

[0053] In exemplary embodiments of the present invention, ingestion and exhaustion of open loop fluid 400 may not take place along select portions of the rear gap 44, such as the upper and lower edges. In other embodiments, ingestion and exhaustion of open loop fluid 400 may take place along the entirety of rear gap 44, with the possible exception of the buffer zones 46.

[0054] **FIGURE 5** illustrates the front panel 10 removed, revealing that the electronic display 70 which may be affixed behind front panel 10 and within perimeter wall 55. The assembly 5 may further comprise a series of intake apertures 65 located above the electronic display 70, between the display 70 and the secondary display 40. The illustrated intake apertures 65 are merely exemplary, any number and shape of intake apertures 65 is contemplated. The intake apertures 65 may be configured to facilitate the ingestion of a fluid, such as ambient air, into an open loop that flows behind the electronic display 70. A pair of side interior channels 21 and 22 may run the majority of the length of each side of the electronic display 70.

[0055] **FIGURE 6** illustrates the rear panel 60 removed, revealing an interior rear panel 80 secured behind the rear panel 60. The interior rear panel 80 may cover a majority of the rear surface of the assembly 5. The assembly may contain a series of rear intake apertures 75 located above the interior rear panel 80 and sometimes within rear perimeter wall 54. The illustrated rear intake apertures 75 are merely exemplary, any number and shape of said apertures 75 is contemplated. As will be explained in greater detail in subsequent figures, the apertures 75 may be configured to facilitate the ingestion of the open loop fluid.

[0056] Similarly, the assembly 5 may further comprise a series of rear exhaust apertures 85 located below the interior rear panel 80 and sometimes within rear perimeter wall 54. The illustrated rear exhaust apertures 85 are merely exemplary, any number and shape of rear exhaust apertures 85 is contemplated. As will be explained in greater detail in subsequent figures, the rear exhaust apertures 85 may be configured to facilitate the exhaust of the open loop fluid. Optional fans 81 may be affixed behind interior rear panel 80 and above rear exhaust apertures

85. The fans 81 may be configured to control the flow of the open loop fluid. Any number of fans 81 is contemplated. In other embodiments, the fans 81 may be located at any number of locations along the open loop flow path, or any position between the intake 75 and exhaust apertures 85.

[0057] FIGURE 7 and FIGURE 8 illustrate the lower half of the assembly 5 and free standing display housing 15. A side beam 90 may be located on the opposite side of post 20 and may run a majority of the length of the assembly 5. The side beam 90 may be comprised of a metal and be configured to provide structural support and rigidity to the assembly 5. An electronics cavity 16 may be placed within the interior of the assembly 5. An optional heat exchanger 100 may be affixed within or near the electronics cavity 16. In exemplary embodiments the heat exchanger 100 may be a cross flow heat exchanger, but other types of heat exchangers can be used, especially counter flow heat exchangers and others. A series of electronic components 105 may also be affixed within the electronics cavity 16. As will be explained in greater detail in subsequent figures, open loop fluid 400, such as an external air, may circulate through the heat exchanger 100. Closed loop fluid, such as a circulating gas 700 may circulate through the electronics cavity, as well as over and through electronic components 105, and through heat exchanger 100.

[0058] As will be explained in greater detail in subsequent figures, in this embodiment open loop fluid 400 may exhaust the assembly 5 via gap 45 and optional rear gap 44. As indicated by the flow lines, open loop fluid may follow a zigzag path from a right side channel 19, out of the assembly 5. Alternatively, other route shapes may be utilized and are expressly contemplated.

[0059] When using a liquid crystal display as the electronic display 70, a backlight 106 may be placed behind the electronic display 70 and is preferably a direct lit LED backlight, but other illumination sources can be used with the exemplary embodiments. A plate 104 or other substantially planar object may be placed behind the backlight 106 in order to create a channel 102 for accepting open loop fluid 400. Preferably, the channel 102 is sealed to prevent open loop fluid 400

from entering other portions of the display assembly, specifically the electronics compartment 16.

[0060] **FIGURE 9** and **FIGURE 10** illustrate the upper half of assembly 5 and free standing display housing 15, which are similar to the lower half as shown in FIG. 7 and FIG. 8, respectively, with the exception of a pair of optional stiffeners 110. The optional stiffeners 110 will be explained in greater detail in subsequent figures. As will be explained in greater detail in subsequent figures, in this embodiment open loop fluid 400 may enter the assembly 5 via gap 45 and optional rear gap 44. As indicated by the flow lines, open loop fluid 400 may follow a zigzag path to the right side channel 19. Alternatively, other route shapes may be utilized and are expressly contemplated.

[0061] **FIGURE 11** is a front plan view of the assembly of FIG. 1 and indicates section lines F-F, G-G, and H-H.

[0062] **FIGURE 12A** and **FIGURE 12B** illustrates, as will be explained in greater detail in subsequent figures, a pair of channel septums 130 and a central septum 140 are preferably positioned substantially horizontally and near the vertical centerline of the assembly 5, although embodiments could also place them near the top or bottom of the assembly 5, away from the vertical centerline.

[0063] In this embodiment, Figure 12A shows the area of the gap 45 (and optional rear gap 44) that is designated as the intake of the open loop fluid 400.

[0064] Also shown in these figures, as well as Figure 12C is the fan 81, which is positioned to cause the flow of open loop fluid 400 into the portion of gap 45 (and optional rear gap 44) that is generally used as in intake for ambient air (filtered or unfiltered), down the left side interior channel 21 (intake channel), across/through channel 102, down the right side interior channel 22, and exhausting out of the portion of the gap 45 (and optional rear gap 44) that is used as an exhaust for the fluid 400. It should be noted that the left and right side interior channels 21 and 22 are optional as an alternative embodiment would include the following path for open loop fluid 400: into the portion of gap 45 (and optional rear gap 44) that is generally used as in intake for ambient air (filtered or unfiltered), across/through

channel 102, and exhausting out of the portion of the gap 45 (and optional rear gap 44) that is used as an exhaust for the fluid 400.

[0065] FIGURE 12C is a top sectional view taken along section line H-H of FIG. 11 and indicates Detail R. In this embodiment, this figure shows the area of the gap 45 (and optional rear gap 44) that is designated as the exhaust of the open loop fluid 400.

[0066] FIGURE 13A illustrates the ingestion of open loop fluid 400 via rear gap 44. The open loop fluid 400 may pass through an optional door stiffener 115 via aperture 122.

[0067] FIGURE 13B illustrates an exemplary embodiment of the assembly within the region of the optional buffer zone 46. In this embodiment, buffer zone 46 may comprise essentially an area at, near, or within the gap 45 (and optional rear gap 44) that contains one or more fluid-blocking plugs which are placed along the path of open loop fluid 400 so that it may not pass through in any substantial amount. In exemplary embodiments, the buffer zone 46 would contain the channel septums 130 along with the central septum 140, but some embodiments would utilize only the channel septum 130 (if the embodiment does not permit fluid 400 to flow through the door stiffeners). In some embodiments, rather than placing the channel septums 130 within the right and left side channels 18 and 19, the buffer zone 46 may contain a plug that is positioned near or at the end of the gap 44. Generally speaking, the buffer zone is horizontal and is placed near the vertical centerline of the assembly 5, although it could be placed near the top or bottom of the assembly 5.

[0068] It is notable that the buffer zone 46 should exist on both lateral sides of the assembly 5, as well as both on the front and rear of the assembly 5 (if using the rear gap 44) such that the buffer zone 46 blocks a portion of the front gap 45 (and the rear gap 44) on both the right and left sides of the assembly 5.

[0069] FIGURE 13C illustrates the exhaustion of open loop fluid 400 via rear gap 44. The open loop fluid 400 may pass through a door stiffener 115 via aperture 122.

[0070] It should be noted that although Figures 13A-13C illustrate the rear gap 44, in an exemplary embodiment the front gap 45 has a similar orientation as to the rear gap 44. It has not been shown here as it would be substantially duplicative.

[0071] **FIGURE 14** illustrates the combined areas of the gap 45 and the rear gap 44, as indicated by the cross hatched area. In exemplary embodiments, outside of the buffer zone 46, the cross hatched area allows the flow of open loop fluid 400 either into or out of the gap 45 (and the optional rear gap 44).

[0072] **FIGURE 15** illustrates the assembly 5 in isolation from the free standing display housing 15. A door stiffener 120 may be affixed immediately behind the front panel 10. In some embodiments, the door stiffener 120 may be affixed to a rear surface of the front panel 10. The door stiffener 120 may run substantially the perimeter of the front panel 10. The door stiffener 120 may be comprised of a metallic or other material suitably rigid to provide structural rigidity and strength to the assembly 5. The door stiffener 120 may comprise a series of apertures 125 that permit the flow of open loop fluid 400. The illustrated door stiffener apertures 125 are merely exemplary. Any number and shape of apertures 125 are contemplated.

[0073] **FIGURE 16** illustrates the rear panel 60 in isolation. In exemplary embodiments, rear door stiffeners 115 may be affixed around the perimeter edges of the rear panel 60, thereby framing rear panel 60. A door cavity 17 may be defined by the space between the rear panel 60, the interior surfaces of rear door stiffeners 115, and the interior rear panel 80 (not shown in the current figure). Open loop fluid 400 ingested via the rear gap 44 may be considered open loop fluid 400b once it travels through the rear door stiffeners 115 via apertures 122 into the door cavity 17. The illustrated apertures 122 are merely exemplary, any number and shape of apertures is contemplated. Optional stiffeners 110 in the form of elongate members may extend substantially the length of the rear panel 60. The optional stiffeners 110 may be comprised of a metal, a polymer, or other material suitably rigid to provide structural rigidity and strength to the rear panel 60. The optional stiffeners 110 may comprise a series of apertures 135 that

facilitate open loop fluid 400b to flow through the optional stiffeners 110. The illustrated optional stiffeners 110 and the apertures 135 are merely exemplary, any number and shape of the optional stiffeners 110 and the apertures 135 is contemplated.

[0074] The portion of the open loop fluid 400 traveling in the door cavity 17 is referred to as open loop fluid 400b. As shown, open loop fluid 400b may pass behind the interior panel 80 and be ingested via the intake apertures 75 in order to be directed towards the channel 102. In an exemplary embodiment, the fluid 400b would flow through intake apertures 75 and be directed into left side channel 18, which distributes the fluid 400b across the channel 102, and exhausted out of right side channel 19.

[0075] **FIGURE 17** illustrates, via flow lines, the circulation of open loop fluid 400a through the front and rear of assembly 5. Open loop fluid may be ingested via the gap 45, travel through the door stiffener 120 via the apertures 125 and travel vertically through the right side channel 19 sometimes defined in part by the right side interior channel 22 and side beam 90. Similarly, the open loop fluid 400a may be ingested via the rear gap 44, travel through the door stiffener 115 via the apertures 122, through optional stiffeners 110 via aperture 135, and enter the right side channel 19. On the opposite side of the assembly 5, a similar route may be taken whereby the open loop fluid ultimately enters a left side channel 18 sometimes defined in part by the left side interior channel 21 and post 20.

[0076] A substantially identical flow path in reverse may be taken for exhaustion of the open loop fluid at on the opposite end of the assembly 5. Again, in exemplary embodiments, ingestion takes place in the upper half of assembly 5 and exhaustion takes place in the lower half of assembly 5. In other embodiments, ingestion takes place in the lower half and exhaustion in the upper half of the assembly 5. In still other embodiments, ingestion may take place on the right side while exhaustion takes place on the left side with the buffer zone 46 placed at the top and bottom edges of the assembly to prevent cross inhalation of the two flow paths.

[0077] **FIGURE 18** illustrates an exemplary flow path for the open loop fluid 400 after being ingested via the gap 45 and the rear gap 44. The open loop fluid 400 which is ingested via the rear gap 44 may travel along the door cavity 17 between the optional door stiffeners 110 and can be referred to as the open loop fluid 400b. The open loop fluid 400b may then travel vertically along the rear interior panel 80 and be ingested via the rear intake apertures 75. Other portion of open loop fluid 400 may travel along the left side channel 18 and the right side channel 19 and be referred to as the open loop fluid 400a. After traveling vertically through the side channels 18 and 19, the open loop fluid 400a may travel over the top of said channels and be ingested via the intake apertures 75. Similarly, the open loop fluid 400 may be ingested via the gap 45, travel through the door stiffener apertures 125 below front panel 10, and be ingested via the intake apertures 65.

[0078] **FIGURE 19A** illustrates a rear perspective view of the assembly of FIG. 1 shown in isolation from the free standing display 15 and indicating Detail S.

[0079] **FIGURE 19B** illustrates a front perspective view of the assembly of FIG. 1 shown in isolation from the free standing display 15 and indicating Detail T.

[0080] **FIGURE 20** illustrates that the portion of open loop fluid 400 traveling in the right side channel 19 is referred to as open loop fluid 400a. The open loop fluid 400a may travel inside the right side channel 19, over the top of the right side interior channel 22, and into the intakes apertures 75.

[0081] **FIGURE 21**, similar to FIG. 20 but shown from a front perspective, illustrates that the portion of open loop fluid 400 traveling in the left side channel 18 is referred to as open loop fluid 400a. The open loop fluid 400a may travel inside the left side channel 18, over the top of the left side interior channel 21, and into the intakes apertures 65.

[0082] **FIGURE 22** is bottom perspective section view taken along section line B-B of FIG. 4. Once the open loop fluid 400a/400b is ingested via the various intake apertures 75 and 65, it is combined and then apportioned between a first portion of open loop fluid 400 which travels through the open loop gas pathways of the

heat exchanger 100, and a second portion of open loop fluid 400 which is directed through the channel 102.

[0083] One or more circulating fans 32 are used to force circulating gas 700 across the electronic components and through the closed loop gas pathways of the heat exchanger 100, as well as between the electronic display 70 and the front panel 10, forming a closed loop. In this embodiment, the circulating gas 700 passes through the opening within the pass through gasket 200 while the open loop fluid 400 travels around the pass through gasket, substantially ensuring that the open loop fluid 400 and circulating gas 700 do not mix. This design can be flipped however, where , the circulating gas 700 travels around the pass through gasket 200 while the external air 400 travels through the pass through gasket 200.

[0084] A portion of the flow of open loop fluid 400 is shown traversing the left side interior channel 21 and passing by the cross through gasket 200 in order to enter the channel 102 that runs behind the electronic display 70 (here behind the backlight 106). The channel 102 is preferably defined as the space between the rear surface of the electronic display 70 (here behind the backlight 106) and a plate 104. A preferably corrugated and preferably continuous heat sink is ideally placed within the channel in order to facilitate the conductive transfer of heat from the electronic display 101 to the continuous heat sink, to be removed by convection with the open loop fluid 400.

[0085] The heat exchanger 100 preferably contains a plurality of layers that define channels that contains either circulating gas 700 or open loop fluid 400. Preferably, the circulating gas 700 is not permitted to mix with the open loop fluid 400.

[0086] The flow of open loop fluid 400 travels through the channel 102 and again passes around the pass through gasket 200 to enter the left side interior channel 22, eventually being directed out of the portions of the gap 45 (and the optional rear gap 44) which have been designated for exhaustion of the fluid 400. In this embodiment, the circulating gas 700 is shown exiting the heat exchanger 100 and

passing through the opening within the pass through gasket 200 and then between the electronic display 70 and the front panel 10.

[0087] In a preferred embodiment, the heat exchanger 100 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 100 may be a cross-flow, parallel flow, or counter-flow heat exchanger. In an exemplary embodiment, the heat exchanger 100 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, external air 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 open loop fluid 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).

[0088] 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).

[0089] 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.

[0090] 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).

[0091] In an exemplary embodiment, the electronic display 70 would be a direct LED backlit LCD where the LED backlight would contain a plurality of LEDs mounted on a thermally conductive substrate (preferably a metal core PCB). The rear surface of the LED backlight would preferably contain a thermally conductive plate which may be in conductive thermal communication with the channel 102.

[0092] The circulating gas 700 and open loop fluid 400 can be any number of gaseous matters. In some embodiments, air may be used as the gas for all. Preferably, because the circulating gas 700 travels in front of the electronic display 70 it should be substantially clear, so that it will not affect the appearance of the image to a viewer. The circulating gas 700 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. Generally speaking, exemplary embodiments would utilize ambient air as the open loop fluid 400.

[0093] The cooling system may run continuously. However, if desired, temperature sensing devices 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.

[0094] FIGURES 23 through 25 illustrate a central septum 140 which is preferably positioned substantially horizontally and near the vertical centerline of the assembly 5, although embodiments could also place them near the top or bottom of the assembly 5, away from the vertical centerline that extends along substantially the midline of the front surface of the rear panel 60. A right channel septum 130 extends substantially along the midline of the right side interior edge of the free standing display housing 15 such that it is generally aligned with the central septum 140. Similarly, a left channel septum 130 may be affixed on the left side interior edge of the assembly 5 such that it is aligned with the central septum 140.

[0095] The central septum 140, the right channel septum 130, and the left channel septum 130 (hereinafter collectively the “horizontal partition”) may be configured to substantially divide the door cavity 17 into an upper and lower half. The horizontal partition may be configured such that it creates a substantially air-tight seal between the upper and lower halves of the door cavity 17. Optionally, the horizontal partition may further comprise an expandable material, such as polyurethane foam, utilized in conjunction with the horizontal partition to provide

the airtight seal between the upper and lower halves. In exemplary embodiments the central septum 140 may be comprised of a sufficiently flexible material, such as a polymer, to create an airtight seal in the door cavity 17. In alternate embodiments, the central septum 140 may be comprised of a rigid material. In exemplary embodiments, the right channel septum 130 and the left channel septum 130 may be rigid.

[0096] In an exemplary embodiment, the open loop fluid 400 may be ingested via the gap 45 (and optional rear gap 44) in the upper half of the assembly 5. Said open loop fluid 400a may travel along the right side channel 19 until a portion of said fluid reaches the right channel septum 130 and is prevented from traveling beyond. Similarly, the open loop fluid 400a may travel along the left side channel 18 until a portion of said fluid reaches the left side channel septum 130. Said portions of the open loop fluid may be forced to return vertically in the opposite direction and circulate through the upper half of right side channel 19 and the left side channel 18, respectively, until eventually being ingested via the intake apertures 65 and 75, as discussed in the previous figures.

[0097] In a similar fashion, open loop fluid 400b which travels along the door cavity 17 may travel vertically until a portion of said fluid 400b reaches central septum 140 and is prevented from traveling beyond. In this way, fluid 400b which has been ingested (but has not traveled through the heat exchanger 100 or the channel 102) cannot mix with the fluid 400b which has travelled through the heat exchanger 100 or the channel 102 and needs to be exhausted out of the gap 45 (and optional rear gap 44).

[0098] As also discussed in the previous figures, the open loop fluid 400 may circulate through the optional heat exchanger 100 until eventually being exhausted via the exhaust apertures 85. The open loop fluid 400 may then eventually return to the right side channel 19 or the left side channel 18 and travel vertically therein. The right channel septum 130 and the left channel septum 130, respectively, may prevent said open loop fluid from traveling beyond the midline of assembly 5 and thereby prevent the open loop fluid from each half of the

assembly 5 from becoming mixed. That is, open loop fluid not yet ingested via the intake apertures 65 and 75 may not be mixed with open loop fluid already ingested via said intake apertures 65 and 75. The open loop fluid encountering the right side septum 130 and the left side septum 130, respectively, may be forced to return vertically in the opposite direction until eventually being exhausted from the assembly 5 via the gap 45 (and optional rear gap 44).

[0099] FIGURE 26A and FIGURE 26B illustrate exemplary embodiments of the channel septums 130. In such embodiments, a portion of the channel septums 141 may be adjustable such that (if desired) a portion of the open loop fluid 400a may be permitted to pass by the channel septums 130, thereby permitting a limited amount of mixing between the ingestion and exhaustion open loop fluids. In such embodiments, a second portion of the channel septums 142 may be static, such that they may not be adjusted and provide a substantially air-tight seal such that ingestion and exhaustion open loop fluids may not be mixed. In other embodiments, the entirety of the channel septums 130 may be adjustable. In still other embodiments, the entirety of the channel septums 130 may be static.

[00100] 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 electronic image assemblies: 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 thin panel electronic image assembly. 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 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.

[00101] As is well known in the art, electronic displays can be oriented in a portrait manner or landscape manner and either can be used with the embodiments herein.

[00102] It should also be noted that the variety of cooling loops that are shown in the figures may be shown in a horizontal or vertical arrangement but it is clearly contemplated that this can be reversed or changed depending on the particular embodiment. Thus, the open loop may run horizontally or vertically and in a clockwise or counter-clockwise direction. Further, the open loop may also be horizontal or vertical and can run left to right, right to left, and top to bottom, or bottom to top.

[00103] 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. An electronic display assembly comprising:
 - an electronic display;
 - a housing and front panel which surround the electronic display;
 - an ingestion gap positioned along a portion of a perimeter of the front panel;
 - an exhaustion gap positioned along a portion of a perimeter of the front panel;
 - a channel positioned behind the electronic display;
 - a first gaseous pathway for open loop fluid to travel from the ingestion gap to the channel;
 - a second gaseous pathway for open loop fluid to travel from the channel to the exhaustion gap; and
 - a fan positioned to cause the flow of the open loop fluid.
2. The electronic display assembly of claim 1 further comprising:
 - a buffer zone positioned between the ingestion gap and the exhaustion gap.
3. The electronic display assembly of claim 1 wherein:
 - the ingestion gap permits the ingestion of ambient air into the housing
4. The electronic display assembly of claim 2 further comprising:
 - a central septum placed within the buffer zone.
5. The electronic display assembly of claim 1 further comprising:
 - a first side channel positioned vertically and forming at least a portion of the first gaseous pathway; and
 - a second side channel positioned vertically and forming at least a portion of the second gaseous pathway.

6. The electronic display assembly of claim 5 further comprising:
a channel septum placed within the first side channel.
7. The electronic display assembly of claim 6 wherein:
the channel septum substantially prevents the vertical flow of open loop fluid.
8. The electronic display assembly of claim 1 wherein:
the ingestion gap and the exhaustion gap face an intended observer of the electronic display.
9. An electronic display assembly comprising:
an electronic display;
a housing surrounding the electronic display;
an ingestion gap on the housing positioned to face an intended observer of the electronic display;
an exhaustion gap on the housing positioned to face an intended observer of the electronic display;
a channel positioned behind the electronic display;
a first side channel positioned vertically and permitting gaseous communication between the ingestion gap and the channel; and
a second side channel positioned vertically and permitting gaseous communication between the channel and the exhaustion gap; and
a fan positioned to cause open loop fluid to flow into the ingestion gap, through the first side channel, through the channel, through the second side channel, and exhausting out of the exhaustion gap.
10. The electronic display assembly of claim 9 further comprising:
a channel septum placed within the first side channel.

11. The electronic display assembly of claim 9 further comprising:
a buffer zone positioned between the ingestion gap and the exhaustion gap.
12. The electronic display assembly of claim 11 further comprising:
a central septum placed at the same vertical height as the buffer zone.
13. The electronic display assembly of claim 9 further comprising:
a heat exchanger having a first pathway for open loop fluid and a second
pathway for circulating gas; and
a circulating fan positioned to force circulating gas through the heat
exchanger.
14. The electronic display assembly of claim 9 wherein:
the channel is defined by the space between an LED backlight and a
plate.
15. The electronic display assembly of claim 9 wherein:
the ingestion gap is positioned on a first vertical half of the assembly,
while the exhaustion gap is positioned on the opposing vertical half
of the assembly.
16. The electronic display assembly of claim 9 further comprising:
a door cavity behind the electronic display which accepts open loop fluid
from the first side channel and directs it towards the channel behind
the electronic display.
17. An electronic display assembly comprising:
an electronic display;
a housing and front panel which surround the electronic display;
an ingestion gap positioned above the vertical center of the electronic

display and located between the front panel and the housing;
an exhaustion gap positioned below the vertical center of the electronic display and located between the front panel and the housing;
a heat exchanger having a first pathway for open loop fluid and a second pathway for circulating gas;
a circulating fan positioned to force circulating gas through the heat exchanger;
a central septum placed between the ingestion gap and the exhaustion gap and near the vertical center of the electronic display; and
a fan positioned to cause the flow of open loop fluid into the ingestion gap, through the heat exchanger, and out of the exhaustion gap.

18. The electronic display assembly of claim 17 further comprising:
a first side channel positioned vertically and permitting gaseous communication between the ingestion gap and the heat exchanger;
and
a second side channel positioned vertically and permitting gaseous communication between the heat exchanger and the exhaustion gap.
19. The electronic display assembly of claim 18 further comprising:
a first side channel septum placed within the first side channel; and
a second side channel septum placed within the second side channel
20. The electronic display assembly of claim 19 wherein:
the first and second side channel septums substantially block the vertical flow of open loop fluid.

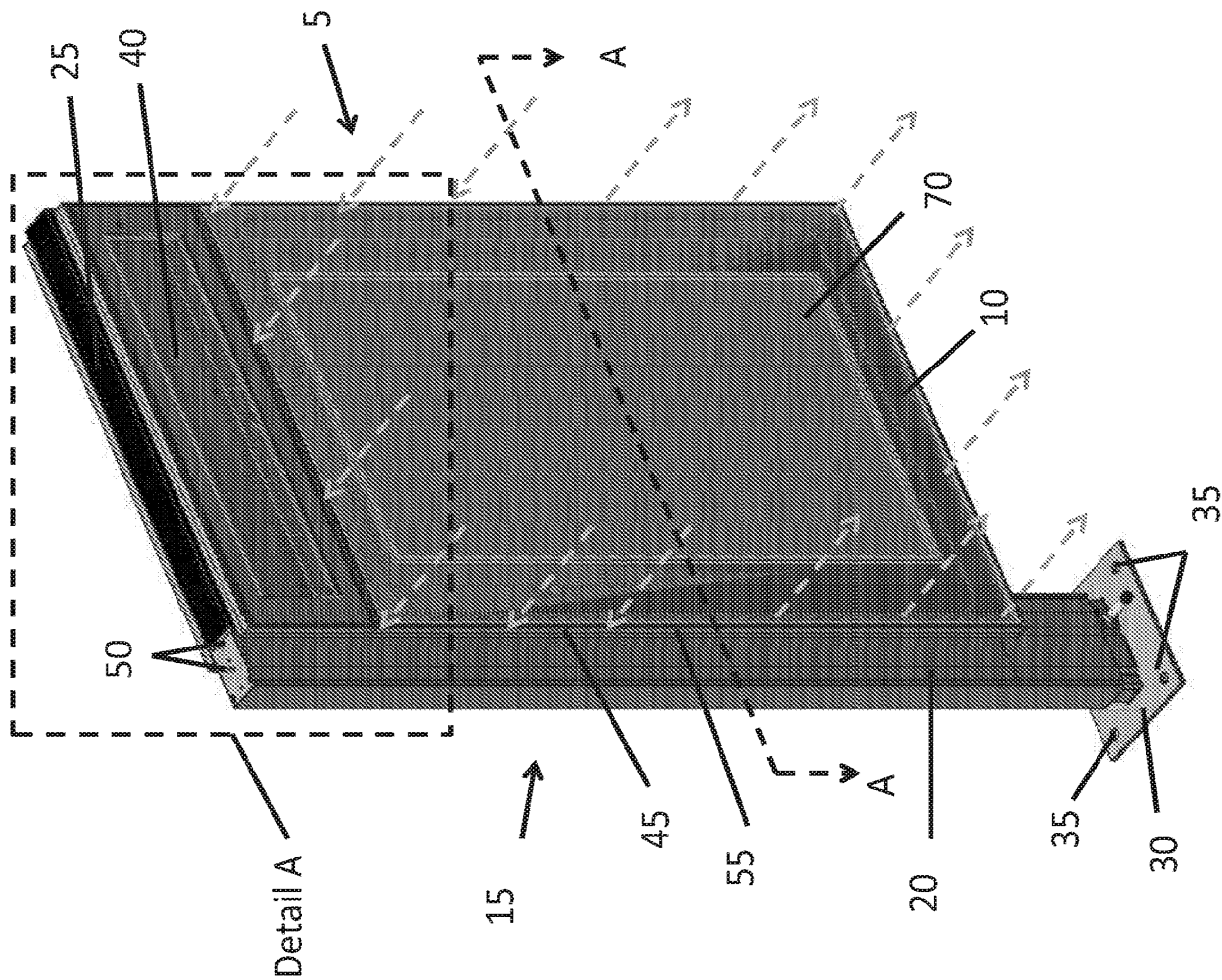


Figure 1

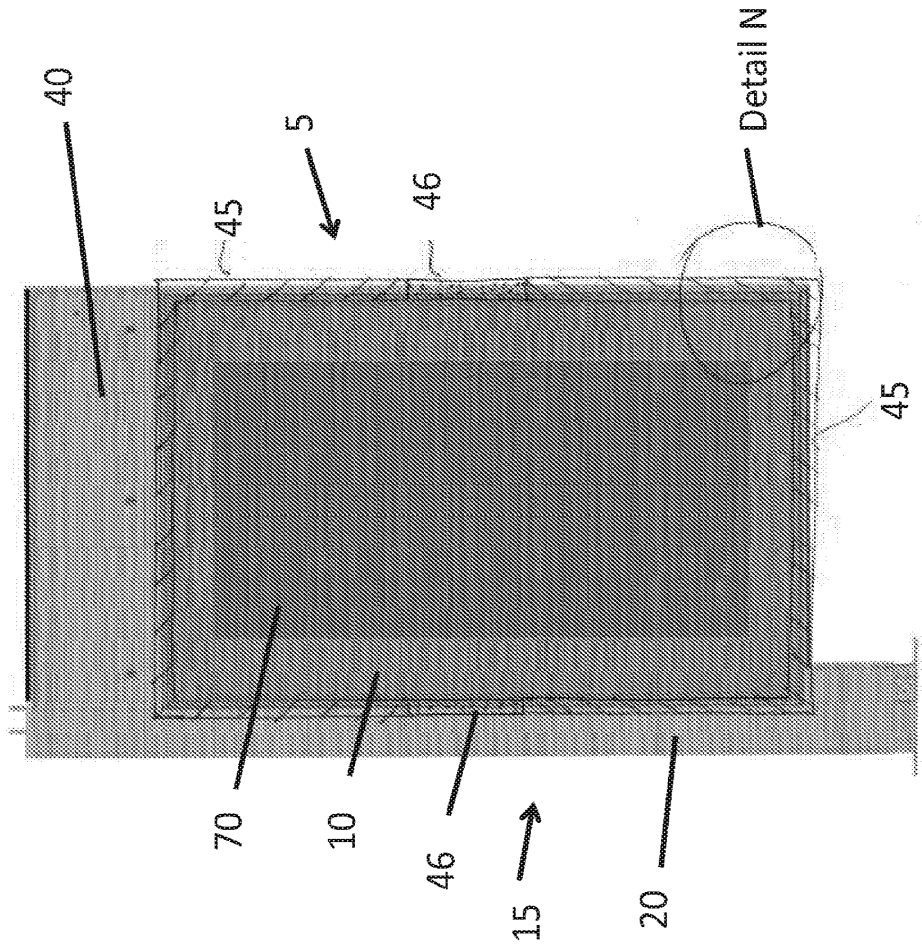


Figure 2

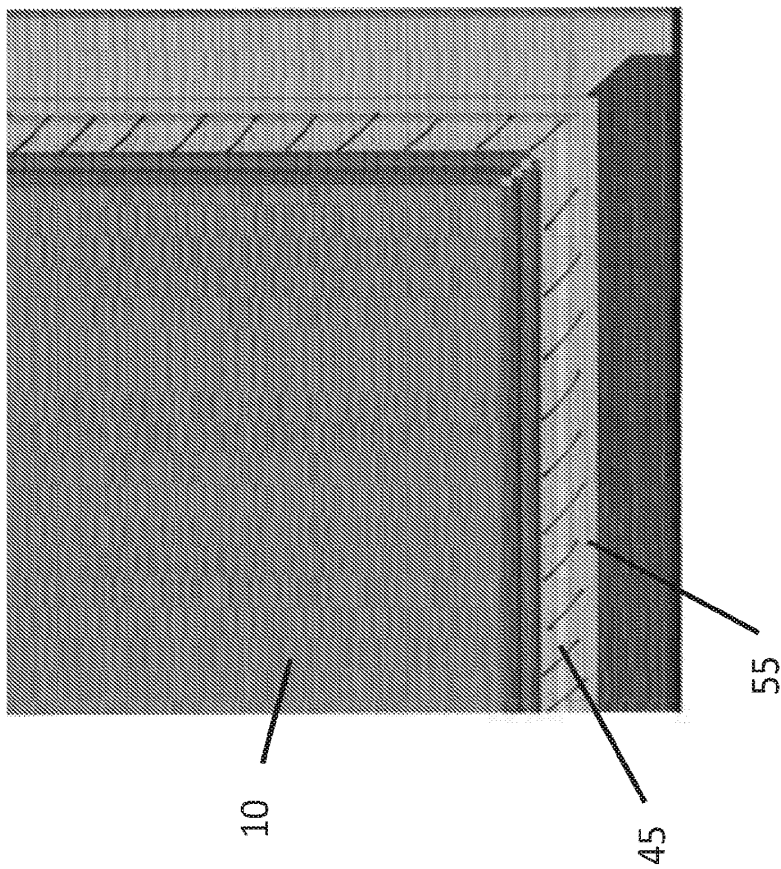


Figure 3

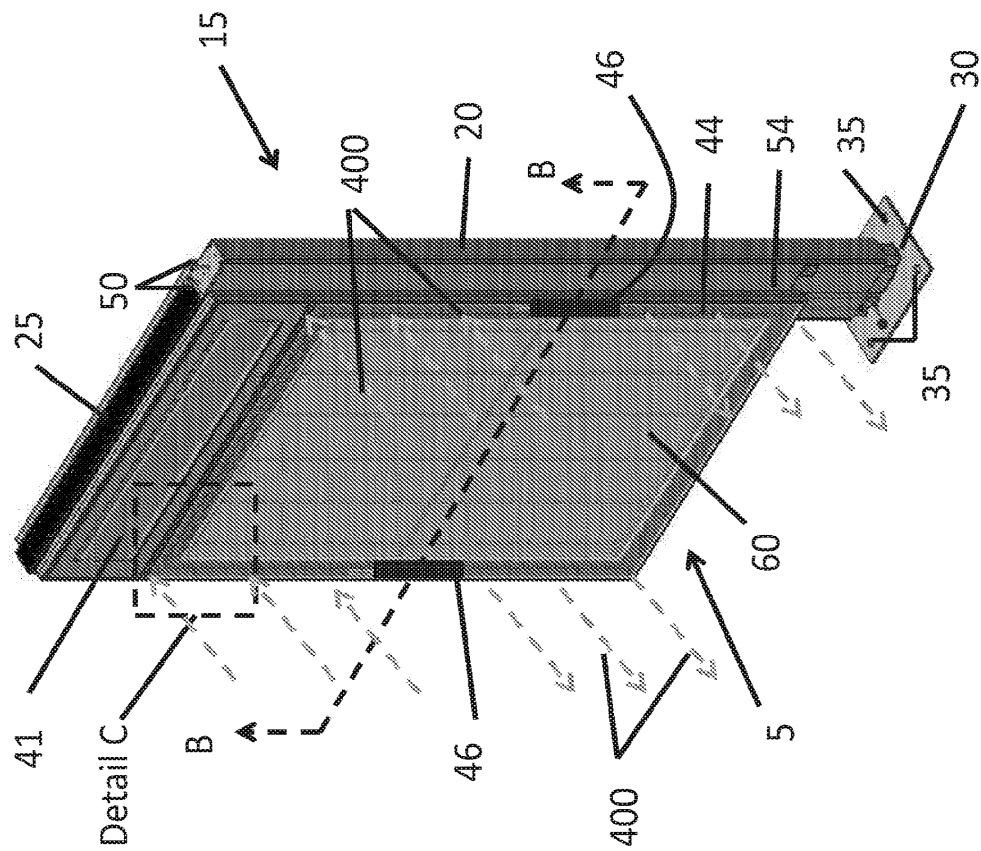


Figure 4

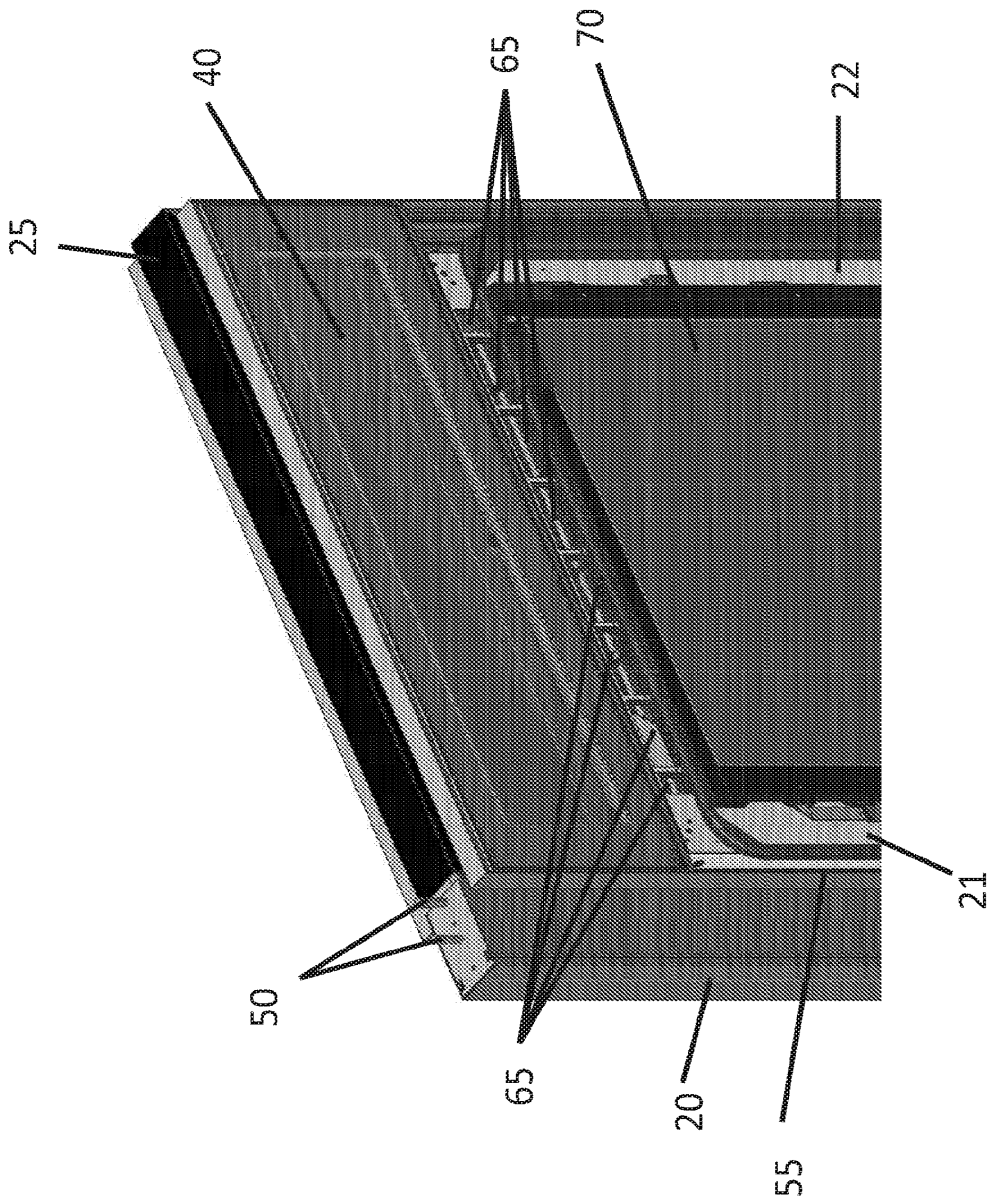


Figure 5

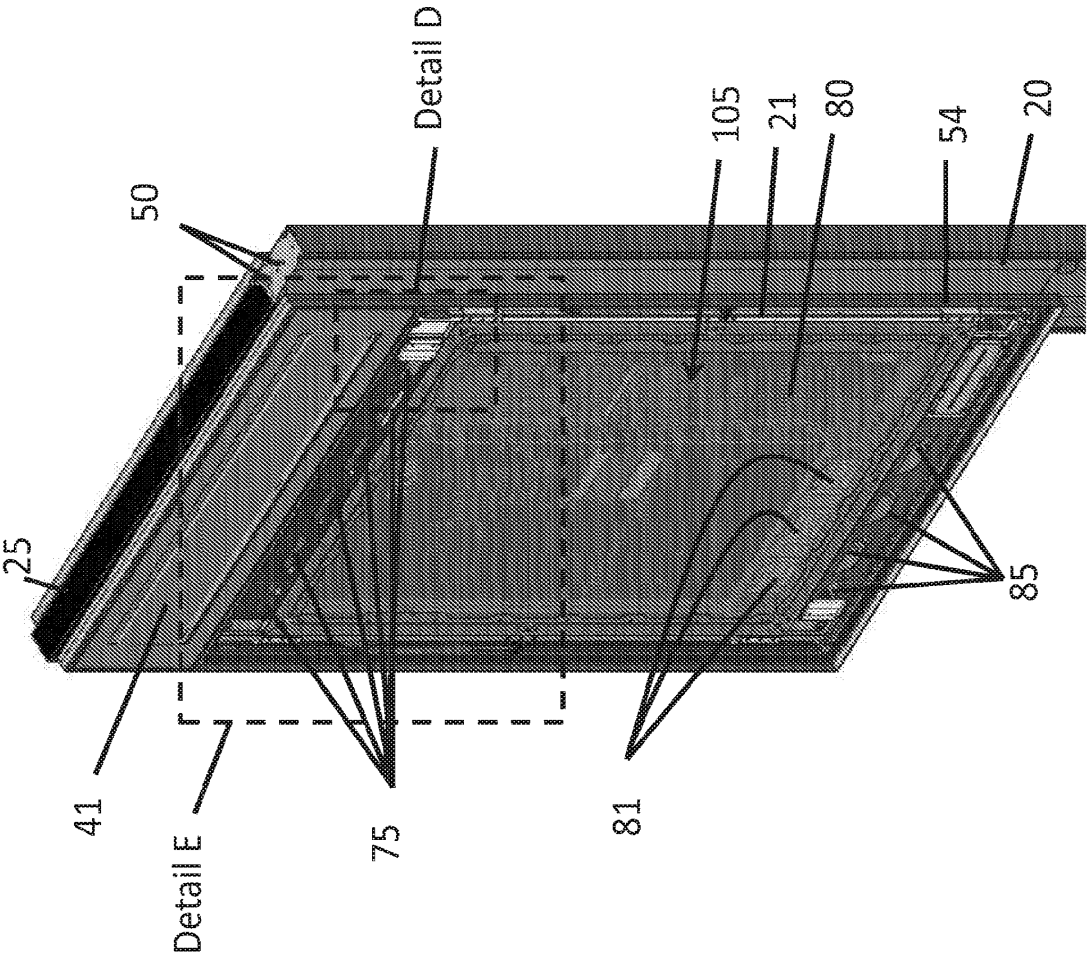


Figure 6

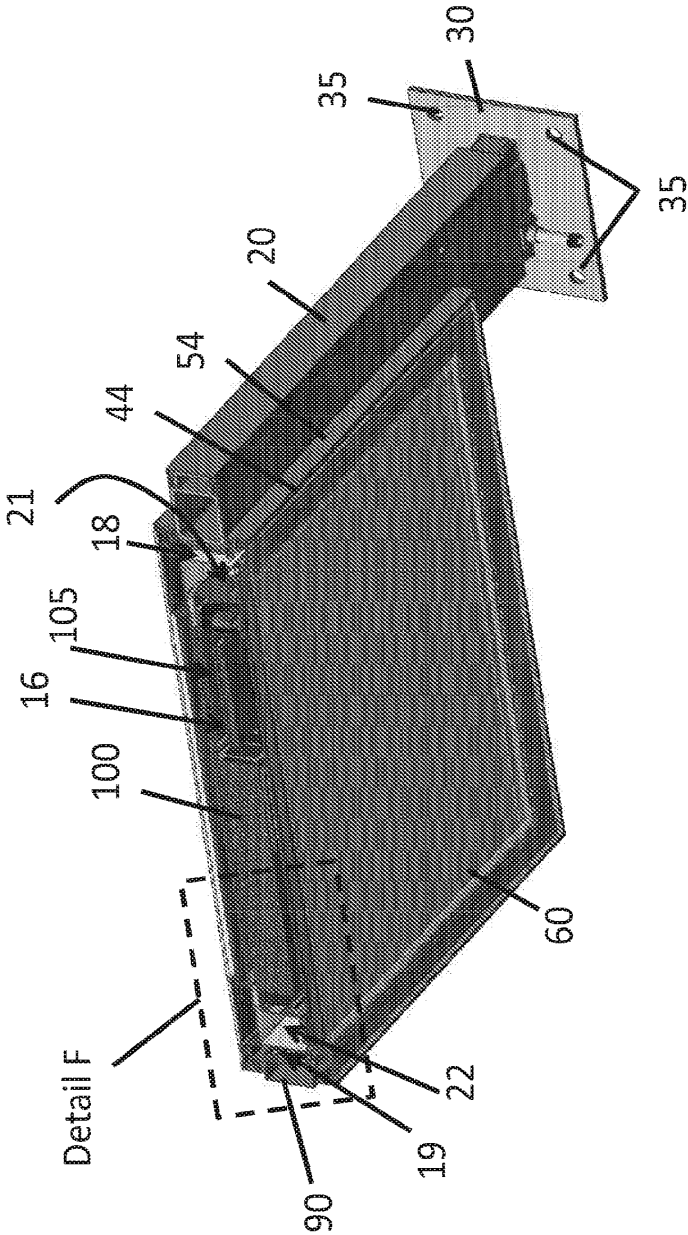


Figure 7

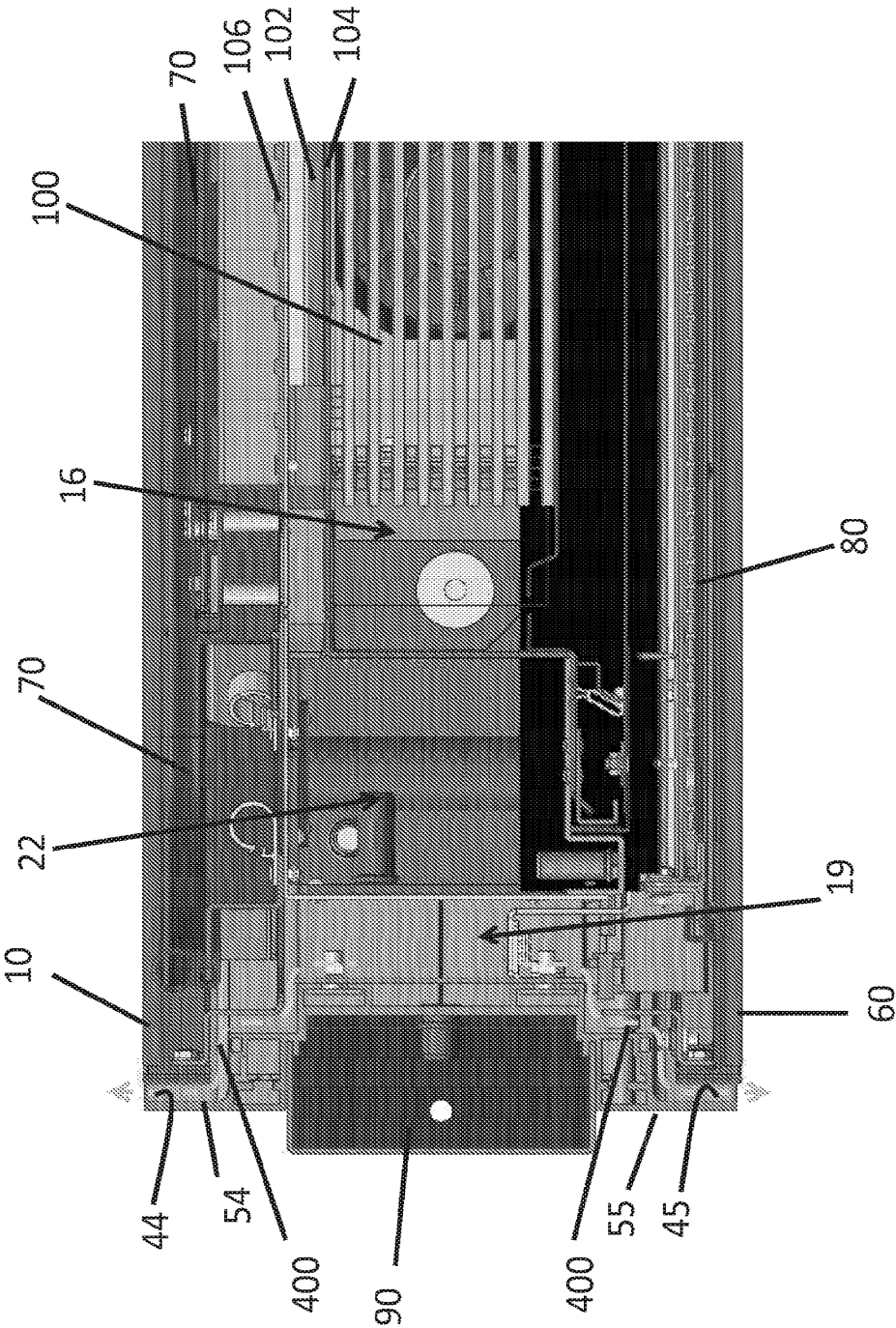


Figure 8

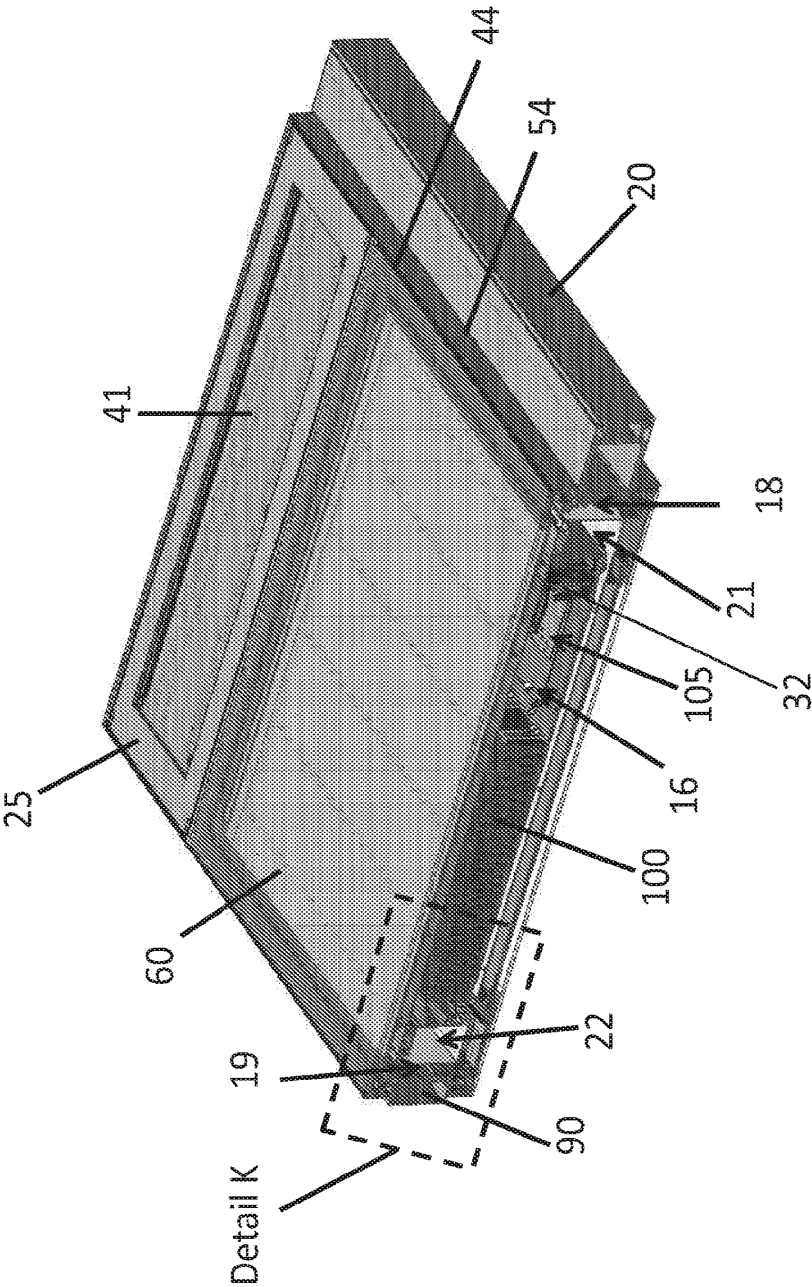


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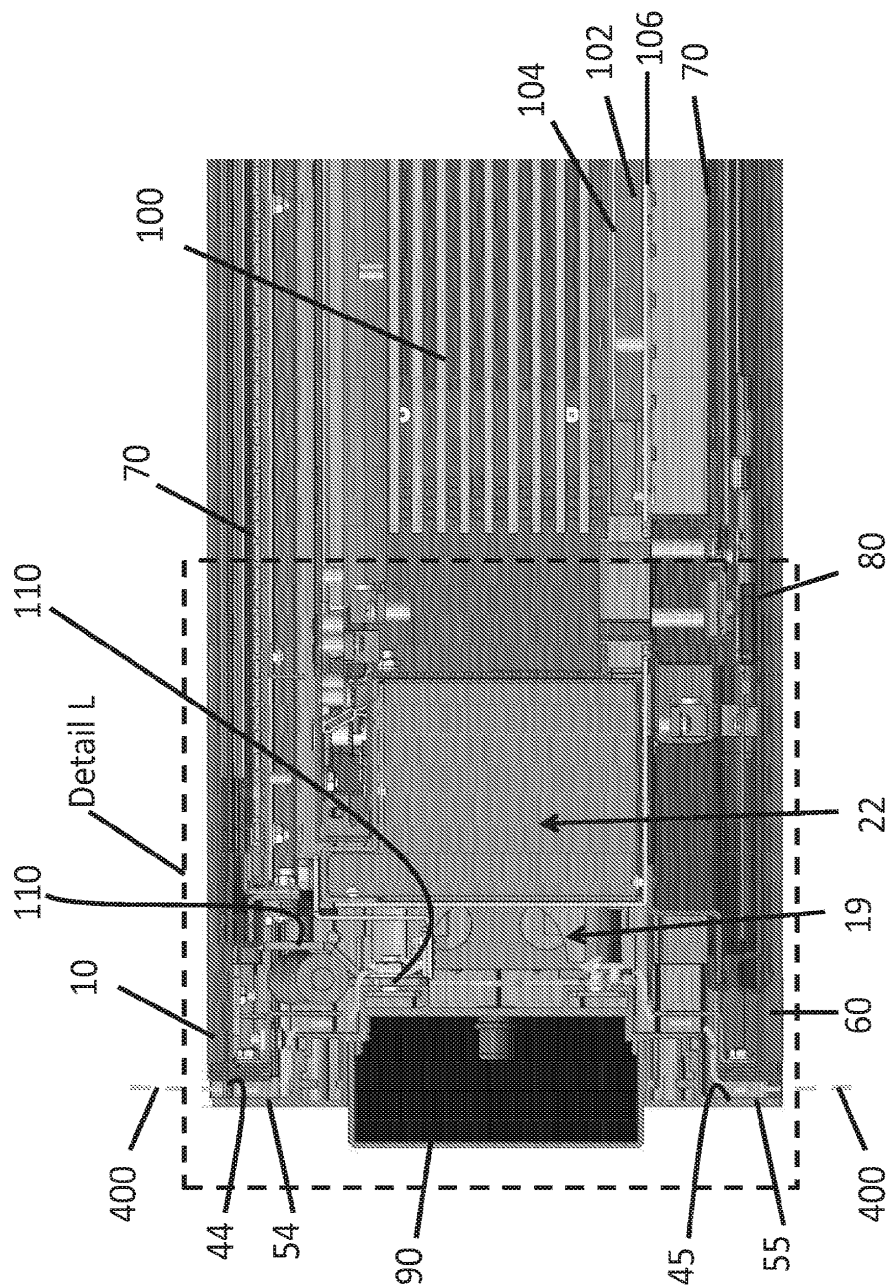


