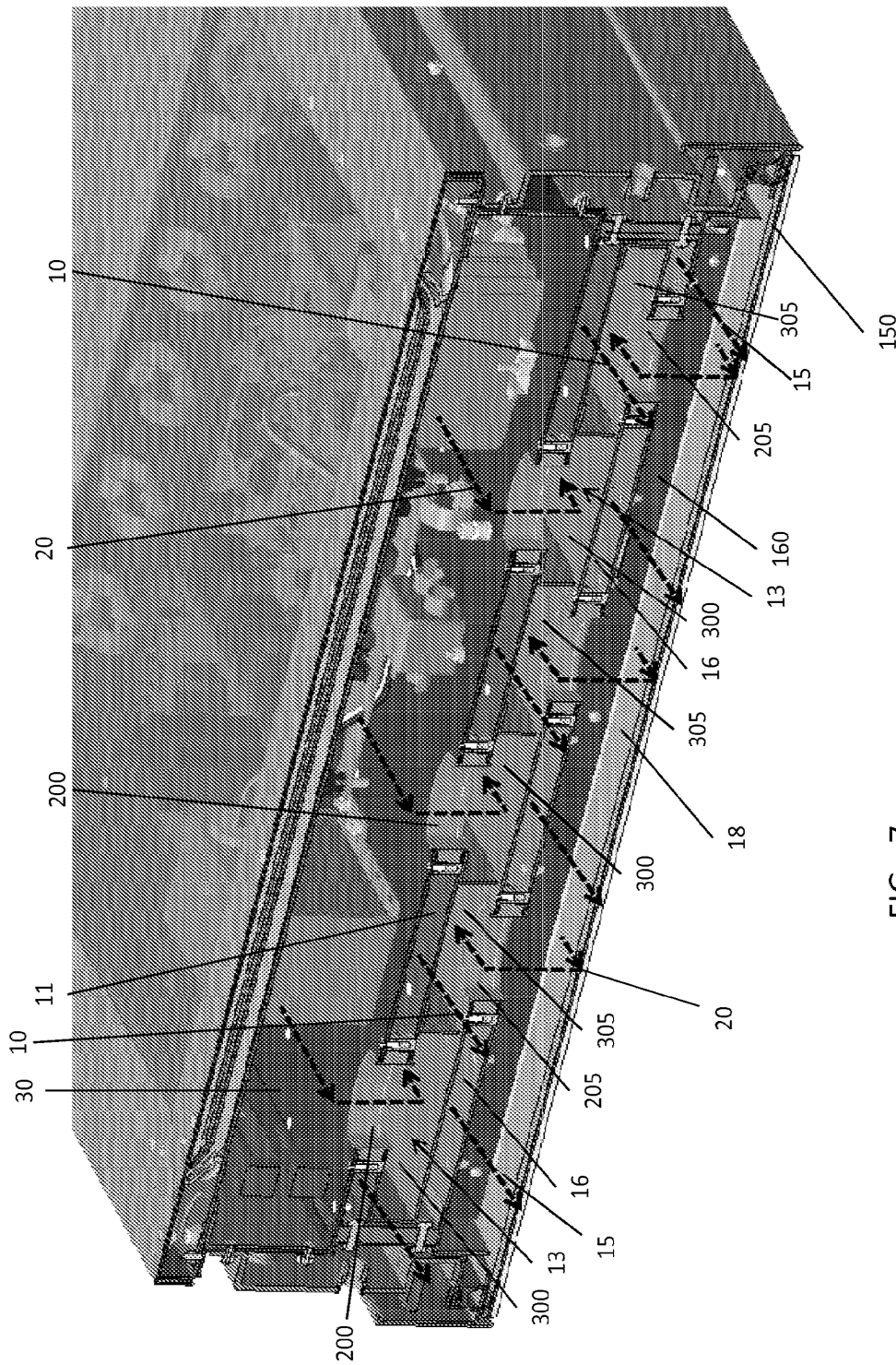


FIG - 7



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HYBRID REAR COVER AND MOUNTING BRACKET FOR ELETRONIC DISPLAY

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A system and method for mounting an electronic display is disclosed herein. A rear cover mounting bracket may contain a rear plate and a sidewall which surrounds a perimeter of the plate. A plurality of mounting holes may be placed within the plate to allow fastening the rear plate to a vertical surface. An electronic display assembly module may contain a thermal plate where the attachment of the rear cover mounting bracket to the module creates a plenum which can house one or more electronic components. In a preferred embodiment, the rear plate contains a pair of hooks and the module contains a pair of corresponding cylinders which can be engaged with the hooks so that the module can hang from the hooks.

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DO, DZ, EC, EG, ES, FI, GB, GD, GE, GH, GM, GT,
HN, HR, HU, ID, IL, IN, IR, IS, JP, KE, KG, KN, KP, KR,
KZ, LA, LC, LK, LR, LS, LU, LY, MA, MD, ME, MG,
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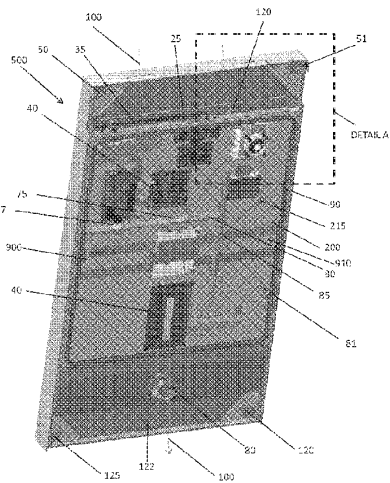


FIG - 1

(57) **Abstract:** A system and method for mounting an electronic display is disclosed herein. A rear cover mounting bracket may contain a rear plate and a sidewall which surrounds a perimeter of the plate. A plurality of mounting holes may be placed within the plate to allow fastening the rear plate to a vertical surface. An electronic display assembly module may contain a thermal plate where the attachment of the rear cover mounting bracket to the module creates a plenum which can house one or more electronic components. In a preferred embodiment, the rear plate contains a pair of hooks and the module contains a pair of corresponding cylinders which can be engaged with the hooks so that the module can hang from the hooks.

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INTERNATIONAL SEARCH REPORT

International application No.

PCT/US15/19975

A. CLASSIFICATION OF SUBJECT MATTER IPC(8) - H05K 5/00, 7/14, 7/20 (2015.01) CPC - H05K 7/20145, 7/20154, 7/20954 According to International Patent Classification (IPC) or to both national classification and IPC		
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C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X — Y	US 5,748,269 A (HARRIS, D. et al.) May 05, 1998; figures 1-3, 4B, 5 and 6; column 3, lines 14-18, 37-38, 53-59; column 4, lines 33-37; column 5, lines 15-40; column 6, lines 21-31	1-6 — 7-9, 11, 14, 15
X — Y	US 2013/0270975 A1 (MANUFACTURING RESOURCES INTERNATIONAL, INC.) October 17, 2013; figures 1-4; paragraphs [0016], [0018], [0020] and [0023]	10, 12, 13, 16-20 — 7-9, 11, 14, 15
☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.		
* Special categories of cited documents: "A" document defining the general state of the art which is not considered to be of particular relevance "E" earlier application or patent but published on or after the international filing date "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified) "O" document referring to an oral disclosure, use, exhibition or other means "P" document published prior to the international filing date but later than the priority date claimed "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art "&" document member of the same patent family		
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Name and mailing address of the ISA/ Mail Stop PCT, Attn: ISA/US, Commissioner for Patents P.O. Box 1450, Alexandria, Virginia 22313-1450 Facsimile No. 571-273-8300		Authorized officer: Shane Thomas PCT Helpdesk: 571-272-4300 PCT OSP: 571-272-7774

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DISPLAY APPARATUS

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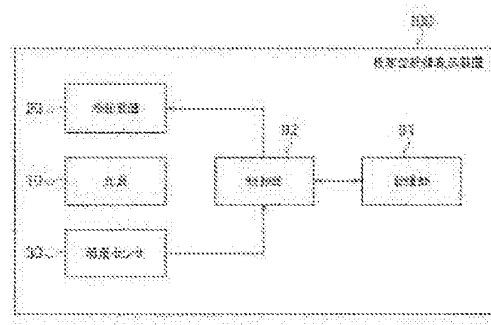
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Application number: JP20060152475 20060531 Global Dossier

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Abstract of JP2007322718 (A)

PROBLEM TO BE SOLVED: To provide a display device capable of optimizing the environment temperature of each light source while saving power of the display device. ;SOLUTION: The projection type display apparatus 100 having a plurality of LEDs 10 includes: a plurality of cooling devices 20 provided for the corresponding LEDs 10 and used for adjusting the environment temperatures of the LEDs 10; an illuminance sensor 30 for detecting the state of each LED 10; and a control section 92 used for comparing the state of each LED 10 detected by the illuminance sensor 30 with a target state determined for each LED 10 and then controlling each of the cooling devices 20 based on the result of the comparison between the state of the corresponding LED 10 and its target state. The control section 92 controls the cooling devices 20 while maintaining the total consumption power of the cooling devices 20 at the maximum power consumption level for an adjustment section or below. ;COPYRIGHT: (C) 2008,JPO&INPIT



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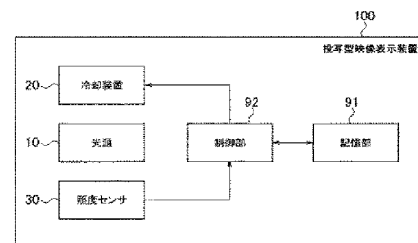
(54) 【発明の名称】 表示装置

(57) 【要約】

【課題】表示装置の省電力化を図りながら、各光源の環境温度を最適化することを可能とする表示装置を提供する。

【解決手段】複数のLED10を有する投写型表示装置100が、LED10毎に設けられており、LED10の環境温度を調節する複数の冷却装置20と、LED10の状態をLED10毎に検出する照度センサ30と、照度センサ30によって検出されたLED10の状態とLED10毎に定められた目標状態とを比較して、LED10の状態と目標状態とを比較した結果に基づいて、複数の冷却装置20をそれぞれ制御する制御部92とを備え、制御部92が、複数の冷却装置20の消費電力の合計を調節部最大消費電力以下に保ちながら冷却装置20を制御する。

【選択図】 図3



【特許請求の範囲】

【請求項1】

複数の光源を有する表示装置であって、
前記光源毎に設けられており、前記光源の環境温度を調節する複数の温度調節部と、
前記光源の状態を前記光源毎に検出する状態検出部と、
前記状態検出部によって検出された前記光源の状態と前記光源毎に定められた目標状態とを比較して、前記光源の状態と前記目標状態とを比較した結果に基づいて、前記複数の温度調節部をそれぞれ制御する制御部とを備え、
前記制御部は、前記複数の温度調節部の消費電力の合計を調節部最大消費電力以下に保ちながら、前記温度調節部を制御することを特徴とする表示装置。

【請求項2】

前記制御部は、前記複数の光源の照度の比率を一定比率に保ちながら、前記温度調節部を制御することを特徴とする請求項1に記載の表示装置。

【請求項3】

前記制御部は、前記光源の状態が前記目標状態に達せずに、前記複数の温度調節部の消費電力の合計が前記調節部最大消費電力を超えた場合に、前記複数の光源の照度の比率を一定比率に保ちながら、前記温度調節部を制御することを特徴とする請求項1に記載の表示装置。

【請求項4】

前記制御部は、
前記温度調節部に加えて、前記複数の光源をそれぞれ制御しており、
前記複数の温度調節部の消費電力及び前記複数の光源の消費電力の合計を最大消費電力以下に保ちながら、前記温度調節部及び前記光源を制御することを特徴とする請求項1に記載の表示装置。

【請求項5】

前記温度調節部は、前記光源の環境温度を液体の流量によって調節しており、
前記制御部は、前記液体の流量を制御することを特徴とする請求項1に記載の表示装置。

【請求項6】

前記光源の状態は、前記光源の照度又は前記光源の環境温度であることを特徴とする請求項1に記載の表示装置。

【発明の詳細な説明】

【技術分野】

【0001】

本発明は、複数の光源を有する表示装置に関する。

【背景技術】

【0002】

従来、複数の光源（例えば、赤色、緑色及び青色の光源）を有する表示装置が一般的に広く知られている。なお、表示装置とは、LCDディスプレイ、リアプロジェクションテレビ、プロジェクタなどである。

【0003】

また、光源の環境温度が高くなると、光源の照度や寿命が劣化するため、このような表示装置には、光源を冷却する冷却装置が設けられている（例えば、特許文献1）。

【0004】

表示装置に設けられる冷却装置としては、各光源に対する冷却能力が一律に同じである冷却装置が挙げられる。このような冷却装置によれば、冷却能力の制御を一元化することができるため、冷却能力の制御が容易である。一方で、各光源の照度や寿命に対して環境温度が与える影響は光源の種類（色など）によって異なるため、各光源の環境温度を個別に最適化することが好ましい。

【0005】

また、各光源の照度や寿命などを光源毎に考慮して、各光源に対する冷却能力が個別に制御される冷却装置も提案されている。このような冷却装置によれば、各光源に対する冷却能力が個別に制御されるため、各光源の環境温度を個別に最適化することができる。

【特許文献1】特開2005-149943号公報（請求項1、図1など）

【発明の開示】

【発明が解決しようとする課題】

【0006】

ところで、近年では、地球温暖化などの問題に対応するために、装置の省電力化が叫ばれている。これに伴って、上述した表示装置でも省電力化を図りたいという要望が高まっている。

【0007】

ここで、各光源に対する冷却能力が個別に制御される冷却装置では、冷却装置の全体に係る冷却能力は、光源毎に個別に制御される冷却能力の合計である。従って、冷却装置を有する表示装置の設置場所が高温となれば、各光源に対応する冷却能力がそれぞれ強化されるため、冷却装置の全体に係る冷却能力も強化される。すなわち、冷却装置を有する表示装置の設置場所が高温となった場合には、冷却装置の全体に係る消費電力が増加する。

【0008】

このように、各光源に対する冷却能力を個別に最適化しようとすると、表示装置（冷却装置）の全体に係る消費電力が増加してしまう場合があった。すなわち、各光源の環境温度の最適化のみを考慮すると、表示装置の省電力化を図ることができない場合があった。

【0009】

そこで、本発明は、上述した課題を解決するためになされたものであり、表示装置の省電力化を図りながら、各光源の環境温度を最適化することを可能とする表示装置を提供することを目的とする。

【課題を解決するための手段】

【0010】

本発明の一の特徴は、複数の光源（LED10）を有する表示装置（投写型表示装置100）が、前記光源毎に設けられており、前記光源の環境温度を調節する複数の温度調節部（冷却装置20）と、前記光源の状態を前記光源毎に検出する状態検出部（照度センサ30）と、前記状態検出部によって検出された前記光源の状態と前記光源毎に定められた目標状態とを比較して、前記光源の状態と前記目標状態とを比較した結果に基づいて、前記複数の温度調節部をそれぞれ制御する制御部（制御部92）とを備え、前記制御部が、前記複数の温度調節部の消費電力の合計を調節部最大消費電力以下に保ちながら、前記温度調節部を制御することを要旨とする。

【0011】

かかる特徴によれば、制御部が、複数の温度調節部の消費電力の合計を調節部最大消費電力以下に保ちながら温度調節部を制御することによって、表示装置の設置場所が高温となった場合などに、表示装置の消費電力が無制限に増加することを抑制することができる。また、制御部が複数の温度調節部を個別に制御することによって、光源の環境温度を個別に最適化することができる。

【0012】

本発明の一の特徴は、本発明の上述した特徴において、前記制御部が、前記複数の光源の照度の比率（ホワイトバランス）を一定比率に保ちながら、前記温度調節部を制御することを要旨とする。

【0013】

本発明の一の特徴は、本発明の上述した特徴において、前記制御部が、前記光源の状態が前記目標状態に達せずに、前記複数の温度調節部の消費電力の合計が前記調節部最大消費電力を超えた場合に、前記複数の光源の照度の比率（ホワイトバランス）を一定比率に保ちながら、前記温度調節部を制御することを要旨とする。

【0014】

本発明の一の特徴は、本発明の上述した特徴において、前記制御部が、前記温度調節部に加えて、前記複数の光源をそれぞれ制御しており、前記複数の温度調節部の消費電力及び前記複数の光源の消費電力の合計を最大消費電力以下に保ちながら、前記温度調節部及び前記光源を制御することを要旨とする。

【0015】

本発明の一の特徴は、本発明の上述した特徴において、前記温度調節部が、前記光源の環境温度を液体の流量によって調節しており、前記制御部が、前記液体の流量を制御することを要旨とする。

【0016】

本発明の一の特徴は、本発明の上述した特徴において、前記光源の状態が、前記光源の照度又は前記光源の環境温度であることを要旨とする。

【発明の効果】

【0017】

本発明によれば、表示装置の省電力化を図りながら、各光源の環境温度を最適化することを可能とする表示装置を提供することができる。

【発明を実施するための最良の形態】

【0018】

以下において、本発明の実施形態について図面を参照しながら説明する。なお、以下の図面の記載において、同一又は類似の部分には、同一又は類似の符号を付している。ただし、図面は模式的なものであることに留意すべきである。

【0019】

ただし、図面は模式的なものであり、各寸法の比率などは現実のものとは異なることに留意すべきである。従って、具体的な寸法などは以下の説明を参酌して判断すべきである。また、図面相互間においても互いの寸法の関係や比率が異なる部分が含まれていることは勿論である。

【0020】

〔第1実施形態〕

（投写型表示装置の構成）

以下において、本発明の第1実施形態に係る投写型表示装置の構成について、図面を参照しながら説明する。図1及び図2は、本発明の第1実施形態に係る投写型表示装置100を示す図である。図1に示すように、投写型表示装置100は、投写レンズ80を有しており、投写レンズ80によって拡大された像をスクリーン200上に投写する。

【0021】

図2に示すように、投写型表示装置100は、複数のLED10と、複数の冷却装置20と、複数の照度センサ30と、複数のテーパロッド40と、複数の導光部材50と、複数の液晶パネル60と、ダイクロイックプリズム70と、投写レンズ80とを有する。

【0022】

LED10は、各色の光を発する光源（LED10r、LED10g及びLED10b）である。なお、LED10の照度（輝度）は、LED10の環境温度に依存する。

【0023】

冷却装置20は、LED10毎に設けられており、各LED10の環境温度を個別に調節する冷却装置（冷却装置20r、冷却装置20g及び冷却装置20b）である。具体的には、冷却装置20は、液冷や空冷などの方法で各LED10の環境温度を下げる装置であり、制御部（図2では、不図示）によって個別に制御される。また、各冷却装置20の冷却能力を上げようとすると、冷却装置20が消費する消費電力が大きくなる。

【0024】

例えば、液冷に係る冷却装置20で冷却能力を上げるためには、液体の流量を増やす必要がある。また、液体の流量を増やすためにポンプの駆動力を上げる必要があるため、冷却装置20の消費電力が大きくなる。一方、空冷に係る冷却装置20で冷却能力を上げるためには、空気の流量を増やす必要がある。また、空気の流量を増やすためにファンの駆

動力を上げる必要があるため、冷却装置 20 の消費電力が大きくなる。

【0025】

なお、冷却装置 20 は、液冷や空冷に係る装置だけではなくて、ペルチェ素子などであってもよい。

【0026】

照度センサ 30 は、LED 10 が発する光の照度（輝度）を LED 10 毎に検出するセンサ（照度センサ 30 r、照度センサ 30 g 及び照度センサ 30 b）である。なお、照度センサ 30 が配置される位置は、LED 10 が発する光の照度が検出可能であれば、どこに配置されてもよいことは勿論である。

【0027】

テーパーロッド 40 は、各 LED 10 が発する光を導光部材 50 側に導くロッド（テーパーロッド 40 r、テーパーロッド 40 g 及びテーパーロッド 40 b）であり、テーパー形状を有している。

【0028】

導光部材 50 は、各 LED 10 が発する光を液晶パネル 60 側に導く部材（導光部材 50 r、導光部材 50 g 及び導光部材 50 b）であり、角柱状の形状を有している。

【0029】

液晶パネル 60 は、各 LED 10 が発する光を変調する光変調素子（液晶パネル 60 r、液晶パネル 60 g 及び液晶パネル 60 b）である。

【0030】

ダイクロイックプリズム 70 は、各液晶パネル 60 から出射された光を合成して、合成された光を投写レンズ 80 側に出射する。

【0031】

投写レンズ 80 は、ダイクロイックプリズム 70 から出射された光を拡大して、スクリーン 200 上に映像を投写する。

【0032】

（投写型表示装置の機能ブロック）

以下において、本発明の第 1 実施形態に係る投写型表示装置の機能ブロックについて、図面を参照しながら説明する。図 3 は、本発明の第 1 実施形態に係る投写型表示装置 100 の機能ブロックを示す図である。なお、図 3 では、本発明について明確に説明するために、投写型表示装置 100 の構成の一部が省略されている点に留意すべきである。

【0033】

図 3 に示すように、投写型表示装置 100 は、上述した構成に加えて、記憶部 91 と、制御部 92 とを有する。

【0034】

記憶部 91 は、LED 10 毎に定められた各 LED 10 の照度の目標照度を記憶している。ここで、目標照度は、LED 10 毎に定められた照度の絶対値である。また、記憶部 91 は、各 LED 10 の照度の比率に係る目標比率（ホワイトバランス）を記憶する。なお、ホワイトバランスは、LED 10 毎に定められた目標照度の比率によって算出されてもよい。

【0035】

さらに、記憶部 91 は、各冷却装置 20 の消費電力の合計に対して許容可能な最大消費電力を記憶している。なお、記憶部 91 は、最大消費電力に代えて、各冷却装置 20 の冷却能力の合計に対して許容可能な最大冷却能力を記憶していてもよい。

【0036】

制御部 92 は、各冷却装置 20（冷却装置 20 r、冷却装置 20 g、冷却装置 20 b）、各照度センサ 30（照度センサ 30 r、照度センサ 30 g 及び照度センサ 30 b）及び記憶部 91 に接続されている。また、制御部 92 は、各冷却装置 20 に供給される電流を制御することによって、各冷却装置 20 の冷却能力を制御する。

【0037】

具体的には、制御部92は、各照度センサ30から取得する検出照度と記憶部91に記憶された目標照度とを比較して、検出照度が目標照度に達していないLED10に対応する冷却装置20の冷却能力を強化する。

【0038】

また、制御部92は、各冷却装置20の消費電力の合計を記憶部91に記憶された最大消費電力以下に保ちながら、各冷却装置20に供給する電流（冷却能力）を制御する。

【0039】

例えば、制御部92は、LED10の照度を目標照度に近づけるために、各冷却装置20の冷却能力を強化しようとする。各冷却装置20の消費電力の合計が最大消費電力を超えてしまう場合には、記憶部91に記憶されたホワイトバランスを保ちながら、冷却装置20に供給する電流（冷却能力）を最適化する。すなわち、制御部92は、LED10の照度が目標照度となるまで冷却装置20の冷却能力を強化せずに、最大消費電力を超えない範囲内でホワイトバランスを保ちながら冷却装置20を最適に制御する。

【0040】

（照度制御の一例）

以下において、本発明の第1実施形態に係る照度制御の一例について、図面を参照しながら説明する。図4及び図5は、本発明の第1実施形態に係る照度制御の一例について説明するための図である。

【0041】

最初に、LED10の環境温度に応じて、LED10の照度が変化する例について、図4を参照しながら説明する。なお、図4において、縦軸はLED10の照度であり、横軸はLED10に供給される電流である。

【0042】

図4に示すように、電流－照度特性は、LED10の環境温度が低くなること（冷却能力を強化すること）によって向上し、LED10の環境温度が高くなること（冷却能力を緩和すること）によって低下する。例えば、LED10に供給される電流が I_0 であり、目標照度が L_0 である場合を例に挙げると、検出照度が L_1 である場合には、冷却能力を強化することによってLED10の照度を目標照度（ L_0 ）とすることができる。一方、検出照度が L_2 である場合には、冷却能力を緩和することによってLED10の照度を目標照度（ L_0 ）とすることができる。

【0043】

次に、検出照度と目標照度とを比較して、冷却装置20の冷却能力を制御する例について、図5を参照しながら説明する。なお、図5（a）は、記憶部91に記憶された目標照度の一例を示しており、図5（b）は、照度センサ30によって検出された検出照度の一例を示している。

【0044】

このような場合には、制御部92は、検出照度と目標照度との差分比率に応じて、各冷却装置20の冷却能力を以下のように割り当てる。具体的には、LED10rの差分比率（ R_w ）は、 $R_w = (30 - 20) / 30 = 0.33$ である。同様に、LED10gの差分比率（ G_w ）は、 $G_w = (60 - 50) / 60 = 0.17$ であり、LED10bの差分比率（ B_w ）は、 $B_w = (10 - 10) / 10 = 0$ である。

【0045】

続いて、冷却装置20rに割り当てられる冷却能力の割合（ R ）は、 $R = R_w / (R_w + G_w + B_w) = 0.33 / (0.33 + 0.17 + 0) = 0.66$ となる。同様に、冷却装置20gに割り当てられる冷却能力の割合（ G ）は、 $G = G_w / (R_w + G_w + B_w) = 0.17 / (0.33 + 0.17 + 0) = 0.34$ となり、冷却装置20bに割り当てられる冷却能力の割合（ B ）は、 $B = B_w / (R_w + G_w + B_w) = 0 / (0.33 + 0.17 + 0) = 0$ となる。

【0046】

なお、制御部92は、算出された割合（割合（ R ）、割合（ G ）及び割合（ B ））に応

じて、複数の冷却装置20の全体に許容される最大冷却能力を各冷却装置20に割り当てる。

【0047】

このように、制御部92が、検出照度と目標照度との差分比率に応じて各冷却装置20に冷却能力を割り当てることによって、各冷却装置20の冷却能力（消費電力）の合計が最大冷却能力（最大消費電力）を超えずに、ホワイトバランスを維持することができる。

【0048】

（投写型表示装置の動作）

以下において、本発明の第1実施形態に係る投写型表示装置の動作について、図面を参照しながら説明する。図6は、本発明の第1実施形態に係る投写型表示装置100の動作を示すフロー図である。

【0049】

図6に示すように、ステップ10において、投写型表示装置100は、LED10毎にLED10の照度を検出する。

【0050】

ステップ20において、投写型表示装置100は、ステップ10で検出された検出照度と記憶部91に記憶された目標照度と比較する。

【0051】

ステップ30において、投写型表示装置100は、検出照度が目標照度と一致するか否かをLED10毎に判定する。また、投写型表示装置100は、全てのLED10について検出照度が目標照度と一致する場合には、一連の処理を終了する。一方、投写型表示装置100は、検出照度が目標照度と一致しないLED10がある場合には、ステップ40の処理に移る。

【0052】

ステップ40において、投写型表示装置100は、各LED10の照度を目標照度と一致させるために必要な各冷却装置20の消費電力を見積もる。

【0053】

ステップ50において、投写型表示装置100は、ステップ40で見積もられた消費電力の合計（消費電力見積）が最大消費電力を超えるか否かを判定する。また、投写型表示装置100は、消費電力見積が最大消費電力を超える場合には、ステップ70の処理に移り、消費電力見積が最大消費電力以下である場合には、ステップ60の処理に移る。

【0054】

ステップ60において、投写型表示装置100は、各LED10の照度を目標照度と一致させるために、各冷却装置20に供給すべき電流を個別に決定する。具体的には、投写型表示装置100は、検出照度と目標照度との差分に応じて、低下させる必要がある温度を算出し、算出した温度だけLED10の環境温度を低下させるために必要な電流を決定する。

【0055】

ステップ70において、投写型表示装置100は、ホワイトバランスを維持しながら、各冷却装置20に供給すべき電流（各冷却装置20に割り当てるべき冷却能力）を決定する。具体的には、投写型表示装置100は、検出照度と目標照度との差分比率に応じて、冷却装置20に供給すべき電流（冷却装置20に割り当てるべき冷却能力）を決定する。

【0056】

ステップ80において、投写型表示装置100は、ステップ60又はステップ70で決定された電流（冷却能力）に従って冷却装置20を個別に制御する。

【0057】

なお、投写型表示装置100は、ステップ80の処理が終了すると、再びステップ10の処理に戻って、ステップ10～ステップ80をループ処理することによって、LED10の環境温度を最適化する。

【0058】

(作用及び効果)

本発明の第1実施形態に係る投写型表示装置100によれば、制御部92が、複数の冷却装置20の消費電力の合計を最大消費電力以下に保ちながら冷却装置20を制御することによって、投写型表示装置100の設置場所が高温となった場合などに、投写型表示装置100の消費電力が無制限に増加することを抑制することができる。また、制御部92が複数の冷却装置20を個別に制御することによって、LED10の環境温度を個別に最適化することができる。

【0059】

また、本発明の第1実施形態に係る投写型表示装置100によれば、制御部92は、LED10の照度を目標照度と一致させようとする、各冷却装置20の消費電力の合計が最大消費電力を超えてしまう場合に、LED10の照度が目標照度と一致するまで冷却装置20の冷却能力を強化せずに、ホワイトバランスを保ちながら冷却装置20を制御する。従って、投写型表示装置100の消費電力が無制限に増加することなく、LED10の照度を最適化することができる。

【0060】

〔第2実施形態〕

以下において、本発明の第2実施形態について説明する。なお、以下においては、上述した第1実施形態と第2実施形態との相違点について主として説明する。

【0061】

具体的には、上述した第1実施形態では、投写型表示装置100は、冷却装置20に供給される電流（冷却能力）のみについて制御する。これに対して、第2実施形態では、投写型表示装置100は、冷却装置20に供給される電流（冷却能力）に加えて、LED10に供給される電流を制御する。

【0062】

(投写型表示装置の機能ブロック)

以下において、本発明の第2実施形態に係る投写型表示装置の機能ブロックについて、図面を参照しながら説明する。図7は、本発明の第2実施形態に係る投写型表示装置100の機能ブロックを示す図である。なお、図7では、上述した図3と同一の構成については同一の符号を付している。また、図7では、上述した図3と同様に、投写型表示装置100の構成の一部が省略されている点に留意すべきである。

【0063】

図7に示すように、投写型表示装置100は、LED10と、冷却装置20と、照度センサ30と、記憶部91と、制御部92とを有する。

【0064】

記憶部91は、各冷却装置20の消費電力及び各LED10の消費電力の合計に対する最大消費電力（冷却装置＋光源）を記憶している。また、記憶部91は、LED10に供給することが許容される電流の最大定格をLED10毎に記憶している。

【0065】

制御部92は、冷却装置20、照度センサ30及び記憶部91に加えて、LED10にも接続されており、各冷却装置20に供給する電流（冷却能力）に加えて、各LED10に供給する電流を制御する。また、制御部92は、各冷却装置20の消費電力及び各LED10の消費電力の合計を記憶部91に記憶された最大消費電力（冷却装置＋光源）以下に保つとともに、各LED10に供給される電流を記憶部91に記憶された最大定格以下に保ちながら、各冷却装置20に供給する電流及び各LED10に供給する電流を制御する。

【0066】

具体的には、制御部92は、冷却装置20に供給する電流を増やすことによってLED10の照度が向上する割合（以下、冷却装置電流制御効率）と、LED10に供給する電流を増やすことによってLED10の照度が向上する割合（以下、光源電流制御効率）とを比較する。

【0067】

また、制御部92は、光源電流制御効率が冷却装置電流制御効率よりも高い場合には、各LED10に供給する電流を各冷却装置20に供給する電流よりも優先して制御する。一方、制御部92は、光源電流制御効率が冷却装置電流制御効率以下である場合には、各冷却装置20に供給する電流を各LED10に供給する電流よりも優先して制御する。

【0068】

(照度制御の一例)

以下において、本発明の第2実施形態に係る照度制御の一例について、図面を参照しながら説明する。図8及び図9は、本発明の第2実施形態に係る照度制御の一例について説明するための図である。

【0069】

最初に、冷却装置電流制御効率について図8(a)及び図8(b)を参照しながら説明する。なお、図8(a)において、縦軸はLED10の照度であり、横軸はLED10の環境温度である。また、図8(b)において、縦軸はLED10の環境温度あり、横軸は冷却装置20に供給される電流であり、 T_a は投写型表示装置100の外気温である。

【0070】

図8(a)に示すように、LED10の照度は、LED10の環境温度が上がるに従って低下する。例えば、LED10の環境温度が T_2 である場合には、LED10の照度は L_2 であり、LED10の環境温度が T_1 である場合には、LED10の照度は L_1 である。

【0071】

なお、目標照度が L_0 である場合を例に挙げると、LED10の照度が L_2 である場合には、LED10の環境温度を上げることによってLED10の照度を下げることが可能である。一方、LED10の照度が L_1 である場合には、LED10の環境温度を下げることによってLED10の照度を上げることが可能である。

【0072】

一方、図8(b)に示すように、冷却装置20に供給される電流(冷却装置20の消費電力)を増やすことによってLED10の環境温度が低下する割合(以下、環境温度低下割合)は、LED10の環境温度が外気温(T_a)に近づくに従って小さくなる。例えば、環境温度が T_3 である場合には環境温度低下割合が高いが、環境温度が T_4 である場合には環境温度低下割合が非常に低い。

【0073】

図8(a)及び図8(b)に示したように、LED10の環境温度が外気温(T_a)に近づくに従って環境温度低下割合が小さくなるため、冷却装置20に供給される電流(冷却装置20の消費電力)を増やしても、LED10の照度を上げることが難しくなる。すなわち、冷却装置電流制御効率は、LED10の環境温度が外気温(T_a)に近づくに従って小さくなる。

【0074】

次に、光源電流制御効率について図9を参照しながら説明する。なお、図9において、縦軸はLED10の照度であり、横軸はLED10に供給される電流である。

【0075】

図9に示すように、LED10の照度は、LED10に供給される電流(LED10の消費電力)が増えるに従って上昇する。例えば、LED10の照度が目標照度(L_0)である場合を例に挙げると、LED10に供給される電流は I_0 であるが、LED10に供給される電流を最大定格(I_{MAX})まで上げると、LED10の照度は L_{MAX} まで上昇する。

このように、LED10の消費電力が最大定格(I_{MAX})を超えない範囲内であれば、LED10の照度を上げることが可能である。

【0076】

図8及び図9を参照しながら説明したように、冷却装置電流制御効率は、外気温(T_a)

) と L E D 1 0 の環境温度との温度差によって制約を受け、光源電流制御効率、各 L E D 1 0 の最大定格によって制約を受ける。

【0077】

(投写型表示装置の動作)

以下において、本発明の第2実施形態に係る投写型表示装置の動作について、図面を参照しながら説明する。図10は、本発明の第2実施形態に係る投写型表示装置100の動作を示すフロー図である。なお、図10において、ステップ10～ステップ70の処理は、上述した図6と同様であるため、その説明については省略する。

【0078】

図10に示すように、ステップ110において、投写型表示装置100は、光源電流制御効率が冷却装置電流制御効率よりも高いか否かを判定する。また、投写型表示装置100は、光源電流制御効率が冷却装置電流制御効率よりも高い場合には、ステップ120の処理に移り、光源電流制御効率が冷却装置電流制御効率以下である場合には、ステップ40の処理に移る。

【0079】

なお、ステップ110は、ステップ30で検出照度が目標照度と一致しない L E D 1 0 があると判定された場合に行われる処理である。

【0080】

ステップ120において、投写型表示装置100は、 L E D 1 0 の照度を目標照度と一致させるために、 L E D 1 0 に供給すべき電流を見積もる。具体的には、投写型表示装置100は、照度センサ30によって検出された検出照度と記憶部91に記憶された目標照度との差分に基づいて、 L E D 1 0 に供給すべき電流を見積もる。

【0081】

ステップ130において、投写型表示装置100は、ステップ120で見積もられた電流（供給電流見積）が最大定格を超えるか否かを L E D 1 0 毎に判定する。また、投写型表示装置100は、供給電流見積が最大定格を超える L E D 1 0 がある場合には、ステップ40の処理に移り、供給電流見積が最大定格を超える L E D 1 0 がいない場合には、ステップ140の処理に移る。

【0082】

ステップ140において、投写型表示装置100は、各 L E D 1 0 の照度を目標照度と一致させるために、各 L E D 1 0 に供給すべき電流を個別に決定する。具体的には、投写型表示装置100は、検出温度と目標温度との差分に応じて、 L E D 1 0 に供給すべき電流を決定する。

【0083】

ステップ80aにおいて、投写型表示装置100は、ステップ60、ステップ70又はステップ130で決定された供給電流に従って、 L E D 1 0 又は冷却装置20を個別に制御する。

【0084】

なお、投写型表示装置100は、ステップ80の処理が終了すると、再びステップ10の処理に戻って、ステップ10～ステップ80をループ処理することによって、 L E D 1 0 の環境温度を最適化する。

【0085】

このように、投写型表示装置100がステップ10～ステップ80をループ処理することによって、 L E D 1 0 に供給する電流を増やすことに起因して L E D 1 0 の環境温度が増加しても、 L E D 1 0 の環境温度が最適化される。

【0086】

(作用及び効果)

本発明の第2実施形態に係る投写型表示装置100によれば、制御部92は、各冷却装置20に供給される電流だけでなく、 L E D 1 0 に供給される電流を制御する。また、制御部92は、複数の L E D 1 0 及び複数の冷却装置20の消費電力の合計が最大消費電

力（光源＋冷却装置）を超えない範囲内で、LED 10及び冷却装置20を制御する。従って、LED 10の環境温度が外気温（ T_a ）に近づいて冷却装置電流制御効率が低下する場合であっても、LED 10の照度を効率的に高めることができる。その結果、投写型表示装置100の消費電力の増加を抑制することができる。

【0087】

〔その他の実施形態〕

本発明は上述した実施形態によって説明したが、この開示の一部をなす論述及び図面は、この発明を限定するものであると理解すべきではない。この開示から当業者には様々な代替実施形態、実施例及び運用技術が明らかとなろう。

【0088】

例えば、上述した第1実施形態及び第2実施形態では、表示装置が投写型表示装置100であるものとして説明したが、これに限定されるものではない。具体的には、表示装置は、複数の光源を有する表示装置であればよく、LCDディスプレイ、プロジェクタ、リアプロジェクションテレビなどであってもよい。

【0089】

また、上述した第1実施形態及び第2実施形態では、光源の状態を検出する状態検出部が照度センサ30であるものとして説明したが、これに限定されるものではない。具体的には、状態検出部は、光源の環境温度を検出する温度センサであってもよい。

【0090】

なお、状態検出部が温度センサである場合には、制御部92は、光源の照度ではなくて、光源の環境温度を用いて、冷却装置20やLED 10に供給される電流を制御する。

【0091】

さらに、上述した第1実施形態及び第2実施形態では、光源がLED 10であるものとして説明したが、これに限定されるものではない。具体的には、光源が温度依存性を有していれば、本発明を適用可能であり、光源は、レーザダイオードなどであってもよい。

【0092】

また、上述した第1実施形態及び第2実施形態では、温度調節部がLED 10の環境温度を下げる冷却装置20であるものとして説明したが、これに限定されるものではない。例えば、温度調節部は、LED 10の環境温度を下げるとともに、LED 10の環境温度を上げることも可能な装置であってもよい。

【0093】

さらに、上述した第1実施形態及び第2実施形態では特に触れていないが、制御部92は、LED 10の経時劣化を考慮して、冷却装置20やLED 10に供給される電流を制御してもよい。

【0094】

また、上述した第2実施形態では、制御部92は、LED 10に供給される電流の見積（供給電流見積）が最大定格を超える場合には、LED 10に供給される電流を制御せずに、冷却装置20に供給される電流を制御するが、これに限定されるものではない。具体的には、制御部92は、供給電流見積が最大定格を超える場合であっても、最大定格内でLED 10に供給される電流を制御するとともに、冷却装置20に供給される電流を制御することによって、各LED 10の照度の向上を図ってもよい。

【図面の簡単な説明】

【0095】

【図1】本発明の第1実施形態に係る投写型表示装置100を示す図である（その1）。

【図2】本発明の第1実施形態に係る投写型表示装置100を示す図である（その2）。

【図3】本発明の第1実施形態に係る投写型表示装置100の機能ブロックを示す図である。

【図4】本発明の第1実施形態に係る照度制御の一例について説明するための図である（その1）。

【図5】本発明の第1実施形態に係る照度制御の一例について説明するための図である（

その２）。

【図6】本発明の第１実施形態に係る投写型表示装置１００の動作を示すフロー図である。

。

【図7】本発明の第２実施形態に係る投写型表示装置１００の機能ブロックを示す図である。

【図8】本発明の第２実施形態に係る照度制御の一例について説明するための図である（その１）。

【図9】本発明の第２実施形態に係る照度制御の一例について説明するための図である（その２）。

【図10】本発明の第２実施形態に係る投写型表示装置１００の動作を示すフロー図である。

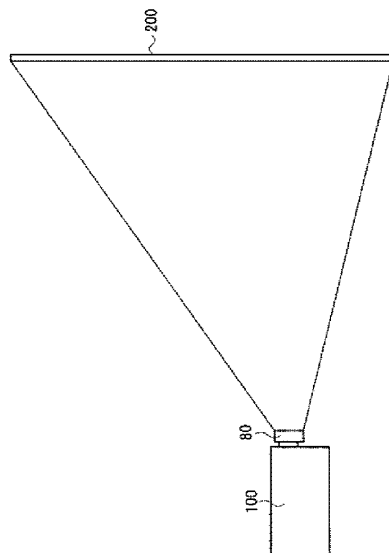
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【符号の説明】

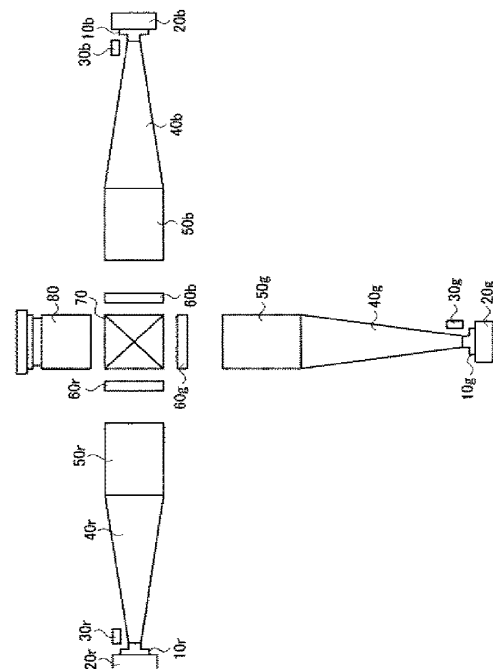
【0096】

LED 10、冷却装置 20、照度センサ 30、テーパロッド 40、導光部材 50、液晶パネル 60、ダイクロイックプリズム 70、投写レンズ 80、記憶部 91、制御部 92、投写型表示装置 100、スクリーン 200

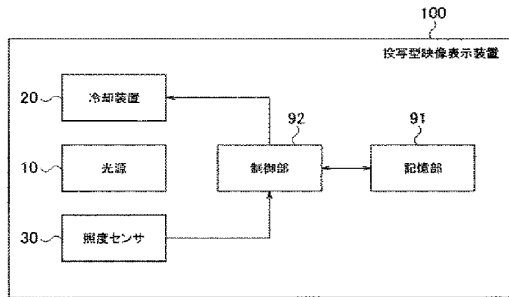
【図1】



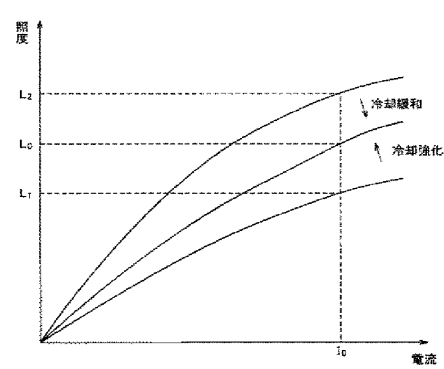
【図2】



【図3】



【図4】



【図5】

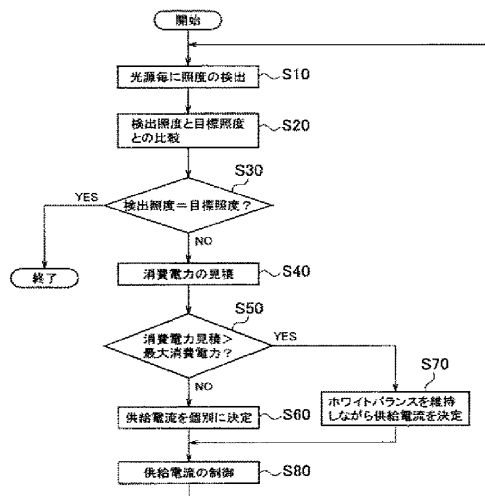
(a)

R	G	B
30	60	10

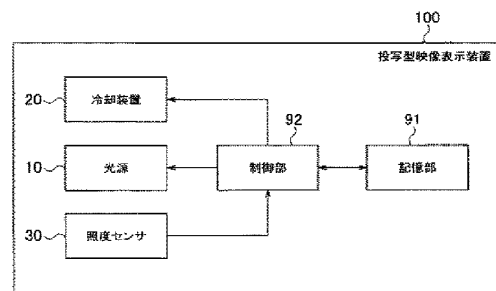
(b)

R	G	B
20	50	10

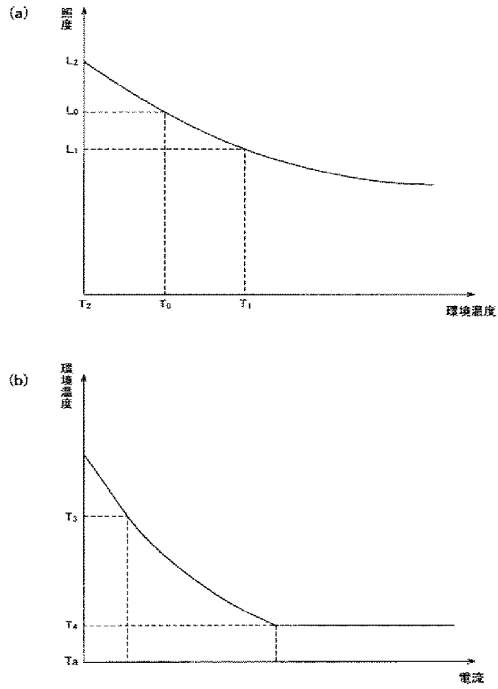
【図6】



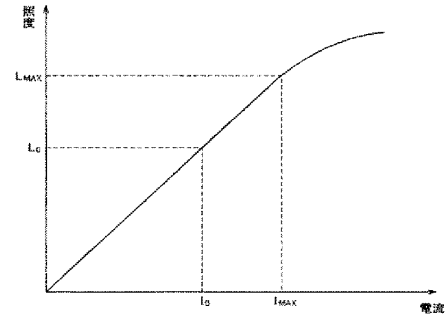
【図7】



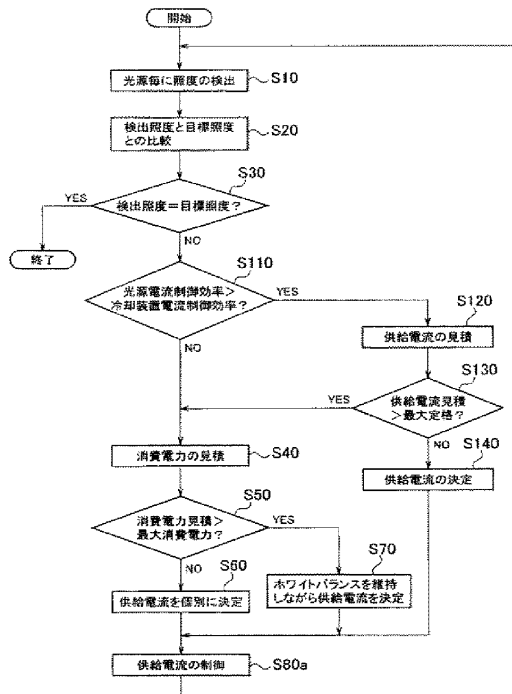
【図8】



【図9】



【図10】



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COOLING DEVICE OF HYBRID-TYPE

Inventor(s):

Applicant(s):

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- cooperative: F28D15/0233; F28D15/0266; F28D15/046; H01L23/427; F28F2210/02; F28F2245/02; H01L2924/0002 more

Application number: JP20040567181 20031028 [Global Dossier](#)

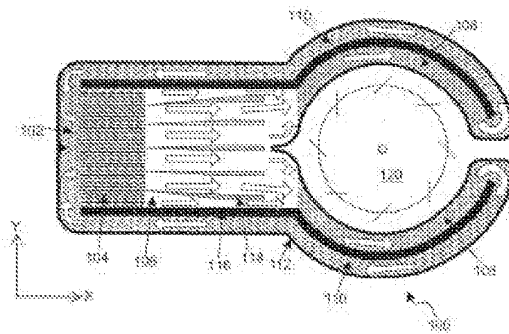
Priority number (s): [KR20030004932 20030124](#) ; [WO2003KR02282 20031028](#)

Also published as: [AU2003273116 \(A1\)](#) [CN100419355 \(C\)](#) [CN1759284 \(A\)](#) [EP1595099 \(A1\)](#) [EP1595099 \(A4\)](#) more

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The present invention provides a hybrid-type cooling device which can perform cooling by phase transition, ventilation and convection.



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D

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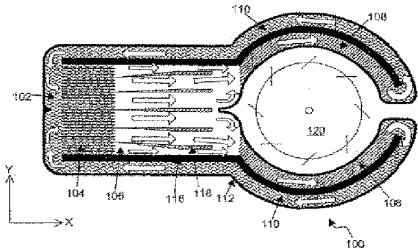
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最終頁に続く

(54) 【発明の名称】 ハイブリッド型の冷却装置

(57) 【要約】
【課題】 ハイブリッド型の冷却装置を提供する。
【解決手段】 相変化による冷却と、送風及び対流による冷却とが何れも可能なハイブリッド型の冷却装置である。



【特許請求の範囲】

【請求項1】

外部の熱源からの熱を冷却させるためのハイブリッド型の冷却装置において、
内部に相変化する冷媒の循環ループが形成されるが、その一側に分岐部を備える相変化冷却器と、

前記相変化冷却器の分岐部に設置されたファンと、を備えるが、

前記相変化冷却器は、

その内部の一端に形成されるが、前記液状の冷媒が毛細管現象によって少なくとも一部に充填され、充填された液状の冷媒が外部の熱源から伝えられた熱によって気化される蒸発部と、

前記蒸発部と隣接して形成されるが、気化された冷媒が前記分岐部に向って移動する気状冷媒移動部と、

前記分岐部の少なくとも一部の領域であって、前記気状冷媒移動部と隣接した領域に形成されるが、少なくとも二段に分岐され、前記気状の冷媒が液状に凝縮される凝縮部と、

前記分岐部の少なくとも一部の領域であって、前記凝縮部に隣接した領域に形成されるが、前記蒸発部と断熱され、液状に凝縮された冷媒が前記蒸発部に向って移動する液状冷媒移動部と、

前記蒸発部と前記液状冷媒移動部の少なくとも一部を断熱させる断熱部と、を備えることを特徴とするハイブリッド型の冷却装置。

【請求項2】

前記液状冷媒移動部の少なくとも一部は、前記液状の冷媒が保存される冷媒保存部であることを特徴とする請求項1に記載のハイブリッド型の冷却装置。

【請求項3】

前記気状冷媒移動部と前記液状冷媒移動部は、前記断熱部により互いに分離されたことを特徴とする請求項1に記載のハイブリッド型の冷却装置。

【請求項4】

前記液状冷媒移動部は、液状の冷媒と前記液状冷媒移動部の内壁との間の表面張力が重力より大きく設定された少なくとも一つの微細チャンネルを備えることを特徴とする請求項1に記載のハイブリッド型の冷却装置。

【請求項5】

前記気状冷媒移動部には、気状の冷媒を前記凝縮部に移動させるための複数のガイドを備えることを特徴とする請求項1に記載のハイブリッド型の冷却装置。

【請求項6】

前記相変化冷却器の外側において、前記凝縮部に対応する領域に形成された複数のフィンをも更に備えることを特徴とする請求項1に記載のハイブリッド型の冷却装置。

【請求項7】

前記複数のフィンのうち、少なくとも一部は、X-Y平面での断面が曲線状に形成されたことを特徴とする請求項6に記載のハイブリッド型の冷却装置。

【請求項8】

少なくとも一つの前記相変化冷却器をも更に備えるが、前記相変化冷却器の相互間に少なくとも前記蒸発部を共有することを特徴とする請求項1に記載のハイブリッド型の冷却装置。

【請求項9】

前記蒸発部の所定位置から上下に分岐が形成され、前記共有された蒸発部で気化された気体が、前記複数の相変化冷却器のそれぞれに分岐されて移動できる冷媒流路をも更に備えることを特徴とする請求項8に記載のハイブリッド型の冷却装置。

【請求項10】

前記気状冷媒移動部の所定位置から上下に分岐が形成され、前記共有された蒸発部で気化された気体が、前記複数の相変化冷却器のそれぞれに分岐されて移動できる冷媒流路を

更に備えることを特徴とする請求項8に記載のハイブリッド型の冷却装置。

【請求項11】

少なくとも一つの前記相変化冷却器を更に備えるが、前記相変化冷却器のそれぞれの蒸発部が熱的に接触したことを特徴とする請求項1に記載のハイブリッド型の冷却装置。

【請求項12】

前記分岐部の終端は、相互間に連結されて一つの閉環を形成することを特徴とする請求項1に記載のハイブリッド型の冷却装置。

【請求項13】

外部の熱源からの熱を冷却させるためのハイブリッド型の冷却装置において、
内部に相変化する冷媒の循環ループが形成されるが、その一側に少なくとも二段の分岐部が形成された相変化冷却器と、
前記相変化冷却器の分岐部に設置されたファンと、を備えるが、
前記相変化冷却器は、
その内部の前記分岐部に隣接した領域に形成されるが、前記液状の冷媒が毛細管現象によって少なくとも一部に充填され、充填された液状の冷媒が外部の熱源から伝えられた熱によって気化される蒸発部と、
前記蒸発部と隣接して形成されるが、気化された冷媒が前記分岐部の逆方向に向かって移動する気状冷媒移動部と、
前記分岐部に形成されるが、前記気状の冷媒が流入されて液状に凝縮される凝縮部と、
前記凝縮部に隣接して形成されるが、前記液状に凝縮された冷媒が前記蒸発部に向かって移動する液状冷媒移動部と、を備えることを特徴とするハイブリッド型の冷却装置。

【請求項14】

前記液状冷媒移動部の少なくとも一部は、前記液状の冷媒が保存される冷媒保存部であることを特徴とする請求項13に記載のハイブリッド型の冷却装置。

【請求項15】

前記液状冷媒移動部は、液状の冷媒と前記液状冷媒移動部の内壁との間の表面張力が重力より大きく設定された少なくとも一つの微細チャンネルを備えることを特徴とする請求項13に記載のハイブリッド型の冷却装置。

【請求項16】

前記気状冷媒移動部には、気状の冷媒を前記凝縮部に移動させるための複数のガイドを備えることを特徴とする請求項13に記載のハイブリッド型の冷却装置。

【請求項17】

前記相変化冷却器の外側において、前記凝縮部に対応する領域に形成された複数のフィンを更に備えることを特徴とする請求項13に記載のハイブリッド型の冷却装置。

【請求項18】

前記複数のフィンのうち、少なくとも一部は、X-Y平面での断面が曲線状に形成されたことを特徴とする請求項17に記載のハイブリッド型の冷却装置。

【請求項19】

少なくとも一つの前記相変化冷却器を更に備えるが、前記相変化冷却器の相互間に少なくとも前記蒸発部を共有することを特徴とする請求項13に記載のハイブリッド型の冷却装置。

【請求項20】

前記蒸発部の所定位置から上下に分岐が形成され、前記共有された蒸発部で気化された気体が、前記複数の相変化冷却器のそれぞれに分岐されて移動できる冷媒流路を更に備えることを特徴とする請求項19に記載のハイブリッド型の冷却装置。

【請求項21】

前記気状冷媒移動部の所定位置から上下に分岐が形成され、前記共有された蒸発部で気化された気体が、前記複数の相変化冷却器のそれぞれに分岐されて移動できる冷媒流路を更に備えることを特徴とする請求項19に記載のハイブリッド型の冷却装置。

【請求項22】

少なくとも一つの前記相変化冷却器を更に備えるが、前記相変化冷却器のそれぞれの蒸発部が熱的に接触したことを特徴とする請求項13に記載のハイブリッド型の冷却装置。

【請求項23】

前記分岐部の終端は、相互間に連結されて一つの閉環を形成することを特徴とする請求項13に記載のハイブリッド型の冷却装置。

【請求項24】

外部の熱源からの熱を冷却させるためのハイブリッド型の冷却装置において、

(イ) 内部に相変化する冷媒の循環ループが形成されるが、

(イー1) その内部の一端に形成されるが、前記液状の冷媒が毛細管現象によって少なくとも一部に充填され、充填された液状の冷媒が外部の熱源から伝えられた熱によって気化される蒸発部と、

(イー2) 前記蒸発部と隣接して形成されるが、気化された冷媒がその圧力差によって所定方向に移動する気状冷媒移動部と、

(イー3) 少なくとも前記気状冷媒移動部と隣接した領域であって、前記蒸発部の反対側に形成されるが、前記気状の冷媒が一側に流入されて凝縮され、凝縮された液状の冷媒が所定方向に移動して他端に流出され、中央に空間を有するように成形された分岐部と、

(イー4) 前記分岐部の他端と隣接して形成されるが、前記液状の冷媒が前記蒸発部に向って移動する液状冷媒移動部と、

(イー5) 前記蒸発部と前記液状冷媒移動部の少なくとも一部を断熱させる断熱部と、を備える相変化冷却器と、

(ロ) 前記相変化冷却器の前記分岐部の中央空間に設置されたファンを備えることを特徴とするハイブリッド型の冷却装置。

【請求項25】

外部の熱源からの熱を冷却させるためのハイブリッド型の冷却装置において、

(イ) 内部に相変化する冷媒の循環ループが形成されるが、

(イー1) その内部の一端に形成されるが、前記液状の冷媒が毛細管現象によって少なくとも一部に充填され、充填された液状の冷媒が外部の熱源から伝えられた熱によって気化される蒸発部と、

(イー2) 前記蒸発部と隣接して形成されるが、気化された冷媒がその圧力差によって所定方向に移動する気状冷媒移動部と、

(イー3) 前記蒸発部と隣接した領域であって、前記気状冷媒移動部の反対側に形成されるが、前記気状の冷媒が一側に流入されて凝縮され、凝縮された液状の冷媒が所定方向に移動して、前記蒸発部に流出されて中央に空間を有する分岐部と、を備える相変化冷却器と、

(ロ) 前記相変化冷却器の前記分岐部の中空に設置されたファンを備えることを特徴とするハイブリッド型の冷却装置。

【請求項26】

外部の熱源からの熱を冷却させるためのハイブリッド型の冷却装置において、

それぞれの一端が所定角度に曲がるように成形されて、設置時に中央に空間を有する分岐部を構成する一対のヒートパイプと、

前記一対のヒートパイプの曲がった部分が形成する分岐部の中央空間に設置されたファンと、を備えることを特徴とするハイブリッド型の冷却装置。

【請求項27】

外部の熱源からの熱を冷却させるためのハイブリッド型の冷却装置において、

それぞれの一端が所定角度に曲がるように成形されて、設置時に中央に空間を有する分岐部を構成する一対の相変化冷却器と、

前記一対の相変化冷却器が構成する分岐部の中央空間に設置されたファンと、を備えるが、

前記一対の相変化冷却器のそれぞれは、

その内部に相変化する冷媒の循環ループが形成されるが、

(イー１) その内部の一端に形成されるが、前記液状の冷媒が毛細管現象によって少なくとも一部に充填され、充填された液状の冷媒が外部の熱源から伝えられた熱によって気化される蒸発部と、

(イー２) 前記蒸発部と隣接して形成されるが、気化された冷媒が前記分岐部に向って移動する気状冷媒移動部と、

(イー３) 少なくとも前記気状冷媒移動部と隣接して形成されるが、前記分岐部の少なくとも一部を形成するように成形され、前記気状の冷媒が一侧に流入されて凝縮される凝縮部と、

(イー４) 前記凝縮部と隣接して形成されるが、前記分岐部の少なくとも一部を形成するように成形され、前記液状の冷媒が前記蒸発部に向って移動する液状冷媒移動部と、

(イー５) 前記蒸発部と前記液状冷媒移動部の少なくとも一部を断熱させる断熱部と、を備えることを特徴とするハイブリッド型の冷却装置。

【請求項28】

外部の熱源からの熱を冷却させるためのハイブリッド型の冷却装置において、

それぞれの一端が所定角度に曲がるように成形され、設置時に中央に空間を有する分岐部を構成する一対の相変化冷却器と、

前記一対の相変化冷却器が構成する分岐部の中央空間に設置されたファンと、を備えるが、

前記一対の相変化冷却器のそれぞれは、

その内部に相変化する冷媒の循環ループが形成されるが、

(イー１) その内部の一端に形成されるが、前記液状の冷媒が毛細管現象によって少なくとも一部に充填され、充填された液状の冷媒が外部の熱源から伝えられた熱によって気化される蒸発部と、

(イー２) 前記蒸発部と隣接して形成されるが、気化された冷媒が前記分岐部の逆方向に向って移動する気状冷媒移動部と、

(イー３) 前記分岐部に隣接した領域に形成されるが、前記分岐部の少なくとも一部を形成するように成形され、前記気状の冷媒が一侧に流入されて凝縮される凝縮部と、

(イー４) 前記凝縮部と隣接して形成されるが、前記分岐部の少なくとも一部を形成するように成形され、前記液状の冷媒が前記蒸発部に向って移動する液状冷媒移動部と、を備えることを特徴とするハイブリッド型の冷却装置。

【発明の詳細な説明】

【技術分野】

【0001】

本発明は、半導体集積回路装置などの熱を冷却するための冷却装置に係り、特に、作動流体の相変化による冷却方式とフィン及び／またはファンによる冷却方式を併用するハイブリッド型（または、混合型）の冷却装置に関する。

【背景技術】

【0002】

半導体素子の高集積化の傾向により、デザインルールが減少し、それにより、半導体素子を構成する電子回路の線幅が狭くなることにより、単位面積当りのトランジスタ数が増加して、電子装備の小型化、高性能化を達成したが、それに伴って半導体素子の単位面積当りの熱発散率が更に上昇した。このような熱発散率の増加は、半導体素子の性能の低下及び寿命の短縮をもたらす。窮極的には、半導体素子を採用したシステムの信頼度を低下させる。特に、半導体素子においては、その動作温度によって各種パラメータ値が鋭敏に変化して、集積回路の特性を更に劣化させる。

【0003】

このような熱発散率の上昇に対応して、これを冷却するための冷却技術も発展してきたが、公知の通常的な冷却技術としては、フィンファン冷却方式、熱電素子冷却方式、液体噴射冷却方式、浸水冷却方式、ヒートパイプ冷却方式などがある。

【0004】

前記フィンファン冷却方式は、フィン及び／またはファンを利用して強制冷却させる

方法であり、数十年間多く利用されてきたが、ノイズ、振動及び大きい体積に比べて冷却効率が低いという問題点がある。また、前記熱電素子冷却方式は、ノイズ、振動はないが、大きい駆動電源が要求されて、エネルギー保存法則により高熱側で必要以上の過多の熱消散装置が要求されるという問題点がある。また、前記液体噴射冷却方式は、効率性に優れており、冷却器の研究の主流になっているが、外部電源を利用する薄膜ポンプなどを使用して、その構造が複雑であり、重力の影響を多く受け、個人携帯電子装置に適用する場合、ロバスト設計が難しいという問題がある。

【0005】

前記のような問題点により、最近では、ヒートパイプ冷却方式は、構造が簡単であり、製作が容易であるという長所があり、前記フィンファン冷却装置と共に小型冷却装置として多様な形状で広く適用されている。すなわち、図1に示すように、通常のヒートパイプとフィンファンとを結合した冷却装置10は、その一端が熱源20と接触したヒートパイプ12と、前記ヒートパイプ12の他端に設置された複数のフィン14と、前記フィン14の近傍に設置されたファン16とを備えて、熱源20から吸収された熱を前記フィン14によって放出する構造を有する。

【0006】

しかし、前記のようなヒートパイプを使用する冷却装置10では、気体及び液体の流動方向が互いに逆であるため、高熱量がヒートパイプに印加される場合、発生する気体の速い流速により、凝縮部から蒸発部に帰還する液体が気体移動部に再び吸い込まれて、結局、蒸発部まで帰還できず、これによりドライアウトが発生する。また、パイプの内部で気化された冷媒は、浮力と圧力との差に依存して移動し、ヒートパイプの内部では、液化された冷媒が帰還部の媒質の構造及びサイズによって重力に依存するため、設置可能な位置に多くの制限があるという問題点がある。

【0007】

更に、最近の中央処理処置のような高集積化された半導体素子は、その発熱量が、従来の冷却装置では処理しがたい程度の多量であり、前記ヒートパイプとフィンファンとを結合した構造の冷却装置10においても、三つまたは四つに達するヒートパイプ12と、二つまたはそれ以上のファン16とを備えねば冷却が不可能な実情である。このように、構成要素の個数が増加すれば、そのサイズが非常に大きくなり、また、いくつかのファン16によるノイズ及び電力消費も飛躍的に増加して、結局、実用性を失うという問題点がある。このような既存のヒートパイプ冷却モジュールの短所は、流体の相変化を利用するとしても、結局は、広い面積のフィンを通じて熱を伝導させねばならないため、フィン自体での熱伝達損失が、ヒートパイプの相変化媒質での熱伝達に比べて急減するためである。

【発明の開示】

【発明が解決しようとする課題】

【0008】

本発明は、前記の問題点を解決するためになされたものであって、本発明の目的は、相変化時の潜熱による冷却と、送風及び対流による冷却とを併行する小型のハイブリッド型の冷却装置を提供するところにある。

【0009】

また、本発明の他の目的は、フィンとフィンとの間にハイブリッド型の冷却装置を配置して、フィンを通じて熱伝導の損失を最小化し、冷却性能を向上させた小型のハイブリッド冷却装置を提供するところにある。

【0010】

また、本発明の更に他の目的は、重力の影響に関係なく冷却性能を発揮できる小型のハイブリッド型の冷却装置を提供するところにある。

【0011】

また、本発明の更に他の目的は、設置位置や場所に実質的な制限がない小型のハイブリッド型の冷却装置を提供するところにある。

【課題を解決するための手段】

【0012】

前記目的を達成するために、本発明は、外部の熱源からの熱を冷却させるためのハイブリッド型の冷却装置において、内部に相変化する冷媒の循環ループが形成されるが、その一側に分岐部を備える相変化冷却器と、前記相変化冷却器の分岐部に設置されたファンとを備えるが、前記相変化冷却器は、その内部の一端に形成されるが、前記液状の冷媒が毛細管現象によって少なくとも一部に充填され、充填された液状の冷媒が外部の熱源から伝えられた熱によって気化される蒸発部と、前記蒸発部と隣接して形成されるが、気化された冷媒が前記分岐部に向って移動する気状冷媒移動部と、前記分岐部の少なくとも一部の領域であって、前記気状冷媒移動部と隣接した領域に形成されるが、少なくとも二段に分岐され、前記気状の冷媒が液状に凝縮される凝縮部と、前記分岐部の少なくとも一部の領域であって、前記凝縮部に隣接した領域に形成されるが、前記蒸発部と断熱され、液状に凝縮された冷媒が前記蒸発部に向って移動する液状冷媒移動部と、前記蒸発部と前記液状冷媒移動部の少なくとも一部を断熱させる断熱部と、を備えるハイブリッド型の冷却装置を提供する。

【発明を実施するための最良の形態】

【0013】

以下、添付図面を参照して本発明の好ましい実施形態について詳細に説明する。

【0014】

まず、図2を参照すれば、図2は、本発明の第1実施形態によるハイブリッド型の冷却装置の平断面図である。図示するように、本実施形態によるハイブリッド型の冷却装置100は、その内部に相変化する冷媒の循環ループが形成されるが、その循環ループの少なくとも一部は、中空の環状に分岐された部分（以下、“分岐部”）より構成される相変化冷却器112と、前記相変化冷却器の分岐部の中空に設置されたファン120と、を備える。

【0015】

前記相変化冷却器112のハウジングは、シリコンやガリウムのような半導体物質、自己結集単層膜（Self Assembled Monolayer；SAM）のような新素材積層物質、熱伝導率に優れた銅またはアルミニウムのような金属物質及び／またはそれらの合金物質、セラミック物質、プラスチックのような高分子物質や、ダイヤモンドのような結晶質材料などの多様な素材で製造されうる。特に、外部熱源が半導体チップである場合、外部熱源の表面物質と同じ物質より形成して、接触熱抵抗を最小化できる。また、前記相変化冷却器112が半導体物質で製造される場合には、半導体チップの製造工程で、前記外部熱源の表面物質と一体になるように形成することも可能である。

【0016】

次いで、前記相変化冷却器112内に注入される冷媒は、外部の熱により液状と気状との相変化を発生させ得るものから選択されうる。本実施形態によれば、前記冷媒として、潜熱及び表面張力の大きい水を使用することが好ましいが、これは、環境汚染を考慮して、フロン（CFC）系列の冷媒を使用しないことが好ましいためである。

【0017】

また、前記相変化冷却器112の材質により、その内壁と冷媒との間の表面張力のサイズが変わるため、本発明の実施においては、これに適した冷媒を選択せねばならない。例えば、水以外にも、メタノールまたはエタノールなどのアルコール系の冷媒を使用することも可能である。前記のような水やアルコール系の冷媒の場合、熱容量が大きく、半導体物質の内壁との間の表面張力による接触角が小さいため、冷媒の流速が大きくなって、多量の熱を伝達するのに有利であるという長所を有する。また、水またはアルコール系の冷媒の場合には、フロン系の冷媒と違って、ある理由によって前記相変化冷却器112から漏れても、環境汚染の問題が発生しない。

【0018】

このような冷媒の選択は、本発明の実施のための単純な設計的な選択事項に過ぎないた

め、本発明の技術的範囲を限定するものではない。

【0019】

図示するように、前記相変化冷却器112は、その内部の一端に形成されるが、前記液状の冷媒が毛細管現象によって少なくとも一部に充填され、充填された液状の冷媒が外部の熱源（図示せず）から伝えられた熱によって気化される蒸発部104と、前記蒸発部104と隣接して形成されるが、気化された冷媒が、その圧力差によって所定方向に移動する気状冷媒移動部106と、前記気状冷媒移動部106と隣接して形成されるが、二段に分岐され、前記気状の冷媒が液状に凝縮される凝縮部108と、前記凝縮部108に隣接して形成されるが、前記蒸発部104と断熱され、液状に凝縮された冷媒が前記蒸発部104に向って移動する液状冷媒移動部102、110と、を備える。本実施形態では、前記凝縮部108及び液状冷媒移動部110が前記分岐部を構成する。

【0020】

前記相変化冷却器112内で、前記冷媒は、図面の矢印方向に沿って循環ループを形成する。すなわち、前記蒸発部104、前記気状冷媒移動部106、前記凝縮部108、前記凝縮部側の液状冷媒移動部110及び前記蒸発部側の液状冷媒移動部102を順に通って循環されるように構成されている。

【0021】

本発明の実施形態によっては、前記液状冷媒移動部102、110の所定領域に一定量の液状の冷媒が保存されるように、適当な体積を有する冷媒保存部（図示せず）を更に備える。例えば、前記蒸発部側の液状冷媒移動部102の領域が冷媒保存部として形成されて使用される。

【0022】

前記蒸発部側の液状冷媒移動部102の一端（“出口側”）には前記蒸発部104が隣接して形成され、前記蒸発部104は、複数の微細チャンネルが形成されて、毛細管現象によって前記微細チャンネルの少なくとも一部または全部に、前記蒸発部側の液状冷媒移動部102に保存された冷媒が充填される。また、前記蒸発部104は、外部の熱源（図示せず）に隣接するように設置されるが、それにより、前記熱源から伝えられた熱により、前記微細チャンネルに充填された液状の冷媒が気化されて、気状の冷媒に相変化される。従って、前記熱源からの熱は、前記冷媒の相変化による潜熱ほど前記冷媒に吸収され、後述するように、気状の冷媒を再び凝縮させることにより前記熱源の熱を除去する。

【0023】

前記微細チャンネル内での表面張力は、重力より大きく形成されることが好ましい。前記微細チャンネルに充填された液状である冷媒のメニスカスの接触角は小さいほど好ましいが、このためには、前記微細チャンネルの内壁を親水性を有する物質より形成するか、または親水性の処理を実施することが好ましい。このような親水性処理としては、例えば、メッキ処理、塗装処理、コーティング処理、着色処理、アノダイジング処理、プラズマ処理、レーザー処理などがある。また、その熱伝達率を向上させるために前記微細チャンネルの内壁の表面粗度を調節できるが、約1Åないし約100Å程度の表面粗度を有することが好ましい。

【0024】

更に、前記微細チャンネルの断面は、四角形以外にも、円形、楕円形、直方形、正方形、多角形などの多様な形態を有するように形成することもできる。特に、前記微細チャンネルの長手方向（すなわち、X軸方向）に沿って断面積を増加または減少させることにより、冷媒との間の表面張力のサイズを制御でき、その内壁に複数のグルーブまたはノードを設置して、冷媒の移動方向を決定するか、または冷媒の移動速度を制御することも可能である。

【0025】

次いで、前記蒸発部104で気化された冷媒は、前記蒸発部側の液状冷媒移動部102の逆方向に移動するが、このように、気状の冷媒が移動できる通路の役割を行う気状冷媒移動部106を前記蒸発部104に隣接して形成する。図示するように、前記気状冷媒移

動部106は、気化された冷媒が所定の方向（すなわち、前記冷媒保存部102の逆方向）に移動できるように、複数のガイド118を備えうる。前記ガイド118は、前記相変化冷却器112の機械的な強度を上昇させる機能も有する。従って、機械的な強度に問題がない場合には、前記ガイド118を備えなくても良い。

【0026】

次いで、前記凝縮部108は、前記気状冷媒移動部106を介して移動してきた気状の冷媒が、再び凝縮されて液化される領域である。本実施形態によれば、前記凝縮部108は、前記蒸発部104と同じ平面上で、所定距離離れた位置に二段に分岐された環状に形成されている。図示するように、前記凝縮部108を前記分岐部に配置して二段に分岐させることにより、その間にファン120を設置することができる。設置された前記ファン120を回転させて前記凝縮部108の外気を所定方向に送風させれば、前記凝縮部108に到達した気状の冷媒が有する熱を容易に外部に放出させることができ、従って、冷媒は、凝縮されて液化される。

【0027】

本実施形態では、前記凝縮部108が形成された領域を二段に分岐させて全体的に環状に形成したが、分岐部のそれぞれを直線状に形成するか、または“ㄣ”字状に形成して、全体的にひし形に形成することも出来る（図13を参照）。このように形成された分岐部の間に前記ファン120を設置することにより、熱放出効率を向上させ得る構造を達成できる。

【0028】

一方、前記凝縮部108は、前記蒸発部104に形成された微細チャンネルと類似した複数の微細チャンネル（図示せず）を備えうる。このような凝縮部108の微細チャンネルは、後述するように、前記液状冷媒移動部110にも延びて形成され、更に、前記蒸発部側の液状冷媒移動部102にも延びて形成されうる。このような凝縮部108の微細チャンネルは、気状冷媒の凝縮を更に容易にし、凝縮された液状の冷媒が前記蒸発部側の液状冷媒移動部102の方向に移動させる表面張力を提供することにより、冷媒循環ループの完成を促進する。

【0029】

前記凝縮部108の微細チャンネルの深さは、前記蒸発部104の微細チャンネルより深く形成されることが好ましいが、これに限定されるものではない。その外にも、断面の形状や、断面積の変化、グループやノードの形成などに関して、前記蒸発部104の微細チャンネルに関するあらゆる事項が、前記凝縮部108の微細チャンネルにも同一に適用されうるため、その詳細な説明を省略する。

【0030】

また、熱放出の効果を更に向上させるために、前記凝縮部108の外部の相変化冷却器112に複数のフィン形成することもできる（図4ないし図6を参照）。前記フィンは、前記凝縮部108の外部に放射状に形成されるか、または、その他の所定の形状に形成されうる。このようなフィンの中に、前記ファン120によって送風される周りの空気が接触することにより、放熱効果を極大化させうる。また、後述するように、本発明の実施形態によっては、複数の相変化冷却器112を積層して使用することもできるが、この場合には、積層された相変化冷却器112の間にフィンを配置して、フィン内部での温度分布を均一にすることにより、冷却性能を更に向上させうる。

【0031】

更に、前記フィンがマイクロアクチュエータを備えるように形成される場合には、前記凝縮部108から外部に放出される熱を再活用して、周りの空気を循環させるように駆動させることもできる。また、前記フィンが熱電素子を備える微細構造に形成された場合には、前記凝縮部108から放出される熱を電氣的エネルギーに変換させて、微細駆動のためのエネルギーとして使用することもできる。

【0032】

更に、前記凝縮部108の体積を前記蒸発部104の体積より大きく形成することによ

り、広くなる表面的による追加的凝縮効果を達成することもできる。

【0033】

次いで、前記液状冷媒移動部110は、前記凝縮部108の外周側に形成されて、前記凝縮部108で凝縮された液状の冷媒が、前記蒸発部側の液状冷媒移動部102に移動する通路を形成する。図示するように、前記液状冷媒移動部110は、前記断熱部116によって前記気状冷媒移動部106、前記凝縮部108及び蒸発部104から断熱されて区分される。

【0034】

前記断熱部116は、前記相変化冷却器112内の所定位置に形成された内部隔壁の形態に構成するか、または、前記相変化冷却器112内の所定位置に密封された別途の内部空間の形態、または前記相変化冷却器112の上下を貫通するように開放されている形態に構成される。前記相変化冷却器112内に密封された内部空間の形態に形成される場合、前記断熱部116は、真空状態を維持するか、または空気などの断熱物質で満たされることもある。

【0035】

図示するように、前記液状冷媒移動部110は、前記相変化冷却器112の両側外周に沿って対称されるように形成することが好ましい。このような相変化冷却器112の外周に沿って対称的に形成される冷媒循環ループは、薄板の形態、すなわち、断面の縦横比の大きい場合、周りへの熱放出に非常に有利な構造であって、熱源から伝えられた熱を放射方向に拡散させることにより、広い面積を活用して周りへ放出させうる。

【0036】

また、このような両方向の冷媒循環ループは、前記冷却装置100の設置位置により重力の影響を受けて、何れか一方の液状冷媒移動部110での冷媒循環が円滑でない場合にも、他方の液状冷媒移動部110を介して冷媒を循環させうるといふ長所を有する。

【0037】

もちろん、前記のように、前記液状冷媒移動部110も、重力の影響をほとんど受けなため微細チャンネルを備えることができ、その微細チャンネル内には、前記冷媒保存部102に向う方向に複数のグループ（図示せず）を形成するなどの方法を使用できる。

【0038】

一方、前記蒸発部側の液状冷媒移動部102と前記液状冷媒移動部110との境界部分、及び前記凝縮部108と前記液状冷媒移動部110との境界部分に、液状冷媒の移動方向を規定するための複数のガイド（図示せず）を形成して、冷媒の流路が急激に旋回することにより発生する冷媒循環の抵抗を減少させることも可能である。

【0039】

以下、図3を参照すれば、図3は、図2のハイブリッド型の冷却装置100の分解斜視図である。図示するように、前記相変化冷却器112は、基板112a及び上板112bを備える。前記基板112a上に、図2を参照して前記の構造を後述する方法で形成し、外形が同じく形成された上板112bを接着させることが好ましい。実施形態によっては、上板112bの内部にも前記基板112aと同じ構造を形成できるということも言うまでもない。

【0040】

以下では、図4ないし図6を参照して本発明の他の実施形態に関して詳細に説明する。

【0041】

まず、図4Aは、本発明の第2実施形態によるハイブリッド型の冷却装置200の斜視図であり、図4Bは、図4Aのハイブリッド型の冷却装置200の凝縮部部分の拡大斜視図である。図示するように、本実施形態では、複数の相変化冷却器100a、100b及び100cが、上下複数層に配列される。外部の熱源からの熱は、例えば、図面の太い矢印の方向にそれぞれの相変化冷却器100a、100b及び100cの蒸発部に該当する領域に伝えられる。このために、前記相変化冷却器100a、100b及び100cの間に熱伝達物質を充填させることもできる。

【0042】

また、本実施形態では、各相変化冷却器100a、100b及び100cの凝縮部に対応する外側に、放射状に複数のフィン202を形成し、その中央空間にファン120が配置される。これにより、既存のヒートパイプモジュールとは違って、フィン内部での温度分布を均一に維持して冷却性能を極大化させる。このような複数層構造のハイブリッド型の冷却装置200により、外部熱源の冷却効率を飛躍的に向上させる。

【0043】

次いで、図5Aは、本発明の第3実施形態によるハイブリッド型の冷却装置220の斜視図であり、図5Bは、図5Aのハイブリッド型の冷却装置220の側面図である。図示するように、本実施形態による冷却装置220は、図4Aに示す実施形態の相変化冷却器100a、100b及び100c等の冷媒保存部及び蒸発部を備える部分を相互接合させて形成したものである。凝縮部を備える部分は、ファン120による送風の効果を極大化させるために、接合せずに分離させ、最下層及び中間層の相変化冷却器の側面構造は、それにより多少変形された。

【0044】

一方、本実施形態において、前記三層の相変化冷却器のそれぞれに属する蒸発部側の液状冷媒移動部及び蒸発部が相互独立的に形成される代わりに、相互共有されることも可能である。この場合には、蒸発部または気状冷媒移動部の所定位置から上下に分岐が形成される構造に形成される。蒸発部が共有される場合、蒸発部と気体移動部との間に各層の相変化冷却器に通じる流路（図示せず）が形成されて、蒸発部で気化された気体が各層に分岐されて移動する。

【0045】

次いで、図6Aは、本発明の第4実施形態によるハイブリッド型の冷却装置230の斜視図であり、図6Bは、図6Aのハイブリッド型の冷却装置230の側面図である。本実施形態では、図5Aに示す実施形態でのフィンのサイズを、最上層及び最下層の相変化冷却器の外側を外れないように調整した。このようにすることにより、冷却装置230の設置が容易になる。

【0046】

以上で説明した本発明の各実施形態のハイブリッド型の冷却装置を製作する方法は、現在公知された方法により製作されるが、例えば、既に公知されたMIM（Metal Injection Molding）法や、半導体素子の製造工程を応用したMEMS（Micro Electro Mechanical System）法や、SAM（Self Assembled Monolayer）法を応用して製作できる。

【0047】

前記MIM方法によって製作する場合には、まず、前記相変化冷却器112の形状の陰刻された上下モールドを形成し、このモールドにそれぞれバインダとしてポリマーや金属粉末が混ざった溶融体をモールドに注入して成形し、成形物をモールドから分離させた後、溶剤及び熱処理でバインダを除去して、最終的に上下板をブレージングなどの金属接合技術を使用して接合する。

【0048】

あるいは、図2及び図3を参照して、半導体物質で製造する場合の具体的な製作方法の例を簡単に説明すれば、まず、相変化冷却器112の基板112aの表面をエッチングして蒸発部104及びその微細チャンネル、気状冷媒移動部106、凝縮部108及び液状冷媒移動部102、110などを形成する。その後、前記基板112aに対応して一定のパターンの形状が形成された上板112bを形成し、これらを互いに接着する。これらの接着方法の例としては、両者を相互接触させた後、両者に電圧を印加して陰極ボンディングを行える。次いで、前記蒸発部側の液状冷媒移動部102に隣接した相変化冷却器112の所定位置に形成された冷媒注入孔（図示せず）を通じて、真空状態で所定量の冷媒を注入し、前記冷媒注入孔を密封する。

【0049】

次いで、図7を参照すれば、図7は、本発明の第5実施形態に係るハイブリッド型の冷却装置700の平面断面図である。図示するように、本実施形態による冷却装置700の相変化冷却器712は、その分岐部の終端（点線で表示された部分）が相互連結されて、全体的に一つの閉環形状に形成されている。この場合にも、前記冷媒の循環ループは、図2を参照して前記の通りであり、その冷却原理及び効果も同じである。従って、それらの詳細に関しては、これを省略する。

【0050】

図7では、本実施形態の相変化冷却器712が、前記第1実施形態による相変化冷却器112に含まれたガイド118を備えていないと図示されているが、前記ガイド118は、その設計上の選択によって備えられてもよく、備えられていなくてもよいことは前記の通りである。

【0051】

次いで、図8を参照すれば、図8は、本発明の第6実施形態によるハイブリッド型の冷却装置800の平面断面図である。図示するように、本実施形態による冷却装置800において、外部熱源（図示せず）からの熱を吸収して、液状の冷媒を気化させる蒸発部104が相変化冷却器812の中央の付近に形成されて、分岐部に隣接するように配置されている。

【0052】

本実施形態によれば、気状の冷媒を凝縮させて液化させる凝縮部108と、凝縮されて液化された冷媒が、再び前記蒸発部104に向って移動する液状冷媒移動部110とが前記分岐部を構成する。それにより、前記蒸発部104が、前記気状冷媒移動部106と前記分岐部との間に配置される。このような構造により、前記蒸発部104から気化された冷媒は、前記分岐部の反対側に移動し、次いで、ハウジングの外周に沿って前記分岐部まで到達する。前記分岐部の中空にはファン120が設置されて、周りの空気を循環させ、従って、分岐部に到達した気状の冷媒は、凝縮されて液化される。従って、本実施形態では、図示するように、気状冷媒が凝縮される凝縮部108が前記分岐部の外周側に形成される。

【0053】

特に、図示するように、本実施形態においては、前記蒸発部104と前記液状冷媒移動部110とを断熱させる断熱部を別途に形成せずとも、冷媒の循環には問題ない。すなわち、前記気状冷媒移動部106から流出された気状の冷媒は、結局、分岐部の分岐部に到達し、ここで、前記ファン120によって循環される空気により熱を奪われて凝縮される。

【0054】

次いで、液化された冷媒は、前記分岐部の外周に形成された凝縮部108及びその内周に形成された液状冷媒移動部110に沿って移動して、再び前記蒸発部104に帰還する。前記凝縮部108及び液状冷媒移動部110は、隔壁810によって区分されている。前記隔壁810は、設計上の選択によって断熱部の役割も行える。

【0055】

前記蒸発部104の分岐部側には、前記ファン120によって循環される周りの空気が持続的に接触するため、外部の熱源自体を直接冷却させる効果も達成される。

【0056】

本実施形態においても、前記分岐部の終端を相互間に連結する構造を有しうることには言うまでもない。また、本実施形態の相変化冷却器812にも、前記第1実施形態による相変化冷却器112の気状冷媒移動部106に備えられたガイド118が備えられていないと図示されているが、その設計上の選択により前記ガイド118を備えてもよく、備えなくてもよい。

【0057】

次いで、図9を参照すれば、図9は、本発明の第7実施形態によるハイブリッド型の冷却装置の平面断面図である。図示するように、本実施形態による冷却装置900の相変化冷

却器 9 1 2 は、分岐部が閉鎖された環状に形成されるが、その内部の冷媒が対称的に形成された循環ループを循環する代わりに、非対称的に一方向のみに循環する構造を有する。

【0058】

すなわち、前記相変化冷却器 9 1 2 は、その内部の一端に形成された蒸発部 1 0 4 と、前記蒸発部 1 0 4 で気化された冷媒が所定方向に移動する気状冷媒移動部 1 0 6 と、前記気状の冷媒が一側に流入されて凝縮され、凝縮された液状の冷媒が所定方向に移動して他端に流出される部分であって、中央に空間を有する環状の分岐部 1 0 8 と、前記分岐部 1 0 8 の他端と隣接して形成されるが、前記液状の冷媒が前記蒸発部 1 0 4 に向って移動し続ける液状冷媒移動部 1 0 2 と、を備える。前記蒸発部 1 0 4 と気状冷媒移動部 1 0 6 は、隔壁 1 1 6 によって前記液状冷媒移動部 1 0 2 から分離されている。前記隔壁 1 1 6 は、断熱機能を有する断熱部として形成しても良い。

【0059】

本実施形態によれば、前記冷媒の循環ループが非対称型であるという点と、外部熱源からの熱を前記蒸発部 1 0 4 の領域に吸収させるために、前記熱源がハウジングの中心部から多少外れて蒸発部の下部に配置されるという点とを除いては、前記第 1 実施形態の冷却装置 1 0 0 についての前記のあらゆる説明が同じく適用されるため、その詳細な説明を省略する。

【0060】

次いで、図 1 0 を参照すれば、図 1 0 は、本発明の第 8 実施形態によるハイブリッド型の冷却装置の平衡面図である。図示するように、本実施形態による冷却装置 1 0 0 0 の相変化冷却器 1 0 1 2 は、第 7 実施形態による相変化冷却器 9 1 2 の冷媒循環ループと逆方向の冷媒循環ループを有する。

【0061】

すなわち、冷媒を気化させる蒸発部 1 0 4 を分岐部に隣接した領域に形成し、気化された冷媒が前記分岐部 1 0 8 の逆方向に移動するように形成することで、気化された冷媒は、気状冷媒移動部 1 0 6 を通って前記分岐部 1 0 8 の一側に流入される。流入された冷媒は、前記分岐部 1 0 8 の中空に形成されたファン 1 2 0 による空気の循環によって凝縮されて液化される。液化された冷媒は、前記分岐部 1 0 8 を通って再び前記蒸発部 1 0 4 に流入される。

【0062】

本実施形態の場合にも、図 8 を参照して前記したように、前記蒸発部 1 0 4 が前記ファン 1 2 0 に近くに配置されるため、前記ファン 1 2 0 によって循環される周辺空気が、外部熱源自体を冷却させる効果も達成できる。また、前記外部熱源は、前記蒸発部 1 0 4 の下部に配置されることが好ましい。

【0063】

次いで、図 1 1 を参照すれば、図 1 1 は、本発明の第 9 実施形態によるハイブリッド型の冷却装置の平衡面図である。図示するように、本実施形態による冷却装置 1 1 0 0 は、それぞれの一端が所定の角度に曲がるように成形されて中空の分岐部の少なくとも一部を構成するように形成された一对の相変化冷却器 1 1 1 2 a、1 1 1 2 b を備える。本実施形態によれば、前記一对の相変化冷却器 1 1 1 2 a、1 1 1 2 b の曲がった部分が、設置時に分岐部を形成する。このように形成された分岐部の中空にも前記ファン 1 2 0 が設置される。

【0064】

図示するように、本実施形態による相変化冷却器 1 1 1 2 a、1 1 1 2 b のそれぞれは、ヒートパイプでありうる。この場合、一对のヒートパイプ 1 1 1 2 a 及び 1 1 1 2 b のそれぞれは、それ自体が相変化による冷却機能を保有しているため、外部の熱源からの熱を吸収して、これを放熱できる。しかし、本発明によれば、その一部、すなわち、凝縮が発生する部分（点線 1 0 8 で表示された部分）を所定角度に曲げて環状に成形し、その中央の空間にファン 1 2 0 を設置して、周りの空気を循環させることにより、従来のヒートパイプのそれぞれが有している放熱容量をはるかに超える放熱容量を具現できる。

【0065】

もちろん、前記一対の相変化冷却器1112a、1112bのそれぞれは、必ずしもヒートパイプである必要はない。この実施形態が図12Aに図示されている。図12Aは、本発明の第10実施形態によるハイブリッド型の冷却装置1200の平断面図である。本実施形態による冷却装置1200も、設置時に中央に空間を有する分岐部を構成する一対の相変化冷却器1212a、1212bと、前記一対の相変化冷却器1212a、1212bが構成する分岐部の中央空間に設置されたファン120と、を備える。しかし、本実施形態による前記相変化冷却器1212a、1212bのそれぞれは、その一側の端部の所定領域（本明細書では“一端”という）108、110が所定角度に曲がるように成形され、その内部に相変化する冷媒の循環ループが形成されるが、液状の冷媒が毛細管現象によって少なくとも一部に充填され、外部の熱源（図示せず）から伝えられた熱によって充填された液状の冷媒が気化される蒸発部104と、前記蒸発部104と隣接して形成されるが、気化された冷媒が前記一端108、110に向かって移動する気状冷媒移動部106と、少なくとも前記気状冷媒移動部106と隣接して形成されるが、前記一端の少なくとも一部を形成するように成形され、前記気状の冷媒が一側に流入されて凝縮される凝縮部108と、前記凝縮部108と隣接して形成されるが、前記一端の少なくとも一部を形成するように成形され、前記液状の冷媒が前記蒸発部104に向かって移動する液状冷媒移動部110及び前記蒸発部104と、前記液状冷媒移動部110の少なくとも一部を断熱させる断熱部106と、を備える構造を有する。

【0066】

一方、図12Bを参照すれば、図12Bは、本発明の第11実施形態によるハイブリッド型の冷却装置1200'の平断面図である。本実施形態では、図7に示す第5実施形態の場合のように、分岐部の終端が相互連結されている。この実施形態の場合にも、冷媒の循環は、前記第10実施形態の場合と同じである。

【0067】

従って、本実施形態による冷却装置1200、1200'は、図2及び図9に示す実施形態による冷却装置の長所を主に保有する。更に、本実施形態によれば、蒸発部が上下二つに分けられて形成されることにより、離れて設置された複数の熱源から伝えられる熱も放熱させようという長所を有する。また、前記第10実施形態及び第11実施形態による相変化冷却器のそれぞれの蒸発部を相互隣接した位置に形成させることにより、更に広い面積の熱源を放熱させることも可能である。もちろん、この場合には、蒸発部の位置変化により、他の内部構造の配置も対称的に変化する。

【0068】

一方、前記第10実施形態及び第11実施形態での蒸発部104を前記分岐部側に形成することにより、図8に示すような相変化冷却器800での効果を達成させることもできる。言い換えれば、この場合の冷却装置（図示せず）も、設置時に中央に空間を有する分岐部を構成する一対の相変化冷却器と、前記一対の相変化冷却器が構成する分岐部の中央の空間に設置されたファンと、を備える。しかし、この実施形態による前記相変化冷却器のそれぞれは、その一端が所定角度に曲がるように成形され、その内部に相変化する冷媒の循環ループが形成されるが、液状の冷媒が毛細管現象によって少なくとも一部に充填され、充填された液状の冷媒が外部の熱源から伝えられた熱によって気化される蒸発部と、前記蒸発部と隣接して形成されるが、気化された冷媒が前記曲がった一端の逆方向に向かって移動する気状冷媒移動部と、前記曲がった一端に隣接した領域に形成されるが、前記曲がった一端の少なくとも一部を形成するように成形され、前記気状の冷媒が一側に流入されて凝縮される凝縮部と、前記凝縮部と隣接して形成されるが、前記曲がった一端の少なくとも一部を形成するように成形され、前記液状の冷媒が前記蒸発部に向かって移動する液状冷媒移動部と、を備える。

【0069】

本実施形態によれば、図2及び図10に示す実施形態による冷却装置等の長所を主に保有する。更に、本実施形態によれば、蒸発部が上下二つに分けられて形成されることによ

り、離れて設置された複数の熱源から伝えられる熱も放熱させうるという長所を有する。また、前記実施形態による相変化冷却器のそれぞれの蒸発部を相互隣接した位置に形成させることにより、更に広い面積の熱源を放熱させることもできる。もちろん、この場合には、蒸発部の位置変化により他の内部構造の配置も対称的に変化する。

【0070】

前記図7ないし図12による冷却装置も、図2を参照して前記冷却装置100と同様に、複数の相変化冷却器を積層した構造に形成されうるとは言うまでもない。更に、前記分岐部には所定の形状を有する複数のフィンを設置して、冷却効率を上昇させ得る。

【0071】

また、前記相変化冷却器に備えられた凝縮部または液状冷媒移動部には、気状の冷媒がバブル状に備えられていてもよい。このようなバブルは、当然凝縮部の領域に更に多く備えられてもよく、図面では、これを区別するために、斜線領域と波線領域とで区分して示したが、その領域上の区分に限定されるものではないことは言うまでもない。