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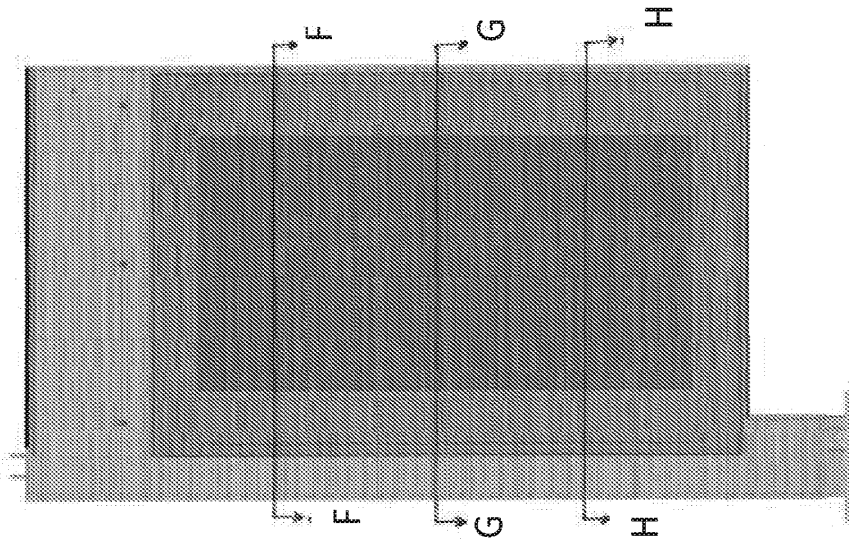
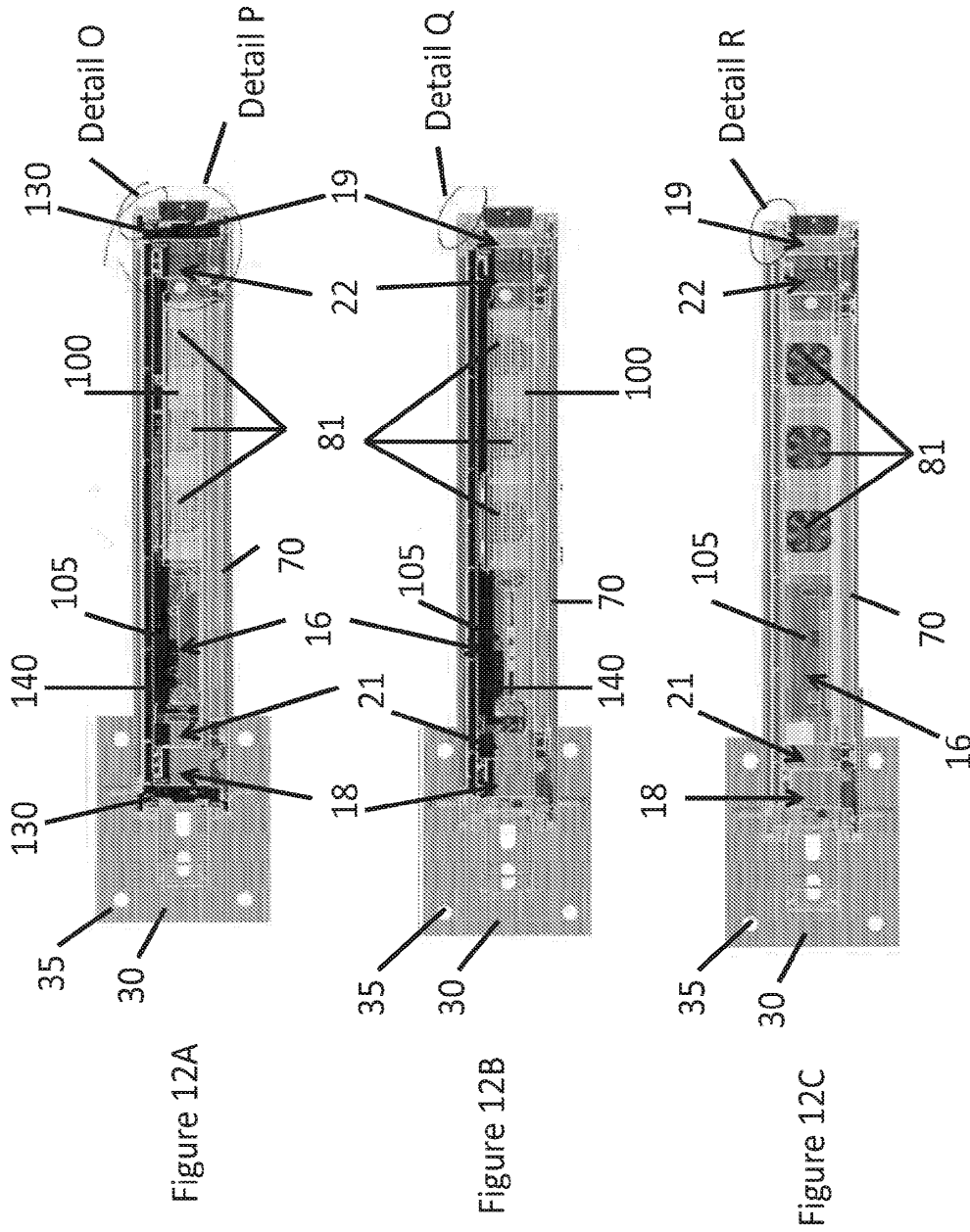


Figure 11



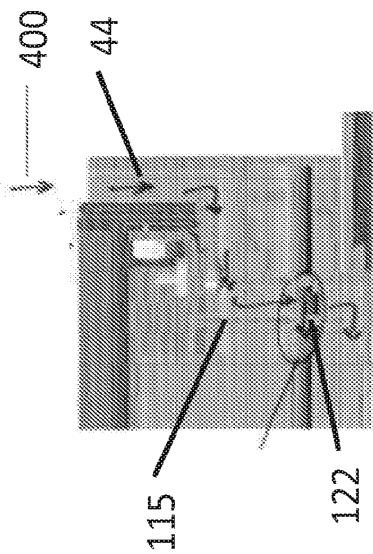


Figure 13A

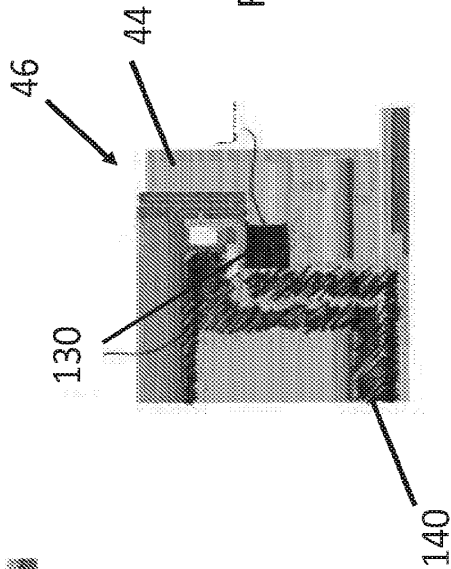


Figure 13B

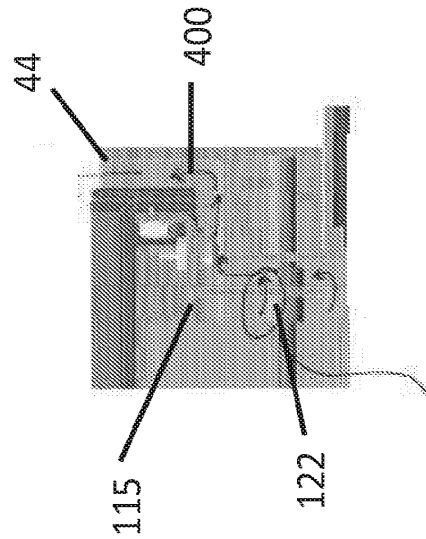


Figure 13C

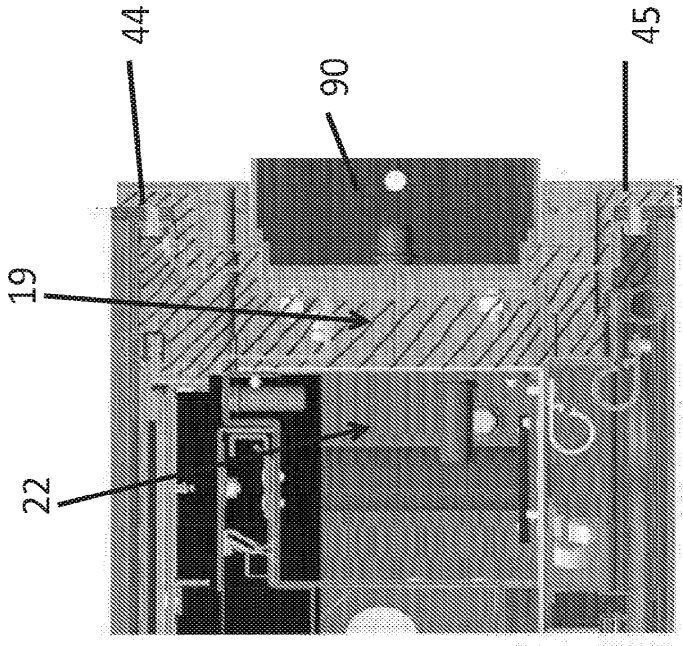


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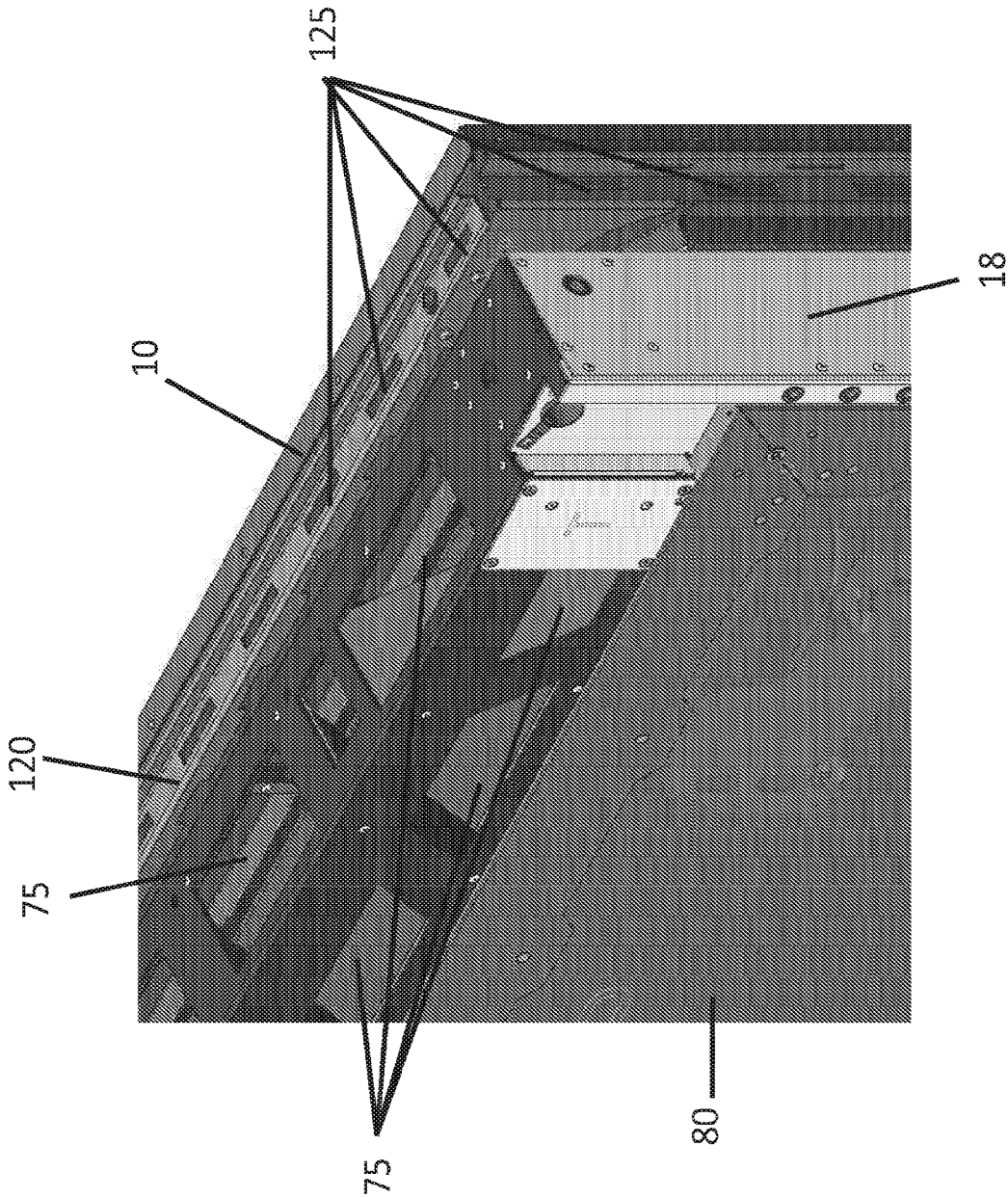


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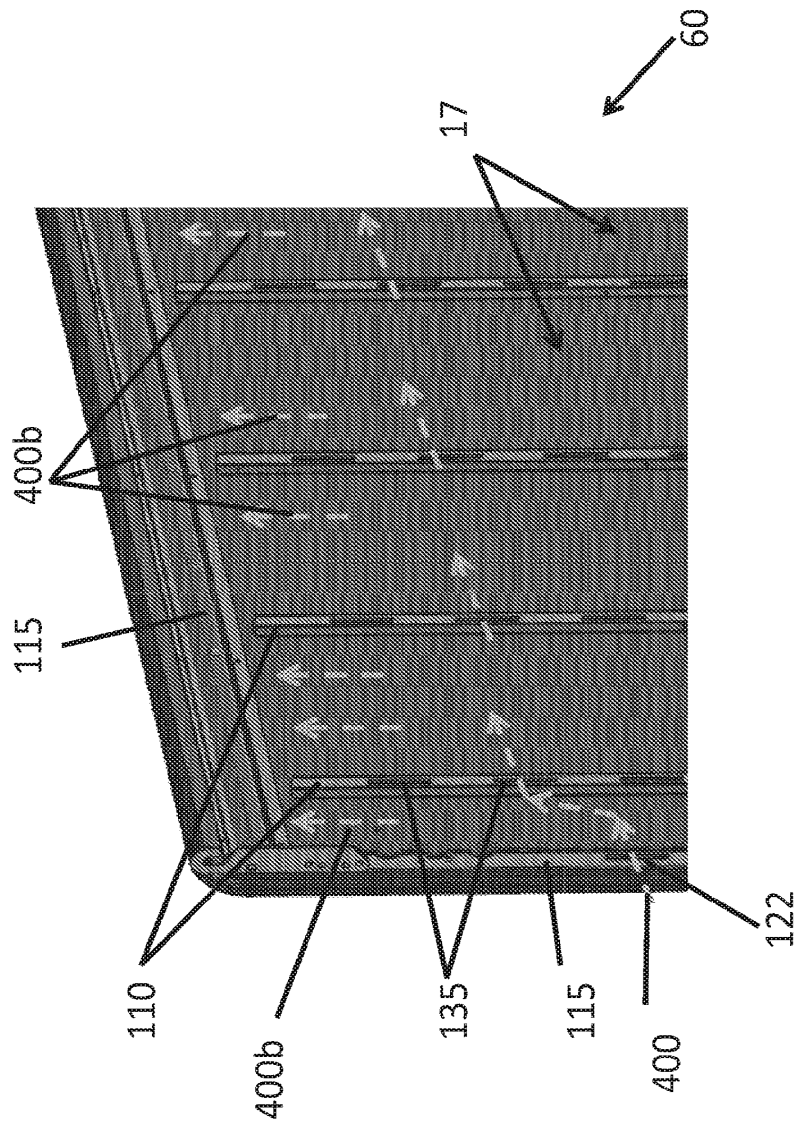


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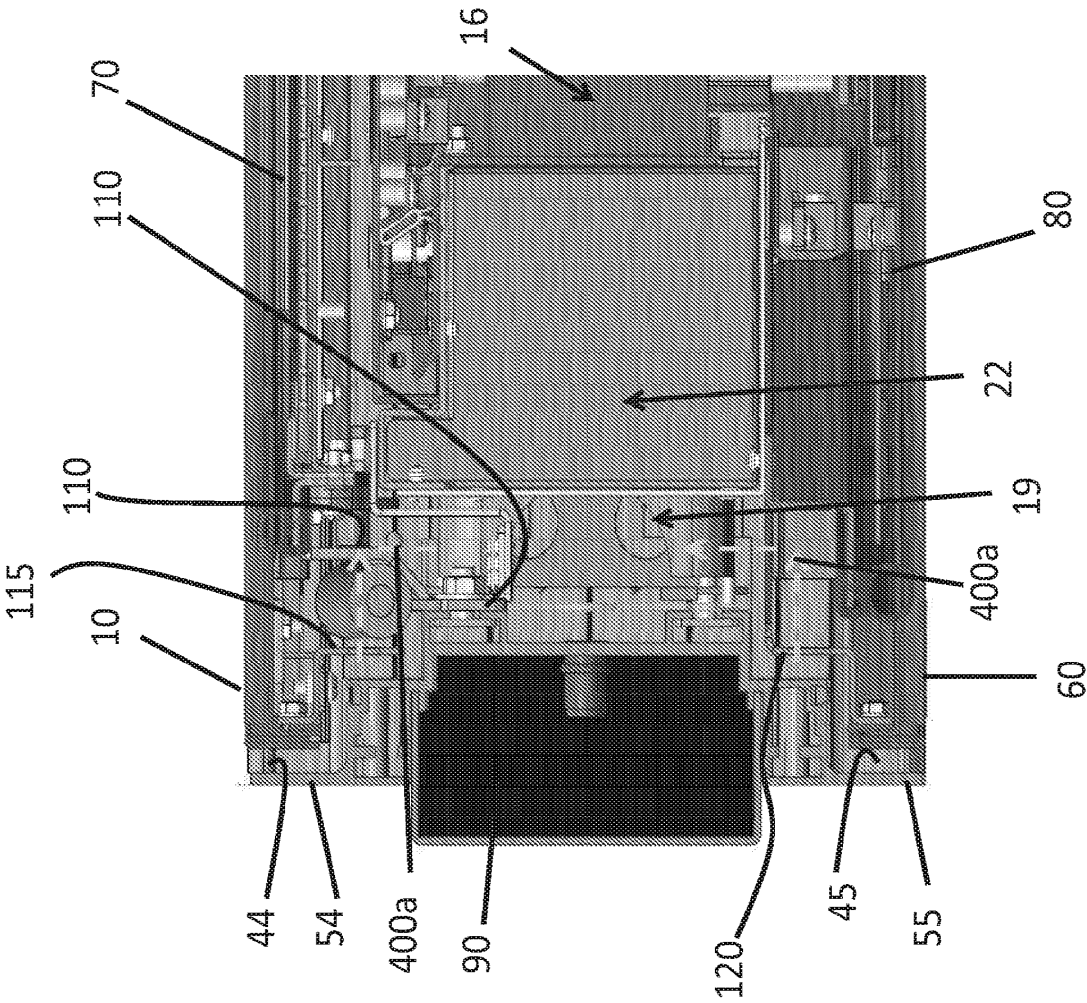


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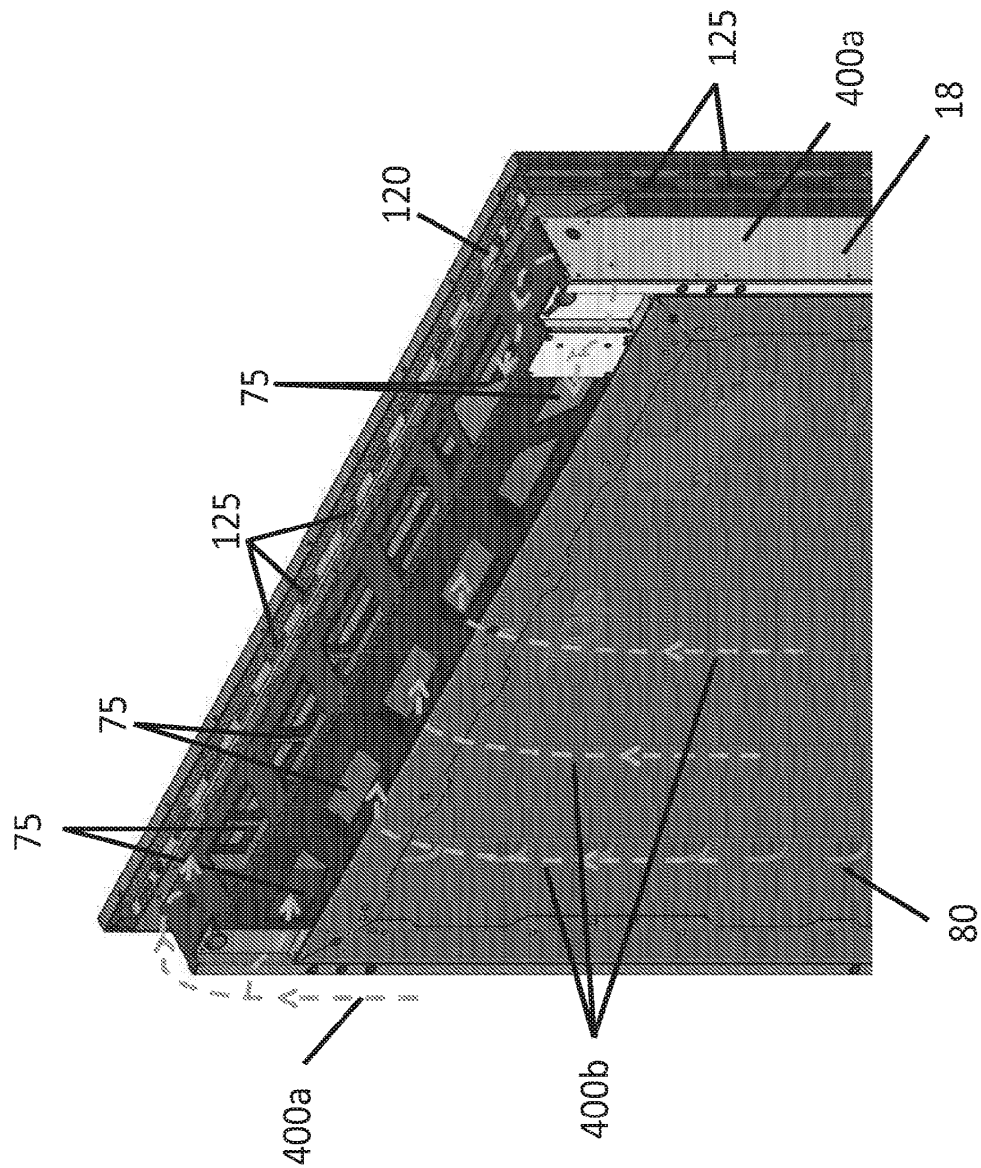


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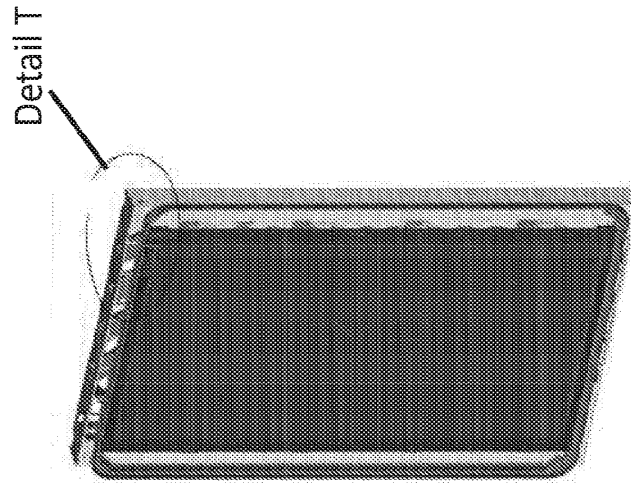


Figure 19B

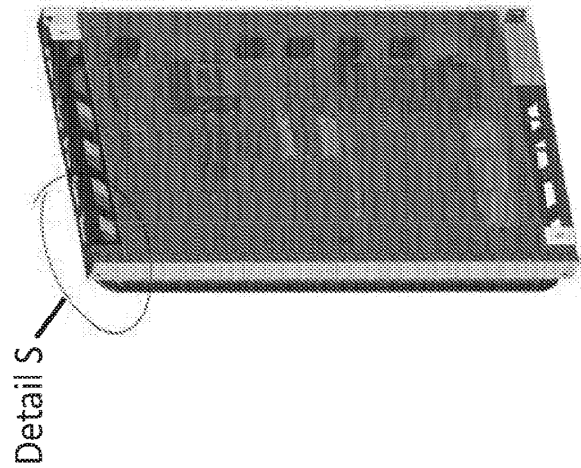


Figure 19A

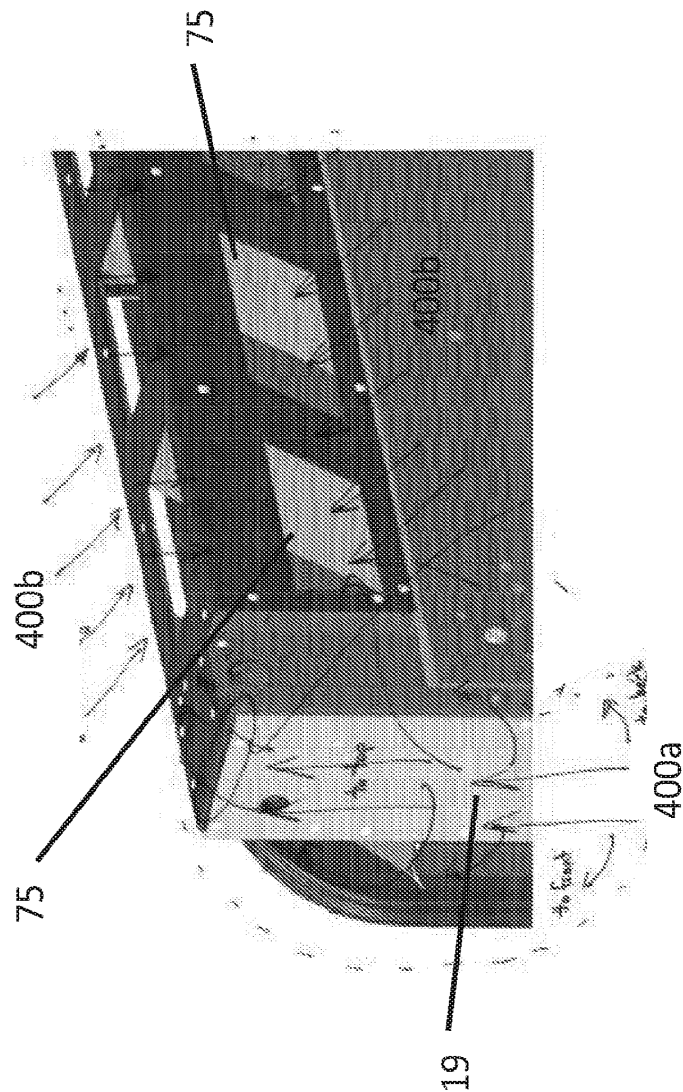


Figure 20

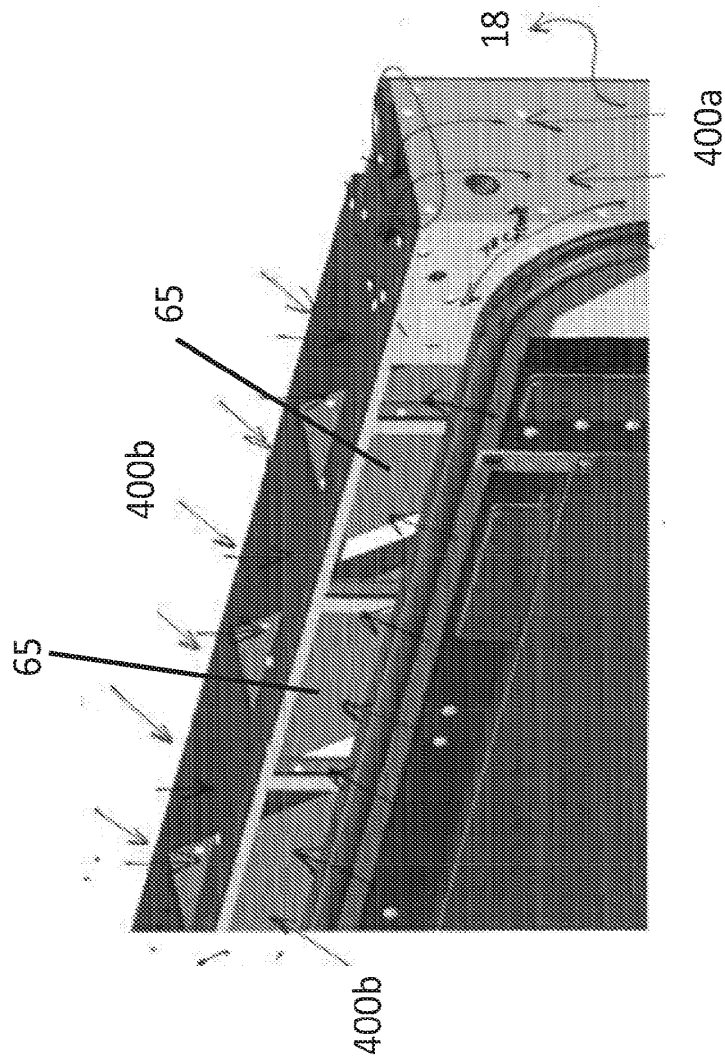


Figure 21

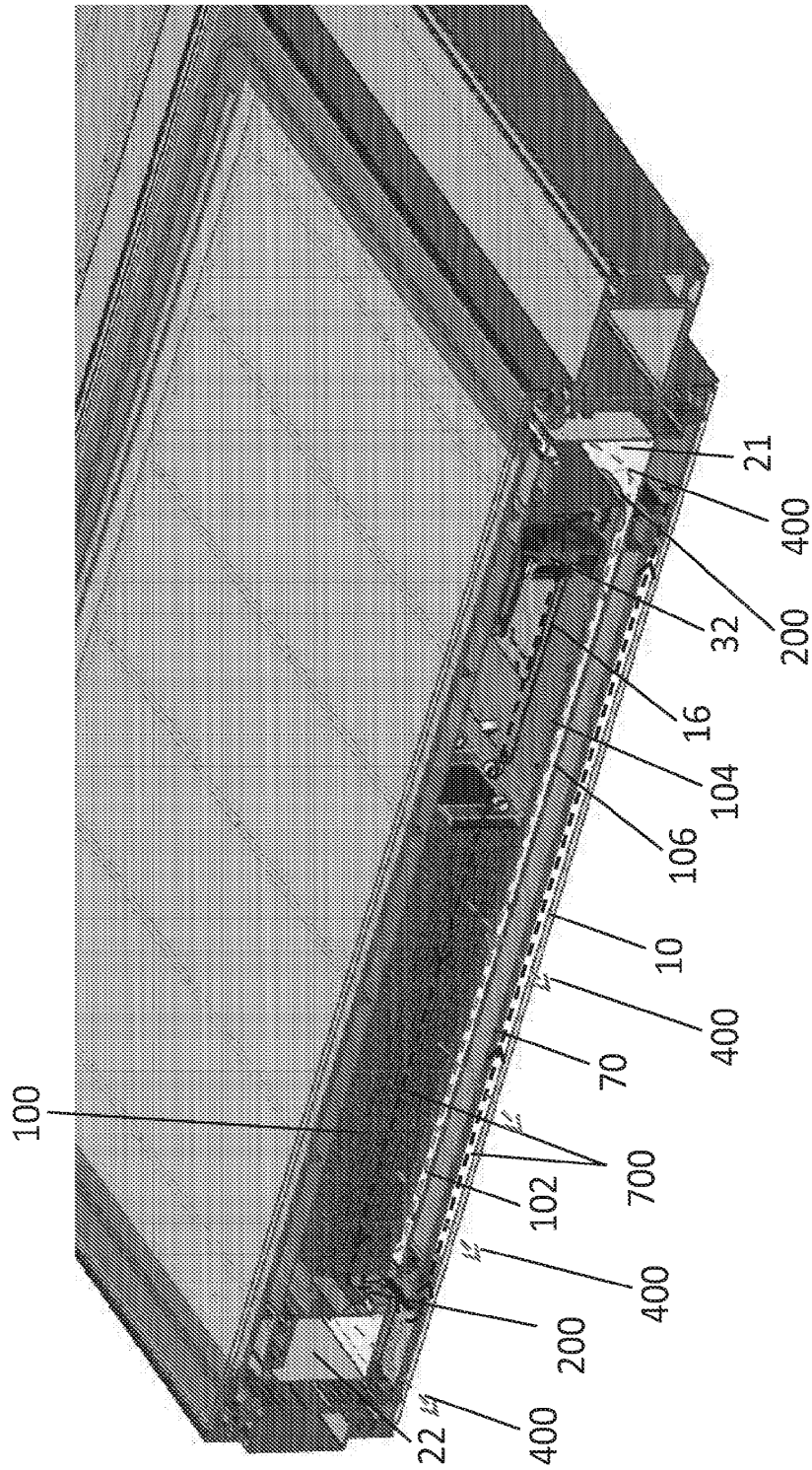


Figure 22

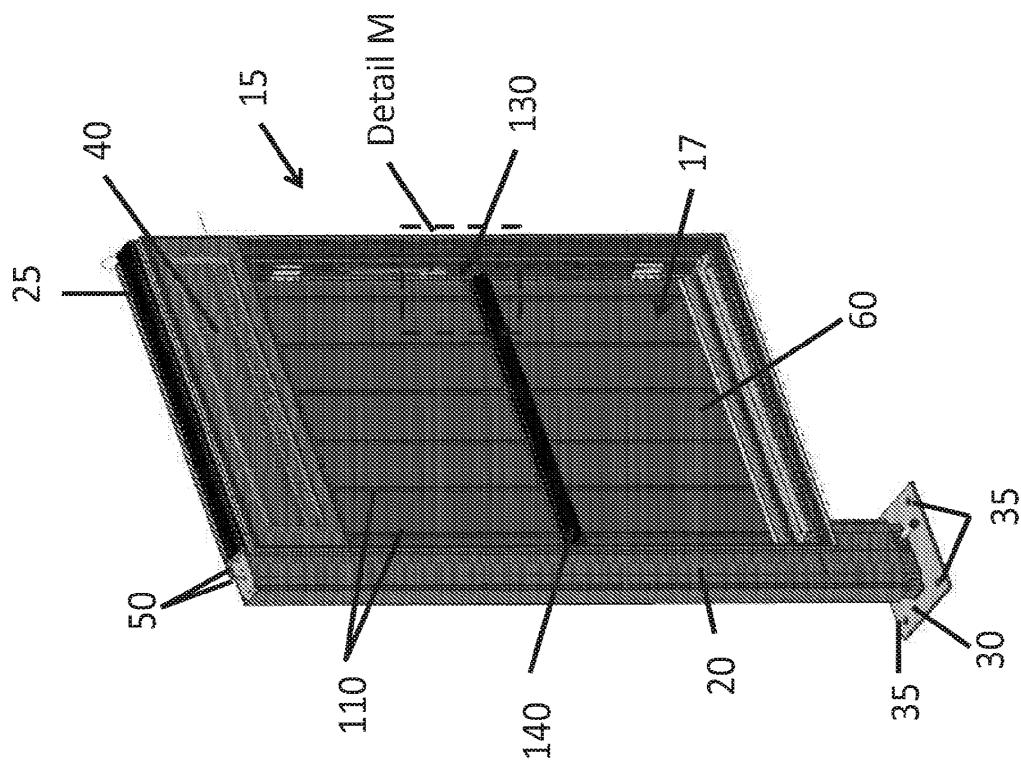


Figure 23

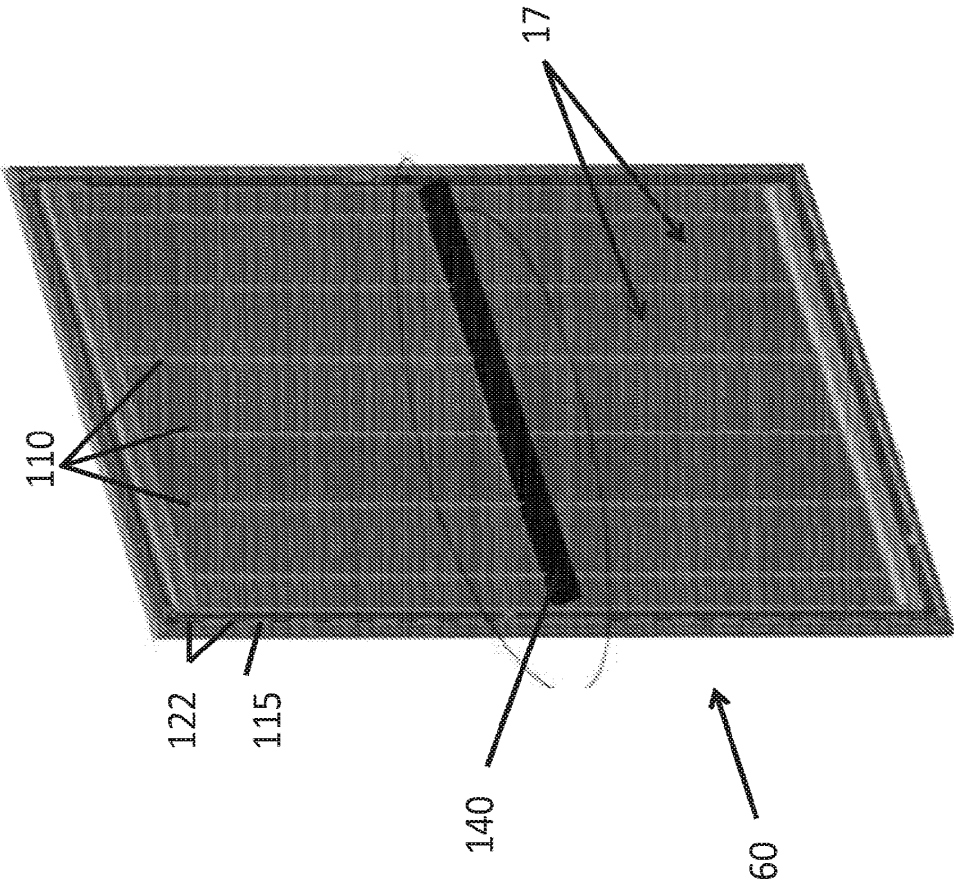


Figure 24

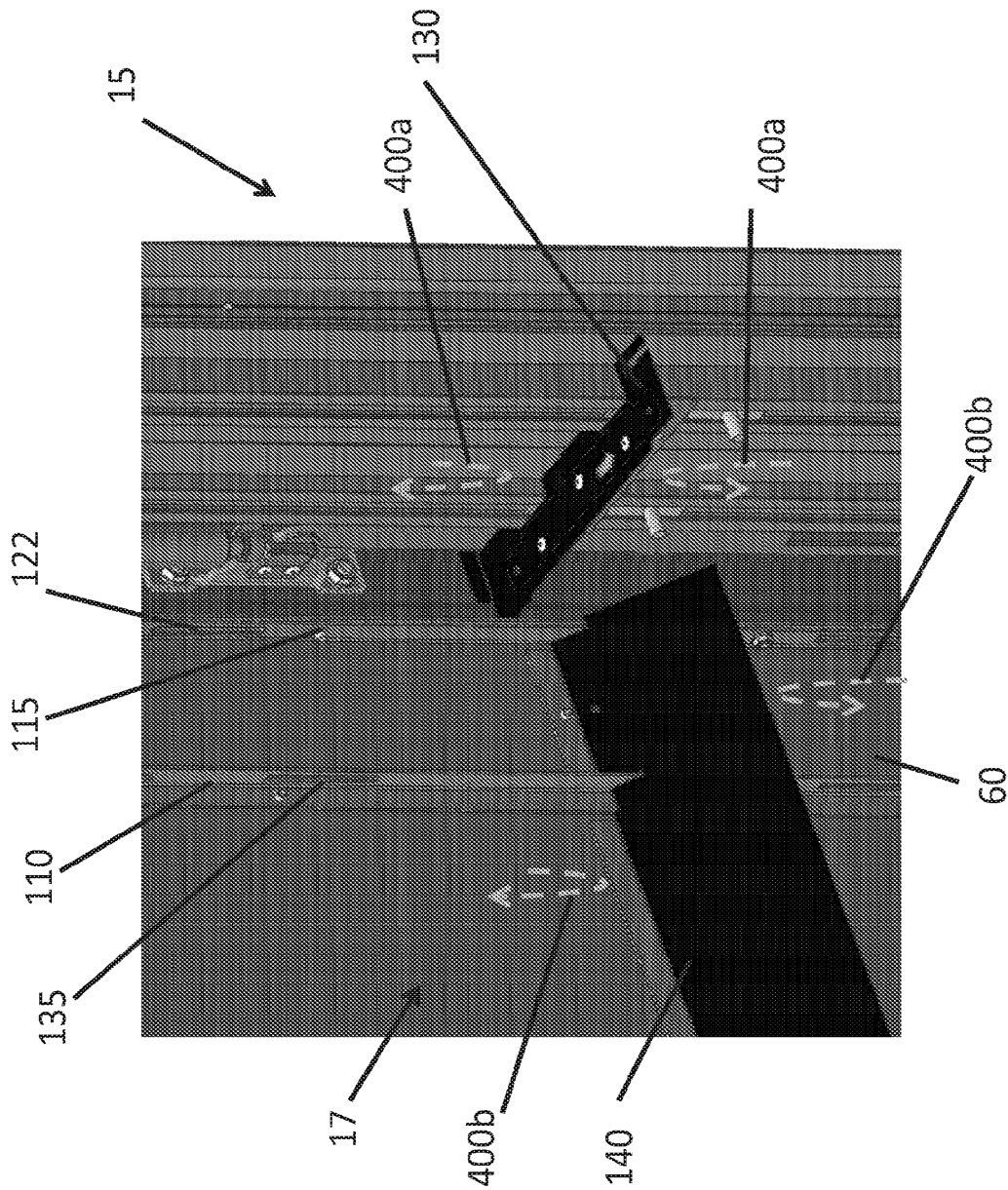


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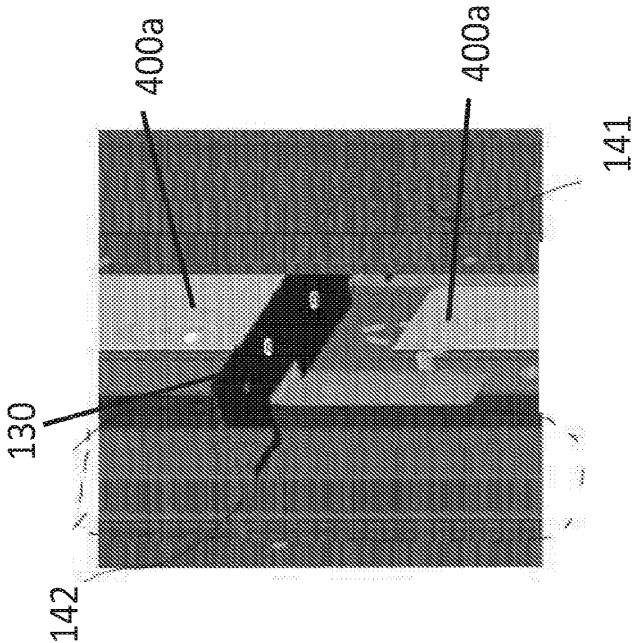


Figure 26B

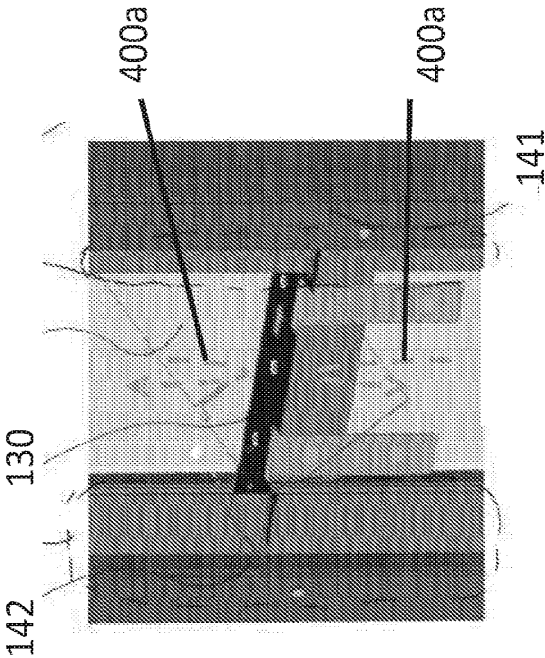


Figure 26A

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US16/17973

A. CLASSIFICATION OF SUBJECT MATTER IPC(8) - H05K 7/20; G02F 1/1335; F21V 29/60 (2016.01) CPC - G02F 1/133385; H05K 7/20954, 7/20972 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) Classifications: H05K 7/20; G02F 1/1335; F21V 29/60; H01L 23/467 (2016.01) CPC Classifications: G02F 1/133385; H05K 7/20954, 7/20972 Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched Electronic data base consulted during the international search (name of data base and, where practicable, search terms used) PatSeer (US, EP, WO, JP, DE, GB, CN, FR, KR, ES, AU, IN, CA, INPADOC Data); Google Scholar; IEEE; EBSCO Keywords used: electronic display; cooling system; ingestion gap; exhaustion gap; fan; buffer zone; central septum		
C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X --- A	US 2011/0058326 A1 (IDEMS, R et al.) March 10, 2011; abstract; figures 6-7, 14-15, 18-19; paragraphs [0005-0007]; [0041]	1, 3, 5-6, 8-10, 13-16 ---
A	US 2008/0209934 A1 (RICHARDS, J) September 04, 2008; figures 8-9; paragraphs [0034-0035]	2, 4, 7, 11-12, 17-20 2, 4, 7, 11-12
A	US 2014/0111758 A1 (MANUFACTURING RESOURCES INTERNATIONAL, INC.) April 24, 2014; figures 2a-2b; paragraphs [0016]; [0018]; [0025]	2, 11, 17-20
A	US 2009/0126906 A1 (DUNN, W) May 21, 2009; figures 2-3; paragraphs [0029]; [0033]	7, 17-20
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Date of the actual completion of the international search 04 April 2016 (04.04.2016)		Date of mailing of the international search report 22 APR 2016
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

Form PCT/ISA/210 (second sheet) (January 2015)

SEC et al. v. MRI
 SEC Exhibit 1022.4545
 IPR2023-00221

Electronic Acknowledgement Receipt	
EFS ID:	40383404
Application Number:	16933932
International Application Number:	
Confirmation Number:	5816
Title of Invention:	ELECTRONIC DISPLAY WITH COOLING
First Named Inventor/Applicant Name:	William Dunn
Customer Number:	8698
Filer:	Adam Jeffery Smith/Brianna Lacy
Filer Authorized By:	Adam Jeffery Smith
Attorney Docket Number:	MAN2241-045R
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Filing Date:	20-JUL-2020
Time Stamp:	09:44:58
Application Type:	Utility under 35 USC 111(a)

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Doc code: IDS

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INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)	Application Number	16933932
	Filing Date	2020-07-20
	First Named Inventor	William Dunn
	Art Unit	2835
	Examiner Name	Michael A Matey
	Attorney Docket Number	MAN2241-045R

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Examiner Initial*	Cite No	Patent Number	Kind Code ¹	Issue Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
	1	9655289	B2	2017-05-16	Dunn et al.	
	2	9797588	B2	2017-10-24	Dunn et al.	
	3	9801305	B2	2017-10-24	Dunn et al.	
	4	9835893	B2	2017-12-05	Dunn	
	5	5351176		1994-09-27	Smith Stephen W. et al.	
	6	5132666		1992-07-21	Fahs	
	7	8827472	B2	2014-09-09	Takada	
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INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)	Application Number		16933932
	Filing Date		2020-07-20
	First Named Inventor	William Dunn	
	Art Unit	2835	
	Examiner Name	Michael A Matey	
	Attorney Docket Number	MAN2241-045R	

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	19	7269023	B2	2007-09-11	Nagano	

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¹ See Kind Codes of USPTO Patent Documents at www.USPTO.GOV or MPEP 901.04. ² Enter office that issued the document, by the two-letter code (WIPO Standard ST.3). ³ For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. ⁴ Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST.16 if possible. ⁵ Applicant is to place a check mark here if English language translation is attached.			