【0072】

また、前記凝縮部または液状冷媒移動部には、前記蒸発部に形成されたものと類似した微細チャンネルを形成して、凝縮された液状冷媒の移動を更に容易にすることもできる。

【0073】

次いで、図13Aないし図13Fを参照すれば、本発明による冷却装置の更に他の実施形態が示されている。図示するように、本発明による冷却装置の分岐部は、必ずしも円形の環状である必要はなく、直線状（図13Aまたは図13Dを参照）、終端が開放されたり閉鎖されたひし形（図13B、図13C、図13E及び図13Fを参照）に形成されることも可能である。従って、このような多様な分岐部の形状は、その設計的な選択事項に過ぎないため、本発明の技術的思想が分岐部の特定形状に限定されないことは言うまでもない。

【0074】

本発明は、以上の実施形態について詳細に説明したが、これに限定されるものではなく、当業者により多様に変形実施できることは言うまでもない。例えば、前記微細チャンネルを直線状に形成する実施形態を説明したが、これを曲線型に形成でき、前記断熱部116の形状も多様に形成でき、その寸法や形状も適切にデザインして使用できることは言うまでもない。

【産業上の利用可能性】

【0075】

本発明によれば、相変化時の潜熱による冷却と、送風及び対流による冷却とを併行できる。

【0076】

また、本発明によれば、各層のフィンとフィンとの間に複数の相変化冷却器を積層されるように配置して、フィンの冷却効率を極大化させて、既存の方式に比べて同じ面積のフィンを使用しても冷却性能を大きく向上させうる。

【0077】

また、本発明によれば、重力の影響に関係なく冷却性能を発揮できる小型のハイブリッド型の冷却装置を提供できる。

【0078】

また、本発明によれば、設置位置や場所に実質的な制限がない小型のハイブリッド型の冷却装置を提供できる。

【0079】

また、本発明によれば、蒸発部及び凝縮部の微細チャンネルが、その内部での表面張力を重力より大きくすれば、重力の影響をほとんど受けずに冷媒を自然循環させうるため、設置位置及び設置方法に制限がない。

【0080】

また、本発明によれば、断熱部により液状の冷媒移動部と気状の冷媒移動部とを熱的及

び物理的に分離させることにより、冷媒流動の安定性を図り、混入限界を抑制させることで冷媒の質量流量を増加させて、冷却効率を向上させた。

【0081】

また、本発明によれば、液状冷媒移動部を冷却装置の両側の外側に沿って配置し、両方向の循環ループより構成することにより、冷媒の過冷効果を上昇させ、重力水頭により一方の液状冷媒移動部への冷媒循環が行われない場合、反対側の液状冷媒移動部を冷媒の流動を円滑にして冷却効率が向上した。

【図面の簡単な説明】

【0082】

【図1】 通常のヒートパイプ型の冷却装置の一例を概略的に示す図面である。

【図2】 本発明の第1実施形態によるハイブリッド型の冷却装置の平断面図である。

【図3】 図2のハイブリッド型の冷却装置の分解斜視図である。

【図4A】 本発明の第2実施形態によるハイブリッド型の冷却装置の斜視図である。

【図4B】 図4Aのハイブリッド型の冷却装置の凝縮部部分の拡大斜視図である。

【図5A】 本発明の第3実施形態によるハイブリッド型の冷却装置の斜視図である。

【図5B】 図5Aのハイブリッド型の冷却装置の側面図である。

【図6A】 本発明の第4実施形態によるハイブリッド型の冷却装置の斜視図である。

【図6B】 図6Aのハイブリッド型の冷却装置の側面図である。

【図7】 本発明の第5実施形態によるハイブリッド型の冷却装置の平断面図である。

【図8】 本発明の第6実施形態によるハイブリッド型の冷却装置の平断面図である。

【図9】 本発明の第7実施形態によるハイブリッド型の冷却装置の平断面図である。

【図10】 本発明の第8実施形態によるハイブリッド型の冷却装置の平断面図である。

【図11】 本発明の第9実施形態によるハイブリッド型の冷却装置の平断面図である。

【図12A】 本発明の第10実施形態によるハイブリッド型の冷却装置の平断面図である。

【図12B】 本発明の第11実施形態によるハイブリッド型の冷却装置の平断面図である。

【図13A】 本発明のハイブリッド型の冷却装置の更に他の実施形態を示す平面図である。

【図13B】 本発明のハイブリッド型の冷却装置の更に他の実施形態を示す平面図である。

【図13C】 本発明のハイブリッド型の冷却装置の更に他の実施形態を示す平面図である。

【図13D】 本発明のハイブリッド型の冷却装置の更に他の実施形態を示す平面図である。

【図13E】 本発明のハイブリッド型の冷却装置の更に他の実施形態を示す平面図である。

【図13F】 本発明のハイブリッド型の冷却装置の更に他の実施形態を示す平面図である。

【符号の説明】

【0083】

100 ハイブリッド型の冷却装置

102 液状冷媒移動部

104 蒸発部

106 気状冷媒移動部

108 凝縮部

102、110 液状冷媒移動部

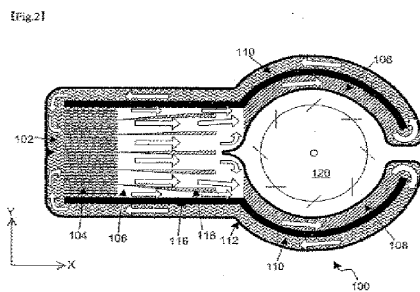
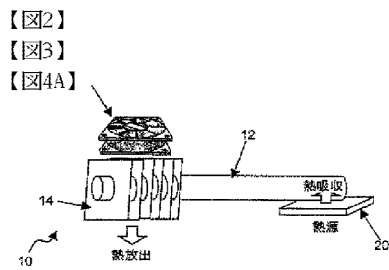
112 相変化冷却器

116 断熱部

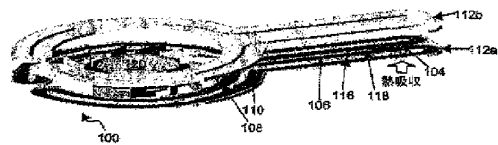
118 ガイド

120 ファン

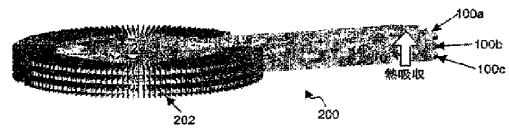
【図1】



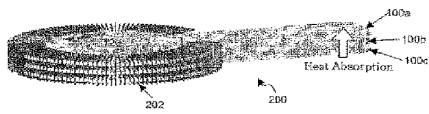
【Fig.3】



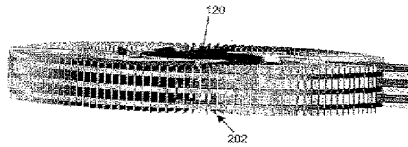
【Fig.4a】



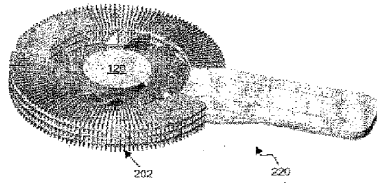
【Fig.4a】



【Fig.4b】



【Fig.5a】

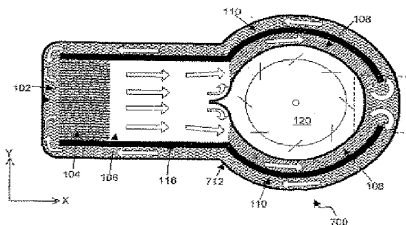


【Fig.5b】



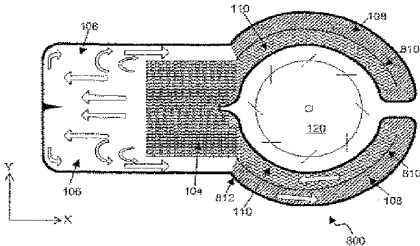
【図7】

【Fig.7】



【図8】

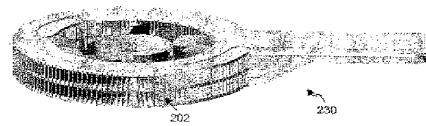
【Fig.8】



【Fig.5b】



【Fig.6a】



【Fig.6b】

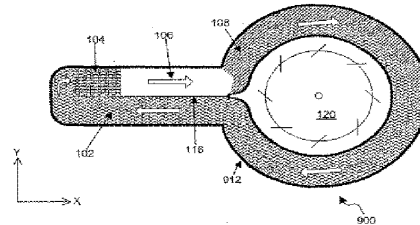


【Fig.5b】



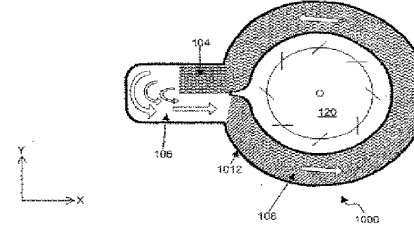
【図9】

【Fig.9】



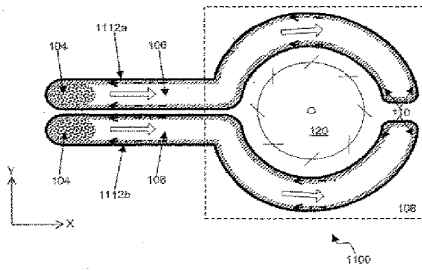
【図10】

【Fig.10】

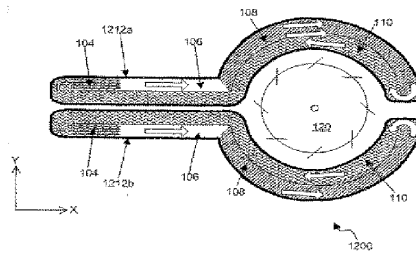


【図11】 【図11】

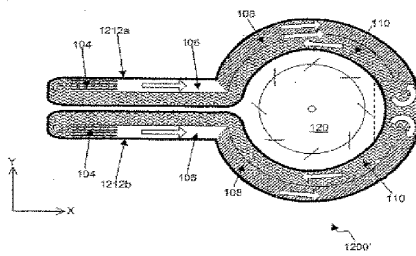
【Fig.11】



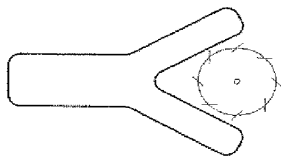
【Fig.12a】



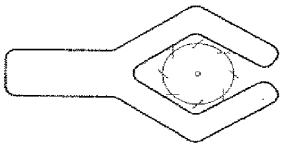
【Fig.12b】



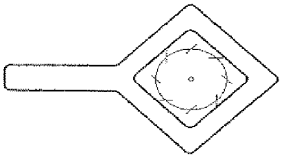
【Fig.13a】



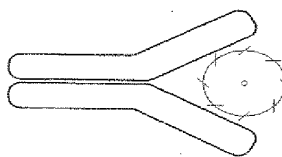
【Fig.13b】



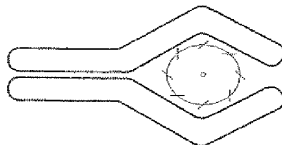
【Fig.13c】



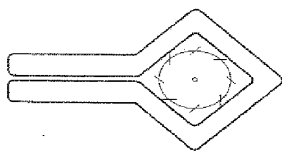
【Fig.13d】



【Fig.13e】



【Fig.13f】



INTERNATIONAL SEARCH REPORT

International application No.
PCT/KR2003/002282

A. CLASSIFICATION OF SUBJECT MATTER		
IPC7 F25D 9/00		
According to International Patent Classification (IPC) or to both national classification and IPC		
B. FIELDS SEARCHED		
Minimum documentation searched (classification system followed by classification symbols)		
IPC7 F25D		
Documentation searched other than minimum: documentation to the extent that such documents are included in the fields searched		
KR, JP : IPC as above		
Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)		
C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP 09-113058 A (Fuji electric Co. Ltd) 02 May 1997 See the whole document.	1 - 12
A	JP 11-063722 A (Daikin IND Ltd, Daikin plant kk) 05 May 1999 See the whole document.	1 - 12
A	JP 13-201233 A (Fujitsu general Ltd) 27 July 2001 See the whole document.	13 - 28
A	JP 07-318269 A (Mitsubishi cable ind Ltd) 8 December 1995 See the whole document.	13 - 28
A	JP 11-121816 A (Morikasu kk. Seiko Seiki Co.Ltd) 30 April 1999 See the whole document.	13 - 28
☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.		
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Date of the actual completion of the international search		Date of mailing of the international search report
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Name and mailing address of the ISA/KR  Korean Intellectual Property Office 920 Dunsan-dong, Seo-gu, Daejeon 302-701, Republic of Korea Facsimile No. 82-42-472-7140		Authorized officer SONG, Seung Hoon Telephone No. 82-42-481-5513 

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エービーティー, 201-1305

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5F136 CA04 CC12 CC13 CC17 CC18 CC20

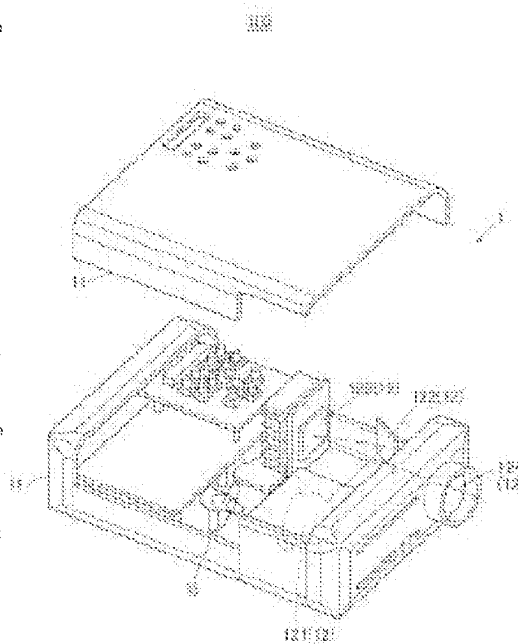
Bibliographic data: JP2007003638 (A) — 2007-01-11

PROJECTION TYPE VIDEO DISPLAY DEVICE

Inventor(s): NAGAO JUN ±
Applicant(s): FUNAI ELECTRIC CO ±
Classification: - international: G03B21/16; H05B37/02
 - european:
Application number: JP20050181413 20050622
Priority number(s): JP20050181413 20050622

Abstract of JP2007003638 (A)

PROBLEM TO BE SOLVED: To provide a projection type video display device capable of efficiently cooling a light source lamp and excellent in handleability. ; **SOLUTION:** The projection type video display device such as a projector 100 includes: a timer for measuring cooling time when the light source lamp 121 is cooled by driving and rotating a cooling fan 13 under the control of a CPU until power supply from a power source part is interrupted after turning off the light source lamp 121, based on input of an instruction to shift to standby; the CPU for performing processing to calculate the average cooling time of the light source lamp until then, based on the cooling time measured by the timer whenever the light source lamp is turned off; a temperature sensor for detecting the temperature of the light source lamp, a timer for measuring the operating time of the light source lamp; and the CPU for adjusting the rotating speed of the cooling fan, based on rotating speed adjusting amount related to the average cooling time of the light source lamp, the temperature of the light source lamp and the operating time of the light source lamp and performing processing to drive and rotate the cooling fan according to the rotating speed and the average cooling time. ; **COPYRIGHT:** (C)2007, JPO&INPIT



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(22) 出願日	平成17年6月22日 (2005. 6. 22)			船井電機株式会社		
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			(72) 発明者	長尾 順		
				大阪府大東市中垣内7丁目7番1号 船井電機株式会社内		
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				DA06	DA24	DA25
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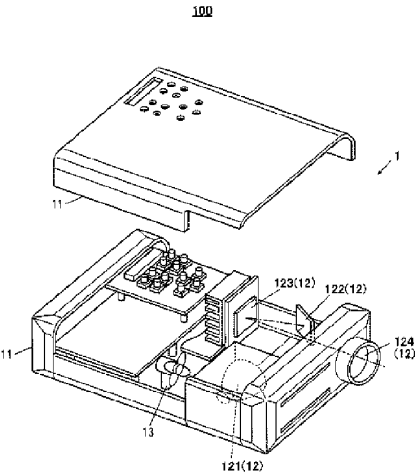
(54) 【発明の名称】 投射型映像表示装置

(57) 【要約】

【課題】光源ランプの冷却を効率良く行える使い勝手に優れた投射型映像表示装置を提供する。

【解決手段】スタンバイ移行指示の入力に基づいて、光源ランプ121の消灯後、電源部からの電力供給が遮断されるまでにCPUの制御下にて冷却用ファン13が回転駆動されて光源ランプ121が冷却される冷却時間を計時するタイマと、光源ランプが消灯される毎にタイマにより計時される冷却時間に基づいて、これまでの光源ランプの平均冷却時間を算出する処理を行うCPUと、光源ランプの温度を検出する温度センサと、光源ランプの使用時間を計時するタイマと、光源ランプの平均冷却時間、光源ランプの温度及び光源ランプの使用時間に係る回転速度調整量に基づいて冷却用ファンの回転速度を調整し、当該回転速度及び平均冷却時間に従って冷却用ファンを回転駆動させる処理を行うCPUとを備えるプロジェクター100である。

【選択図】 図1



【特許請求の範囲】

【請求項1】

光学像を形成するための光源ランプと、前記光源ランプを冷却する冷却用ファンと、前記冷却用ファンを回転駆動させるファン駆動制御手段と、前記ファン駆動制御手段に対して電力を供給する電力供給手段とを備える投射型映像表示装置であって、

前記光源ランプを消灯させて当該投射型映像表示装置をスタンバイモードに移行させるスタンバイ移行指示を出力するためのスタンバイモード指示手段と、

前記スタンバイモード指示手段から出力された前記スタンバイ移行指示の入力に基づいて、前記光源ランプの消灯後、前記電力供給手段から前記ファン駆動制御手段に対する電力供給が遮断されるまでに当該ファン駆動制御手段により前記冷却用ファンが所定の回転速度で回転駆動されて前記光源ランプが冷却される冷却時間を計時する冷却時間計時手段と、

前記光源ランプが消灯される毎に前記冷却時間計時手段により計時される前記冷却時間に基づいて、これまでの前記光源ランプの平均冷却時間を算出する平均時間算出手段と、

前記光源ランプの平均冷却時間と前記ファン駆動制御手段により回転駆動される前記冷却用ファンの回転速度の調整に係る平均冷却時間調整情報とを対応付けて記録する平均冷却時間調整情報記録手段と、

前記光源ランプの温度を検出する温度検出手段と、

前記光源ランプの温度と前記ファン駆動制御手段により回転駆動される前記冷却用ファンの回転速度の調整に係る温度調整情報とを対応付けて記録する温度調整情報記録手段と、

前記光源ランプの使用時間を計時する使用時間計時手段と、

前記光源ランプの使用時間と前記ファン駆動制御手段により回転駆動される前記冷却用ファンの回転速度の調整に係る使用時間調整情報とを対応付けて記録する使用時間調整情報記録手段と、

前記平均時間算出手段により算出された前記平均冷却時間に対応する前記平均冷却時間調整情報を前記平均冷却時間調整情報記録手段から取得する平均冷却時間調整情報取得手段と、

前記温度検出手段により検出された前記光源ランプの温度に対応する前記温度調整情報を前記温度調整情報記録手段から取得する温度調整情報取得手段と、

前記使用時間計時手段により計時された前記光源ランプの使用時間に対応する前記使用時間調整情報を前記使用時間調整情報記録手段から取得する使用時間調整情報取得手段と、を備え、

前記ファン駆動制御手段は、前記平均冷却時間調整情報取得手段により取得された前記平均冷却時間調整情報、前記温度調整情報取得手段により取得された前記温度調整情報、及び前記使用時間調整情報取得手段により取得された前記使用時間調整情報に基づいて前記冷却用ファンの回転速度を調整し、調整された前記回転速度、及び前記平均時間算出手段により算出された前記平均冷却時間に従って前記冷却用ファンを回転駆動させることを特徴とする投射型映像表示装置。

【請求項2】

光学像を形成するための光源ランプと、前記光源ランプを冷却する冷却用ファンと、前記冷却用ファンを回転駆動させるファン駆動制御手段と、前記ファン駆動制御手段に対して電力を供給する電力供給手段とを備える投射型映像表示装置であって、

前記光源ランプを消灯させて当該投射型映像表示装置をスタンバイモードに移行させるスタンバイ移行指示を出力するためのスタンバイモード指示手段と、

前記スタンバイモード指示手段から出力された前記スタンバイ移行指示の入力に基づいて、前記光源ランプの消灯後、前記電力供給手段から前記ファン駆動制御手段に対する電力供給が遮断されるまでに当該ファン駆動制御手段により前記冷却用ファンが所定の回転速度で回転駆動されて前記光源ランプが冷却される冷却時間を計時する冷却時間計時手段

と、

前記光源ランプが消灯される毎に前記冷却時間計時手段により計時される前記冷却時間に基づいて、これまでの前記光源ランプの平均冷却時間を算出する平均時間算出手段と、

前記光源ランプの平均冷却時間と前記ファン駆動制御手段により回転駆動される前記冷却用ファンの回転速度の調整に係る平均冷却時間調整情報とを対応付けて記録する平均冷却時間調整情報記録手段と、

前記平均時間算出手段により算出された前記平均冷却時間に対応する前記平均冷却時間調整情報を前記平均冷却時間調整情報記録手段から取得する平均冷却時間調整情報取得手段と、を備え、

前記ファン駆動制御手段は、前記平均冷却時間調整情報取得手段により取得された前記平均冷却時間調整情報に基づいて前記冷却用ファンの回転速度を調整し、調整された前記回転速度、及び前記平均時間算出手段により算出された前記平均冷却時間に従って前記冷却用ファンを回転駆動させることを特徴とする投射型映像表示装置。

【請求項3】

前記光源ランプの温度を検出する温度検出手段と、

前記光源ランプの温度と前記ファン駆動制御手段により回転駆動される前記冷却用ファンの回転速度の調整に係る温度調整情報とを対応付けて記録する温度調整情報記録手段と、

前記温度検出手段により検出された前記光源ランプの温度に対応する前記温度調整情報を前記温度調整情報記録手段から取得する温度調整情報取得手段と、を備え、

前記ファン駆動制御手段は、さらに、前記温度調整情報取得手段により取得された前記温度調整情報に基づいて、前記冷却用ファンの回転速度を調整することを特徴とする請求項2に記載の投射型映像表示装置。

【請求項4】

前記光源ランプの使用時間を計時する使用時間計時手段と、

前記光源ランプの使用時間と前記ファン駆動制御手段により回転駆動される前記冷却用ファンの回転速度の調整に係る使用時間調整情報とを対応付けて記録する使用時間調整情報記録手段と、

前記使用時間計時手段により計時された前記光源ランプの使用時間に対応する前記使用時間調整情報を前記使用時間調整情報記録手段から取得する使用時間調整情報取得手段と、を備え、

前記ファン駆動制御手段は、さらに、前記使用時間調整情報取得手段により取得された前記使用時間調整情報に基づいて、前記冷却用ファンの回転速度を調整することを特徴とする請求項2に記載の投射型映像表示装置。

【請求項5】

前記光源ランプの温度を検出する温度検出手段と、

前記光源ランプの温度と前記ファン駆動制御手段により回転駆動される前記冷却用ファンの回転速度の調整に係る温度調整情報とを対応付けて記録する温度調整情報記録手段と、

前記光源ランプの使用時間を計時する使用時間計時手段と、

前記光源ランプの使用時間と前記ファン駆動制御手段により回転駆動される前記冷却用ファンの回転速度の調整に係る使用時間調整情報とを対応付けて記録する使用時間調整情報記録手段と、

前記温度検出手段により検出された前記光源ランプの温度に対応する前記温度調整情報を前記温度調整情報記録手段から取得する温度調整情報取得手段と、

前記使用時間計時手段により計時された前記光源ランプの使用時間に対応する前記使用時間調整情報を前記使用時間調整情報記録手段から取得する使用時間調整情報取得手段と、を備え、

前記ファン駆動制御手段は、さらに、前記温度調整情報取得手段により取得された前記温度調整情報、及び前記使用時間調整情報取得手段により取得された前記使用時間調整情

報に基づいて、前記冷却用ファンの回転速度を調整することを特徴とする請求項2に記載の【発明の詳細な説明】。

【技術分野】

【0001】

本発明は、冷却用ファンを回転駆動させて光源ランプの冷却を行う投射型映像表示装置に関する。

【背景技術】

【0002】

従来、プロジェクター等の投射型映像表示装置には、画像データに基づいて所定の光学像を形成するための光源ランプが搭載されている。

【0003】

かかる投射型映像表示装置にあつては、使用により光源ランプが発熱することから、当該光源ランプを冷却用ファンの回転により空冷するようになっている。具体的には、例えば、使用される光源ランプを識別し、識別された光源ランプに応じてその駆動電力や冷却用ファンの回転速度を変更するように構成された投射型映像表示装置が開発されている（例えば、特許文献1参照。）。また、ユーザにより光源ランプの所望の冷却条件が選択可能に構成された投射型映像表示装置も開発されている（例えば、特許文献2参照。）。

【特許文献1】特開2001-332394号公報

【特許文献2】特開2004-21103号公報

【発明の開示】

【発明が解決しようとする課題】

【0004】

ところで、光源ランプの冷却は、例えば、当該光源ランプの消灯後に冷却用ファンを所定の回転速度で少なくとも一定時間、例えば1分間回転駆動させることにより行われるようになっているが、投射型映像表示装置の使用状況によっては、光源ランプの冷却時間を一定時間確保できずに途中で電源が落とされてしまう場合もある。この場合、光源ランプの冷却を十分に行うことができないことから、当該光源ランプの寿命が短縮してしまうといった問題もある。

【0005】

また、かかる場合には、光源ランプの冷却が十分ではないことから、続けて投射型映像表示装置を使用する際に光源ランプを点灯させる所定操作を行っても、当該光源ランプを冷却するための冷却用ファンの回転駆動を所定時間行った後でないと、光源ランプの点灯を行うことができないようになっているものもある。

【0006】

このように、予め設定された一定の冷却時間を確保することができない場合には、光源ランプの冷却を十分に行うことができないだけでなく、その後の投射型映像表示装置の使い勝手が悪くなってしまうといった問題がある。

【0007】

なお、光源ランプの冷却を急速に行う上で、冷却用ファンの回転速度をより高速にすることが考えられるが、冷却用ファンの回転速度が高速になるほど騒音が大きくなってしまふといった問題もあるため、かかる問題も考慮して光源ランプの冷却を効率良く行うことを検討する必要がある。

【0008】

そこで、本発明の課題は、光源ランプの冷却を効率良く行うことができる使い勝手に優れた投射型映像表示装置を提供することである。

【課題を解決するための手段】

【0009】

上記課題を解決するため、請求項1に記載の発明は、

光学像を形成するための光源ランプと、前記光源ランプを冷却する冷却用ファンと、前記冷却用ファンを回転駆動させるファン駆動制御手段と、前記ファン駆動制御手段に対し

て電力を供給する電力供給手段とを備える投射型映像表示装置であって、

前記光源ランプを消灯させて当該投射型映像表示装置をスタンバイモードに移行させるスタンバイ移行指示を出力するためのスタンバイモード指示手段と、

前記スタンバイモード指示手段から出力された前記スタンバイ移行指示の入力に基づいて、前記光源ランプの消灯後、前記電力供給手段から前記ファン駆動制御手段に対する電力供給が遮断されるまでに当該ファン駆動制御手段により前記冷却用ファンが所定の回転速度で回転駆動されて前記光源ランプが冷却される冷却時間を計時する冷却時間計時手段と、

前記光源ランプが消灯される毎に前記冷却時間計時手段により計時される前記冷却時間に基づいて、これまでの前記光源ランプの平均冷却時間を算出する平均時間算出手段と、

前記光源ランプの平均冷却時間と前記ファン駆動制御手段により回転駆動される前記冷却用ファンの回転速度の調整に係る平均冷却時間調整情報とを対応付けて記録する平均冷却時間調整情報記録手段と、

前記光源ランプの温度を検出する温度検出手段と、

前記光源ランプの温度と前記ファン駆動制御手段により回転駆動される前記冷却用ファンの回転速度の調整に係る温度調整情報とを対応付けて記録する温度調整情報記録手段と、

前記光源ランプの使用時間を計時する使用時間計時手段と、

前記光源ランプの使用時間と前記ファン駆動制御手段により回転駆動される前記冷却用ファンの回転速度の調整に係る使用時間調整情報とを対応付けて記録する使用時間調整情報記録手段と、

前記平均時間算出手段により算出された前記平均冷却時間に対応する前記平均冷却時間調整情報を前記平均冷却時間調整情報記録手段から取得する平均冷却時間調整情報取得手段と、

前記温度検出手段により検出された前記光源ランプの温度に対応する前記温度調整情報を前記温度調整情報記録手段から取得する温度調整情報取得手段と、

前記使用時間計時手段により計時された前記光源ランプの使用時間に対応する前記使用時間調整情報を前記使用時間調整情報記録手段から取得する使用時間調整情報取得手段と、を備え、

前記ファン駆動制御手段は、前記平均冷却時間調整情報取得手段により取得された前記平均冷却時間調整情報、前記温度調整情報取得手段により取得された前記温度調整情報、及び前記使用時間調整情報取得手段により取得された前記使用時間調整情報に基づいて前記冷却用ファンの回転速度を調整し、調整された前記回転速度、及び前記平均時間算出手段により算出された前記平均冷却時間に従って前記冷却用ファンを回転駆動させることを特徴としている。

【0010】

請求項2に記載の発明は、

光学像を形成するための光源ランプと、前記光源ランプを冷却する冷却用ファンと、前記冷却用ファンを回転駆動させるファン駆動制御手段と、前記ファン駆動制御手段に対して電力を供給する電力供給手段とを備える投射型映像表示装置であって、

前記光源ランプを消灯させて当該投射型映像表示装置をスタンバイモードに移行させるスタンバイ移行指示を出力するためのスタンバイモード指示手段と、

前記スタンバイモード指示手段から出力された前記スタンバイ移行指示の入力に基づいて、前記光源ランプの消灯後、前記電力供給手段から前記ファン駆動制御手段に対する電力供給が遮断されるまでに当該ファン駆動制御手段により前記冷却用ファンが所定の回転速度で回転駆動されて前記光源ランプが冷却される冷却時間を計時する冷却時間計時手段と、

前記光源ランプが消灯される毎に前記冷却時間計時手段により計時される前記冷却時間に基づいて、これまでの前記光源ランプの平均冷却時間を算出する平均時間算出手段と、

前記光源ランプの平均冷却時間と前記ファン駆動制御手段により回転駆動される前記冷

却用ファンの回転速度の調整に係る平均冷却時間調整情報とを対応付けて記録する平均冷却時間調整情報記録手段と、

前記平均時間算出手段により算出された前記平均冷却時間に対応する前記平均冷却時間調整情報を前記平均冷却時間調整情報記録手段から取得する平均冷却時間調整情報取得手段と、を備え、

前記ファン駆動制御手段は、前記平均冷却時間調整情報取得手段により取得された前記平均冷却時間調整情報に基づいて前記冷却用ファンの回転速度を調整し、調整された前記回転速度、及び前記平均時間算出手段により算出された前記平均冷却時間に従って前記冷却用ファンを回転駆動させることを特徴としている。

【0011】

請求項3に記載の発明は、請求項2に記載の投射型映像表示装置において、

前記光源ランプの温度を検出する温度検出手段と、

前記光源ランプの温度と前記ファン駆動制御手段により回転駆動される前記冷却用ファンの回転速度の調整に係る温度調整情報とを対応付けて記録する温度調整情報記録手段と、

前記温度検出手段により検出された前記光源ランプの温度に対応する前記温度調整情報を前記温度調整情報記録手段から取得する温度調整情報取得手段と、を備え、

前記ファン駆動制御手段は、さらに、前記温度調整情報取得手段により取得された前記温度調整情報に基づいて、前記冷却用ファンの回転速度を調整することを特徴としている。

【0012】

請求項4に記載の発明は、請求項2に記載の投射型映像表示装置において、

前記光源ランプの使用時間を計時する使用時間計時手段と、

前記光源ランプの使用時間と前記ファン駆動制御手段により回転駆動される前記冷却用ファンの回転速度の調整に係る使用時間調整情報とを対応付けて記録する使用時間調整情報記録手段と、

前記使用時間計時手段により計時された前記光源ランプの使用時間に対応する前記使用時間調整情報を前記使用時間調整情報記録手段から取得する使用時間調整情報取得手段と、を備え、

前記ファン駆動制御手段は、さらに、前記使用時間調整情報取得手段により取得された前記使用時間調整情報に基づいて、前記冷却用ファンの回転速度を調整することを特徴としている。

【0013】

請求項5に記載の発明は、請求項2に記載の投射型映像表示装置において、

前記光源ランプの温度を検出する温度検出手段と、

前記光源ランプの温度と前記ファン駆動制御手段により回転駆動される前記冷却用ファンの回転速度の調整に係る温度調整情報とを対応付けて記録する温度調整情報記録手段と、

前記光源ランプの使用時間を計時する使用時間計時手段と、

前記光源ランプの使用時間と前記ファン駆動制御手段により回転駆動される前記冷却用ファンの回転速度の調整に係る使用時間調整情報とを対応付けて記録する使用時間調整情報記録手段と、

前記温度検出手段により検出された前記光源ランプの温度に対応する前記温度調整情報を前記温度調整情報記録手段から取得する温度調整情報取得手段と、

前記使用時間計時手段により計時された前記光源ランプの使用時間に対応する前記使用時間調整情報を前記使用時間調整情報記録手段から取得する使用時間調整情報取得手段と、を備え、

前記ファン駆動制御手段は、さらに、前記温度調整情報取得手段により取得された前記温度調整情報、及び前記使用時間調整情報取得手段により取得された前記使用時間調整情報に基づいて、前記冷却用ファンの回転速度を調整することを特徴としている。

【発明の効果】

【0014】

請求項1に記載の発明によれば、スタンバイモードに移行されて光源ランプの消灯後、電力供給手段からファン駆動制御手段に対する電力供給が遮断されるまでに当該ファン駆動制御手段により冷却用ファンが所定の回転速度で回転駆動されて光源ランプが冷却される冷却時間が計時され、光源ランプが消灯される毎に計時される冷却時間に基づいて、これまでの光源ランプの平均冷却時間が算出され、さらに、当該平均冷却時間に対応する、冷却用ファンの回転速度の調整に係る平均冷却時間調整情報が平均冷却時間調整情報記録手段から取得され、また、光源ランプの温度に対応する、冷却用ファンの回転速度の調整に係る温度調整情報が温度調整情報記録手段から取得され、また、光源ランプの使用時間に対応する、冷却用ファンの回転速度の調整に係る使用時間調整情報が使用時間調整情報記録手段から取得される。そして、これら平均冷却時間調整情報、温度調整情報及び使用時間調整情報に基づいて冷却用ファンの回転速度が調整され、当該回転速度、及び、算出された光源ランプの平均冷却時間に従って冷却用ファンが回転駆動するようになっている。即ち、ユーザによる使用状況及び光源ランプの使用状態を考慮して、これまでの光源ランプの平均冷却時間内で光源ランプの冷却を行うことができるように、冷却用ファンの回転速度を平均冷却時間調整情報、温度調整情報及び使用時間調整情報に基づいて適正に調整することができる。

【0015】

これにより、冷却用ファンの回転速度を必要以上に高速化することなく、光源ランプの冷却を効率良く行うことができる。加えて、当該冷却用ファンの回転速度の高速化に伴って発生する騒音が大きくなるのを防止して使い勝手に優れる投射型映像表示装置を提供することができる。

【0016】

請求項2に記載の発明によれば、スタンバイモードに移行されて光源ランプの消灯後、電力供給手段からファン駆動制御手段に対する電力供給が遮断されるまでに当該ファン駆動制御手段により冷却用ファンが所定の回転速度で回転駆動されて光源ランプが冷却される冷却時間が計時され、光源ランプが消灯される毎に計時される冷却時間に基づいて、これまでの光源ランプの平均冷却時間が算出され、さらに、当該平均冷却時間に対応する、冷却用ファンの回転速度の調整に係る平均冷却時間調整情報が平均冷却時間調整情報記録手段から取得される。そして、平均冷却時間調整情報に基づいて冷却用ファンの回転速度が調整され、当該回転速度、及び、算出された光源ランプの平均冷却時間に従って冷却用ファンが回転駆動するようになっている。即ち、ユーザによる使用状況を考慮して、これまでの光源ランプの平均冷却時間内で光源ランプの冷却を行うことができるように、冷却用ファンの回転速度を平均冷却時間調整情報に基づいて適正に調整することができる。

【0017】

これにより、冷却用ファンの回転速度を必要以上に高速化することなく、光源ランプの冷却を効率良く行うことができる。加えて、当該冷却用ファンの回転速度の高速化に伴って発生する騒音が大きくなるのを防止して使い勝手に優れる投射型映像表示装置を提供することができる。

【0018】

請求項3に記載の発明によれば、請求項2に記載の発明と同様の効果が得られるのは無論のこと、特に、光源ランプの温度に対応する、冷却用ファンの回転速度の調整に係る温度調整情報が温度調整情報記録手段から取得され、当該温度調整情報に基づいて、冷却用ファンの回転速度が調整されるようになっているので、冷却用ファンの回転速度の調整を光源ランプの使用状態を考慮してより適正に行うことができ、光源ランプの冷却をより効率良く行うことができる。

【0019】

請求項4に記載の発明によれば、請求項2に記載の発明と同様の効果が得られるのは無論のこと、特に、光源ランプの使用時間に対応する、冷却用ファンの回転速度の調整に係

る使用時間調整情報が使用時間調整情報記録手段から取得され、当該使用時間調整情報に基づいて、冷却用ファンの回転速度が調整されるようになっているので、冷却用ファンの回転速度の調整を光源ランプの使用状態を考慮してより適正に行うことができ、光源ランプの冷却をより効率良く行うことができる。

【0020】

請求項5に記載の発明によれば、請求項2に記載の発明と同様の効果が得られるのは無論のこと、特に、光源ランプの温度に対応する、冷却用ファンの回転速度の調整に係る温度調整情報が温度調整情報記録手段から取得され、また、光源ランプの使用時間に対応する、冷却用ファンの回転速度の調整に係る使用時間調整情報が使用時間調整情報記録手段から取得され、これら温度調整情報及び使用時間調整情報に基づいて、冷却用ファンの回転速度が調整されるようになっているので、冷却用ファンの回転速度の調整を光源ランプの使用状態を考慮してより適正に行うことができ、光源ランプの冷却をより効率良く行うことができる。

【発明を実施するための最良の形態】

【0021】

以下に、本発明について、図面を用いて具体的な態様を説明する。ただし、発明の範囲は、図示例に限定されない。

【0022】

図1は、本発明を適用した投射型映像表示装置の好適な一実施形態として例示するプロジェクター100を示す斜視図であり、図2は、プロジェクター100の要部構成を示すブロック図である。なお、図1にあっては、プロジェクター100を構成するプロジェクター本体1のケース体11（後述）を開放した状態を示し、また、リモートコントローラ2（後述）の図示は省略している。

【0023】

本発明に係るプロジェクター（投射型映像表示装置）100は、例えば、パーソナルコンピュータやビデオカメラ（図示略）等から入力された画像情報に基づいて画像を形成し、形成した画像を前方に設けられたスクリーン（図示略）などに拡大して投影する装置であり、具体的には、図1及び図2に示すように、プロジェクター本体1と、このプロジェクター本体1を遠隔操作するためのリモートコントローラ2（「リモコン」；図2参照）とを備えて構成されている。

【0024】

先ず、プロジェクター本体1について説明する。

【0025】

プロジェクター本体1は、ケース体11内に、画像（映像）を投影する投影部12と、投影部12に備わる光源ランプ121を冷却する冷却用ファン13と、光源ランプ121の温度を検出する温度センサ14と、リモコン2から送信された信号を受信する信号受信部15と、EEPROM16と、RAM17と、CPU18と、タイマ19と、各部に対する電源を供給するための電源部10等を備えている。

【0026】

投影部12は、例えば、高輝度の光を出射する光源ランプ121と、光源ランプ121から出射された光を反射する反射ミラー122と、反射ミラー122により反射された光が入射されるDMD（Digital Micromirror Device）123と、DMD123により反射された光が通過する光学レンズ124とを備えて構成されている。

【0027】

光源ランプ121は、例えば、メタルハライドランプや超高压水銀ランプ等から構成され、DMD123により光学変調される光を出射するものである。

【0028】

DMD123は、例えば、光源ランプ121から出射され反射ミラー122にて反射されることで入射された光を画像情報に応じて変調することにより光学像を形成する光学変調素子として機能する。

【0029】

光学レンズ124は、例えば、ズームレンズ等により構成され、DMD123によって変調された光（光学像）を集光してスクリーンなどに拡大投影するものである。

【0030】

温度センサ14は、例えば、光源ランプ121の近傍の所定位置（図示略）に配設されており、当該光源ランプ121の使用の際の温度を所定のタイミングで検出し、検出された温度に係る所定の温度情報をCPU18に対して出力するようになっている。

【0031】

冷却用ファン13は、例えば、光源ランプ121の近傍の所定位置に配設されており、CPU18の制御下にて回転駆動して、光源ランプ121を空冷するものである。具体的には、冷却用ファン13は、ユーザによるスタンバイ状態切替スイッチ22の操作に基づいてスタンバイモードに移行して光源ランプ121が消灯された後に、所定の回転速度で高速回転して光源ランプ121を冷却するようになっている（光源ランプ冷却処理）。

【0032】

ここで、本実施形態のプロジェクター100にあっては、電源部10からの電力供給が行われている状態では、冷却用ファン13は所定の回転速度で回転するようになっているが、本発明に係る冷却用ファン13による光源ランプ冷却処理（詳細後述）とは、光源ランプ121の消灯後に冷却用ファン13を所定時間、高速回転させる処理を言うものとする。

【0033】

なお、冷却用ファン13の配置や個数等は、適宜変更しても良い。

【0034】

信号受信部15は、リモコン2の信号送信部から送信された所定の信号を受信するものである。具体的には、信号受信部15は、例えばユーザによるリモコン2のスタンバイ状態切替スイッチ22の所定操作に基づいて当該リモコン2の信号送信部から送信されたスタンバイ移行指示信号等の所定の信号をアンテナ（図示略）等により受信するようになっている。

【0035】

また、信号受信部15は、受信された所定の信号をCPU18に対して出力するようになっている。

【0036】

タイマ19は、例えば、計時回路を備え、光源ランプ121の使用時間や光源ランプ121の冷却時間等を計時するものである。

【0037】

具体的には、タイマ19は、使用時間計時手段として、電源投入後に点灯された光源ランプ121の使用時間（点灯時間）を計時するようになっている。また、タイマ19は、冷却時間計時手段として、ユーザによるスタンバイ状態切替スイッチ22の操作に応じて信号送信部23から送信されたスタンバイ移行指示信号の信号受信部15による受信に基づいて、光源ランプ121の消灯後、電源部10からの電力供給が遮断されるまでにCPU18の制御下にて冷却用ファン13が回転駆動されて光源ランプ121が冷却される冷却時間を計時するようになっている。

【0038】

なお、タイマ19により計時された光源ランプ121の使用時間や光源ランプ121の冷却時間等に係る時間情報は、例えば、CPU18に対して出力され、当該CPU18の制御下にてEEPROM16の所定の格納領域内に格納されるようになっている。

【0039】

ここで、光源ランプ121の冷却時間が、所定の時間、例えば1分を越えた場合には、当該冷却時間は1分間であるとしてその情報が格納されるようになっている。また、光源ランプ121の冷却時間に係る情報は、例えば、タイマ19により計時された時間を積算した合計冷却時間情報として、タイマ19による計時回数を積算した合計回数情報とともに

にEEPROM16に格納されるようになっている。

【0040】

電源部10は、CPU18の制御下にて、当該プロジェクター本体1を構成する各部に電力を供給するものである。

【0041】

また、電源部10は、例えば、当該プロジェクター本体1の主電源のオン／オフ操作を行うための電源スイッチ101を備えている。即ち、電源スイッチ101のユーザによる所定操作に基づいて、当該プロジェクター本体1の電源がオンされると、電源部10から各部に電力が供給されることとなり、光源ランプ121、冷却用ファン13等が駆動するようになっている。一方、電源スイッチ101のユーザによる所定操作に基づいて、当該プロジェクター本体1の電源がオフされると、電源部10からの電力供給が遮断されるようになっている。

【0042】

なお、タイマ19によって電源部10からの電力供給が遮断されるまでの光源ランプ121の冷却時間を計時して、計時された冷却時間をEEPROM16等に格納する場合、これらの処理に係る電力は、電源部10からの電力供給が遮断された後であっても、例えばコンデンサ等の内部電源に蓄積された電気を利用することで行えるようになっている。

【0043】

CPU (Central Processing Unit) 18は、プロジェクター100の各部を統括的に制御するものであり、EEPROM16に記憶されている各種プログラムを読み出してRAM17の作業領域に展開し、当該プログラムに従って各種処理を実行するようになっている。

【0044】

具体的には、CPU18は、例えばリモコン2から送信されて信号受信部15により受信されたスタンバイ移行指示信号に基づいて、所定の制御プログラムを実行して、当該プロジェクター100をスタンバイモードに移行させて光源ランプ121を消灯させる処理の実行を制御するようになっている。その後、CPU18は、所定のプログラムの実行に基づいて、使用後の光源ランプ121を冷却用ファン13を回転駆動させることにより空冷する光源ランプ冷却処理の実行を制御するようになっている。

【0045】

なお、スタンバイモードとは、少なくとも光源ランプ121を消灯した状態とするモードであるが、これに限られるものではなく、電源部10からの電力供給を制御して他の各部の機能の実行も制限するようにしても良い。

【0046】

RAM (Random Access Memory) 17は、例えば、書き換え可能なメモリであり、CPU18の制御下にて記憶部から読み出されたプログラムや各種データ等の格納領域や作業領域等を構成している。

【0047】

EEPROM (Electrically Erasable and Programmable Read Only Memory) 16は、例えば、電氣的にデータの書きこみ、及び消去が可能な読み出し専用のメモリであり、CPU18の制御下にて実行される各種プログラム、各プログラムの処理に係るデータ等を記憶している。

【0048】

具体的には、EEPROM16は、例えば、ファン駆動制御プログラム16a、平均時間算出プログラム16b、平均冷却時間調整情報取得プログラム16c、温度調整情報取得プログラム16d、使用時間調整情報取得プログラム16e等を記憶している。

【0049】

ファン駆動制御プログラム16aは、CPU18の制御下にて冷却用ファン13を所定の回転速度で回転駆動させる処理に係る機能を実現させるためのプログラムである。即ち、電源スイッチ101のオン操作に基づいて電源部10からの電力供給が行われている状

態にあっては、CPU 18は、冷却用ファン13の回転駆動を制御して、当該冷却用ファン13を所定の速度で回転駆動させるようになっている。そして、リモコン2から出力されたスタンバイ移行指示がCPU 18に入力されると、CPU 18は、ファン駆動制御手段として、光源ランプ121を冷却させるために冷却用ファン13の回転速度をより高速に変更（調整）するようになっている。

【0050】

具体的には、CPU 18は、後述する平均冷却時間調整情報取得処理にて取得された回転速度調整量（平均冷却時間調整情報）に基づいて冷却用ファン13の回転速度を高速に調整して、調整された回転速度、及び平均時間算出処理にて算出された平均冷却時間に従って冷却用ファン13を回転駆動させるようになっている。

【0051】

また、冷却用ファン13の回転速度の調整において、CPU 18は、温度調整情報取得処理（後述）にて取得された回転速度調整量（温度調整情報）に基づいて冷却用ファン13の回転速度を調整するようになっている。さらに、CPU 18は、使用時間調整情報取得処理（後述）にて取得された回転速度調整量（使用時間調整情報）に基づいて冷却用ファン13の回転速度を調整するようになっている。

【0052】

平均時間算出プログラム16bは、CPU 18に、平均時間算出手段として、スタンバイモード移行後に光源ランプが消灯される毎にタイマ19により計時される光源ランプ121の冷却時間に基づいて、これまでの光源ランプ121の平均冷却時間を算出する平均冷却時間算出処理に係る機能を実現させるためのプログラムである。

【0053】

即ち、CPU 18による平均時間算出プログラム16bの実行に基づいて、EEPROM 16から光源ランプ121の冷却時間に係る情報としての合計冷却時間情報と合計回数情報を読み出して、合計冷却時間を合計回数で除算することにより、これまでの光源ランプ121の平均冷却時間を算出するようになっている。

【0054】

なお、平均冷却時間算出処理は、例えば、電源部10からの電力供給が開始された後、光源ランプ121が消灯されるまでに実行可能であれば如何なるタイミングで実行されても良い。

【0055】

平均冷却時間調整情報取得プログラム16cは、CPU 18に、平均冷却時間調整情報取得手段として、平均冷却時間算出処理にて算出された平均冷却時間に対応する回転速度調整量を平均冷却時間調整テーブル1から取得する平均冷却時間調整情報取得処理に係る機能を実現させるためのプログラムである。

【0056】

なお、平均冷却時間調整情報取得処理は、例えば、平均冷却時間算出処理後、光源ランプ121が消灯されるまでに実行可能であれば如何なるタイミングで実行されても良い。

【0057】

温度調整情報取得プログラム16dは、CPU 18に、温度調整情報取得手段として、温度センサ14により検出された光源ランプ121の温度に対応する回転速度調整量を温度調整テーブル2から取得する温度調整情報取得処理に係る機能を実現させるためのプログラムである。

【0058】

なお、温度調整情報取得処理は、例えば、平均冷却時間算出処理後、光源ランプ121が消灯されるまでに実行可能であれば如何なるタイミングで実行されても良い。

【0059】

使用時間調整情報取得プログラム16eは、CPU 18に、使用時間調整情報取得手段として、タイマ19により計時された光源ランプ121の使用時間に対応する回転速度調整量を使用時間調整テーブル3から取得する使用時間調整情報取得処理に係る機能を実

現させるためのプログラムである。

【0060】

なお、使用時間調整情報取得処理は、例えば、平均冷却時間算出処理後、光源ランプ 1 2 1 が消灯されるまでに実行可能であれば如何なるタイミングで実行されても良い。

【0061】

また、EEPROM 1 6 には、例えば、プロジェクター 1 0 0 による光源ランプ冷却処理にて用いられる平均冷却時間調整テーブル 1 (図 3 参照)、温度調整テーブル 2 (図 4 参照)、使用時間調整テーブル 3 (図 5 参照) が記憶されている。

【0062】

平均冷却時間調整テーブル 1 は、例えば、光源ランプ 1 2 1 の平均冷却時間と、当該平均冷却時間内にて光源ランプ 1 2 1 を適正に冷却することができるようにして予め規定された冷却用ファン 1 3 の回転速度の調整に係る回転速度調整量(平均冷却時間調整情報)とが対応付けられたものである。ここで、EEPROM 1 6 は、平均冷却時間調整テーブル 1 を記録する平均冷却時間調整情報記録手段を構成している。

【0063】

温度調整テーブル 2 は、例えば、光源ランプ 1 2 1 の温度と、当該温度の光源ランプ 1 2 1 を適正に冷却することができるようにして予め規定された冷却用ファン 1 3 の回転速度の調整に係る回転速度調整量(温度調整情報)とが対応付けられたものである。ここで、EEPROM 1 6 は、温度調整テーブル 2 を記録する温度調整情報記録手段を構成している。

【0064】

使用時間調整テーブル 3 は、例えば、光源ランプ 1 2 1 の使用時間と、当該時間経過後の光源ランプ 1 2 1 を適正に冷却することができるようにして予め規定された冷却用ファン 1 3 の回転速度の調整に係る回転速度調整量(使用時間調整情報)とが対応付けられたものである。ここで、EEPROM 1 6 は、使用時間調整テーブル 3 を記録する使用時間調整情報記録手段を構成している。

【0065】

なお、平均冷却時間調整テーブル 1、温度調整テーブル 2 及び使用時間調整テーブル 3 に係る回転速度調整量とは、例えば、冷却用ファン 1 3 の最大回転速度を 1 0 0 とした場合の回転速度調整前の指標となる所定の回転速度(例えば、6 5 等)に対する回転速度の調整量を表したものである。

【0066】

即ち、平均冷却時間調整テーブル 1 にあっては、平均冷却時間が短くなる程、つまり、光源ランプ 1 2 1 の消灯後に電源オフされるまでの時間が短くなる程、回転速度調整量が大きくなって冷却用ファン 1 3 の回転速度をより高速に回転させるように調整することができるように規定されている。

【0067】

また、温度調整テーブル 2 にあっては、光源ランプ 1 2 1 の温度が高くなる程、回転速度調整量が大きくなって冷却用ファン 1 3 の回転速度をより高速に回転させるように調整することができるように規定されている。

【0068】

また、使用時間調整テーブル 3 にあっては、光源ランプ 1 2 1 の使用時間が長くなる程、回転速度調整量が大きくなって冷却用ファン 1 3 の回転速度をより高速に回転させるように調整することができるように規定されている。

【0069】

なお、平均冷却時間調整テーブル 1、温度調整テーブル 2 及び使用時間調整テーブル 3 に係る回転速度調整量の数値は、一例であって、これらに限定されるものではない。

【0070】

次に、リモコン 2 について説明する。

【0071】

リモコン2は、制御部21と、プロジェクター本体1をスタンバイモードに移行させるためのスタンバイ状態切替スイッチ22と、当該リモコン2の所定操作に基づいて出力される所定の信号を送信する信号送信部23等を備えている。

【0072】

制御部21は、例えば、CPU、メモリ等から構成されており、当該リモコン2の各部を統括的に制御するようになっている。

【0073】

スタンバイ状態切替スイッチ22は、ユーザによる所定操作に基づいて、当該プロジェクター100のスタンバイモードと画像投影モードとを切り替えるためのものであり、具体的には、当該スタンバイ状態切替スイッチ22が所定操作される毎にスタンバイモードに移行させるスタンバイ移行指示信号と、画像投影モードに移行させる指示信号とを交互に出力するようになっている。

【0074】

このように、スタンバイ状態切替スイッチ22は、スタンバイモード指示手段を構成している。

【0075】

信号送信部23は、例えば、ユーザによるスタンバイ状態切替スイッチ22や他の操作スイッチ（図示略）等の所定操作に基づいて、制御部21の制御下にてスタンバイ移行指示信号等の所定の信号を送信するようになっている。

【0076】

なお、リモコン2とプロジェクター本体1との情報通信は、例えば、無線通信方式にて行うようにしても良いし、有線通信方式にて行うようにしても良い。

【0077】

次に、プロジェクター100による光源ランプ冷却処理について、図6を参照して説明する。

【0078】

ここで、図6は、光源ランプ冷却処理に係る動作の一例を示すフローチャートである。

【0079】

以下に説明する光源ランプ冷却処理にあつては、当該プロジェクター100が所定回数使用されることで取得された光源ランプ121の冷却時間に係る情報（合計冷却時間情報及び合計回数情報）がEEPROM16の格納領域に予め格納された状態となっている。

【0080】

まず、ユーザによる電源スイッチ101の所定操作に基づいてプロジェクター100の電源が投入（オン）されると（ステップS1）、CPU18は、画像投影モードに移行させて、所定の制御プログラムを実行して投影部12の光源ランプ121を点灯させる制御を行うとともに、ファン駆動制御プログラム16aを実行して冷却用ファン13を所定の回転速度で回転駆動させる制御を行う（ステップS2）。ここで、光源ランプ121が点灯状態となることに基づいて、CPU18は、所定の制御プログラムを実行して、タイマ19を制御して光源ランプ121の使用時間の計時を開始させる（ステップS3）。

【0081】

また、CPU18は、EEPROM16から平均時間算出プログラム16bを読み出してRAM17に展開し、この平均時間算出プログラム16bの実行に基づいて、光源ランプ121の冷却時間に係る情報（合計冷却時間情報及び合計回数情報）から、これまでの光源ランプ121の平均冷却時間を算出する平均冷却時間算出処理を実行する（ステップS4）。

【0082】

続けて、CPU18は、EEPROM16から平均冷却時間調整情報取得プログラム16cを読み出してRAM17に展開し、この平均冷却時間調整情報取得プログラム16cの実行に基づいて、平均冷却時間算出処理にて算出された平均冷却時間に対応する回転速

度調整量を平均冷却時間調整テーブル 1 から取得する平均冷却時間調整情報取得処理を実行する（ステップ S 5）。

【0083】

そして、例えばプロジェクター本体 1 の投影部 1 2 を用いて画像投影が行われた後、ユーザによってリモコン 2 のスタンバイ状態切替スイッチ 2 2 が所定操作されると、制御部 2 1 は、所定の制御プログラムの実行に基づいて信号送信部 2 3 を制御して、スタンバイ移行指示信号をプロジェクター本体 1 に送信させる（ステップ S 6）。

【0084】

プロジェクター本体 1 にあっては、リモコン 2 から送信されたスタンバイ移行指示信号を信号受信部 1 5 により受信すると、CPU 1 8 は、所定の制御プログラムの実行に基づいて、光源ランプ 1 2 1 を消灯させるとともに、タイマ 1 9 を制御して光源ランプ 1 2 1 の使用時間の計時を停止させる（ステップ S 7）。

【0085】

続けて、CPU 1 8 は、EEPROM 1 6 から使用時間調整情報取得プログラム 1 6 e を読み出して RAM 1 7 に展開し、この使用時間調整情報取得プログラム 1 6 e の実行に基づいて、タイマ 1 9 により計時された光源ランプ 1 2 1 の使用時間に対応する回転速度調整量を使用時間調整テーブル 3 から取得する使用時間調整情報取得処理を実行する（ステップ S 8 1）。

【0086】

また、CPU 1 8 は、EEPROM 1 6 から温度調整情報取得プログラム 1 6 d を読み出して RAM 1 7 に展開し、この温度調整情報プログラムの実行に基づいて、温度センサ 1 4 から出力されて入力された温度情報に係る光源ランプ 1 2 1 の温度に対応する回転速度調整量を温度調整テーブル 2 から取得する温度調整情報取得処理を実行する（ステップ S 8 2）。

【0087】

次に、CPU 1 8 は、平均冷却時間調整情報取得処理、使用時間調整情報取得処理及び温度調整情報取得処理にて取得されたそれぞれの回転速度調整量を加算した値に基づいて冷却用ファン 1 3 の回転速度を設定して、設定された回転速度に従って冷却用ファン 1 3 の回転速度を高速として、平均冷却時間算出処理にて算出された光源ランプ 1 2 1 の平均冷却時間に従って当該冷却用ファン 1 3 を駆動させる（ステップ S 9）。

【0088】

また、ステップ S 7 にて、光源ランプ 1 2 1 が消灯されると、CPU 1 8 は、所定の制御プログラムを実行して、タイマ 1 9 による計時を開始させる（ステップ S 8 3）。

【0089】

そして、ユーザによる電源スイッチ 1 0 1 の所定操作に基づいて電力供給が遮断されると（ステップ S 1 0）、CPU 1 8 の制御下にて、タイマ 1 9 により計時された時間を光源ランプ 1 2 1 の冷却時間として EEPROM 1 6 に記憶させる（ステップ S 1 1）。

【0090】

なお、ステップ S 8 3 にて計時が開始された時間（光源ランプ 1 2 1 の冷却時間）が平均冷却時間以上となると、即ち、平均冷却時間を経過してもユーザによって電源スイッチ 1 0 1 等が操作されずに電力供給が遮断された状態となっていない場合には、CPU 1 8 は、所定の制御プログラムの実行に基づいて、冷却用ファン 1 3 の回転速度を通常状態に戻すようになっている。

【0091】

以上のように、本実施形態のプロジェクター 1 0 0 によれば、スタンバイモードに移行されて光源ランプ 1 2 1 の消灯後、電源部 1 0 からの電力供給が遮断されるまでに CPU 1 8 の制御下にて冷却用ファン 1 3 が回転駆動されて光源ランプ 1 2 1 が冷却される冷却時間がタイマ 1 9 により計時され、光源ランプ 1 2 1 が消灯される毎に計時される冷却時間に基づいて、これまでの光源ランプ 1 2 1 の平均冷却時間が算出され、さらに、当該平均冷却時間に対応する回転速度調整量が平均冷却時間調整テーブル 1 から取得され、ま

た、光源ランプ121の温度に対応する回転速度調整量が温度調整テーブル2から取得され、また、光源ランプ121の使用時間に対応する回転速度調整量が使用時間調整テーブル3から取得されるようになっている。そして、これらの回転速度調整量に基づいて冷却用ファン13の回転速度が設定され、当該回転速度、及び、算出された光源ランプ121の平均冷却時間に従って冷却用ファン13が駆動するようになっている。即ち、ユーザによる使用状況及び光源ランプ121の使用状態を考慮して、これまでの光源ランプ121の平均冷却時間内で光源ランプ121の冷却を行うことができるように、冷却用ファン13の回転速度を回転速度調整量に基づいて適正に調整することができる。

【0092】

これにより、冷却用ファン13の回転速度を必要以上に高速化することなく、光源ランプ121の冷却を効率良く行うことができる。加えて、当該冷却用ファン13の回転速度の高速化に伴って発生する騒音が大きくなるのを防止して使い勝手に優れるプロジェクター100を提供することができる。

【0093】

なお、本発明は、上記実施形態に限定されることなく、本発明の趣旨を逸脱しない範囲において、種々の改良並びに設計の変更を行っても良い。

【0094】

例えば、冷却用ファン13の回転速度を、光源ランプ121の平均冷却時間、温度及び使用時間を考慮して調整するようにしたが、これに限られるものではなく、少なくとも光源ランプ121の平均冷却時間に係る回転速度調整量に基づいて調整するような構成であれば、光源ランプ121の温度、使用時間のそれぞれに係る回転速度調整量を用いるか否かは適宜変更することができる。

【0095】

また、上記実施形態では、スタンバイモード指示手段としてのスタンバイ状態切替スイッチ22をリモコン2に設けるようにしたが、これに限られるものではなく、プロジェクター本体1に設けるようにしても良い。

【0096】

さらに、上記実施形態では、電力供給の遮断を電源スイッチ101の操作に基づいて行うようにしたが、電源プラグをコンセントから取り外すことで行うようにしても良い。

【0097】

また、投影部12の構成は、上記のものに限られるものではなく適宜変更しても良い。例えば、光源ランプ121から出射される光を、R（赤）、G（緑）、B（青）の何れかの単色光に切り替える回転式の分割カラーフィルタであるカラーホイールを設けるようにしても良い。

【図面の簡単な説明】

【0098】

【図1】本発明を適用した投射型映像表示装置の好適な一実施形態として例示するプロジェクターを示す斜視図である。

【図2】図1のプロジェクターの要部構成を示すブロック図である。

【図3】図1のプロジェクターによる光源ランプ冷却処理にて用いられる平均冷却時間調整テーブルを示す図である。

【図4】図1のプロジェクターによる光源ランプ冷却処理にて用いられる温度調整テーブルを示す図である。

【図5】図1のプロジェクターによる光源ランプ冷却処理にて用いられる使用時間調整テーブルを示す図である。

【図6】図1のプロジェクターによる光源ランプ冷却処理に係る動作の一例を示すフローチャートである。

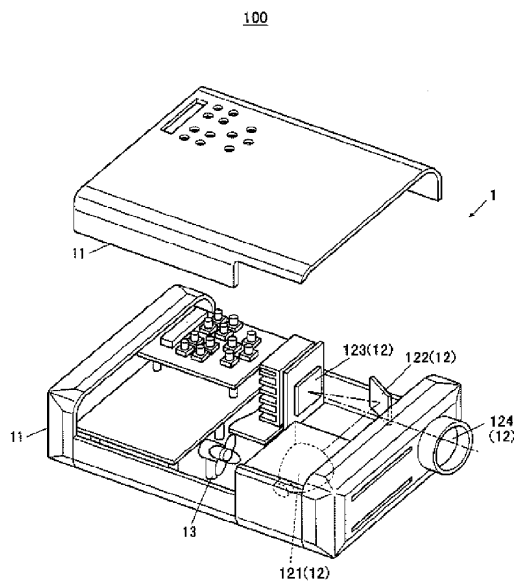
【符号の説明】

【0099】

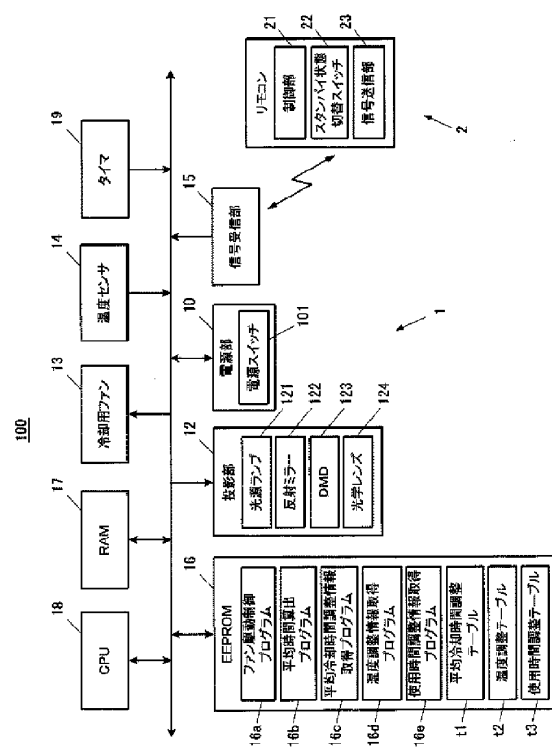
100 プロジェクター（投射型映像表示装置）

- 1 プロジェクター本体
 1 2 1 光源ランプ
 1 3 冷却用ファン
 1 4 温度センサ（温度検出手段）
 1 6 EEPROM（平均冷却時間調整情報記録手段、温度調整情報記録手段、使用時間調整情報記録手段）
 t 1 平均冷却時間調整テーブル
 t 2 温度調整テーブル
 t 3 使用時間調整テーブル
 1 8 CPU（ファン駆動制御手段、平均時間算出手段、平均冷却時間調整情報取得手段、温度調整情報取得手段、使用時間調整情報取得手段）
 1 9 タイマ（冷却時間計時手段、使用時間計時手段）
 1 0 電源部（電力供給手段）
 1 0 1 電源スイッチ
 2 リモートコントローラ
 2 2 スタンバイ状態切替スイッチ（スタンバイモード指示手段）

【図1】



【図2】



【図3】

t_1

平均冷却時間(s)	$0 < x \leq 30$	$30 < x \leq 40$	$40 < x \leq 50$	$50 < x \leq 60$
回転速度調整量	+15	+10	+5	± 0

【図4】

t_2

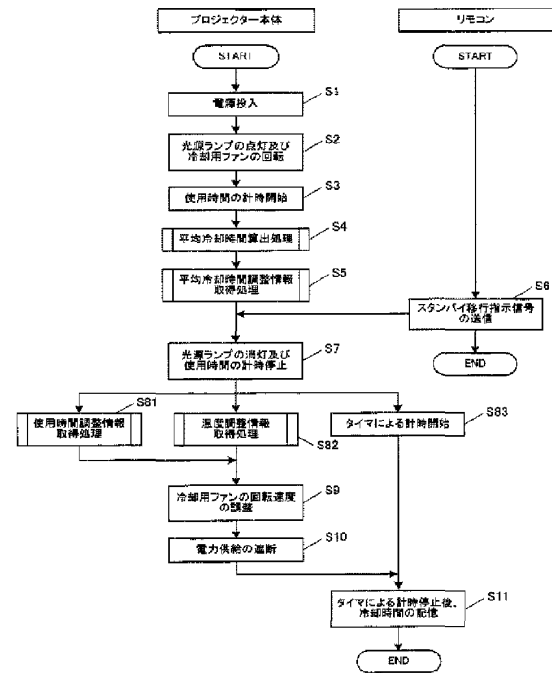
光源温度($^{\circ}\text{C}$)	$0 < y \leq 45$	$45 < y \leq 50$	$50 < y$
回転速度調整量	± 0	+5	+10

【図5】

t_3

光源使用時間(h)	$0 < z \leq 3$	$3 < z \leq 6$	$6 < z$
回転速度調整量	± 0	+5	+10

【図6】



(19)



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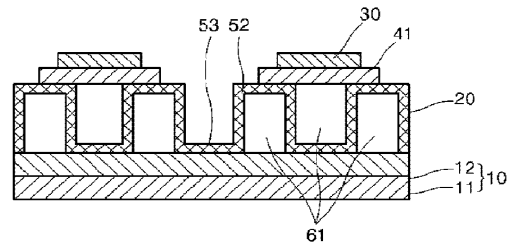
(51) Int. Cl **H01J 17/28**

(54) **PLASMA DISPLAY DEVICE WITH HEAT INSULATION UNIT INTERPOSED BETWEEN CHASSIS AND CIRCUIT BOARD SO AS TO PREVENT HEAT GENERATED FROM PLASMA DISPLAY PANEL FROM BEING TRANSFERRED TO CIRCUIT BOARD**

(57) Abstract:

PURPOSE: A plasma display device is provided to allow for a stable circuit operation by inserting a heat insulation unit into the space between the rear surface of a chassis and a circuit board such that heat generated from a plasma display panel is prevented from being transferred to the circuit board.

CONSTITUTION: A plasma display device comprises a plasma display panel(10); a chassis(20) disposed on the rear surface of the plasma display panel; a circuit board(30) disposed on the rear surface of the chassis; and a heat insulation unit interposed between the circuit board and the chassis. The heat insulation unit includes at least one heat insulation plate(41).



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● 서류명	특허출원서
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● 발명의 국문명칭	단열 수단을 구비하는 플라즈마 디스플레이 장치
● 발명의 영문명칭	Plasma display device comprising adiabatic means
● 출원인 명칭 특허고객번호	삼성에스디아이 주식회사 1-1998-001805-8
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● 심사청구	청구
● 취지	특허법 제42조의 규정에 의한 출원, 특허법 제60조의 규정에 의한 출원심사를 청구합니다.대리인 이영필 (인)대리인 이해영 (인)
● 수수료 기본출원료 가산출원료 우선권 주장료 심사청구료	18 면 29,000 원 0 면 0 원 0 건 0 원 9 항 397,000 원





합계

426,000 원

● 첨부서류

개인정보보호를 위해 비공개합니다.

특허 명세서

● 요약서

요약

본 발명은 플라즈마 디스플레이 장치에 있어서, 플라즈마 디스플레이 패널로부터 발생하는 열이 회로기판으로 전달되는 것을 차단하여 회로 동작의 안전을 향상시킴과 아울러 플라즈마 디스플레이 패널로부터 발생하는 열의 방열을 증대시키는 것을 목적으로 하며, 이 목적을 달성하기 위하여 플라즈마 디스플레이 패널, 상기 플라즈마 디스플레이 패널의 배면에 배치되는 샤시, 상기 샤시의 배면에 배치되는 회로기판, 및 상기 회로기판과 상기 샤시의 사이에 위치하는 단열수단을 포함하며, 상기 샤시는 요철 형상으로 절곡된 것을 특징으로 하는 플라즈마 디스플레이 장치를 제공한다.

● 대표도

도 4

● 명세서

발명의 명칭

단열 수단을 구비하는 플라즈마 디스플레이 장치{Plasma display device comprising adiabatic means}

도면의 간단한 설명

도 1은 일반적인 플라즈마 디스플레이 장치의 일례를 개략적으로 나타낸 분리 사시도이고,
 도 2는 본 발명에 따른 플라즈마 디스플레이 장치의 일례를 개략적으로 나타낸 분리 사시도이고,
 도 3a는 본 발명에 따른 하나의 단열판을 구비하는 플라즈마 디스플레이 장치의 단면도이고,
 도 3b는 본 발명에 따른 두 개 이상의 단열판을 구비하는 플라즈마 디스플레이 장치의 단면도이고,
 도 4는 본 발명에 따른 요철 형상의 샤시를 구비하는 플라즈마 디스플레이 장치의 단면도이고,
 도 5a는 도 4의 플라즈마 디스플레이 장치에 있어서 세로 방향의 통풍구를 가지는 샤시의 사시도이며,
 도 5b는 도 4의 플라즈마 디스플레이 장치에 있어서 가로 방향의 통풍구를 가지는 샤시의 사시도이며,
 도 6a는 도 4의 플라즈마 디스플레이 장치에 있어서 샤시의 돌출부 양측면이 요철 모양으로 형성된 것을 나타낸 단면도이며,
 도 6b는 도 4의 플라즈마 디스플레이 장치에 있어서 샤시의 돌출부 양측면에 흰이 부착된 것을 나타낸 단면도이며,
 도 7은 도 4의 플라즈마 디스플레이 장치에 있어서 샤시의 돌출부가 사다리꼴 모양인 것을 나타낸 단면도이며,
 도 8은 바둑판 모양의 양각 돌출부 형상의 샤시의 일부 사시도이다.

* 도면의 주요부분에 대한 부호의 설명 *

10 : 플라즈마 디스플레이 패널 20 : 샤시

30 : 회로기판 40 : 단열 수단

52 : 돌출부 53 : 요입부

54 : 요철 55 : 흰

56 : 사다리꼴 형상의 요철 57 : 바둑판 형상의 양각 돌출부

61 : 통풍홈

발명의 상세한 설명



**발명의 목적**

● 발명이 속하는 기술분야 및 그 분야의 종래기술

본 발명은 플라즈마 디스플레이 장치에 관한 것으로서, 더욱 상세하게는 플라즈마 디스플레이 패널(plasma display panel)로부터 발생하는 열이 패널을 구동하는 회로기판으로 전달되는 것을 차단하는 구조를 구비하는 플라즈마 디스플레이 장치에 관한 것이다.

플라즈마 디스플레이 장치는 가스 방전현상을 이용하여 화상을 표시하는 평판 디스플레이 장치로서, 표시 용량, 휘도, 콘트라스트, 잔상 및 시야각 등의 각종 표시 능력이 우수하며, 박형이고 대화면 표시가 가능하여 음극선관(CRT)을 대체할 수 있는 차세대 대형 평판 디스플레이 장치로서 각광을 받고 있다.

도 1에는 이러한 일반적인 플라즈마 디스플레이 장치의 일례를 개략적으로 나타낸 분리 사시도가 도시되어 있다.

일반적으로 플라즈마 디스플레이 장치는, 가스 방전을 이용하여 문자나 이미지를 표현하며 전면기판(11)과 배면기판(12)을 포함하는 플라즈마 디스플레이 패널(10)과, 그 배면에 배치되는 사시(20), 및 사시(20)의 배면에 배치되며 플라즈마 디스플레이 패널(10)을 구동하는 회로기판(30)을 구비한다.

일반적인 플라즈마 디스플레이 장치에 있어서 열을 발생시키는 주요 구성 요소는 플라즈마 디스플레이 패널(10)과 회로기판(30)이다. 플라즈마 디스플레이 패널(10)에서 발생하는 열은 주로 열전도율이 높은 사시(20)로 전달되어 외부로 방출되는데, 그 일부는 회로기판(30)으로 전달된다. 회로기판(30)은 플라즈마 디스플레이 패널(10)을 구동하는 구동소자(마도시)를 포함하며, 최근에는 구동회로의 신뢰성 및 생산성을 향상시키기 위하여 여러 가지의 반도체 소자를 하나의 기판에 집적한 하이브리드 집적회로(hybrid integrated circuit)를 사용하고 있는 추세이다. 상기 하이브리드 집적회로는 내부에 발열소자가 집중되어 있기 때문에, 구동 시 고열을 발생하게 된다. 이와 같이 발생된 열은 반도체 소자와 같은 회로부품의 구동 특성을 저하시킨다. 특히, 플라즈마 디스플레이 장치는 음극선관과는 달리 좁은 공간에서 박형으로 화상을 형성하도록 구성되어 있기 때문에, 집적회로에서 발생한 열을 외부로 방출시키기 위한 별도의 냉각장치를 필요로 한다.

그런데, 상기와 같이 구성된 종래의 플라즈마 디스플레이 장치에 있어서는 사시(20) 위에 회로기판(30)을 직접 접촉함으로써, 사시(20)가 플라즈마 디스플레이 패널(10)에서 발생하는 열을 회로기판(30)에 직접 전달하는 매체가 되고 있다. 이러한 구조는 사시(20)의 방열을 방해하기 때문에 플라즈마 디스플레이 패널(10) 잔상 등의 불량을 유발할 뿐만 아니라, 회로기판(30)으로 전달된 열이 회로에 영향을 주어 안정적인 회로 동작을 저해하게 함으로써, 신뢰성을 떨어뜨리는 문제점이 있었다.

● 발명이 이루고자 하는 기술적 과제

본 발명은 상기와 같은 문제점을 해결하기 위한 것으로, 본 발명의 목적은 사시의 배면과 회로기판 사이에 단열 수단을 삽입하여 플라즈마 디스플레이 패널로부터 발생하는 열이 회로 기판으로 전달되는 것을 차단함으로써 안정적인 회로 동작을 가능하도록 하는 플라즈마 디스플레이 장치를 제공하는데 있다. 본 발명의 다른 목적은 방열 능력이 우수한 요철 형상의 사시를 배치함으로써 플라즈마 디스플레이 패널로부터 전달되는 열의 방출을 촉진하는 플라즈마 디스플레이 장치를 제공하는데 있다.

발명(고안)의 구성 및 작용

상기와 같은 목적 및 그 밖의 다른 목적을 달성하기 위하여, 본 발명은 플라즈마 디스플레이 패널, 상기 플라즈마 디스플레이 패널의 배면에 배치되는 사시, 상기 사시의 배면에 배치되는 회로기판, 및 상기 회로기판과 상기 사시의 사이에 위치하는 단열 수단을 포함하는 플라즈마 디스플레이 장치를 제공한다.

본 발명에 있어서 상기 단열 수단은 바람직하게는 적어도 하나의 단열판으로 이루어질 수 있다.

본 발명에 있어서 상기 사시는 바람직하게는 전면 또는 배면 중 적어도 어느 하나의 면에 요입부와 요철부가 교번하도록 요철 형상으로 절곡될 수 있다.

본 발명에 있어서 바람직하게는 상기 돌출부의 양측면에 요철부가 형성되도록 할 수 있다.

본 발명에 있어서 바람직하게는 상기 돌출부의 양측면에 다수의 환이 구비되도록 할 수 있다.

본 발명에 있어서 상기 돌출부와 상기 요입부는 바람직하게는 사다리꼴 형태가 될 수 있다.

이어서, 첨부된 도면들을 참조하여 본 발명의 바람직한 실시예를 상세히 설명한다.

도 2에는 본 발명의 바람직한 일 실시예에 따른 플라즈마 디스플레이 장치의 개략적인 분리 사시도가 도시되어 있다. 도면을 참조하면, 플라즈마 디스플레이 장치는, 가스 방전을 이용하여 문자나 이미지를 표현하며 전면기판(11)과 배면기판(12)을 포함하는 플라즈마 디스플레이 패널(10)과, 그 배면에 배치되는





샤시(20), 및 샤시(20)의 배면에 배치되며 플라즈마 디스플레이 패널(10)을 구동하는 회로기판(30)을 구비하며, 추가적으로 샤시(20)와 회로기판(30) 사이에 단열 수단(40)이 삽입되어 있다. 단열 수단(40)은 도 3a에 도시된 바와 같이, 하나의 단열판(41) 모양으로 할 수도 있고, 도 3b에 도시된 바와 같이 회로기판(30)의 수를 고려하여 둘 이상의 단열판(41)으로 분리되어 삽입될 수 있다. 다수개의 단열판(41)을 삽입할 경우 단열판(41)과 샤시(20)와의 접촉 면적이 작아지므로, 샤시(20)의 방열 면적이 증가되어 샤시(20)의 방열 능력이 향상된다.

더욱이, 회로기판(30)과 샤시(20) 사이에 단열판(41)이 개재되므로, 플라즈마 디스플레이 패널(10)에서 발생된 열이 회로기판(30)으로 전달되는 것을 차단할 수 있어, 회로기판(30) 내에서 회로가 열에 의해 오동작되는 것을 방지할 수 있게 된다.

또한, 플라즈마 디스플레이 패널(41)은 플라즈마 디스플레이 장치의 주된 히트 소스(heat source)인 플라즈마 디스플레이 패널(10)과 회로기판(30)의 방열을 단열판(41)을 경계로 하여 독립적으로 수행하도록 할 수 있게 해주기 때문에, 플라즈마 디스플레이 장치의 설계자들의 방열 방법에 대한 설계 자유도가 증대된다.

샤시(20)는, 도 4에 도시된 바와 같이, 플라즈마 디스플레이 패널(10)로부터의 전달된 열의 방출을 촉진시키기 위해 요철 형상으로 절곡되어 있는 것이 바람직하다. 이와 같은 구성을 갖는 샤시(20)는 증가된 열전달 면적을 갖게 되어 방열 능력이 향상된다. 또한, 요철 형상을 갖는 샤시(20)의 경우, 송풍기(미도시)에 의한 강제 대류가 생성되어 방열될 때뿐만 아니라, 송풍기(미도시)없이 자연 대류에 의해서 방열될 경우에도, 샤시(20)로부터 열전달을 받은 온도가 상승한 공기가 요입부(53)와 돌출부(52)에 형성된 통풍홀(61)을 따라서 자연스럽게 흐르도록 해 주기 때문에 방열 능력이 향상된다.

도 5a에는 플라즈마 디스플레이 패널(10)의 세로 방향으로 통풍홀(61)이 형성된 요철 형상의 샤시(20)가 도시되어 있다. 샤시(20)로부터 열전달을 받은 공기는 온도가 상승하여 부력 효과에 의해 통풍홀(61)을 따라 위쪽으로 원활하게 방출될 수 있기 때문에 방열 능력을 증대시킨다. 또한, 요철 형상에 의해 증가된 열전달 면적과 통풍홀(61)에 의한 공기 유로는 샤시(20)의 방열 능력을 증대시킨다.

도 5b에는 플라즈마 디스플레이 패널(10)의 가로 방향으로 통풍홀(61)이 형성된 요철 형상의 샤시(20)가 도시되어 있다. 일반적으로 회로기판(30)과 플라즈마 디스플레이 패널(10)이 FPCB(flexible printed circuit board)(미도시)를 매개로 하여 연결되는데, FPCB는 샤시(20)의 상부측면 또는 하부측면을 통하여 연장된다. 만일 고온의 공기가 FPCB와 접촉하게 되면 열전달에 의해 FPCB에 형성되어 있는 회로와 FPCB에 실장된 전가소자에 악영향을 줄 수 있다. 따라서, 샤시(20)에 가로 방향으로 통풍홀(61)을 형성시키게 되면, 샤시(20)로부터 열전달을 받은 고온의 공기가 통풍홀(61)을 따라 샤시(20)의 좌우측 방향으로 배출되어, FPCB와의 직접적인 접촉을 하지 않으므로 FPCB가 안정적으로 작동할 수 있게 된다.

도 6a는 요철 형상의 샤시의 돌출부(52)에 요철(54)을 형성시킨 것을 나타낸다. 열전달 면적의 추가적인 증가로 방열 능력이 증대된다.

또한, 도 6b에 도시된 바와 같이 요철 형상의 샤시(20)의 돌출부(52)에 릿(fin)(55)을 설치함으로써 열전달 면적을 증가시켜 방열 능력을 증가시킬 수 있다.

도 7은 사다리꼴 형상의 요철(56)을 나타낸다. 사다리꼴 형상의 요철(56)의 경우도 사각형 형상의 요철처럼 열전달 면적이 증가할 뿐만 아니라, 열전달되는 통풍홀(61)의 유로가 매끄럽게 형성되기 때문에 방열 능력이 우수해진다.

도 8에는 바둑판 모양의 양각 돌출부(57)를 가진 샤시(20)의 일부 샤시도를 나타낸다. 바둑판 모양의 양각 돌출부(57)는 돌출된 부분으로 인하여 평판에 비해 열전달 면적이 증가하여 방열 능력이 향상된다. 또한, 통풍 유로가 플라즈마 디스플레이 패널(10)의 가로 방향뿐만 아니라 세로 방향으로도 형성되어, 샤시(20)로부터 열전달을 받은 고온의 공기가 외부로 원활하게 유출되므로 샤시(20)의 방열 능력을 증가시킨다.

발명(고안)의 효과

상술한 바와 같은 본 발명의 플라즈마 디스플레이 장치에 의하면 다음과 같은 효과가 있다.

첫째, 샤시와 회로기판 사이에 단열 수단을 삽입함으로써 플라즈마 디스플레이 패널로부터 발생하는 열이 회로기판에 전달되어 회로의 오동작이 발생하는 것을 억제한다.

둘째, 단열 수단의 삽입으로 플라즈마 디스플레이 패널로부터 발생하는 열과 회로기판에서 발생하는 열을 분리하여 독립적으로 방출시킬 수 있으므로, 설계자들의 방열 설계의 자유도가 증대된다.





셋째, 사시를 요철 형상으로 형성하여 열전달 면적을 증가시킴으로 방열 능력이 향상된다. 또한, 요철의 돌출부의 양측면에 요철부를 형성하거나 다수의 원을 설치함으로써 열전달 면적의 추가적인 증가로 방열 능력이 증대된다.

넷째, 사시에 요철 형상에 의한 뚫음통을 세로 방향으로 형성할 경우, 자연 대류에 의하여 사시로부터 열전달을 받은 고온의 공기가 원활하게 외부로 배출되므로, 열전달 효과가 증대되어 방열능력이 향상된다. 또한, 뚫음통을 가로 방향으로 형성할 경우, 사시의 상부측면 또는 하부측면에 위치하는 FPCB가 사시로부터 열전달을 받은 고온의 공기에 의해 악영향을 받는 것을 감소시킬 수 있다.

다섯째, 사시와 회로기판 사이에 단열수단을 개재시킴으로 인해 사시의 방열성이 떨어지는 것을 사시의 형상을 요철 형상으로 함으로써 방지 할 수 있다.

본 발명은 도면에 도시된 실시예를 참고로 설명되었으나 이는 예시적인 것에 불과하며, 본 발명이 속하는 기술 분야에서 통상의 지식을 가진 자라면 이로부터 다양한 변형 및 균등한 다른 실시예가 가능하다는 점을 이해할 것이다. 따라서, 본 발명의 진정한 기술적 보호 범위는 첨부된 특허청구범위의 기술적 사상에 의하여 정해져야 할 것이다.

❖ 청구의 범위

❖ 청구항 [1]

플라즈마 디스플레이 패널;

상기 플라즈마 디스플레이 패널의 배면에 배치되는 사시;

상기 사시의 배면에 배치되는 회로기판; 및

상기 회로기판과 상기 사시의 사이에 위치하는 단열 수단을 포함하는 것을 특징으로 하는 플라즈마 디스플레이 장치.

❖ 청구항 [2]

제1항에 있어서, 상기 단열 수단은 적어도 하나의 단열판으로 이루어진 것을 특징으로 하는 플라즈마 디스플레이 장치.

❖ 청구항 [3]

제1항에 있어서, 상기 사시는 전면 또는 배면 중 적어도 어느 하나의 면에 요입부와 돌출부가 교번하도록 요철 형상으로 절곡된 것을 특징으로 하는 플라즈마 디스플레이 장치.

❖ 청구항 [4]

제3항에 있어서, 상기 사시의 상기 요입부 및 상기 돌출부로 이루어진 뚫음구가 상기 플라즈마 디스플레이 패널의 가로 방향과 실질적으로 평행하도록 형성된 것을 특징으로 하는 플라즈마 디스플레이 장치.

❖ 청구항 [5]

제3항에 있어서, 상기 사시의 상기 요입부 및 상기 돌출부로 이루어진 뚫음구가 상기 플라즈마 디스플레이 패널의 세로 방향과 실질적으로 평행하도록 형성된 것을 특징으로 하는 플라즈마 디스플레이 장치.

❖ 청구항 [6]

제3항 내지 제5항 중 어느 한 항에 있어서, 상기 돌출부의 양측면에 요철부가 형성된 것을 특징으로 하는 플라즈마 디스플레이 장치.

❖ 청구항 [7]

제3항 내지 제5항 중 어느 한 항에 있어서, 상기 돌출부의 양측면에 다수의 원이 구비된 것을 특징으로 하는 플라즈마 디스플레이 장치.

❖ 청구항 [8]

제3항 내지 제5항 중 어느 한 항에 있어서, 상기 돌출부와 상기 요입부가 사다리꼴의 형상인 것을 특징으로 하는 플라즈마 디스플레이 장치.

❖ 청구항 [9]

제1항 또는 제2항에 있어서, 상기 사시는 배면에 바둑판 모양의 양각 돌출부를 구비하는 것을 특징으로 하는 플라즈마 디스플레이 장치.

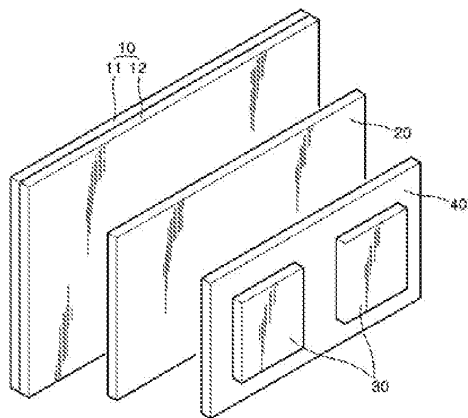
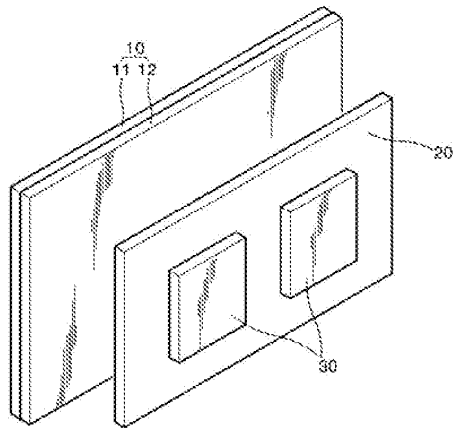


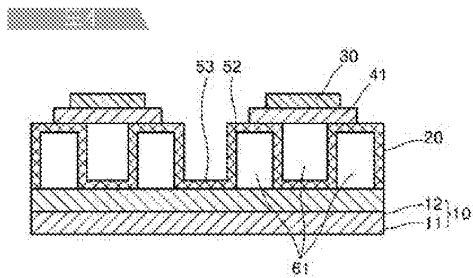
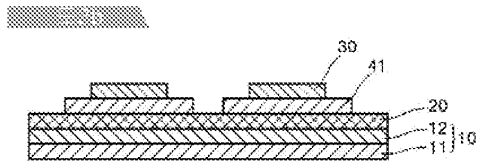
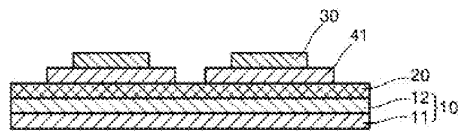


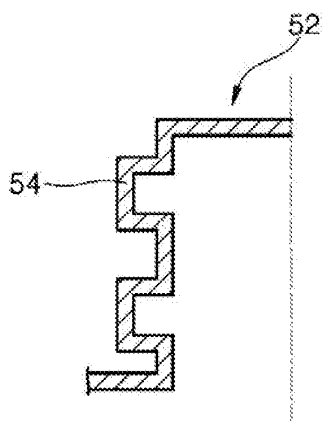
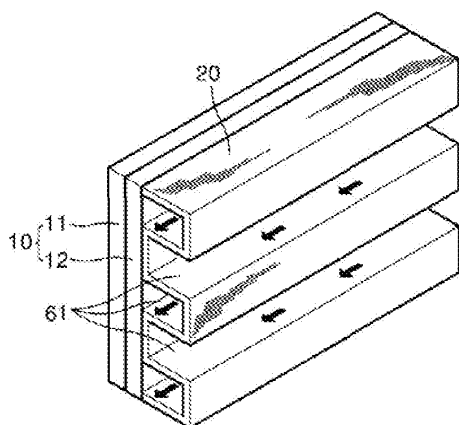
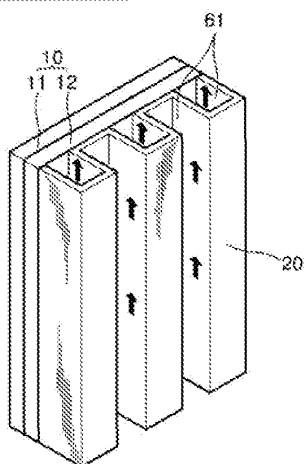
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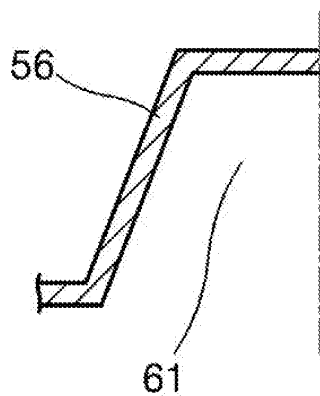
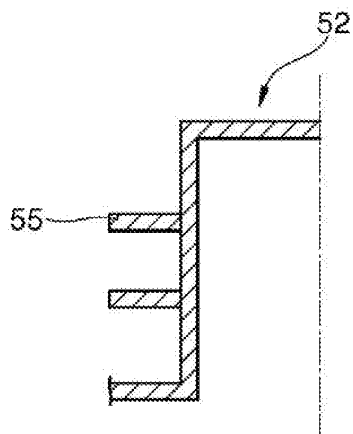
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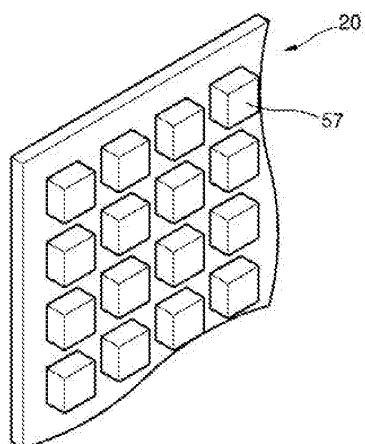
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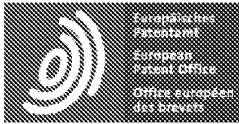




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Bibliographic data: KR20060016469 (A) — 2006-02-22**BACK LIGHT UNIT AND LIQUID CRYSTAL DISPLAY APPARATUS HAVING THE SAME****Inventor(s):** RA DONG GYUN [KR] ± (RA, DONG GYUN)**Applicant(s):** SAMSUNG ELECTRONICS CO LTD [KR] ± (SAMSUNG ELECTRONICS CO., LTD)**Classification:** - international: G02F1/13357
- cooperative: G02B6/0011; G02B6/0031; G02F1/133308;
G02F1/133385; G02F1/133603; G02F1/133604;
G02F2001/133628 [more](#)**Application number:** KR20040064922 20040818 [Global Dossier](#)**Priority number (s):** KR20040064922 20040818

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DESCRIPTION KR20060016469

BACKLIGHT UNIT AND LIQUID CRYSTAL DISPLAY DEVICE INCLUDING THE SAME

1 is an exploded perspective view of a backlight unit according to an embodiment of the present invention.

Fig. 2 is a plan view of the backlight unit of Fig. 1 from below. Fig.

3 is a side view for explaining the cooling process of the backlight unit of FIG.

4 is an exploded perspective view of a backlight unit according to another embodiment of the present invention.

5 is a plan view showing the backlight unit of FIG. 4 from below.

6 is a side view for explaining the cooling process of the backlight unit of FIG.

7 is an exploded perspective view of a backlight unit according to another embodiment of the present invention.

8 is a plan view showing the backlight unit of FIG. 7 from the bottom.

9 is a side view for explaining the cooling process of the backlight unit of FIG.

10 is an exploded perspective view of a backlight unit according to another embodiment of the present invention.

Fig. 11 is a plan view showing the backlight unit of Fig. 10 from below. Fig.

12 is a side view for explaining the cooling process of the backlight unit of FIG.

13 is an exploded perspective view showing a liquid crystal display device having the backlight unit of FIG.

14 is an exploded perspective view showing a liquid crystal display device having the backlight unit of Fig.