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)	Application Number		16933932
	Filing Date		2020-07-20
	First Named Inventor	William Dunn	
	Art Unit	2835	
	Examiner Name	Michael A Matey	
	Attorney Docket Number	MAN2241-045R	

CERTIFICATION STATEMENT

Please see 37 CFR 1.97 and 1.98 to make the appropriate selection(s):

That each item of information contained in the information disclosure statement was first cited in any communication from a foreign patent office in a counterpart foreign application not more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(1).

OR

☐ That no item of information contained in the information disclosure statement was cited in a communication from a foreign patent office in a counterpart foreign application, and, to the knowledge of the person signing the certification after making reasonable inquiry, no item of information contained in the information disclosure statement was known to any individual designated in 37 CFR 1.56(c) more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(2).

See attached certification statement.

The fee set forth in 37 CFR 1.17 (p) has been submitted herewith.

☒ A certification statement is not submitted herewith.

SIGNATURE

A signature of the applicant or representative is required in accordance with CFR 1.33, 10.18. Please see CFR 1.4(d) for the form of the signature.

Signature	/Adam J. Smith/	Date (YYYY-MM-DD)	2020-08-26
Name/Print	Adam J. Smith	Registration Number	72962

This collection of information is required by 37 CFR 1.97 and 1.98. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 1 hour to complete, including gathering, preparing and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

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5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.
6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).
7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.
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9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.



Espacenet

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SYSTEM AND METHOD FOR THERMALLY CONTROLLING AN ELECTRONIC DISPLAY

Inventor(s): 던 윌리엄 알.

Applicant(s): 매뉴팩처링 리소시스 인터내셔널 인코포레이티드

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EP2225603 (A4) EP2225603 (B1) more

Abstract not available for KR101764381 (B1)

Abstract of corresponding document: WO2009065125 (A2)

Embodiments relate generally to various thermal control features for electronic displays. One feature comprises a closed loop isolated gas chamber, where a first chamber is in contact with the display surface and transfers heat between the isolated gas and the display surface. A second chamber is in gaseous communication with the first chamber and is adapted to heat or cool the isolated gas and reintroduce the isolated gas into the first chamber. Another feature uses constricted convection to facilitate the cooling of the backlight assembly for the electronic display. Another feature uses

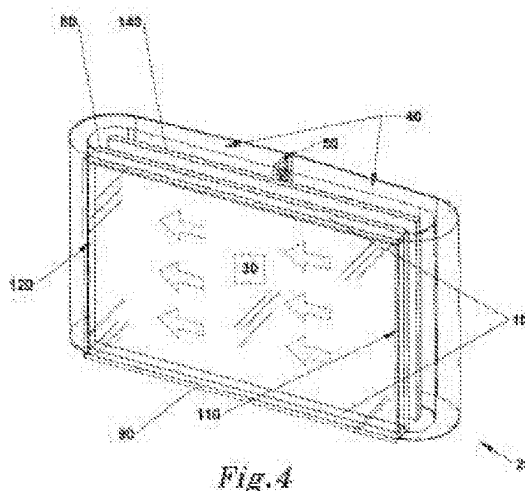
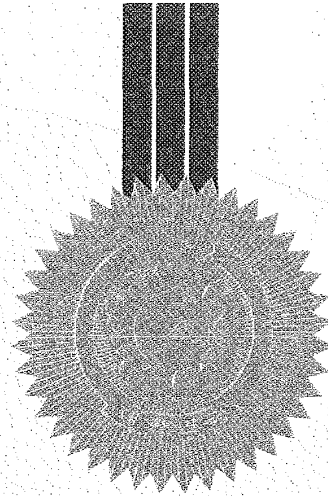


Fig. 4

an air curtain to further heat or cool the exterior viewing surface of the display. Another feature uses a linear polarizer with an insulating gap to reduce the solar loading of the display stack and provide insulation from the ambient air temperature. Another feature uses a fluid system to contact fluid coolant with the display surface in order to cool the display. Each of the features may be used alone, or in combination to provide the proper operating temperature for the display depending on its desired operating environment.

특허증

CERTIFICATE OF PATENT



특허

Patent Number

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발명의 명칭 Title of the Invention

전자 디스플레이 장치의 열 제어 방법 및 시스템

특허권자 Patentee

매뉴팩처링 리소시스 인터내셔널 인코포레이티드
미국 조지아 30005 알파레타 실로 로드 이스트 6415

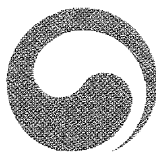
발명자 Inventor

던 윌리엄 알.

미국 조지아 30005 알파레타 유니온 힐 로드 1600

위의 발명은 「특허법」에 따라 특허등록원부에 등록되었음을 증명합니다.

This is to certify that, in accordance with the Patent Act, a patent for the invention has been registered at the Korean Intellectual Property Office.



특허청

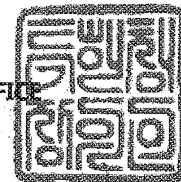
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특허청장

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(73) Patentee: MANUFACTURING RESOURCES
INTERNATIONAL, INC.

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(74) Attorney: Jang Won Park

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Examiner: YOO, Chang Hoon

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- (86) 국제출원번호 PCT/US2008/083792
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- (56) 선행기술조사문헌
JP2006513577 A*
KR1020070048294 A*
US05991153 A*
*는 심사관에 의하여 인용된 문헌
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- (74) 대리인
박장원

전체 청구항 수 : 총 19 항

심사관 : 유창훈

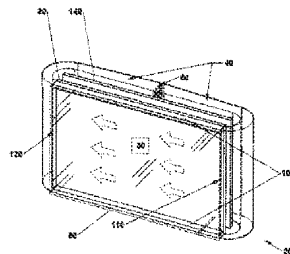
(54) 발명의 명칭 전자 디스플레이 장치의 열 제어 방법 및 시스템

(57) 요약

실시형태들은 일반적으로 전자 디스플레이 장치용의 여러 열 제어 피치들에 관한 것이다. 하나의 피치는 레류프 고립 가스 챔버를 포함하며, 여기서 제1 챔버는 상기 디스플레이 표면과 접촉하고, 고립 가스와 디스플레이 표면 사이에서 열을 전달한다. 제2 챔버는 상기 제1 챔버와 가스 연통하며, 상기 고립 가스를 가열하거나 냉각하며,

(뒷면에 계속)

대표도 - 도4



고압 가스를 제1 챔버로 재도입한다. 다른 피쳐는 전자 디스플레이 장치용 백라이트 어셈블리를 냉각하기 위해 수축 대류를 사용한다. 다른 피쳐는 디스플레이 장치의 외부 가시면을 추가로 가열 또는 냉각하기 위해 에어 커튼을 사용한다. 다른 피쳐는 상기 디스플레이 스택의 태양광 부하를 줄이고 주위 공기 온도와 절연하기 위한 절연 캡을 구비하는 선형 편광판을 사용한다. 다른 피쳐는 디스플레이 장치를 냉각하기 위해 디스플레이 표면과 유체 냉각제가 접촉하는 유체 시스템을 사용한다. 소망하는 작동 환경에 따라 디스플레이 장치에 적당한 작동 온도를 제공하기 위해 각 피쳐들은 단독으로 사용될 수 있고, 서로 조합되어 사용될 수도 있다.

(30) 우선권주장

61/033,058	2008년03월03일	미국(US)
61/033,064	2008년03월03일	미국(US)
61/039,454	2008년03월26일	미국(US)
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61/076,126	2008년06월26일	미국(US)
12/191,834	2008년08월14일	미국(US)
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12/235,200	2008년09월22일	미국(US)
12/237,365	2008년09월24일	미국(US)
61/115,333	2008년11월17일	미국(US)

명세서

청구범위

청구항 1

디스플레이 표면과 후방면을 구비하는 전자 디스플레이용 가스 냉각 시스템으로,
순환 가스를 포함하며, 상기 전자 디스플레이를 둘러싸는 폐쇄형 루프 가스 순환 경로; 및
상기 폐쇄형 루프 가스 순환 경로의 개방된 중앙부를 관통하며, 주위 공기 유동을 받아들이고 그 주위 공기 유동이 전자 디스플레이의 후방면을 따라 이동하도록 구성되는 주위 공기 채널을 포함하고,
상기 폐쇄형 루프 가스 순환 경로 내의 순환 가스가 주위 공기 채널을 관통하여 유동하는 주위 공기와 격리되어 있는 것을 특징으로 하는, 전자 디스플레이용 가스 냉각 시스템.

청구항 2

제1항에 있어서,
팬을 획정하기 위해 디스플레이 표면의 전방에 위치하는 투명 전광판; 및
상기 순환 가스가 상기 팬을 통해 유동하도록 순환 가스를 강제 송풍하게 위치하는 팬을 추가로 포함하는 것을 특징으로 하는, 전자 디스플레이용 가스 냉각 시스템.

청구항 3

삭제

청구항 4

제1항에 있어서,
전자 디스플레이의 후방면을 따라 주위 공기가 유동하도록 주위 공기를 강제 송풍하게 위치하는 팬을 추가로 포함하는 것을 특징으로 하는, 전자 디스플레이용 가스 냉각 시스템.

청구항 5

제1항에 있어서,
주위 공기 채널은, 상기 채널을 관통하는 주위 공기의 유동 방향이 폐쇄형 루프 가스 순환 경로 내에서의 순환 가스의 유동 방향과 적교하도록 배향되어 있는 것을 특징으로 하는, 전자 디스플레이용 가스 냉각 시스템.

청구항 6

열 제어 전자 디스플레이로,
인입구와 배출구를 구비하는 하우징;
디스플레이 표면을 구비하는 액정 스택;
상기 액정 스택의 전방에 위치하는 열전도성 후방면을 구비하는 LED 백라이트;
순환 가스를 포함하며, 상기 액정 스택과 LED 백라이트 주위 둘레에 위치하는 연속된 순환 가스 경로; 및
주위 공기의 유동이 하우징 인입구를 통해 인입되어 LED 백라이트의 후방면을 따라 이동한 후 하우징 배출구를 통해 빠져나가도록 위치하는 팬을 포함하는 것을 특징으로 하는 열 제어 전자 디스플레이.

청구항 7

제6항에 있어서,
상기 팬이, 주위 공기의 유동 방향이 폐쇄형 루프 내의 순환 가스의 유동 방향과 적교하도록 배향되어 있는 것

을 특징으로 하는 열 제어 전자 디스플레이.

청구항 8

열 제어 액정 디스플레이 어셈블리로,

디스플레이 표면을 구비하는 액정 스택;

상기 액정 스택의 전방에 위치하는 열전도성 후방면을 구비하는 LED 백라이트;

디스플레이 표면의 전방에 위치하여, 디스플레이 표면과의 사이에 채널을 형성하는 공간이 형성되도록 하는 유리판;

순환 가스가 상기 채널을 관통하며 흐르도록, 상기 액정 스택과 LED 백라이트를 둘러싸도록 위치하는 순환 가스의 폐쇄형 루프; 및

주위 공기 유동이 LED 백라이트의 후방면과 접촉하도록 하는 수단을 포함하는 것을 특징으로 하는 열 제어 액정 디스플레이 어셈블리.

청구항 9

제8항에 있어서,

상기 수단은, 주위 공기의 유동 방향이 폐쇄형 루프 내의 순환 가스의 유동 방향과 직교하도록 하는 것을 특징으로 하는 열 제어 액정 디스플레이 어셈블리.

청구항 10

제8항에 있어서,

내부 표면과 외부 표면을 구비하는 플레임으로, 순환 가스가 내부 표면과 접촉하게 되고, 주위 공기가 외부 표면과 접촉하도록 구성되는 플레임을 추가로 포함하는 것을 특징으로 하는 열 제어 액정 디스플레이 어셈블리.

청구항 11

후방면을 구비하는 전자 디스플레이를 냉각하는 방법으로,

전자 디스플레이와 수축 대류관 사이에 갭이 형성되도록, 전자 디스플레이의 후방면에 인접하게 수축 대류관을 위치시키는 단계;

전자 디스플레이 주위로 가스가 순환하기 위한 폐쇄형 루프 경로를 위치시키는 단계;

폐쇄형 루프 주위에 순환 가스를 강제 송풍하는 단계; 및

상기 갭을 통해 찬 공기를 강제 송풍하는 단계를 포함하는 것을 특징으로 하는 전자 디스플레이 냉각 방법.

청구항 12

제11항에 있어서,

상기 수축 대류관이 냉각 챔버의 벽으로 재공되는 것을 특징으로 하는 전자 디스플레이 냉각 방법.

청구항 13

제11항에 있어서,

갭을 통해 찬 공기를 강제 송풍하는 단계는 갭을 통해 주위 공기를 빨아들이는 팬에 의해 수행되는 것을 특징으로 하는 전자 디스플레이 냉각 방법.

청구항 14

제11항에 있어서,

갭을 통해 찬 공기를 강제 송풍하는 단계는 갭을 통해 주위 공기를 밀어내는 팬에 의해 수행되는 것을 특징으로 하는 전자 디스플레이 냉각 방법.

청구항 15

제11항에 있어서,

갭을 통해 찬 공기를 강제 송풍하기 전에 여과하는 단계를 추가로 포함하는 것을 특징으로 하는 전자 디스플레이 냉각 방법.

청구항 16

전방면과, 전자 디스플레이의 후방면과 제2의 전방면 사이에 설정되는 갭을 구비하는 전자 디스플레이를 냉각하는 방법으로,

전자 디스플레이 주위로 폐쇄형 루프로 가스를 순환시키는 단계;

상기 가스가 전자 디스플레이의 전방면과 접촉하도록 하는 단계; 및

상기 갭을 통해 찬 공기를 강제 송풍하는 단계를 포함하며,

상기 찬 공기가 상기 순환 가스와 격리되어 있는 것을 특징으로 하는 전자 디스플레이 냉각 방법.

청구항 17

제16항에 있어서,

폐쇄형 루프 내에서 전자 디스플레이 주위로 가스를 순환시키는 단계가,

전자 디스플레이의 전방면의 앞에 위치하는 제1 가스 챔버;

전자 디스플레이의 후방면의 뒤쪽에 위치하며, 상기 제1 가스 챔버와 가스 연통하는 제2 가스 챔버; 및

상기 제2 가스 챔버 내에 위치하여, 상기 제1 가스 챔버와 제2 가스 챔버 주위로 가스를 송풍하는 데에 사용되는 냉각 챔버 팬에 의해 수행되는 것을 특징으로 하는 전자 디스플레이 냉각 방법.

청구항 18

제16항에 있어서,

갭을 통해 찬 공기를 강제 송풍하는 단계가 팬에 의해 수행되는 것을 특징으로 하는 전자 디스플레이 냉각 방법.

청구항 19

LED 백라이트가 후방면을 구비하고, 액정 디스플레이는 전방 가시면과, LED 백라이트의 후방면과 이격 배치되어 갭을 형성하는 후방면을 포함하는 LED 백라이트 액정 디스플레이를 냉각하는 방법으로,

액정 디스플레이와 백라이트 주위를 폐쇄형 루프로 가스를 순환시키는 단계;

갭을 통해 찬 공기를 강제 송풍하는 단계; 및

상기 순환 가스와 찬 공기가 혼합되지 않도록 하는 단계를 포함하는 것을 특징으로 하는 LED 백라이트 액정 디스플레이 냉각 방법.

청구항 20

제19항에 있어서,

액정 디스플레이와 백라이트 주위를 폐쇄형 루프로 가스를 순환시키는 단계가,

액정 디스플레이의 전방 가시 면의 앞에 위치하는 제1 가스 챔버;

LED 백라이트의 후방면의 뒤쪽에 위치하며, 상기 제1 가스 챔버와 가스 연통하는 제2 가스 챔버; 및

상기 제2 가스 챔버 내에 위치하여, 상기 제1 가스 챔버와 제2 가스 챔버 주위로 가스를 송풍하는 데에 사용되는 냉각 챔버 팬에 의해 수행되는 것을 특징으로 하는 LED 백라이트 액정 디스플레이 냉각 방법.

발명의 설명

기술 분야

[0001] 예시적 실시형태들은 일반적으로 전자 디스플레이 장치를 가열/냉각하는 시스템에 관한 것이다.

배경 기술

[0002] 전자 디스플레이 장치는 온도가 조절되는 실내에서 사용되는 것이 일반적이다. 디스플레이 장치 주위의 온도는 비교적 안정적(실내 온도 근방)이기는 하지만, 디스플레이 장치의 부품들은 다양한 열을 발생시킬 수 있다. 이러한 열이 적절하게 배출되지 않으면, 디스플레이 장치에 손상을 입히거나, 수명을 단축시키게 된다. 통상적으로 디스플레이 장치 내의 전자부품들에서 발생한 열을 디스플레이 장치의 측면을 통해 방출하기 위해, 전도 및 대류 열전달 시스템이 사용되고 있다. 이러한 열전달 시스템이 과거에는 성공적으로 사용되었지만, 오늘날 전자 디스플레이 장치는 더 큰 냉각 능력(일부 경우에는 가열 능력)을 필요로 한다.

[0003] 현대의 전자 디스플레이 장치는 실외 환경과 주변 온도가 실내 온도보다 높거나 낮은 상황에서도 사용되고 있다. 주위 공기로부터 열이 전달되는 외에도, 디스플레이 장치 표면을 통한 태양으로부터의 복사 열전달도 주요 요인이 될 수 있다. 일부 응용분야 및 사용 위치에서, 그러한 디스플레이 장치 표면을 통해 200 와트 또는 그 이상의 전력이 사용되는 것이 일반적이다. 또한, 시장에서는 보다 대형의 그리고 보다 밝은 디스플레이 장치를, 때로는 고해상도 디스플레이 장치를 요구한다. 전자 디스플레이 장치가 대형화함에 따라, 태양으로부터 다량의 열을 흡수하게 되고, 다량의 열이 디스플레이 장치 내로 전달되게 된다. 태양으로부터 나오는 주변 빛과 주위 표면에서 반사되는 빛과 경쟁하여, 디스플레이 장치들은 더 많은 양의 빛을 발생시켜야 하며, 이는 디스플레이 장치 및/또는 백라이트 어셈블리로부터 더 많은 열이 발생되게 한다.

[0004] 또한, 일부 응용 분야에서, 온도는 실온보다 상당히 밑으로 떨어질 수도 있다. 전자 디스플레이 장치가 저온에 노출됨으로써, 일부 부품들이 오작동하거나 영구적으로 손상될 수 있다. 예를 들어, 액정 디스플레이(LCD) 내의 액정 소재의 성능이 저온에 의한 영향을 받을 수 있다.

발명의 내용

해결하려는 과제

[0005] 예시적 실시형태들은 본 명세서에 기재되어 있는 하나 또는 그 이상의 열 제어 피쳐(feature)들을 구비할 수 있다. 복수의 열 제어 피쳐들이 기재되어 있으며, 이들 피쳐들은 개별적으로 사용되거나, 임의로 서로 조합되어 사용될 수 있다. 이들 피쳐들의 특정한 조합은 대상으로 하는 디스플레이 장치의 냉각/가열 수요에 따라 달라질 수 있고, 디스플레이 장치의 종류, 크기 및 특히 사용 환경에 따라 달라질 수 있다. 예시적 실시형태들은 LCD, 발광 다이오드(LED), 유기발광 다이오드(OLED), 전계 방출형 디스플레이(FED), 음극선관(CRT), 플라즈마 및 프로젝션 디스플레이를 포함하는 어떠한 형태의 전자 디스플레이 장치에서 실시될 수 있다. 다만, 이들 디스플레이 장치만으로 한정되는 것은 아니다.

과제의 해결 수단

[0006] 하나의 열 피쳐(thermal feature)는 고립 가스 냉각 시스템에 관한 것이다. 가스 냉각 시스템은 투명 전방판을 포함하는 제1 가스 챔버와 냉각 플레넘을 포함하는 제2 가스 챔버를 포함하여 구성되는 폐쇄형 루프인 것이 바람직하다. 상기 제1 가스 챔버가 앞쪽에 있으며, 전자 디스플레이 장치의 가시 화면과 동연(同延)한다. 상기 투명 전방판은 상기 제1 가스 챔버의 깊이를 획정하는 전자 디스플레이 장치 표면의 앞에 설치될 수 있다. 냉각 챔버 팬 또는 이와 균등한 수단이 냉각 플레넘 앞에 위치하여, 가스가 고립 가스 냉각 챔버 루프 주위를 돌게 하는 데에 사용될 수 있다. 가스가 제1 가스 챔버를 지나감에 따라, 가스는 전자 디스플레이 장치 표면과 접촉하여 그 표면으로부터 열을 흡수하게 된다. 가스와 상기 제1 가스 챔버의 관계된 표면은 투명하기 때문에, 화질은 여전히 탁월한 상태를 유지한다. 가스가 상기 투명 제1 가스 챔버를 통과한 후, 그 가스는 가스가 냉각되는 후방의 냉각 플레넘을 향하게 된다.

[0007] 다른 열적 피쳐는 그 냉각 능력을 대신하거나 그 냉각 능력에 추가하여, 고립 가스 시스템을 가열 장치로서 사용한다. 고립 가스 가열 시스템은 상기 디스플레이 표면의 전방에 있는 제1 가스 챔버와 가열 플레넘 또는 냉각/가열 플레넘을 포함하는 제2 챔버를 구비하는 폐쇄형 루프 시스템일 수 있다. 가열 요소들은 제2 챔버 내의 가

스를 가열하기 위해, 상기 플레넘 안쪽에 배치될 수 있다. 가스가 제1 챔버 내로 강제로 넣어짐에 따라, 가스의 열이 디스플레이 표면으로 전달될 수 있다. 그런 다음, 다른 가열 사이클을 수행하기 위해, 가스는 상기 플레넘으로 복귀한다. 특정 디스플레이 장치와 그 특정 작동 환경에 따라, 상기 플레넘은 냉각 플레넘만으로 또는 가열 플레넘만으로 기능하거나 또는 가열/냉각 플레넘의 조합으로 기능한다.

[0008] 일부 실시형태들은 상기 전자 디스플레이 장치를 작동하는 데에 사용되는 전자 부품들을 상기 고립 가스 챔버의 플레넘 내에 배치시킬 수 있다. 상기 전자 부품들은 변압기, 회로판, 프로세서, 레지스터, 커패시터, 배터리, 모터, 전원 장치, 조명 장치, 배선과 배선 하니스, 및 스위치를 포함할 수 있다. 다만, 이들만으로 한정되는 것은 아니다. 플레넘이 냉각 플레넘으로 사용되는 경우, 상기 플레넘 내의 냉각 가스는 작동 중에 자연적으로 열을 발생시키는 전자 부품들을 냉각시키는 데에 추가로 사용될 수 있다. 또한, 플레넘이 디스플레이 장치용 열원으로 사용되는 경우, 전자 부품들로부터 나오는 자연 열이 플레넘 내의 가스를 가열하여 가열 요소에 공급되어야 하는 에너지 양을 줄여주게 된다.

[0009] 일부 실시형태에서, 전자 디스플레이 장치 위에 가해지는 태양에너지를 추가로 줄이기 위해 선형 편광판(linear polarizer)이 사용될 수 있다. 이 편광판은 고립 가스 챔버와 조합되어 사용되거나, 단순히 그 편광판과 디스플레이 장치 사이에 절연 겹을 구비하는 전자 디스플레이 장치의 전방에 위치하여 사용될 수 있다. 상기 절연 겹은 편광판과 디스플레이 장치 사이에 전달되는 열의 양을 줄여준다.

[0010] 일례로 LCD와 같은 일부 전자 디스플레이 장치들은 디스플레이 표면에 이미지를 형성하기 위해 백라이트 어셈블리를 필요로 한다. 상기 백라이트 어셈블리들은 일반적으로 디스플레이 장치에 있어 대형의 열 발생원이다. 따라서, 일부 실시형태들은 수축 대류 시스템(constricted convection system)을 사용하여 디스플레이 장치를 백라이트 유닛을 냉각한다. 상기 수축 대류 시스템은 상기 백라이트 어셈블리에 근접하게 위치하여 겹을 형성하는 수축 대류판을 포함할 수 있다. 백라이트 어셈블리를 보다 용이하고 효율적으로 냉각하기 위해, 가스가 상기 겹을 통해 강제 유동한다. 일부 실시형태에서, 플레넘의 벽은 수축 대류판을 구성한다.

[0011] 일부 실시형태들은 또한 상기 디스플레이 어셈블리의 외부 표면 위로 공기(찬 공기 또는 더운 공기)를 강제 송풍시키는 에어커튼 장치를 사용할 수 있다.

[0012] 마지막으로, 일부 실시형태들은 디스플레이 표면을 냉각하기 위해 유체가 디스플레이 표면과 접촉하는 유체 어셈블리를 사용할 수도 있다. 유체는 실질적으로 투명한 형태의 냉각 유체로, 유체는 디스플레이 표면에 포함되어 있는 전방 캐비티를 통해 평평된다.

[0013] 아래의 발명의 상세한 설명과 첨부된 도면들을 통해 예시적 실시형태를 보다 잘 이해될 것이다. 도면에서 동일한 도면부호는 동일한 부분을 지칭한다.

발명의 효과

[0014] 본 발명에 의한 전자 디스플레이 장치의 열 제어 장치는 비교적 대형, 고화질의 LCD 디스플레이 장치에 사용될 수 있으며, 또한 태양이 강렬한 속의 환경에 사용되기에 적합할 수도 있으며, 디스플레이 장치의 열적 안정성이 문제가 되는 실내 장치(일례로, 공장 환경, 쿨러/냉동고 등)에 적합할 수도 있다.

도면의 간단한 설명

[0015] 도 1은 예시적 전자 디스플레이 장치와 결합된 예시적 실시형태의 사시도이다.

도 2는 고립 가스 냉각 시스템의 구성부품들을 보여주는, 예시적 실시형태의 분해 사시도이다.

도 3은 상기 냉각 챔버의 예시적 실시형태의 평면도이다.

도 4는 고립 냉각 챔버, 복귀 제1 가스 챔버의 전방면이 투명한 일 실시형태의 전방 사시도이다.

도 5는 플레넘 내에 배치된 선택적인 전자 구성부품들을 보여주는, 고립 냉각 챔버의 일 실시형태의 후방 사시도이다.

도 6은 상기 플레넘에 포함될 수 있는 변 피쳐들을 보여주는, 고립 냉각 챔버의 일 실시형태의 후방 사시도이다.

도 7은 상기 플레넘에 포함될 수 있는 변 피쳐들을 보여주는, 고립 냉각 챔버의 일 실시형태의 평면도이다.

도 8은 열전기 모듈을 포함하는 고립 냉각 챔버의 일 실시형태의 전방 사시도이다.

- 도 9는 열전기 모듈을 포함하는 고립 냉각 챔버의 예시적 실시형태의 평면도이다.
- 도 10은 고립 가스 냉각 시스템의 구성부품들을 보여주는, 예시적 실시형태의 분해 사시도이다.
- 도 11은 가열 챔버의 예시적 실시형태의 평면도이다.
- 도 12는 가열 요소들과 선택적인 전기 구성부품들을 보여주는, 가열 챔버의 일 실시형태의 후방 사시도이다.
- 도 13 및 도 14는 고립 가스 시스템 또는 절연 집을 구비하는 선행 편광관을 사용하는 예시적 실시형태의 단면도이다.
- 도 15a 및 도 15b는 수축 대류관을 구비하는 수축 대류 냉각 시스템의 예시적 실시형태의 측면도이다.
- 도 16은 냉각 플레넘이 수축 대류관으로 사용되는, 예시적 실시형태의 평면도이다.
- 도 17a 내지 도 17c는 냉각 플레넘이 수축 대류관으로 사용되는, 실시형태의 단면도이다.
- 도 18은 에어커튼 장치를 사용하는 디스플레이 장치의 정면도이다.
- 도 19는 에어커튼 장치를 사용하는 디스플레이 장치의 단면도이다.
- 도 20은 액체 냉각 디스플레이 장치용 구성부품들을 보여주는 도면이다.

발명을 실시하기 위한 구체적인 내용

- [0016] 개시된 실시형태들의 기술사상과 범위는 LCD를 포함하는 디스플레이 장치의 열 제어 디스플레이 장치를 포함하지만, LCD만으로 한정되는 것이 아님을 이해해야 한다. 설명을 간단하게 할 목적으로 LCD 디스플레이용 부품과 연계하여 실시형태들을 개시할 것이다. 일례로 실시형태들은 LCD, 발광 다이오드(LED), 유기발광 다이오드(OLED), 전계 방출형 디스플레이(FED), 음극선관(CRT), 플라즈마 및 프로젝션 디스플레이 중에서 선택된 디스플레이 장치와 결합될 수 있다. 다만, 이들만으로 한정하는 것은 아니다. 또한, 실시형태들은 아직 개발되지 않은 유형의 디스플레이 장치에 사용될 수도 있다. 특히, 실시형태들이 완전 칼라, 평면 패널 OLED 디스플레이 장치에 꽤 적합한 것으로 생각될 수 있다. 또한, 실시형태들이 비교적 대형, 고화질의 LCD 디스플레이 장치에 사용될 수 있는 것도 생각할 수 있다. 본 명세서에 개시된 실시형태들이 옥외 환경에 사용되기에 적합할 수도 있는 반면, 실시형태들이 디스플레이 장치의 열적 안정성이 문제가 되는 실내 장치(일례로, 공장 환경, 콜라/냉동고 등)에 적합할 수도 있다.
- [0017] 고립 가스 냉각 시스템(isolated gas cooling system)
- [0018] 도 1에 도시한 바와 같이, 디스플레이 장치(10)가 실외 환경에 노출되어 있는 경우에 냉각 장치를 사용하지 않으면, 디스플레이 장치(10) 내부의 온도는 상당히 변화할 수 있다. 이에 따라, 디스플레이 장치(10)는 제대로 작동하지 않거나, 사용 수명이 상당히 감소하게 된다. 디스플레이 장치(10)의 내부 온도를 증가시키는 요인으로, 태양 직사광이 특히 문제가 된다.
- [0019] 도 1에서, 도시되어 있는 전자 디스플레이 장치의 디스플레이 영역은 좁은 가스 챔버를 포함하는데, 상기 가스 챔버는 전자 디스플레이 장치 표면의 전방에 그리고 디스플레이 장치 표면과 동연(coextensive)되어 있다. 도시된 디스플레이 장치에는 흡전으로 에어커튼 장치(114)가 부착되어 있다. 에어커튼 장치(114)는 아래에서 상세하게 논의된다. 선택적으로, 상기 디스플레이 표면 상에서 태양광의 반사를 줄이기 위해, 상기 디스플레이 장치는 반사 실드(119)를 포함할 수 있다. 추가적으로, 실외 환경에서, 하우징(70)은 태양광을 반사하는 색상인 것이 바람직하다.
- [0020] 도 2에 도시한 바와 같이, 디스플레이 장치(10)의 예시적 실시형태는 디스플레이 하우징(70) 내에 수용되는 고립 가스 냉각 챔버(20)를 포함한다. 스페이서(100)와 투명 전방판(90)에 의해, 투명 제1 가스 챔버가 형성된다. 제2 투명 전방판(130)이 전방판(90)에 라미네이트되어 전방판(90)이 파손되는 것을 방지하고 디스플레이 장치의 내부를 보호할 수 있다. 냉각 챔버(20)는 디스플레이 스택(80)과 이와 연계된 백라이트 어셈블리(140)를 둘러싼다.
- [0021] 디스플레이 장치(10)는 상기 제2 가스 챔버 내에 수용되는 냉각 가스를 위한 수단을 포함할 수 있다. 이 수단은 디스플레이 하우징(70)의 베이스에 위치할 수 있는 하나 또는 그 이상의 팬(60)을 포함할 수 있다. 팬(60)은 차가운 공기를 빨아들이고, 빨아들인 더 차가운 공기를 후방 냉각 플레넘(45)의 적어도 하나의 외부 표면 위로 강제 송풍시킨다. 필요하다면, 플레넘(45)의 외부 표면과 접촉하는 공기를 냉각시키기 위해, 공기조화기(미도시)

- 가 사용될 수도 있다. 선택적으로, 팬(60)은 단순히 주위 공기를 뿜어줄 수 있다.
- [0022] 도 3을 참조하면, 고립 가스 냉각 챔버(20)의 실시형태들은 제1 가스 챔버(30)와 제2 가스 챔버(40)를 포함하는 폐쇄형 루프를 포함할 수 있다. 상기 제1 가스 챔버는 투명판(90)을 포함한다. 상기 제2 가스 챔버는 냉각 플레넘(45)을 포함한다. "고립 가스"(isolated gas)란 용어는 고립 가스 냉각 챔버(20) 내의 가스가 본래 디스플레이 장치의 하우징 내의 외부 공기와 격리(isolation)되어 있다는 것을 의미한다. 제1 가스 챔버(30)가 전자 디스플레이 표면(85)의 전방에 위치하기 때문에, 가스에는 디스플레이 화질에 악 영향을 줄 수 있는, 먼지 또는 다른 오염물질이 실질적으로 없어야 한다. 오염을 방지하고 먼지가 제1 가스 챔버(30) 내로 들어오는 것을 방지하기 위해, 선택적 필터(바도시)가 사용될 수 있다.
- [0023] 상기 고립 가스는 거의 투명한 가스로, 그 예로는 보통의 공기, 질소, 헬륨 또는 기타의 다른 투명 가스가 있다. 상기 가스는 화질에 영향을 주지 않도록 무색인 것이 바람직하다. 또한, 고립 가스 냉각 챔버(20)는 외부 공기에 대해 반드시 긴밀하게 밀봉될 필요는 없다. 챔버 내의 가스는 먼지와 오염물질들이 실질적으로 제1 가스 챔버 내로 유입되는 것이 실질적으로 방지될 수 있을 정도로 격리되는 것만으로 충분하다.
- [0024] 도 3에 도시된 폐쇄형 루프 장치에서, 제1 가스 챔버(30)는 제2 가스 챔버(40)와 가스 연통하고 있다. 냉각 플레넘(45) 내에 냉각 챔버 팬(50)이 제공되어서 고립 가스 냉각 챔버(20) 주위로 가스를 추진시키는 데 사용될 수 있다. 제1 가스 챔버(30)는 전자 디스플레이 표면(85)의 전방에 장착되어 있는 적어도 하나의 전방 유리(90)를 포함한다.
- [0025] 도 4를 참조하면, 전방판(90)은 이격 부재(spacing member)(100)에 의해 전자 디스플레이 표면(85)으로부터 앞쪽으로 나와 있다. 이격 부재(100)는 전자 디스플레이 표면(85)의 전방을 통과하는 협록 채널의 깊이를 정의한다. 이격 부재(100)는 장치의 다른 구성부품들과 독립된 별개의 부재일 수 있고, 선택적으로는 이들 부품들과 일체로 통합 구성될 수도 있다(일체로 전방판(90)과 일체로 구성). 전자 디스플레이 표면(85), 이격 부재(100) 및 투명 전방판(90)은 제1 가스 챔버(30)를 형성한다. 챔버(30)는 인입 개구(110)와 인출 개구(120)를 통해 플레넘(45)과 가스 연통하고 있다.
- [0026] 도 3에 도시되어 있는 바와 같이, 제1 가스 챔버(30)의 후방면은 디스플레이 스택(80)의 전자 디스플레이 표면(85)을 포함하는 것이 바람직하다. 제1 가스 챔버(30) 내의 고립 가스가 디스플레이 장치를 지나감에 따라, 고립 가스는 전자 디스플레이 표면(85)과 접촉한다. 냉각 가스가 전자 디스플레이 표면(85)과 직접 접촉함으로써, 전자 디스플레이 표면(85)으로부터 대류 열전달 방출이 향상된다. 예시적 실시형태에서, 전자 디스플레이 표면(85)은 제1 가스 챔버(30)의 후방면을 포함한다. 이에 따라, "전자 디스플레이 표면"(electronic display surface)이란 용어는 (본 명세서에 기재된 실시형태에는 없는) 일반적인 전자 디스플레이 장치의 전방 표면을 의미하는 것이다.
- [0027] 예시적 실시형태에서, 전자 디스플레이 표면(85), 전방판(90) 및 선택적 제2 전방판(130)은 유리 기판으로 구성될 수 있다. 그러나, 전자 디스플레이 표면(85), 투명 전방판(90), 선택적 제2 전방판(130)이 반드시 유리일 필요는 없다. 따라서 본 명세서에서, "유리"(glass)란 용어는 판(plate)이란 용어로 혼용될 수도 있으며, 유리 소재만이 필요한 것은 아니다. 또한, 전자 디스플레이 표면(85)이 반드시 전방 가스 격실(30)의 전방면 벽을 포함할 필요는 없다. 추가의 판이 사용될 수도 있다. 그러나, 가스 격실(30)의 후방면 벽으로 전자 디스플레이 표면(85)을 사용함으로써, 디스플레이 장치를 관통하는 가시광이 더 작은 면과 충돌할 수 있다. 또한, 장치가 더 경량화되며 제조 비용이 낮아질 수 있다.
- [0028] 도시된 실시형태들이 전자 디스플레이 표면(85)을 사용하고 있지만, 장치의 광학 성능을 향상시키거나 가스 냉각제를 수용하기 위해, 어느 변형물 및/또는 코팅(일체로, 반사 방지 코팅)이 전자 디스플레이 표면(85)에 또는 본 시스템의 다른 구성부품들에 부가될 수 있다. 도시된 실시형태에서, 전자 디스플레이 표면(85)은 액정 디스플레이(LCD) 스택의 전방 유리판일 수 있다. 그러나, 본 냉각 시스템의 실시형태들에 적합한 임의의 다른 디스플레이 표면일 수도 있다. 필수적인 것은 아니지만, 전자 디스플레이 표면(85)과 접촉하도록 제1 가스 챔버(30) 내에 냉각 가스를 흐르게 하는 것이 바람직하다. 이러한 방식으로, 디스플레이 부품으로부터 순환하는 가스로의 대류 열전달이 극대화될 수 있다.
- [0029] 도 4를 참조하면, 제1 가스 챔버(30)의 전방판(90)은 투명하고, 전자 디스플레이 표면(85)의 앞쪽에 위치하고 있다. 도시되어 있는 화살표는 제1 가스 챔버(30)를 통한 고립 가스의 이동방향을 나타낸다. 도시되어 있는 바와 같이, 고립 가스는 제1 가스 챔버(30) 내에서 수평방향으로 이동한다. 가스가 수평방향 또는 수직방향 중 어느 한 방향으로 이동하는 것으로 냉각 시스템(20)이 구성될 수 있지만, 수평방향으로 추진시키는 것이 바람직하다.

- 다. 이러한 방식으로, 먼지 또는 오염물들이 제1 가스 챔버(30)로 유입되는 경우, 먼지 또는 오염물들은 디스플레이 장치의 가시 영역의 외부로 챔버(30)의 바닥으로 떨어지게 된다. 본 시스템은 공기를 좌측에서 우측으로, 또는 선택적으로는 우측에서 좌측으로 이동시킬 수 있다. 가스가 제1 가스 챔버(30)를 지나간 후, 가스는 인출 개구(120)를 통해 빠져나간다. 인출 개구(120)는 후방 냉각 플레넘(45)에 대해서는 일구부를 형성한다.
- [0030] 도 5는 후방 냉각 플레넘(설명을 위해 부명하게 도시)을 개략적으로 도시하고 있다. 플레넘 내의 하나 또는 그 이상의 팬(50)은 고립 가스가 고립 가스 냉각 챔버를 관통하는 데에 필요한 힘을 제공한다. 제1 가스 챔버(30)는 디스플레이 장치의 전자 디스플레이 표면(85)으로부터 열을 수집하도록 설계되는 반면, 제2 가스 챔버(40)는 가스로부터 열을 추출하여 상기 냉각 챔버(20)로부터 열을 제거하도록 설계된다. 제2 가스 챔버(40)는 주어진 전자 디스플레이 장치 내에서 내부 구조물들을 수용하기 위한 다양한 윤곽과 피쳐들을 구비할 수 있다.
- [0031] 필요하다면, 제2 가스 챔버(40) 전체의 어느 곳에도 다양한 전자 부품들(200)이 배치될 수 있다. 전자 부품들(200)은 변압기, 회로판, 프로세서, 레지스터, 커패시터, 배터리, 모터, 전원 장치, 조명 장치, 배선과 배선 하니스, 및 스위치를 포함할 수 있지만, 이들만으로 한정되는 것은 아니다. 이들 부품들은 챔버의 벽 위에 직접 장착될 수도 있고, 막대 또는 포스트(209) 상에 지지될 수도 있다. 이에 따라, 냉각 플레넘은 제1 가스 챔버(30)로부터 열을 빼앗으면서도 이들 각종 전자 부품들(200)을 냉각시키도록 설계될 수 있다(추가적으로 아래에서 논의하고 있는 바와 같이, 고립 가스 시스템이 디스플레이 장치를 가열하는 데에 사용되는 경우, 전자 부품들은 고립 가스의 가열을 조장할 수 있음).
- [0032] 도 6 및 도 7을 참조하면, 플레넘(45)으로부터의 열 방출을 개선하기 위해, 다양한 면 피쳐들(150)이 추가될 수 있다. 이들 면 피쳐들(150)은 큰 표면적을 형성하여, 제2 가스 챔버(40) 내의 가스로부터 열을 방출시키도록 한다. 이들 피쳐들(150)은 플레넘(45) 표면 위의 많은 지점에 위치할 수 있다.
- [0033] 도 8 및 도 9를 참조하면, 제2 가스 챔버(40) 내에 포함되어 있는 가스를 추가로 냉각하기 위해, 적어도 하나의 플레넘(45) 표면 위에 하나 또는 그 이상의 열전기 모듈(160)이 위치할 수 있다. 열전기 모듈(160)은 면 피쳐들(150)과 독립하여 또는 면 피쳐들과 결합하여 사용될 수 있다. 선택적으로, 추운 환경에서 고립 가스 시스템이 디스플레이 장치를 가열하는 데에 사용되는 경우, 열전기 모듈(160)은 플레넘 내에서 가스를 가열하는 데에 사용될 수 있다.
- [0034] 도 10은 후방 플레넘(45)에 포함되어 있는 가스에서 열을 제거하는 예시적 방법을 나타낸다. 공기를 빨아들이고, 그 공기를 플레넘(45)의 전방면과 후방면으로 끌어넣기 위해 팬(60)이 위치할 수 있다. 팬(60)은 공기 조화된 공기를 디스플레이 장치 하우징(70) 내로 빨아들이거나 단순히 주워 공기를 빨아들일 수 있다. 또한, 본 장치에서, 팬(60)은 공기가 전자 디스플레이 장치의 열 발생 부품(일례로, 디스플레이 스택(80)과 백라이트 어셈블리(140))를 강제로 통과하도록 하여 디스플레이 장치 전체의 냉각 능력을 추가로 개선할 수 있다. 본 실시형태는 아래에서 상세하게 논의되는 수축 대류 냉각 방법과 조합될 수 있음에 주목해야 한다. 가열된 배기 공기는 디스플레이 하우징(70) 상에 위치하는 하나 또는 그 이상의 작은구멍(aperture)(179)을 통해 빠져나갈 수 있다.
- [0035] 고립 가스 가열 시스템(isolated gas heating system)
- [0036] 전술한 바와 같이, 고립 가스 시스템은 전자 디스플레이 장치를 가열하는 데에도 사용될 수 있다. 도 11 및 도 12를 참조하면, 가열 요소들(220)이 제2 가스 챔버(40) 내에 위치할 수 있으며, 가스가 제2 가스 챔버(40)를 통과할 때에 가스를 대우도록 작동한다. 이들 가열 요소들은 관용될 수 있는 많은 가열 요소들 또는 열전기 모듈들 중 어느 하나일 수 있다. 여러 번, 이들 요소들은 단순히 전기 저항이 큰 소재일 수 있으며, 이에 따라 전류가 이들 요소들을 흐를 때에 열을 발생하게 된다. 가열 요소들은 다음의 요소들 중 어느 하나일 수 있지만, 이들만으로 한정되는 것은 아니다: 니크롬 와이어 또는 리본, 세라믹 절연 금속(일반적으로 강) 플레이트 상에 적층된 스크린 프린트 금속/세라믹 트랙, CalRod(일반적으로 터프 금속 셀 내에 세라믹 막안드가 밀봉되어 있는 니크롬 미세 코일), 히트 램프 및 저항 세라믹 PTC(positive thermal coefficient).
- [0037] 전술한 바와 같이, 플레넘(45)은 전자 디스플레이 장치에 전원을 공급하고 제어하는 전기 부품들(200)을 포함할 수 있다. 상기 전기 부품들은 변압기, 마이크로프로세서, 인쇄회로기판, 전원장치, 레지스터, 모터, 와이어 하니스 및 커패시터들 중 어느 하나일 수 있다. 전기 부품들(200)용 전기 연결은 플레넘(45) 벽을 관통할 수 있다. 상기 전기 부품들(200)은 플레넘(45) 내의 어느 곳에도 위치할 수 있다. 전기 부품들(200)은 상기 플레넘의 전방면 또는 후방면 상에 장착될 수 있고, 플레넘 표면 위에 바로 장착되거나 마운팅 포스트에 의해 현가되어 가스가 상기 부품의 모든 불레부위를 지나갈 수 있게 할 수도 있다.