Description of the Related Art [0002]

100

: Plane light source device 110: reflector

112

: Coupling hole 120: Side wall

130

: Driving substrate 140: light emitting diode light source

[200]

200, 300: storage container 210, 310: bottom plate

[220]

220, 320: first side wall 230, 330: second side wall

[240]

240, 340: third side wall 250, 350: fourth side wall

[260]

260, 360: inner space 212, 312: through hole

[214]

214, 314: first drive circuit portions 222a, 322a, 332a, 342a, 352a: fan

[222]

222B, 322b, 332b, 342b, 352b: fans 224, 324:

[500]

500, 600: backlight unit 800, 900: liquid crystal display

820

: Optical sheet 840: Liquid crystal display panel

842

: Thin film transistor substrate 844: liquid crystal

846

: Color filter substrate 848: Driving module

860

: Chassis

BACKGROUND OF THE INVENTION 1. Field of the Invention The present invention relates to a backlight unit and a liquid crystal display including the same, and more particularly, to a backlight unit and a liquid crystal display including the same. In general, a liquid crystal display device displays an image using electrical and optical characteristics of a liquid crystal. The liquid crystal display device is advantageous in that it is very small in volume and light in weight compared to a CRT, and as a result, is widely used in portable computers, communication devices, liquid crystal TVs, and the

like. In order to control the liquid crystal, the liquid crystal display requires a liquid crystal control part for controlling the liquid crystal and a light supply part for supplying light to the liquid crystal. As the light supply part of the liquid crystal display device, a cold cathode fluorescent lamp (CCFL) having a rod shape or a light emitting diode (LED) having a dot shape is mainly used. The light emitting diode has the advantage of high color reproducibility. However, the light emitting diode generates a lot of heat due to its luminescent characteristics. Particularly, the light emitting diode has a lot of heat radiated backward from the liquid crystal display device, and the temperature of the storage container for storing the light emitting diode is extremely high. In order to prevent an increase in the temperature of the storage container, the storage container may include a heat sink having a metal material such as aluminum. However, even if the storage container includes the heat sink, the thickness and weight of the storage container increase, and the thickness and weight of the liquid crystal display also increase. Therefore, when the light emitting diode is used as a light supply part of a liquid crystal display device or when another device generating a lot of heat other than the light emitting diode is used as a light supply part, the temperature of the storage container may increase, And the weight increases. Accordingly, it is an object of the present invention to provide a backlight unit having an increased cooling effect and reduced thickness and weight. Another object of the present invention is to provide a liquid crystal display device having the aforementioned backlight unit.

In order to achieve the object of the present invention, the present invention provides a backlight unit including a light generating unit and a storage container. The light generating unit generates light. The storage container houses the light generating portion, and has an intake portion for sucking outside air and an exhaust portion for releasing internal air. In order to achieve another object of the present invention, the present invention provides a backlight unit including a light generating unit and a storage container. The light generating unit generates light. The storage container houses the light generating portion, and has an intake portion for sucking outside air and an exhaust portion for discharging internal air. In order to achieve another object of the present invention, the present invention includes a backlight unit and a liquid crystal display panel. The backlight unit includes a light generating unit for generating light, and a storage container for storing the light generating unit, an intake unit for sucking outside air, and an exhaust unit for emitting internal air. The liquid crystal display panel displays an image using light emitted from the light generating unit. In order to achieve another object of the present invention, the present invention includes a backlight unit and a liquid crystal display panel. The backlight unit includes a light generating unit for generating light, and a storage container for storing the light generating unit, an intake

unit for sucking outside air, and an exhaust unit for emitting internal air. The liquid crystal display panel displays an image using light emitted from the light generating unit. According to the present invention, the thickness and weight of the backlight unit are reduced, and the cooling effect is increased. Further, the brightness and the contrast ratio of the backlight unit are prevented from lowering. Hereinafter, a backlight unit and a liquid crystal display including the same according to preferred embodiments of the present invention will be described in detail with reference to the accompanying drawings, but the present invention is not limited or limited by the following embodiments. 1 is an exploded perspective view of a backlight unit according to an embodiment of the present invention, and FIG. 2 is a plan view showing a backlight unit of FIG. 1 from the bottom. Referring to FIGS. 1 and 2, the backlight unit 500 includes a surface light source device 100 and a storage container 200.

The surface light source device 100 includes a reflector 110, a side wall 120, a driving substrate 130, and a plurality of light emitting diode light sources 140. The reflection plate 110 has a rectangular flat plate shape and reflects downward light of the light emitted from the light emitting diode light sources 140 upward. A plurality of coupling holes 112 are formed in the reflection plate 110 so that the light emitting diode light source 140 can be coupled. The side wall 120 is formed at the edge of the reflector 110 so that the surface light source device 100 can be easily coupled to the storage container 200. In the present embodiment, the side wall 120 is formed at a pair of opposing edges of the reflection plate 110. The driving substrate 130 is arranged at a lower portion of the reflection plate 110. A driving power source is applied to the driving substrate 130 to light the light emitting diode light sources 140. The light emitting diode light sources 140 are arranged in a line on the driving substrate 130 and are coupled to the upper surface of the reflection plate 110 through the coupling holes 112. Preferably, the light emitting diode light sources 140 include a red light emitting diode R for generating red light, a green light emitting diode G for generating green light, and a blue light emitting diode B for generating blue light. The red light, the green light, and the blue light emitting diodes R, G, and B generate white light according to a predetermined combination ratio. For example, the ratio of the number of the red light emitting diode R, the number of the green light emitting diode G, and the number of the blue light emitting diode B may be 2: 1: 1 or 2: 2: 1. Further, the red light, the green light, and the blue light light emitting diodes R, G, and B may be disposed more than the numbers shown in FIG. Alternatively, the light emitting diode light sources 140 may include a white light emitting diode that generates white light. The storage container 200 houses the surface light source device 100. The storage container 200 includes a bottom plate 210, a first side wall 220, a second side wall 230, a third side wall 240 and a fourth side wall 250.

The bottom plate 210 has a rectangular plate shape and includes a first driving circuit 214 and a plurality of through holes 212. The first driving circuit portion 214 is disposed on the bottom plate 210 and drives the surface light source device 100. The through holes 212 are formed in a portion excluding the portion where the first driving circuit portion 214 is disposed, and are formed through the bottom plate 210. Through the through holes 212, air can be moved. In the present embodiment, the through - holes 212 serve as an intake unit in which external air is sucked. The first to fourth sidewalls 220, 230, 240, and 250 extend from the edges of the bottom plate 210 to form a storage space and an inner space, respectively. The first sidewall 220 is disposed at one edge of the bottom plate 210 and is preferably not perpendicular to the bottom plate 210. Specifically, the first side wall 220 is inclined outward with respect to the bottom plate 210. Alternatively, the first sidewall 220 may be perpendicular to the bottom plate 210. The second to fourth sidewalls 230, 240 and 250 are respectively disposed at the other edge portions of the bottom plate 210 and are perpendicular to the bottom plate 210. The second sidewall 230 is disposed adjacent to the first sidewall 220. The third sidewall 240 is disposed adjacent to the second sidewall 230 and faces the first sidewall 220. The fourth sidewall 250 is disposed adjacent to the first and third sidewalls 220 and 240 and opposes the second sidewall 230. The first sidewall 220 is formed with a plurality of fans 222a. The fans 222a are actuated to cause air to flow out of the internal space. Accordingly, the heat generated from the surface light source device 100 is transmitted to the outside from the inner space. In the present embodiment, the fans 222a function as an exhaust unit that emits internal air. The first sidewall 220 may further include a second driving circuit portion 224.

The second driving circuit portion 224 is disposed on the first sidewall 220 and includes components of the apparatus having the backlight unit 100 according to the present embodiment as a light supply part, And can be used for driving the liquid crystal display panel. Alternatively, the second driving circuit portion 224 may be disposed on the second to fourth sidewalls 230, 240, and 250. Meanwhile, the first to fourth sidewalls 220, 230, 240 and 250 may be coupled to the reflector 110 of the surface light source device 100 in a hook - like manner. Hereinafter, the cooling process of the backlight unit having the above - described structure will be described in detail with reference to the drawings. 3 is a side view for explaining the cooling process of the backlight unit of FIG. Referring to FIG. 3, the light emitting diode array substrate 110 of the surface light source device 100 is driven to generate heat. The temperature of the air staying in the internal space 260 between the surface light source device 100 and the storage container 200 is raised by the heat. The heated air is discharged to the outside of the backlight unit 500 by the plurality of fans 222a formed on the first sidewall 220. When the hot air is discharged to the outside of the backlight unit 1000, the pressure of the inner space 260 is lowered. Therefore, cold air, which is cooler than the hot air in the

inner space 260, flows from the outside of the backlight unit 500 through the through holes 212. Accordingly, the processes of releasing the high - temperature internal air and the low - temperature external air are continuously repeated, and as a result, the heat generated in the surface light source device 100 is cooled by the flow of air. Particularly, the cooling process according to the present embodiment is mainly performed by free convection of air. That is, the temperature of the air in the internal space 260 rises due to the heat generated in the surface light source device 100, and the high temperature air rises upward in the internal space 260 by the convection action. And is then discharged to the outside by the discharge ports 222a.

Then, the outside low - temperature air flows into the internal space 260 through the through - holes 212, and the temperature is raised by the heat generated in the surface light source device and is raised by the convection action . In this embodiment, the through holes are formed on the bottom plate, but the through holes may be additionally formed in the first to fourth sidewalls, and may be formed only in the first to fourth sidewalls . That is, the through - hole may be formed in at least one of the bottom plate and the first to fourth sidewalls. Also, in this embodiment, the fan is formed on the first sidewall, but the fan may be additionally formed on at least one of the bottom plate and the second to fourth sidewalls. Meanwhile, in the present embodiment, the surface light source device including the light emitting diode is used as a light generating portion, but an apparatus including another light source requiring cooling may also be applied as the light generating portion of the present invention. According to the present embodiment, the components that perform the cooling function directly are formed in the storage container of the backlight unit. Therefore, the thickness and weight of the backlight unit are reduced. In addition, the cooling effect is increased by the natural convection phenomenon according to the operation of the components. Thus, the luminance and contrast ratio of the backlight unit are prevented from lowering. 4 is an exploded perspective view of a backlight unit according to another embodiment of the present invention, and FIG. 5 is a plan view showing a backlight unit of FIG. 4 from the bottom. Referring to FIGS. 4 and 5, the backlight unit 600 includes the surface light source device 100 and the storage container 300. The planar light source device 100 employed in the present embodiment has the same structure and function as the planar light source device shown in FIG. 1, and thus a repetitive description thereof will be omitted. The storage container 300 houses the surface light source device 100. The storage container 300 includes a bottom plate 310, a first side wall 320, a second side wall 330, a third side wall 340 and a fourth side wall 350. The bottom plate 310 has a rectangular plate shape and includes a first driving circuit portion 314 and a plurality of through holes 312.

The first driving circuit portion 314 is disposed on the bottom plate 310 and drives the surface light source device 100. [The through holes 312 are formed in a portion excluding the portion where the first driving circuit portion 314 is disposed, and are formed through the bottom plate 310. Through the through holes 312, air can move. In the present embodiment, the through - holes 312 serve as an intake unit in which outside air is sucked. The first to fourth sidewalls 320, 330, 340, and 350 extend from the edges of the bottom plate 310, respectively, to form a storage space and an inner space. Each of the first to fourth sidewalls 320, 330, 340 and 350 is disposed at one edge of the bottom plate 310 and is preferably not perpendicular to the bottom plate 310. Specifically, the first to fourth sidewalls 320, 330, 340, and 350 are inclined outward with respect to the bottom plate 310. Alternatively, some or all of the first through fourth sidewalls 320, 330, 340, and 350 may be perpendicular to the bottom plate 310. The first to fourth sidewalls 320, 330, 340, and 350 are sequentially disposed adjacent to each other. The first sidewall 320 and the third sidewall 340 are opposed to each other and the second sidewall 330 and the fourth sidewall 350 are opposed to each other. A plurality of fans 322a, 332a, 342a, and 352a are formed on the first to fourth sidewalls 320, 330, 340, and 350, respectively. The fans 322a, 332a, 342a, and 352a are actuated to cause air to flow out of the interior space. Accordingly, the heat generated from the surface light source device 100 is transmitted to the outside from the inner space. In the present embodiment, the fans 322a, 332a, 342a, and 352a function as an exhaust unit that emits internal air. The first sidewall 320 may further include a second driving circuit portion 324. The second driving circuit portion 324 is disposed on the first sidewall 320 and includes components of the apparatus having the backlight unit 100 according to the present embodiment as a light supply part, And can be used for driving the liquid crystal display panel.

Alternatively, the second driving circuit portion 324 may be disposed on the second to fourth sidewalls 330, 340 and 350. Meanwhile, the first to fourth sidewalls 320, 330, 340 and 350 may be coupled to the reflector 110 of the surface light source device 100 in a hook - like manner. Hereinafter, the cooling process of the backlight unit having the above - described structure will be described in detail with reference to the drawings. 6 is a side view for explaining the cooling process of the backlight unit of FIG. Referring to FIG. 6, the driving substrate 130 of the surface light source device 100 is driven to generate heat. The temperature of the air staying in the internal space 360 between the surface light source device 100 and the storage container 300 is raised by the heat. The raised temperature of the air is discharged to the outside of the backlight unit 2000 by the plurality of fans 322a, 332a, 342a, and 352a formed on the first to fourth sidewalls 320, 330, 340, When the hot air is discharged to the outside of the backlight unit 2000, the pressure of the inner space 360 is lowered. Therefore, cold air, which is cooler than the hot air in the inner space 360, flows from the outside of the backlight unit 2000

through the through holes 312. Accordingly, the processes of releasing the high - temperature internal air and the low - temperature external air are continuously repeated, and as a result, the heat generated in the surface light source device 100 is cooled by the flow of air. In this embodiment, the through holes are formed on the bottom plate, but the through holes may be additionally formed in the first to fourth sidewalls, and may be formed only in the first to fourth sidewalls . That is, the through - hole may be formed in at least one of the bottom plate and the first to fourth sidewalls. Further, in this embodiment, the fan is formed on the first to fourth sidewalls, but the fan can be additionally formed on the bottom plate, and the fan can be formed on the bottom plate and the first to fourth side walls As shown in FIG.

That is, the fan may be formed on at least one of the bottom plate and the first to fourth sidewalls. Meanwhile, in the present embodiment, the surface light source device including the light emitting diode is used as a light generating portion, but an apparatus including another light source requiring cooling may also be applied as the light generating portion of the present invention. According to the present embodiment, the components that perform the cooling function directly are formed in the storage container of the backlight unit. In particular, the fans are formed in the various sidewalls of the storage container to further improve the cooling function. Therefore, the thickness and weight of the backlight unit are reduced. In addition, the cooling effect is increased by the natural convection phenomenon according to the operation of the components. Thus, the luminance and contrast ratio of the backlight unit are prevented from lowering. 7 is an exploded perspective view of a backlight unit according to another embodiment of the present invention, and Fig. 8 is a plan view showing a backlight unit of Fig. 7 from the bottom. In the third embodiment, elements having the same structure and function as the elements in the first embodiment are denoted by the same reference numerals, and a detailed description thereof will be omitted. Referring to FIGS. 7 and 8, a plurality of fans 222b are formed on the first sidewall 220. As shown in FIG. The fans 222b are operated to flow air from the outside to the inner space. Accordingly, the heat generated in the surface light source device 100 is cooled by the low - temperature air introduced from the outside. In the present embodiment, the fans 222b function as an intake unit for sucking outside air. In addition, the fans 222b act as a cooler for cooling the surface light source device 100 actively. Hereinafter, the cooling process of the backlight unit having the above - described structure will be described in detail with reference to the drawings. 9 is a side view for explaining a cooling process of the backlight unit of FIG. Referring to FIG. 9, the driving substrate 130 of the surface light source device 100 is driven to generate heat. The temperature of the air staying in the internal space 260 between the surface light source device 100 and the storage container 200 can be increased by the heat.

Here, the fans 222 b inject the outside air of the low temperature backlight unit 500 into the internal space 260 at a high speed. The injected outside air collides with a reflecting plate 110 where heat is generated to cool the reflecting plate 110. Meanwhile, since the outside air is introduced into the inside by the fans 222b, the internal pressure increases. Therefore, the air in the inner space 260 is discharged to the outside of the backlight unit 500 through the through holes 212. As a result, the inflow of the low - temperature external air and the high - temperature internal air are continuously repeated, and as a result, the heat generated in the surface light source 100 is cooled by the flow of air. Particularly, the cooling process according to the present embodiment is mainly performed by the forced convection phenomenon of the fans 222b functioning as the cooler. That is, the low - temperature external air introduced by the fans 222b collides with the surface light source device 100 generating heat at a high speed to cool the surface light source device 100. [Accordingly, the fans 222a according to the first embodiment have a passive function of discharging the hot air of the internal space 260 to the outside, whereas the fans 222b according to the present embodiment are active Function. Generally, heat transfer effect by forced convection is greater than heat transfer effect by natural convection phenomenon. Therefore, the cooling according to the present embodiment can be more effective. In the present embodiment, the through holes are formed on the bottom plate, but the through holes may be additionally formed in the first to fourth sidewalls, and may be formed only in the first to fourth sidewalls. That is, the through - hole may be formed in at least one of the bottom plate and the first to fourth sidewalls. Also, in this embodiment, the fan is formed on the first sidewall, but the fan may be additionally formed on at least one of the bottom plate and the second to fourth sidewalls. Meanwhile, in the present embodiment, the surface light source device including the light emitting diode is used as a light generating portion, but an apparatus including another light source requiring cooling may also be applied as the light generating portion of the present invention.

According to the present embodiment, the components that perform the cooling function directly are formed in the storage container of the backlight unit. Therefore, the thickness and weight of the backlight unit are reduced. In addition, the forced convection phenomenon in accordance with the operation of the above components increases the cooling effect. Thus, the brightness and contrast ratio of the backlight unit are prevented from lowering. 10 is an exploded perspective view of a backlight unit according to another embodiment of the present invention, and FIG. 11 is a plan view showing a backlight unit of FIG. 10 from below. In the fourth embodiment, elements having the same structure and function as the elements in the second embodiment are denoted by the same reference numerals, and a detailed description thereof will be omitted. Referring to FIGS. 10 and 11, a plurality of fans 322b, 332b, 342b, and 352b are formed

on the first to fourth sidewalls 320, 330, 340, and 350, respectively. The fans 322b, 332b, 342b, and 352b can cool the heat generated from the surface light source device 100 by sucking outside air at a low temperature. In the present embodiment, the fans 322b, 332b, 342b, and 352b function as an air intake unit for sucking outside air. In addition, the fans 322b, 332b, 342b, and 352b function as a cooler for actively cooling the surface light source device 100. [Hereinafter, the cooling process of the backlight unit having the above - described structure will be described in detail with reference to the drawings. 12 is a side view for explaining the cooling process of the backlight unit of FIG. Referring to FIG. 12, the driving substrate 130 of the surface light source device 100 is driven to generate heat. The temperature of the air staying in the internal space 360 between the surface light source device 100 and the storage container 300 can be increased by the heat. The fans 322b, 332b, 342b, and 352b inject outside air of the low temperature backlight unit 600 into the internal space 360 at a high speed. The injected outside air collides with a reflecting plate 110 where heat is generated to cool the reflecting plate 110.

Meanwhile, since the outside air is introduced into the inside by the fans 322b, 332b, 342b, and 352b, the internal pressure increases. Therefore, the air in the inner space 360 is discharged to the outside of the backlight unit 600 through the through holes 312. As a result, the inflow of the low - temperature external air and the high - temperature internal air are continuously repeated, and as a result, the heat generated in the surface light source 100 is cooled by the flow of air. In the present embodiment, the through holes are formed on the bottom plate, but the through holes may be additionally formed in the first to fourth sidewalls, and may be formed only in the first to fourth sidewalls. That is, the through - hole may be formed in at least one of the bottom plate and the first to fourth sidewalls. Further, in this embodiment, the fan is formed on the first to fourth sidewalls, but the fan can be additionally formed on the bottom plate, and the fan can be formed on the bottom plate and the first to fourth side walls As shown in FIG. That is, the fan may be formed on at least one of the bottom plate and the first to fourth sidewalls. Meanwhile, in the present embodiment, the surface light source device including the light emitting diode is used as a light generating portion, but an apparatus including another light source requiring cooling may also be applied as the light generating portion of the present invention. According to the present embodiment, the components that perform the cooling function directly are formed in the storage container of the backlight unit. In particular, the fans are formed in the various sidewalls of the storage container to further improve the cooling function. Therefore, the thickness and weight of the backlight unit are reduced. In addition, the forced convection phenomenon in accordance with the operation of the above components increases the cooling effect. Thus, the luminance and contrast ratio of the backlight unit are prevented from lowering. Liquid Crystal Display Device Embodiment 5 Fig. 13 is an exploded

perspective view showing a liquid crystal display device having the backlight unit of Fig. 13, the liquid crystal display device 800 includes a backlight unit 500, a liquid crystal display panel 840, and a chassis 860.

The backlight unit 500 employed in this embodiment has the same structure and function as those of the backlight unit shown in FIG. 1, and thus a repetitive description thereof will be omitted. The liquid crystal display panel 840 displays an image using light emitted from the surface light source device 100. The liquid crystal display panel 840 includes a thin film transistor (TFT) substrate 842, a liquid crystal 844, a color filter substrate 846, and a driving module 848. The TFT substrate 842 includes a pixel electrode (not shown) arranged in a matrix form, a thin film transistor (not shown), a gate line (not shown) and a data line (not shown) for applying a driving voltage to each of the pixel electrodes. The color filter substrate 846 includes a color filter (not shown) arranged to face the pixel electrode formed on the TFT substrate 842, and a common electrode (not shown) formed on the color filter. The liquid crystal 844 is interposed between the TFT substrate 842 and the color filter substrate 846. The driving module 848 drives the liquid crystal display panel 840. Alternatively, the second driving circuit portion 224 may be disposed on one of the bottom plate 210 and the first to fourth side walls 220, 230, 240, and 250 to drive the liquid crystal display panel 840. The edge of the color filter substrate 846 is enclosed by the chassis 860 and a part of the chassis 860 is coupled to the storage container 200. The chassis 860 prevents breakage of the liquid crystal display panel 840 which is vulnerable to an external impact and prevents the liquid crystal display panel 840 from flowing. The liquid crystal display device 800 may further include an optical sheet 820 for improving luminance uniformity of the light emitted from the surface light source device 100. The optical sheet 820 may include a diffusion sheet, a prism sheet, a protective sheet, and the like. A middle chassis (not shown) may be further provided on the optical sheet 820. The middle chassis abuts the optical sheet 820 to press the optical sheet 820 toward the storage container 200 side.

According to the present embodiment, the components that perform the cooling function directly are formed in the storage container of the backlight unit. Therefore, the thickness and weight of the backlight unit are reduced. In addition, the cooling effect is increased by the natural convection phenomenon according to the operation of the components. Thus, the thickness and weight of the liquid crystal display including the backlight unit are reduced, the cooling effect is increased, and the luminance and contrast ratio are prevented from lowering. Embodiment 6 Fig. 14 is an exploded perspective view showing a liquid crystal display device having a backlight unit of Fig. 14, the liquid crystal display device 900 includes a backlight unit 600, a liquid crystal display panel 840, and a chassis 860. The liquid crystal display device according to this

embodiment has the same structure and function as those of the liquid crystal display device according to the fifth embodiment except for the backlight unit. Further, the backlight unit 600 employed in this embodiment has the same structure and function as the backlight unit shown in Fig. According to the present embodiment, the components that perform the cooling function directly are formed in the storage container of the backlight unit. Therefore, the thickness and weight of the backlight unit are reduced. Further, by the forced convection phenomenon according to the operation of the components, the cooling effect is increased. Thus, the thickness and weight of the liquid crystal display device including the backlight unit are reduced, the cooling effect is increased, and the decrease in luminance and contrast ratio is prevented.

As described above, according to the present invention, according to the present embodiment, the components that perform the cooling function directly are formed in the storage container of the backlight unit. Therefore, the thickness and weight of the backlight unit are reduced. Further, the natural convection phenomenon or the forced convection phenomenon caused by the operation of the above - mentioned components increases the cooling effect. Thus, the thickness and weight of the liquid crystal display including the backlight unit are reduced, the cooling effect is increased, and the luminance and contrast ratio are prevented from lowering. While the present invention has been described in connection with what is presently considered to be practical and exemplary embodiments, it is to be understood that the invention is not limited to the disclosed embodiments, but, on the contrary, It will be understood by those skilled in the art that various changes in form and details may be made therein without departing from the spirit and scope of the invention.



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CLAIMS KR20060016469

1.

A light generating unit for generating light; And a storage container for storing the light generating part and including an intake part for sucking outside air and an exhaust part for releasing internal air.

2.

The backlight unit of claim 1, wherein the storage container includes a bottom plate and a plurality of side walls extending from an edge of the bottom plate to provide a storage space for accommodating the light generating unit.

3.

3. The apparatus of claim 2, wherein the sidewalls comprise a first sidewall, a second sidewall disposed adjacent the first sidewall, a third sidewall disposed adjacent the second sidewall and opposite the first sidewall, And a fourth sidewall disposed adjacent

the third sidewall and opposite the second sidewall.

4.

4. The air conditioner according to claim 3, wherein the intake portion includes at least one through - hole formed in at least one of the bottom plate and the first to fourth sidewalls, and the exhaust portion includes at least one of the bottom plate and the first to fourth sidewalls & Lt; / RTI & gt; wherein the backlight unit comprises at least one fan formed on at least one of the plurality of light sources.

5.

The backlight unit according to claim 4, wherein the through hole is formed through the bottom plate, and the fan is formed on the first side wall.

6.

The backlight unit according to claim 5, wherein the first side wall is inclined outward with respect to the bottom plate.

7.

The backlight unit according to claim 4, wherein the fan is formed on the first to fourth sidewalls, respectively.

8.

The backlight unit according to claim 2, further comprising a first driving circuit part disposed on one of the bottom plate and the side walls of the storage container to drive the light generating part.

9.

The backlight unit according to claim 1, wherein the light generating unit is a surface light source device.

10.

The backlight unit according to claim 9, wherein the surface light source device includes a light emitting diode light source.

11.

11. The backlight unit according to claim 10, wherein the surface light source device further comprises a reflector disposed between the storage container and the light emitting diode light source.

12.

A light generating unit for generating light; And a storage container for storing the light generating portion and including an intake portion for sucking outside air and an exhaust portion for discharging internal air.

13.

13. The apparatus of claim 12, wherein the containment vessel includes a bottom plate and a plurality of side walls extending from an edge of the bottom plate to provide a containment space for receiving the light generating unit, A second sidewall disposed adjacent to the first sidewall, a third sidewall disposed adjacent the second sidewall and opposite the first sidewall, and a second sidewall disposed adjacent the first and third sidewalls, Wherein the first side wall is a first side wall.

14.

14. The air conditioner of claim 13, wherein the exhaust unit includes at least one through hole formed in at least one of the bottom plate and the first to fourth sidewalls of the storage container, Wherein the at least one fan comprises at least one fan formed on at least one.

15.

15. The backlight unit according to claim 14, wherein the through - hole is formed through the bottom plate, and the fan is formed on the first side wall.

16.

16. The backlight unit according to claim 15, wherein the first side wall is inclined outward with respect to the bottom plate.

17.

14. The backlight unit of claim 13, further comprising a first driving circuit part disposed on one of the bottom plate and the sidewalls of the storage container to drive the light generating part.

18.

13. The backlight unit of claim 12, wherein the light generating unit is a surface light source device including a light emitting diode light source.

19.

19. The backlight unit of claim 18, wherein the surface light source device further comprises a reflector disposed between the storage container and the light emitting diode light source.

20.

A backlight unit including a light generating unit for generating light, and a storage container for storing the light generating unit and including an intake unit for sucking outside air and an exhaust unit for releasing internal air; And a liquid crystal display panel for displaying an image using light emitted from the light generating unit.

21.

21. The apparatus of claim 20, wherein the containment vessel includes a bottom plate and a plurality of sidewalls, wherein the intake section includes at least one through-hole formed through at least one of the bottom plate and the sidewalls, A bottom plate, and at least one fan formed on at least one of the side walls.

22.

22. The liquid crystal display of claim 21, wherein the through hole is formed through the bottom plate, and the fan is formed on a first sidewall of the sidewalls outwardly inclined with respect to the bottom plate.

23.

23. The liquid crystal display of claim 22, wherein the fan is formed on each of the side walls, and each of the side walls is inclined outward with respect to the bottom plate.

24.

21. The liquid crystal display of claim 20, wherein the light generating unit is a surface light source device including a light emitting diode light source.

25.

The liquid crystal display device according to claim 20, further comprising: a first driving circuit part disposed on one of the bottom plate and the sidewalls for driving the light generating part; and a second driving circuit part disposed on one of the bottom plate and the sidewalls And a second driving circuit unit arranged on the second substrate.

26.

26. The apparatus of claim 25, wherein the first driving circuit portion is disposed on a bottom plate of the storage container, and the second driving circuit portion is disposed on a first sidewall of the sidewalls that is inclined outward with respect to the bottom plate .

27.

A backlight unit including a light generating unit for generating light, and a storage container for storing the light generating unit and including an intake unit for sucking outside air and an exhaust unit for releasing internal air; And a liquid crystal display panel for displaying an image using light emitted from the light generating unit.

28.

28. The apparatus of claim 27, wherein the containment vessel includes a bottom plate and a plurality of sidewalls, wherein the exhaust section includes at least one through-hole formed through at least one of the bottom plate and the sidewalls, A bottom plate, and at least one fan formed on at least one of the side walls.

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(54) 백라이트 유닛 및 이를 포함하는 액정표시장치

요약

백라이트 유닛 및 이를 포함하는 액정표시장치가 개시된다. 백라이트 유닛은 광 발생부 및 수납 용기를 포함한다. 광 발생부는 광을 발생한다. 수납 용기는 광 발생부를 수납하고, 외부 공기가 흡입되는 흡기부 및 내부 공기를 방출하는 배기부가 형성된다. 이에 따라, 백라이트 유닛의 두께 및 무게가 감소되고, 냉각 효과가 증가된다.

대표도

도 1

색인어

백라이트 유닛, 냉각, 대류

명세서

도면의 간단한 설명

도 1은 본 발명의 일 실시예에 따른 백라이트 유닛의 분해 사시도이다.

도 2는 도 1의 백라이트 유닛을 하부에서 도시한 평면도이다.

도 3은 도 1의 백라이트 유닛의 냉각 과정을 설명하기 위한 측면도이다.

도 4는 본 발명의 다른 실시예에 따른 백라이트 유닛의 분해 사시도이다.

도 5는 도 4의 백라이트 유닛을 하부에서 도시한 평면도이다.

도 6은 도 4의 백라이트 유닛의 냉각 과정을 설명하기 위한 측면도이다.

도 7은 본 발명의 또 다른 실시예에 따른 백라이트 유닛의 분해 사시도이다.

도 8는 도 7의 백라이트 유닛을 하부에서 도시한 평면도이다.

도 9은 도 7의 백라이트 유닛의 냉각 과정을 설명하기 위한 측면도이다.

도 10는 본 발명의 또 다른 실시예에 따른 백라이트 유닛의 분해 사시도이다.

도 11는 도 10의 백라이트 유닛을 하부에서 도시한 평면도이다.

도 12는 도 10의 백라이트 유닛의 냉각 과정을 설명하기 위한 측면도이다.

도 13은 도 1의 백라이트 유닛을 갖는 액정표시장치를 나타내는 분해 사시도이다.

도 14는 도 7의 백라이트 유닛을 갖는 액정표시장치를 나타내는 분해 사시도이다.

<도면의 주요부분에 대한 부호의 설명>

100 : 면광원 장치 110 : 반사판

112 : 결합공 120 : 측벽

130 : 구동 기관 140 : 발광 다이오드 광원

200,300 : 수납 용기 210,310 : 바닥판

220,320 : 제1 측벽 230,330 : 제2 측벽

240,340 : 제3 측벽 250,350 : 제4 측벽

260,360 : 내부 공간 212,312 : 관통공

214,314 : 제1 구동 회로부 222a,322a,332a,342a,352a : 팬

222b,322b,332b,342b,352b : 팬 224,324 : 제2 구동 회로부

500,600 : 백라이트 유닛 800,900 : 액정표시장치

820 : 광학 시트 840 : 액정표시패널

842 : 박막 트랜지스터 기관 844 : 액정

846 : 필터필터 기관 848 : 구동 모듈

860 : 샤시

발명의 상세한 설명

발명의 목적

발명이 속하는 기술 및 그 분야의 종래기술

본 발명은 백라이트 유닛 및 이를 포함하는 액정표시장치에 관한 것으로서, 보다 상세하게는 냉각 효과를 향상시킬수 있는 백라이트 유닛 및 이를 포함하는 액정표시장치에 관한 것이다.

일반적으로, 액정표시장치는 액정의 전기적 특성 및 광학적 특성을 이용하여 영상을 디스플레이 한다. 상기 액정표시장치는 CRT 등에 비하여 부피가 매우 작고 무게가 가벼운 장점을 갖고, 그 결과 휴대용 컴퓨터, 통신 기기, 액정 TV 등에 널리 사용되고 있다.

상기 액정을 제어하기 위해, 상기 액정표시장치는 상기 액정을 제어하는 액정 제어 파트 및 상기 액정에 광을 공급하는 광 공급 파트를 필요로 한다. 상기 액정표시장치의 상기 광공급 파트로는 막대 형상을 갖는 냉음극선관 방식 램프(Cold Cathode Fluorescent Lamp, CCFL) 또는 도드 형상을 갖는 발광 다이오드(Light Emitting Diode, LED)가 주로 사용된다.

상기 발광 다이오드는 고색재현성의 장점을 갖는다. 그러나 상기 발광 다이오드는 발광 특성상 많은 열을 발생한다. 특히, 상기 발광 다이오드는 액정표시장치의 뒤로 발산되는 열이 많아, 상기 발광 다이오드를 수납하는 수납 용기의 온도가 매우 높다.

상기 수납 용기의 온도 증가를 방지하기 위해, 상기 수납 용기는 알루미늄과 같은 금속 재료를 갖는 히트 싱크(heat sink) 등을 포함할 수 있다. 그러나, 상기 수납 용기가 상기 히트 싱크를 포함하더라도, 상기 수납 용기의 두께 및 무게가 증가하여 액정표시장치의 두께 및 무게 또한 증가한다.

따라서, 상기 발광 다이오드를 액정표시장치의 광공급 파트로 사용하는 경우나, 상기 발광 다이오드 이외의 많은 열이 발생하는 다른 장치를 광공급 파트로 사용하는 경우, 상기 수납 용기의 온도가 증가하거나, 두께 및 무게가 증가한다.

발명이 이루고자 하는 기술적 과제

따라서, 본 발명의 일 목적은 냉각 효과가 증가되고, 두께 및 무게가 감소된 백라이트 유닛을 제공하는 것이다.

본 발명의 다른 목적은 상기한 백라이트 유닛을 갖는 액정표시장치를 제공하는 것이다.

발명의 구성 및 작용

이와 같은 본 발명의 일 목적을 구현하기 위하여 본 발명은 광 발생부 및 수납 용기를 포함하는 백라이트 유닛을 제공한다. 상기 광 발생부는 광을 발생한다. 상기 수납 용기는 상기 광 발생부를 수납하고, 외부 공기가 흡입되는 흡기부 및 내부 공기를 방출하는 배기부가 형성된다.

본 발명의 다른 목적을 구현하기 위하여 본 발명은 광 발생부 및 수납 용기를 포함하는 백라이트 유닛을 제공한다. 상기 광 발생부는 광을 발생한다. 상기 수납 용기는 상기 광 발생부를 수납하고, 외부 공기를 흡입하는 흡기부 및 내부 공기가 방출되는 배기부가 형성된다.

본 발명의 또 다른 목적을 구현하기 위하여 본 발명은 백라이트 유닛 및 액정표시패널을 포함한다. 상기 백라이트 유닛은 광을 발생하는 광 발생부 및 상기 광 발생부를 수납하고, 외부 공기가 흡입되는 흡기부 및 내부 공기를 방출하는 배기부가 형성된 수납 용기를 포함한다. 상기 액정표시패널은 상기 광 발생부로부터 출사되는 광을 이용하여 영상을 표시한다.

본 발명의 또 다른 목적을 구현하기 위하여 본 발명은 백라이트 유닛 및 액정표시패널을 포함한다. 상기 백라이트 유닛은 광을 발생하는 광 발생부 및 상기 광 발생부를 수납하고, 외부 공기를 흡입하는 흡기부 및 내부 공기가 방출되는 배기부가 형성된 수납 용기를 포함한다. 상기 액정표시패널은 상기 광 발생부로부터 출사되는 광을 이용하여 영상을 표시한다.

본 발명에 따르면, 백라이트 유닛의 두께 및 무게가 감소되고, 냉각 효과가 증가된다. 또한, 백라이트 유닛의 휘도 및 콘트라스트비(contrast ratio)의 저하를 방지한다.

이하, 첨부된 도면들을 참조하여 본 발명의 바람직한 실시예들에 따른 백라이트 유닛 및 이를 포함하는 액정표시장치에 대하여 상세하게 설명하지만, 본 발명이 하기 실시예들에 의해 제한되거나 한정되는 것은 아니다.

백라이트 유닛

실시예 1

도 1은 본 발명의 일 실시예에 따른 백라이트 유닛의 분해 사시도이고, 도 2는 도 1의 백라이트 유닛을 하부에서 도시한 평면도이다.

도 1 및 도 2를 참조하면, 백라이트 유닛(500)은 면광원 장치(100) 및 수납 용기(200)를 포함한다.

상기 면광원 장치(100)는 반사판(110), 측벽(120), 구동 기관(130) 및 복수의 발광 다이오드 광원(140)들을 포함한다.

상기 반사판(110)은 사각 평판 형상을 가지며, 상기 발광 다이오드 광원(140)들로부터 발생한 광 중 하방으로 향하는 광을 상방으로 반사한다. 상기 반사판(110)에는 상기 발광 다이오드 광원(140)이 결합될 수 있도록, 복수의 결합공(112)들이 형성된다.

상기 측벽(120)은 상기 반사판(110)의 에지부에 형성되어, 상기 면광원 장치(100)가 상기 수납 용기(200)와 용이하게 결합되도록 한다. 본 실시예에서, 상기 측벽(120)은 상기 반사판(110)의 대향하는 한 쌍의 에지부들에 형성된다.

상기 구동 기관(130)은 상기 반사판(110)의 하부에서 나란히 배열된다. 구동 전원이 상기 구동 기관(130)에 인가되어 상기 발광 다이오드 광원(140)들을 점등한다.

상기 발광 다이오드 광원(140)들은 상기 구동 기관(130) 상에 일렬로 배치되고, 상기 결합공(112)들을 관통하여 상기 반사판(110)의 상면에 위치하도록 결합된다. 바람직하게, 상기 발광 다이오드 광원(140)들은, 적색광을 발생하는 적색광 발광 다이오드(R), 녹색광을 발생하는 녹색광 발광 다이오드(G) 및 청색광을 발생하는 청색광 발광 다이오드(B)를 포함한다. 상기 적색광, 녹색광 및 청색광 발광 다이오드들(R,G,B)은 소정의 조합비에 의해 백색광을 발생한다. 예를 들어, 적색광 발광 다이오드(R), 녹색광 발광 다이오드(G) 및 청색광 발광 다이오드(B)의 개수의 비는 2:1:1, 또는 2:2:1로 구성될 수 있다. 또한, 상기 적색광, 녹색광 및 청색광 발광 다이오드들(R,G,B)은 도 1에 도시된 수보다 더 많이 배치될 수 있다. 이와는 달리, 상기 발광 다이오드 광원(140)들은 백색광을 발생하는 백색광 발광 다이오드를 포함할 수 있다.

상기 수납 용기(200)는 상기 면광원 장치(100)를 수납한다. 상기 수납 용기(200)는 바닥판(210), 제1 측벽(220), 제2 측벽(230), 제3 측벽(240) 및 제4 측벽(250)을 포함한다.

상기 바닥판(210)은 직사각형 평판의 형상을 갖고, 제1 구동 회로부(214) 및 복수의 관통공(212)들을 포함한다. 상기 제1 구동 회로부(214)는 상기 바닥판(210) 상에 배치되고, 상기 면광원 장치(100)를 구동한다. 상기 관통공(212)들은 상기 제1 구동 회로부(214)가 배치된 부분을 제외한 부분에 형성되고, 상기 바닥판(210)을 관통하여 형성된다. 상기 관통공(212)들을 통하여, 공기가 이동할 수 있다. 본 실시예에서, 상기 관통공(212)들은 외부 공기가 흡입되는 흡기부의 기능을 한다.

상기 제1 내지 제4 측벽들(220,230,240,250)은 상기 바닥판(210)의 에지부들로부터 각각 연장되어 수납 공간 및 내부 공간을 형성한다.

상기 제1 측벽(220)은 상기 바닥판(210)의 일 에지부에 배치되고, 바람직하게, 상기 바닥판(210)과 수직하지 않는다. 구체적으로, 상기 제1 측벽(220)은 상기 바닥판(210)에 대해서 외측으로 경사진다. 이와는 달리, 상기 제1 측벽(220)은 상기 바닥판(210)과 수직할 수 있다. 상기 제2 내지 제4 측벽들(230,240,250)은 상기 바닥판(210)의 다른 에지부들에 각각 배치되고, 상기 바닥판(210)과 수직한다. 상기 제2 측벽(230)은 상기 제1 측벽(220)과 인접하여 배치된다. 상기 제3 측벽(240)은 상기 제2 측벽(230)과 인접하여 배치되고, 상기 제1 측벽(220)과 대향한다. 상기 제4 측벽(250)은 상기 제1 및 제3 측벽들(220,240)과 인접하여 배치되고, 상기 제2 측벽(230)과 대향한다.

상기 제1 측벽(220)에는 복수의 팬(fan, 222a)들이 형성된다. 상기 팬(222a)들은 공기를 상기 내부 공간에서 외부로 유동시키도록 작동된다. 따라서, 상기 면광원 장치(100)에서 발생된 열은 상기 내부 공간에서 외부로 전달된다. 본 실시예에서, 상기 팬(222a)들은 내부 공기를 방출하는 배기부의 기능을 한다.

상기 제1 측벽(220)은 제2 구동 회로부(224)를 더 포함할 수 있다. 상기 제2 구동 회로부(224)는 상기 제1 측벽(220) 상에 배치되고, 본 실시예에 따른 백라이트 유닛(100)을 광 공급 파트로 갖는 장치의 구성요소들, 예를 들면 액정표시장치의 액정표시패널을 구동하는 데에 사용될 수 있다. 이와는 달리, 상기 제2 구동 회로부(224)는 상기 제2 내지 제4 측벽들(230,240,250) 상에 배치될 수도 있다.

한편, 상기 제1 내지 제4 측벽들(220,230,240,250)은 상기 면광원 장치(100)의 상기 반사판(110)과 후크 결합 등의 방식으로 결합될 수 있다.

이하, 상술한 구조를 갖는 상기 백라이트 유닛의 냉각 과정을 도면을 참조하여 상세하게 설명한다.

도 3은 도 1의 백라이트 유닛의 냉각 과정을 설명하기 위한 측면도이다.

도 3을 참조하면, 상기 면광원 장치(100)의 상기 발광 다이오드 어레이 기판(110)이 구동되어 열이 발생한다. 상기 열에 의해 상기 면광원 장치(100) 및 상기 수납 용기(200) 사이의 상기 내부 공간(260)에 채류하는 공기의 온도가 상승한다. 상기 온도가 상승된 공기는 상기 제1 측벽(220)에 형성된 복수의 팬(222a)들에 의해서 상기 백라이트 유닛(500)의 외부로 방출된다. 상기 고온의 공기가 상기 백라이트 유닛(1000)의 외부로 방출되면, 상기 내부 공간(260)의 압력이 낮아진다. 따라서, 상기 백라이트 유닛(500)의 외부로부터 상기 내부 공간(260)의 고온의 공기보다 차가운 저온의 공기가 상기 관통공(212)들을 통하여 유입된다. 이에 따라, 고온의 내부 공기의 방출 및 저온의 외부 공기의 유입 과정들이 계속적으로 반복되고, 그 결과 상기 면광원 장치(100)에서 발생한 열은 공기의 흐름에 의하여 냉각된다.

특히, 본 실시예에 따른 냉각 과정은 주로 공기의 자연 대류(free convection) 현상에 의해서 이루어진다. 즉, 상기 면광원 장치(100)에서 발생한 열에 의해, 상기 내부 공간(260)의 공기의 온도가 상승하고, 상기 고온의 공기는 대류 작용에 의해 상기 내부 공간(260)의 상방으로 상승하여 상기 팬(222a)들에 의해 외부로 방출된다. 이어서, 외부의 저온의 공기는 상기 관통공(212)들을 통하여 상기 내부 공간(260)으로 유입되고, 다시 상기 면광원 장치에서 발생한 열에 의해, 온도가 상승하여 대류 작용에 의해 상승하게 되는 과정을 거친다.

본 실시예에서, 상기 관통공은 상기 바닥판 상에 형성되지만, 상기 관통공은 상기 제1 내지 제4 측벽들에 추가로 형성될 수 있고, 상기 제1 내지 제4 측벽들에만 형성될 수도 있다. 즉, 상기 관통공은 바닥판 및 상기 제1 내지 제4 측벽들 중 어느 하나 이상에 형성될 수 있다.

또한, 본 실시예에서, 상기 팬은 상기 제1 측벽 상에 형성되지만, 상기 팬은 바닥판 및 상기 제2 내지 제4 측벽들 중 어느 하나 이상에 추가로 형성될 수 있다.

한편, 본 실시예에서, 상기 발광 다이오드를 포함하는 상기 면광원 장치가 광 발생부로 이용되지만, 냉각이 요구되는 다른 광원을 포함하는 장치도 본 발명의 광 발생부로 적용될 수 있다.

본 실시예에 따르면, 상기 백라이트 유닛의 상기 수납 용기에 직접 냉각 기능을 수행하는 구성 요소들이 형성된다. 따라서, 상기 백라이트 유닛의 두께 및 무게가 감소된다. 또한, 상기 구성 요소들의 작동에 따른 상기 자연 대류 현상에 의해, 냉각 효과가 증가된다. 이에 따라, 상기 백라이트 유닛의 휘도 및 콘트라스트비의 저하를 방지한다.

실시예 2

도 4는 본 발명의 다른 실시예에 따른 백라이트 유닛의 분해 사시도이고, 도 5는 도 4의 백라이트 유닛을 하부에서 도시한 평면도이다.

도 4 및 도 5를 참조하면, 백라이트 유닛(600)은 면광원 장치(100) 및 수납 용기(300)를 포함한다.

본 실시예에 채용된 상기 면광원 장치(100)는 도 1에 도시된 면광원 장치와 구조 및 기능이 동일하므로, 반복 설명은 생략한다.

상기 수납 용기(300)는 상기 면광원 장치(100)를 수납한다. 상기 수납 용기(300)는 바닥판(310), 제1 측벽(320), 제2 측벽(330), 제3 측벽(340) 및 제4 측벽(350)을 포함한다.

상기 바닥판(310)은 직사각형 평판의 형상을 갖고, 제1 구동 회로부(314) 및 복수의 관통공(312)들을 포함한다. 상기 제1 구동 회로부(314)는 상기 바닥판(310) 상에 배치되고, 상기 면광원 장치(100)를 구동한다. 상기 관통공(312)들은 상기 제1 구동 회로부(314)가 배치된 부분을 제외한 부분에 형성되고, 상기 바닥판(310)을 관통하여 형성된다. 상기 관통공(312)들을 통하여, 공기가 이동할 수 있다. 본 실시예에서, 상기 관통공(312)들은 외부 공기가 흡입되는 흡기부의 기능을 한다.

상기 제1 내지 제4 측벽들(320,330,340,350)은 상기 바닥판(310)의 에지부들로부터 각각 연장되어 수납 공간 및 내부 공간을 형성한다.

상기 제1 내지 제4 측벽들(320,330,340,350)은 각각 상기 바닥판(310)의 일 에지부에 배치되고, 바람직하게, 상기 바닥판(310)과 수직하지 않는다. 구체적으로, 상기 제1 내지 제4 측벽들(320,330,340,350)은 상기 바닥판(310)에 대해서 외측으로 경사진다. 이와는 달리, 상기 제1 내지 제4 측벽들(320,330,340,350) 중 일부 또는 전부는 상기 바닥판(310)과 수직할 수 있다. 상기 제1 내지 제4 측벽들(320,330,340,350)은 차례로 서로 인접하여 배치된다. 상기 제1 측벽(320)과 상기 제3 측벽(340)은 서로 대향하고, 상기 제2 측벽(330)과 상기 제4 측벽(350)은 서로 대향한다.

상기 제1 내지 제4 측벽들(320,330,340,350)에는 각각 복수의 팬(322a,332a,342a,352a)들이 형성된다. 상기 팬(322a,332a,342a,352a)들은 공기를 상기 내부 공간에서 외부로 유동시키도록 작동된다. 따라서, 상기 면광원 장치(100)에서 발생한 열은 상기 내부 공간에서 외부로 전달된다. 본 실시예에서, 상기 팬(322a,332a,342a,352a)들은 내부 공기를 방출하는 배기부의 기능을 한다.

상기 제1 측벽(320)은 제2 구동 회로부(324)를 더 포함할 수 있다. 상기 제2 구동 회로부(324)는 상기 제1 측벽(320) 상에 배치되고, 본 실시예에 따른 백라이트 유닛(100)을 광 공급 파트로 갖는 장치의 구성요소들, 예를 들면 액정표시장치의 액정표시패널을 구동하는 데에 사용될 수 있다. 이와는 달리, 상기 제2 구동 회로부(324)는 상기 제2 내지 제4 측벽들(330,340,350) 상에 배치될 수도 있다.

한편, 상기 제1 내지 제4 측벽들(320,330,340,350)은 상기 면광원 장치(100)의 상기 반사판(110)과 후크 결합 등의 방식으로 결합될 수 있다.

이하, 상술한 구조를 갖는 상기 백라이트 유닛의 냉각 과정을 도면을 참조하여 상세하게 설명한다.

도 6은 도 4의 백라이트 유닛의 냉각 과정을 설명하기 위한 측면도이다.

도 6을 참조하면, 상기 면광원 장치(100)의 상기 구동 기판(130)이 구동되어 열이 발생한다. 상기 열에 의해 상기 면광원 장치(100) 및 상기 수납 용기(300) 사이의 상기 내부 공간(360)에 채류하는 공기의 온도가 상승한다. 상기 온도가 상승된 공기는 상기 제1 내지 제4 측벽들(320,330,340,350)에 형성된 복수의 팬(322a,332a,342a,352a)들에 의해서 상기 백라이트 유닛(2000)의 외부로 방출된다. 상기 고온의 공기가 상기 백라이트 유닛(2000)의 외부로 방출되면, 상기 내부 공간(360)의 압력이 낮아진다. 따라서, 상기 백라이트 유닛(2000)의 외부로부터 상기 내부 공간(360)의 고온의 공기보다 차가운 저온의 공기가 상기 관통공(312)들을 통하여 유입된다. 이에 따라, 고온의 내부 공기의 방출 및 저온의 외부 공기의 유입 과정들이 계속적으로 반복되고, 그 결과 상기 면광원 장치(100)에서 발생한 열은 공기의 흐름에 의하여 냉각된다.

본 실시예에서, 상기 관통공은 상기 바닥판 상에 형성되지만, 상기 관통공은 상기 제1 내지 제4 측벽들에 추가로 형성될 수 있고, 상기 제1 내지 제4 측벽들에만 형성될 수도 있다. 즉, 상기 관통공은 바닥판 및 상기 제1 내지 제4 측벽들 중 어느 하나 이상에 형성될 수 있다.

또한, 본 실시예에서, 상기 팬은 상기 제1 내지 제4 측벽들 상에 형성되지만, 상기 팬은 상기 바닥판에 추가로 형성될 수 있고, 상기 팬은 바닥판 및 상기 제1 내지 제4 측벽들 중 일부에만 형성될 수 있다. 즉, 상기 팬은 바닥판 및 상기 제1 내지 제4 측벽들 중 어느 하나 이상에 형성될 수 있다.

한편, 본 실시예에서, 상기 발광 다이오드를 포함하는 상기 면광원 장치가 광 발생부로 이용되지만, 냉각이 요구되는 다른 광원을 포함하는 장치도 본 발명의 광 발생부로 적용될 수 있다.

본 실시예에 따르면, 상기 백라이트 유닛의 상기 수납 용기에 직접 냉각 기능을 수행하는 구성 요소들이 형성된다. 특히, 상기 팬들이 상기 수납 용기의 여러 측벽들에 형성되어 상기 냉각 기능이 더욱 향상된다. 따라서, 상기 백라이트 유닛의 두께 및 무게가 감소된다. 또한, 상기 구성 요소들의 작동에 따른 상기 자연 대류 현상에 의해, 냉각 효과가 증가된다. 이에 따라, 상기 백라이트 유닛의 휘도 및 콘트라스트비의 저하를 방지한다.

실시예 3

도 7은 본 발명의 또 다른 실시예에 따른 백라이트 유닛의 분해 사시도이고, 도 8은 도 7의 백라이트 유닛을 하부에서 도시한 평면도이다. 제3 실시예에 있어서, 제1 실시예에서의 구성요소와 동일한 구조 및 기능을 갖는 구성요소에 대해서는 동일한 참조번호를 병기하고, 이들에 대한 구체적인 설명은 생략한다.

도 7 및 도 8을 참조하면, 복수의 팬(222b)들은 제1 측벽(220) 상에 형성된다. 상기 팬(222b)들은 공기를 외부에서 내부 공간으로 유동시키도록 작동된다. 따라서, 면광원 장치(100)에서 발생된 열은 상기 외부에서 유입된 상기 저온의 공기에 의해 냉각된다. 본 실시예에서, 상기 팬(222b)들은 외부 공기를 흡입하는 흡기부의 기능을 한다. 또한, 상기 팬(222b)들은 능동적으로 상기 면광원 장치(100)를 냉각시키는 냉각기의 기능을 한다.

이하, 상술한 구조를 갖는 상기 백라이트 유닛의 냉각 과정을 도면을 참조하여 상세하게 설명한다.

도 9는 도 7의 백라이트 유닛의 냉각 과정을 설명하기 위한 측면도이다.

도 9를 참조하면, 상기 면광원 장치(100)의 구동 기판(130)이 구동되어 열이 발생한다. 상기 열에 의해 상기 면광원 장치(100) 및 수납 용기(200) 사이의 상기 내부 공간(260)에 채류하는 공기의 온도가 상승할 수 있다. 여기서, 상기 팬(222b)들이 저온의 상기 백라이트 유닛(500)의 외부 공기를 고속으로 상기 내부 공간(260)으로 주입한다. 주입된 상기 외부 공기는 열이 발생하는 반사판(110)에 충돌하여 상기 반사판(110)을 냉각시킨다. 그 동안, 상기 팬(222b)들에 의해 상기 외부 공기가 내부로 유입되므로, 내부 압력이 증가한다. 따라서, 상기 내부 공간(260)의 공기는 관통공(212)들을 통하여 상기 백라이트 유닛(500)의 외부로 방출된다. 이에 따라, 상기 저온의 외부 공기의 유입 및 상기 고온의 내부 공기의 방출 과정들이 계속적으로 반복되고, 그 결과 상기 면광원 장치(100)에서 발생된 열은 공기의 흐름에 의하여 냉각된다.

특히, 본 실시예에 따른 냉각 과정은 주로 상기 냉각기의 기능을 하는 상기 팬(222b)들의 강제 대류(forced convection) 현상에 의해서 이루어진다. 즉, 상기 팬(222b)들에 의해 유입되는 상기 저온의 외부 공기는 열이 발생하는 상기 면광원 장치(100)에 고속으로 충돌하여 상기 면광원 장치(100)를 냉각시킨다. 따라서, 상술한 제1 실시예에 따른 팬(222a)들은 내부 공간(260)의 고온의 공기를 외부로 방출하는 소극적인 기능을 하는데 비하여, 본 실시예에 따른 상기 팬(222b)들은 적극적인 상기 냉각기의 기능을 한다. 일반적으로, 자연 대류 현상에 의한 열전달 효과보다 강제 대류 현상에 의한 열전달 효과가 더 크다. 따라서 본 실시예에 의한 냉각은 보다 효과적일 수 있다.

본 실시예에서, 상기 관통공은 바닥판 상에 형성되지만, 상기 관통공은 제1 내지 제4 측벽들에 추가로 형성될 수 있고, 상기 제1 내지 제4 측벽들에만 형성될 수도 있다. 즉, 상기 관통공은 상기 바닥판 및 상기 제1 내지 제4 측벽들 중 어느 하나 이상에 형성될 수 있다.

또한, 본 실시예에서, 상기 팬은 상기 제1 측벽 상에 형성되지만, 상기 팬은 바닥판 및 상기 제2 내지 제4 측벽들 중 어느 하나 이상에 추가로 형성될 수 있다.

한편, 본 실시예에서, 상기 발광 다이오드를 포함하는 상기 면광원 장치가 광 발생부로 이용되지만, 냉각이 요구되는 다른 광원을 포함하는 장치도 본 발명의 광 발생부로 적용될 수 있다.

본 실시예에 따르면, 상기 백라이트 유닛의 상기 수납 용기에 직접 냉각 기능을 수행하는 구성 요소들이 형성된다. 따라서, 상기 백라이트 유닛의 두께 및 무게가 감소된다. 또한, 상기 구성 요소들의 작동에 따른 상기 강제 대류 현상에 의해, 냉각 효과가 증가된다. 이에 따라, 상기 백라이트 유닛의 휘도 및 콘트라스트비 저하를 방지한다.

실시예 4

도 10은 본 발명의 또 다른 실시예에 따른 백라이트 유닛의 분해 사시도이고, 도 11은 도 10의 백라이트 유닛을 하부에서 도시한 평면도이다. 제4 실시예에 있어서, 제2 실시예에서의 구성요소와 동일한 구조 및 기능을 갖는 구성요소에 대해서는 동일한 참조번호를 병기하고, 이들에 대한 구체적인 설명은 생략한다.

도 10 및 도 11을 참조하면, 복수의 팬(322b, 332b, 342b, 352b)들은 각각 제1 내지 제4 측벽들(320, 330, 340, 350) 상에 형성된다. 상기 팬(322b, 332b, 342b, 352b)들은 상기 면광원 장치(100)에서 발생된 열을 저온의 외부 공기를 흡입하여 냉각시킬 수 있다. 본 실시예에서, 상기 팬(322b, 332b, 342b, 352b)들은 외부 공기를 흡입하는 흡기부의 기능을 한다. 또한, 상기 팬(322b, 332b, 342b, 352b)들은 능동적으로 상기 면광원 장치(100)를 냉각시키는 냉각기의 기능을 한다.

이하, 상술한 구조를 갖는 상기 백라이트 유닛의 냉각 과정을 도면을 참조하여 상세하게 설명한다.

도 12는 도 10의 백라이트 유닛의 냉각 과정을 설명하기 위한 측면도이다.

도 12를 참조하면, 상기 면광원 장치(100)의 구동 기판(130)이 구동되어 열이 발생한다. 상기 열에 의해 상기 면광원 장치(100) 및 수납 용기(300) 사이의 내부 공간(360)에 체류하는 공기의 온도가 상승할 수 있다. 여기서, 상기 팬(322b, 332b, 342b, 352b)들이 저온의 상기 백라이트 유닛(600)의 외부 공기를 고속으로 상기 내부 공간(360)으로 주입한다. 주입된 상기 외부 공기는 열이 발생하는 반사판(110)에 충돌하여 상기 반사판(110)을 냉각시킨다. 그 동안, 상기 팬(322b, 332b, 342b, 352b)들에 의해 상기 외부 공기가 내부로 유입되므로, 내부 압력이 증가한다. 따라서, 상기 내부 공간(360)의 공기는 관통공(312)들을 통하여 상기 백라이트 유닛(600)의 외부로 방출된다. 이에 따라, 상기 저온의 외부 공기의 유입 및 상기 고온의 내부 공기의 방출 과정들이 계속적으로 반복되고, 그 결과 상기 면광원 장치(100)에서 발생한 열은 공기의 흐름에 의하여 냉각된다.

본 실시예에서, 상기 관통공은 바닥판 상에 형성되지만, 상기 관통공은 제1 내지 제4 측벽들에 추가로 형성될 수 있고, 상기 제1 내지 제4 측벽들에만 형성될 수도 있다. 즉, 상기 관통공은 상기 바닥판 및 상기 제1 내지 제4 측벽들 중 어느 하나 이상에 형성될 수 있다.

또한, 본 실시예에서, 상기 팬은 상기 제1 내지 제4 측벽들 상에 형성되지만, 상기 팬은 상기 바닥판에 추가로 형성될 수 있고, 상기 팬은 바닥판 및 상기 제1 내지 제4 측벽들 중 일부에만 형성될 수 있다. 즉, 상기 팬은 바닥판 및 상기 제1 내지 제4 측벽들 중 어느 하나 이상에 형성될 수 있다.

한편, 본 실시예에서, 상기 발광 다이오드를 포함하는 상기 면광원 장치가 광 발생부로 이용되지만, 냉각이 요구되는 다른 광원을 포함하는 장치도 본 발명의 광 발생부로 적용될 수 있다.

본 실시예에 따르면, 상기 백라이트 유닛의 상기 수납 용기에 직접 냉각 기능을 수행하는 구성 요소들이 형성된다. 특히, 상기 팬들이 상기 수납 용기의 여러 측벽들에 형성되어 상기 냉각 기능이 더욱 향상된다. 따라서, 상기 백라이트 유닛의 두께 및 무게가 감소된다. 또한, 상기 구성 요소들의 작동에 따른 상기 강제 대류 현상에 의해, 냉각 효과가 증가된다. 이에 따라, 상기 백라이트 유닛의 휘도 및 콘트라스트비의 저하를 방지한다.

액정표시장치

실시예 5

도 13은 도 1의 백라이트 유닛을 갖는 액정표시장치를 나타내는 분해 사시도이다.

도 13을 참조하면, 액정표시장치(800)는 백라이트 유닛(500), 액정표시패널(840) 및 샤시(860)를 포함한다.

본 실시예에 채용된 상기 백라이트 유닛(500)은 도 1에 도시된 백라이트 유닛과 구조 및 기능이 동일하므로, 반복 설명은 생략한다.

상기 액정표시패널(840)은 면광원 장치(100)로부터 출사되는 광을 이용하여 영상을 표시한다. 상기 액정표시패널(840)은 박막 트랜지스터(thin film transistor, TFT) 기판(842), 액성(844), 컬러필터 기판(846) 및 구동 모듈(848)을 포함한다.

상기 TFT 기관(842)은 매트릭스 형태로 배치된 화소 전극(미도시), 각 상기 화소 전극에 구동 전압을 인가하는 박막 트랜지스터(미도시), 게이트 라인(미도시) 및 데이터 라인(미도시)을 포함한다.

상기 컬러필터 기관(846)은 상기 TFT 기관(842)에 형성된 상기 화소 전극과 마주보도록 배치된 컬러필터(미도시), 상기 컬러필터 상에 형성된 공통전극(미도시)을 포함한다.

상기 액정(844)은 상기 TFT 기관(842)과 상기 컬러필터 기관(846) 사이에 개재된다.

상기 구동 모듈(848)은 상기 액정표시패널(840)을 구동한다. 이와는 달리, 상기 액정표시패널(840)을 구동하기 위하여 제 2 구동 회로부(224)가 바닥판(210) 및 제1 내지 제4 측벽(220,230,240,250)들 중 어느 하나 상에 배치될 수 있다.

상기 컬러필터 기관(846)의 에지부는 상기 샤시(860)에 의하여 감싸여지고, 상기 샤시(860)의 일부는 수납용기(200)에 결합된다. 상기 샤시(860)는 외부 충격에 의한 상기 액정표시패널(840)의 깨짐을 방지하고, 상기 액정표시패널(840)의 유동을 방지한다.

상기 액정표시장치(800)는 상기 면광원 장치(100)로부터 출사된 상기 광의 휘도 균일성을 향상시키기 위한 광학 시트(820)를 더 포함할 수 있다. 상기 광학 시트(820)는 확산 시트, 프리즘 시트, 보호 시트 등을 포함할 수 있다.

상기 광학 시트(820)의 상측에는 미들 샤시(미도시)가 더 구비될 수 있다. 상기 미들 샤시는 상기 광학 시트(820)와 접하여 상기 광학 시트(820)를 상기 수납 용기(200) 측으로 가압한다.

본 실시예에 따르면, 상기 백라이트 유닛의 상기 수납 용기에 직접 냉각 기능을 수행하는 구성 요소들이 형성된다. 따라서, 상기 백라이트 유닛의 두께 및 무게가 감소된다. 또한, 상기 구성 요소들의 작동에 따른 상기 자연 대류 현상에 의해, 냉각 효과가 증가된다. 이에 따라, 상기 백라이트 유닛을 포함하는 액정표시장치의 두께 및 무게가 감소되고, 냉각 효과가 증가되며, 휘도 및 콘트라스트비의 저하를 방지한다.

실시예 6

도 14는 도 7의 백라이트 유닛을 갖는 액정표시장치를 나타내는 분해 사시도이다.

도 14를 참조하면, 액정표시장치(900)는 백라이트 유닛(600), 액정표시패널(840) 및 샤시(860)를 포함한다.

본 실시예에 따른 액정표시장치는 백라이트 유닛을 제외하면, 제5 실시예에 따른 액정표시장치와 구조 및 기능이 동일하다. 또한, 본 실시예에 채용된 상기 백라이트 유닛(600)은 도 2에 도시된 백라이트 유닛과 구조 및 기능이 동일하다.

본 실시예에 따르면, 상기 백라이트 유닛의 수납 용기에 직접 냉각 기능을 수행하는 구성 요소들이 형성된다. 따라서, 상기 백라이트 유닛의 두께 및 무게가 감소된다. 또한, 상기 구성 요소들의 작동에 따른 강제 대류 현상에 의해, 냉각 효과가 증가된다. 이에 따라, 상기 백라이트 유닛을 포함하는 액정표시장치의 두께 및 무게가 감소되고, 냉각 효과가 증가되며, 휘도 및 콘트라스트비의 저하가 방지된다.

발명의 효과

이상에서 설명한 바와 같이, 본 발명에 따르면 본 실시예에 따르면, 백라이트 유닛의 수납 용기에 직접 냉각 기능을 수행하는 구성 요소들이 형성된다. 따라서, 상기 백라이트 유닛의 두께 및 무게가 감소된다.

또한, 상기 구성 요소들의 작동에 따른 자연 대류 현상 또는 강제 대류 현상에 의해, 냉각 효과가 증가된다.

이에 따라, 상기 백라이트 유닛을 포함하는 액정표시장치의 두께 및 무게가 감소되고, 냉각 효과가 증가되며, 휘도 및 콘트라스트비의 저하를 방지한다.

앞서 설명한 본 발명의 상세한 설명에서는 본 발명의 바람직한 실시예를 참조하여 설명하였지만, 해당 기술분야의 숙련된 당업자 또는 해당 기술분야에 통상의 지식을 갖는 자라면 후술될 특허청구범위에 기재된 본 발명의 사상 및 기술 영역으로부터 벗어나지 않는 범위 내에서 본 발명을 다양하게 수정 및 변경시킬 수 있음을 이해할 수 있을 것이다.

(57) 청구의 범위

청구항 1.

광을 발생하는 광 발생부; 및

상기 광 발생부를 수납하고, 외부 공기가 흡입되는 흡기부 및 내부 공기를 방출하는 배기부가 형성된 수납 용기를 포함하는 백라이트 유닛.

청구항 2.

제 1 항에 있어서, 상기 수납 용기는 바닥판 및 상기 바닥판의 에지부로부터 연장된 복수의 측벽들을 포함하여 상기 광 발생부를 수납하기 위한 수납 공간을 제공하는 것을 특징으로 하는 백라이트 유닛.

청구항 3.

제 2 항에 있어서, 상기 측벽들은 제1 측벽, 상기 제1 측벽과 인접하여 배치된 제2 측벽, 상기 제2 측벽과 인접하여 배치되며 상기 제1 측벽과 대향하는 제3 측벽, 및 상기 제1 및 제3 측벽과 인접하여 배치되며 상기 제2 측벽과 대향하는 제4 측벽을 포함하는 것을 특징으로 하는 백라이트 유닛.

청구항 4.

제 3 항에 있어서, 상기 흡기부는 상기 바닥판 및 상기 제1 내지 제4 측벽들 중 적어도 하나에 형성된 1개 이상의 관통공을 포함하고, 상기 배기부는 상기 바닥판 및 상기 제1 내지 제4 측벽들 중 적어도 하나에 형성된 1개 이상의 팬을 포함하는 것을 특징으로 하는 백라이트 유닛.

청구항 5.

제 4 항에 있어서, 상기 관통공은 상기 바닥판을 관통하여 형성되고, 상기 팬은 상기 제1 측벽에 형성된 것을 특징으로 하는 백라이트 유닛.

청구항 6.

제 5 항에 있어서, 상기 제1 측벽은 상기 바닥판에 대해서 외측으로 경사진 것을 특징으로 하는 백라이트 유닛.

청구항 7.

제 4 항에 있어서, 상기 팬은 상기 제1 내지 제4 측벽들 상에 각각 형성된 것을 특징으로 하는 백라이트 유닛.

청구항 8.

제 2 항에 있어서, 상기 광 발생부를 구동하기 위하여 상기 수납 용기의 바닥판 및 상기 측벽들 중 어느 하나 상에 배치된 제1 구동 회로부를 더 포함하는 것을 특징으로 하는 백라이트 유닛.

청구항 9.

제 1 항에 있어서, 상기 광 발생부는 면광원 장치인 것을 특징으로 하는 백라이트 유닛.

청구항 10.

제 9 항에 있어서, 상기 면광원 장치는 발광 다이오드 광원을 포함하는 것을 특징으로 하는 백라이트 유닛.

청구항 11.

제 10 항에 있어서, 상기 면광원 장치는 상기 수납 용기 및 상기 발광 다이오드 광원 사이에 배치된 반사판을 더 포함하는 것을 특징으로 하는 백라이트 유닛.

청구항 12.

광을 발생하는 광 발생부; 및

상기 광 발생부를 수납하고, 외부 공기를 흡입하는 흡기부 및 내부 공기가 방출되는 배기부가 형성된 수납 용기를 포함하는 백라이트 유닛.

청구항 13.

제 12 항에 있어서, 상기 수납 용기는 바닥판 및 상기 바닥판의 에지로부터 연장된 복수의 측벽들을 포함하여 상기 광 발생부를 수납하기 위한 수납 공간을 제공하고, 상기 측벽들은 제1 측벽, 상기 제1 측벽과 인접하여 배치된 제2 측벽, 상기 제2 측벽과 인접하여 배치되며 상기 제1 측벽과 대향하는 제3 측벽, 및 상기 제1 및 제3 측벽과 인접하여 배치되며 상기 제2 측벽과 대향하는 제4 측벽을 포함하는 것을 특징으로 하는 백라이트 유닛.

청구항 14.

제 13 항에 있어서, 상기 배기부는 상기 수납 용기의 상기 바닥판 및 상기 제1 내지 제4 측벽들 중 적어도 하나에 형성된 1개 이상의 관통공을 포함하고, 상기 흡기부는 상기 바닥판 및 상기 측벽들 중 적어도 하나에 형성된 1개 이상의 팬을 포함하는 것을 특징으로 하는 백라이트 유닛.

청구항 15.

제 14 항에 있어서, 상기 관통공은 상기 바닥판을 관통하여 형성되고, 상기 팬은 상기 제1 측벽에 형성되는 것을 특징으로 하는 백라이트 유닛.

청구항 16.

제 15 항에 있어서, 상기 제1 측벽은 상기 바닥판에 대해서 외측으로 경사진 것을 특징으로 하는 백라이트 유닛.

청구항 17.

제 13 항에 있어서, 상기 광 발생부를 구동하기 위하여 상기 수납 용기의 바닥판 및 상기 측벽들 중 어느 하나 상에 배치된 제1 구동 회로부를 더 포함하는 것을 특징으로 하는 백라이트 유닛.

청구항 18.

제 12 항에 있어서, 상기 광 발생부는 발광 다이오드 광원을 포함하는 면광원 장치인 것을 특징으로 하는 백라이트 유닛.

청구항 19.

제 18 항에 있어서, 상기 면광원 장치는 상기 수납 용기 및 상기 발광 다이오드 광원 사이에 배치된 반사판을 더 포함하는 것을 특징으로 하는 백라이트 유닛.

청구항 20.

광을 발생하는 광 발생부 및 상기 광 발생부를 수납하고, 외부 공기가 흡입되는 흡기부 및 내부 공기를 방출하는 배기부가 형성된 수납 용기를 포함하는 백라이트 유닛; 및

상기 광 발생부로부터 출사되는 광을 이용하여 영상을 표시하는 액정표시패널을 포함하는 액정표시장치.

청구항 21.

제 20 항에 있어서, 상기 수납 용기는 바닥판 및 복수의 측벽들을 포함하며, 상기 흡기부는 상기 바닥판 및 상기 측벽들 중 적어도 하나를 관통하여 형성된 1개 이상의 관통공을 포함하고, 상기 배기부는 상기 바닥판 및 상기 측벽들 중 적어도 하나에 형성된 1개 이상의 팬을 포함하는 것을 특징으로 하는 액정표시장치.

청구항 22.

제 21 항에 있어서, 상기 관통공은 상기 바닥판을 관통하여 형성되고, 상기 팬은 상기 측벽들 중 상기 바닥판에 대해서 외측으로 정사진 제1 측벽에 형성되는 것을 특징으로 하는 액정표시장치.

청구항 23.

제 22 항에 있어서, 상기 팬은 상기 측벽들에 각각 형성되고, 상기 측벽들은 각각 상기 바닥판에 대해서 외측으로 정사진 것을 특징으로 하는 액정표시장치.

청구항 24.

제 20 항에 있어서, 상기 광 발생부는 발광 다이오드 광원을 포함하는 면광원 장치인 것을 특징으로 하는 액정표시장치.

청구항 25.

제 20 항에 있어서, 상기 광 발생부를 구동하기 위하여 상기 바닥판 및 상기 측벽들 중 어느 하나에 배치된 제1 구동 회로부 및 상기 액정표시패널을 구동하기 위하여 상기 바닥판 및 상기 측벽들 중 어느 하나에 배치된 제2 구동 회로부를 더 포함하는 것을 특징으로 하는 액정표시장치.

청구항 26.

제 25 항에 있어서, 상기 제1 구동 회로부는 상기 수납 용기의 바닥판에 배치되고, 상기 제2 구동 회로부는 상기 측벽들 중 상기 바닥판에 대해서 외측으로 경사진 제1 측벽에 배치된 것을 특징으로 하는 액정표시장치.

청구항 27.

광을 발생하는 광 발생부 및 상기 광 발생부를 수납하고, 외부 공기를 흡입하는 흡기부 및 내부 공기가 방출되는 배기부가 형성된 수납 용기를 포함하는 백라이트 유닛; 및

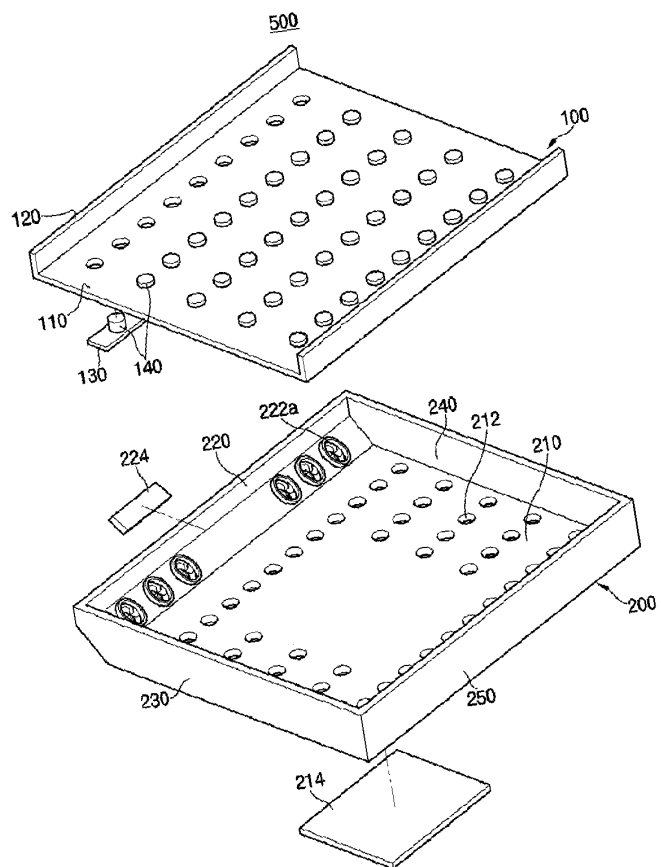
상기 광 발생부로부터 출사되는 광을 이용하여 영상을 표시하는 액정표시패널을 포함하는 액정표시장치.

청구항 28.

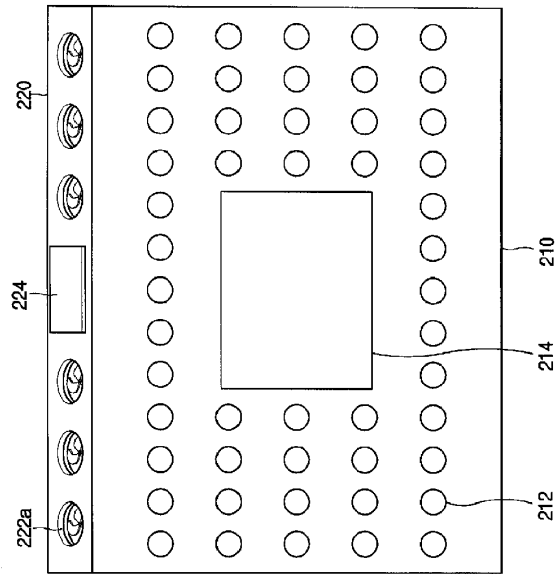
제 27 항에 있어서, 상기 수납 용기는 바닥판 및 복수의 측벽들을 포함하며, 상기 배기부는 상기 바닥판 및 상기 측벽들 중 적어도 하나를 관통하여 형성된 1개 이상의 관통공을 포함하고, 상기 흡기부는 상기 바닥판 및 상기 측벽들 중 적어도 하나에 형성된 1개 이상의 팬을 포함하는 것을 특징으로 하는 액정표시장치.

도면

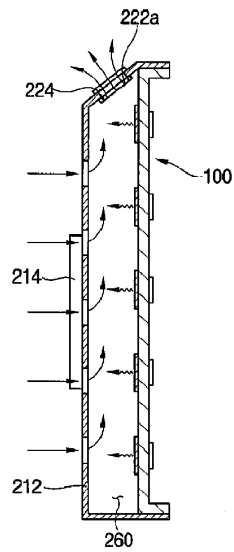
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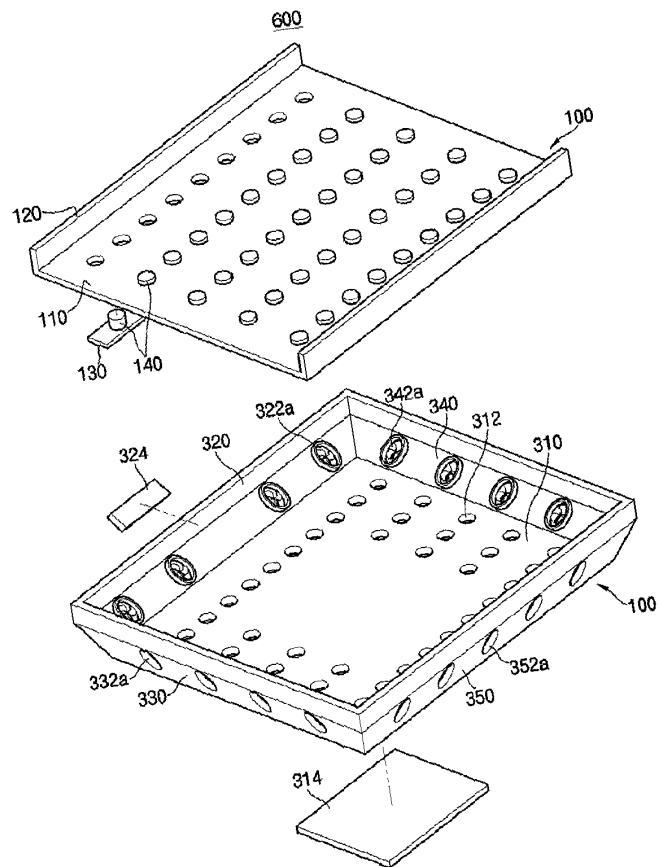
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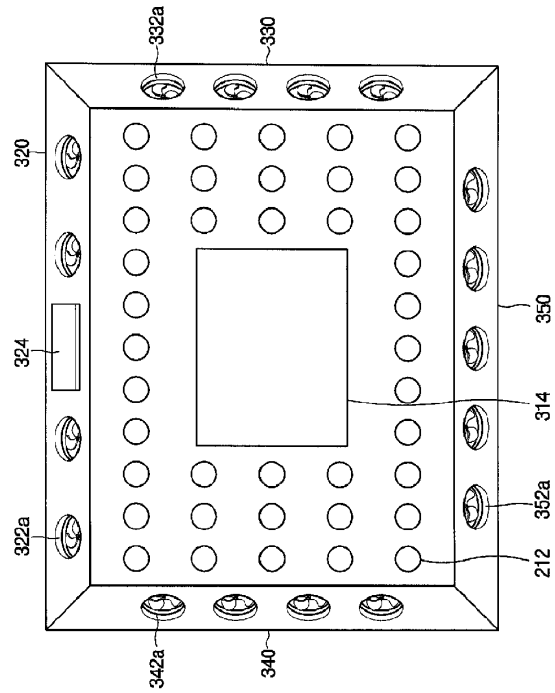
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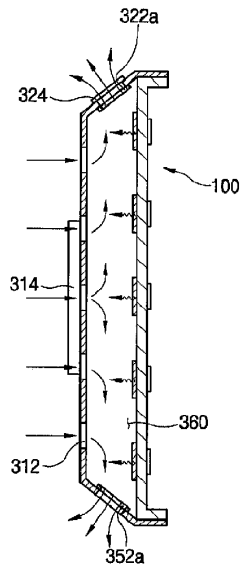
도면4



도면5



도면6



도면7

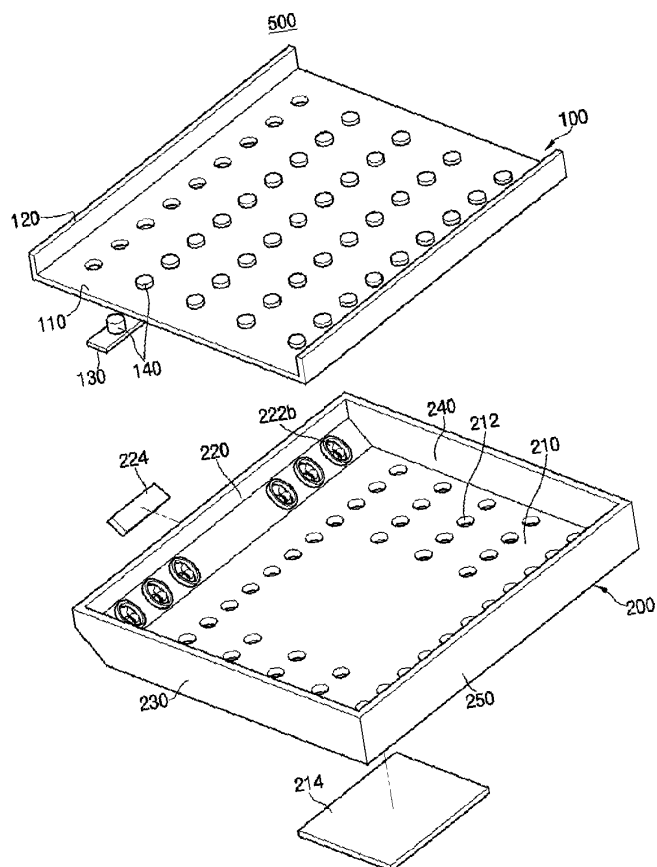


FIG. 8

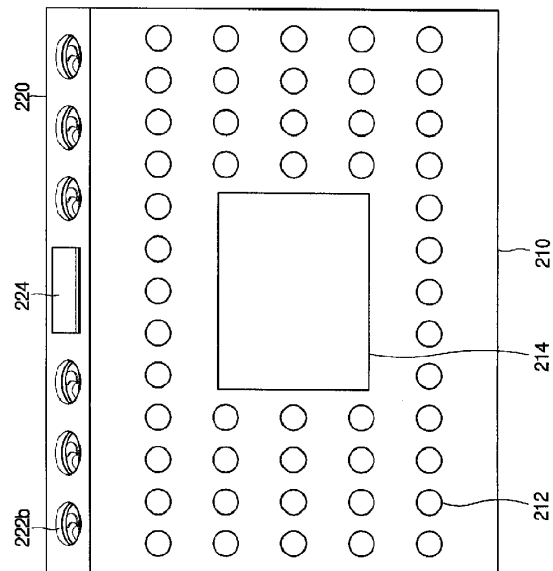
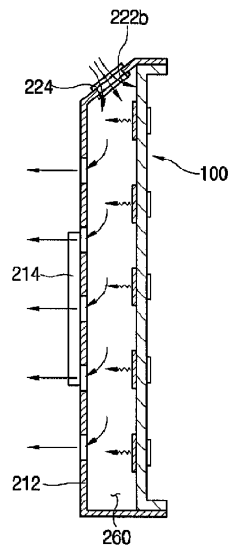
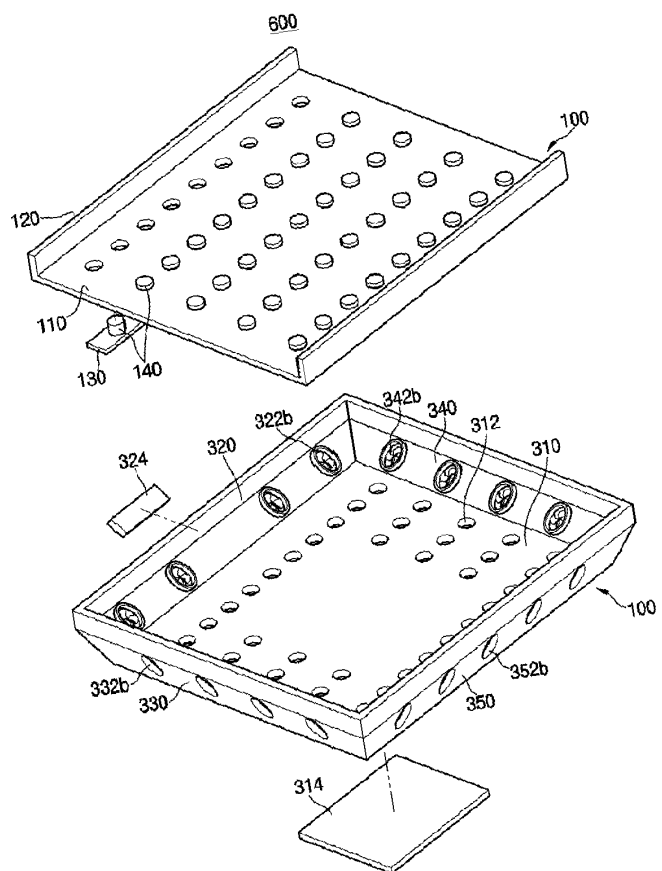


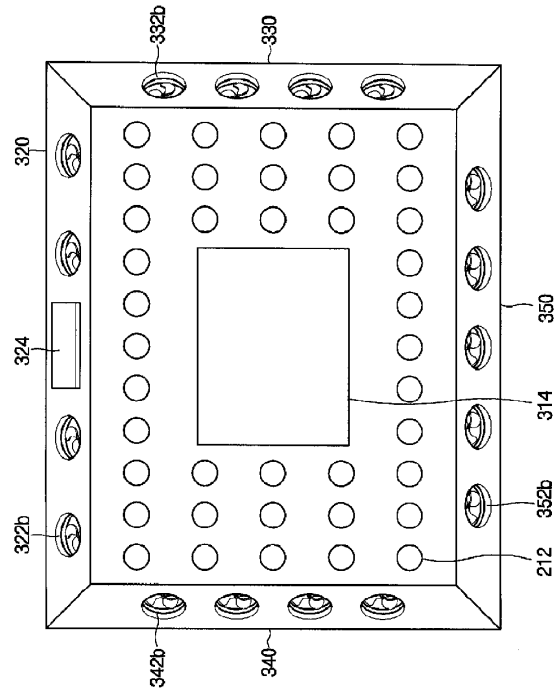
FIG. 9



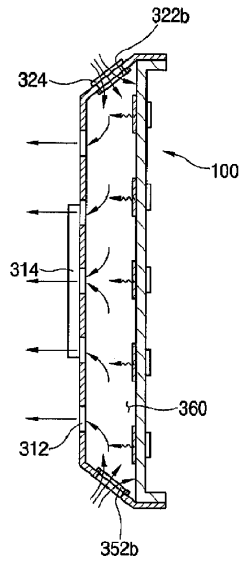
도면10



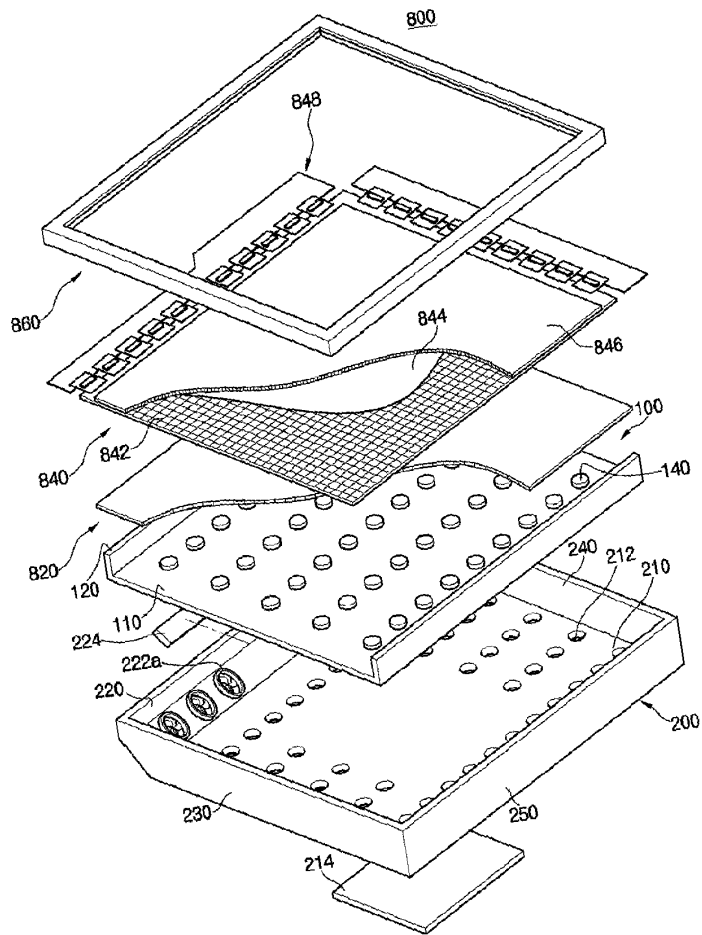
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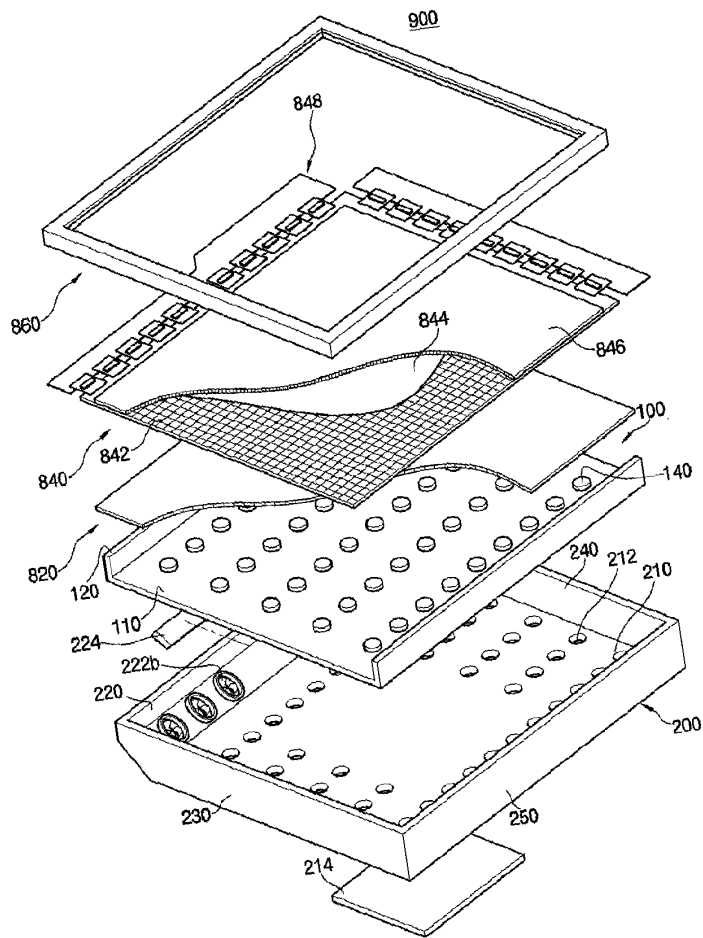
도면12



도면13



도면14



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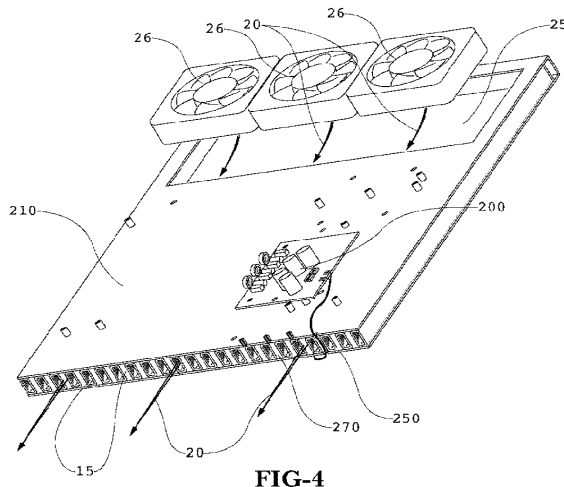
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[Continued on next page]

(54) Title: MODULAR DISTRIBUTED COMPONENTS FOR LED BACKLIGHT



(57) Abstract: A system for powering an LED backlight where power assemblies have electrical communications ran through pass through apertures in a mounting plate and LED backlight panel. A channel may be defined between the mounting plate and the LED backlight panel (or optional thermal plate attached to the rear portion of the LED backlight panel). Sub-channels can be created within the channel which are defined by ribs which connect between the mounting plate and the LED backlight panel (or optional thermal plate attached to the rear portion of the LED backlight panel). Cooling air can be prevented from entering one or more specific sub-channels so that electrical connections can pass through the mounting plate, LED backlight panel, and sub-channel without the risk of cooling air contaminates entering one of the pass through apertures.

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Modular Distributed Components for LED Backlight

Inventor: William Dunn

Technical Field

[0001] Exemplary embodiments generally relate to electrical systems for LCD backlights.

Background of the Art

[0002] Electronic displays are now being used indoors and outdoors for a variety of different purposes. Some of these displays have also grown substantially in size and are now found in sizes over 55 inches in diagonal. Specifically for liquid crystal displays (LCD), as the backlight increases in size there is also an increase in power that is required to drive the backlight. Also, as the backlight increases in size it generates more heat which, especially in an outdoor environment (sometimes with high ambient temperatures), can become a concern.

[0003] **FIGURE 1** illustrates one of the previous approaches for powering and controlling an LED backlight for a large LCD display. A typical LED backlight may be divided into several sections (panels) where each section (either a single panel or several panels) is powered by its own power circuit. A typical power circuit usually contains several electronic components, including a power module and inductors. Previously, it was thought that power modules and inductors should be grouped separately, with the resulting connections for the LEDs being routed around the edge (perimeter or periphery) of the backlight. Thus, as shown in Figure 1, several power modules 100 have electrical connections 110 running to a grouping of inductors 150. Electrical connections 160 then travel around the edge of the backlight and connect with each LED panel.

[0004] It has been found that the previous method results in a large amount of electrical connectors (wiring) with a substantial amount of assembly time in order to route and connect all of the wiring.