- [0038] 디스플레이 장치가 작동하는 동안, 고립 가스 냉각 시스템이 연속적으로 작동할 수 있다. 그러나, 필요하다면, 온도 센서(미도시)와 스위치(미도시)가 전자 디스플레이 장치 내에 통합될 수 있다. 이에 따라, 온도가 사전에 결정된 문턱값에 도달했는지를 감지하고, 디스플레이 장치 내의 온도가 사전에 결정된 온도에 도달한 경우에 고립 가스 시스템이 선택적으로 작동하도록, 서모스탯(thermostat)이 사용될 수 있다. 사전에 미리 결정된 문턱 온도(threshold temperature)가 선택되고, 고립 가스 시스템이 디스플레이 장치를 가열, 냉각 또는 가열과 냉각 모두를 수행하도록 구성되는 것이 디스플레이 장치를 용인할 수 있는 온도 범위 내에서 유지하는 데에 유리하다.
- [0039] 선택적 절연체 겹을 구비한 선형 편광판(linear polarizer with optional insulator gap)
- [0040] 도 13은 다른 열 제어 피치를 위한 다른 예시적 실시형태의 단면도이다. 도시된 장치에서, 전방판(90)과 제2 전방판(130)은 유리로 이루어질 수 있으며, 서로 라미네이트되어 있다. 제1 및 제2 전방 패널(90, 130)은 인덱스 정합형 광학 접착제(201) 층에 의해 서로가 고정되어 전방 글라스 유닛(206)을 형성할 수 있다. 디스플레이 스택(80)은 전방 편광판(216)과 후방 편광판(214) 사이에 개재되어 있는 액정 어셈블리(212)를 포함할 수 있다. 다른 실시형태에서, 상기 디스플레이 스택(80)은 다른 유형의 전자 디스플레이 장치용의 다른 종류의 어셈블리일 수 있다. 디스플레이 스택(80)과 전방 글라스 유닛(206) 사이의 공간은 절연체 겹(300)을 확장한다. 상기 절연체 겹(300)은 상기 LCD 스택(80)과 상기 전방 글라스 유닛(206)을 열 격리시킨다. 이러한 열 격리는 태양광이 LCD 스택에 부하를 가하기보다는 열이 전방 글라스 유닛 위로만 국한되도록 한다. 고립 가스 시스템과 조합하여 사용되는 경우, 상기 절연체 겹(300)은 제1 가스 챔버(30)를 포함할 수 있다. 다른 실시형태에서, 절연체 겹(300)은 고립 가스 시스템을 사용하지 않으면서 단순히 태양광 부하와 주위 공기 모두로부터 절연시키는 절연층으로 사용될 수 있다.
- [0041] 제2 전방 패널은 제1 표면(202)과 제2 표면(208)을 구비할 수 있다. 상기 제1 표면(202)은 요소들에 노출될 수 있는 반면, 제2 표면(208)은 상기 인덱스 정합형 광학 접착제(201)에 의해 제1 전방판(90)에 고정될 수 있다. 상기 제1 전방판(90)은 제3 표면(209)과 제4 표면(204)을 구비할 수 있다. 제3 표면(209)은 상기 인덱스 정합형 광학 접착제(201)에 의해 제2 전방판(130)에 고정될 수 있는 반면, 제4 표면은 절연체 겹(300)에 직접적으로 인접할 수 있다. 일부 실시형태에서, 디스플레이 스택(80)에 대한 태양광 부하를 줄이고 영상 화질을 개선하기 위해, 상기 제1 표면(202)과 제4 표면(204) 위에 반사방지 코팅이 부착될 수 있다. 다른 실시형태에서, 반사방지 코팅은 상기 제1, 제2, 제3 또는 제4 표면(202, 208, 209, 204)들 중 적어도 어느 하나의 표면에만 부착될 수도 있다.
- [0042] 도 14는 전방 글라스 유닛(206)의 다른 예시적 실시형태의 단면도이다. 도시된 장치에서, 전방 글라스 유닛(206)은 제2 전방판(130), 인덱스 정합형 광학 접착제 층(201), 선형 편광판(400) 및 제1 전방판(90)을 포함한다. 상기 선형 편광판(400)은 적어도 하나의 제1, 제2, 제3 또는 제4 표면(202, 208, 209, 204) 각각에 접촉될 수 있다. 반사방지 층들이 적어도 하나의 제1, 제2, 제3 또는 제4 표면(202, 208, 209, 204) 각각에 부착될 수 있다. 전방 글라스 유닛(206)에 선형 편광판(400)을 포함시키면, 디스플레이 스택(80)에 대한 태양광 부하를 추가로 줄일 수 있다. 태양광 부하의 감소는 전자 디스플레이 장치 내부 온도를 상당히 감소시킬 수 있다. 선형 편광판(300)은 또한 전방 글라스 유닛(206)과 디스플레이 스택(80)의 기온 반사도 감소시킬 수 있다. 전술한 바와 같이, 고립 가스 시스템과 조합하여 사용되는 경우, 절연체 겹(300)은 제1 가스 챔버(30)를 포함할 수 있다. 다른 실시형태에서, 절연체 겹(300)은 상기 고립 가스 시스템을 사용하지 않고 단순히 태양광 부하와 주위 공기 모두로부터 격리시키는 절연층으로 사용될 수 있다. 상기 디스플레이 스택(80)은 LCD 스택일 수 있고, 또한 디스플레이 스택(80)은 다른 유형의 전자 디스플레이 장치일 수도 있다는 점을 인지해야 한다.
- [0043] 또한 제2 전방판(130)이 사용되지 않을 수도 있다는 점을 인식해야 한다. 실시형태들은 전방판(90)의 전방면 또는 후방면에 선형 편광판이 부착되어 있는 제1 전방판(90)만을 사용할 수도 있다. 반사방지 층이 상기 전방판(90)의 전방면 또는 후방면에 부착될 수도 있다. 제2 전방판(130)없이 전방판(90)만을 사용하는 경우, 강도를 추가로 증가시키기 위해 전방판(90)을 템퍼링할 수 있다.
- [0044] 수축 대류(constricted convection)
- [0045] 가시 스크린 상에 화상을 형성하기 위해, 일부 종류의 전자 디스플레이 장치는 백라이트 어셈블리를 필요로 한다. LCD는 백라이트 어셈블리를 필요로 하는 디스플레이 장치 중의 하나이다. 플라스마 디스플레이 및 OLED와 같은 다른 유형의 디스플레이 장치는 이들 자체가 발광하기 때문에, 백라이트 어셈블리를 필요로 하지 않는다. 그러나, 이러한 종류의 디스플레이 장치는 여전히 상당한 양의 열을 발생한다. 따라서, 전술한 사항에서, 백라이트 어셈블리와 관련하여 수축 대류 시스템을 기재하지만, 상기 실시형태들이 다른 종류의 디스플레이 장치에

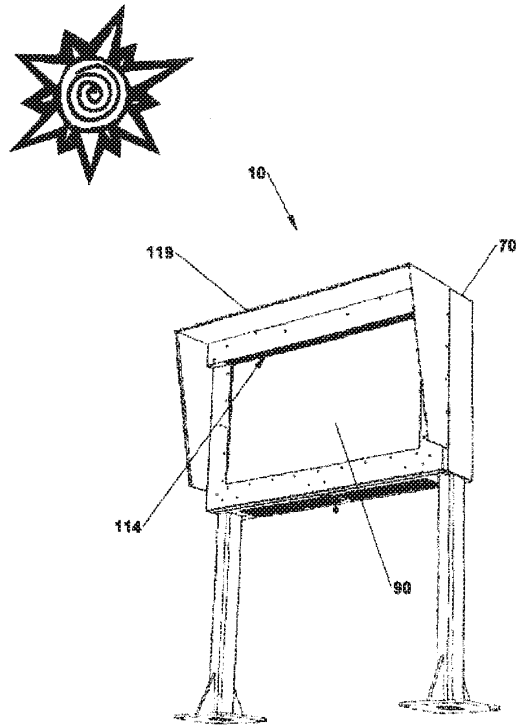
- 서도 사용될 수 있다는 점을 인식해야 한다. 따라서, 백라이트 또는 백라이트 어셈블리에 대해 논의할 때, 이들 어셈블리들은 다른 열-발생 디스플레이 장치의 후방면일 수도 있고, 상기 수축 대류 시스템은 이들 다른 디스플레이 장치를 보다 효율적으로 냉각시킬 수도 있다. 도 15a 및 도 15b와 도 17a 내지 도 17c는 축척에 맞추어 도시된 것이 아님을 알아야 한다. 요소들 간의 관계는 설명의 목적으로 과장되어 있을 수 있다.
- [0046] 도 15a는 수축 대류관(300)과 백라이트(140)의 단면도로, 이들 물체들 사이의 공간은 좁은 갭(305)을 형성한다. 상기 갭의 크기는 디스플레이 장치의 크기, 디스플레이 장치의 작동 조건, 백라이트 어셈블리와 그 후방면 소재의 종류, 및 다양한 수축 대류 팬의 수량과 어들에 공급되는 전력량을 포함하는 여러 요인들에 따라 변할 수 있다. 일부 예시적 실시형태들은 약 0.25-3.5 인치의 갭 거리를 사용할 수 있다. 다른 실시형태들은 이보다 좀 더 큰 갭을 사용할 수 있다. 상기 갭(305)을 통한 공기의 강제 송풍은 백라이트(140)의 냉각 능력을 증가시킨다는 것을 알 수 있었다. 상기 갭(305)을 통해 공기를 빨아들이기 위해 하나 또는 그 이상의 수축 대류 팬(310)이 사용될 수 있다. 도 15b는 상기 갭(305)을 통해 공기를 밀어 넣기 위해 하나 또는 그 이상의 수축 대류 팬(310)이 사용되는 수축 대류 시스템에 대한 다른 실시형태의 단면도이다.
- [0047] 도 16은 전술한 코립 가스 시스템의 평면도이다. 상기 코립 가스 시스템을 관통하는 단면라인 17-17'이 도시되어 있다.
- [0048] 도 17a 내지 도 17c는 도 16에 도시되어 있는 17-17' 부분의 단면을 도시한다. 먼저 도 17a를 참조하면, 전자 디스플레이 장치(80)와 연결하고 있는 제1 가스 챔버(30)가 디스플레이 장치의 전방을 향하고 있다. 상기 제1 가스 챔버(30)의 앞쪽에는 전방판(90)이 있다. 디스플레이 장치의 후방부에서, 백라이트(140)가 제2 가스 챔버(40)와 근접하게 배치되어 있다. 본 장치에서, 제2 가스 챔버(40)의 외벽은 수축 대류관으로 기능한다. 본 실시형태는 수축 대류 팬을 사용하지 않는 대신에 상기 디스플레이 장치 하우징의 외부로부터 공기를 빨아들여 그 공기를 제2 가스 챔버(40)의 표면으로 강제 송풍시키는 팬(60)을 사용하고 있다. 전술한 바와 같이, 이 공기는 단순히 주위 공기이거나 선택적으로는 공기조화 장치(미도시)에서 나온 공기일 수 있다. 백라이트(140)와 냉각 챔버(40) 사이에서의 공기 흐름을 용이하게 하기 위해, 가이드 장치(320)가 사용될 수 있다.
- [0049] 도 17b를 참조하면, 냉각 챔버(40)는 가이드 피쳐(41)를 포함한다. 가이드 피쳐(41)는 상기 가이드 장치(320)와 함께 조합되어 백라이트와 냉각 챔버 사이에서의 공기 흐름을 용이하게 한다. 도 17c는 외부 팬(60)과 수축 대류 팬(310) 모두가 사용되는 선택적 실시형태를 나타낸다. 이 실시형태는 또한 도 17a 및 도 17b에 도시된 가이드 장치들을 사용할 수도 있다.
- [0050] 백라이트(140)는 전자 디스플레이 장치(80)와 대면하는 사이드에 장착되는 복수의 라이트를 구비한 인쇄회로기판(PCB)을 포함할 수 있다. 상기 백라이트 내의 상기 라이트들은 LED, 유기발광 다이오드(OLED), 전계 방출형 디스플레이(FED), 발광 폴리머(LEP: light emitting polymer) 또는 유기 전계 발광(OEL) 라이트 중 어느 하나일 수 있다. 예시적 실시형태에서, 백라이트(140)는 전자 디스플레이 장치(80)와 대면하는 사이드의 제2 가스 챔버와 대면하는 사이드 사이의 열 저항이 작은 것이 이상적이다. 이와 같이 낮은 레벨의 열 저항을 달성하기 위해, 금속 인쇄회로기판(PCB) 기술로 백라이트(140)를 구성하여 상기 라이트들로부터 더 많은 열을 방출시킬 수 있다. 대류 열전달 특성을 추가로 향상시키기 위해, 백라이트(140)의 후방면은 금속 또는 다른 열전도성 소재일 수 있다. 상기 표면은 대류 열전달 특성을 추가로 개선하기 위해 핀(fin)과 같은 복수의 표면 피쳐들을 구비할 수 있다. 수축 대류 팬(310)은 더운 공기를 배출구(179)(도 2에 도시)를 통해 내보냄으로써 공기가 디스플레이 장치를 완전히 빠져나가게 된다.
- [0051] 디스플레이 장치가 작동하는 중에, 외부 팬(60)과 수축 대류 팬(310)도 연속적으로 작동할 수 있다. 그러나, 원하는 경우, 온도 센서(미도시)와 스위치(미도시)가 전자 디스플레이 장치 내에 통합되어 있을 수 있다. 온도가 사전에 결정된 문턱값에 도달했는지를 감지하기 위해 효과적인 서모스탯이 사용될 수 있다. 이러한 경우, 디스플레이 장치 내의 온도가 사전에 결정된 값에 도달했을 때에, 여러 팬들이 선택적으로 작동할 수 있다. 디스플레이 장치가 용인가능한 온도 영역 내에 유지되도록 하기 위해, 문턱값이 사전에 선택되고, 시스템은 서모스탯(미도시)을 구비하여 구성되는 것이 유리하다. 이는 장치의 사용 수명에 유용할 뿐만 아니라, 에너지 비용도 절감시킨다.
- [0052] 에어 커튼(air curtain)
- [0053] 전술한 다양한 열 조절 피쳐들 외에도, 에어 커튼이 사용될 수도 있다. 에어 커튼 장치는 장치 단독으로 사용되거나, 전술한 다른 임의의 열 제어 피쳐들과 조합하여 사용될 수 있다.
- [0054] 도 18은 하우징(70)과 전방판(90)을 구비하는 전자 디스플레이 장치(10)를 도시한다. 에어 커튼용 에어 배플

- (air baffle)(114)이 상기 도면에서 파선으로 도시되어 있다. 단면 라인 19-19도 도시되어 있다.
- [0055] 도 19는 도 18에 도시되어 있는 라인 19-19를 따르는 단면도이다. 이 도면은 팬(60)이 기동할 때 이루어지는 하우징(70)을 통한 공기의 순환을 보여주고 있다. 전술한 바와 같이, 팬(60)은 인입구(51)를 통해 공기를 하우징(70) 내로 빨아들인다. 이 공기는 주위 공기일 수 있으며, 선택적으로는 공기 조화된 공기일 수 있다. 빨아들여진 공기의 유동 방향이 화살표 121로 표시되어 있다. 상기 디스플레이 하우징(70) 내에서, 공기는 화살표(121)를 따라 위쪽으로 유동한다. 이 공기는 전술한 열 제어 피쳐들 중 어느 하나와 함께 사용될 수 있다. 일례로, 공기는 제2 챔버(플래닛) 내의 고압 가스를 냉각하는 데에 사용되거나 전술한 수축 대류 시스템에서 사용될 수도 있다.
- [0056] 설명의 목적으로, 디스플레이 장치의 내부 부품들에 대한 상세한 사항은 도면에 기재하지 않았으며, 단지 캐비티(61)만을 도시하였다. 에어 커튼이 다른 어떠한 유형의 전자 디스플레이 장치에서 실시될 수 있으며, 전술한 열 제어 피쳐들과 조합되어도 실시될 수 있다는 점을 주목해야 한다. 공기가 배플(114)을 향해 흐르도록 하기 위해, 캐비티(61) 내에 여러 내부 피쳐들(비도시)이 배치될 수 있다. 빨아들여진 공기는 화살표(121)를 따라 캐비티(61)를 관통해 연속 유동해서 배플(114)에 도달한다. 배플(114)은 공기를 디스플레이 장치의 외부면 쪽으로 지향시킨다. 이 외부면은 제1 전방판(90)일 수 있으며, 선택적으로는 위에서 상술한 추가적인 전방판(일례로 제2 전방판(130))일 수 있다.
- [0057] 이에 따라, 에어 커튼은 디스플레이 장치의 내부 부품들을 냉각하기 위한 배출구로 사용될 수 있다. 선택적으로, 에어 커튼으로부터 나오는 차가운 공기는 상당한 태양광 부하를 받거나 또는 주위의 뜨거운 공기로부터 열을 전달받는 디스플레이 장치의 외부 전방면을 추가로 식히는 데에 사용될 수 있다.
- [0058] 유체 냉각 시스템(fluid cooling system)
- [0059] 도 20은 다른 열 제어 피쳐를 설명하는 예시적 개략도이다. 도면으로부터 이해할 수 있는 바와 같이, 냉각 시스템(22)은 유체 연통하는 여러 부품들을 포함한다. 바람직하기로는, 유체 연통은 부품들을 일련의 튜브들 또는 파이프들(개념적으로 설명하기 위해 점선으로 표시)로 연결함으로써 달성된다. 냉각 시스템(22) 부품들은 유체 연통하는 저장 탱크(37), 펌프(47) 및 냉각 챔버(4)를 포함한다. 바람직하기로는, 상기 시스템은 역시 유체 연통하는 필터(83)와 라디에이터(72)도 포함한다. 선택적으로, 상기 시스템은 팬 유닛(94)을 포함한다. 그러나, 선택적 팬 유닛은 다른 부품들과는 유체 연통하지 않는 것이 바람직하다.
- [0060] 저장 탱크(37)는 냉각 유체의 대부분의 양을 보유하며, 냉각 유체가 탱크(37) 내에 저장되어 있는 동안에 유체로부터 열 방출을 수행하는 표면을 제공한다. 상기 탱크는 출구포트(3)와 복귀포트(14)의 적어도 2개의 개구부를 구비한다. 선택적으로, 저장 탱크는 환기포트(66)를 포함한다. 펌프(47)는 냉각 유체가 시스템(22)을 관통해서 이동하도록 한다. 통상의 기술자라면 이해할 수 있는 바와 같이, 펌프(47)는 적당한 성과를 얻기 위해 냉각 유체 동로를 따라 복수의 지점에 위치할 수 있다. 그러나 플레이트들(44, 128)의 곡률을 최소화하기 위해서는, 냉각 챔버(4) 뒤에 펌프(47)를 배치하여, 펌프가 냉각 챔버(4)의 바닥에서 상부로 액상 냉각제를 끌어올리도록 하는 것이 바람직하다. 펌프가 이와 같이 배치되면 상기 펌프는 냉각 챔버(4)의 상부에 저가압 영역을 생성할 수 있다. 이러한 방식으로, 유체는 화살표를 따라 냉각 챔버(4)를 통해 유동한다. 일부 냉각 유체들은 "슬리퍼 점성"(slipperiness)이 있기 때문에, 펌프(47)는 용적식 펌프(positive displacement pump)인 것이 바람직하다.
- [0061] 냉각 챔버를 통과하는 냉각 유체의 유량을 조절하기 위해, 밸브(634)를 구비하는 바이패스 라인이 제공될 수 있다. 상기 바이패스 라인은 냉각 유체가 냉각 챔버(4)를 우회하도록 하는 우회루트를 제공한다. 밸브(634)는 바이패스 라인을 통과하여 우회하는 냉각 유체의 양을 용이하게 조절할 수 있다. 바이패스 라인과 밸브(634)는 냉각 챔버(4)를 향해 유동하는 유체로부터 사전에 결정된 양의 냉각 유체가 우회하도록 하여 냉각 챔버 자체를 관통하는 유량을 용이하게 조절할 수 있게 된다. 이러한 방식으로, 냉각 챔버를 통과하는 유량이 조절된다.
- [0062] 통상의 기술자라면 냉각 챔버를 통과하는 유동을 조절하기 위해 다른 방법 및 장치들이 사용될 수 있다는 점을 이해할 수 있을 것이다. 일례로, 펌프(47)의 크기와 펌프 속도는 주어진 환경에 따라 최적화될 수 있다. 선택적으로, 가변 속도 펌프가 사용될 수도 있다. 바람직하기로는, 가변 속도 펌프는 적어도 하나의 압력 트랜스듀서(비도시)와 전기적으로 연동되어 있다. 바람직하기로는, 압력 트랜스듀서는 냉각 챔버(4)의 상류부에 위치할 수 있고, 다른 압력 트랜스듀서는 냉각 챔버(4)의 하류부에 위치할 수 있다. 상기 적어도 하나의 압력 트랜스듀서에 의해 제공되는 압력 정보는 가변 속도 펌프의 작동 속도를 설정하는 데에 사용될 수 있다. 이러한 방식에 따라, 냉각 챔버(4)를 통과하는 유량이 조절되어, 장치 내에서 적절한 압력이 유지될 수 있다. 냉각 챔버(4) 내에

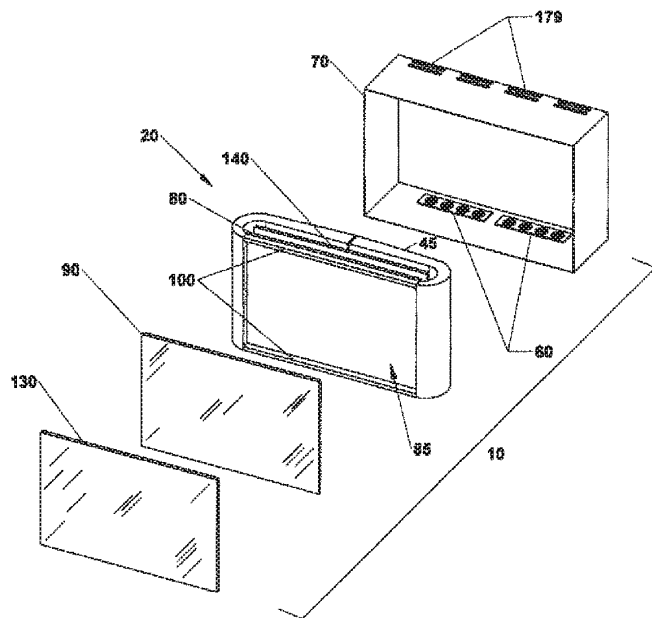
- 서 적절한 압력을 유지하는 것은 디스플레이 글라스의 변형이나 파손을 방지하는 데에 중요하다.
- [0063] 유체 내의 오염물질을 제거하기 위해 선택적 필터(83)가 추가될 수 있다. 바람직하기로는, 보다 큰 열적 안정성을 제공하기 위해 라디에이터(72)와 펌 유닛(94)이 포함될 수도 있다. 선택적으로, 시스템에 냉각 유체를 채우고 시스템에서 냉각 유체를 바꾸는 작업을 용이하게 하기 위해 수도꼭지(spigot)(미도시)가 제공될 수 있다.
- [0064] 작동하는 중에, 유체는 저장 탱크(37)의 아래쪽에 위치하는 출구포트(13)를 통해 저장 탱크(36)를 빠져나간다. 냉각 챔버(4)로 가는 중에, 유체는 선택적 필터(83)를 지나간다. 필터(83)로부터 나온 유체는 매니폴드(59)의 인입구(98)를 통해 다시 냉각 챔버(4)로 들어간다. 냉각 유체는 점선으로 표시된 방향을 따라 냉각 챔버(4)의 유체 격실을 통해 이동한다. 냉각 유체는 상부 매니폴드(60)의 유출구(99)를 통해 냉각 챔버(4)를 빠져나간다. 바람직하기로는, 유체는 선택적 라디에이터(72)에 의해 인입된다. 선택적 라디에이터(72)를 통해 이동하는 중에, 냉각 유체로부터 열을 빼앗는 것을 보조하기 위해, 선택적 펌 유닛(94)이 유체가 라디에이터(72)를 통과하도록 강제한다. 라디에이터(72) 뒤쪽에 위치할 수 있는 펌프(72)가 저장 탱크를 향해 유체를 빨아들인다. 유체는 복귀포트(14)를 통해 저장 탱크(37) 내로 들어간다. 바람직하기로는, 복귀하는 유체가 출구포트(13)를 통해 저장 탱크(37)를 빠져나가기 전에 커다랗게 냉각될 수 있도록 하기 위해, 복귀포트(14)는 출구포트(13)와 상당히 떨어진 곳에 위치할 수 있다.
- [0065] 필요에 따라, 펌 유닛이 디스플레이 장치(15)의 냉각 챔버(4) 바로 위의 하우징(75)의 베이스에 위치할 수 있다. 펌 유닛은 공기 종류가 하우징(75)의 내부를 통과하도록 할 수 있다. 바람직하기로는, 공기유동은 저장 탱크(37)의 적어도 하나의 외부 표면 위로 지향될 수 있다. 전술한 바와 같이, 배기되는 공기 유동은 궁극적으로는 선택적 에어 커튼 시스템(114)에 의해 냉각 챔버 표면(44) 위로 다시 보내질 수 있다.
- [0066] 필요하다면, 온도 센서(미도시)와 스위치(미도시)가 전자 디스플레이 장치 내에 통합될 수 있다. 온도가 사전에 결정된 문턱값에 도달했는지를 감지하기 위해 온도 센서가 사용될 수 있다. 이러한 경우, 디스플레이 장치 내의 온도가 사전에 결정된 온도에 도달한 때에 펌프가 선택적으로 작동될 수 있다. 디스플레이 장치가 비교적 일정한 온도로 유지하거나 적어도 용인할 수 있는 온도 범위 내에서 유지하도록 하기 위해, 소정의 문턱 온도가 사전에 선택되고, 시스템은 서모스탯(미도시)과 함께 구성되는 것이 유리하다. 선택적으로, 서모스탯을 사용하지 않기 위해, 전자 디스플레이 장치가 작동하는 중에 펌프(47)가 연속적으로 작동할 수 있다.

도면

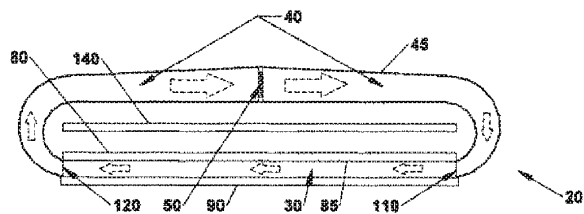
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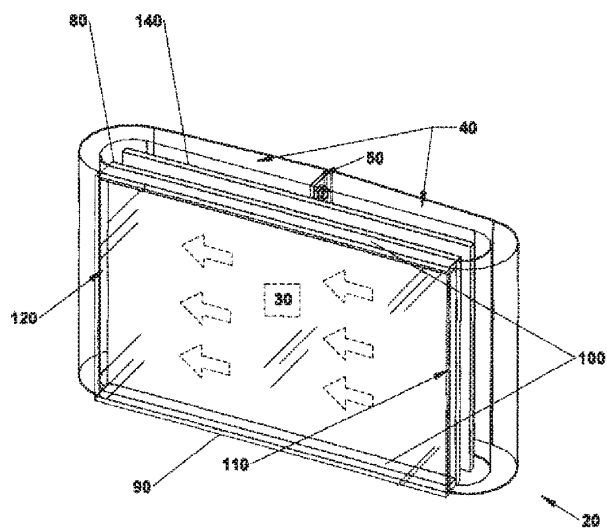
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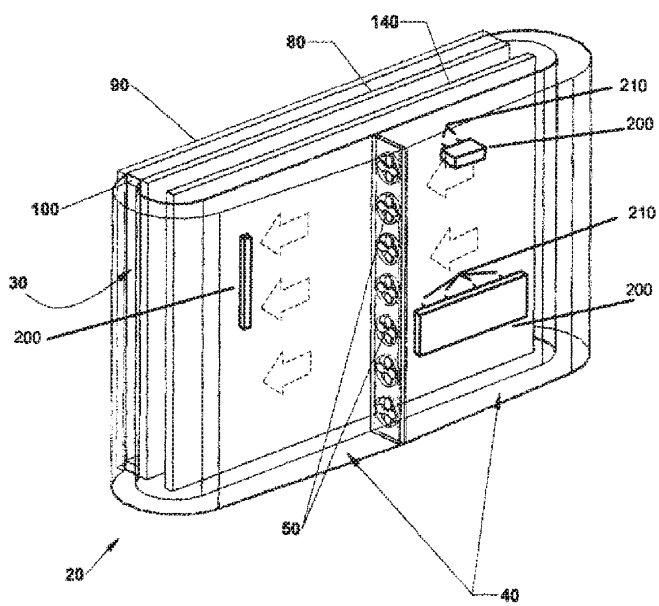
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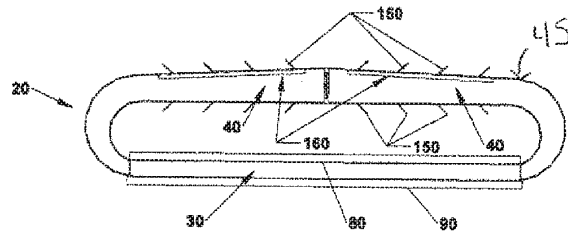
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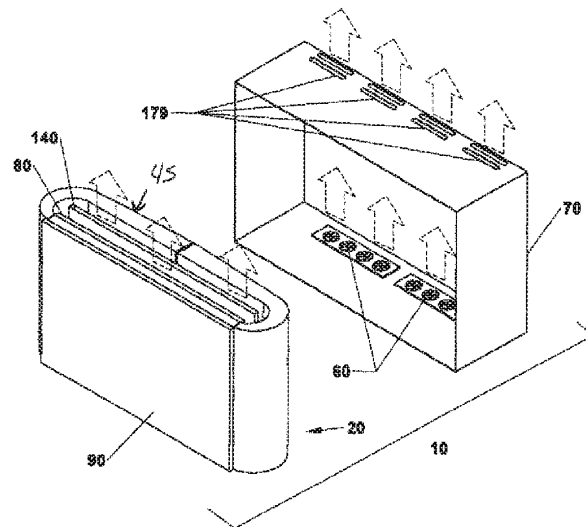
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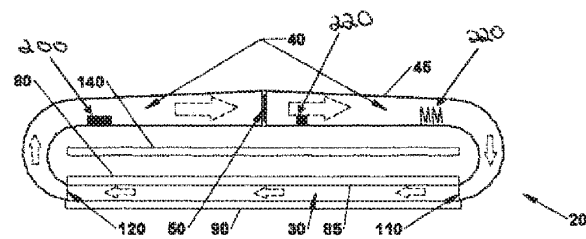
도면9



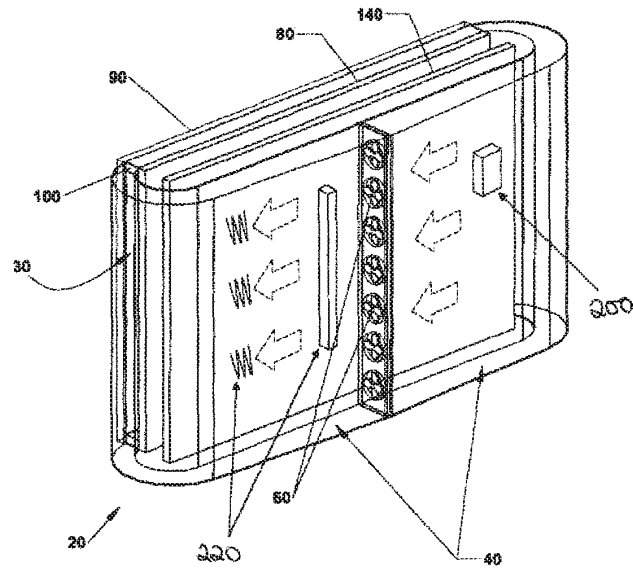
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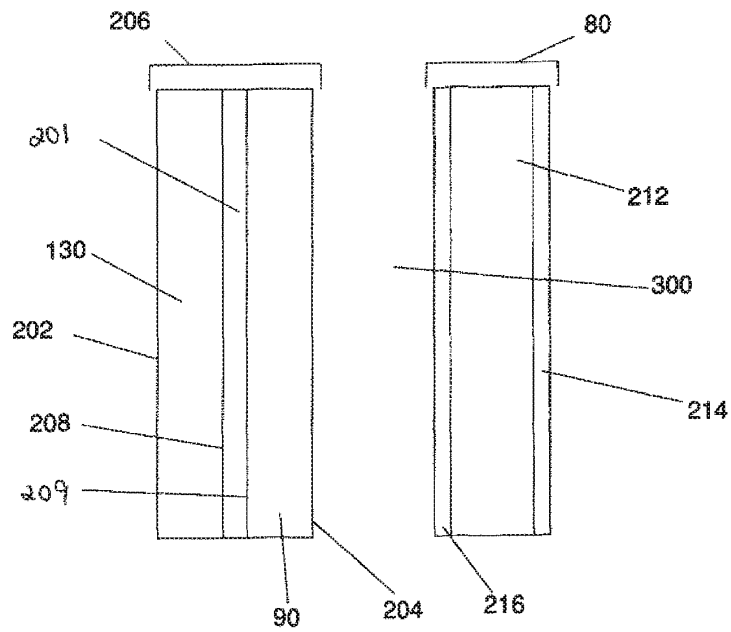
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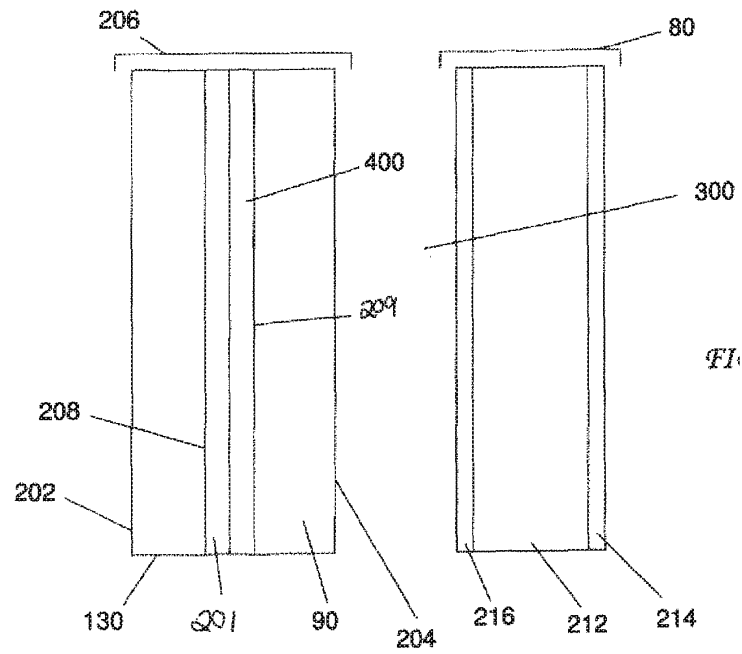
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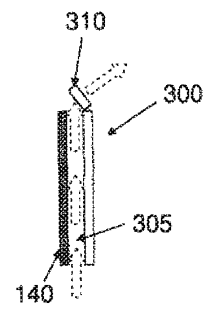
도면13



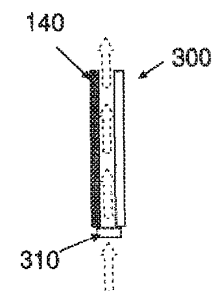
도면14



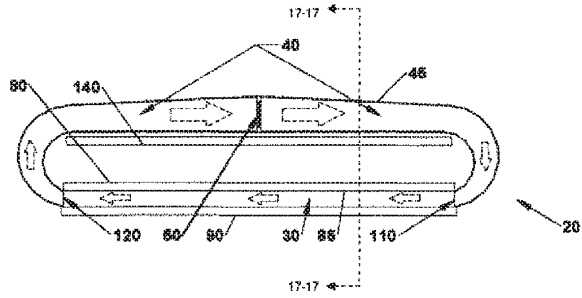
도면15a



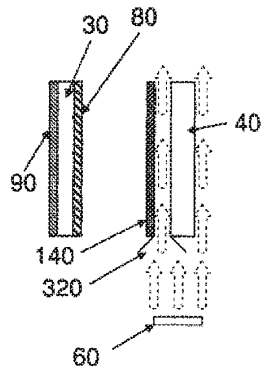
도면15b



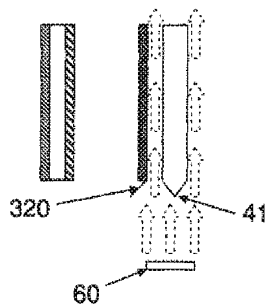
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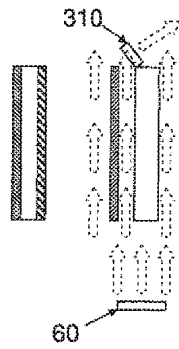
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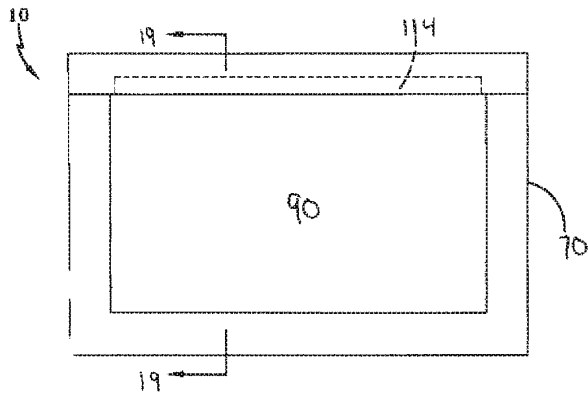
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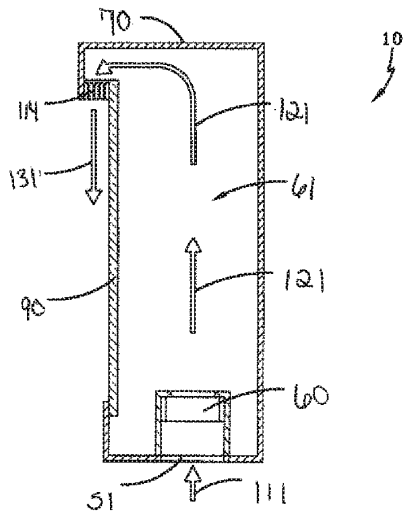
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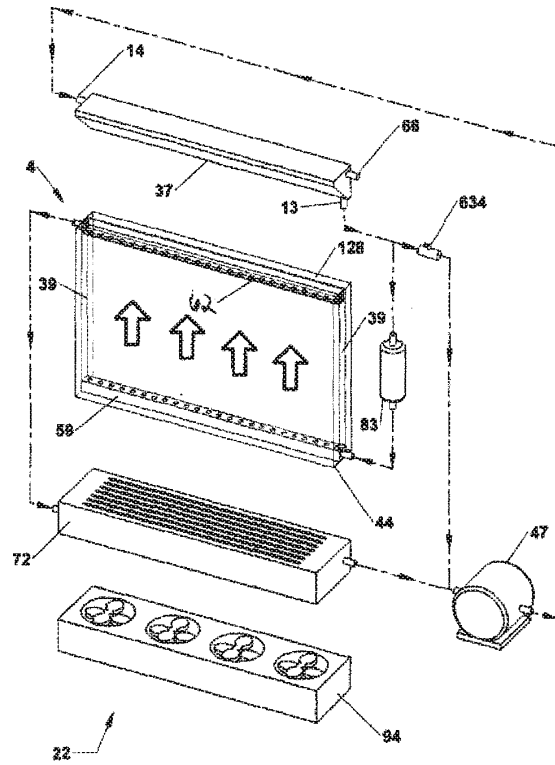
도면18



도면19



도면20



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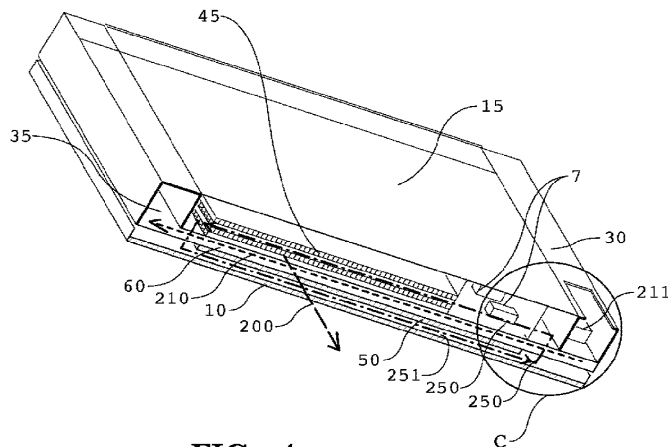


FIG - 4

(57) Abstract: A system for cooling an electronic image assembly. One embodiment of the system contains a plurality of channels place behind the electronic image assembly and preferably in conductive thermal communication with the image assembly. Ambient gas is ingested into the display housing and directed to a manifold which distributes the ambient gas to the plurality of channels. Another embodiment of the system uses a heat exchanger with an internal fan assembly. Circulating gas may also be used to cool a front portion of the electronic image assembly or any other internal cavity of the electronic display housing. The circulating gas may be drawn through a heat exchanger so that heat may be transferred to an ambient gas. The heat exchanger may have an internal fan assembly for drawing ambient air through the heat exchanger and exhausting it out of the display housing.

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SYSTEM FOR COOLING AN ELECTRONIC IMAGE ASSEMBLY

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Technical Field

[0001] Exemplary embodiments generally relate to cooling systems and in particular to cooling systems for electronic displays.

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 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.

[0006] 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

[0007] Exemplary embodiments 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. 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.

[0008] 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.

[0009] 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,

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 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.

[0010] 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.

[0011] 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

[0012] 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:

[0013] FIGURE 1A provides a front perspective view of an exemplary embodiment of the electronic display.

[0014] FIGURE 1B provides a rear perspective view of an exemplary embodiment of the electronic display.

[0015] FIGURE 2 provides a rear perspective view similar to that shown in Figure 1B where the rear cover has been removed.

[0016] **FIGURE 3** provides a perspective sectional view along the A-A section line shown in Figure 1B.

[0017] **FIGURE 4** provides a perspective sectional view along the B-B section line shown in Figure 1B.

[0018] **FIGURE 5** provides a perspective sectional view of insert C shown in Figure 4.

[0019] **FIGURE 6** provides a perspective sectional view of one embodiment of the cross through plate.

[0020] **FIGURE 7** provides an exploded perspective view of one exemplary embodiment of the heat exchanger and fan assembly.

[0021] **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).

[0022] **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.

Detailed Description

[0023] 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.

[0024] 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.

[0025] 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.

[0026] 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.

[0027] 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.

[0028] 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.

[0029] 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.

[0030] 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.

[0031] 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.

[0032] 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.

[0033] 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).

[0034] Optionally, ambient gas 210 may also be ingested into the display through inlet aperture 24 (or a separate inlet aperture). 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 (channels 60) 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 (channels 60) and combines them into a single flow and exhausts it out of the exit aperture 25 (or a separate exit aperture). 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 (channels 60). 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.

[0035] The first and second manifolds 30 and 35 may be placed along any opposing edges of the display. However, it is preferable that the first and second manifolds 30 and 35 are placed along the vertical edges of the display with the channels 60 travelling horizontally. Other embodiments may place the first and second manifolds 30 and 35 along the horizontal edges of the display with the channels 60 travelling vertically.

[0036] 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.

[0037] **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 contaminants 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.

[0038] An electronic image assembly 50 may be placed behind the front plate 10. A plurality of channels 60 may be placed 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 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/plate on the rear portion of the electronic image assembly 50 so that heat can easily transfer to this surface/plate and be removed by the ambient gas 210.

[0039] 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. Preferably, the channels 60 are metallic and even more preferably aluminum. Further, in an exemplary embodiment the channels 60 are in conductive thermal communication with the electronic image assembly 50.

[0040] **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. In this way, the heat exchanger 45 and the front channel 251 are placed in gaseous communication with each other.

[0041] 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.

[0042] Also shown in this sectional view is the path of the ambient gas 210 travelling down one of the channels 60 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. In other words, each channel 60 preferably has an inlet which is in gaseous communication with the first manifold 30 as well as an exit which is in gaseous communication with the second manifold 35. As shown in this Figure, the paths of the ambient gas 210 and the circulating gas 250 may 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.

[0043] 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.

[0044] 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. Thus, an exemplary cross through plate 500 contains two gaseous pathways where the two pathways do not allow the gaseous matter to mix. Here, the first gas pathway would be 525 while the second gas pathway would be 550.

[0045] **FIGURE 7** provides an exploded perspective view of one exemplary embodiment of the heat exchanger 45 and fan assembly 46. In this view, the fan assembly 46 is shown removed from its mounted position within the fan housing 51. In this embodiment, the heat exchanger 45 is divided into two portions 47 and 48 where the fan housing 51 is used to provide a gaseous communication between the two portions 47 and 48. Here, 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 reduced because the surrounding portions 47 and 48 of the heat exchanger 45 essentially act as a muffler for the fan assembly 46.

[0046] 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). As shown, the fan housing 51 may be used to connect two portions of a heat exchanger which may be of different lengths. As shown, portion 48 of the heat exchanger is thinner than the fan housing 51. In an alternative embodiment, both portions 48 and 47 may be thinner than the fan assembly 46 such that a fan housing 51 may be used to provide a sealed gaseous communication between the two portions, even though they are both thinner than the fan assembly 51. This design may be preferable when it is desirable to create the largest possible heat exchanger 45 (for maximum cooling abilities) even though

space is limited. 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). Some exemplary embodiments may place fans within the heat exchanger 45 to drive both the ambient gas 200 and circulating gas 250.

[0047] 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).

[0048] 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).

[0049] 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.

[0050] 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).

[0051] **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 enclose the area between the LCD 300 and the backlight 320 in order to 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. In this way, the backlight cavity is placed in gaseous communication with the heat exchanger 45.

[0052] **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 through the front channel 251 (the area defined between the LCD 300 and front plate 10). Circulating fan assembly 255 may be placed so that it can draw circulating gas 350 through the backlight cavity as well as circulating gas 250 through the front channel 251. 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). In this way, both the front channel 251 and the backlight cavity are placed in gaseous communication with the heat exchanger 45.

[0053] Also shown in Figure 9 is the optional additional flow of ambient gas 210 which may travel immediately behind the electronic image assembly (in this embodiment 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.

[0054] 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 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 and the thermal communication between the channels 60 and the backlight 320 would be conductive thermal communication.

[0055] 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.

[0056] The circulating gases 250 and 350, ambient gas 200, and optional ambient gas 210 can be any number of gaseous matters. In some embodiments, air may be used as the gas for all. As well known by those of ordinary skill in the art, air typically contains some amount of water vapor. It should be noted that the use of the term 'gas' herein does not designate pure gas and that it is specifically contemplated that any of the gaseous matters described herein may contain some amount of impurities including but not limited to water vapor. Preferably, because the circulating gases 250 and 350 may travel in front of the image assembly and backlight respectively, they should be substantially clear, so that they will not affect the appearance of the image to a viewer. The circulating gases 250 and 350 should also preferably be substantially free of contaminants and/or particulate 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 gases 200 and 210 from having contaminants as well. Filters may be used to help reduce the particulate within ambient gases 200 and 210.

Filters could be placed near the inlet aperture 24 so that ambient gases 200 and/or 210 could be drawn through the filter. However, in an exemplary embodiment the display may be designed so that contaminants could be present within the ambient gases 200 and 210 but this will not harm the display. In these embodiments, the heat exchanger 45, manifolds 30 and 35, channels 60, and any other pathway for ambient or circulating gas should be properly sealed so that any contaminants in the ambient gas would not enter sensitive portions of the display. Thus, in these exemplary embodiments, ambient air may be ingested for the ambient gases 200 and 210, even if the ambient air contains contaminants or particulate. This can be particularly beneficial when the display is used in outdoor environments or indoor environments where contaminants are present in the ambient air.

[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 electronic image assemblies. As used herein, the term 'electronic image assembly' is any electronic assembly for creating an image. At this time this, these are 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 thin/flat panel electronic image assembly. 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 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 a concern.

[0059] As is well known in the art, electronic displays can be oriented in a portrait manner or landscape manner and either can be used with the embodiments herein.

[0060] 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 assembly for cooling an electronic image assembly within a housing having an inlet aperture for ambient gas, exit aperture for ambient gas, and internal cavity for circulating gas, the assembly comprising:
 - a first portion of a heat exchanger which accepts ambient gas from the inlet aperture;
 - a second portion of a heat exchanger which accepts ambient gas from the first portion;
 - an first fan positioned between the first and second portions which pulls ambient gas through the first portion and pushes ambient gas through the second portion;
 - a second fan which forces circulating gas through the internal cavity and at least one of the heat exchanger portions;
 - a plurality of channels placed behind the electronic image assembly, each channel having an inlet and exit;
 - a first manifold in gaseous communication with the inlet of each channel;
 - a second manifold in gaseous communication with the exit of each channel; and
 - a third fan positioned to force ambient gas through the channels.
2. A system for cooling an electronic image assembly with ambient gas, the system comprising:
 - a plurality of channels placed behind the electronic image assembly, each channel having an inlet and exit;
 - a first manifold in gaseous communication with the inlet of each channel;
 - a second manifold in gaseous communication with the exit of each channel; and
 - a fan positioned to force ambient gas through the channels.
3. The cooling system of claim 2 wherein:
 - the channels are in thermal communication with the electronic image assembly.
4. The cooling system of claim 2 wherein:

the first and second manifolds are placed along a pair of vertical edges of the electronic image assembly.

5. The cooling system of claim 2 wherein:
the fan is placed within either the first or second manifold.
6. The cooling system of claim 2 wherein:
the channels have a rectangular cross-section.
7. The cooling system of claim 2 wherein:
the channels are arranged in horizontal rows.
8. The cooling system of any one of claims 2-7 wherein:
the cooling channels are metallic.
9. The cooling system of claim 2 further comprising:
a front plate placed in front of the electronic image assembly, the space between the front plate and the electronic image assembly defining a front channel;
a circulating fan position to force circulating gas through the front channel; and
a pass through plate having a first pathway for ambient gas travelling through the plurality of channels behind the electronic image assembly and a second pathway for circulating gas travelling through the front channel.
10. The cooling system of claim 9 wherein:
the first and second gas pathways are substantially perpendicular.
11. The cooling system of claim 9 wherein:
the first and second gas pathways do not allow the ambient gas and circulating gas to mix.
12. The cooling system of claim 9 wherein:

the pass through plate is positioned adjacent to the first manifold.

13. An electronic display assembly comprising:
 - a housing;
 - an electronic image assembly contained within the housing and having a pair of opposing edges;
 - an inlet aperture in the housing for accepting ambient gas;
 - an exhaust aperture in the housing for exhausting ambient gas;
 - a plurality of channels placed behind the electronic image assembly;
 - a first manifold placed along one of the opposing edges which accepts ambient gas from the inlet aperture and distributes ambient gas to the plurality of channels;
 - a second manifold placed along the opposite edge as the first manifold which accepts ambient gas from the channels and directs it towards the exhaust aperture; and
 - a fan which forces the ambient gas through the channels.
14. The electronic display assembly of claim 13 wherein:
 - the fan is placed within the first manifold.
15. The electronic display assembly of claim 13 wherein:
 - the housing contains a top and bottom portion;
 - the inlet aperture is located at the top portion of the housing; and
 - the exhaust aperture is located at the bottom portion of the housing.
16. The electronic display assembly of claim 13 wherein:
 - the first and second manifolds are oriented vertically; and
 - the plurality of channels are oriented horizontally.
17. The electronic display assembly of any one of claims 13-16 wherein:

the channels are in conductive thermal communication with the electronic image assembly.

18. The electronic display assembly of claim 13 further comprising:

- a transparent front plate placed in front of the electronic image assembly, the space between the front plate and the electronic image assembly defining a front channel;
- a circulating fan position to force circulating gas through the front channel; and
- a first pass through plate adjacent to the first manifold and a second pass through plate adjacent to the second manifold, each pass through plate having a first pathway for ambient gas travelling through the plurality of channels behind the electronic image assembly and a second pathway for circulating gas travelling through the front channel.

19. The cooling system of claim 18 wherein:

- the first and second gas pathways are substantially perpendicular.

20. An electronic display assembly comprising:

- a housing having a top portion, bottom portion, and a pair of vertical edges;
- an electronic image assembly contained within the housing;
- an inlet aperture in the housing for accepting ambient gas;
- an exhaust aperture in the housing for exhausting ambient gas;
- a plurality of metallic channels placed behind and in conductive thermal communication with the electronic image assembly;
- a first manifold placed along one of the vertical edges which accepts ambient gas from the inlet aperture and distributes ambient gas to the plurality of channels;
- a second manifold placed along the opposite vertical edge as the first manifold which accepts ambient gas from the channels and directs it towards the exhaust aperture; and

a plurality of fans within the first manifold which draw the ambient gas into the inlet aperture and through the channels.

21. The electronic display assembly of claim 20 wherein:
the electronic image assembly is a liquid crystal display.
22. An assembly for cooling an electronic image assembly within a housing having an inlet aperture for ambient gas, exit aperture for ambient gas, and internal cavity for circulating gas, the assembly comprising:
a first portion of a heat exchanger which accepts ambient gas from the inlet aperture;
a second portion of a heat exchanger which accepts ambient gas from the first portion;
an first fan positioned between the first and second portions which pulls ambient gas through the first portion and pushes ambient gas through the second portion; and
a second fan which forces circulating gas through the internal cavity and at least one of the heat exchanger portions.
23. The cooling assembly of claim 22 wherein:
the first fan also draws ambient gas through the inlet aperture.
24. The cooling assembly of claim 23 wherein:
the first fan also pushes ambient gas through the exit aperture.
25. The cooling assembly of claim 22 further comprising:
an electronic component placed within the path of the circulating gas.
26. The cooling assembly of claim 25 wherein:
the electronic component is a power module.

27. The cooling assembly of claim 22 wherein:
the heat exchanger portions are comprised of corrugated layers.
28. The cooling assembly of claim 22 wherein:
the heat exchanger portions are cross-flow heat exchanger portions.
29. An assembly for cooling an electronic image assembly within a housing having an inlet aperture for ambient gas, exit aperture for ambient gas, and internal cavity for circulating gas, the assembly comprising:
a heat exchanger having first and second gas pathways;
an first fan placed within the heat exchanger to draw ambient gas through the inlet aperture and the first gas pathway of the heat exchanger; and
a second fan placed to draw circulating gas through the internal cavity and the second gas pathway of the heat exchanger.
30. The cooling assembly of claim 29 wherein:
the first fan comprises an inlet side and exhaust side such that a portion of the heat exchanger is adjacent to the inlet side and a further portion of the heat exchanger is adjacent to the exhaust side.
31. The cooling assembly of claim 29 wherein:
the internal cavity comprises a front channel defined by the space between the electronic image assembly and a transparent front plate.
32. The cooling assembly of claim 29 wherein:
the first fan also forces the ambient gas out the exit aperture.
33. The cooling assembly of claim 29 further comprising:
an electronic component placed within the path of the circulating gas.
34. The cooling assembly of claim 33 wherein:

the electronic component is a power module.

35. The cooling assembly of claim 29 wherein:
the heat exchanger is comprised of corrugated layers.
36. The cooling assembly of claim 29 wherein:
the heat exchanger is a cross-flow heat exchanger.
37. An electronic display assembly comprising:
a housing having an inlet aperture and exit aperture for ambient gas;
an electronic image assembly within the housing;
a transparent front plate in front of the electronic image assembly, the space
between the transparent front plate and the electronic image assembly
defining a channel;
a heat exchanger in gaseous communication with the channel, the heat
exchanger comprising two portions, each portion having first and second
gas pathways, where the first gas pathways are in gaseous
communication with the inlet and exit apertures and the second gas
pathways are in gaseous communication with the channel;
a first fan assembly placed between the two portions of the heat exchanger to
force ambient gas through the first gas pathways; and
a second fan assembly positioned to force gas through the channel and the
second gas pathways.
38. The electronic display assembly of claim 37 further comprising:
a power module placed within the path of the circulating gas.
39. The electronic display assembly of claim 37 wherein:
the electronic image assembly is a liquid crystal display.
40. The electronic display assembly of claim 37 wherein:

the electronic image assembly is an OLED display.

41. The electronic display assembly of claim 37 wherein:

the heat exchanger is a cross-flow heat exchanger comprised of corrugated layers.

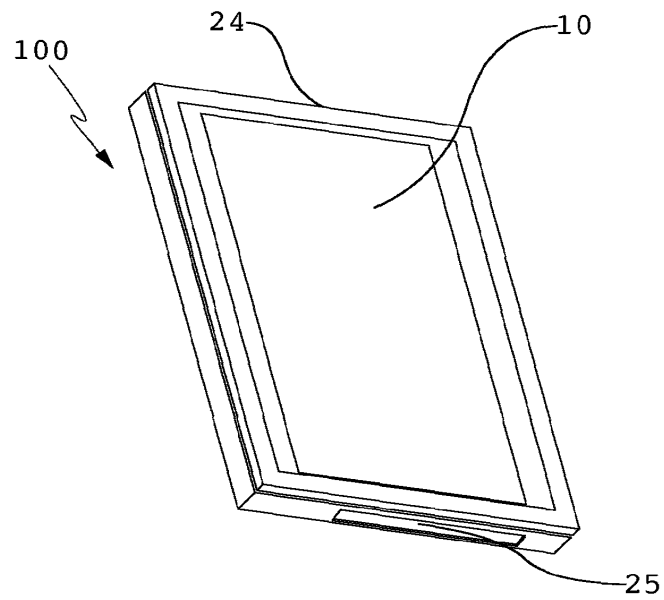


FIG - 1A

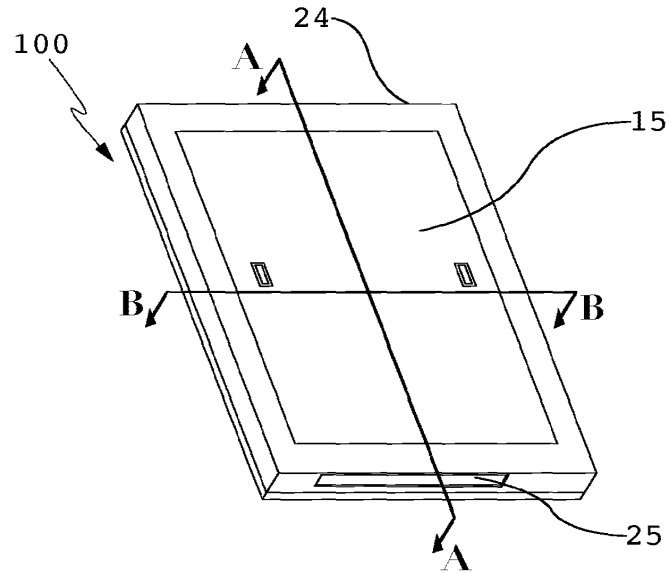


FIG - 1B

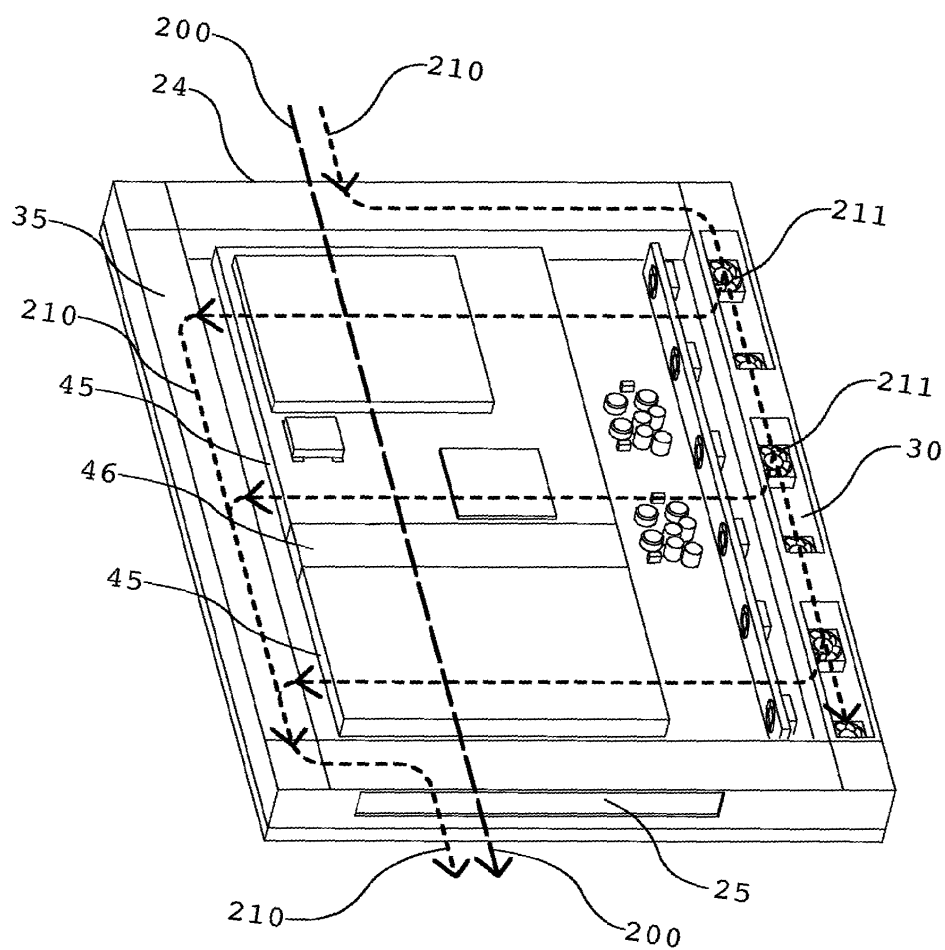
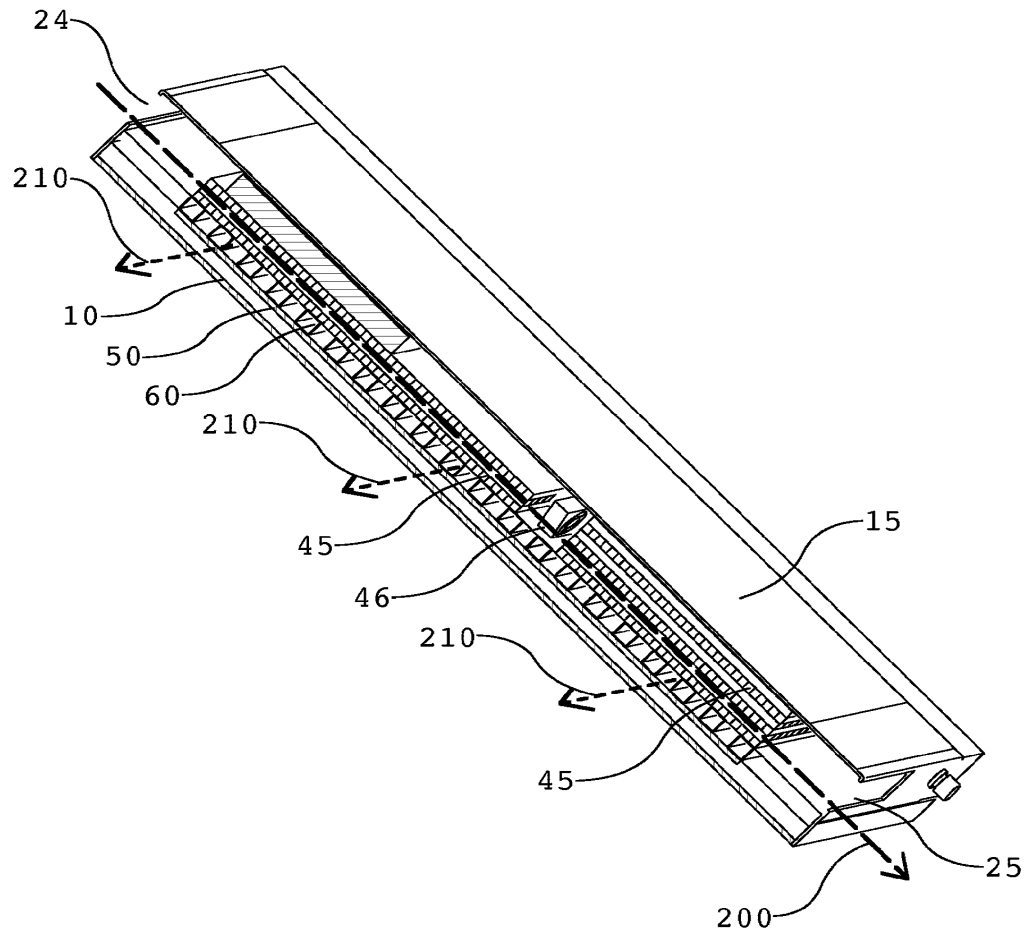


FIG - 2

**FIG - 3**

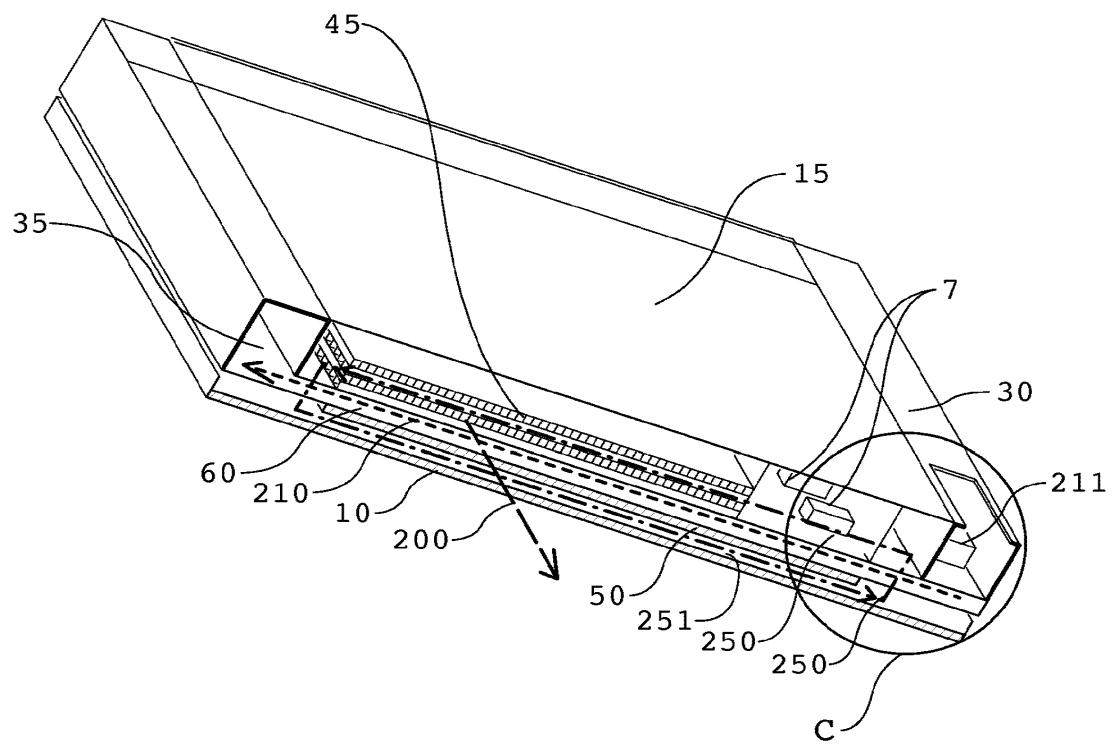


FIG - 4

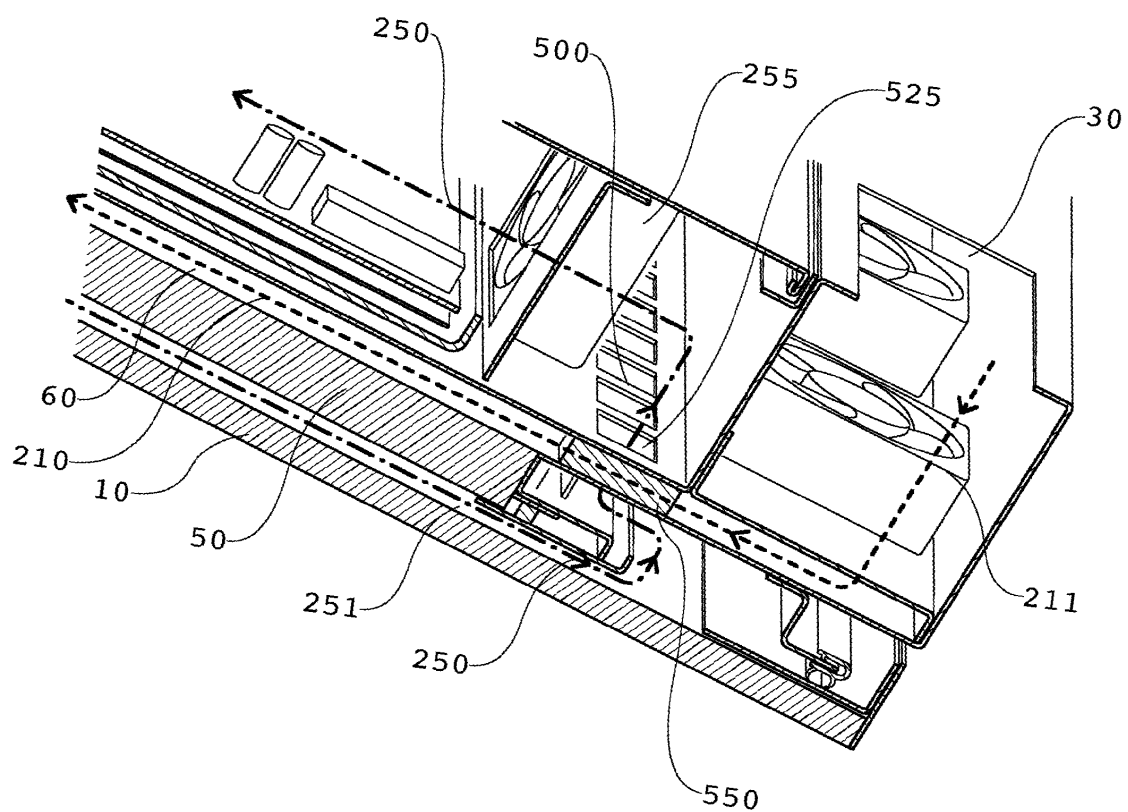


FIG - 5

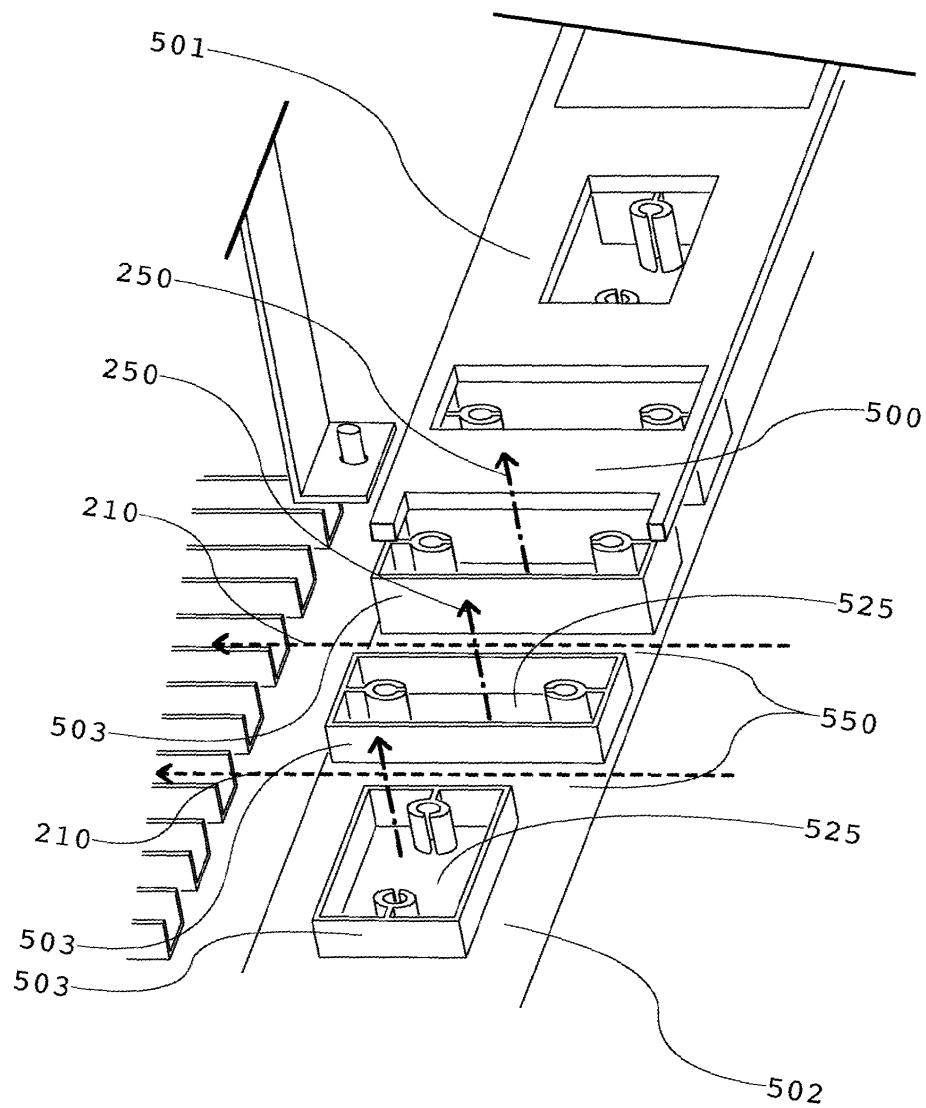


FIG - 6

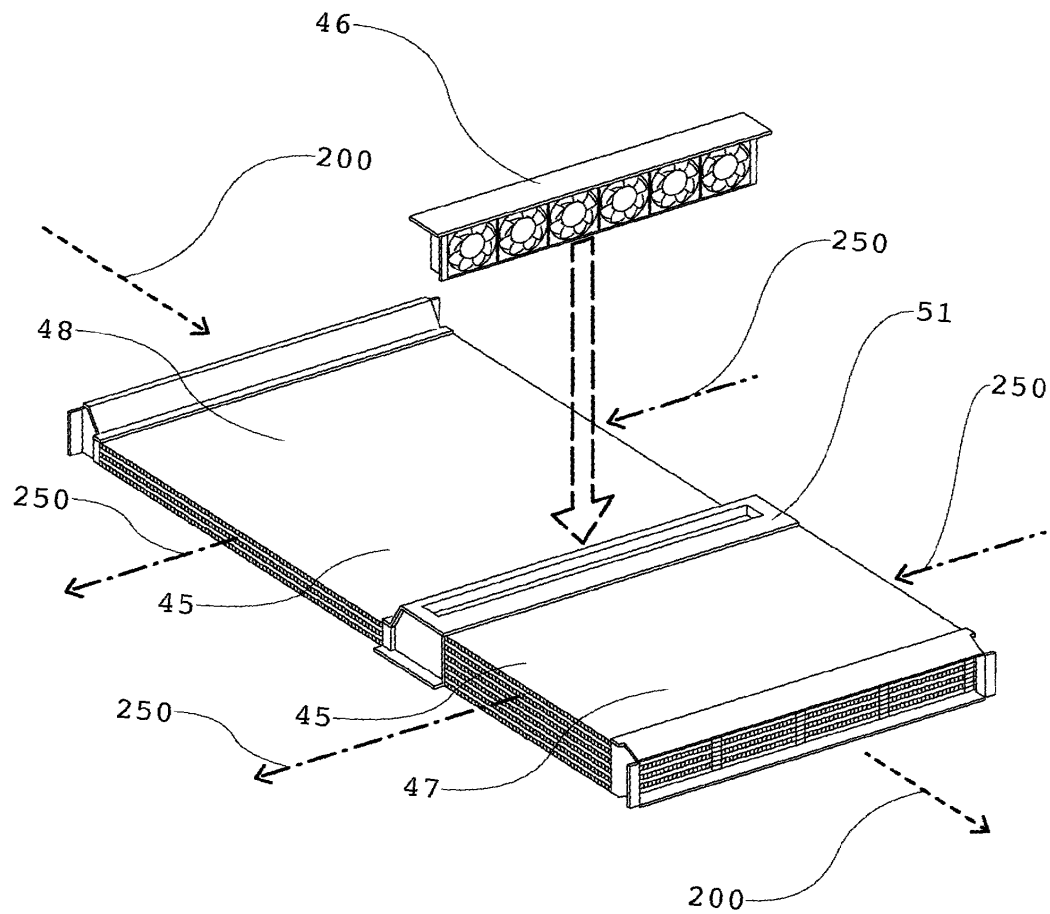
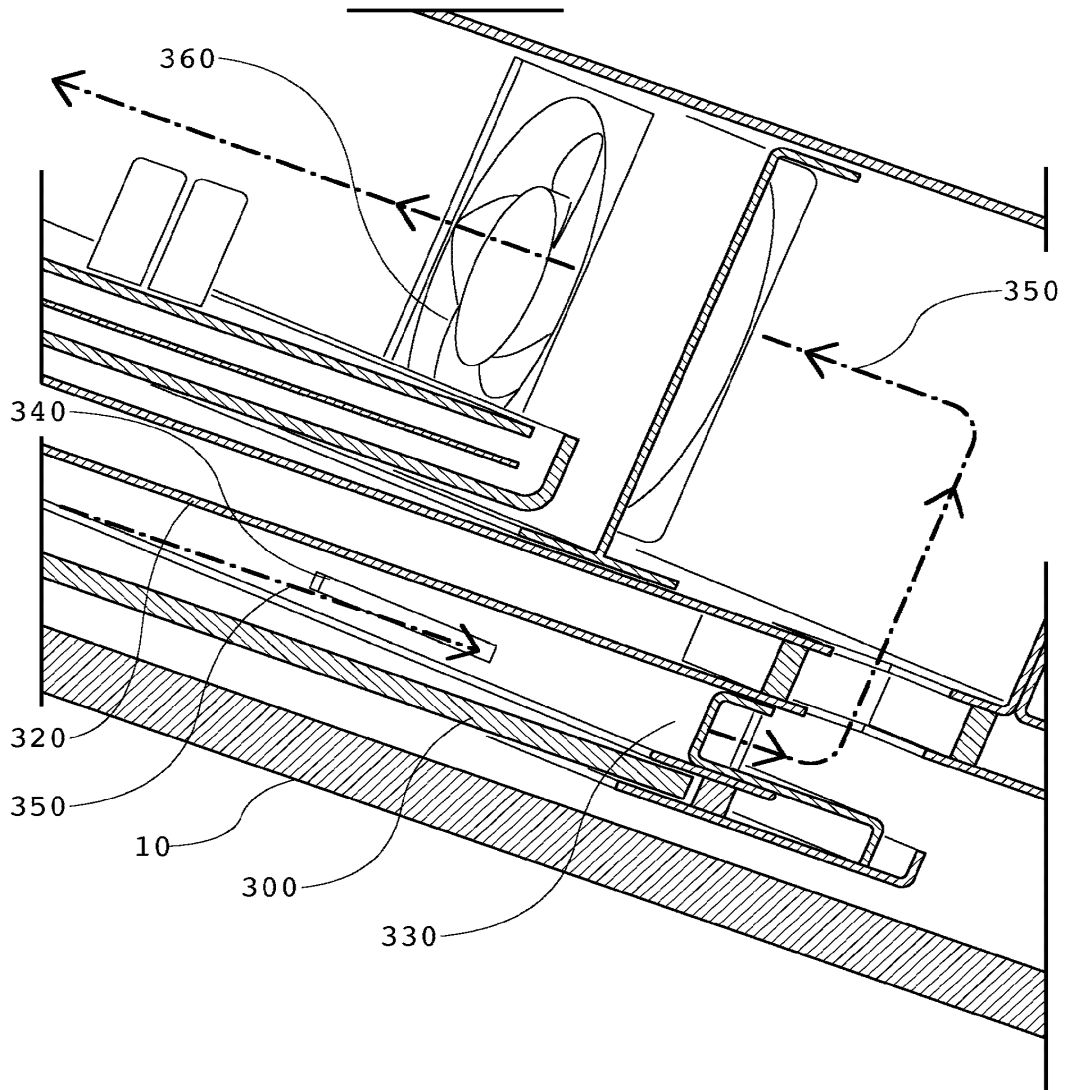


FIG - 7

**FIG - 8**

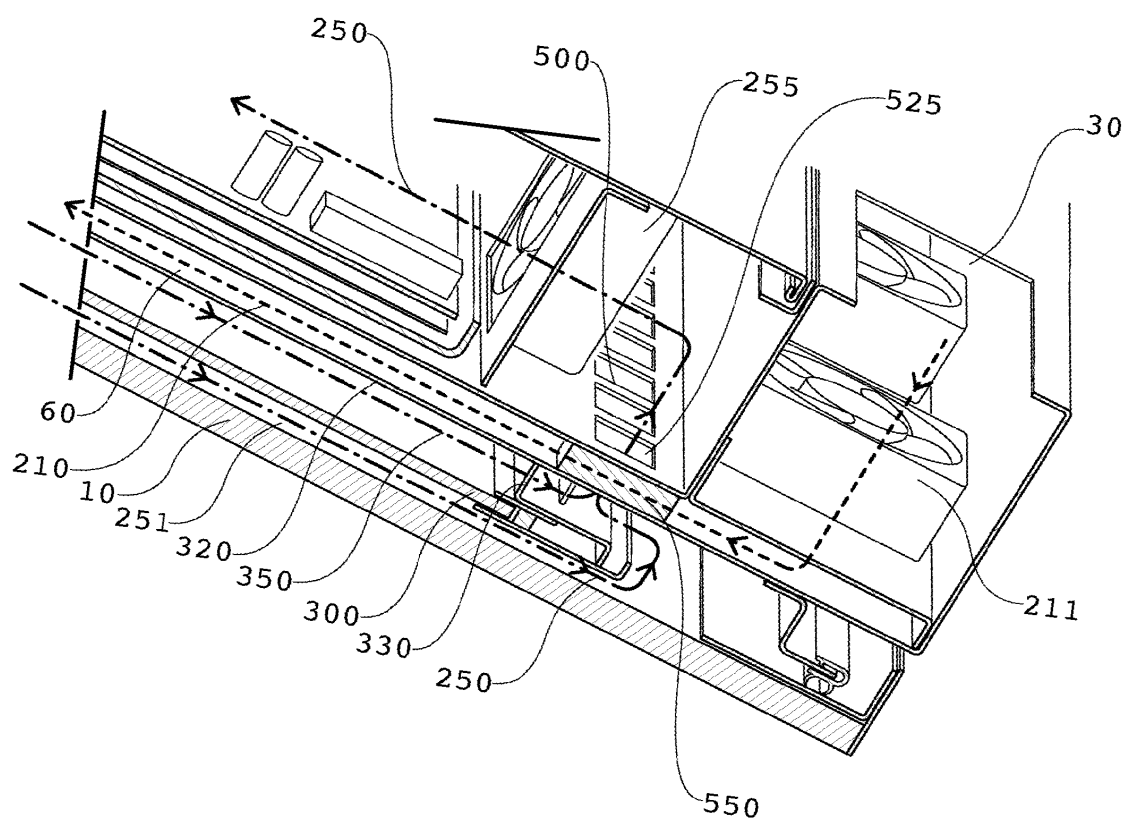


FIG - 9

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

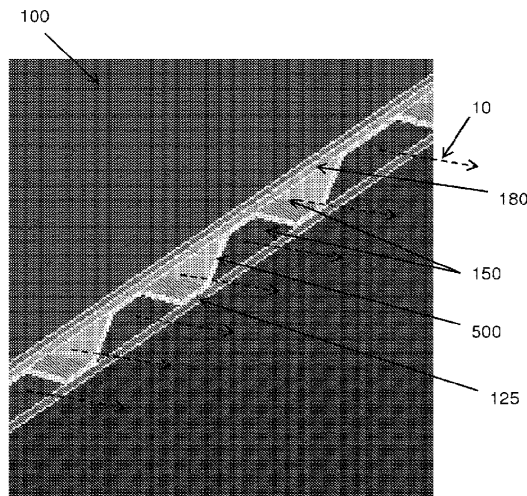


FIG - 1B

(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;

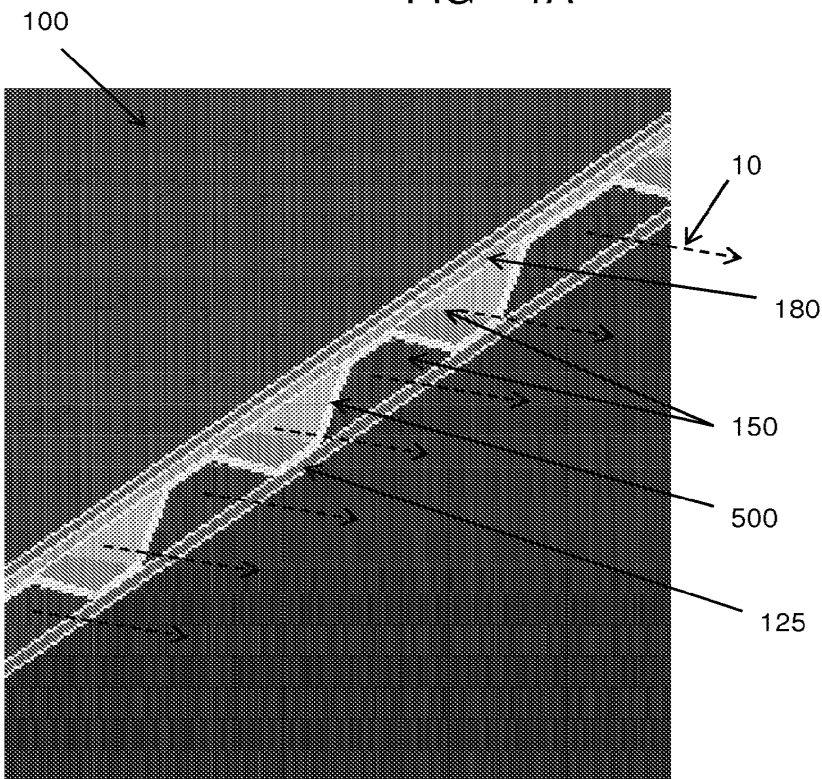
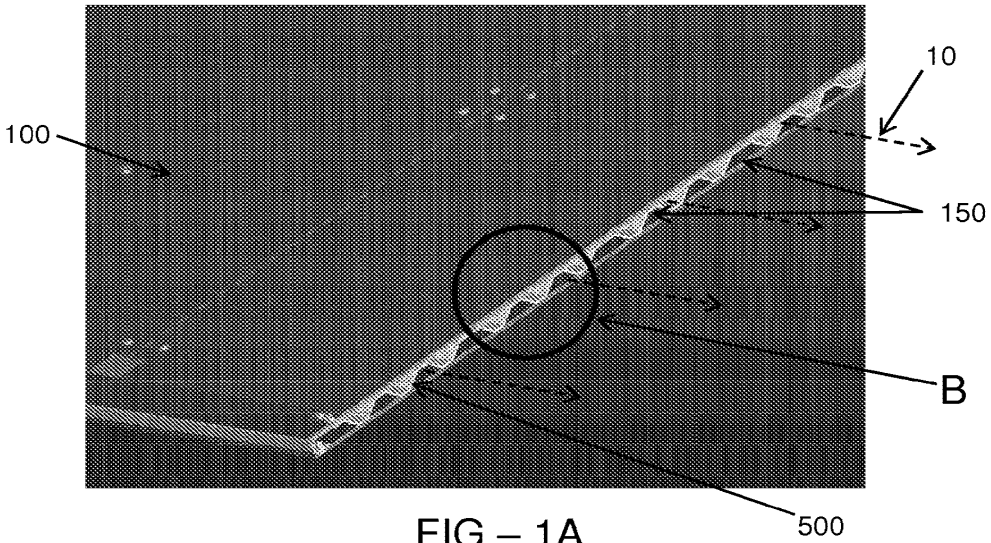
an LED backlight placed above and in thermal communication with the continuous sheet;

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.



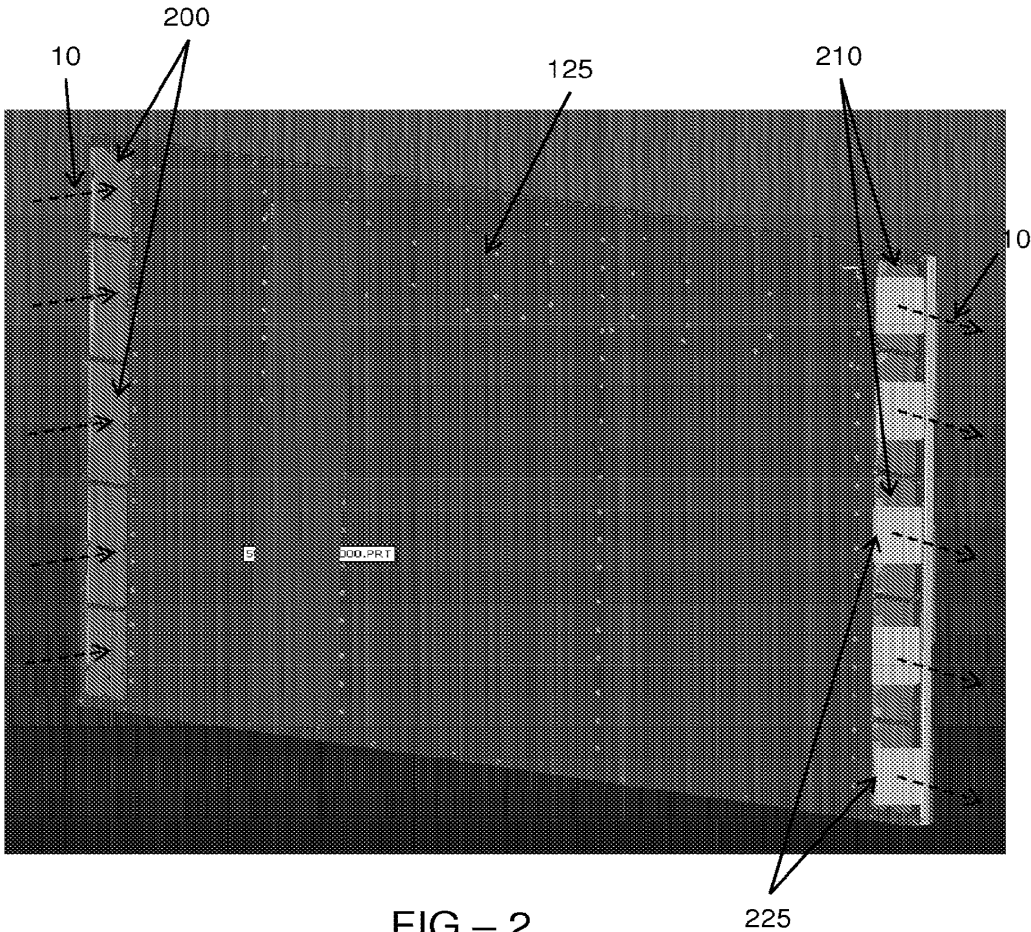
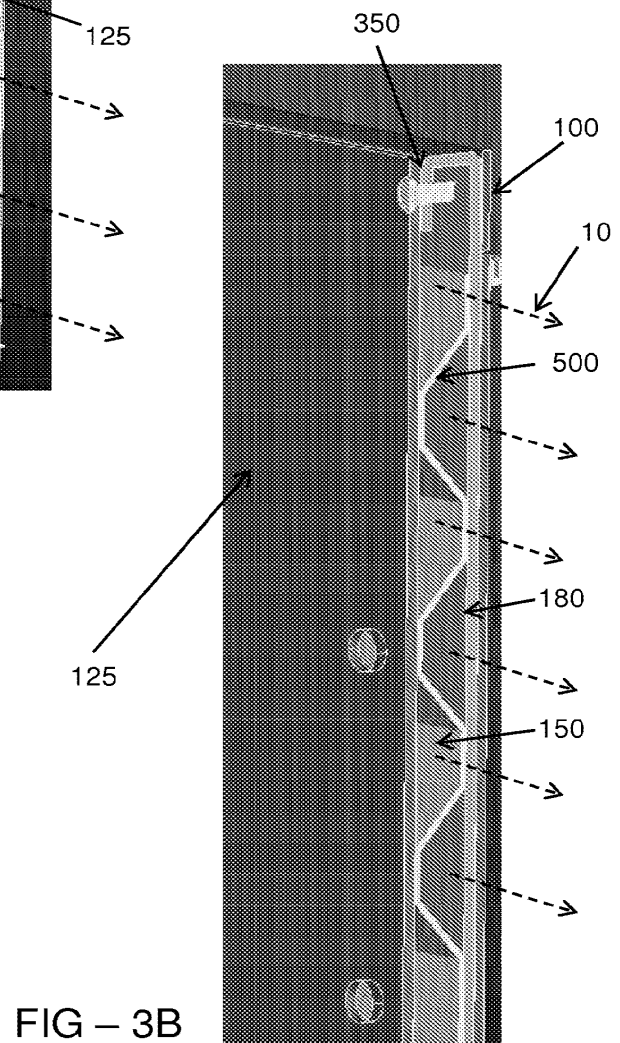
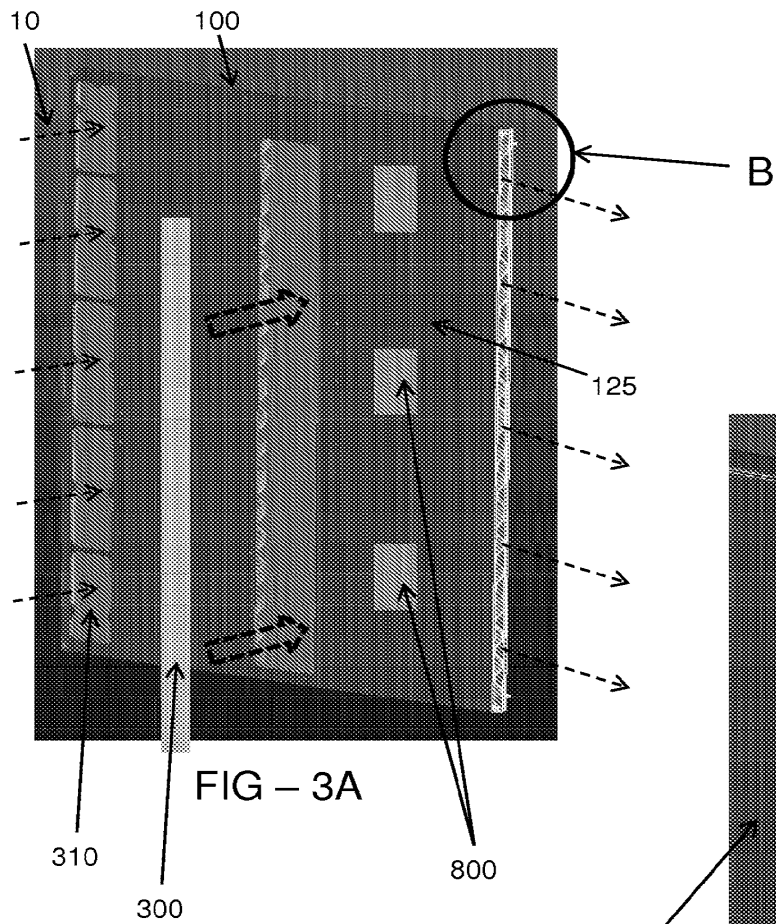


FIG - 2



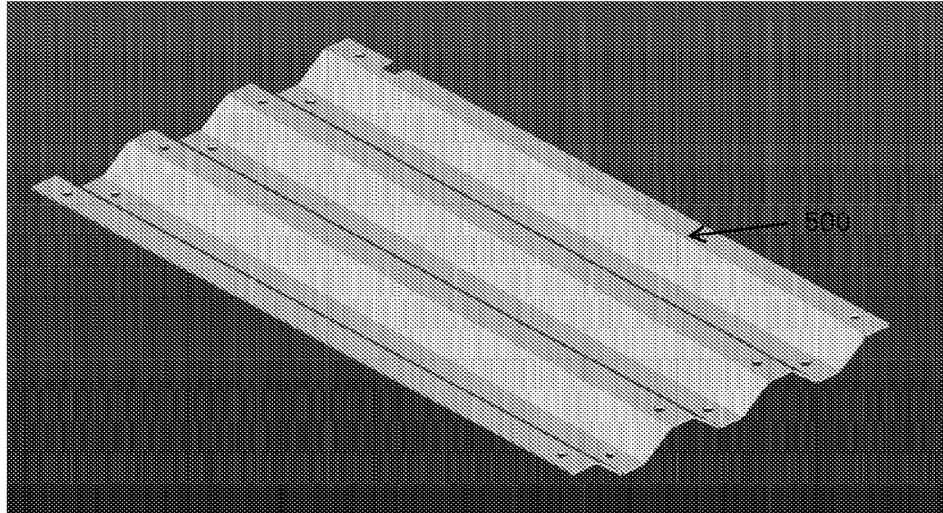


FIG - 4

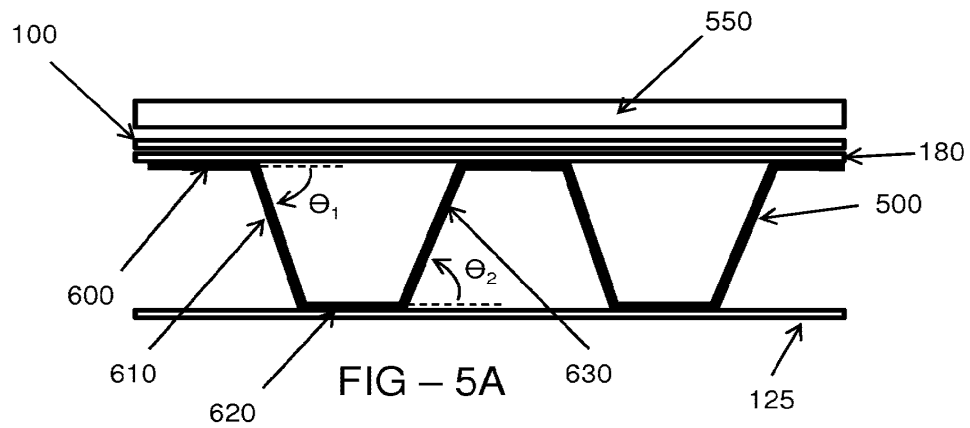
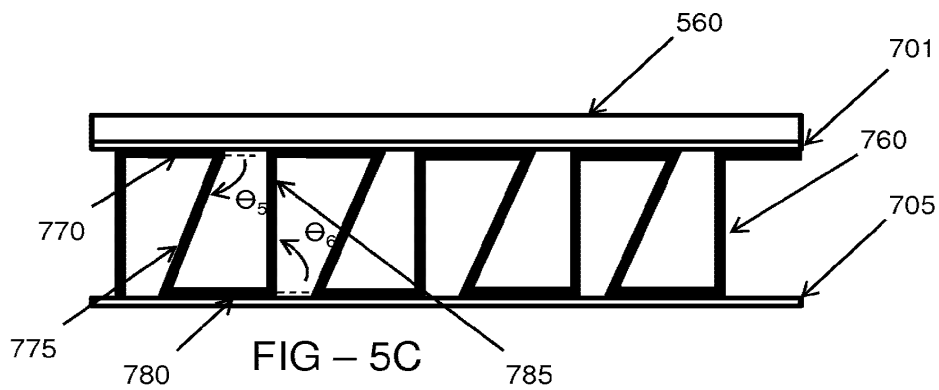
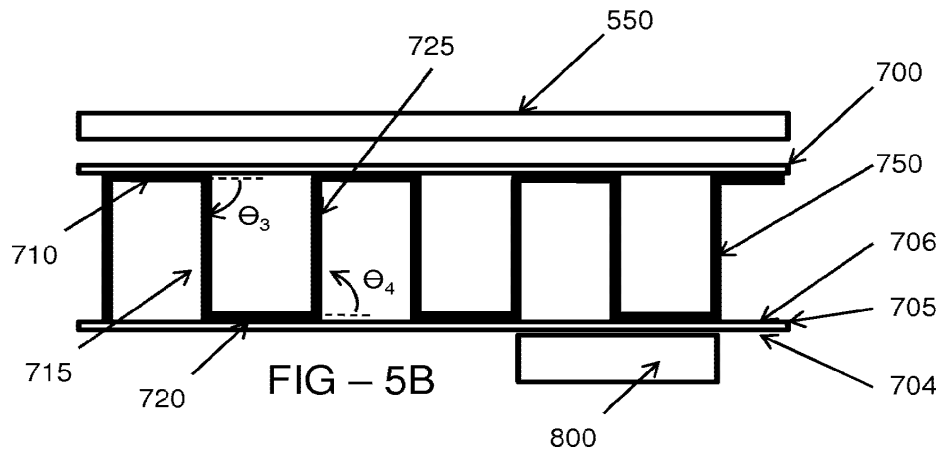


FIG - 5A





Espacenet

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SYSTEM OF HEAT CONTROL FOR ELECTRONIC DISPLAY

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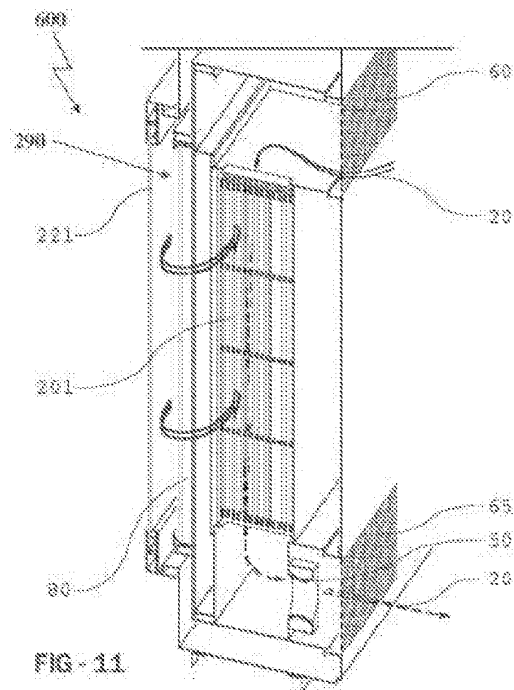
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Abstract of RU2513043 (C2)

FIELD: heating SUBSTANCE: invention relates to cooling systems, and, in particular, to cooling systems for electronic displays. In a cooling unit for an electronic image unit and a display unit that comprises it, in some versions of realisation they use ambient gas for cooling of power supply modules and/or the image unit (sometimes back lighting). In other versions they use a closed circuit of circulating gas, which passes along the front surface of the image unit and via a heat exchanger. The open circuit passes via the heat exchanger and extracts heat from the circulating gas. Atmospheric air may be used as ambient gas. For cooling of the rear section of the image unit or back lighting with the help of ambient gas they may use a non-obligatory additional channel. In some versions of realisation they also use heat-conducting plates and ribs to distribute heat and to exclude hot points in the display.EFFECT: improved working characteristics of components of electronic displays and their increased service life due to prevention of high oscillations of temperature in use of electronic displays in external environments under conditions of direct sunlight or under other heavy thermal conditions.15 cl, 13 dwg



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ПО ИНТЕЛЛЕКТУАЛЬНОЙ СОБСТВЕННОСТИ

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(54) СИСТЕМА ТЕРМОРЕГУЛИРОВАНИЯ ДЛЯ ЭЛЕКТРОННОГО ДИСПЛЕЯ

(57) Реферат:

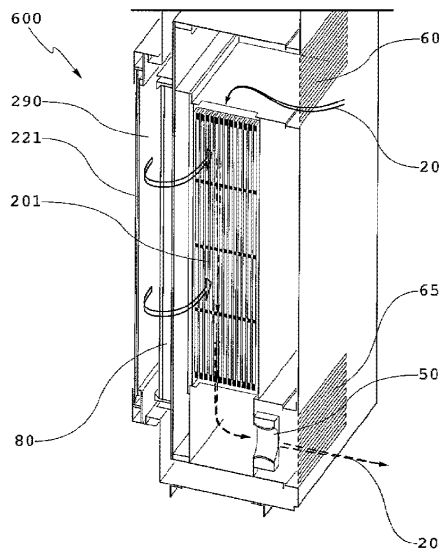
Изобретение относится к системам охлаждения и, в частности, к системам охлаждения для электронных дисплеев. Технический результат - улучшение рабочих характеристик компонентов электронных дисплеев и увеличение их срока службы за счет предотвращения больших колебаний температуры при использовании электронных дисплеев в наружных средах в условиях прямого солнечного света или в других тяжелых тепловых условиях. Достигается тем, что в охлаждающем

блоке для электронного блока изображения и блоке дисплея, содержащем его, в некоторых вариантах осуществления используется газ окружающей среды для охлаждения модулей питания и/или блока изображения (иногда задней подсветки). В других вариантах используется замкнутый контур циркулирующего газа, который проходит по передней поверхности блока изображения и через теплообменник. Разомкнутый контур проходит через теплообменник и извлекает тепло из

Стр.: 1

циркулирующего газа. В качестве газа окружающей среды может использоваться атмосферный воздух. Для охлаждения заднего участка блока изображения или задней подсветки с помощью газа окружающей среды может использоваться необязательный дополнительный

канал. В некоторых вариантах осуществления также используются теплопроводящие пластины и ребра для распределения тепла и исключения горячих точек в дисплее. 3 н.п. и 12 з.п. ф-лы, 13 ил.



Фиг. 11

RU 2513043 C2

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(54) **SYSTEM OF HEAT CONTROL FOR ELECTRONIC DISPLAY**

(57) Abstract:

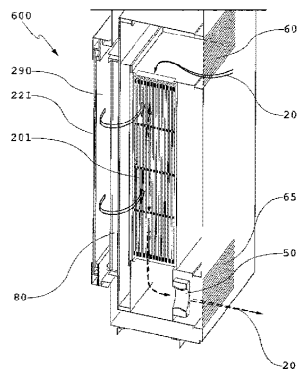
FIELD: heating.

SUBSTANCE: invention relates to cooling systems, and, in particular, to cooling systems for electronic displays. In a cooling unit for an electronic image unit and a display unit that comprises it, in some versions of realisation they use ambient gas for cooling of power supply modules and/or the image unit (sometimes back lighting). In other versions they use a closed circuit of circulating gas, which passes along the front surface of the image unit and via a heat exchanger. The open circuit passes via the heat exchanger and extracts heat from the circulating gas. Atmospheric air may be used as ambient gas. For cooling of the rear section of the image unit or back lighting with the help of ambient gas they may use a non-obligatory additional channel. In some versions of realisation they also use heat-conducting plates and ribs to distribute heat and to exclude hot points in the display.

EFFECT: improved working characteristics of components of electronic displays and their increased service life due to prevention of high oscillations of temperature in use of electronic displays in external environments under conditions of direct sunlight or under other heavy thermal conditions.

15 cl, 13 dwg

RU 2513043 C2



Фиг. 11

RU 2513043 C2

Область техники, к которой относится изобретение

Примерные варианты осуществления в общем относятся к системам охлаждения и в частности к системам охлаждения для электронных дисплеев.