Summary of the Exemplary Embodiments

[0005] Exemplary embodiments group the power module and inductors for various sections of the backlight together, resulting in power assemblies. The power assemblies are placed in a relatively close spatial relationship with the sections of the backlight that these components actually correspond with. The electrical connections between the power assemblies and LEDs are preferably passed through a mounting panel and the backlight.

[0006] In some embodiments there may be a flow of cooling air which passes immediately behind the backlight. This cooling air may be drawn from the surrounding ambient environment and may contain various contaminants, including dust, pollen, dirt, water vapor, smoke, etc. In these embodiments, the electrical connections may also pass through a sealed channel (or sub-channel) within the path of the cooling air so that there will be little or no contamination of the backlight or rear housing. In other words, the cooling air would preferably not be permitted to enter the cavities which contain the backlight or the power modules, video cards, hard drives, etc.

[0007] The foregoing and other features and advantages will be apparent from the following more detailed description of the particular embodiments of the invention, as illustrated in the accompanying drawings.

Brief Description of the Drawings

[0008] A better understanding of an exemplary embodiment will be obtained from a reading of the following detailed description and the accompanying drawings wherein identical reference characters refer to identical parts and in which:

[0009] **FIGURE 1** is a rear view of one of the previous approaches for powering and controlling an LED backlight for a large LCD display;

[0010] **FIGURE 2** is a section view of a first embodiment;

[0011] **FIGURE 3** is a section view of a second embodiment;

[0012] **FIGURE 4** is a rear perspective section view of an embodiment using a plurality of ribs between the backlight and the panel for mounting the power modules;

[0013] **FIGURE 5** is a front perspective section view of an embodiment using a plurality of ribs between the backlight and the panel for mounting the power modules;

[0014] **FIGURE 6** is a rear perspective section view showing electrical connectors passing through a sub-channel; and

[0015] **FIGURE 7** is a rear view of an exemplary embodiment for powering and controlling an LED backlight.

Detailed Description

[0016] **FIGURE 2** provides a sectional view of an exemplary embodiment. Several power assemblies 200 (preferably power modules with the associated inductors) have their electrical connections 225 (ex. conduction lines) passing through a mounting panel 210 and connected to the backlight 250. The backlight 250 in this embodiment includes a plurality of illumination devices 32 which are mounted on a plurality of panels 30 and 31. In an exemplary embodiment, the illumination devices 32 would be LEDs and the panels 30 and 31 would be a PCB and more preferably a metal core PCB. The connection with the backlight 250 may be on the front or rear of the backlight 250.

[0017] **FIGURE 3** provides a sectional view of another embodiment. Again, Several power assemblies 200 (preferably power modules with the associated inductors) have their electrical connections 225 passing through a mounting panel 210 and connected to the backlight 250. In this embodiment, a cooling channel 270 is placed immediately behind the backlight 250. An optional thermally conductive plate 280 may be in thermal communication with the backlight 250 so that heat from the backlight 250 may be transferred to the thermal plate 280. Alternative embodiments may simply allow the cooling air 20 to contact the rear surface of the backlight 250 (without using an additional thermal plate 280). A path of cooling air 20 may be directed along the cooling channel 270 so that heat from the thermal plate 280 (or backlight 250 if thermal plate 280 is not used) may be transferred to the cooling air 20 and removed from the display.

[0018] When using the cooling channel 270, the pass through apertures 290 (locations where the electrical connections 225 pass through the mounting panel 210, thermal plate 280, and/or backlight 250) may provide an opportunity for contaminants which are present within the cooling air 20 to enter the display housing or the backlight. This may be undesirable, as it may cause damage to the display components or affect

the image quality of the display. Thus, it may be desirable to seal the pass through apertures 290 to ensure that contaminants do not enter the display housing or backlight areas of the display. This may be accomplished by using grommets, which are typically comprised of a soft plastic where they are designed to fit tightly around the electrical connections. Alternatively, or in addition to the grommets, the pass-through points 290 may be sealed with a sealant, for example silicon, glues, or caulk-type material. Still alternatively, a sealed sub-channel can be provided within the main cooling channel 270 which would allow the electrical connections to pass through without the fear of contamination from the cooling air 20. The sealed sub-channel may reduce the assembly time for the display as grommets would not have to be inserted nor would each pass-through point require sealant (although it could be used if desired).

[0019] **FIGURE 4** is a rear perspective section view of an embodiment using a plurality of ribs 15 between the backlight 250 and the mounting panel 210. The plurality of ribs 15 may define a number of sub-channels within the main cooling channel 270 defined between the backlight 250 and the mounting panel 210. A power assembly 200 is shown attached to the mounting panel 210. In an exemplary embodiment, the mounting panel 210 would provide a gaseous and contaminate barrier between the side containing the ribs 15 and the side containing the power assembly 200 and any other relatively sensitive electronic components. If the plate 210 provides an adequate barrier, ambient air may be ingested as cooling air 20 and the risk of contaminants entering the side of the plate 210 containing the sensitive electronic components may be reduced or eliminated.

[0020] Figure 4 also provides one example of an inlet aperture 25 which accepts the cooling air 20 and directs it along the ribs 15. One or more fans 26 may be used to draw the air 20 into the inlet aperture 25 and through the ribs 15. In some embodiments, the air 20 may be air conditioned before it is directed along the ribs 15. In some embodiments, the inlet aperture 25 may contain a filter in order to remove any particulate from the air 20. Although shown adjacent to the inlet aperture 25, the fans 26 could alternatively be placed adjacent to an outlet aperture, or adjacent to both the inlet and outlet apertures.

[0021] One or more of the sub-channels created by the ribs 15 may be sealed to allow the electrical connections for the power modules to pass through, without risking contamination from the cooling air 20. The ribs 15 shown in this embodiment contain a hollow rectangular cross-section, but this is not required. Other embodiments may contain ribs with I-beam cross-sections, hollow square cross-sections, solid rectangular or solid square cross-sections, 'T' cross-sections, 'Z' cross-sections, a honeycomb cross-section, or any combination or mixture of these. The ribs 15 are preferably thermally conductive and in thermal communication with the backlight 25, but this is not required. In an exemplary embodiment, the ribs 15 would be metallic.

[0022] **FIGURE 5** is a front perspective section view of an embodiment using a plurality of ribs 15 within the channel defined between the backlight 250 and the mounting panel 210. The backlight 250 in this embodiment includes a plurality of illumination devices 32 which are mounted on a plurality of panels 30 and 31. In an exemplary embodiment, the illumination devices 32 would be LEDs and the panels 30 and 31 would be a PCB and more preferably a metal core PCB. On the surface of the panels 30 and 31 which faces the ribs 15 there may be a thermal plate 280. In an exemplary embodiment, the thermal plate 280 would be metallic and more preferably aluminum. It is preferred that the ribs 15 are in thermal communication with the thermal plate 280. Cooling air 20 may again be forced along the ribs 15 in order to remove heat from the backlight assembly 250. Of course, this could also occur through natural convection.

[0023] **FIGURE 6** is a section view showing electrical connections 225 passing through a sub-channel 18 which is defined by the space enclosed by the ribs 16 and 17, thermal plate 280, and mounting panel 210. The electrical connections 225 may enter the sub-channel 18 though pass-through apertures 290. The electrical connections 225 may establish electrical communication between the backlight 250 and the power assembly 200. The electrical connections 225 connect with the backlight 250 at connection point 300 while connecting with the power assembly 200 at connection point 310. In this embodiment, the portion of the inlet aperture which is adjacent to sub-channel 18 may be blocked so that cooling air cannot enter the sub-channel 18. This prevents any contaminants which may be present within the cooling air from entering

either of the pass-through apertures 290. Thus, as long as the sub-channel 18 is properly sealed from the adjacent sub-channels, blocking the inlet of the channel 18 may reduce the risk of contaminants from the cooling air entering the pass-through points 290 and sensitive portions of the display. The sub-channel 18 may be blocking by using any type of blocking device/method including but not limited to: placing a plug (plastic, rubber, fabric, or any combination) at the entrance of the sub-channel, blocking the entrance with adhesive, blocking the entrance with double-sided tape or adhesive-backed substrate, welding a cover plate to cover the entrance, and attaching a cover plate with mechanical fasteners or adhesives.

[0024] FIGURE 7 is a rear view of an exemplary embodiment for powering and controlling an LED backlight for a large LCD. A plurality of power supplies 400 with the associated inductors 410 (i.e. power assemblies) have electrical connections 450 (ex. conduction lines) passing through a mounting panel 210 and connected to the backlight. The exemplary designs herein allow for a backlight to be connected with power assemblies using only a minimal amount of wiring as well as a minimal amount of assembly time. Furthermore, the exemplary embodiments ensure that a clean, contaminate free environment is maintained between the LED controlling electronics and the LED backlight.

[0025] It should be noted that although 4 power assemblies are shown, embodiments may use more or less than 4 power assemblies with any particular arrangement. The size and type of display/backlight may control the actual number of power assemblies used.

[0026] Further, it should be noted that the drawings herein are not necessarily drawn to scale. For the sake of simplicity and clarity, some components may be shown enlarged or simplified for explanatory purposes.

[0027] Having shown and described preferred embodiments, those skilled in the art will realize that many variations and modifications may be made to affect the described embodiments and still be within the scope of the claimed invention. Additionally, many of the elements indicated above may be altered or replaced by different elements which will provide the same result and fall within the spirit of the claimed invention. It is the intention, therefore, to limit the invention only as indicated by the scope of the claims.

CLAIMS

1. A system for powering a LED backlight comprised of several backlight panels, the system comprising:
 - a mounting panel placed adjacent to the LED backlight;
 - a power module in electrical communication with at least one backlight panel and attached to the mounting panel;
 - further power modules in electrical communication with the remaining backlight panels and attached to the mounting panel; and
 - wherein the electrical communication is provided by conduction lines which pass through both the mounting panel and the LED backlight.
2. The LED backlight powering system of claim 1 further comprising:
 - a thermally conductive plate attached to the LED backlight; and
 - a fan positioned to draw cooling air across the thermally conductive plate.
3. The LED backlight powering system of claim 1 further comprising:
 - a cooling channel defined by the space between the LED backlight and the mounting plate; and
 - a fan positioned to force cooling air through the cooling channel.
4. The LED backlight powering system of claim 3 further comprising:

a sub-channel within the cooling channel and containing the conduction lines.

5. The LED backlight powering system of claim 4 further comprising:

a blocking device placed within the sub-channel to block cooling air from passing through the sub-channel.

6. A LED backlight system comprising:

a printed circuit board (PCB) having a front and rear side;

a plurality of LEDs on the front side of the PCB;

a mounting plate adjacent to the rear side of the PCB;

an electrical power assembly mounted to the mounting plate;

a first pass through aperture located on the PCB;

a second pass through aperture located on the mounting plate; and

electrical connections between the power assembly and LEDs which pass through the first and second pass through apertures.

7. The LED backlight system of claim 6 further comprising:

a thermally conductive plate attached to the rear side of the PCB; and

a fan positioned to force cooling air over the thermally conductive plate.

8. The LED backlight system of claim 6 further comprising:

a cooling channel defined by the space between the rear side of the PCB and the mounting plate; and

a fan positioned to draw cooling air through the cooling channel.

9. The LED backlight system of claim 8 further comprising:

a sub-channel within the cooling channel and containing the first and second pass through holes and electrical connections.

10. The LED backlight system of claim 9 wherein:

the sub-channel is defined by the rear side of the PCB, mounting plate, and a pair of ribs which connect between the rear side of the PCB and mounting plate.

11. The LED backlight system of claim 9 further comprising:

a blocking device placed within the sub-channel to block cooling air from passing through the sub-channel.

12. The LED backlight system of claim 10 wherein:

the pair of ribs are thermally conductive and in thermal communication with the rear side of the PCB.

13. A LED backlight system comprising:
- a plurality of LEDs mounted on a substrate having a front and rear side;
 - a mounting plate spaced apart from the rear side of the substrate and substantially parallel to the substrate;
 - a plurality of ribs interposed between the mounting plate and rear side of the substrate and in thermal communication with the substrate;
 - a fan positioned to draw cooling air between the plate and substrate and along the ribs;
 - an electrical power assembly mounted to the mounting plate;
 - a first pass through aperture located on the substrate;
 - a second pass through aperture located on the mounting plate; and
 - electrical connections between the power assembly and LEDs which pass through the first and second pass through apertures.
14. The LED backlight system of claim 13 wherein:
- the substrate is a metal core printed circuit board.
15. The LED backlight system of claim 13 wherein:
- the ribs are metallic.
16. The LED backlight system of claim 13 further comprising:
- one rib which contains a hollow cross-section that is aligned with the first and second pass through apertures so that the electrical connections may pass through the hollow cross-section of the rib.
17. The LED backlight system of claim 13 wherein:

the first and second apertures are located between a pair of ribs.

18. The LED backlight system of claim 17 further comprising:
a blocking device placed between the pair of ribs which contain the first and second apertures to prevent cooling air from passing through.

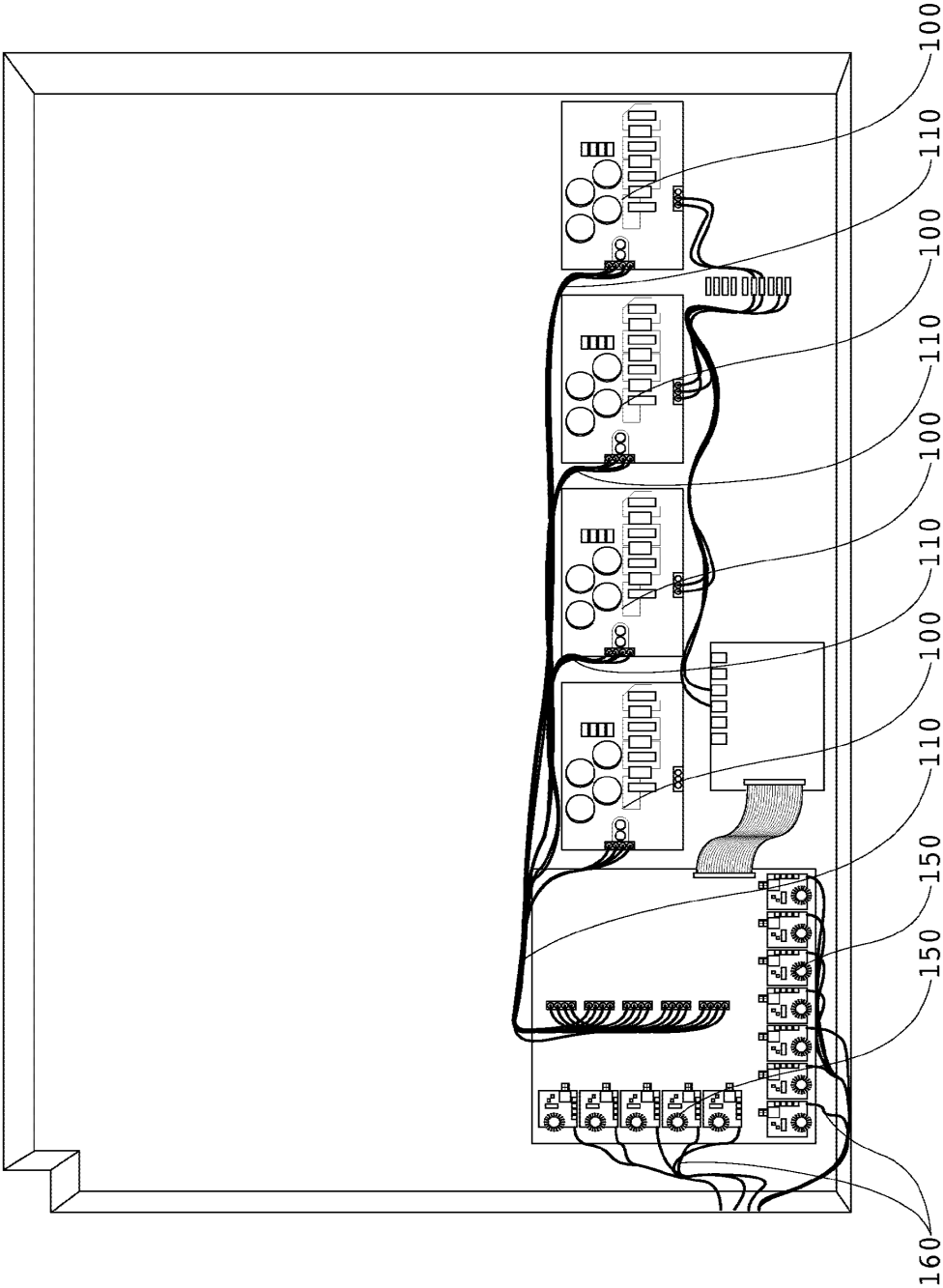


FIG-1 PRIOR ART

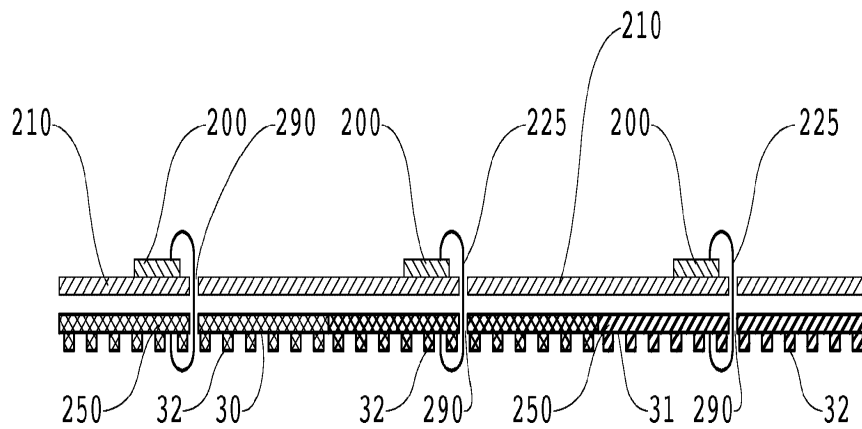


FIG-2

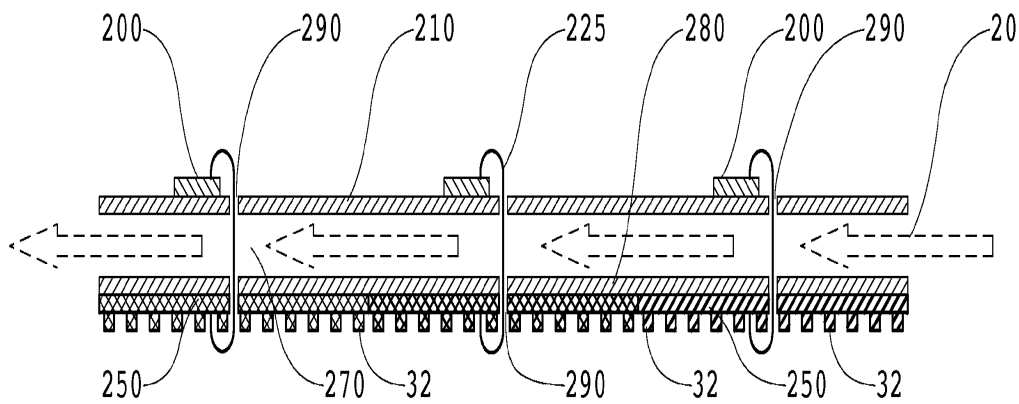


FIG-3

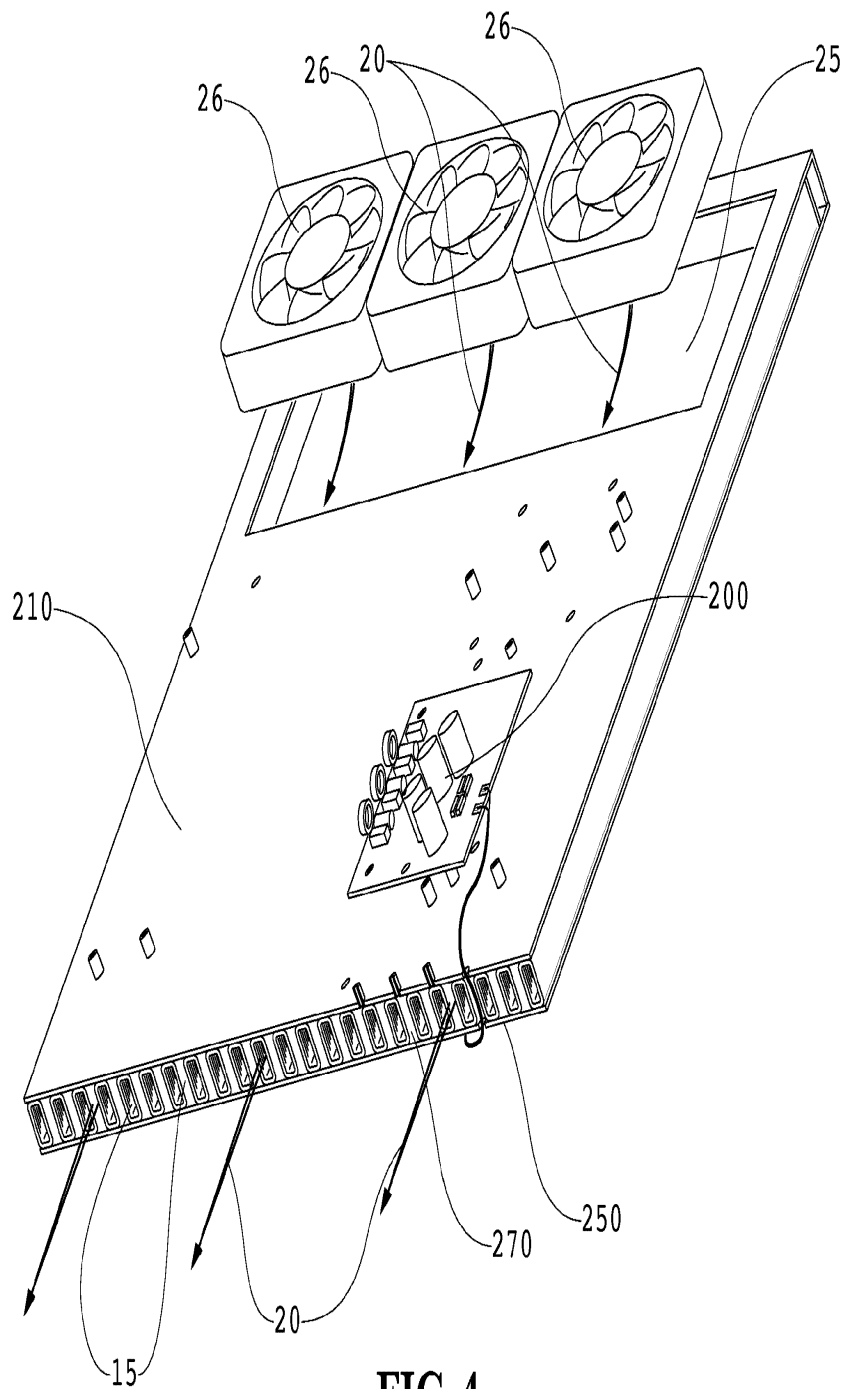


FIG-4

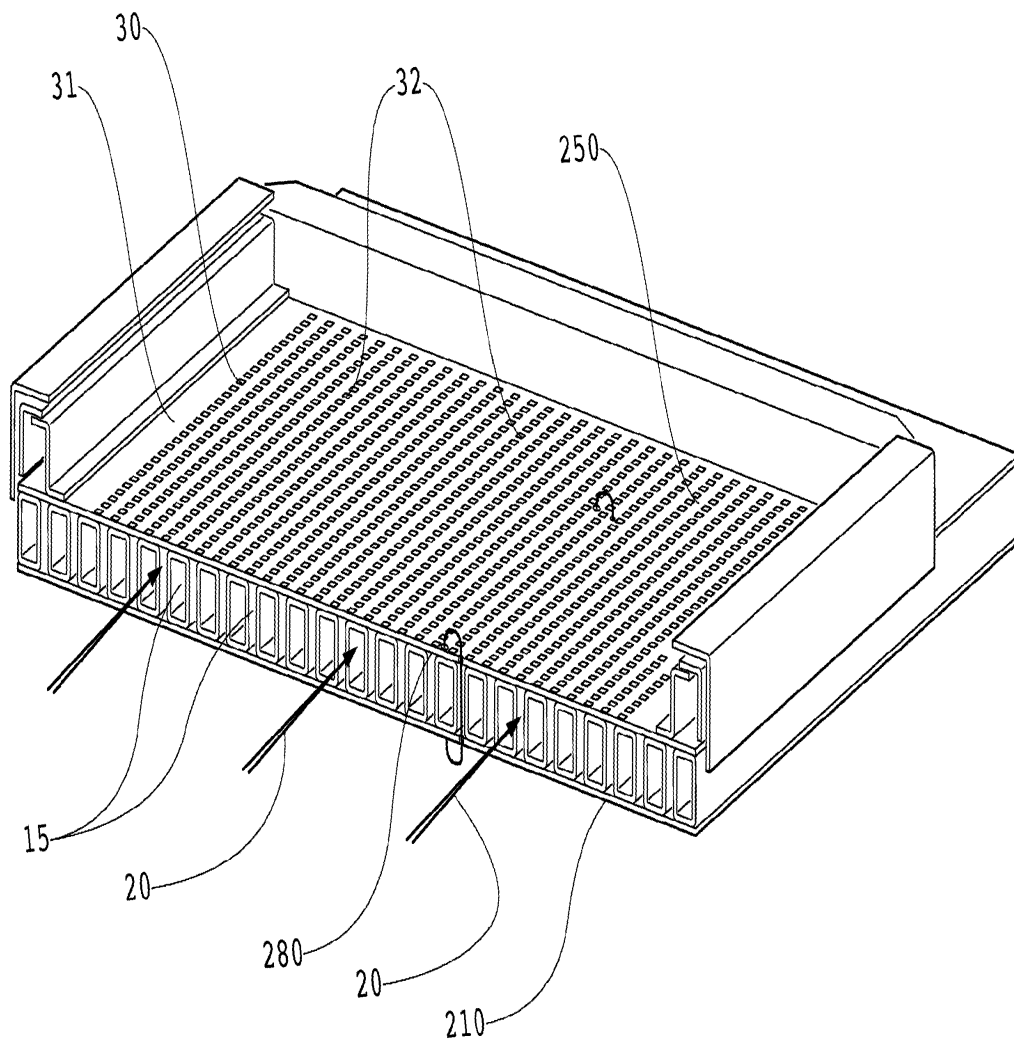


FIG-5

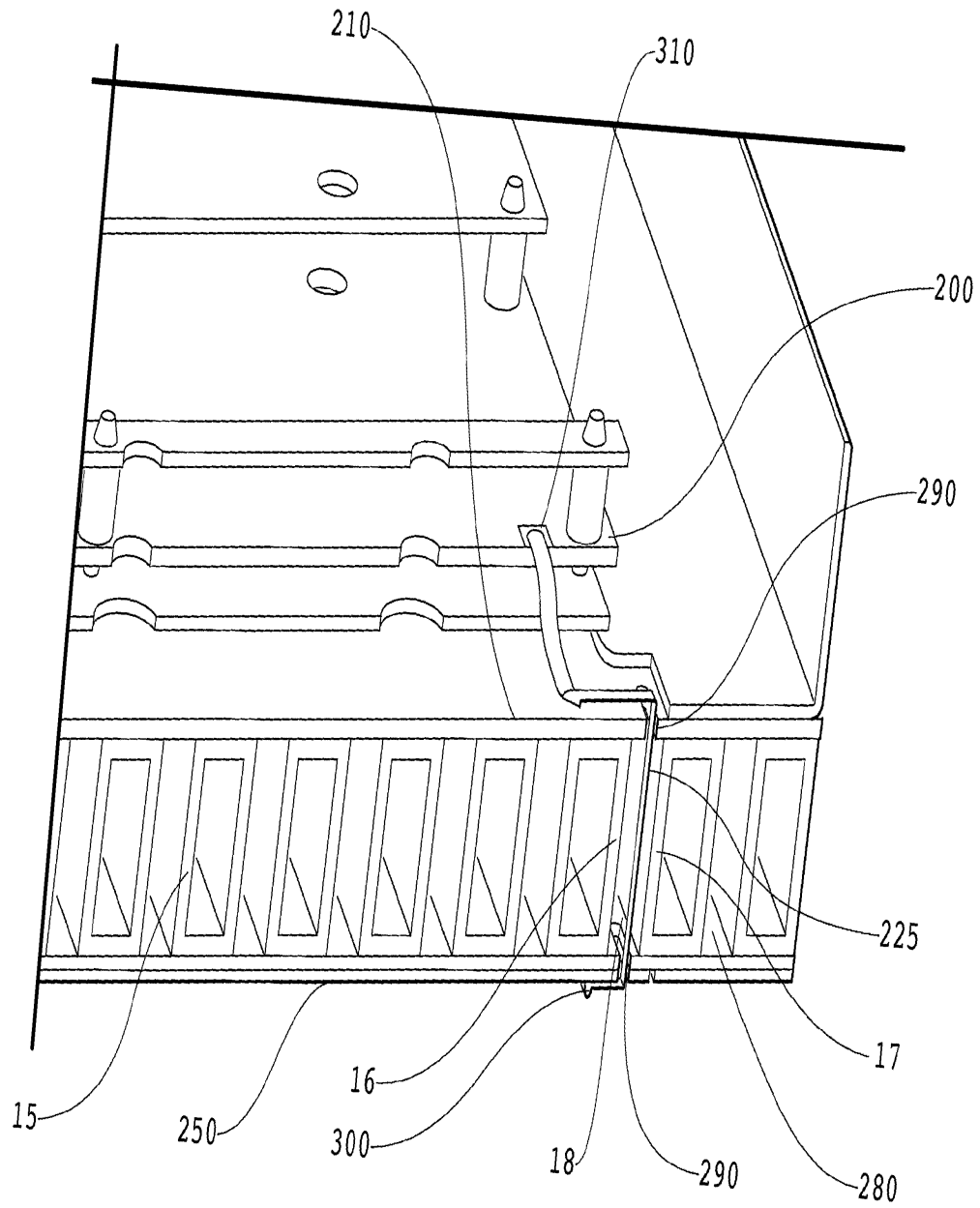


FIG-6

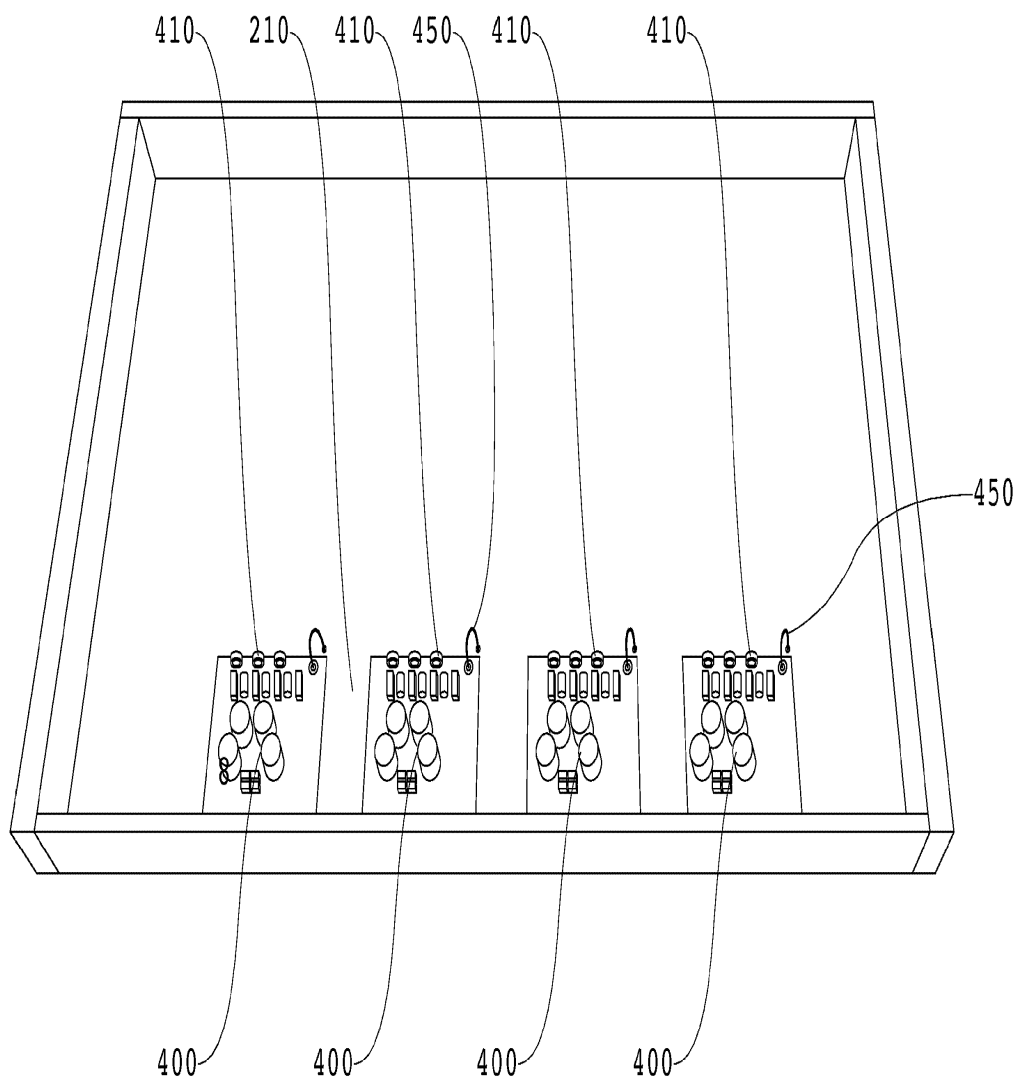


FIG-7



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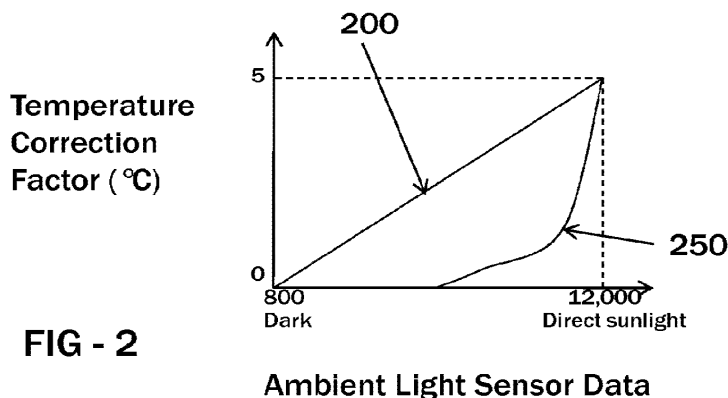
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(54) **Title:** APPARATUS AND METHOD FOR REDUCING THE THERMAL INERTIA OF AN ELECTRONIC DISPLAY



(57) **Abstract:** An apparatus and method for reducing the thermal inertia of an electronic display based on the amount of ambient light present. An ambient light sensor is used to measure the amount of ambient light which is contacting the display. To anticipate a temperature rise and lower the thermal inertia of the display, the fan speed is increased when high ambient light levels are measured at the exterior of the display but prior to a substantial increase in temperature. The ambient light sensor data may be used to apply a temperature correction factor to a temperature sensor within the display. Alternatively, the ambient light sensor data may be used to apply a fan speed correction factor to a desired fan speed (calculated based on a temperature sensor within the display).

Apparatus and Method for Reducing the Thermal Inertia of an Electronic Display

Inventors: John Schuch and Rick De Laet

Technical Field

[0001] Exemplary embodiments generally relate to systems and methods for anticipating a temperature rise in an electronic display and reducing the thermal inertia of the display.

Background of the Art

[0002] Improvements to electronic displays now allow them to be used in outdoor environments for informational, advertising, or entertainment purposes. While displays of the past were primarily designed for operation near room temperature, it is now desirable to have displays which are capable of withstanding large surrounding environmental temperature variations. For example, some displays are capable of operating at temperatures as low as -22F and as high as 113 F or higher. When surrounding temperatures rise, the cooling of the internal display components can become even more difficult.

[0003] Additionally, modern displays have become extremely bright, with some backlights producing 1,000-2,000 nits or more. Sometimes, these illumination levels are necessary because the display is being used outdoors, or in other relatively bright areas where the display illumination must compete with other ambient light. In order to produce this level of brightness, illumination devices and electronic displays may produce a relatively large amount of heat.

[0004] Still further, in some situations radiative heat transfer from the sun through a front display surface can also become a source of heat. In some locations 800-1400 Watts/m² or more through such a front display surface is common. Furthermore, the market is demanding larger screen sizes for displays. With increased electronic display screen size and corresponding front display surfaces, more heat will be generated and more heat will be transmitted into the displays.

[0005] Exemplary modern displays have found some effective means for cooling the electronic displays which may be used in high ambient temperatures and/or in direct sunlight. Some modern displays may move some type of cooling gas with a fan assembly, either circulating within the display (closed loop) or passing through the display (ingested/exhausted or open loop). Typical designs would measure the temperature within the display and engage the cooling fans once the temperatures within the display reach a predetermined threshold. However, it has been found that electronic displays typically have a large amount of thermal inertia and large amounts of power are required to reverse the increase in temperature and cool the display. In other words, it is much harder and requires much more energy to cool the display once the temperature within the display has actually risen. Energy consumption has become a major concern with large electronic displays and it is desirable to limit and/or reduce their overall energy consumption as much as possible without effecting its performance.

[0006] Thus, it is now desirable to predict when and to what extent the display will rise in temperature, and preemptively engage the cooling fans so that the cooling gas can begin flowing and mitigate any potential rise in temperature.

Summary of the Exemplary Embodiments

[0007] Thus, it has been discovered that the exposure of the front display surface and/or housing to sunlight is a typical cause of many internal temperature rises within the display. This discovery has led to a potential relationship between a measurement of the amount of ambient light and a potential temperature rise within the display. The exemplary embodiments herein use the data from an ambient light sensor in order to apply a correction factor to the actual temperature data and/or the fan speeds in order to anticipate a rise in temperature and reduce its impact on the display.

[0008] The temperature sensors may be placed in one or more places within the display. Typically, the temperature sensors are placed in close proximity to one or more components that are known to increase in heat during operation (especially in high ambient temperatures and/or direct sunlight). In some embodiments, the temperature sensors are placed within or near the image assembly, on or in close proximity to one or more power modules, and/or near the backlight (if using a display type that requires a backlight, ex. liquid crystal displays). The fans are typically oriented so that they can force or draw cooling gas over these components (as well as others). The fans, temperature sensors, and ambient light sensor may be in electrical communication with a microprocessor (or other appropriate electronic control) so that a correction factor can be applied to the data from the temperature sensors so that the system 'thinks' it has already increased in temperature. Alternatively, the microprocessor could simply direct the fans to increase in speed depending on the data from the ambient light sensor.

[0009] The foregoing and other features and advantages will be apparent from the following more detailed description of the particular embodiments of the invention, as illustrated in the accompanying drawings.

Brief Description of the Drawings

[0010] A better understanding of an exemplary embodiment will be obtained from a reading of the following detailed description and the accompanying drawings wherein identical reference characters refer to identical parts and in which:

[0011] **FIGURE 1A** shows an electrical block diagram for an exemplary display which contains a basic embodiment of the cooling system.

[0012] **FIGURE 1B** shows an electrical block diagram for an exemplary display which contains an embodiment of the cooling system for cooling a LCD.

[0013] **FIGURE 2** shows a pair of example graphical relationships between the ambient light sensor data and the temperature correction factor.

[0014] **FIGURE 3** shows a pair of example graphical relationships between the corrected temperature sensor data and the fan speed.

[0015] **FIGURE 4** shows a flow chart for the logic in operating an exemplary system or the steps in practicing an exemplary method.

[0016] **FIGURE 5** shows a pair of example graphical relationships between the representative temperature sensor data and the fan speed.

[0017] **FIGURE 6** shows a pair of example graphical relationships between the ambient light sensor data and a fan speed correction factor.

[0018] **FIGURE 7** shows a flow chart for the logic in operating another exemplary system or the steps in practicing another exemplary method.

Detailed Description

[0019] **FIGURE 1A** shows an electrical block diagram for an exemplary display 100 which contains an embodiment of the cooling system. In this embodiment, an electronic image assembly 10 is placed behind a front display panel 12 (which may be used to protect the electronic image assembly 10 from damage). The electronic image assembly 10 shown here could be used with any type of electronic assembly for generating an image, including but not limited to: LCD, organic light-emitting diode (OLED), plasma, light emitting polymer (LEP), LED, or electroluminescent display.

[0020] An ambient light sensor 15 may be placed near the front portion of the display relatively close to the front display panel 12. The electronic image assembly 10 and the ambient light sensor 15 may be in electrical communication with a signal backplane 31. A display controller assembly 24 may be electrical communication with the signal backplane 31 and may contain several electronic components for controlling the various operations of the display.

[0021] A power backplane 20 may be in electrical communication with the signal backplane 31. One or more power modules 22 may be in electrical communication with the power backplane 20. In some embodiments, the signal backplane and power backplane may be combined into a single backplane to provide various electrical connections and communication to portions of the display. In other embodiments, there may be more backplanes in addition to the signal and power backplanes shown in this

embodiment. In this embodiment, because there is electrical communication between the signal backplane 31 and the power backplane 20, components which are shown as being in electrical communication with either backplane could easily be shown or described as in electrical communication with the other backplane. The backplane designs which are shown are simply a suggestion and are not required.

[0022] A fan assembly 40 may be placed in electrical communication with the power backplane 20. The fan assembly 40 may be positioned so that it can force cooling gas over one or more components that are known to increase in heat during operation (especially in high ambient temperatures and/or direct sunlight). A temperature sensor 35 may be placed in electrical communication with the signal backplane 31. The temperature sensor 35 may also be positioned so that it can measure the temperature of one or more components that are known to increase in heat during operation (especially in high ambient temperatures and/or direct sunlight). A power input 28 may be connected to the power backplane 20 in order to supply power to the display.

[0023] The display controller assembly 24 may include several different components including, but not limited to a video receiving unit, decompressor, buffer, timing and control board, and display interface board (DIB). The display controller assembly 24 may also include a microprocessor or CPU for performing the logic to operate the exemplary embodiments herein. Thus, the temperature sensor 35, fan assembly 40, and ambient light sensor 15 may be in electrical communication with a microprocessor or CPU (located within the display controller assembly 24).

[0024] A video input 25 accepts the video data from a video source and may connect to the signal backplane 31 or may connect directly to the display controller assembly 24.

[0025] FIGURE 1B shows an electrical block diagram for an exemplary display 110 which contains an embodiment of the cooling system for cooling a LCD. In this embodiment, a backlight 60 is placed behind a liquid crystal assembly 50. One or more temperature sensors 30 are placed on or near the backlight 60 and in electrical communication with the signal backplane 31. Further, one or more temperature sensors 36 are placed on or near the power modules 22. In this embodiment, a first fan assembly 42 is placed to force or draw cooling gas over the backlight 60. Also in this embodiment, a second fan assembly is placed to force or draw cooling gas over the power modules 22. Because the power modules 22 and the backlight 60 may increase in temperature as well as cool in different manners, it may be advantageous to use individual fan assemblies to cool each component, as shown here.

[0026] FIGURE 2 shows a pair of example graphical relationships between the ambient light sensor data and the temperature correction factor. Thus, in one embodiment of the system and method, the ambient light sensor data is used to calculate a temperature correction factor, which can be used to modify the actual temperature sensor data. As shown in Figure 2, a linear relationship 200 may be used to calculate a temperature correction factor from a given value for the ambient light sensor data. For the linear relationship 200, the temperature correction factor increases linearly as the ambient light sensor data increases. Alternatively, a non-linear relationship 250 may be used to represent this data. The precise relationship may be

selected depending on the particular electronic display and its desired operating conditions. The precise relationship can be determined through experimentation or simply by selecting a min/max and using linear interpolation. In general, as the amount of ambient light increases it becomes more likely that the internal components of the display will also increase in temperature. Accordingly, as the amount of ambient light increases a larger temperature correction factor is applied to the temperature sensor.

[0027] FIGURE 3 shows a pair of example graphical relationships between the corrected temperature sensor data and the fan speed. The term 'corrected temperature data' is used here to represent the values which result from applying the temperature correction factors to the actual temperature data (i.e. modifying the actual temperature data by the correction factor. This could be done by any mathematic operation. In a basic embodiment, the temperature correction factors may simply be added to the actual temperature data). The fan speed can be adjusted in a number of ways depending on the corrected temperature data. Here, a linear relationship 300 is shown where the fan speed increases linearly as the corrected temperature increases. Further, a non-linear relationship 350 can also be used to represent the desired fan speeds for each corrected temperature. In general, the fan speeds increase as the corrected temperature data increases. The precise relationship can be determined through experimentation and/or theory or simply by selecting a min/max and using linear interpolation. It should be noted that the values for the x and y axis on both Figure 2 and Figure 3 were simply selected as examples and should not be used to imply that the operating conditions would only occur within these values or that an exemplary system could only handle data values within this range.

[0028] FIGURE 4 shows a flow chart for the logic in operating an exemplary system or the steps in practicing an exemplary method. Initially, the data from the temperature sensor(s) and ambient light sensor is collected. As discussed in reference to Figures 1A-1B above, there may be several temperature sensors located in several places throughout the display. When multiple temperature sensors are used, an average value may be calculated from the various sensors or a maximum value may be selected as the representative data for the system (herein 'representative temperature data'). Based on the data from the ambient light sensor, a temperature correction factor may be selected. The temperature correction factor may be selected by using one of the relationships shown and described in reference to Figure 2, or anything similar. Next, the selected temperature correction factor may be applied to the representative temperature measurement. In general, the temperature correction factor is added or multiplied to the representative temperature measurement in order to create the corrected temperature data. As shown in Figure 2, for some values of the ambient light sensor data, the temperature correction factor may be zero. Obviously, in this case there is no requirement that the temperature correction factor is applied to the representative temperature data since the correction factor is zero and this step may not be performed.

[0029] Once a corrected temperature value has been calculated, the fan speed may be selected based on this corrected value. The fan speed may be selected based on one of the relationships discussed in reference to Figure 3 above. Thus, the temperature correction factor may cause the fan to run at a higher speed given the higher amount of ambient light that is contacting the display. The higher fan speeds

can be used to increase the cooling ability of the display prior to letting the heat from the ambient light transfer into the interior of the display. By preemptively engaging the fans at a higher speed, the temperature increase due to high ambient light levels can be slowed or eliminated in an efficient manner, reducing the power consumption of the display and the wear/tear on fans and other electronics.

[0030] **FIGURE 5** shows a pair of example graphical relationships between the representative temperature sensor data and the fan speed. Here, this graphical relationship is similar to that of Figure 3 with the notable exception that the fan speed is dependent upon the actual representative temperature data and not the corrected temperature data. Again, the fan speed can be adjusted in a number of ways depending on the representative data from the temperature sensor(s). Here, a linear relationship 500 may be used where the desired fan speed increases linearly as the temperature increases. Further, a non-linear relationship 550 can also be used to represent the desired fan speeds for each temperature measurement. In general, the desired fan speeds increase as the temperatures increase. The precise relationship can be determined through experimentation or simply by selecting a min/max and using linear interpolation.

[0031] **FIGURE 6** shows a pair of example graphical relationships between the ambient light sensor data and a fan speed correction factor. Thus, in this embodiment a fan speed correction factor is used instead of a temperature correction factor. The fan speed correction factor may simply be a percentage of the desired fan speed (determined above in reference to Figure 5). Thus, when the ambient light values are high, it may be desirable to increase the fan speed by 20%-30%. In one example, the

fan speed correction factor increases linearly 600 as the ambient light sensor data increases. In another example, the fan speed correction factor increases non-linearly 650 as the ambient light sensor data increases.

[0032] It should again be noted that the values for the x and y axis on both Figure 5 and Figure 6 were simply selected as examples and should not be used to imply that the operating conditions would only occur within these values or that an exemplary system could only handle data values within this range.

[0033] **FIGURE 7** shows a flow chart for the logic in operating another exemplary system or the steps in practicing another exemplary method. Initially, the data from the temperature sensor(s) is collected. As discussed in reference to Figures 1A-1B and 4 above, there may be several temperature sensors located in several places throughout the display. When multiple temperature sensors are used, an average value may be calculated from the various sensors or a maximum value may be selected as the representative data for the system (herein 'representative temperature data'). Based on the representative temperature data, a desired fan speed may be selected. The desired fan speed may be selected by using one of the relationships shown and described in reference to Figure 5. Next, the data from the ambient light sensor is gathered and used to determine a fan speed correction factor. The fan speed correction factor may be selected by using one of the relationships shown and described in reference to Figure 6. Finally, the fan speed correction factor may be applied to the desired fan speed to account for the high levels of ambient light (provided that the fan speed correction factor is greater than 0%).

[0034] As shown in Figure 1B, there may be multiple fan assemblies placed throughout the display. In these embodiments, there may be a control system for each fan assembly or even each fan. Further, each control system may have independent parameters. Thus, in reference to Figure 1B, the logic which controls fan assembly 42 for cooling the backlight 60 may be different than the logic which controls fan assembly 43 for cooling the power modules 22.

[0035] Any number of gaseous matters may be used as the cooling gas described herein. The cooling gas may be circulating around the display, ingested into the display and exhausted, and/or circulated through the display. In some embodiments, the cooling gas may be ambient air which is ingested into the display. In some embodiments, the cooling gas may be ambient air which has been air conditioned prior to being ingested into the display.

[0036] Having shown and described preferred embodiments, those skilled in the art will realize that many variations and modifications may be made to affect the described embodiments and still be within the scope of the claimed invention. Additionally, many of the elements indicated above may be altered or replaced by different elements which will provide the same result and fall within the spirit of the claimed invention. It is the intention, therefore, to limit the invention only as indicated by the scope of the claims.

CLAIMS

What is claimed is:

1. An apparatus for reducing the thermal inertia of a component within an electronic display where an ambient light sensor is used to measure ambient light contacting the display, a temperature sensor is used to measure the temperature of the component, and a fan is used to force cooling gas over the component, characterized by:

a microprocessor in electrical communication with the ambient light sensor, fan, and temperature sensor and adapted to increase the speed of the fan when a substantial increase in ambient light levels is measured but prior to a substantial increase in temperature measurement.

2. The apparatus of claim 1 wherein:

the microprocessor applies a fan speed correction factor to the fan in response to ambient light measurements.

3. The apparatus of claim 1 wherein:

the microprocessor applies a temperature correction factor to the temperature sensor data in response to ambient light measurements.

4. The apparatus of claim 1 wherein:

the component having a reduction in thermal inertia is a backlight.

5. An electronic display assembly comprising:

an electronic image assembly;

a backplane in electrical communication with the electronic image assembly;

an ambient light sensor producing a signal;

a power module in electrical communication with the backplane;

a fan placed to force cooling gas over the power module;

a temperature sensor producing a signal and placed to measure the temperature
of the power module; and

a microprocessor which receives the ambient light sensor signal and
temperature sensor signal and uses both signals to control the speed of
the fan.

6. The electronic display of claim 5 wherein:

the electronic image assembly is a backlit liquid crystal display.

7. The electronic display of claim 5 wherein:

the electronic image assembly is a OLED display.

8. The electronic display of claim 7 further comprising:

a second fan placed to force cooling gas over the backlight.

9. The electronic display of claim 8 further comprising:

a second temperature sensor producing a signal and placed to measure the temperature of the backlight.

10. The electronic display of claim 9 wherein:

the microprocessor also receives the second temperature sensor signal and uses the ambient light sensor signal and second temperature sensor signal to control the speed of the second fan.

11. The electronic display of any one of claims 5-10 wherein:

the ambient light sensor is positioned to measure the ambient light contacting the electronic image assembly.

12. A method for reducing the thermal inertia of an electronic display, the method comprising the steps of:

measuring the ambient light contacting the display;

measuring a temperature within the display;

selecting a temperature correction factor based on the ambient light measurement;

applying the temperature correction factor to the temperature measurement to produce corrected temperature data;

selecting a fan speed based on the corrected temperature data; and

driving the cooling fan at the selected fan speed.

13. The method of claim 12 wherein:

the temperature measurement is performed near a power module which powers the electronic display.

14. The method of claim 12 wherein:

the temperature measurement is performed near a backlight component of the electronic display.

15. A method for reducing the thermal inertia of an electronic display, the method comprising the steps of:

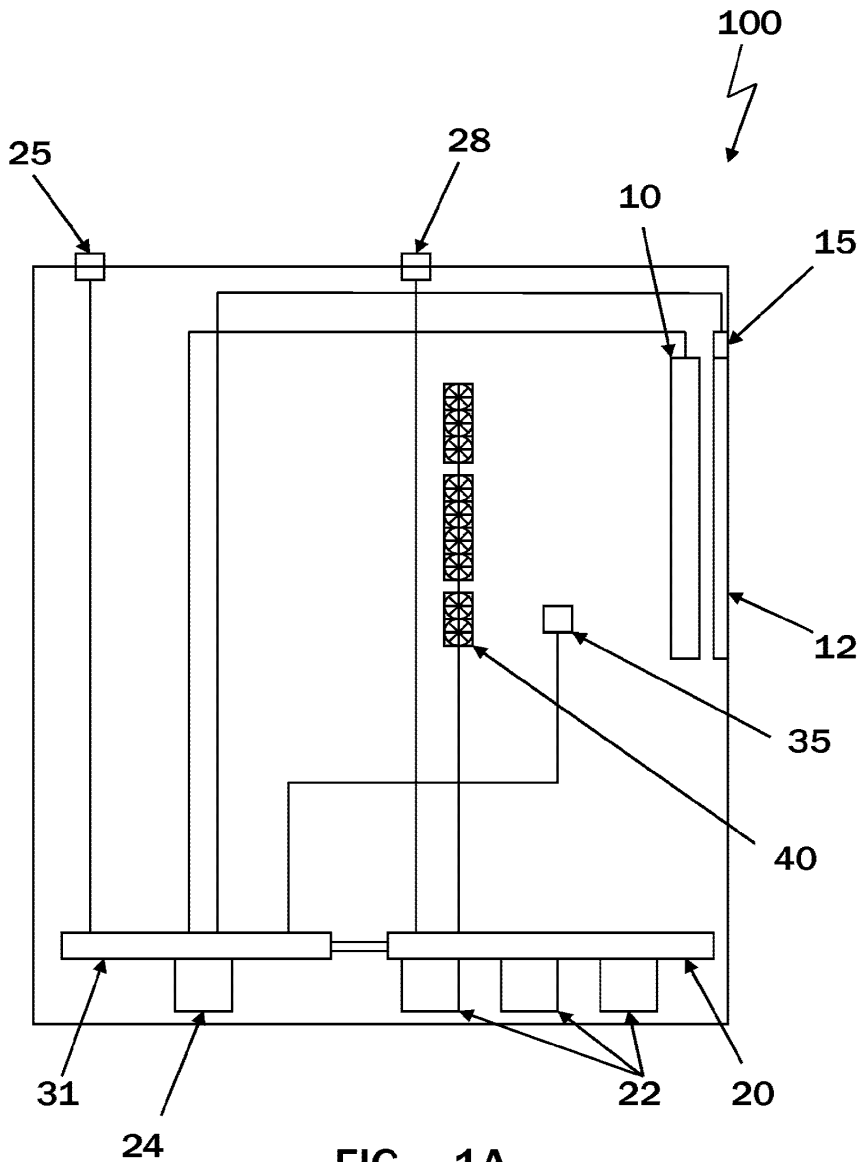
- measuring a temperature within the display;
- selecting a desired fan speed based on the temperature measurement;
- measuring the ambient light contacting the display;
- selecting a fan speed correction factor based on the ambient light measurement;
- applying the fan speed correction factor to the desired fan speed to produce a corrected fan speed; and
- driving the cooling fan at the corrected fan speed.

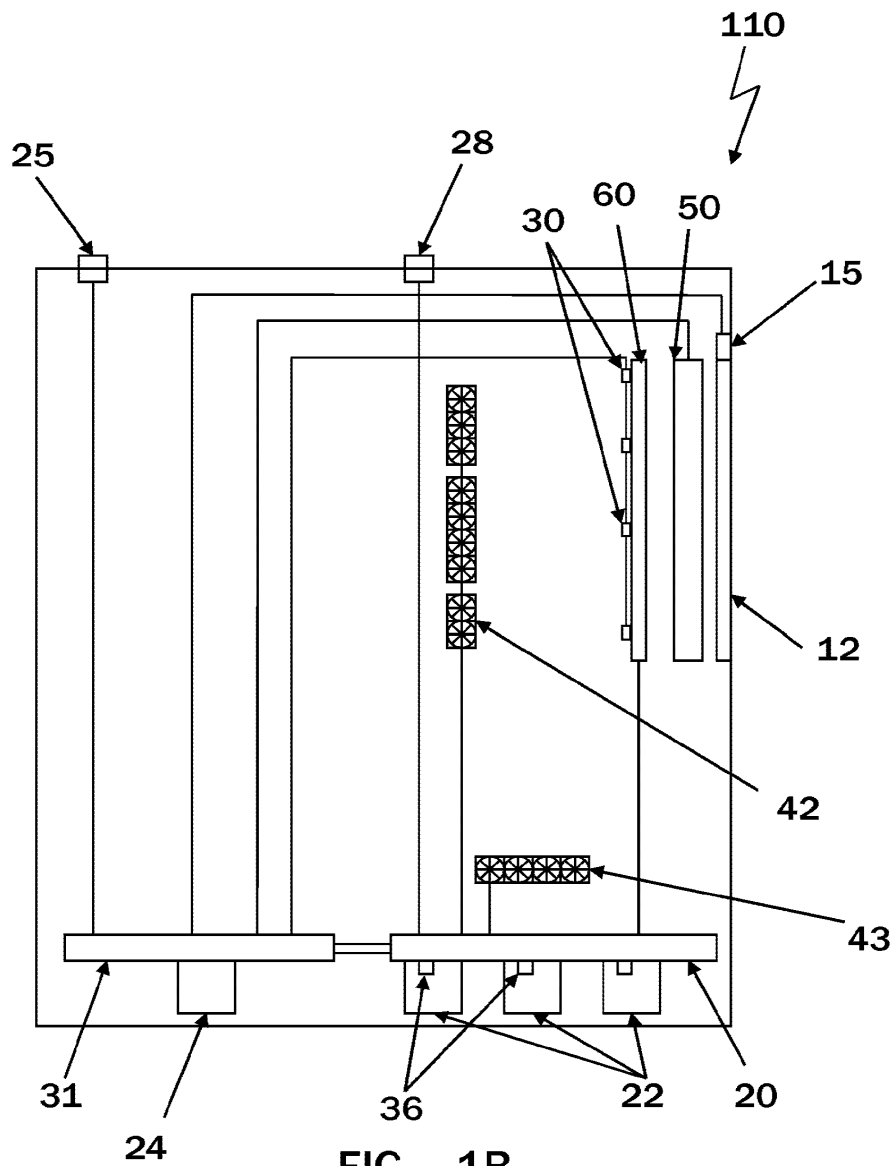
16. The method of claim 15 wherein:

- the temperature measurement is performed near a power module which powers the electronic display.

17. The method of claim 15 wherein:

- the temperature measurement is performed near a backlight component of the electronic display.





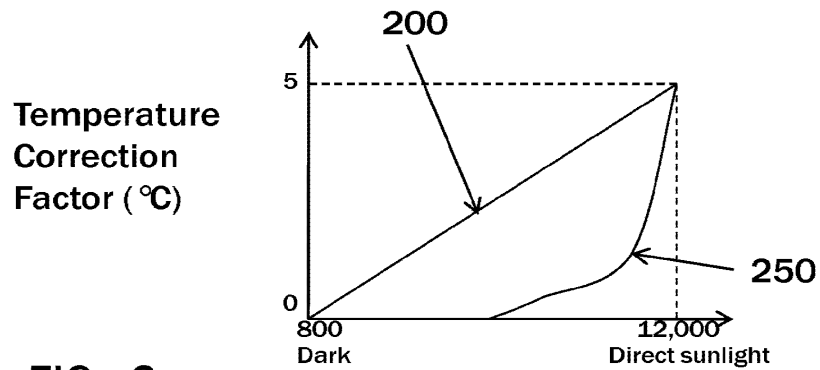


FIG - 2

Ambient Light Sensor Data

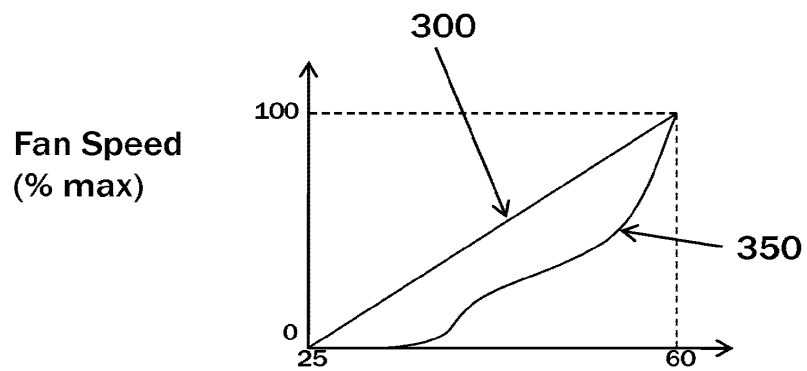


FIG - 3

Corrected Temperature Data (°C)

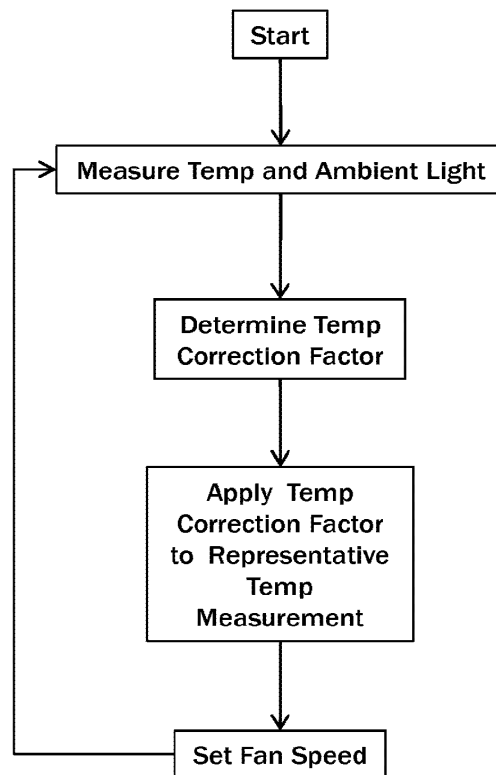
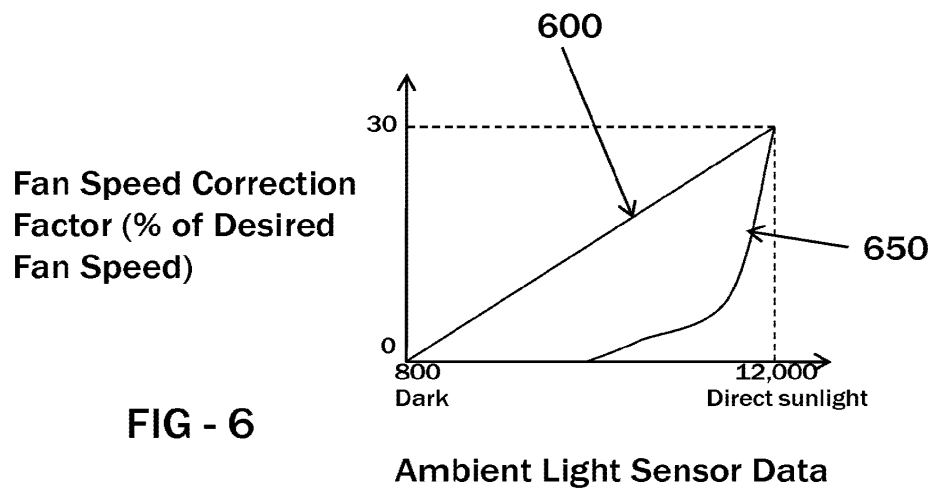
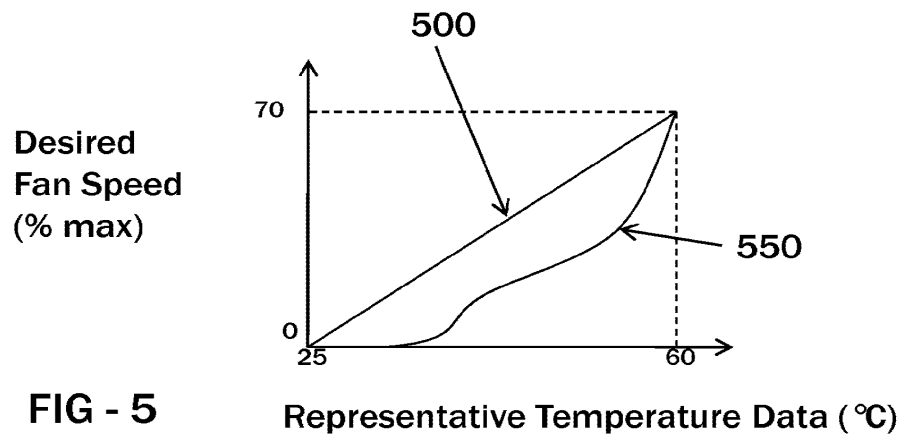


FIG - 4



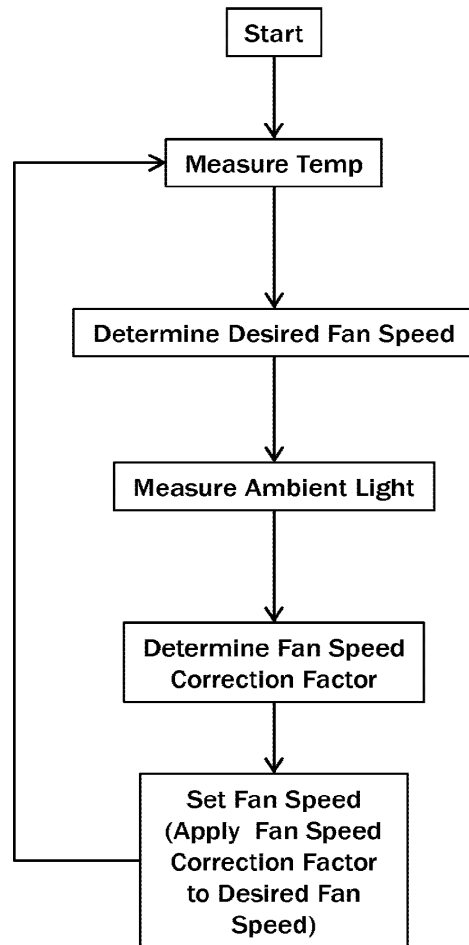


FIG - 7

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(54) Title: SYSTEM AND METHOD FOR THERMALLY CONTROLLING AN ELECTRONIC DISPLAY WITH REDUCED NOISE EMISSIONS

(57) Abstract: An assembly for cooling an electronic image assembly having a rear channel placed behind the image assembly and a heat exchanger for accepting ambient air. The system contains a first fan placed within the heat exchanger to force ambient air through the heat exchanger and the rear channel. A second fan may be used to force circulating gas through an interior portion of the display housing and through the heat exchanger in order to transfer heat to the ingested ambient air.

WO 2012/024426 A2

SYSTEM FOR THERMALLY CONTROLLING AN ELECTRONIC DISPLAY WITH REDUCED NOISE EMISSIONS

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Cross-Reference to Related Applications

[0001] This application claims priority to U.S. Application No. 13/211,887 filed on August 17, 2011, herein incorporated by reference in its entirety. This application claims priority to U.S. Application No. 61/375,470 filed on August 20, 2010, herein incorporated by reference in its entirety. This application is a continuation-in-part of U.S. Application No. 13/100,580 filed on May 4, 2011, herein incorporated by reference in its entirety. This application is also a continuation-in-part of U.S. Application No. 13/100,556 filed on May 4, 2011, herein incorporated by reference in its entirety. This application is also a continuation-in-part of U.S. Application No. 12/905,704 filed on October 15, 2010, herein incorporated by reference in its entirety.

Technical Field

[0002] Exemplary embodiments generally relate to cooling systems and in particular to cooling systems for electronic displays.

Background of the Art

[0003] Improvements to electronic displays now allow them to be used in outdoor environments for informational, advertising, or entertainment purposes. While displays of the past were primarily designed for operation near room temperature, it is now desirable to have displays which are capable of withstanding large surrounding environmental temperature variations. For example, some displays are capable of operating at temperatures as low as -22F and as high as 113 F or higher. When surrounding temperatures rise, the cooling of the internal display components can become even more difficult.

[0004] Additionally, modern displays have become extremely bright, with some backlights producing 1,000-2,000 nits or more. Sometimes, these illumination levels are necessary because the display is being used outdoors, or in other relatively bright

areas where the display illumination must compete with other ambient light. In order to produce this level of brightness, illumination devices and electronic displays may produce a relatively large amount of heat.

[0005] Still further, in some situations radiative heat transfer from the sun through a front display surface can also become a source of heat. In some locations 800-1400 Watts/m² or more through such a front display surface is common. Furthermore, the market is demanding larger screen sizes for displays. With increased electronic display screen size and corresponding front display surfaces, more heat will be generated and more heat will be transmitted into the displays.

[0006] Exemplary modern displays have found some effective means for cooling the displays including circulating a closed loop of gas around the display and drawing ambient gas through the display so that the closed loop of gas may be cooled (as well as portions of the electronic display). Various thermal communications have been discovered which can transfer heat away from the sensitive electronic components and out of the display. Heat exchangers were found to produce an excellent means for transferring heat between the closed loop of gas and the ambient gas. However, previous designs for moving the gas through the display have been found to generate an undesirable amount of noise emission from the display as well as thermal gradients where portions of the display were cooled but others remained warm.

[0007] When using LCD displays, it was found that backlights were often a source of heat and it was desirable to move gas across the rear surface of the backlight in order to cool it. While desirable, it was thought that the front surface of the backlight could not be cooled for fear that the backlight cavity would become contaminated with dust, dirt, or other particulate.

Summary of the Exemplary Embodiments

[0008] Exemplary embodiments may use a combination of circulating gas and ambient gas in order to adequately cool an electronic display. Circulating gas may be used to remove heat from the front of the image assembly. Circulating gas may also be used to remove heat from internal electronic assemblies. When using a LCD as the electronic image assembly, circulating gas may also be used to remove heat from the

backlight cavity of the LCD. Because the gas is only circulating within the display, it can remain free of particulate and contaminants and will not harm the display.

[0009] Ambient gas may be ingested into the display in order to cool the circulating gas. The ambient gas and the circulating gas may be drawn through a heat exchanger which will allow the heat to transfer from the circulating gas to the ambient gas, preferably without letting the ambient and circulating gases mix with one another. An exemplary embodiment would use a cross-flow heat exchanger. An additional flow of ambient gas can be drawn across the rear surface of the image assembly to remove heat from the rear portion of the image assembly. When using a LCD as the electronic image assembly, this additional flow of ambient gas can be used to remove heat from the rear portion of the backlight for the LCD.

[0010] In order to reduce noise emissions, the fans which drive the ambient and/or circulating gas through the heat exchanger may be placed within the heat exchanger (or between two separate heat exchangers), which can then act as a muffler and reduce the noise emitted by the fans. Further, if using the additional ambient gas pathway behind the electronic image assembly, a manifold may be used to collect the ambient gas along an edge of the display and distribute this into a number of smaller flows. The fans for driving this additional ambient gas pathway can be placed within the manifold in order to reduce the noise emitted by the fans and provide an even distribution of ambient gas across the display. In an exemplary embodiment, a single fan assembly can be used to drive the ambient gas through both the heat exchanger(s) and behind the electronic image assembly.

[0011] It has been found that ingesting ambient gas from the top or bottom edge of the display is preferable as these edges are not typically observable to the viewer. However, when ingesting ambient gas from the top or bottom of a portrait-oriented display, it has been found that as the cool ambient gas travels across the rear portion of the electronic image assembly and accepts heat it increases in temperature. Once the cooling air reaches the opposite edge (either top or bottom), it may have increased in temperature substantially and may no longer provide adequate cooling to the opposing portion of the display. Thus, the manifolds herein allow for cool ambient air to

adequately cool the entire electronic image assembly in an even manner and reduce any 'hot spots' within the electronic image assembly.

[0012] The foregoing and other features and advantages will be apparent from the following more detailed description of the particular embodiments of the invention, as illustrated in the accompanying drawings.

Brief Description of the Drawings

[0013] A better understanding of an exemplary embodiment will be obtained from a reading of the following detailed description and the accompanying drawings wherein identical reference characters refer to identical parts and in which:

[0014] FIGURE 1A provides a front perspective view of an exemplary embodiment of the electronic display.

[0015] FIGURE 1B provides a rear perspective view of an exemplary embodiment of the electronic display.

[0016] FIGURE 2 provides a rear perspective view similar to that shown in Figure 1B where the rear cover has been removed.

[0017] FIGURE 3 provides a perspective sectional view along the A-A section line shown in Figure 1B.

[0018] FIGURE 4 provides a perspective sectional view along the B-B section line shown in Figure 1B.

[0019] FIGURE 5 provides a perspective sectional view of insert C shown in Figure 4.

[0020] FIGURE 6 provides a perspective sectional view of one embodiment of the cross through plate.

[0021] FIGURE 7 provides an exploded perspective view of one embodiment of the heat exchanger.

[0022] FIGURE 8 provides a perspective sectional view of another embodiment which uses a flow of circulating gas through the backlight cavity of a liquid crystal display (LCD).

[0023] FIGURE 9 provides a perspective sectional view of an exemplary embodiment which uses a flow of circulating gas through the backlight cavity in addition to the flow of circulating gas between the LCD and front plate.

[0024] FIGURE 10 provides a rear perspective view of an embodiment using a single fan assembly to control the flow of ambient gas, the embodiment shown with the rear cover removed.

[0025] FIGURE 11A provides a perspective sectional view of the embodiment from Figure 10 based on section line 11A-11A shown in Figure 10.

[0026] FIGURE 11B provides a perspective sectional view of insert B from Figure 11A.

Detailed Description

[0027] The invention is described more fully hereinafter with reference to the accompanying drawings, in which exemplary embodiments of the invention are shown. This invention may, however, be embodied in many different forms and should not be construed as limited to the exemplary embodiments set forth herein. Rather, these embodiments are provided so that this disclosure will be thorough and complete, and will fully convey the scope of the invention to those skilled in the art. In the drawings, the size and relative sizes of layers and regions may be exaggerated for clarity.

[0028] It will be understood that when an element or layer is referred to as being "on" another element or layer, the element or layer can be directly on another element or layer or intervening elements or layers. In contrast, when an element is referred to as being "directly on" another element or layer, there are no intervening elements or layers present. Like numbers refer to like elements throughout. As used herein, the term "and/or" includes any and all combinations of one or more of the associated listed items.

[0029] It will be understood that, although the terms first, second, third, etc., may be used herein to describe various elements, components, regions, layers and/or sections, these elements, components, regions, layers and/or sections should not be limited by these terms. These terms are only used to distinguish one element, component, region, layer or section from another region, layer or section. Thus, a first element, component, layer or section from another region, layer or section. Thus, a first element, component,

region, layer or section discussed below could be termed a second element, component, region, layer or section without departing from the teachings of the present invention.

[0030] Spatially relative terms, such as "lower", "upper" and the like, may be used herein for ease of description to describe the relationship of one element or feature to another element(s) or feature(s) as illustrated in the figures. It will be understood that the spatially relative terms are intended to encompass different orientations of the device in use or operation, in addition to the orientation depicted in the figures. For example, if the device in the figures is turned over, elements described as "lower" relative to other elements or features would then be oriented "upper" relative the other elements or features. Thus, the exemplary term "lower" can encompass both an orientation of above and below. The device may be otherwise oriented (rotated 90 degrees or at other orientations) and the spatially relative descriptors used herein interpreted accordingly.

[0031] The terminology used herein is for the purpose of describing particular embodiments only and is not intended to be limiting of the invention. As used herein, the singular forms "a", "an" and "the" are intended to include the plural forms as well, unless the context clearly indicates otherwise. It will be further understood that the terms "comprises" and/or "comprising," when used in this specification, specify the presence of stated features, integers, steps, operations, elements, and/ or components, but do not preclude the presence or addition of one or more other features, integers, steps, operations, elements, components, and/or groups thereof.

[0032] Embodiments of the invention are described herein with reference to cross-section illustrations that are schematic illustrations of idealized embodiments (and intermediate structures) of the invention. As such, variations from the shapes of the illustrations as a result, for example, of manufacturing techniques and/or tolerances, are to be expected. Thus, embodiments of the invention should not be construed as limited to the particular shapes of regions illustrated herein but are to include deviations in shapes that result, for example, from manufacturing.

[0033] For example, an implanted region illustrated as a rectangle will, typically, have rounded or curved features and/or a gradient of implant concentration at its edges

rather than a binary change from implanted to non-implanted region. Likewise, a buried region formed by implantation may result in some implantation in the region between the buried region and the surface through which the implantation takes place. Thus, the regions illustrated in the figures are schematic in nature and their shapes are not intended to illustrate the actual shape of a region of a device and are not intended to limit the scope of the invention.

[0034] Unless otherwise defined, all terms (including technical and scientific terms) used herein have the same meaning as commonly understood by one of ordinary skill in the art to which this invention belongs. It will be further understood that terms, such as those defined in commonly used dictionaries, should be interpreted as having a meaning that is consistent with their meaning in the context of the relevant art and will not be interpreted in an idealized or overly formal sense unless expressly so defined herein.

[0035] FIGURE 1A provides a front perspective view of an exemplary embodiment of the electronic display 100. A transparent front plate 10 is placed on the front portion of the display to protect the internal components and allow the images produced by the display 100 to be seen. Some embodiments may use glass as the transparent front plate 10. Exemplary embodiments may use two pieces of glass laminated with index-matching optical adhesive. Some front plates 10 may provide other utility such as anti-reflection or polarizing functions. An inlet aperture 24 and exit aperture 25 may be provided in the housing so that the display 100 can accept ambient gas for cooling the display 100.

[0036] FIGURE 1B provides a rear perspective view of an exemplary embodiment of the electronic display 100. A rear cover 15 may be used to provide access to the internal components of the display 100.

[0037] FIGURE 2 provides a rear perspective view similar to that shown in Figure 1B where the rear cover 15 has been removed. Ambient gas 200 may be ingested into the display through the inlet aperture 24 and pass through a heat exchanger 45 and exit the display through the exit aperture 25. The ambient gas 200 may be drawn into the display and forced through the heat exchanger 45 using heat exchanger fan assembly 46. An exemplary placement for the heat exchanger fan assembly 46 is discussed

further below, but in many embodiments the fan assembly 46 can be placed near the inlet aperture 24 and/or exit aperture 25 and may or may not be placed within the heat exchanger 45 (as shown in Figure 2).

[0038] Optionally, ambient gas 210 may also be ingested into the display through inlet aperture 24. Ambient gas 210 may then be directed through a first manifold 30 which travels along the edge of the display. The first manifold 30 accepts the single larger inlet flow of ambient gas 210 and distributes it into a plurality of smaller flows across the display. A second manifold 35 may be placed along the opposite edge of the display as the first manifold 30. The second manifold 35 accepts the plurality of smaller flows and combines them into a single flow and exhausts it out of the exit aperture 25. In this embodiment, a manifold fan assembly 211 is used to draw the ambient gas 210 into the inlet aperture 24 and force the ambient gas 210 across the display. For this particular embodiment, the manifold fan assembly 211 is placed within the first manifold 30 and is used to draw the ambient gas 210 into the display as well as distribute the single flow into a plurality of smaller flows. This is not required however, as some embodiments may place the manifold fan assembly 211 in the second manifold 35, or within both the first and second manifolds 30 and 35.

[0039] While both flows of ambient gas may be used in an exemplary embodiment, there is no requirement that they are both used. Some embodiments may use only ambient gas 200 or ambient gas 210. Also, if using both flows of ambient gas 200 and ambient gas 210 there is no requirement that they share the same inlet and exit apertures. Thus, there may be separate inlet and exit apertures for the two flows of ambient gas.

[0040] **FIGURE 3** provides a perspective sectional view along the A-A section line shown in Figure 1B. Again, ambient gas 200 may be ingested into the display through the inlet aperture 24 and pass through a heat exchanger 45 and exit the display through the exit aperture 25. The ambient gas 200 may be drawn into the display and forced through the heat exchanger 45 using heat exchanger fan assembly 46. Obviously, the inlet aperture 24 may contain a filter or other coverings so that contaminants, insects, garbage, and/or water/fluids cannot easily be ingested into the display. However, an exemplary embodiment would not be damaged if the ambient gas 200 contained

contaminates as they would only pass through the heat exchanger 45 which may not be susceptible to damage from particulate or contaminants. Exit aperture 25 may also contain some type of covering to ensure that contaminants and/or insects could not enter the display.

[0041] An electronic image assembly 50 may be placed behind the front plate 10. A plurality of channels 60 may be placed behind (preferably immediately behind) the electronic image assembly 50. Ambient gas 210 may be forced through the channels 60 after travelling through the first manifold 30 (not shown here). The flow of ambient gas 210 immediately behind the electronic image assembly 50 may be used to remove any buildup of heat from the rear portion of the electronic image assembly 50. It may be preferable to have a thermally conductive surface on the rear portion of the electronic image assembly 50 so that heat can easily transfer to this plate and be removed by the ambient gas 210.

[0042] The channels 60 can take on any number of forms. Although shown in this embodiment with a square cross-section this is not required. Other embodiments may contain channels 60 with I-beam cross-sections, hollow square cross-sections, hollow rectangular cross-section, solid rectangular or solid square cross-sections, 'T' cross-sections, 'Z' cross-sections, a honeycomb cross-section, or any combination or mixture of these. The channels 60 are preferably thermally conductive and also preferably in thermal communication with the electronic image assembly 50. Thus, in a preferred embodiment, heat which accumulates on the rear portion of the electronic image assembly 50 may be transferred throughout the channels 60 and removed by ambient gas 210.

[0043] **FIGURE 4** provides a perspective sectional view along the B-B section line shown in Figure 1B. In this view, the path of the circulating gas 250 can also be observed. The space between the front plate 10 and the electronic image assembly 50 may define a front channel 251, through which the circulating gas 250 may travel in order to remove any accumulation of heat on the front surface of the electronic image assembly 50. The circulating gas 250 is preferably then directed into the heat exchanger 45 where heat may be transferred from the circulating gas 250 to the ambient gas 200. Upon exiting the heat exchanger 45, the circulating gas 250 may be

re-directed into the front channel 251. The circulating gas 250 may also be directed over various electronic components 7 so that heat may be transferred from the electronic components 7 to the circulating gas 250. The electronic components 7 could be any one of the following but not limited to: power modules, heat sinks, capacitors, motors, microprocessors, hard drives, AC/DC converters, transformers, or printed circuit boards.

[0044] Also shown in this sectional view is the path of the ambient gas 210 travelling down one of the channels 60 directly behind the electronic image assembly 50. In this embodiment, the ambient gas 210 is forced out of the first manifold 30, across the channels 60, and into the second manifold 35 by manifold fan assembly 211. As shown in this Figure, the paths of the ambient gas 210 and the circulating gas 250 will likely cross, but it is preferable to keep the two gases from mixing (as the ambient gas 210 may contain particulate or contaminants while the circulating gas 250 can remain substantially free of particulate and contaminants). It may be preferable to keep the circulating gas 250 from having particulate or contaminants because it travels in front of the electronic image assembly 50. Thus, to keep the image quality from being impaired, it may be desirable to keep the circulating gas 250 clean and prevent it from mixing with the ambient gas 210.

[0045] **FIGURE 5** provides a perspective sectional view of insert C shown in Figure 4. As noted above, if practicing an embodiment which uses ambient gas 210 as well as the circulating gas 250, the pathways of the two gases may need to cross over one another and it may be desirable to prohibit them from mixing to prevent contamination of sensitive portions of the display. Here, cross through plate 500 allows the pathways of the two gases to cross over one another without letting them mix together. The cross through plate 500 in this embodiment contains a series of voids which pass through the plate. A first series of voids 550 passes through the cross through plate 500 and allows ambient gas 210 to travel from the first manifold 30 into the channels 60 which run behind the electronic image assembly 50. A second series of voids 525 pass through the cross through plate 500 in a direction substantially perpendicular to that of the first series of voids 550. The second series of voids 525 allows the circulating gas to exit the front channel 251, cross over the ambient gas 210, and continue towards the heat

exchanger 45. In this embodiment, a circulating gas fan assembly 255 is used to draw the circulating gas 250 through the front channel 251 and through the heat exchanger 45. Much like the other fan assemblies shown and described here, the circulating gas fan assembly 255 could be placed anywhere within the display, including but not limited to the entrance/exit of the heat exchanger 45 or the entrance/exit of the front channel 251.

[0046] FIGURE 6 provides a perspective sectional view of one embodiment of the cross through plate 500. In this embodiment, the cross through plate 500 is comprised of a plurality of hollow blocks 503 sandwiched between a top plate 501 and bottom plate 502 with sections of the plates 501 and 502 removed to correspond with the hollow sections of the blocks 503. A portion of the top plate 501 has been removed to show the detail of the hollow blocks 503, first series of voids 550, and second series of voids 525. The cross through plate 500 could take on any number of forms and could be constructed in a number of ways. Some other embodiments may use a solid plate where the first and second series of voids 550 and 525 are cut out of the solid plate. Other embodiments could use two sets of hollow blocks where the hollow sections are perpendicular to each other and the blocks are fastened together. Still other embodiments could use a design similar to those that are taught below for the heat exchanger 45, for example any type of cross-flow heat exchanger design could be used.

[0047] FIGURE 7 provides an exploded perspective view of one embodiment of the heat exchanger 45. In this view, the heat exchanger fan assembly 46 is shown removed from its mounted position within the heat exchanger 45. In this embodiment, the heat exchanger 45 is divided into two portions 47 and 48 where the fan assembly 46 is placed between the two portions 47 and 48. While the fan assembly 46 can be placed anywhere so that it draws ambient gas 200 through the heat exchanger 45, it has been found that placing the fan assembly 46 between the two portions of the heat exchanger can provide a number of benefits. First, the volumetric flow rate of the ambient gas 200 through the heat exchanger is high, which results in better cooling capabilities for the heat exchanger 45. Second, the noise produced by the fan assembly 46 can be drastically reduced because the surrounding portions 47 and 48 of

the heat exchanger 45 essentially act as a muffler for the fan assembly 46. In this embodiment, portion 48 is thinner and longer than portion 47. This was done in order to free up more space within the housing so that additional electronic components could fit within the housing (adjacent to portion 48). This design may be preferable when it is desirable to create the largest possible heat exchanger 45 (for maximum cooling abilities). This is of course not required, and other embodiments may have portions which are of equal width and length. Also, although this embodiment uses the fan assembly 46 to drive the ambient gas 200, other embodiments could use a fan assembly placed within the heat exchanger to drive the circulating gas 250 instead and drive the ambient gas 200 with another fan assembly (possibly placed within the heat exchanger or located at the entrance/exit of the heat exchanger).

[0048] The ambient gas 200 travels through a first pathway (or plurality of pathways) of the heat exchanger 45 while the circulating gas 250 travels through a second pathway (or plurality of pathways) of the heat exchanger 45. Although not required, it is preferable that the circulating gas 250 and ambient gas 200 do not mix. This may prevent any contaminants and/or particulate that is present within the ambient gas 200 from harming the interior of the display. In a preferred embodiment, the heat exchanger 45 would be a cross-flow heat exchanger. However, many types of heat exchangers are known and can be used with any of the embodiments herein. The heat exchanger 45 may be a cross-flow, parallel flow, or counter-flow heat exchanger. In an exemplary embodiment, the heat exchanger 45 would be comprised of a plurality of stacked layers of thin plates. The plates may have a corrugated, honeycomb, or tubular design, where a plurality of channels/pathways/tubes travel down the plate length-wise. The plates may be stacked such that the directions of the pathways are alternated with each adjacent plate, so that each plate's pathways are substantially perpendicular to the pathways of the adjacent plates. Thus, ambient gas or circulating gas may enter an exemplary heat exchanger only through plates whose channels or pathways travel parallel to the path of the gas. Because the plates are alternated, the circulating gas and ambient gas may travel in plates which are adjacent to one another and heat may be transferred between the two gases without mixing the gases themselves (if the heat exchanger is adequately sealed, which is preferable but not required). In other words,

an exemplary heat exchanger would have at least a first gas pathway for ambient gas and at least a second gas pathway for circulating gas, where the two pathways are substantially perpendicular and adjacent to each other and do not allow the ambient gas and circulating gas to mix.

[0049] In an alternative design for a heat exchanger, an open channel may be placed in between a pair of corrugated, honeycomb, or tubular plates. The open channel may travel in a direction which is perpendicular to the pathways of the adjacent plates. This open channel may be created by running two strips of material or tape (esp. very high bond (VHB) tape) between two opposite edges of the plates in a direction that is perpendicular to the direction of the pathways in the adjacent plates. Thus, gas entering the heat exchanger in a first direction may travel through the open channel (parallel to the strips or tape). Gas which is entering in a second direction (substantially perpendicular to the first direction) would travel through the pathways of the adjacent plates).

[0050] Other types of cross-flow heat exchangers could include a plurality of tubes which contain the first gas and travel perpendicular to the path of the second gas. As the second gas flows over the tubes containing the first gas, heat is exchanged between the two gases. Obviously, there are many types of cross-flow heat exchangers and any type would work with the embodiments herein.

[0051] An exemplary heat exchanger may have plates where the sidewalls have a relatively low thermal resistance so that heat can easily be exchanged between the two gases. A number of materials can be used to create the heat exchanger. Preferably, the material used should be corrosion resistant, rot resistant, light weight, and inexpensive. Metals are typically used for heat exchangers because of their high thermal conductivity and would work with these embodiments. However, it has been discovered that plastics and composites can also satisfy the thermal conditions for electronic displays. An exemplary embodiment would utilize polypropylene as the material for constructing the plates for the heat exchanger. It has been found that although polypropylene may seem like a poor thermal conductor, the large amount of surface area relative to a small sidewall thickness, results in an overall thermal resistance that is low. Thus, an exemplary heat exchanger would be made of plastic

and would thus produce a display assembly that is thin and lightweight. Specifically, corrugated plastic may be used for each plate layer where they are stacked together in alternating fashion (i.e. each adjacent plate has channels which travel in a direction perpendicular to the surrounding plates).

[0052] FIGURE 8 provides a perspective sectional view of another embodiment which uses a flow of circulating gas 350 through the backlight cavity of a liquid crystal display (LCD) 300. In this embodiment, a LCD 300 and an associated backlight 320 are used as the electronic image assembly. A backlight wall 330 may be placed between the LCD 300 and the backlight 320 in order to enclose the area and create a backlight cavity. Typically, the backlight cavity is closed to prevent contaminants/particulate from entering the backlight cavity and disrupting the optical/electrical functions of the backlight 320. However, as discussed above the exemplary embodiments may use a clean gaseous matter for the circulating gases which could now be used to ventilate the backlight cavity in order to cool the backlight 320 and even the rear portion of the LCD 300. An opening 340 can be placed in the backlight wall 330 to allow circulating gas 350 to flow through the backlight cavity. A fan assembly 360 may be used to draw the circulating gas 350 through the backlight cavity. In an exemplary embodiment there would be an opening on the opposing backlight wall (on the opposite side of the display as shown in this figure) so that circulating gas 350 could easily flow through the backlight cavity.

[0053] FIGURE 9 provides a perspective sectional view of an exemplary embodiment which uses a flow of circulating gas 350 through the backlight cavity in addition to the flow of circulating gas 250 between the LCD 300 and front plate 10. Circulating gas fan assembly 255 may be placed so that it can draw circulating gas 350 through the backlight cavity as well as circulating gas 250 between the LCD 300 and the front plate 10. As discussed above, the circulating gases 250 and 350 are preferably forced through the heat exchanger 45 (not shown in this figure) so that they may be cooled by the ambient gas 200 (also not shown in this figure).

[0054] Also shown in Figure 9 is the optional additional flow of ambient gas 210 which may travel immediately behind the backlight 320. Once travelling through the first manifold 30, the ambient gas 210 may pass through the channels 60 in order to

remove heat from the backlight 320 and even the channels 60 themselves (if they are thermally conductive). The manifold fan assembly 211 may be used to draw the ambient gas 210 into the first manifold 30 and through the channels 60. Again, the cross through plate 500 may be used to allow the circulating gases 350 and 250 to cross paths with the ambient gas 210 without letting the two gases mix.

[0055] In an exemplary embodiment, the backlight 320 would contain a plurality of LEDs mounted on a thermally conductive substrate (preferably a metal core PCB). On the surface of the thermally conductive substrate which faces the channels 60 there may be a thermally conductive front plate which may be in thermal communication with the channels 60. In an exemplary embodiment, the thermally conductive plate would be metallic and more preferably aluminum.

[0056] **FIGURE 10** provides a rear perspective view of an embodiment 1000 using a single fan assembly 1050 to control the flow of ambient gas. The embodiment 1000 is shown here with the rear cover removed. In this figure, the main display assembly is still within the exterior display housing 1001. Similar to some of the embodiments describe above, a circulating gas fan assembly 1105 may be used to draw circulating gas 1106 into and through the heat exchanger 1100. Further, another circulating gas fan assembly 1205 may be used to draw circulating gas 1106 through heat exchanger 1200. The circulating gas 1106 may also be used to extract heat from various electrical components 1109.

[0057] An ambient gas fan assembly 1050 may be used to draw ambient gas into the inlet aperture 1009 and exhaust the ambient gas out of an exit aperture 1010. The ambient gas preferably travels through the heat exchangers 1200 and 1100 as well as the channel behind the electronic image assembly (if used). The section line 11A-11A is shown cutting horizontally through the display embodiment 1000.

[0058] **FIGURE 11A** provides a perspective sectional view of the embodiment from Figure 10 based on section line 11A-11A shown in Figure 10. For clarity, the exterior housing 1001 has been removed. Once the circulating gas 1106 has traveled through the heat exchangers 1200 and 1100, it may then be directed between the front transparent plate 1500 and the electronic image assembly 1600. After passing between the front transparent plate 1500 and the electronic image assembly 1600, the

circulating gas 1106 may then return to the heat exchangers 1200 and 1100. In this embodiment, fan assembly 1050 is used to control the flow of ambient gas 1055 and 1056. Ambient gas 1055 is directed through the heat exchangers 1200 and 1100 while ambient gas 1056 is directed behind the electronic image assembly 1600.

[0059] FIGURE 11B provides a perspective sectional view of insert B from Figure 11A. The channel 1700 may be defined by the space between the rear surface or portion of the electronic image assembly 1600 and a plate which is substantially parallel to the rear surface or portion of the electronic image assembly 1600. The channel 1700 may also contain ribs which are also thermally conductive and preferably in thermal communication with the electronic image assembly 1600. By placing the fan assembly 1050 so as to direct the ambient gas within the channel 1700 and the heat exchangers 1200 and 1100 simultaneously, several improvements can be achieved, including but not limited to: increased air flow, less fan noise, and a less expensive/lighter assembly. In this embodiment, the paths for ambient gas 1055 and ambient gas 1056 are substantially parallel to one another.

[0060] As noted above, many electronic image assemblies (especially LEDs, LCDs, and OLEDs) may have performance properties which vary depending on temperature. When 'hot spots' are present within an image assembly, these hot spots can result in irregularities in the resulting image which might be visible to the end user. Thus, with the embodiments described herein, the heat which may be generated by the image assembly (sometimes containing a backlight assembly) can be distributed (somewhat evenly) throughout the channels 60 and thermally-conductive surfaces to remove hot spots and cool the backlight and/or electronic image assembly.

[0061] The circulating gases and ambient gases can be any number of gaseous matters. In some embodiments, air may be used as the gas for all. Preferably, because the circulating gases may travel in front of the image assembly and/or within the backlight cavity, they should be substantially clear, so that they will not affect the appearance of the image to a viewer. The circulating gases should also preferably be substantially free of contaminants and/or particulate (ex. dust, dirt, pollen, water vapor, smoke, etc.) in order to prevent an adverse effect on the image quality and/or damage to the internal electronic components. It may sometimes be preferable to keep ambient