Предшествующий уровень техники

5 Проводящие и конвективные теплообменные системы для электронных дисплеев в общем стремятся отводить тепло от электронных компонентов в дисплее через максимально возможное количество боковых стенок дисплея. Для того чтобы это выполнять, системы предшествующего уровня техники полагались прежде всего на вентиляторы для перемещения внутреннего воздуха, находящегося внутри корпуса, 10 мимо компонентов, подлежащих охлаждению, и наружу из дисплея. Эти компоненты в общем представляют собой источники электропитания. В некоторых случаях нагретый воздух перемещается в конвективном тепловом контакте с оребрением.

Хотя такие теплообменные системы в прошлом имели некоторый успех, усовершенствования дисплеев и новых применений дисплеев требуют еще больших 15 возможностей охлаждения. В частности, охлаждающие устройства для электронных дисплеев предшествующего уровня техники обычно использовали конвективные системы рассеяния тепла, которые функционировали только для охлаждения заднего внутреннего участка дисплея. При использованиях вне помещений или в других теплых окружающих средах они непригодны, особенно когда лучистая теплопередача от солнца через 20 переднюю поверхность дисплея становится основным фактором. Во многих применениях обычной является мощность, поступающая через переднюю поверхность дисплея, которая составляет 200 Вт или больше. Кроме того, рынок требует для дисплеев экранов больших размеров. С увеличением размеров экрана электронного дисплея и соответствующих размеров передней поверхности дисплея будет вырабатываться 25 больше тепла и больше тепла будет передаваться в дисплей. Кроме того, когда дисплеи используются в наружных средах, атмосферный воздух может содержать загрязнения (пыль, грязь, пыльцу, водяной пар, частицы износа рабочих поверхностей тормозных механизмов, песок, дым и т.д.), которые, если засасываются в дисплей для охлаждения внутреннего пространства, могут повреждать внутренние компоненты дисплея.

30 Современные дисплеи (особенно те, которые используют вне помещений) становятся все более яркими, с некоторыми задними подсветками, производящими 1,000-2,000 нит или больше. Чтобы производить такой уровень яркости, устройства освещения, такие как блоки CCFL (люминесцентных ламп с холодным катодом), LED (светодиодов), органических LED и плазменные блоки, могут производить относительно 35 большое количество тепла. Кроме того, устройства освещения требуют относительно большого количества энергии, чтобы генерировать необходимый уровень яркости. Это большое количество энергии в общем поставляется посредством одного или более источников электропитания для дисплея. Эти источники электропитания также могут стать существенным источником тепла для дисплея.

40 Большое колебание температуры является обычным при использовании устройств предшествующего уровня техники в наружных средах в условиях прямого солнечного света или в других тяжелых тепловых условиях. Такое температурное колебание оказывает негативное влияние и на срок службы, и на рабочие характеристики электронных компонентов в этих устройствах.

Сущность примерных вариантов осуществления

В то время как системы предшествующего уровня техники стремились отводить тепло только через стороны, не осуществляющие отображения, и задние компоненты электронного дисплея, предпочтительный вариант осуществления может также вызывать

конвективную теплопередачу от лицевой поверхности блока изображения (от стороны, которая обращена к намеченному наблюдателю). Эти предпочтительные варианты осуществления могут содержать два отдельных пути потоков для газа через электронный дисплей. Первый путь потока может быть замкнутым контуром, а второй путь потока
 5 может быть разомкнутым контуром. Путь замкнутого контура проходит через переднюю поверхность блока изображения, продолжается к задней части дисплея, где он может входить в теплообменник, и, наконец, возвращается к передней поверхности блока изображения. Путь разомкнутого контура втягивает газ (например, атмосферный воздух) через заднюю часть дисплея (возможно, через теплообменник) и затем выпускает
 10 его из корпуса дисплея. Теплообменник может использоваться для того, чтобы передавать тепло из замкнутого контура в разомкнутый контур и выпускать из дисплея. Необязательно, разомкнутый контур также может нагнетаться позади блока изображения (иногда задней подсветки, в другие моменты времени OLED (органические светоизлучающие диоды) или другого типа блоки создания изображений) для
 15 охлаждения блока изображения и/или блока задней подсветки (если задняя подсветка необходима для определенного типа используемого дисплея). В примерном варианте осуществления может использоваться теплообменник с пересекающимися направлениями потоков.

Другие варианты осуществления относятся к системе, предназначенной для
 20 охлаждения следующих участков электронного дисплея, либо одного, либо в сочетании: (1) модуля (модулей) питания, (2) задней подсветки и (3) передней поверхности дисплея. Модули питания с блоками рассеивания тепла (например, охлаждающими пластинами и/или теплоотводами) можно использовать с некоторыми вариантами осуществления, в которых сторона модуля питания, содержащая блок рассеивания тепла, размещена
 25 на пути газа окружающей среды, в то время как сторона модуля питания, содержащая чувствительные электрические компоненты, остается в отдельной окружающей среде. Изолирующая конструкция может обеспечивать газовую изоляцию (и иногда изоляцию от твердых частиц/загрязнений) между этими двумя сторонами модулей питания. При охлаждении модулей питания с помощью разомкнутого контура газа окружающей
 30 среды замкнутый контур может использоваться или не использоваться.

Задние подсветки с передними и задними сторонами могут использоваться с некоторыми вариантами осуществления для жидкокристаллических дисплеев (ЖКД, LCD), в которых передняя сторона содержит устройства освещения, а задняя сторона содержит теплопроводящую поверхность для того, чтобы рассеивать тепло от устройств
 35 освещения. В идеале между передними и задними сторонами задних подсветок должен быть низкий уровень теплового сопротивления.

В других вариантах осуществления модули питания можно поместить в тепловой контакт со множеством теплопроводящих ребер, при этом ребра размещены на пути охлаждающего воздуха (иногда газа окружающей среды). Тепло от модулей питания
 40 распределяется по всем ребрам и отводится охлаждающим воздухом. Было обнаружено, что нагнетание воздуха в относительно узкие каналы, определяемые ребрами, улучшает возможность отводить тепло от модулей питания.

В другом варианте осуществления и модули питания, и задняя подсветка дисплея (или блок изображения) находятся в тепловом контакте с ребрами. Таким образом,
 45 единственный путь охлаждающего воздуха (иногда газа окружающей среды) может использоваться для охлаждения двух из самых теплых компонентов типичного электронного дисплея. Посредством примера, а не ограничения, в качестве устройств освещения для дисплеев ЖКД обычно используются матрицы из LED. Было обнаружено,

что оптические свойства диодов LED (и других устройств освещения) могут изменяться в зависимости от температуры. Таким образом, когда LED подвергается воздействию комнатных температур, он может производить свет с определенной яркостью, длиной волны и/или цветовой температурой. Однако, когда тот же самый LED подвергается воздействию высоких температур, яркость, длина волны, цветовая температура и другие свойства могут изменяться. Таким образом, когда происходит изменение температуры вдоль задней подсветки LED (некоторые области находятся при более высокой температуре, чем другие), могут возникать оптические несогласованности вдоль задней подсветки, которые могут быть видимыми для наблюдателя. Благодаря использованию вариантов осуществления, представленных в данном описании, теплообразование может равномерно распределяться по ребрам и отводиться из дисплея. Это может предотвращать образование любых потенциальных «горячих точек» в задней подсветке, которые могут становиться видимыми для наблюдателя из-за изменения в оптических свойствах устройств освещения (иногда диодов LED, но не всегда). В других вариантах осуществления блок изображения (скорее чем задняя подсветка) находится в тепловом контакте с ребрами. Блок изображения может содержать электронный блок любой формы для генерирования изображения, включая, но не ограничиваясь этим: ЖКД, светоизлучающий диод (LED), органический светоизлучающий диод (OLED), дисплеи с автоэлектронной эмиссией (FED), светоизлучающие полимеры (LEP), плазменные дисплеи и любые другие дисплеи с плоским/тонким экраном.

Ребра могут обеспечивать изолированную камеру от остальной части дисплея так, чтобы для охлаждения ребер можно было засасывать и использовать атмосферный воздух. Это выгодно для ситуаций, в которых дисплей подлежит использованию в наружной среде и засасываемый воздух может содержать загрязнения (пыльцу, грязь, пыль, воду, дым и т.д.), которые могут повреждать чувствительные электронные компоненты дисплея.

Если задняя подсветка используется с конкретным применением дисплея, то можно использовать заднюю подсветку с передней и задней сторонами, при этом передняя сторона содержит устройства освещения, а задняя сторона содержит теплопроводящую поверхность для рассеивания тепла от устройств освещения. В идеале между передними и задними сторонами задних подсветок должен быть низкий уровень теплового сопротивления. Примерный вариант осуществления содержит PCB (печатную плату) с металлическим сердечником, с диодами LED на передней стороне и металлической поверхностью на задней стороне.

С помощью описанных ниже аспектов примерные варианты осуществления, представленные в данном описании, сделали возможным подходящее охлаждение для больших электронных дисплеев даже в условиях жаркого климата и размещения в условиях прямого солнечного света. Варианты осуществления также не требуют какой-либо формы кондиционера (хотя, если требуется, его можно использовать), и это уменьшает потребности в пространстве и электроэнергии для дисплея.

Вышеизложенные и другие признаки и преимущества примерных вариантов осуществления будут очевидны из последующего более подробного описания определенных вариантов осуществления изобретения, иллюстрируемых на прилагаемых чертежах.

Краткое описание чертежей

Лучше понять примерный вариант осуществления можно при прочтении последующего подробного описания и с помощью прилагаемых чертежей, на которых идентичные позиционные обозначения относятся к идентичным частям и на которых:

фиг. 1 - перспективное изображение типичного модуля питания;

фиг. 2 - перспективное изображение двух модулей питания, установленных внутри изолирующей конструкции;

фиг. 3 - перспективное изображение варианта осуществления, в котором охлаждающий воздух может использоваться для охлаждения модулей питания и блока задней подсветки;

фиг. 4 - перспективное изображение варианта осуществления, который подобен варианту осуществления, показанному на фиг. 3, за исключением того, что теперь теплоотвод используется с модулями питания;

фиг. 5 показывает перспективное изображение варианта осуществления, в котором между блоком задней подсветки и изолирующей конструкцией образовано множество каналов;

фиг. 7 показывает перспективное изображение в разрезе другого варианта осуществления, который использует теплопроводящую пластину и теплопроводящие ребра;

фиг. 8 показывает перспективное изображение в разрезе другого варианта осуществления, в котором ребра используются для распределения тепла от блока задней подсветки и его охлаждения;

фиг. 9 - перспективное изображение сзади варианта осуществления, в котором задняя крышка дисплея удалена;

фиг. 10А - перспективное изображение в разрезе другого варианта осуществления, показывающее каналы замкнутого контура и разомкнутого контура;

фиг. 10В - перспективное изображение в разрезе, подобное изображению, показанному на фиг. 10А, в котором задняя и боковые крышки удалены;

фиг. 11 - перспективное изображение в разрезе другого варианта осуществления, показывающее впускные и выпускные отверстия для газа окружающей среды, который используется только в пределах теплообменника, а не в дополнительных необязательных каналах; и

фиг. 12 - перспективное изображение в разрезе примерного варианта осуществления, в котором используется теплообменник с пересекающимися направлениями потоков, чтобы разделять блоки электропитания большой и малой мощности.

Подробное описание изобретения

Фиг. 1 показывает один вариант осуществления типичного модуля 7 питания, который может использоваться с некоторыми из вариантов осуществления, описанных в данном описании. Печатная плата 6 может быть прикреплена к модулю 7 питания и может содержать множество электронных компонентов 5, которые могут быть необходимыми для работы и управления модулем 7 питания. Эти электронные компоненты 5 могут включать в себя резисторы, конденсаторы, операционные усилители, монтажные жгуты, соединители и катушки индуктивности, но не ограничиваясь этим. Базовая плата 8 может быть прикреплена к модулю 7 питания и может действовать как блок рассеивания тепла для модуля 7 питания, так что тепло, которое образуется модулем 7 питания, передается к базовой плате 8. В некоторых вариантах осуществления может быть больше используемых компонентов, например контактная площадка, расположенная между модулем питания и базовой платой 8. Кроме того, как дополнительно обсуждается ниже, с базовой платой 8 может использоваться любой тип теплоотвода или сборки ребер, чтобы дополнительно улучшать ее термодинамические свойства. Также между базовой платой 8 и блоком теплоотвода могут быть размещены контактные площадки.

Фиг. 2 показывает два модуля питания, установленные внутри изолирующей конструкции 9, которая по существу предотвращает передачу газа и загрязнений между двумя сторонами модуля питания. Базовые платы 8 модулей питания показаны на стороне изолирующей конструкции 9, на которой охлаждающий воздух 4 окружающей среды предназначен для прохождения поверх базовых плат 8. Могут использоваться уплотнительные прокладки 11, чтобы обеспечивать газонепроницаемое (и/или непроницаемое для загрязнений) уплотнение между модулями питания и изолирующей конструкцией 9. Охлаждающий воздух 4 иногда втягивается из среды, окружающей дисплей. Эта окружающая среда может содержать вредные загрязнения, которые могут вызывать повреждения различных электрических компонентов в дисплее. Эти вредные загрязнения включают в себя: пыль, дым, пыльцу, водяной пар, другие вредные твердые частицы и другие вредные газы, но не ограничиваясь этим. Таким образом, одно из назначений изолирующей конструкции 9 состоит в том, чтобы предотвращать контакт охлаждающего воздуха 4 окружающей среды с некоторыми из чувствительных электронных компонентов дисплея, включая, но не ограничиваясь этим, электронные компоненты 5 (показанные на фиг. 1), которые требуются для работы и управления модулями питания. Благодаря установлению модулей питания внутри изолирующей конструкции 9 охлаждающий воздух 4 окружающей среды может втягиваться в корпус дисплея и нагнетаться поверх базовых плат 8 (и необязательно по теплоотводам и ребрам) для охлаждения модулей питания. Это может быть выполнено, не подвергая чувствительные электронные компоненты воздействию потенциально вредного охлаждающего воздуха 4 окружающей среды.

Фиг. 3 и 4 показывают варианты осуществления, в которых охлаждающий воздух 4 может использоваться для охлаждения модулей питания и блока 140 задней подсветки. Эти варианты осуществления показывают блок 140 задней подсветки, который содержит множество устройств 141 освещения (например, LED), которые смонтированы на печатной плате (PCB). В примерном варианте осуществления может использоваться PCB с металлическим сердечником или любая другая монтажная конструкция, которая может иметь относительно низкий уровень теплового сопротивления, чтобы тепло могло передаваться от устройств 141 освещения к задней поверхности блока 140 задней подсветки, откуда оно может отводиться посредством охлаждающего воздуха 4. Устройствами 141 освещения могут быть LED, галоген, CCFL или любое другое устройство, которое производит свет. Кроме того, блок задней подсветки, возможно, даже не является необходимым для некоторых вариантов осуществления, таких как плазменные дисплеи, дисплеи на основе OLED, LEP или FED. Однако эти типы дисплея также известны как вырабатывающие тепло и в которых охлаждение задней подсветки, описываемое в этой заявке, эти способы также могут быть применены к охлаждению задних поверхностей этих электронных блоков изображения. Таким образом, там, где показаны блоки задней подсветки, они могут быть заменены на плазменные, OLED, FED или LEP блоки изображения. Электронные компоненты 5 могут быть изолированы от охлаждающего воздуха 4 с помощью использования изолирующей конструкции 9.

Фиг. 4 показывает вариант осуществления, который подобен варианту осуществления, показанному на фиг. 3, за исключением того, что теплоотвод 12 теперь находится в тепловом контакте с модулями питания, чтобы дополнительно облегчать передачу тепла от модулей питания. Конечно, следует отметить, что доступны множество типов теплоотводов, которые изготавливают из множества различных материалов и которые имеют много различных типов конфигураций. В частности, предполагается, что любая форма теплоотвода может использоваться с различными вариантами осуществления

и может использоваться для удовлетворения различным условиям функционирования.

Фиг. 5 показывает другой вариант осуществления, в котором между блоком 140 задней подсветки и изолирующей конструкцией 9 образовано множество каналов 15. Можно использовать разделители 16 каналов, чтобы отделять каждый канал 15 и обеспечивать конструктивную жесткость для всего блока. Разделители 16 каналов предпочтительно можно изготавливать из теплопроводящего материала так, чтобы они также могли осуществлять передачу тепла между блоком 140 задней подсветки и изолирующей конструкцией 9. Теплопроводящий разделитель 16 каналов также может удалять тепло либо от блока 140 задней подсветки, либо от изолирующей конструкции 9 и может рассеивать тепло в воздух, перемещающийся по каналу 15. Таким образом, некоторые разделители 16 каналов могут содержать ребрение или теплоотводы, чтобы облегчать теплопередачу к воздуху, перемещающемуся по каналу 15.

Фиг. 6 показывает вид внизу единственного канала 15, который содержит теплоотвод 12 для модуля питания, установленного внутри изолирующей конструкции 9. Некоторые каналы 15 могут содержать модули питания, а другие могут их не содержать. Для того чтобы втягивать воздух через канал 15 для охлаждения теплоотвода 12 (если он используется) и разделителей 16 каналов (если они теплопроводящие), так же как задней подсветки 140 (или блока LED для светодиодного дисплея), может использоваться вентилятор 17 канала. Каждый канал 15 может содержать один или более вентиляторов 17 канала. Некоторые каналы могут вообще не содержать вентилятор, а могут полагаться исключительно на естественную конвекцию, позволяя теплу увеличиваться и выходить из канала. Как будет подробно обсуждаться ниже, вентиляторы могут быть размещены в блоке дисплея где угодно и могут использоваться для того, чтобы втягивать воздух через каналы, проталкивать воздух через каналы или и для того, и для другого.

В то время как дисплей находится в процессе работы, вентиляторы 17 канала могут работать непрерывно. В качестве альтернативы, в каждый канал могут быть помещены термочувствительные устройства (не показаны) и использоваться для измерения температуры внутри канала или любого из компонентов канала (блока задней подсветки или дисплея, изолирующей конструкции или разделителей каналов). Основываясь на данных, полученных от этих термочувствительных устройств, могут быть вовлечены по выбору различные вентиляторы в зависимости от того, для какого канала требуется охлаждение. Таким образом, вентиляторы 17, которые втягивают воздух через каналы 15, содержащие модули питания, могут работать чаще или на более высоких скоростях вращения из-за большего количества тепла, поступающего от модулей питания. Кроме того, каналы, которые содержат модули питания, для охлаждения канала могут содержать более крупные вентиляторы или множество вентиляторов.

Фиг. 7 показывает другой вариант осуществления, в котором используется теплопроводящая пластина 10 и ребра 18. В одном варианте осуществления базовая плата 8 модуля питания может находиться в тепловом контакте с теплопроводящей пластиной 10. В других вариантах осуществления базовая плата 8 может не использоваться и вместо этого модуль 7 питания может находиться в прямом тепловом контакте с теплопроводящей пластиной 10. Из-за теплопроводящей природы пластины 10 и ребер 18 и теплового контакта между ними тепло, которое производится модулями питания, может распределяться по всей пластине 10 и всем ребрам 18. В примерном варианте осуществления путь охлаждающего воздуха 20 (газа окружающей среды) используется для отведения тепла, которое накапливается на пластине 10 и ребрах 18. В качестве альтернативы, также может использоваться процесс естественной конвекции,

чтобы позволять теплу выходить из пластины 10 и ребер 18.

Для того чтобы устанавливать электронные блоки, такие как PCB, накопители на жестких дисках, панели синхронизации и управления, катушки индуктивности и даже модули питания, если требуется, могут использоваться множество монтажных клемм.

5 Монтажные клеммы также могут быть теплопроводящими, чтобы тепло, которое вырабатывается этими электронными блоками, также могло передаваться к пластине 10 и ребрам 18 и отводиться охлаждающим воздухом 20.

В примерном варианте осуществления пластина 10 может обеспечивать барьер для газа и загрязнений между стороной, содержащей ребра 18 (и охлаждающий воздух 20),
10 и стороной, содержащей монтажные клеммы, модули питания и любые другие электронные блоки. Если пластина 10 обеспечивает соответствующий барьер, атмосферный воздух может засасываться в качестве охлаждающего воздуха 20 и риск проникновения загрязнений на сторону пластины 10, содержащий чувствительные электронные компоненты, может быть уменьшен или исключен. Впускное отверстие
15 25 может использоваться для того, чтобы принимать охлаждающий воздух 20 и направлять его вдоль ребер 18.

Ребра 18, показанные в этом варианте осуществления, имеют полое прямоугольное сечение, но это не является необходимым. Другие варианты осуществления могут содержать ребра с двутавровым профилем, с сечениями в виде полых квадратов, с
20 сечениями в виде тела с прямоугольными гранями или тела с квадратными гранями, Т-образными сечениями, Z-образными сечениями, с сечением гофрированного гнутого профиля, или с сотообразным сечением, или с любой их комбинацией или композицией. Предпочтительно, чтобы ребра 18 были теплопроводящими. В некоторых вариантах осуществления для изготовления ребер 18 может использоваться металл.

25 Фиг. 8 показывает другой вариант осуществления, в котором ребра 18 используются для распределения тепла от блока задней подсветки и его охлаждения. Блок задней подсветки в этом варианте осуществления включает в себя множество устройств 32 освещения, которые установлены на теплопроводящей подложке 30. В примерном варианте осуществления устройствами 32 освещения могут быть LED, а
30 теплопроводящей подложкой 30 может быть PCB и более предпочтительно PCB с металлическим сердечником. На поверхности теплопроводящей подложки 30, которая обращена к ребрам 18, может быть теплопроводящая поверхность 35. В примерном варианте осуществления теплопроводящая поверхность 35 может быть металлической и более предпочтительно алюминиевой. Является предпочтительным, чтобы ребра 18
35 находились в тепловом контакте с задней поверхностью 35 и чтобы задняя поверхность 35 находилась в тепловом контакте с теплопроводящей подложкой 30. Однако в некоторых вариантах осуществления теплопроводящая подложка 30 может содержать традиционные материалы PCB, а не PCB с металлическим сердечником или любые материалы с высокой теплопроводностью. Наиболее предпочтительным является,
40 чтобы между устройствами 32 освещения и ребрами 18 был низкий уровень теплового сопротивления. Охлаждающий воздух 20 снова может нагнетаться вдоль ребер 18, чтобы отводить тепло от блока задней подсветки. Конечно, это также может происходить через естественную конвекцию, но более эффективное охлаждение обычно наблюдается при использовании нагнетаемой конвекции. Блок изображения (такой,
45 как дисплей OLED, в котором задняя подсветка может не использоваться) также может использоваться вместо блока задней подсветки для охлаждения блока изображения.

Как было отмечено выше, многие устройства освещения (особенно диоды LED и OLED) могут иметь эксплуатационные характеристики, которые изменяются в

зависимости от температуры. Когда «горячие точки» присутствуют внутри блока задней подсветки или освещения, эти горячие точки могут приводить к неоднородностям в получающемся изображении, которые могут быть видимыми для конечного пользователя. Таким образом, с вариантами осуществления, описанными в данном описании, тепло, которое может вырабатываться блоком задней подсветки, может 5 распределяться по различным ребрам и по всем теплопроводящим поверхностям, чтобы устранять горячие точки и охлаждать заднюю подсветку.

В примерном варианте осуществления ребра 18 могут использоваться для охлаждения и блока задней подсветки, и модулей питания. В дополнительном примерном варианте 10 осуществления ребра 18 также могут использоваться для охлаждения любых дополнительных электронных блоков посредством их размещения в тепловом контакте с теплопроводящей пластиной 10. Таким образом, с ребрами 18 в центральном расположении, «передняя сторона» может быть направлена к намеренному наблюдателю дисплея, в то время как «задняя сторона» будет на противоположной стороне от 15 намеренного наблюдателя. Поэтому передняя сторона ребер 18 может быть в тепловом контакте с блоком задней подсветки (или другим блоком освещения или блоком создания изображений), а задняя сторона ребер будет в тепловом контакте с задней пластиной (то есть с теплопроводящей пластиной 10). Тогда для охлаждения внутреннего пространства дисплея может использоваться единственный путь охлаждающего воздуха, 20 в то время как различные горячие точки могут распределять тепло по всем ребрам и другим теплопроводящим поверхностям, чтобы обеспечивать наиболее эффективное охлаждение. Это может быть выполнено без необходимости подвергать чувствительные электрические компоненты воздействию загрязнений и/или твердых частиц газа окружающей среды.

Фиг. 9 показывает задний участок примерного электронного дисплея 100, в котором задняя крышка для корпуса дисплея удалена, чтобы показать внутренние компоненты. В этом варианте осуществления блоки 102 и 103 вентиляторов для замкнутого контура циркулирующего газа могут быть размещены вдоль двух противоположных краев теплообменника 101. Предпочтительно блок 102 вентилятора является входом для 30 теплообменника, а блок 103 вентилятора является выходом для теплообменника 101. Однако, необязательно, эти блоки могут быть инвертированы таким образом, чтобы блок 103 вентилятора являлся входом, а блок 102 вентилятора являлся выходом. Кроме того, оба блока 102 и 103 не являются необходимыми. Некоторые варианты осуществления могут использовать только один блок вентилятора для замкнутого 35 контура циркулирующего газа. Если используется только один блок вентилятора, предпочтительно размещать этот блок вентилятора на входе теплообменника 101, чтобы циркулирующий газ «вытягивался» через переднюю сторону блока изображения и проталкивался через теплообменник 101. Однако это не является необходимым; в других вариантах осуществления изолированный газ может вытягиваться через 40 теплообменник 101. В других вариантах осуществления изолированный газ может проталкиваться через переднюю сторону блока изображения. Блоки 104 и 105 вентиляторов для разомкнутого контура газа окружающей среды могут быть размещены вдоль двух противоположных краев корпуса дисплея. Снова оба блока 104 и 105 не являются необходимыми, поскольку в некоторых вариантах осуществления может 45 использоваться только один блок, и блоки вентиляторов разомкнутого контура могут использовать в конструкции проталкивания или втягивания. Поэтому, когда делается ссылка на размещение различных блоков вентиляторов, термины «проталкивать», «вытягивать», «всасывать» и «нагнетать» могут использоваться взаимозаменяемым

образом и любая ориентация может использоваться с различными вариантами осуществления, представленными в данном описании.

Циркулирующий газ, который нагнетается с помощью блоков вентиляторов замкнутого контура, прежде всего циркулирует вокруг дисплея. Например, циркулирующий газ перемещается в контуре, в котором он контактирует с передней поверхностью блока изображения (см. фиг. 10A-10B), и передает тепло от блока изображения к циркулирующему газу. Затем циркулирующий газ предпочтительно направляется (или вытягивается, или нагнетается и т.д.) в теплообменник 101, чтобы передавать тепло от циркулирующего газа к газу окружающей среды. Впоследствии, циркулирующий газ выходит из теплообменника 101 и может возвращаться к передней поверхности блока изображения. Циркулирующий газ также может проходить поверх некоторых электронных компонентов 110, чтобы удалять тепло также из этих устройств. Электронные компоненты 110 могут быть любыми компонентами или блоками, используемыми для манипулирования дисплеем, включая, но не ограничиваясь этим: трансформаторы, печатные платы, резисторы, конденсаторы, батареи, модули питания, двигатели, катушки индуктивности, устройства освещения, межсоединения и монтажные жгуты, источники света, термоэлектрические устройства и переключатели. В некоторых вариантах осуществления электрические компоненты 110 также могут включать в себя нагреватели, когда блок дисплея может использоваться в окружающих средах холодного климата.

Чтобы охлаждать циркулирующий газ (а также, необязательно, охлаждать блоки задней подсветки или блоки изображения, как представлено выше), газ окружающей среды засасывается в корпус дисплея блоком 104 и/или 105 вентилятора разомкнутого контура. Газ окружающей среды может быть просто атмосферным воздухом, который окружает дисплей 100. В некоторых вариантах осуществления газ окружающей среды может быть кондиционирован до всасывания в дисплей с помощью одного или более блоков кондиционирования воздуха (не показаны). Как только газ окружающей среды засасывается в дисплей, он может быть направлен (или нагнетен) в теплообменник 101 и, необязательно, также через заднюю поверхность блока задней подсветки или блока изображения (см. фиг. 10A-10B), или даже ребра/каналы, как показано выше, или через модули питания, как показано выше. При использовании теплообменника 101, тепло передается от циркулирующего газа к газу окружающей среды. Затем нагретый газ окружающей среды удаляется из корпуса дисплея.

Хотя это не является необходимым, предпочтительно, чтобы циркулирующий газовый и газ окружающей среды не смешивались. В предпочтительном варианте осуществления теплообменник 101 может быть теплообменником с пересекающимися направлениями потоков. Однако известны множество типов теплообменников, и они могут использоваться с любым из вариантов осуществления, представленных в данном описании. Теплообменник 101 может быть теплообменником с пересекающимися направлениями потоков, с параллельными потоками или с перекрестными потоками («трубка внутри трубки» или иначе). В примерном варианте осуществления теплообменник 101 может быть с пересекающимися направлениями потоков, и он может состоять из множества расположенный друг над другом слоев тонких пластин. Пластины могут иметь гофрированную или сотообразную конструкцию, в которой множество проходов или каналов проходят вниз по пластине в продольном направлении. Пластины могут быть сложены так, что направления проходов чередуются с каждой смежной пластиной, так что проходы каждой пластины являются по существу перпендикулярными проходам смежных пластин. Таким образом, газ может входить

в теплообменник только через пластины, проходы или каналы которых проходят параллельно пути прохождения газа. Поскольку пластины чередуются, газы замкнутого контура и окружающей среды могут перемещаться в пластинах, которые являются смежными друг с другом, и тепло может передаваться между этими двумя газами без
 5 смешивания самих газов (если теплообменник соответствующим образом герметизирован, что является предпочтительным, но не обязательным).

В альтернативной конструкции в промежутке между парами снабженных каналами или сотообразных пластин может быть размещен открытый зазор. Открытый зазор может проходить в направлении, которое перпендикулярно каналам пластин. Этот
 10 открытый зазор может быть создан с помощью двух полос материала или ленты (особенно ленты клеевого соединения с очень высокой прочностью (VNB)) между двумя противоположными краями пластин в направлении, которое перпендикулярно направлению каналов в смежных пластинах. Таким образом, газ может проходить через открытый зазор (параллельный полосам или ленте), но не может проходить через
 15 открытый зазор в направлении, которое перпендикулярно полосам или ленте (параллельно каналам смежных пластин).

Другие типы теплообменников с пересекающимися направлениями потоков могут включать в себя множество трубок, которые содержат первый газ и проходят перпендикулярно пути прохождения второго газа. Когда второй газ протекает поверх
 20 трубок, содержащих первый газ, между этими двумя газами происходит теплообмен. Очевидно, что существует много типов теплообменников с пересекающимися направлениями потоков, и любой тип может работать с вариантами осуществления, представленными в данном описании.

Примерный теплообменник может иметь пластины, у которых боковые стенки являются относительно тонкими, так что можно легко осуществлять теплообмен между
 25 двумя путями прохождения газа. Для создания теплообменника можно использовать множество материалов. Предпочтительно используемый материал должен быть коррозионно-устойчивым, устойчивым к гниению, иметь легкий вес и быть недорогим. Для теплообменников обычно используются металлы из-за их высокой
 30 теплопроводности. Однако было обнаружено, что пластмассы и композиционные материалы также могут удовлетворять условиям теплового режима для электронных дисплеев. В примерном варианте осуществления можно использовать полипропилен в качестве материала, предназначенного для конструирования пластин для теплообменника. Было найдено, что, хотя полипропилен может походить на плохой
 35 проводник тепла, большая величина площади поверхности относительно маленькой толщины материала приводит к полному тепловому сопротивлению, которое является низким. Таким образом, примерный теплообменник может быть сделан из пластмассы, и, таким образом, можно производить блок дисплея, который является тонким и легким. В частности, для каждого слоя пластины может использоваться гофропласт
 40 (гофрируемая пластмасса) или сотопласт (сотообразная пластмасса).

Как упомянуто выше, блоки и проточного, и вытяжного вентиляторов для этих вариантов осуществления не являются необходимыми. В качестве альтернативы, для каждого контура может использоваться только один блок вентилятора. Таким образом, с замкнутым контуром может использоваться только блок проточного вентилятора,
 45 а с разомкнутым контуром может использоваться только блок вытяжного вентилятора. В качестве альтернативы, один из контуров может иметь оба блока и проточного, и вытяжного вентилятора, в то время как у другого контура имеется только либо проточный, либо вытяжной блок.

Газ, используемый в обоих контурах, может быть любым из множества газообразных веществ. В некоторых вариантах осуществления в качестве газа для обоих контуров может использоваться воздух. Предпочтительно газ, который перемещается через замкнутый контур, должен быть в значительной степени чистым, чтобы, когда он
 5 проходит перед блоком изображения, он не влиял на внешний вид изображения для наблюдателя. Газ, который перемещается по замкнутому контуру, также должен быть по существу свободным от загрязнений и/или твердых частиц (например, пыли, грязи, пыльцы, водяного пара, дыма и т.д.), чтобы предотвращать отрицательное воздействие на качество изображения и повреждение внутренних электронных компонентов. Также
 10 может быть предпочтительным поддерживать газ в пределах разомкнутого контура свободным от загрязнений. Может использоваться необязательный фильтр (не показан), чтобы гарантировать, что воздух (либо в замкнутом, либо в разомкнутом контуре) остается свободным от загрязнений. Однако в примерном варианте осуществления разомкнутый контур может быть разработан так, чтобы загрязнения, возможно,
 15 присутствовали в газе окружающей среды, но это не оказывало вредное воздействие на дисплей. В этих вариантах осуществления теплообменник (и необязательный путь позади блока изображения или задней подсветки или через ребра) должным образом герметизирован так, чтобы любые загрязнения в газе окружающей среды не могли попасть к чувствительным участкам дисплея. Таким образом, в этих примерных
 20 вариантах осуществления засасывание атмосферного воздуха для газа окружающей среды, даже если атмосферный воздух содержит загрязнения, не будет оказывать вредное воздействие на дисплей. Это может быть особенно выгодно, когда дисплей используется в наружных средах или внутренних средах, в которых в атмосферном воздухе присутствуют загрязнения.

Фиг. 10А показывает сечение другого варианта осуществления дисплея 200. На этом чертеже задняя крышка 250 и боковые крышки 251 и 252 показаны для иллюстрирования одного способа герметизации всего дисплея 200. Блок 220 изображения показан вблизи от передней стороны дисплея 200. Как обсуждалось выше, блок 220 изображения может содержать электронный блок любой формы для генерирования изображения, включая,
 30 но не ограничиваясь этим: ЖКД, светоизлучающие диоды (LED), органические светоизлучающие диоды (OLED), дисплеи с автоэлектронной эмиссией (FED), светоизлучающие полимеры (LEP), плазменные дисплеи и любые другие дисплеи с плоским/тонким экраном. Передняя поверхность 221 дисплея размещена перед блоком 220 изображения, определяя канал 290, по которому может протекать циркулирующий
 35 газ. Передняя поверхность 221 дисплея может быть любым прозрачным материалом (стекло, пластмасса или композиционный материал), и она может содержать несколько слоев для поляризации света, уменьшения бликов или отражений и защиты внутренних компонентов дисплея. В примерном варианте осуществления передняя поверхность 221 дисплея может содержать две стеклянные панели, которые изготовлены в виде
 40 слоистой структуры с оптическим клеем (предпочтительно с согласующимся показателем преломления). Кроме того, к одной из стеклянных панелей может быть прикреплен поляризующий слой, чтобы уменьшать внутренние отражения и солнечную нагрузку на блок 220 изображения. Самым предпочтительным является то, что поляризующий слой прикреплен к внутренней поверхности передней поверхности 221 дисплея
 45 (обращенной к каналу 290 замкнутого контура) и также содержит просветляющее (AR) покрытие.

Для варианта осуществления, показанного на фиг. 10А, блок 220 изображения может быть ЖКД, объединенным с блоком 222 задней подсветки. Для некоторых задних

подсветок можно использовать люминесцентные лампы с холодным катодом (CCFL), чтобы производить освещение, необходимое для генерирования изображения. В примерном варианте осуществления блок 222 задней подсветки может содержать печатную плату (PCB) с множеством LED (светоизлучающих диодов) на передней поверхности. Как обсуждалось выше, примерный вариант осуществления может иметь низкий уровень теплового сопротивления между передней поверхностью блока 222 задней подсветки и задней поверхностью 223 задней подсветки. С этой целью может использоваться металлическая PCB. Задняя поверхность 223 задней подсветки может содержать теплопроводящий материал, такой как металл. Примерным материалом для задней поверхности 223 может быть алюминий. Вторая поверхность (или пластина) 224 может быть размещена в непосредственной близости позади задней поверхности 223 блока 222 задней подсветки. Пространство между задней поверхностью 223 задней подсветки и второй поверхностью 224 может определять дополнительный необязательный канал 225 разомкнутого контура, через который может проходить газ окружающей среды для охлаждения блока 222 задней подсветки. Этот канал 225 разомкнутого контура может быть подобен каналу 15, показанному выше, за исключением того, что канал 225 разомкнутого контура может быть более узким.

Фиг. 10B показывает такой же вид в разрезе, как фиг. 10A, с удаленными задней крышкой 250 и боковыми крышками 251 и 252 и воздушными потоками закрытого и разомкнутого контура, показанными для пояснительных целей. Блок 202 вентилятора замкнутого контура используется для того, чтобы приводить в движение циркулирующий газ 210 по замкнутому контуру. Первый блок 203 вентилятора разомкнутого контура может использоваться для втягивания газа 211 окружающей среды через теплообменник 201. Необязательно, второй блок 204 вентилятора разомкнутого контура может использоваться для втягивания газа окружающей среды 212 через необязательный канал 225 для охлаждения блока 222 задней подсветки. Необязательный второй блок 204 вентилятора разомкнутого контура также может использоваться для того, чтобы выпускать газ окружающей среды, который перемещается через теплообменник 201 и по каналу 225. Если второй блок 204 вентилятора разомкнутого контура не используется, первый блок 203 вентилятора разомкнутого контура может использоваться для того, чтобы выпускать газ 211 окружающей среды, который прошел через теплообменник 201.

Как отмечено выше, в примерном варианте осуществления газ окружающей среды не смешивается с циркулирующим газом. Для качества изображения может быть важно, чтобы циркулирующий газ оставался свободным от твердых частиц и загрязнений, поскольку этот газ перемещается перед блоком 220 изображения. Так как газ для разомкнутого контура может содержать различные загрязнения, предпочтительный вариант осуществления должен быть соответствующим образом герметизирован, чтобы предотвращать смешивание газа из этих двух контуров. Однако это не является необходимым, поскольку фильтры (либо съемные, либо постоянные) могут использоваться для того, чтобы сводить к минимуму воздействие твердых частиц и для разомкнутого, и для замкнутого контуров.

Фиг. 11 представляет перспективное изображение в разрезе другого варианта осуществления блока 600 дисплея, показывающего впускное 60 и выпускное 65 отверстия для газа 20 окружающей среды. Впускное отверстие 60 может содержать экран или фильтр (съемный или постоянный), чтобы удалять любые твердые частицы (хотя это может не являться необходимым). Один или более вентиляторов 50 могут использоваться для того, чтобы втягивать газ 20 окружающей среды во впускное отверстие 60 и через

теплообменник 201. В этом варианте осуществления газ 20 окружающей среды втягивается только через теплообменник 201, а не через какие-либо дополнительные необязательные каналы или ребра. Этот вариант осуществления может использоваться, когда блок 80 дисплея (или блок задней подсветки) не требует дополнительного
 5 охлаждения для дополнительного канала. В качестве примера, а не посредством ограничения, этот вариант 600 осуществления может использоваться, когда в качестве блока 80 изображения используются OLED. Кроме того, этот вариант 600 осуществления может использоваться, когда задняя подсветка ЖКД не образует большое количество тепла, потому что она не должна быть чрезвычайно яркой (возможно, потому что она
 10 не используется в условиях прямого солнечного света). Помимо этого данный вариант осуществления может использоваться, когда газ 20 окружающей среды содержит твердые частицы или загрязнения, которые могут повредить дисплей. В этих ситуациях может потребоваться ограничивать воздействие на дисплей газа 20 окружающей среды. Таким образом, в этих ситуациях может потребоваться засасывать газ 20 окружающей
 15 среды только в теплообменник 201, а не через какие-либо дополнительные каналы охлаждения.

В некоторых вариантах осуществления газ 20 окружающей среды может быть кондиционирован (или в противном случае охлажден) прежде, чем он будет направлен в теплообменник 201. Передняя поверхность 221 дисплея может использоваться для
 20 того, чтобы образовывать предшествующую (переднюю) стенку канала 290 и/или защищать блок 80 изображения от повреждений. Примерная передняя поверхность 221 дисплея может быть стеклянной. Другой вариант осуществления для передней поверхности 221 дисплея может представлять собой две стеклянные панели, которые изготовлены в виде слоистой структуры с использованием оптического клея. Солнечная
 25 нагрузка (лучистая теплопередача от солнца через переднюю поверхность 221 дисплея может привести к теплообразованию в блоке 80 изображения (например, в блоке OLED или ЖКД). Это тепло может быть передано циркулирующему газу, в котором это тепло затем может быть передано газу 20 окружающей среды и удалено из дисплея. Блок изображения может быть любым из следующих: ЖКД, блока плазменного дисплея,
 30 OLED, блока светоизлучающего полимера (LEP), блока органического электролюминесцентного дисплея (OEL) или блока светодиодного дисплея.

Фиг. 12 показывает примерный вариант осуществления, в котором циркулирующий газ 400 нагнетается между передней поверхностью 221 дисплея и блоком 80 изображения и затем через теплообменник 201, чтобы отводить по меньшей мере часть тепла,
 35 поглощенного от блока 80 изображения и передней поверхности 221 дисплея. Циркулирующий газ 400 может приводиться в движение блоком 410 вентилятора замкнутого контура. Теплообменник 201 может принимать циркулирующий газ 400 в одном направлении, в то же время принимая газ 310 окружающей среды по существу в перпендикулярном направлении, так что между этими двумя газами может
 40 осуществляться теплопередача.

В этом варианте осуществления необязательный дополнительный поток газа 300 окружающей среды принимается через впускное отверстие 350 и направляется по каналу 225 для охлаждения заднего участка блока 80 изображения (возможно, задней
 45 подсветки). Этот вариант осуществления использует ряд ребер 18, подобных конструкциям, показанным выше на фиг. 7 и 8. Этот вариант осуществления также использует теплопроводящую пластину 10, подобную теплопроводящей пластине, показанной на фиг. 7. Когда используется этот необязательный дополнительный поток газа 300 окружающей среды, предпочтительно, чтобы предшествующая (передняя)

поверхность 500 канала 225 была теплопроводящей и предпочтительно находилась в тепловом контакте по меньшей мере с участком (предпочтительно задним участком) блока 80 изображения. Впускное отверстие 350 может принимать оба потока газа 310 и 300 окружающей среды, или для каждого потока газа 310 и 300 могут быть отдельные впускные отверстия.

Подобно некоторым из ранее описанных вариантов осуществления, циркулирующий газ 400 также проходит поверх электронных блоков, чтобы принимать тепло от этих электронных блоков. В этом примерном варианте осуществления электронные блоки были разделены теплообменником 201 на две группы. Первую группу электронных блоков 900 можно рассматривать как блоки большой мощности, и они могут включать в себя, но не ограничиваясь этим: модули питания, катушки индуктивности, трансформаторы и другие связанные с питанием устройства. Вторую группу электронных блоков 910 можно рассматривать как маломощные блоки, и они могут включать в себя, но не ограничиваясь этим: панели синхронизации и управления, накопители на жестких дисках и другие устройства хранения данных, видеокарты, программные драйверы, микропроцессоры и другие управляющие устройства. Специалистам в данной области техники должно быть известно, что некоторые электронные блоки большой мощности могут вызывать взаимные электрические помехи с другими электронными блоками, которые могут быть чувствительными к электрическим помехам. Таким образом, в показанном примерном варианте осуществления, теплообменник 201 используется для отделения электронных блоков 910 более низкой мощности от электронных блоков 900 большой мощности, чтобы гарантировать минимальную величину взаимных электрических помех между ними. Кроме того, некоторые электронные блоки 900 большой мощности, как известно, также вырабатывают тепло. Это тепло может быть передано циркулирующему газу 400 до введения этого газа в теплообменник 201. В показанном примерном варианте осуществления атмосферный воздух может засасываться в качестве газа 310 окружающей среды, и существует лишь небольшой риск повреждения электрических блоков 910 и 900, потому что газ 310 окружающей среды предпочтительно никогда не контактирует с этими электрическими блоками. Однако электрические блоки 910 и 900 будут оставаться холодными (так же как чистыми и сухими) благодаря поперечному течению циркулирующего газа 400.

Система охлаждения, описанная в данном описании, может работать непрерывно. Однако, если требуется, в электронный дисплей могут быть включены термочувствительные устройства (не показаны), чтобы обнаруживать, когда температуры достигают предварительно определенного порогового значения. В таком случае, когда температура в дисплее достигает предварительно определенного значения, по выбору могут быть задействованы различные вентиляторы. Могут быть выбраны предварительно определенные пороговые значения, и система может быть выполнена с возможностью благоприятно поддерживать дисплей в пределах приемлемого диапазона температур. Для выполнения этой задачи могут использоваться типичные блоки термостатов. В качестве термочувствительных устройств могут использоваться термопары. Скорость вращения различных блоков вентиляторов также может изменяться в зависимости от температуры внутри дисплея.

В частности, следует отметить, что сущность и объем раскрытых вариантов осуществления предусматривают охлаждение любого типа электронного дисплея. Посредством примера, а не посредством ограничения, варианты осуществления могут использоваться в связи с любым устройством из следующих: ЖКД (всеми типами),

светоизлучающими диодами (LED), органическими светоизлучающими диодами (OLED), дисплеем с автоэлектронной эмиссией (FED), светоизлучающим полимером (LEP), органическим электролюминесцентным дисплеем (OEL), плазменными дисплеями и любым другим типом дисплея с плоским/тонким экраном. Кроме того, варианты осуществления могут использоваться с дисплеями других типов, включая еще не открытые. В частности, предполагается, что система может хорошо подходить для использования с большими жидкокристаллическими (ЖКД) дисплеями с задней подсветкой LED и высокой разрешающей способностью (1080i или 1080p или больше). Хотя описанные в данном описании варианты осуществления хорошо подходят для наружных сред, они также могут быть подходящими для внутренних применений (например, для заводских/производственных сред, курортов, раздевалок, кухонь, ванных комнат), в которых температурная устойчивость дисплея может находиться в опасности.

Следует также отметить, что многообразные охлаждающие каналы, которые показаны на чертежах, могут быть показаны в горизонтальном или вертикальном расположении, но должно быть ясно, что предполагается, что они могут быть реверсированы или изменены в зависимости от конкретного варианта осуществления. Таким образом, замкнутый контур может проходить горизонтально или вертикально и в направлении по часовой стрелке или против часовой стрелки. Кроме того, разомкнутый контур также может быть горизонтальным или вертикальным и может проходить слева направо, справа налево и сверху донизу или снизу доверху.

При наличии показанных и описанных предпочтительных вариантов осуществления, специалистам в данной области техники должно быть понятно, что могут быть сделаны множество изменений и модификаций, влияющих на описанное изобретение и все еще остающихся в рамках объема заявленного изобретения. Дополнительно, многие из элементов, указанных выше, могут быть изменены или заменены другими элементами, которые обеспечивают такой же результат и все еще находятся в пределах сущности заявленного изобретения. Следовательно, изобретение должно быть ограничено только указанным объемом формулы изобретения.

30 Формула изобретения

1. Система охлаждения для электронного блока 220/80 изображения, имеющего перед и зад, причем система содержит переднюю поверхность 221 дисплея, пространственно разнесенную с передом электронного блока 220/80 изображения, канал 290, определенный пространством между передней поверхностью 221 дисплея и передом электронного блока 220/80 изображения, теплообменник 201, находящийся в газовой связи с каналом 290, при этом теплообменник имеет первый и второй проходы для газа, причем первый проход для газа находится в газовой связи с каналом 290, первый блок 202/410 вентилятора, расположенный так, чтобы нагнетать циркулирующий газ 210/400 в канал 290 и первый проход для газа, и второй блок 203/50 вентилятора, расположенный так, чтобы нагнетать газ 211/310 окружающей среды во второй проход для газа.

2. Система охлаждения по п. 1, в которой теплообменник 201 представляет собой теплообменник с пересекающимися направлениями потоков.

3. Система охлаждения по п. 1, дополнительно содержащая пластину 10, пространственно разнесенную с задом электронного блока 220/80 изображения, второй канал 225, определенный пространством между пластиной 10 и задом электронного блока 220/80 изображения, и третий блок 204 вентилятора дополнительно расположен так, чтобы нагнетать газ 212/300 окружающей среды во второй канал 225.

4. Система охлаждения по п. 3, дополнительно содержащая модуль питания, находящийся в электрической связи с электронным блоком 220/80 изображения, и теплоотвод 12, находящийся в тепловом контакте с модулем питания и размещенный внутри второго канала 225.

5 Система охлаждения по любому из пп. 3 или 4, дополнительно содержащая множество ребер 18, размещенных внутри второго канала 225.

6. Блок электронного дисплея, содержащий электронный блок 220/80 изображения, изолирующую конструкцию 9, пространственно разнесенную с электронным блоком 220/80 изображения, канал 15/225, определенный пространством между изолирующей конструкцией 9 и электронным блоком 220/80 изображения, модуль питания, имеющий электронные компоненты 5 на первой стороне и теплоотвод 12 на второй стороне, при этом модуль питания прикреплен к изолирующей конструкции 9 так, что теплоотвод 12 находится внутри канала 15/225, а электронные компоненты 5 находятся снаружи канала 15/225, и вентилятор 204, расположенный так, чтобы вытягивать газ окружающей среды в канал 15/225.

7. Блок электронного дисплея по п. 6, дополнительно содержащий ребро 18, расположенное внутри канала 15/225 и в тепловом контакте с изолирующей конструкцией 9.

8. Блок электронного дисплея по п. 7, дополнительно содержащий поверхность 500, расположенную внутри канала 15/225 и в тепловом контакте с электронным блоком 220/80 изображения и ребром 18.

9. Блок электронного дисплея по любому из пп. 6, 7 или 8, в котором электронный блок 220/80 изображения представляет собой жидкокристаллический дисплей.

10. Блок электронного дисплея по любому из пп. 6, 7 или 8, в котором электронный блок 220/80 изображения представляет собой дисплей OLED.

11. Блок электронного дисплея, содержащий электронный блок 220/80 изображения, имеющий перед и зад, поверхность 500 сзади электронного блока 220/80 изображения и в тепловом контакте с электронным блоком 220/80 изображения, пластину 10, пространственно разнесенную с поверхностью 500, первый канал 225, определенный пространством между пластиной 10 и поверхностью 500, модуль 900 питания, находящийся в электрической связи с электронным блоком 220/80 изображения и в тепловом контакте с пластиной 10, и первый вентилятор 204, расположенный так, чтобы вытягивать газ окружающей среды в первый канал 225.

12. Блок электронного дисплея по п. 11, дополнительно содержащий ребро 18, размещенное внутри первого канала 225 и в тепловом контакте с пластиной 10 и поверхностью 500.

13. Блок электронного дисплея по п. 12, дополнительно содержащий переднюю поверхность 221 дисплея, пространственно разнесенную с передом электронного блока 220/80 изображения, второй канал 290, определенный пространством между передней поверхностью 221 дисплея и передом электронного блока 220/80 изображения, теплообменник 201, находящийся в газовой связи со вторым каналом 290, причем теплообменник 290 имеет первый и второй проходы для газа, при этом первый проход для газа находится в газовой связи со вторым каналом 290, второй вентилятор 203/50, расположенный так, чтобы нагнетать газ 211/310 окружающей среды во второй проход для газа, и третий вентилятор 202/410, расположенный так, чтобы нагнетать циркулирующий газ 210/400 во второй канал 290 и первый проход для газа.

14. Блок электронного дисплея по любому из пп. 11-13, в котором электронный блок 220/80 изображения представляет собой ЖКД.

15. Блок электронного дисплея по любому из пп. 11-13, в котором электронный блок 220/80 изображения представляет собой OLED.

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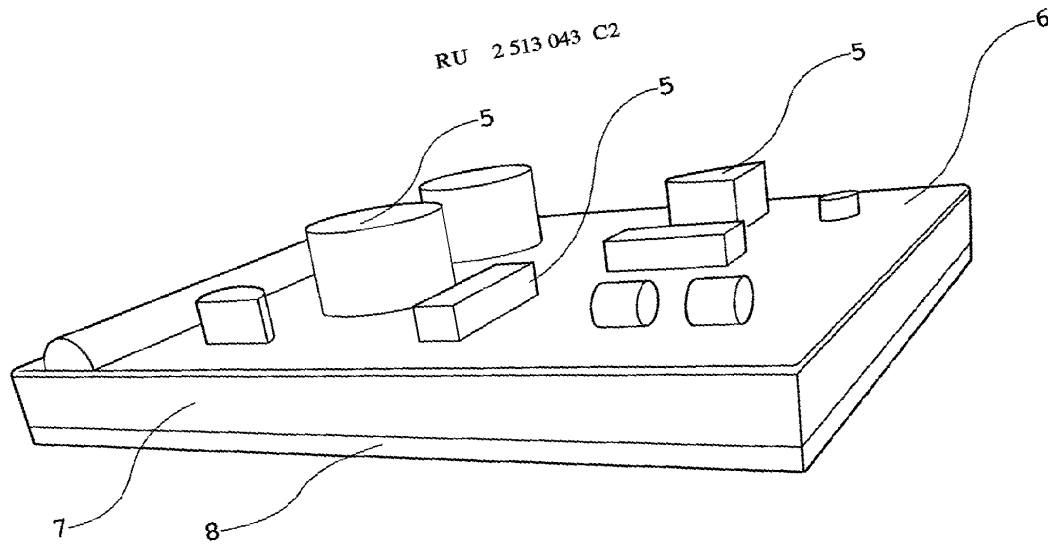
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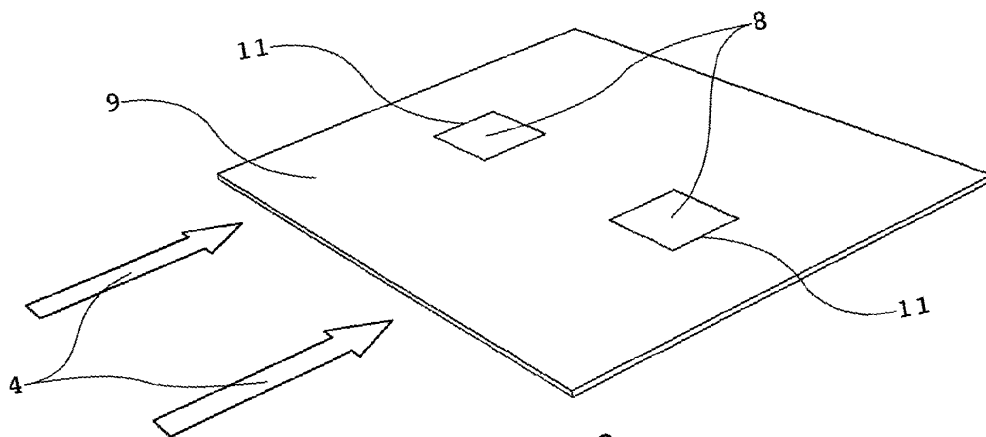
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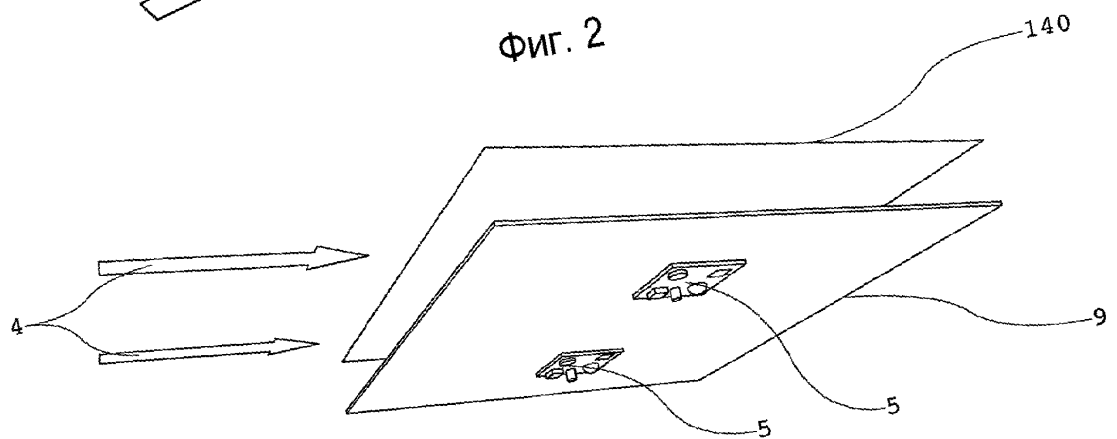
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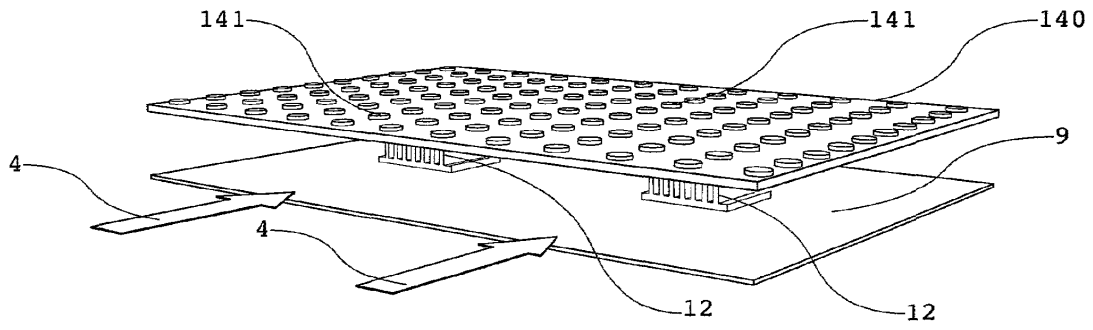
ФИГ. 1



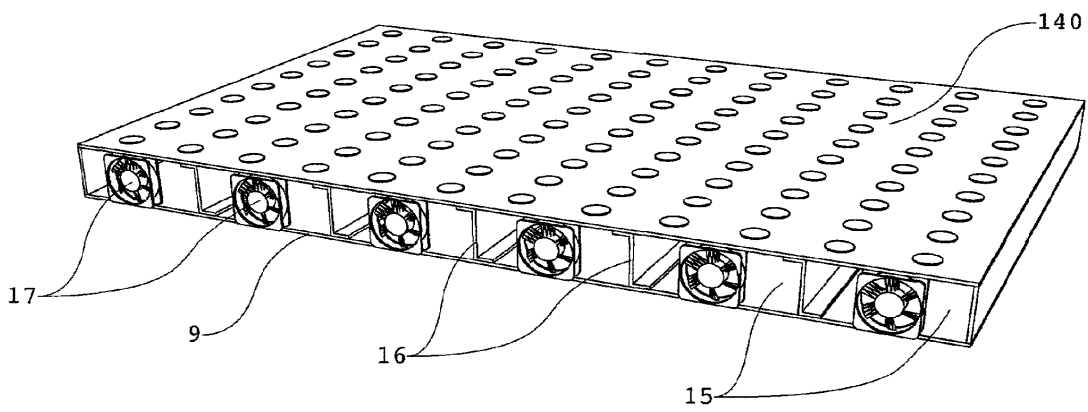
ФИГ. 2



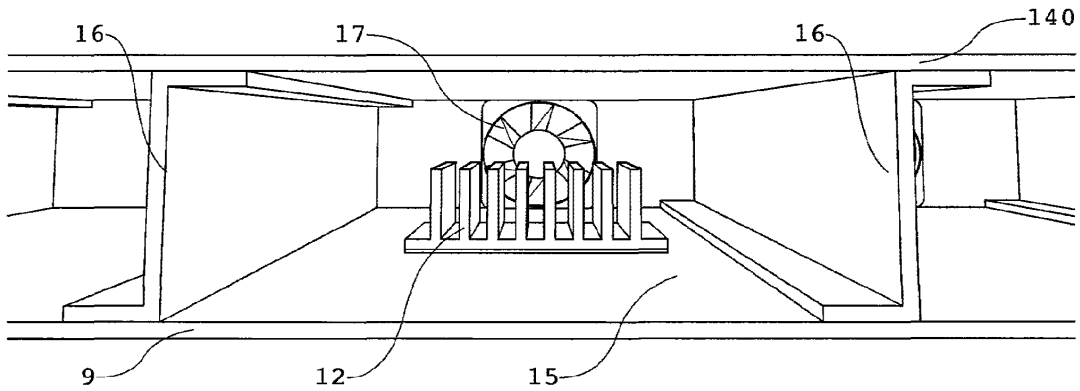
ФИГ. 3



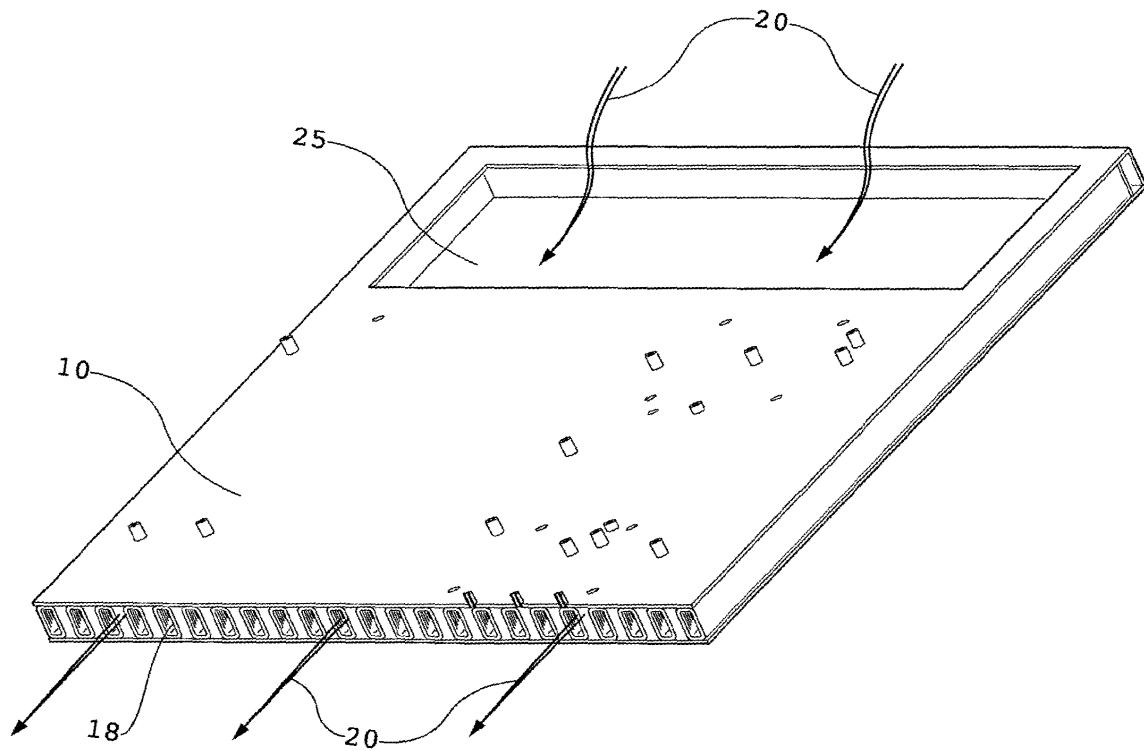
Фиг. 4



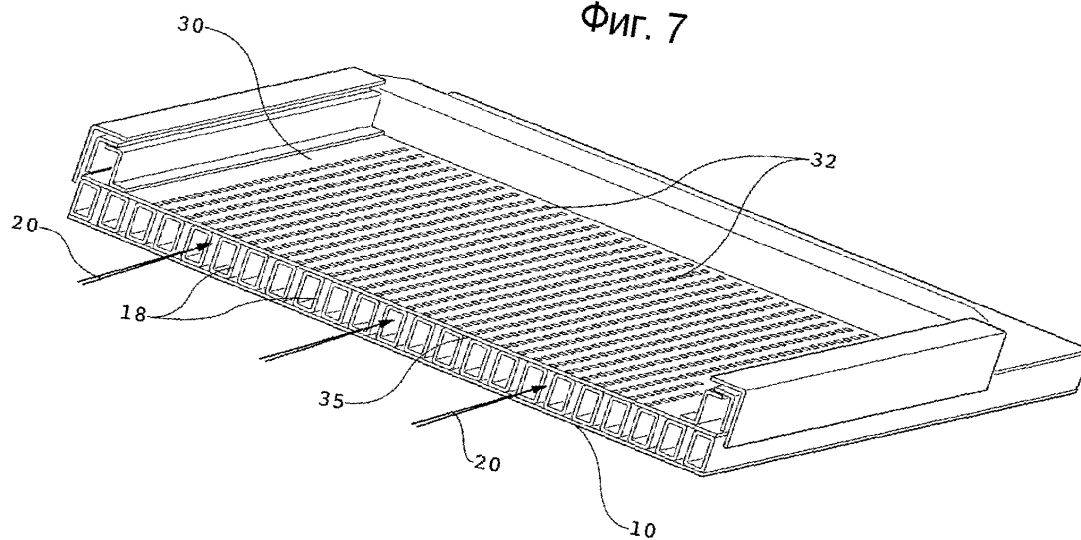
Фиг. 5



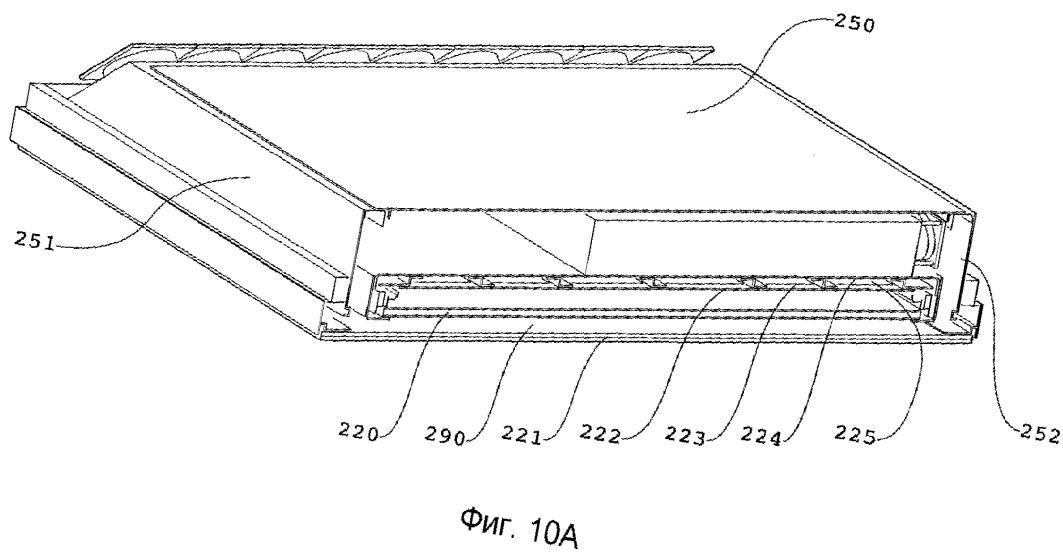
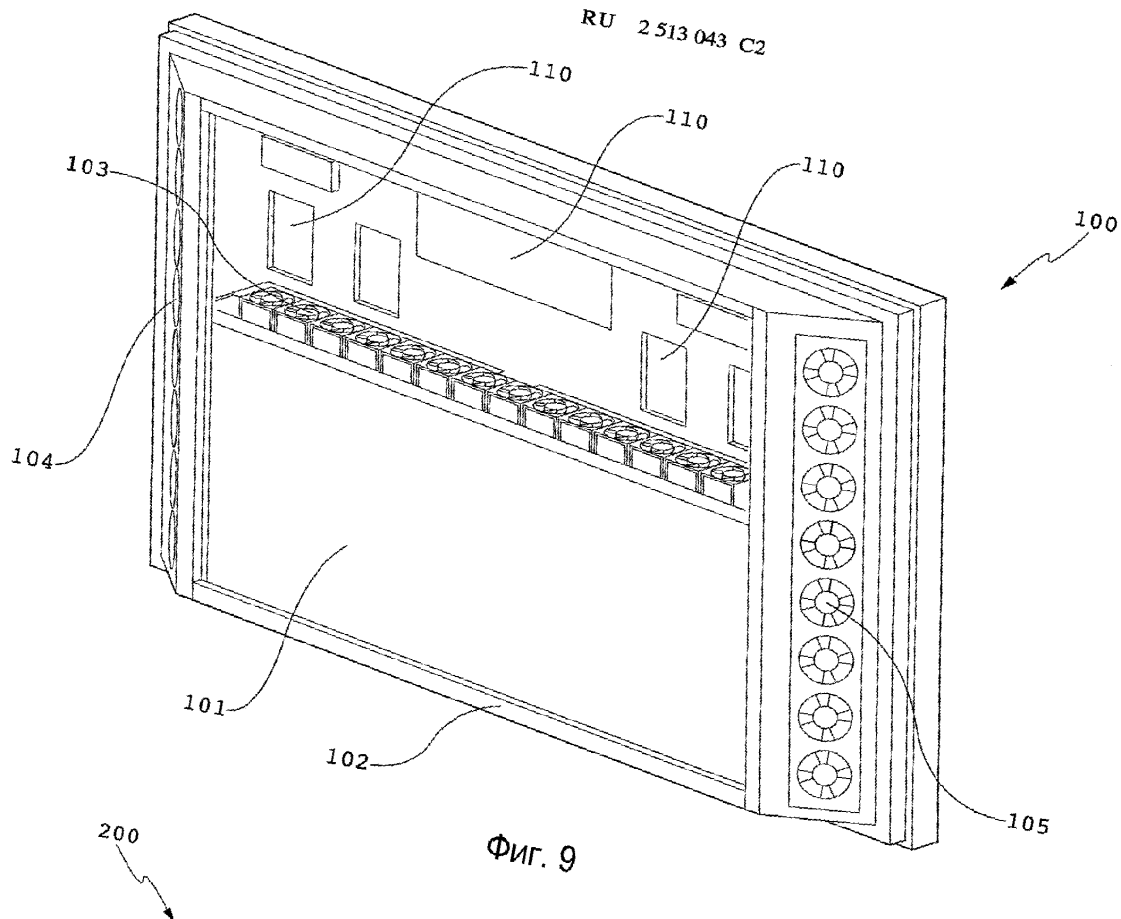
Фиг. 6

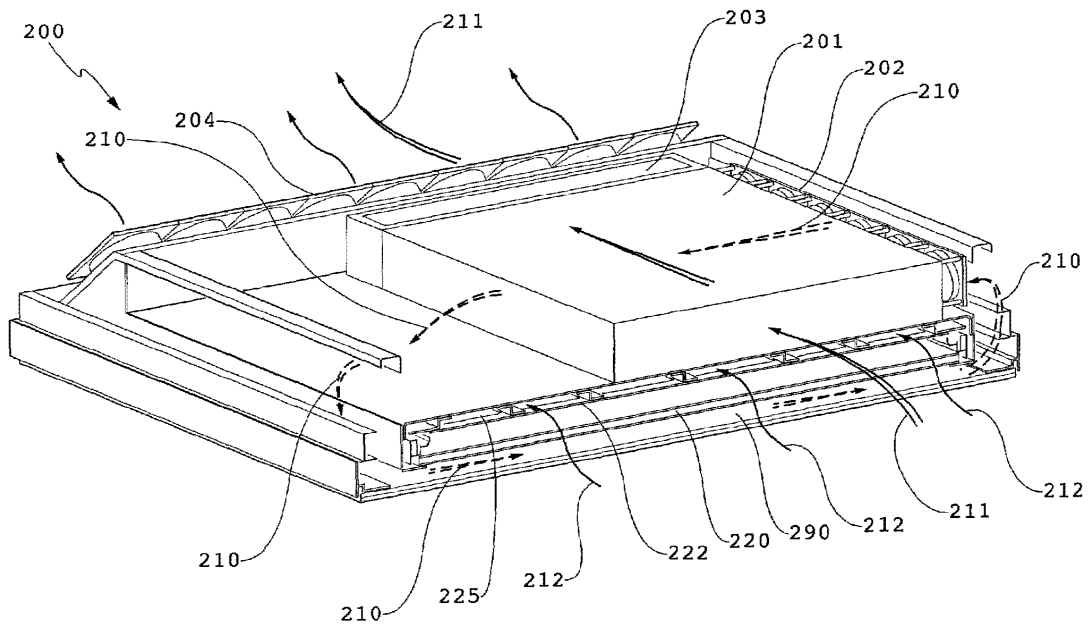


Фиг. 7

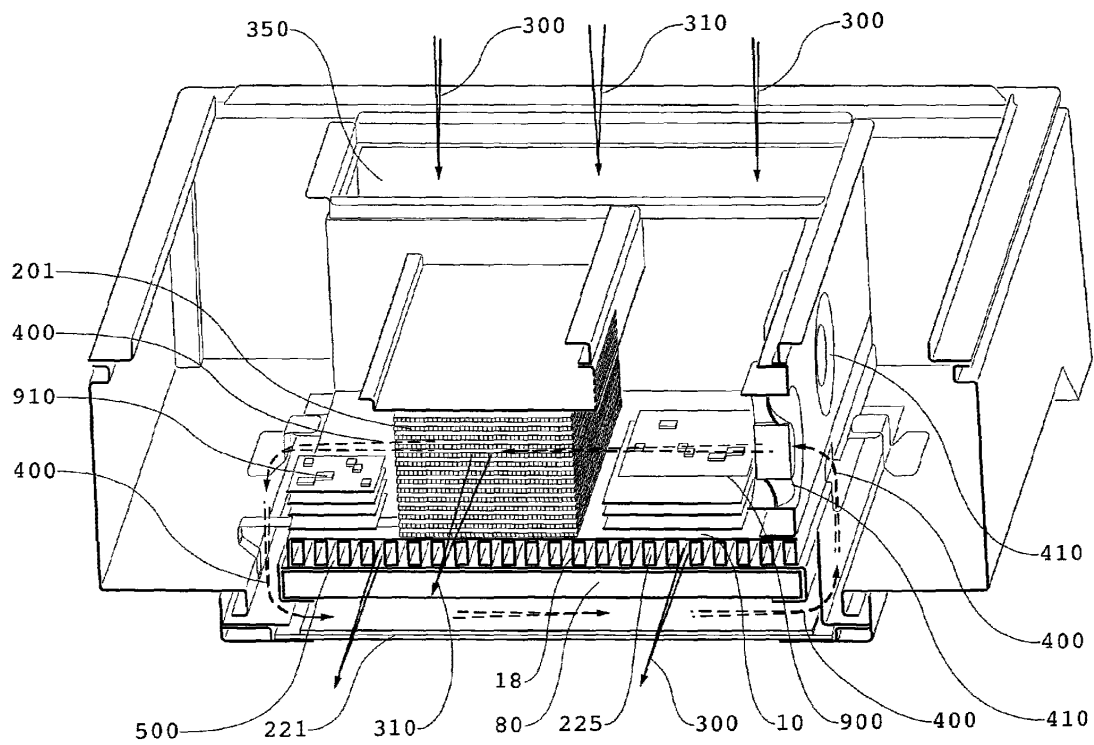


Фиг. 8





Фиг. 10В



Фиг. 12

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[Continued on next page]

(54) Title: COOLING SYSTEM FOR DOUBLE SIDED DISPLAY ASSEMBLY

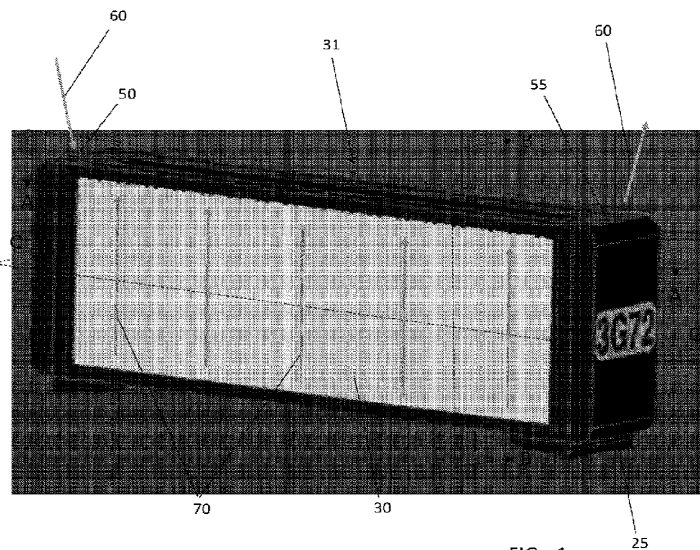


FIG - 1

(57) Abstract: A pair of electronic displays (30 and 31) are placed back to back and are configured for mounting to a vehicle. A pair of thermal plates (126 and 127) are located behind the electronic displays and a pair of transparent plates (35 and 36) are located in front of the electronic displays. A closed loop of air travels vertically through the space between the electronic displays and transparent panels and through a closed loop plenum. An open loop of air travels horizontally through the space between thermal plates and the rear surface of the electronic displays.

WO 2017/152166 A1



-
- *before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments (Rule 48.2(h))*

COOLING SYSTEM FOR DOUBLE SIDED DISPLAY ASSEMBLY

Inventor(s): Marcos Diaz

CROSS REFERENCE TO RELATED APPLICATIONS

[0001] The application claims the benefit of US Provisional Patent Application No. 62/303,806 filed on March 4, 2016, which is hereby incorporated by reference in its entirety.

TECHNICAL FIELD

[0002] Embodiments of the present invention generally relate to cooling systems for electronic displays.

BACKGROUND

[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 INVENTIVE CONCEPT

[0004] Exemplary embodiments may comprise multiple separate flow paths for a fluid, such as air, through an electronic display housing. At least one path may be a closed loop and several other paths may provide open loops. The closed loop path preferably circulates through a sealed electronics compartment as well as pass between the electronic display(s) and a front transparent panel. A first open loop of ambient air may pass behind the first electronic display while a second path of ambient air may pass behind the second electronic display. In some embodiments the open loop air also removes heat from a thermal plate having electronic

components and in some embodiments the open loop air also removes heat from an LED backlight (or LED display). The fans can be positioned so as to precisely control the amount of fluid travelling through each path.

BRIEF DESCRIPTION OF THE DRAWINGS

[0005] In addition to the features mentioned above, other aspects of the present invention will be readily apparent from the following descriptions of the drawings and exemplary embodiments, wherein like reference numerals across the several views refer to identical or equivalent features, and wherein:

[0006] **FIGURE 1** is a front perspective view showing an exemplary embodiment of the double sided display assembly, as well as the location for section lines A-A, B-B, and C-C.

[0007] **FIGURE 2** is a side section view of the embodiment shown in Figure 1, taken along the section line A-A.

[0008] **FIGURE 3** is a front section view of the embodiment shown in Figure 1, taken along the section line B-B.

[0009] **FIGURE 4** is a top section view of the embodiment shown in Figure 1, taken along the section line C-C and indicating the location for Detail A.

[0010] **FIGURE 5** is a detailed section view of Detail A.

[0011] **FIGURE 6** is a partial exploded view of the embodiment shown in Figure 1.

DETAILED DESCRIPTION OF EXEMPLARY EMBODIMENT(S)

[0012] 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.

[0013] 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.

[0014] 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.

[0015] 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.

[0016] FIGURE 1 is a front perspective view showing an exemplary embodiment of the double sided display assembly, as well as the location for section lines A-A, B-B, and C-C. Generally speaking, an exemplary embodiment includes two displays 30 and 31 positioned back to back and placed within a housing 25. An inlet aperture 50 accepts a flow of ambient air 60 into and through the housing 25. The ambient air 60 is preferably exhausted out of the housing 25 through the exhaust aperture 55. A closed loop flow of circulating gas 70 travels within the housing 25 as well, but preferably does not mix with the flow of ambient air 60 in any substantial manner.

[0017] As used herein, the term ambient air 60 simply refers to common atmospheric air that would provide the surrounding environment for the assembly. This ambient air 60 is known to contain a mixture of different types of gaseous elements, as well as dust, dirt, pollen, water vapor, and other particulate. Also as used herein, the term circulating gas 70 can refer to any gaseous matter, which might be a mixture of different types of gases or could be a pure gaseous matter. Preferably, the circulating gas 70 does not contain substantial amounts of dust, dirt, pollen, or other types of particulate.

[0018] Exemplary embodiments of the present invention may be configured for mounting to a vehicle, preferably to the roof. The housing 25 may be sized and configured for fitting atop a vehicle roof. Further, the housing 25 may be sized and adapted to minimize aerodynamic drag. The housing 25 may comprise a pair of feet 26 for mounting the housing 25 to the vehicle. The feet 26 may be sized and configured to be secured to a vehicle's roof, or to be secured to internal supports placed on or within the vehicle. In such embodiments, the housing 25 is preferably thin and comprises rounded corners and other features to minimize aerodynamic drag. The housing 25 may comprise a variety of stiffening members to provide

structural rigidity and strength to accommodate the forces caused by a moving vehicle. Likewise, the various components of the display assembly may be configured or comprised of a sufficiently rigid material so as to accommodate the forces caused by a moving vehicle. Furthermore, the housing and various components of the display assembly may be configured to withstand the forces, vibrations, and other rigors of being mounted to a vehicle. For example, but not to serve as a limitation, the feet 26 and other components of the display assembly may comprise rubber pads or other vibration and shock absorption devices.

[0019] As indicated in the figure, section line A-A is positioned horizontally down the center of the assembly and cuts through the assembly vertically. Section line B-B is oriented vertically and cuts through the assembly horizontally. Finally, section line C-C is oriented horizontally and cuts through the assembly horizontally as well. The section line arrows in figure 1 indicate the direction of hypothetical cut to obtain the section view.

[0020] FIGURE 2 is a side section view of the embodiment shown in Figure 1, taken along the section line A-A. The ambient air 60 may enter the housing 25 through the inlet aperture 50, where it may then be directed into an entrance plenum, and pass through one of a plurality of entrance apertures 200 which connect with the open loop channels (described further below). The ambient air 60 is preferably pulled by one or more fans 100, but the fans 100 could also be positioned to push the ambient air 60, or several fans could be used for a combination of push/pull. In this particular embodiment, the fan 100 is located near an exit plenum, where the ambient air 60 is collected from the open loop channels by travelling through one of a plurality of exit aperture 201, collected within the exit plenum, and directed out of the housing 25 through the exhaust aperture 55.

[0021] As will be described further below, the entrance apertures 200 and exit apertures 201 are in gaseous communication with a first open loop channel running behind the electronic display 31. There is preferably another set of entrance apertures and exit apertures on the opposite side of the assembly (not shown in this view), which communicate with a second open loop channel running behind the electronic display 30. The apertures 200 and 201 are preferably distributed across the width of the electronic display 30/31 in a substantially equidistant manner from one another. The apertures 200/201 allow the flow of ambient air 60 to pass through the housing 25 and the open loop channels without substantially mixing with the circulating gas 70 or entering the sealed electronics compartment 125.

[0022] A plurality of electronic components 110 are preferably placed within a sealed electronics compartment 125 which forms a part of the closed loop for the circulating gas 70. The electronic components 110 may comprise one or more of the following: power modules, video player, electronic data storage, microprocessor, satellite/wireless receiver/transmitter, and timing and control board. At least some of the electronic components 110 may be in electrical connection with the displays 30 and 31.

[0023] One or more fans 90 may force the closed loop of circulating gas 70 over the electronic components 110. While shown with two fans 90, this is not required. Additionally, while shown pushing the circulating gas 70 over the electronic components 110, this is not required as the fans 90 could also be positioned to pull the circulating gas 70, or several fans 90 could be used in a combination push/pull of the circulating gas 70.

[0024] **FIGURE 3** is a front section view of the embodiment shown in Figure 1, taken along the section line B-B. Here, the closed loop of circulating gas 70 can be clearly

shown. As mentioned above, the circulating gas 70 preferably travels over the electronic components 110 within the sealed electronics compartment 125 and then splits to wrap around each of the displays 30 and 31. Regarding the first display 30, a transparent panel 35 is preferably placed in front of the display 30 to define a closed loop channel between the display 30 and the transparent panel 35 for accepting circulating gas 70. Once the circulating gas 70 has travelled across the display 30, it is directed back in to the sealed electronics compartment 125 to begin the closed loop again.

[0025] Similarly, regarding the second display 31, a transparent panel 36 is preferably placed in front of the display 31 to define a closed loop channel between the display 31 and the transparent panel 36 for accepting circulating gas 70. Once the circulating gas 70 has travelled across the display 31, it is directed back in to the sealed electronics compartment 125 to begin the closed loop again.

[0026] As shown, the flow of ambient air 60 is preferably split into at least two channels, with one open loop channel travelling behind each display. Regarding display 30, a path of ambient air 60 preferably travels between the rear surface of the display 30 and a thermal wall 126 of the sealed electronics compartment 125. Although not required, when using a direct LED backlit LCD as the display 30, the ambient air 60 preferably travels between the rear surface of the LED backlight 40 and the thermal wall 126. As shown above, a plurality of electronic components 110 are preferably attached to (or near) one or both thermal walls 126 and 127. In this way, heat from the electronic components 110 may be transferred (preferably through conduction but some convection and radiation may occur as well) to the walls 126 and 127 and removed by the flow of ambient air 60.

[0027] Similarly regarding display 31, a path of ambient air 60 preferably travels between the rear surface of the display 31 and a thermal wall 127 of the sealed electronics compartment 125. Although not required, when using a direct LED backlit LCD as the display 31, the ambient air 60 preferably travels between the rear surface of the LED backlight 41 and the thermal wall 127. It should be expressly noted that although a direct LED backlit LCD is shown in these embodiments, this type of display and its associated backlight is not necessary for every embodiment. The displays 30 and 31 could be any one of the following: plasma, OLED, LCD (direct lit or edge lit), LED, and any type of electroluminescent polymer display.

[0028] **FIGURE 4** is a top section view of the embodiment shown in Figure 1, taken along the section line C-C and indicating the location for Detail A. In this figure, the two channels for ambient air 60 behind each of the displays 30 and 31 can be seen. Again, preferably the two paths of ambient air 60 can remove heat from the electronic displays 30 and 31 as well as the electronics 110 (through the thermal walls 126 and 127).

[0029] **FIGURE 5** is a detailed section view of Detail A. Once the ambient air 60 has travelled through each of the open loop channels, it can be gathered by the exit plenum and forced out of the display housing 25 by the fan 100.

[0030] **FIGURE 6** is a partial exploded view of the embodiment shown in Figure 1. This shows the stacking of the elements for one side of the assembly, i.e. the components surrounding electronic display 31. The ambient air 60 is preferably directed through the entrance apertures 200 so that it may pass between the thermal plate 127 and the rear of the electronic display 31 (in this embodiment, the rear surface of the LED backlight 41). Once passing through the open loop channel, the ambient air 60 is preferably directed out of an exit aperture 201 so that it can be

collected in the exit plenum and exhausted out of the display housing. The circulating gas 70 generally encircles the open loop channel(s) having the ambient air 60. In other words, the open loop ambient air 60 passes through the center of the closed loop of circulating gas 70.

[0031] As noted above, the circulating gas 70 preferably passes over electronic components 110, exits the sealed electronics compartment 125, travels between the front transparent plate 36 and the front of the electronic display 31, eventually returning to the sealed electronics compartment 125. Again it should be noted that only one half of the embodiment is shown in this partial exploded view. Generally, there would be a second closed loop of circulating gas 70 travelling around the opposing display 30 and a second open loop channel for ambient air 60 passing behind the display 30, as shown and described above.

[0032] It should also be noted that the variety of open and closed cooling loops that are shown in the figures may be shown in a horizontal or vertical arrangement but it is clearly contemplated that this can be reversed or changed depending on the particular embodiment. Thus, the closed loop may run horizontally or vertically and in a clockwise or counter-clockwise direction. Further, the open loop may also be horizontal or vertical and can run left to right, right to left, and top to bottom, or bottom to top.

[0033] 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

WHAT IS CLAIMED IS:

1. A display assembly for mounting on a vehicle comprising:
 - a first and second electronic display positioned back to back;
 - a first and second transparent panel, each positioned in front of one of the first and second electronic displays;
 - an open loop pathway located between the first and second electronic displays and configured to receive ambient air;
 - a closed loop pathway configured to receive circulating gas and comprising:
 - a first and second channel defined by the first and second transparent panels and the first and second electronic displays, respectively,
 - and
 - a plenum located between the first and second electronic displays and in gaseous communication with the channels; and
 - a housing adapted to be mounted to the roof of a vehicle, wherein the housing and the first and second transparent panels create an enclosure substantially surrounding the first and second electronic displays, the open loop pathway, and the closed loop pathway;
 - wherein the closed loop pathway and the open loop pathway are configured to transfer thermal energy from the circulating gas to the ambient air while not allow the circulating gas and the ambient air to mix in any substantial manner.
2. The display assembly of claim 1, further comprising:
 - a first and second thermal plate, each placed behind a rear surface of one of the first and second electronic displays.

3. The display assembly of claim 2, further comprising:
a number of electronic components mounted to a rear surface of at least one
of the thermal plates.
4. The display assembly of claim 2, further comprising:
a first and second open loop channel, each defined by the first and second
thermal plates and the rear surface of the first and second electronic
displays, respectively.
5. The display assembly of claim 4, wherein:
the open loop pathway comprises the first and second open loop channels.
6. The display assembly of claim 5, wherein:
the open loop pathway is configured such that ambient air travels horizontally
through the first and second open loop channels.
7. The display assembly of claim 1, wherein:
the closed loop pathway is configured such that closed loop air travels
vertically through the first and second channels and the plenum.
8. The display assembly of claim 1, wherein:
the open loop pathway further comprises:
an inlet aperture located in the housing for ingesting ambient air, and
an exhaust aperture located in the housing for exhausting ambient air.
9. The display assembly of claim 8, wherein:
the open loop pathway further comprises:
a number of entrance apertures in gaseous communication with the
inlet aperture and the first and second open loop channels, and
a number of exit apertures in gaseous communication with the first and
second open loop channels and the exhaust aperture.

10. The display assembly of claim 5, wherein:
the closed loop pathway comprises a first and second flow wherein the first
and second flows vertically encircle the first and second electronic
display, respectively.
11. The display assembly of claim 10, wherein:
the first and second open loop channels pass through the middle of the first
and second flows.
12. The display assembly of claim 1, further comprising:
at least one open loop fan placed within the open loop pathway and
configured to propel ambient air through the open loop pathway.
13. The display assembly of claim 1, further comprising:
at least one closed loop fan placed with the closed loop pathway and
configured to propel circulating gas through the closed loop pathway.
14. A display assembly for mounting on a vehicle comprising:
a pair of electronic displays placed back to back and having a front and a rear
surface;
a pair of transparent panels, each positioned in front of the front surface of
one the electronic displays;
a pair of closed loop channels, each located between one of the transparent
panels and one of the electronic displays;
a pair of thermal plates, each positioned behind the rear surface of one of the
electronic displays;
a pair of open loop channels, each located between one of the thermal plates

and the rear surface of one of the electronic displays, wherein the open loop channels are configured to allow ambient air to pass horizontally therethrough; and

a closed loop plenum defined by the pair of thermal plates, wherein the closed loop plenum is in gaseous communication with the pair of closed loop channels;

wherein the closed loop channels and the closed loop plenum are configured to allow circulating gas to pass vertically therethrough.

15. The display assembly of claim 14, further comprising:

a number of electronic components mounted to a rear surface of at least one of the thermal plates.

16. The display assembly of claim 14, further comprising:

a pair of closed loop fans spaced apart and configured to propel circulating gas through the closed loop plenum and the closed loop channels.

17. The display assembly of claim 14, further comprising:

an open loop fan positioned to propel ambient air through the open loop channels.

18. The display assembly of claim 14, further comprising:

a housing adapted to be mounted to the roof of a vehicle.

19. A display assembly for mounting on a vehicle comprising:

a pair of electronic displays placed back to back, the space between the electronic displays defining a gap;

a housing configured to surround the electronic displays and be mounted to the roof of the vehicle;

a closed loop pathway that surrounds each of said electronic displays and
travels through the gap; and
a pair of open loop pathways that travel through the gap;
wherein the open loop pathways and the closed loop pathway do not
intersect.

20. The display assembly of claim 19, further comprising:

a pair of thermal plates located between the electronic displays and
separating the open loop pathways from the closed loop pathway.

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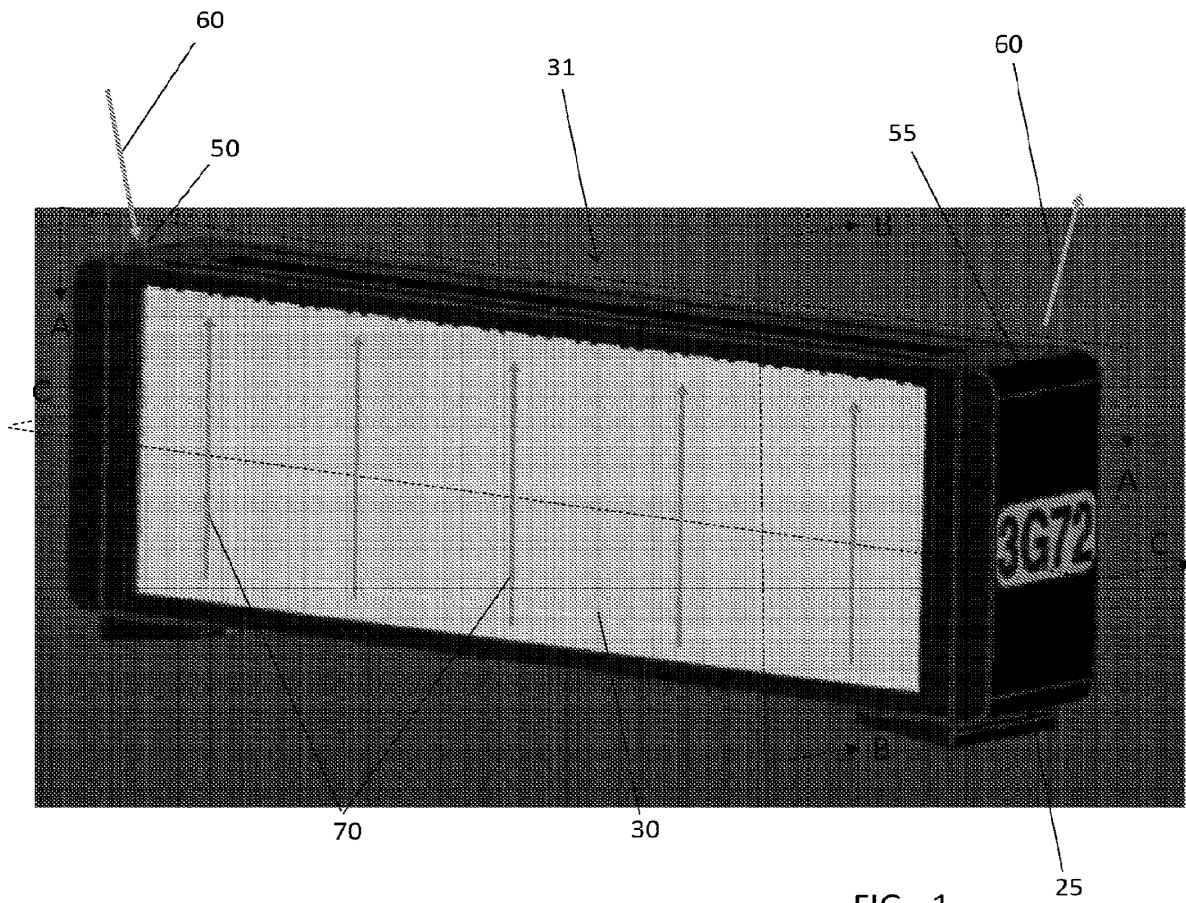
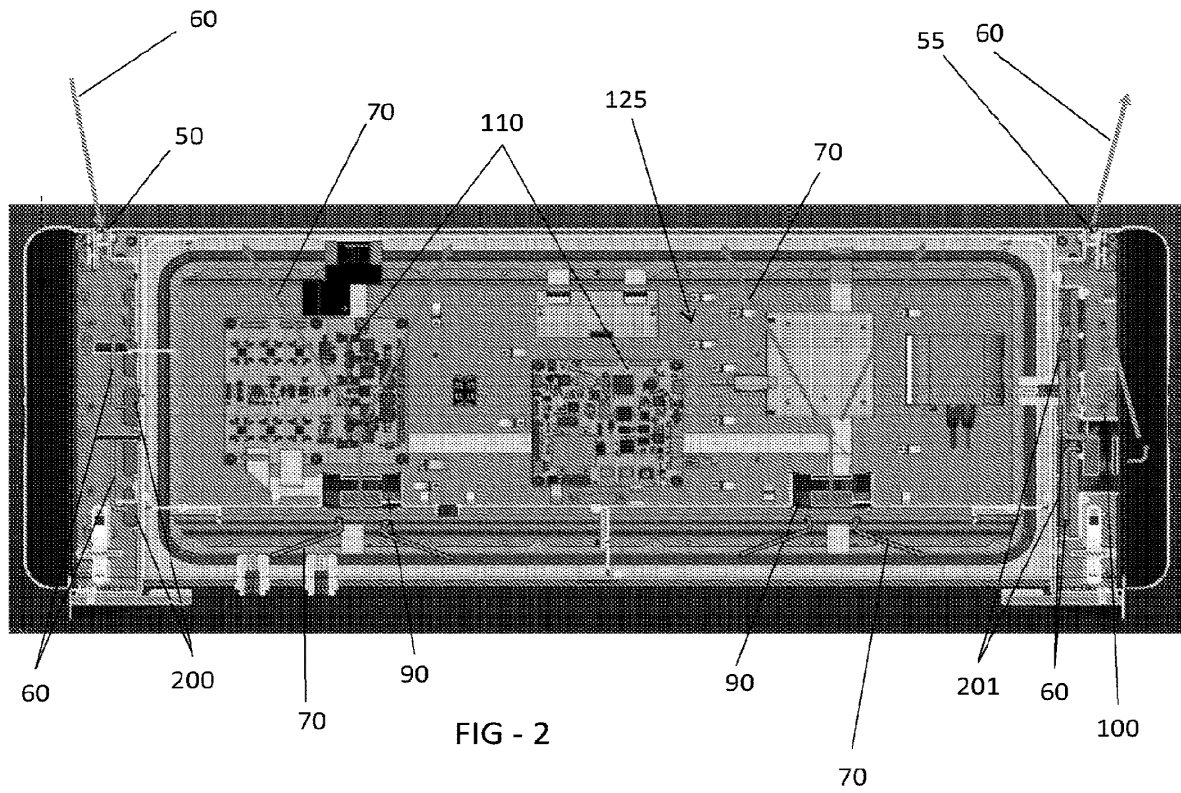
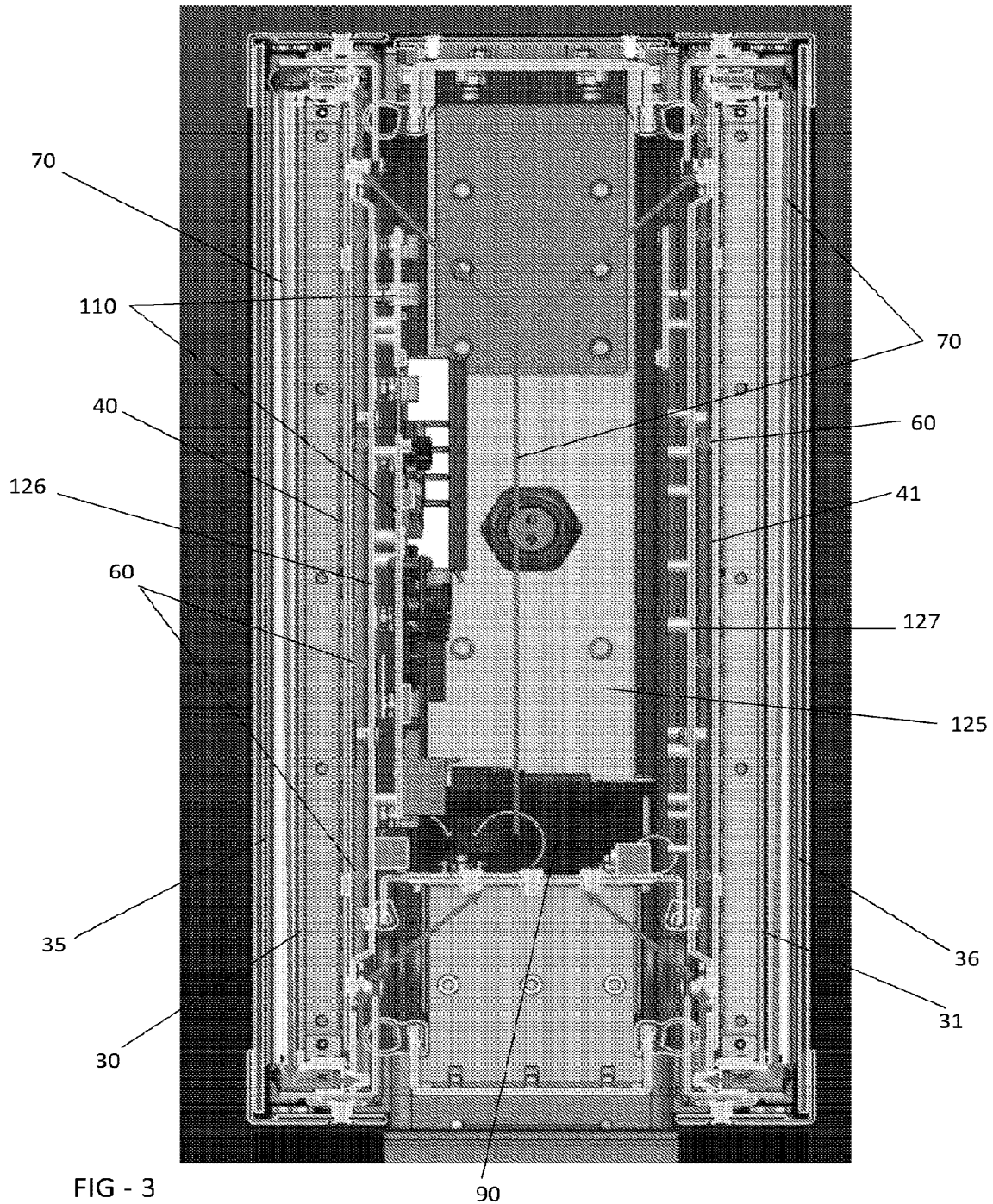


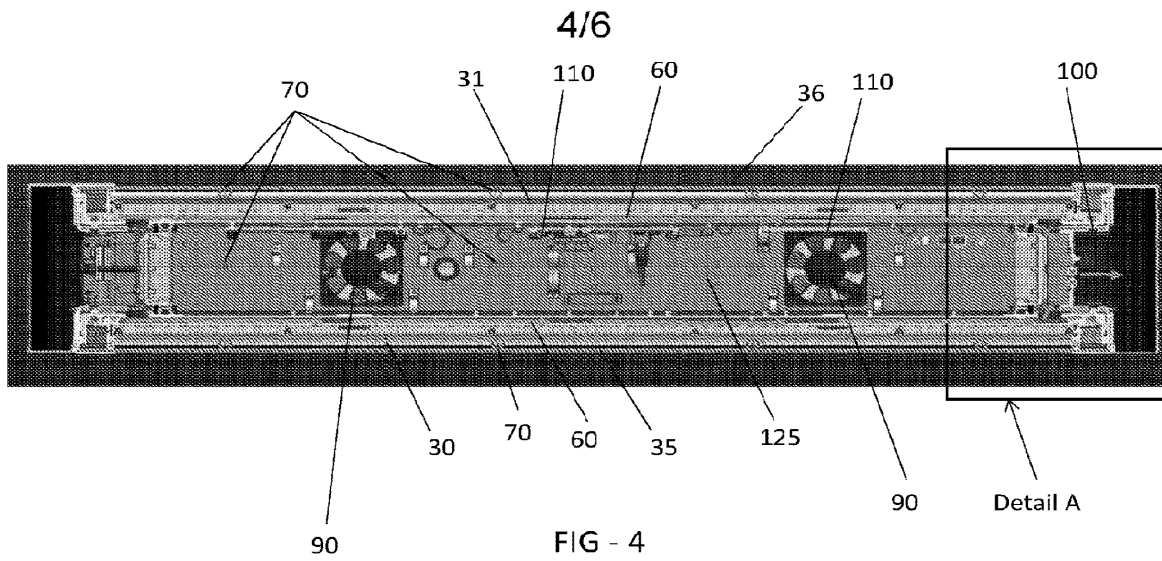
FIG - 1

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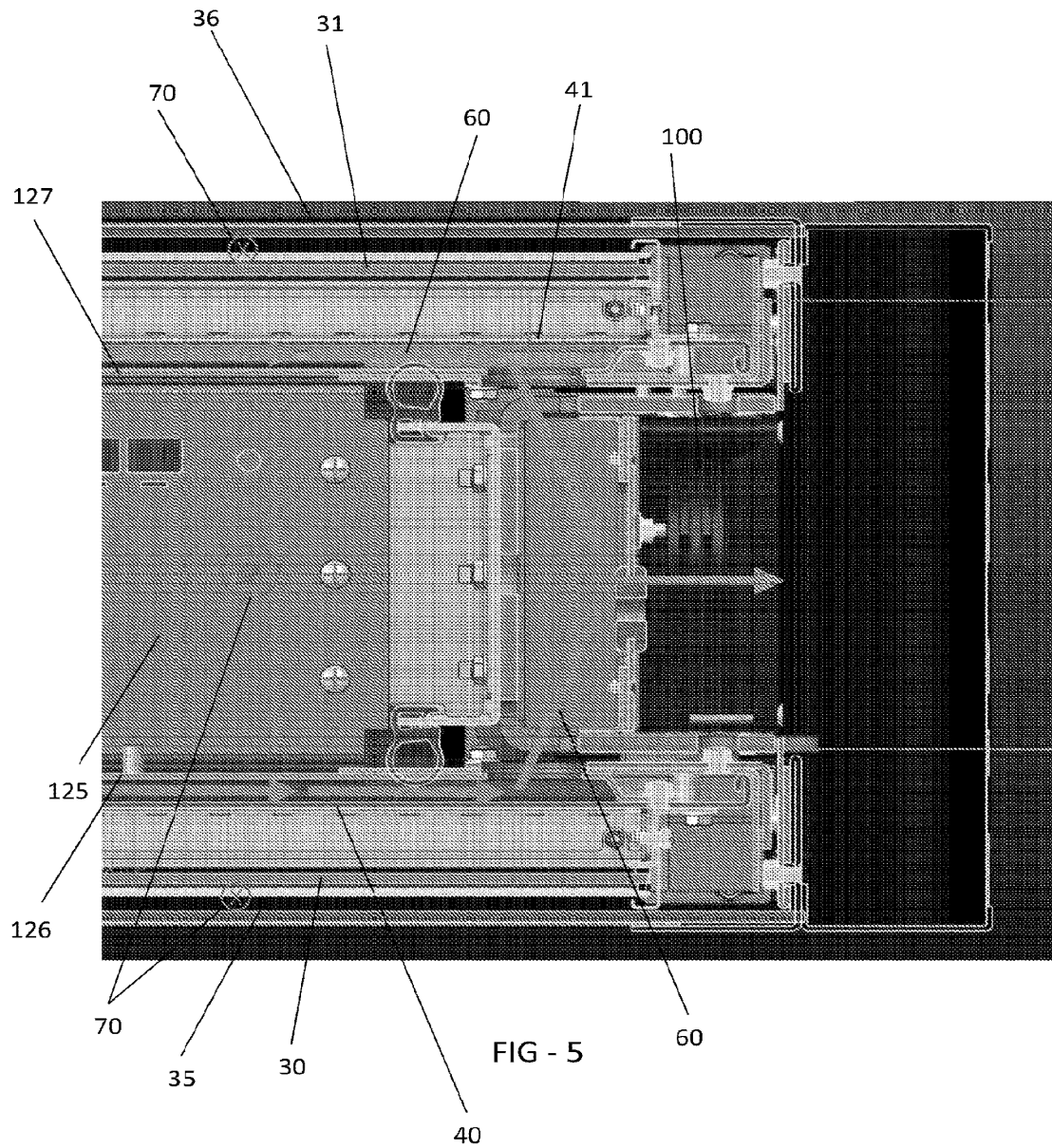


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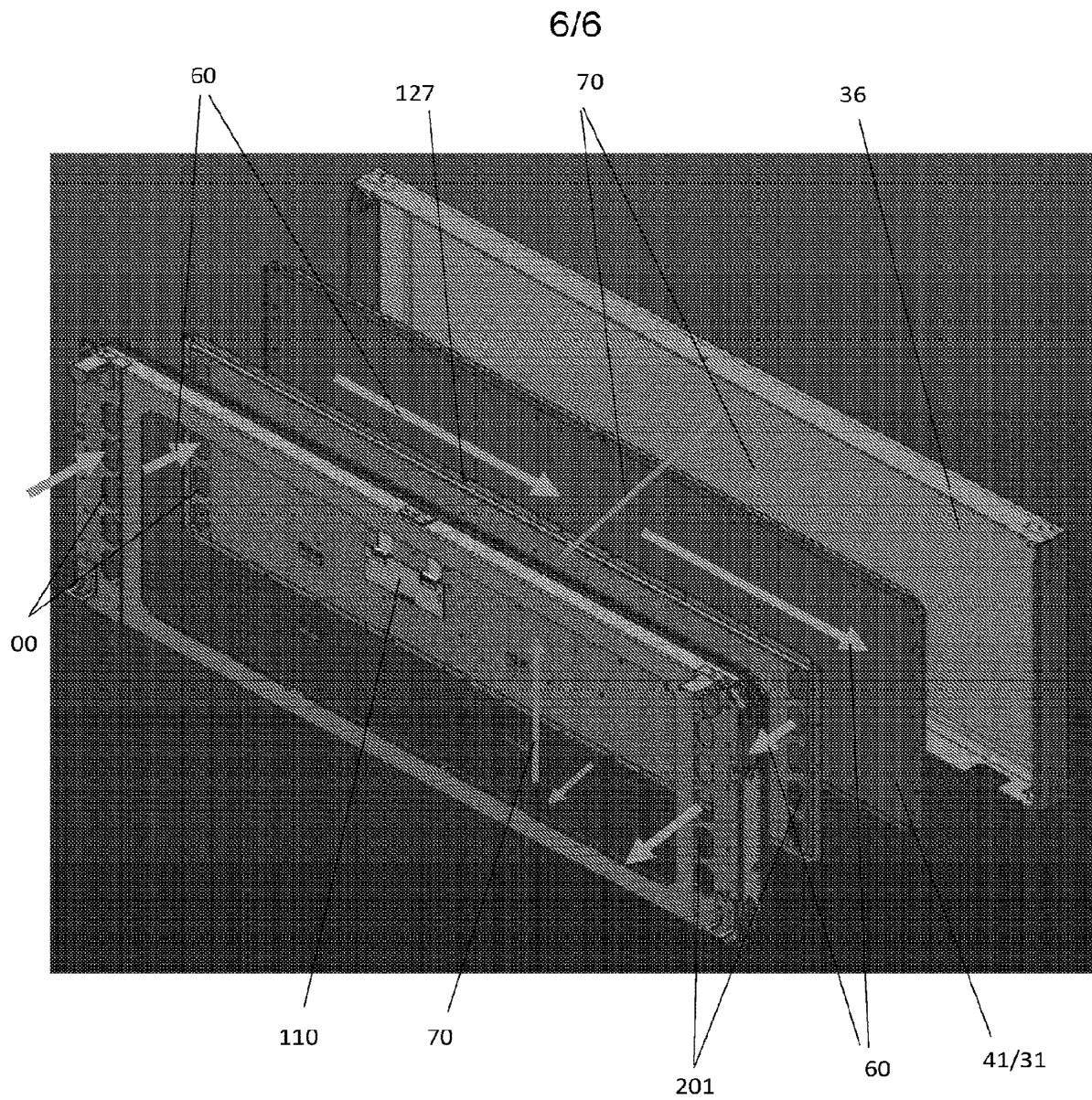


FIG - 6

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US17/20884

A. CLASSIFICATION OF SUBJECT MATTER

IPC - G02B 27/00, 27/02; H05K 7/06, 7/20 (2017.01)

CPC - H05K 7/20, 7/20009, 7/20127, 7/20954, 7/20136, 7/20145, 7/20154, 7/202

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)

See Search History document

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

See Search History document

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

See Search History document

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 2011/0085301 A1 (DUNN, W) April 14, 2011; figures 1, 2B, 3C, paragraphs [0017]-[0018], [0020], [0023], [0026], [0034], [0037], [0041]	1-9, 12-13 & 19-20
Y	US 2005/0253699 A1 (MADONIA, J) November 17, 2005; abstract, figures 1 & 5, paragraphs [0016] & [0019]	1-9, 12-13 & 19-20
Y	US 2014/0134767 A1 (HITACHI HIGH-TECHNOLOGIES CORPORATION); May 15, 2014; figure 4, paragraph [0067]	3
Y --- A	US 2015/0366101 A1 (MANUFACTURING RESOURCES INTERNATIONAL, INC.) December 17, 2015; abstract, paragraph [0037], claim 1	6 --- 1-5, 7-13 & 19-20

☐ 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

Date of the actual completion of the international search

21 June 2017 (21.06.2017)

Date of mailing of the international search report

Name and mailing address of the ISA/

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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

Form PCT/ISA/210 (second sheet) (January 2015)

INTERNATIONAL SEARCH REPORT

International application No.

PCT/US17/20884

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

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

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:
2. ☐ Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:
3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

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

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

Group I: Claims 1-13, 19, & 20: Group II: Claims 14-18

-Continued within extra sheet-

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.
2. ☐ As all searchable claims could be searched without effort justifying additional fees, this Authority did not invite payment of additional fees.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:
4. ☒ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:
1-13 & 19-20

Remark on Protest

- ☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.
- ☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.
- ☐ No protest accompanied the payment of additional search fees.

Form PCT/ISA/210 (continuation of first sheet (2)) (January 2015)

INTERNATIONAL SEARCH REPORT

International application No.

PCT/US17/20884

****-Continued from Box No. III - Observations where unity of invention is lacking-****

This application contains the following inventions or groups of inventions which are not so linked as to form a single general inventive concept under PCT Rule 13.1. In order for all inventions to be examined, the appropriate additional examination fee must be paid.

Group I: Claims 1-13, 19, & 20 appear to be directed towards at least a housing for an electronic display.

Group II: Claims 14-18 appear to be directed towards a pair of thermal plates.

The inventions listed as Groups I & II do not relate to a single general inventive concept under PCT Rule 13.1 because, under PCT Rule 13.2, they lack the same or corresponding special technical features.

The special technical features of Group I are at least a housing adapted to be mounted to the roof of a vehicle, wherein the housing and the first and second transparent panels create an enclosure substantially surrounding the first and second electronic displays, the open loop pathway, and the closed loop pathway; wherein the closed loop pathway and the open loop pathway are configured to transfer thermal energy from the circulating gas to the ambient air while not allow the circulating gas and the ambient air to mix in any substantial manner, which are not present in Group II.

The special technical features of Group II are at least a pair of thermal plates, each positioned behind the rear surface of one of the electronic displays; a pair of open loop channels, each located between one of the thermal plates and the rear surface of one of the electronic displays, wherein the open loop channels are configured to allow ambient air to pass horizontally therethrough; and a closed loop plenum defined by the pair of thermal plates, wherein the closed loop plenum is in gaseous communication with the pair of closed loop channels; wherein the closed loop channels and the closed loop plenum are configured to allow circulating gas to pass vertically therethrough, which are not present in Group I.

The common technical features of Groups I and II are a first and second electronic display positioned back to back; a first and second transparent panel, each positioned in front of one of the first and second electronic displays; an open loop pathway located between the first and second electronic displays and configured to receive ambient air; a closed loop pathway configured to receive circulating gas and comprising: a first and second channel defined by the first and second transparent panels and the first and second electronic displays, respectively, and a plenum located between the first and second electronic displays and in gaseous communication with the channels

US 2011/0085301 A1 (DUNN) discloses a first and second electronic display positioned back to back (dual electronic image assembly that are back to back; title, abstract); a first and second transparent panel, each positioned in front of one of the first and second electronic displays (illustrated figure 2A); an open loop pathway located between the first and second electronic displays and configured to receive ambient air (illustrated figure 2B); a closed loop pathway configured to receive circulating gas and comprising: a first and second channel defined by the first and second transparent panels and the first and second electronic displays (closed loop pathway configured to receive circulating gas and comprises left and right channels defined by the panels; figure 3C), respectively, and a plenum located between the first and second electronic displays and in gaseous communication with the channels (illustrated at 300 in figure 3C).

Since the common technical features were previously disclosed by DUNN, they are not special and groups I & II lack unity.



Espacenet

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Back To Back Electronic Display Assembly

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Abstract of corresponding document: US2015319882 (A1)

The exemplary embodiments herein comprise a back to back electronic display assembly having a first display assembly positioned back to back with a second display assembly. A plenum is preferably positioned in between the first and second display assemblies with a first gap defined between the plenum and the first display assembly and a second gap defined between the plenum and the second display assembly. A fan is preferably positioned to force air through the first and second gaps. A plenum fan may be used to circulate air around the plenum. Preferably, the second display assembly can move relative to the first display assembly to provide access to the interior of the plenum.

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(54) 【発明の名称】 背合わせの電子ディスプレイ・アセンブリ

(57) 【要約】

本開示における典型的な実施形態は、第2のディスプレイ・アセンブリと背中合わせに配置される第1のディスプレイ・アセンブリを有する背合わせの電子ディスプレイ・アセンブリを備えている。ブレナムは、好ましくは、第1及び第2のディスプレイ・アセンブリの間に配置されて、第1の隙間は、ブレナムと第1のディスプレイ・アセンブリとの間によって規定され、第2の隙間は、ブレナムと第2のディスプレイ・アセンブリとの間によって規定される。ファンは、好ましくは、第1及び第2の隙間を介して空気に力を与えるように配置される。ブレナム・ファンは、ブレナムの周囲の空気を循環するために使用されてもよい。好ましくは、第2のディスプレイ・アセンブリは、第1のディスプレイ・アセンブリに対して相対的に移動することができ、これにより、ブレナムの内部にアクセス可能である。

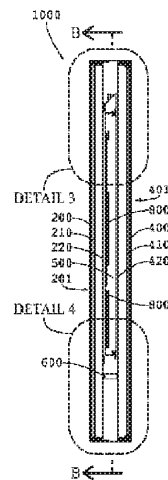


Fig. 2

【特許請求の範囲】

【請求項 1】

第 2 のディスプレイ・アセンブリと背中合わせで置かれている第 1 のディスプレイ・アセンブリと、

前記第 1 のディスプレイ・アセンブリと前記第 2 のディスプレイ・アセンブリとの間に位置するプレナムと、

前記プレナムと前記第 1 のディスプレイ・アセンブリとの間で規定される第 1 の隙間と

、前記プレナムと前記第 2 のディスプレイ・アセンブリとの間で規定される第 2 の隙間と

、前記第 1 の隙間及び前記第 2 の隙間を介して空気に力を与えるように配置されたファンと、

を備える、背合わせの電子ディスプレイ・アセンブリ。

【請求項 2】

前記プレナム内に配置されたプレナム・ファンを

更に備える請求項 1 に記載の背合わせの電子ディスプレイ・アセンブリ。

【請求項 3】

前記プレナムは、前記ファンから力を受けた空気が前記プレナムに入ることを防止するように密封される、請求項 1 に記載の背合わせの電子ディスプレイ・アセンブリ。

【請求項 4】

前記プレナム内には、第 1 のディスプレイを作動させるための 1 以上の電子構成要素が配置される、請求項 1 に記載の背合わせの電子ディスプレイ・アセンブリ。

【請求項 5】

前記電子構成要素は、電源モジュールである、請求項 4 に記載の背合わせの電子ディスプレイ・アセンブリ。

【請求項 6】

前記プレナムは、互いに対向する第 1 の壁及び第 2 の壁と、頂部壁と、底部壁と、1 組の側部壁と、を有する、請求項 1 に記載の背合わせの電子ディスプレイ・アセンブリ。

【請求項 7】

前記頂部壁と前記第 2 の壁との間に配置されるガasket を

更に備える請求項 6 に記載の背合わせの電子ディスプレイ・アセンブリ。

【請求項 8】

前記第 2 のディスプレイ・アセンブリは、前記第 1 のディスプレイ・アセンブリに対して相対的に移動可能である、請求項 1 に記載の背合わせの電子ディスプレイ・アセンブリ。

【請求項 9】

前記第 2 のディスプレイ・アセンブリは、前記第 1 のディスプレイ・アセンブリからつりさがる、請求項 1 に記載の背合わせの電子ディスプレイ・アセンブリ。

【請求項 10】

前記第 1 の壁は、前記第 1 のディスプレイ・アセンブリに対して相対的に固定され、

前記第 2 の壁は、前記第 2 のディスプレイ・アセンブリに対して相対的に固定される、請求項 6 に記載の背合わせの電子ディスプレイ・アセンブリ。

【請求項 11】

前記第 1 の隙間は、前記プレナムの前記第 1 の壁と前記第 1 のディスプレイ・アセンブリ用の LED バックライトとによって、更に規定され、

前記第 2 の隙間は、前記プレナムの前記第 2 の壁と前記第 2 のディスプレイ・アセンブリ用の LED バックライトとによって、更に規定される、請求項 6 に記載の背合わせの電子ディスプレイ・アセンブリ。

【請求項 12】

前記プレナム内に配置される第 1 の仕切り壁と、

前記プレナム内に配置され、前記第 1 の仕切り壁と実質的に垂直に配置される第 2 の仕切り壁と、

を更に備える請求項 1 に記載の背合わせの電子ディスプレイ・アセンブリ。

【請求項 1 3】

前記第 1 の仕切り壁又は前記第 2 の仕切り壁内に配置されるプレナム・ファンを

更に備える請求項 1 2 に記載の背合わせの電子ディスプレイ・アセンブリ。

【請求項 1 4】

第 2 の LED バックライト・ディスプレイと背中合わせで置かれている第 1 の LED バックライト・ディスプレイと、

前記第 1 の LED バックライト・ディスプレイと前記第 2 の LED バックライト・ディスプレイとの間に位置するプレナムと、 10

前記第 1 の LED バックライト・ディスプレイ及び前記第 2 の LED バックライト・ディスプレイに沿って、前記プレナムの周囲の空気に力を与えるように配置されたファンと、

を備える、背合わせの電子ディスプレイ・アセンブリ。

【請求項 1 5】

前記第 2 の LED バックライト・ディスプレイは、前記第 1 の LED バックライト・ディスプレイに対して相対的に移動可能である、請求項 1 4 に記載の背合わせの電子ディスプレイ・アセンブリ。

【請求項 1 6】

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前記第 2 の LED バックライト・ディスプレイが前記第 1 の LED バックライト・ディスプレイに対して相対的に移動することで、プレナムの内部部分にアクセス可能になる、請求項 1 5 に記載の背合わせの電子ディスプレイ・アセンブリ。

【請求項 1 7】

前記プレナム内に配置される仕切り壁と、

前記仕切り壁を介して流れる空気が循環するように、前記仕切り壁に取り付けられるプレナム・ファンと、

を更に備える、請求項 1 4 に記載の背合わせの電子ディスプレイ・アセンブリ。

【請求項 1 8】

第 2 の LED バックライト・ディスプレイと背中合わせで置かれている第 1 の LED バックライト・ディスプレイと、 30

前記第 1 の LED バックライト・ディスプレイと前記第 2 の LED バックライト・ディスプレイとの間に位置するプレナムであって、

第 1 の LED バックライトと対向する第 1 の壁と、

第 2 の LED バックライトと対向する第 2 の壁と、

頂部壁と、

底部壁と、

1 組の側部壁と、

を有する前記プレナムと、

前記第 1 の壁と前記第 1 の LED バックライトとの間の空間によって規定される第 1 の隙間と、 40

前記第 2 の壁と前記第 2 の LED バックライトとの間の空間によって規定される第 2 の隙間と、

前記第 1 の壁又は前記第 2 の壁に取り付けられる電子構成要素と、

前記第 1 の隙間及び前記第 2 の隙間を介して空気に力を与えるように配置された第 1 のファンと、

前記プレナム内に配置されて、前記プレナムの前記第 1 の壁と前記第 2 の壁との間を接続する仕切り壁と、

前記仕切り壁に設けられる前記第 2 のファンと、

を備える、背合わせの電子ディスプレイ・アセンブリ。 50

【請求項 19】

前記第1の壁は、第1のディスプレイに対して相対的に固定され、

前記第1の壁は、第1のディスプレイに対して相対的に固定される、請求項18に記載の背合わせの電子ディスプレイ・アセンブリ。

【請求項 20】

前記プレナム内に配置されて、前記第1の仕切り壁と接続し、且つ前記プレナムの前記第1の壁と前記第2の壁との間を接続する追加の仕切り壁を

更に備える請求項18に記載の背合わせの電子ディスプレイ・アセンブリ。

【発明の詳細な説明】

【技術分野】

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【0001】

(関連出願の相互参照)

本出願は、2014年4月30日付け出願の米国特許出願第61/986,724号の優先権を主張し、その参照により、その全体を取り込むものである。

【0002】

(技術分野)

実施形態は、概して、電子ディスプレイを導入するための冷却システム及びその方法に関する。

【背景技術】

【0003】

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(技術背景)

電子ディスプレイは、屋外環境又は他の領域にしばしば用いられ、そこでは周囲温度が高いか、或いはそこにはディスプレイ内の温度を上昇させ得るソーラー負荷等の熱源がある。しかしながら、そのディスプレイのいくつかの部分は、単にディスプレイのいくつかの部分に周りの空気を取り込むだけでは冷却することが困難であり、そのディスプレイの感度の良い部分にはこりが入って汚れてしまうので、故障を早めてしまう。いくつかの場所において、小さい設置面積だけが許容され、結果として、背合わせで電子ディスプレイを設置することが望まれている。

【発明の概要】

【課題を解決するための手段】

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【0004】

(典型的な実施形態の概要)

典型的な実施形態により、背合わせの電子ディスプレイ・アセンブリが提供され、そこでは電子構成要素が、シールされたプレナム内に含まれている。外部空気は、そのプレナムの壁と電子ディスプレイ・アセンブリの裏面との間に取り入れられて通過する。2つの電子ディスプレイ・アセンブリは、互いに相対的に移動可能であり、その結果、プレナムは、容易に開けることができ、電子機器は、保守及び／又は交換を利用することができる。

【0005】

本発明の前述の特徴及び利点、並びに他の特徴及び利点は、添付の図面で図示される特定の実施形態のより詳細な説明によって、明らかになるであろう。

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【図面の簡単な説明】

【0006】

(図面の簡単な説明)

典型的な実施形態をより良く理解するために、以下の詳細な説明及び添付の図面を参照することができ、添付図面においては、同一の部品には同一の符号が付されている。

【図1】縦断面線A-Aを示す典型的な背合わせの電子ディスプレイ・アセンブリの正面平面図である。

【図2】Detail 3(細部3)及びDetail 4(細部4)とともに縦断面線B-Bを示す縦断面線A-Aに沿った断面図である。

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【図3】細部3の詳細な断面図である。

【図4】細部4の詳細な断面図である。

【図5】第1のディスプレイ・アセンブリから回転して離れた第2のディスプレイ・アセンブリを示し、且つDetail 6（細部6）も示す縦断面線A－Aに沿った断面図である。

【図6】細部6の詳細な断面図である。

【図7】第2のディスプレイ・アセンブリから回転して離れた第1のディスプレイ・アセンブリの代替的な実施形態の透視図である。

【図8】Detail 9（細部9）を表す縦断面線B－Bに沿った透視図である。

【図9】柱である細部9の詳細な透視図である。

【図10】第2のディスプレイ・アセンブリ上の対応するフックの詳細な透視図である。 10

【発明を実施するための形態】

【0007】

（詳細な説明）

本発明の典型的な実施形態が示される添付の図面を参酌することによって、以下に、本発明をより十分に説明する。しかしながら、本発明は、多くの異なる態様で実施することができ、従って、本明細書での典型的な実施形態に限定されることを意図されていない。むしろ、これらの実施形態が提供されることで、本開示は、完全に完成し、本発明の範囲を完全に当業者に理解させることができる。図面において、層及び範囲のサイズ、相対的サイズは、明確化のため、強調されている場合がある。

【0008】

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本明細書における用語は、特定の実施形態を説明する目的で使用されており、本発明を限定する意図を持っていない。本明細書において使用されている、単数形は、明らかにその文脈から異なることが明示されていない限り、複数形をも含む意図を持っている。また、用語「備える」及び／又は「備えている」は、本明細書における使用において、記載された特徴、整数、ステップ、動作、構成及び／又は構成要素の存在を明示していることを理解することができるが、1又は複数の他の特徴、整数、ステップ、動作、構成、構成要素、及び／又はそれらの群の存在を排除するものではない。

【0009】

本発明の実施形態は、本発明の理想的な実施形態（及び中間構造）が図示された概要である図面を参酌しながら、以下に説明する。従って、結果として図示された形状における変更、例えば、製造上の技法及び／又は許容誤差などは、予期されている。従って、本発明の実施形態は、本出願で図示された領域の特定の形状に限定されることを意図しておらず、例えば製造からの結果物の形状には偏差を含むものである。

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【0010】

他に定義しない限り、本明細書で使用される用語（技術用語及び化学用語を含む）は、本発明が属する技術分野の当業者によって通常理解される意味を持つ。例えば一般的に用いられる辞書で定義された用語は、関連技術の文脈における意味と一致する意味を持つように理解されるべきであり、特に本明細書で定義されない限り理想的な意味又は過度に正式な意味で解釈されるものではない。

【0011】

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図1は、縦断面線A－Aを示す、典型的な背合わせのディスプレイ・アセンブリ1000の平面図である。この方位において、第1のディスプレイ・アセンブリ201は、視認できる唯一のディスプレイである。

【0012】

図2は、Detail 3（細部3）及びDetail 4（細部4）とともに縦断面線B－Bを示す縦断面線A－Aに沿った断面図である。第1のディスプレイ・アセンブリ201は、第2のディスプレイ・アセンブリ401と、背中合わせで置かれている。典型的な実施形態において、2つのディスプレイ・アセンブリ201及び401は、各ディスプレイ・アセンブリが互いに向き合う背面と実質的に平行である。好ましくは、第1のディスプレイ・アセンブリ201は、フロント・カバー・ガラス200、LCDパネル210、LEDバックライト220を含む。好 50

ましくは、第2のディスプレイ・アセンブリ401は、フロント・カバー・ガラス400、LCDパネル410、LEDバックライト420を含む。本明細書にはLEDバックライトLCDテクノロジーで示され、説明されているが、本明細書における典型的な実施形態は、任意の形態のフラット・パネル・ディスプレイで実施されてもよく、その任意の形態は、限定されるものではないが、OLED、LED、プラズマ、他の発光ポリマを含んでいる。これらの実施形態において、LEDバックライトの背面は、単純に、OLED、LED、プラズマ、又は発光ポリマのディスプレイの背面になる。

【0013】

取り囲まれたプレナム(plenum)500は、好ましくは、2つのディスプレイを作動させる電子機器800を含み、また、2つのディスプレイ・アセンブリ201及び401の間に位置している。ファン600も、2つのディスプレイ・アセンブリ201及び401の間に位置し、また、アセンブリ1000を通過する周囲の外部空気を引くように位置し、好ましくは、外部空気のプレナム500への流れ込みを不可能にする。単一のファン600だけが示されているが、図示されたファン600と同じ位置又は異なる位置で複数のファンをいくつかの実施形態に用いてもよい。更に、ファン600がアセンブリ1000から外部空気を引くように示されているが、ファン600は、アセンブリ1000から外部空気を押すように位置してもよい。加えて、アセンブリ1000の底部に示されているが、その代わりに頂部に配置されてもよい。

【0014】

図3は、細部3の詳細な断面図である。図4は、細部4の詳細な断面図である。プレナム500は、好ましくは、第1のディスプレイ・アセンブリ201と対向する第1の壁740と、第2のディスプレイ・アセンブリ401と対向する第2の壁730と、頂部壁710と、底部壁715と、(この図面に図示されない)1組の対向する側部壁と、で取り囲まれる。この実施形態において、第1の壁740、頂部壁710、底部壁715及び1組の対向する側部壁は、互いに相対的に固定される一方、第2の壁730は、これらの部材に対して相対的に移動可能である。ここに示されている一方、他の実施形態では、第2の壁730は、頂部壁710、底部壁715及び1組の対向する側部壁に対して相対的に固定されてもよく、第1の壁740がこれらの部材に対して相対的に移動可能であってもよい。好ましくは、壁740,710,715,730及び側部壁は、金属製であり、更に好ましくは、アルミニウムである。

【0015】

ガasket700が第2の壁730と、第1の壁740、頂部壁710、底部壁715、1組の対向する側部壁との間で圧縮される場合に、第2の壁730は、プレナム500を密封する。そのプレナム内に含まれる電子機器800は、外部空気の流れ575及び550、また可能性のある任意の汚染物質、微粒子、又は存在し得る水蒸気から保護される。その電子機器は、これらに限定されないが、例えば、電源、マイクロプロセッサ、プリント回路基板、電子メモリ、送信/受信・デバイス、及びビデオ・プレイヤを含む。好ましくは、電子機器800は、また、第1の壁740又は第2の壁730と、或いはその両者と、熱的に伝達可能である(更に好ましくは伝導性を有する)。この方法で、電子機器800からの熱は、第1の壁740に伝わって第1の外部空気の流れ575で取り除くことができ、又は第2の壁730に伝わって第2の外部空気の流れ550で取り除くことができる。

【0016】

第1の隙間は、好ましくは、第1のディスプレイ・アセンブリ201とプレナム500の第1の壁740とで規定される。第2の隙間は、好ましくは、第2のディスプレイ・アセンブリ401とプレナム500の第2の壁730とで規定される。この特定の実施形態において、LEDバックライトを備えるLCDが用いられ、その第1の隙間は、LEDバックライト220の背面と第1の壁740と間に設けれ、その第2の隙間は、LEDバックライト420の背面と第2の壁730と間に設けられている。第1の外部空気の流れ575は、入口の開口部を介してハウジングの内部に取り込まれ、第1の隙間を介して力を受け、出口の開口部を介してハウジングの外部に排出される。第2の外部空気の流れ550は、入口の開口部を介してハウジングの内部に取り込まれ、第2の隙間を介して力を受け、出口の開口部を介してハウジングの外部に排出される。この方法で、空気の流れ575は、LEDバックライト220及び第1の壁

740から同時に熱を除去することができ、また、空気の流れ550は、LEDバックライト420及び第2の壁730から同時に熱を除去することができる。

【0017】

図5は、第1のディスプレイ・アセンブリから回転して離れた第2のディスプレイ・アセンブリを示し、且つDetail 6（細部6）も示す縦断面線A-Aに沿った断面図である。この実施形態において、第1のディスプレイ・アセンブリ201は、固定されたままである一方、第2のディスプレイ・アセンブリ401は、第1のディスプレイ・アセンブリ201から離れるように移動又は回転することができ、これにより、プレナムの内側及び電子機器800の内部にアクセスすることができる。

【0018】

図6は、細部6の詳細な断面図である。ここでは、傾斜したレイン・キャッチャー(rain catcher)705が入口の開口部の下でプレナムの上に配置され、これにより、任意の液化したものを集めて第1の隙間に向けることができる。また、この図面は、第2のディスプレイ・アセンブリ401と一緒に第2の壁730の移動を示し、これらが第1の壁740、頂部壁710、底部壁715及び1組の対向する側部壁から遠ざかる場合に、プレナムの内部にアクセスすることができる。

【0019】

図7は、第2のディスプレイ・アセンブリから回転して離れた第1のディスプレイ・アセンブリの代替的な実施形態の透視図であり、第1のディスプレイ・アセンブリ201は、（固定したままである）第2のディスプレイ・アセンブリ401から離れるように回転する。ここでは、1組のガス・スプリング850が用いられて、ディスプレイ・アセンブリ201の回転を補助し、その開位置を保ったままで、プレナム500の内部を保守点検することができる。

【0020】

図8は、Detail 9（細部9）を表す縦断面線B-Bに沿った透視図である。この実施形態において、第1の壁740は、様々な電子機器800を固定するために使用することができる。なお、これらの機器はその壁の代わりに背部壁730に固定されてもよい。いくつかの実施形態において、電子機器800は、第1の壁740及び第2の壁730の双方に固定されてもよい。頂部壁710は、プレナムに空気の流れが入ることを実質的に防止する。開口120は、好ましくは、頂部壁710の上又はその近くに配置され、これにより、空気の流れ575は、第1の壁740とLEDバックライト220の背部との間の空間の開口によって規定される隙間に入ることができる。同様の方法で、もう1つの開口（ここでは図示せず）は、好ましくは、頂部壁710の上又はその近くに配置され、これにより、空気の流れ550は、第2の壁730とLEDバックライト420の背部との間の空間の開口によって規定される隙間に入ることができる。

【0021】

ガスケット700は、好ましくは、第1の壁740の外周の周りに配置され、その結果、ガスケット700は、ユニットが閉じる時に、プレナムの壁（頂部壁710、底部壁715及び1組の対向する側部壁）と第2の壁730との間で圧縮される。好ましくは、1組の仕切り壁80/85が使用されて、仕切り壁の一方（ここでは80）だけを通るプレナム500の周囲のループを規定することができる。一般的には、仕切り壁80/85は、プレナムの第1の壁740と第2の壁730との間を接続する。典型的な実施形態において、仕切り壁80は、仕切り壁85に垂直である。更により好ましくは、仕切り壁80は、水平に配置されてファンを含む一方、仕切り壁85は、仕切り壁80の端部に接続されて、且つ垂直に配置されるがファンを含まない。ファンは仕切り壁80内のみ示されているが、ファンは、その代わりに、仕切り壁85内に位置してもよい。即ち、仕切り壁85内だけファンが設けられて、仕切り壁80内にはファンが設けられなくてもよい。典型的な空気の流れに関して、第1のファン75をディスプレイ・アセンブリの中央に置き、第2のファン77をディスプレイ・アセンブリの外周に置くことで、1組のガス・ループ501及び510がそれぞれ発生する。

【0022】

複数の入口／出口の電気接続部25は、好ましくは、ディスプレイ・アセンブリ201の頂部で、傾斜したレイン・キャッチャ705の下に配置される。また、1組の固定ピン50及び51は、ディスプレイ・アセンブリ201の頂部に設けられる。複数のラッチ120,122,125は、好ましくは、ディスプレイ・アセンブリ201の底部に設けられる。なお、3つのラッチを備える図示の実施形態は、1つ又は2つのラッチだけを備えるものに置換されてもよい。この図面には、ガス・スプリング850又は他の指示抵抗要素のために、取り付けブラケット900及び910が示されている。

【 0 0 2 3 】

図9は、柱である細部9の詳細な透視図である。ここでは、柱51の詳細が図示される。この実施形態において、シリンダは、水平に移動し、2つの位置決め壁53（ディスプレイ・アセンブリ201の外周に最も近い）及び54（ディスプレイ・アセンブリ201の中心に最も近い）によって分割されている。その後、シリンダは、固定部分55（壁53/54の間に位置する）及び内部部分52（モジュール500の中心に向かって移動する壁54で始まる）によって識別することができる。

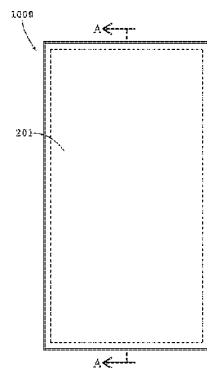
【 0 0 2 4 】

図10は、第2のディスプレイ・アセンブリ401上の対応するフック450の詳細な透視図である。1組の固定フック450は、好ましくは、第2のディスプレイ・アセンブリ401の頂部に配置され、固定柱50及び51にそれぞれ対応する。好ましくは、フック450は、固定部分55の周囲の周りを包み、そこでは、フック300が壁54及び53の間で安定している。

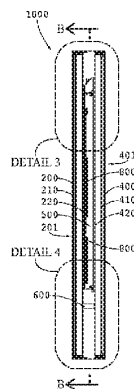
【 0 0 2 5 】

本発明の好ましい実施形態を示し、説明することによって、当該技術分野の当業者は、説明した発明に係る多くの変形及び修正が特許請求の範囲に記載の発明の範囲内に含まれることを理解することができる。加えて、上述の要素の多くは、特許請求の範囲に記載の発明の精神内で同じ結果を生む異なる要素に置換することができる。従って、本発明は、特許請求の範囲によって明示された時だけ、その範囲で限定されるものである。

【例 1】



【☒ 2】



【図 3】

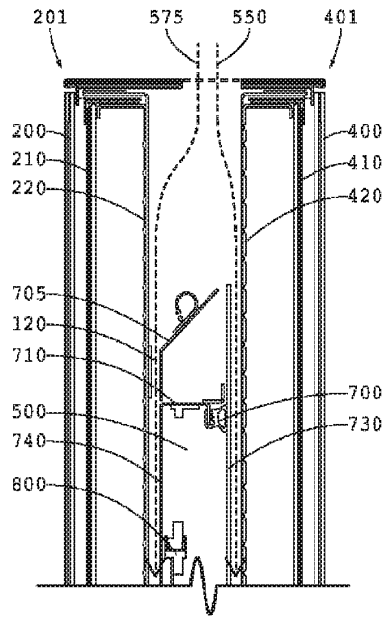


Fig. 3

【図 4】

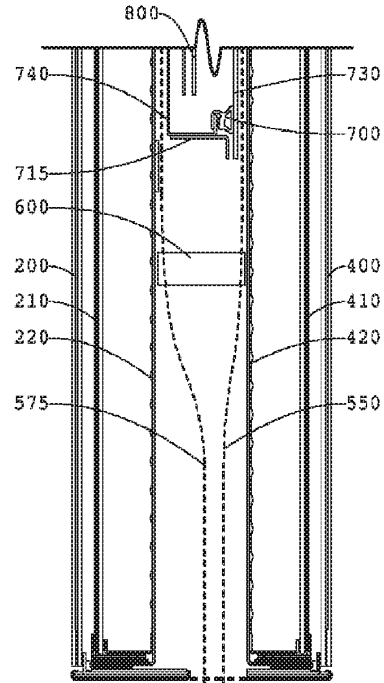


Fig. 4

【図 5】

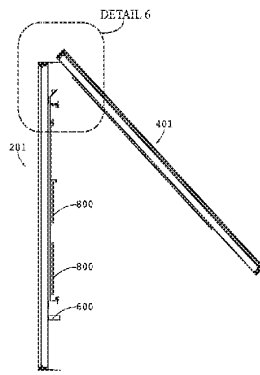


Fig. 5

【図 6】

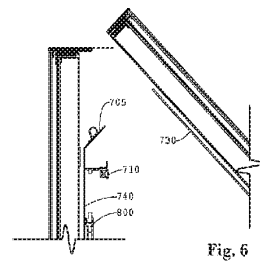


Fig. 6

【図 7】

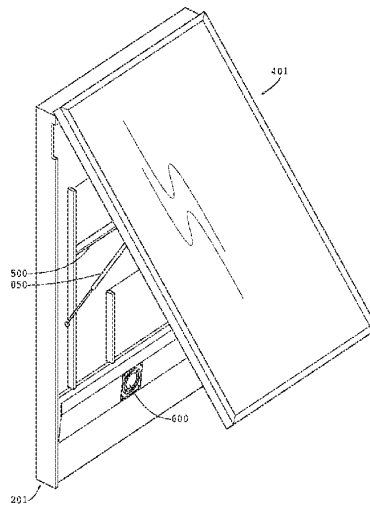


Fig. 7

【 図 8 】

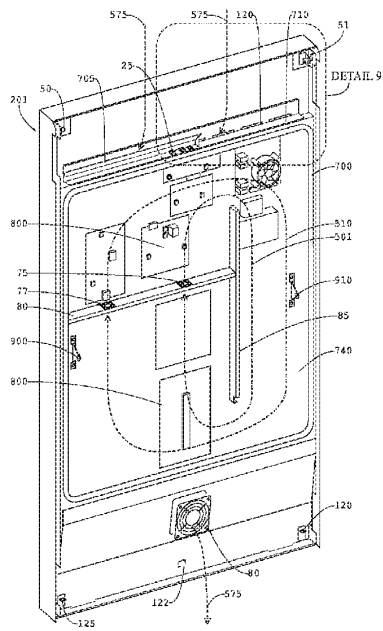


Fig. 8

【 図 9 】

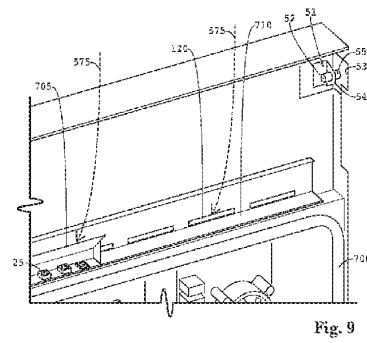


Fig. 9

【 図 10 】

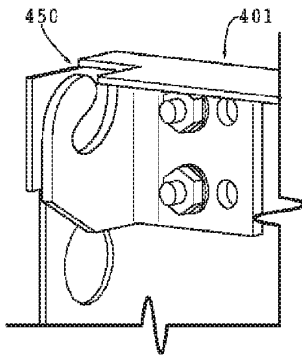


Fig. 10

【手続補正書】

【提出日】平成28年11月30日(2016.11.30)

【手続補正1】

【補正対象書類名】特許請求の範囲

【補正対象項目名】全文

【補正方法】変更

【補正の内容】

【特許請求の範囲】

【請求項1】

第2のディスプレイ・アセンブリと背中合わせで置かれている第1のディスプレイ・アセンブリと、

前記第1のディスプレイ・アセンブリと前記第2のディスプレイ・アセンブリとの間に位置するプレナムであって、前記プレナムから空気が出ることを防止するように、実質的に密封される前記プレナムと、

前記プレナムと前記第1のディスプレイ・アセンブリとの間で規定される第1の隙間と、

前記プレナムと前記第2のディスプレイ・アセンブリとの間で規定される第2の隙間と、

前記第1の隙間及び前記第2の隙間を介して空気に力を与えるように配置されたファンと、

を備える、背合わせの電子ディスプレイ・アセンブリ。

【請求項2】

前記プレナム内に配置されたプレナム・ファンを

更に備える請求項1に記載の背合わせの電子ディスプレイ・アセンブリ。

【請求項3】

前記プレナム内には、第1のディスプレイを作動させるための1以上の電子構成要素が配置される、請求項1に記載の背合わせの電子ディスプレイ・アセンブリ。

【請求項4】

前記電子構成要素は、電源モジュールである、請求項3に記載の背合わせの電子ディスプレイ・アセンブリ。

【請求項5】

前記プレナムは、互いに対向する第1の壁及び第2の壁と、頂部壁と、底部壁と、1組の側部壁と、を有する、請求項1に記載の背合わせの電子ディスプレイ・アセンブリ。

【請求項6】

前記頂部壁と前記第2の壁との間に配置されるガasketを

更に備える請求項5に記載の背合わせの電子ディスプレイ・アセンブリ。

【請求項7】

前記第2のディスプレイ・アセンブリは、前記第1のディスプレイ・アセンブリに対して相対的に移動可能である、請求項1に記載の背合わせの電子ディスプレイ・アセンブリ。

【請求項8】

前記第1の壁は、前記第1のディスプレイ・アセンブリに対して相対的に固定され、

前記第2の壁は、前記第2のディスプレイ・アセンブリに対して相対的に固定される、請求項5に記載の背合わせの電子ディスプレイ・アセンブリ。

【請求項9】

前記第1の隙間は、前記プレナムの前記第1の壁と前記第1のディスプレイ・アセンブリ用のLEDバックライトとによって、更に規定され、

前記第2の隙間は、前記プレナムの前記第2の壁と前記第2のディスプレイ・アセンブリ用のLEDバックライトとによって、更に規定される、請求項5に記載の背合わせの電子ディスプレイ・アセンブリ。

【請求項 10】

前記プレナム内に配置される第 1 の仕切り壁と、
前記プレナム内に配置され、前記第 1 の仕切り壁と実質的に垂直に配置される第 2 の仕切り壁と、
を更に備える請求項 1 に記載の背合わせの電子ディスプレイ・アセンブリ。

【請求項 11】

前記第 1 の仕切り壁又は前記第 2 の仕切り壁内に配置されるプレナム・ファンを
更に備える請求項 10 に記載の背合わせの電子ディスプレイ・アセンブリ。

【請求項 12】

第 2 の L E D バックライト・ディスプレイと背中合わせで置かれている第 1 の L E D バックライト・ディスプレイと、
前記第 1 の L E D バックライト・ディスプレイと前記第 2 の L E D バックライト・ディスプレイとの間に位置するプレナムであって、
第 1 の L E D バックライトと対向する第 1 の壁と、
第 2 の L E D バックライトと対向する第 2 の壁と、
頂部壁と、
底部壁と、
前記第 1 の壁と前記第 2 の壁との間に延びる、1 組の側部壁と、
を有する前記プレナムと、
前記第 1 の壁と前記第 1 の L E D バックライトとの間の空間によって規定される第 1 の隙間と、
前記第 2 の壁と前記第 2 の L E D バックライトとの間の空間によって規定される第 2 の隙間と、
前記第 1 の壁又は前記第 2 の壁に取り付けられる電子構成要素と、
前記第 1 の隙間及び前記第 2 の隙間を介して空気に力を与えるように配置された第 1 のファンと、
前記プレナム内に配置されて、前記プレナムの前記第 1 の壁と前記第 2 の壁との間を接続する仕切り壁と、
前記仕切り壁に設けられる前記第 2 のファンと、
前記プレナム内に配置されて、前記第 1 の仕切り壁と接続し、且つ前記プレナムの前記第 1 の壁と前記第 2 の壁との間を接続する追加の仕切り壁と、
を備える、背合わせの電子ディスプレイ・アセンブリ。

【請求項 13】

前記第 1 の壁は、第 1 のディスプレイに対して相対的に固定され、
前記第 1 の壁は、第 1 のディスプレイに対して相対的に固定される、請求項 12 に記載の背合わせの電子ディスプレイ・アセンブリ。

【国際調査報告】

INTERNATIONAL SEARCH REPORT		International application No. PCT/US2015/026461
A. CLASSIFICATION OF SUBJECT MATTER IPC(8) - H05K 7/20 (2015.01) CPC - H05K 7/20954 (2015.07) 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) - G02F 1/1335; H05K 7/18, 7/20 (2015.01) CPC - G02F 1/133382, 1/133385; H05K 7/20039, 7/20435, 7/20445, 7/202, 7/20954, 7/20972 (2015.07) Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched USPC - 349/58, 161; 351/695 (keyword delimited) Electronic data base consulted during the international search (name of data base and, where practicable, search terms used) Orbit, Google Patents, Google Search terms used: display, LCD, LED, multiple, dual, back-to-back, cooling, plenum, hinged		
C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2011/0068301 A1 (DUNN) 14 April 2011 (14.04.2011) entire document	1-2, 6, 10-14, 17-19
Y		4-5, 7-8, 15-16
Y	US 2006/0268216 A1 (WIEMEYER et al) 30 November 2006 (30.11.2006) entire document	4-5
Y	US 5,748,288 A (HARRIS et al) 05 May 1998 (05.05.1998) entire document	7
Y	US 2010/0232107 A1 (DUNN) 16 September 2010 (16.09.2010) entire document	8-9, 15-16
A	US 2011/0068326 A1 (IDEMIS et al) 10 March 2011 (10.03.2011) entire document	1-20
☐ 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		
Date of the actual completion of the international search 06 July 2015		Date of mailing of the international search report 29 JUL 2015
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 Blaine Copenheaver PCT Hq/6600: 571-273-4300 PCT CSP: 571-273-7774

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Perimeter Ventilation System for Electronic Display

Inventor(s): 德马尔斯·瑞安

Applicant(s): 制造资源国际公司

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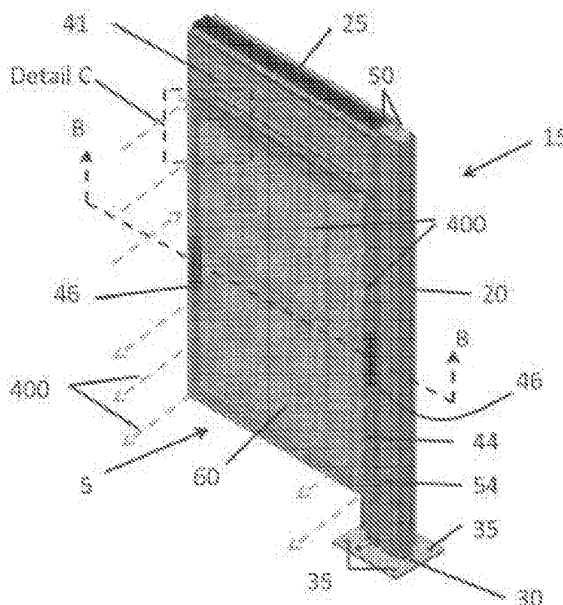
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Abstract not available for CN107251671 (A)

Abstract of corresponding document: US2016242329 (A1)

The exemplary embodiments herein provide an electronic display assembly having an electronic display surrounded by a front panel and a housing. An ingestion gap may be placed near a portion of the perimeter of the front panel while an exhaustion gap may be placed near an opposing portion of the perimeter of the front panel. A buffer zone may be defined between the ingestion gap and the exhaustion gap. A fan may be positioned to draw open loop fluid into the ingestion gap, through a channel behind the electronic display, and out of the exhaustion gap. This fan may also draw open loop fluid through an optional heat exchanger. A circulating fan may force circulating air through an optional heat exchanger.





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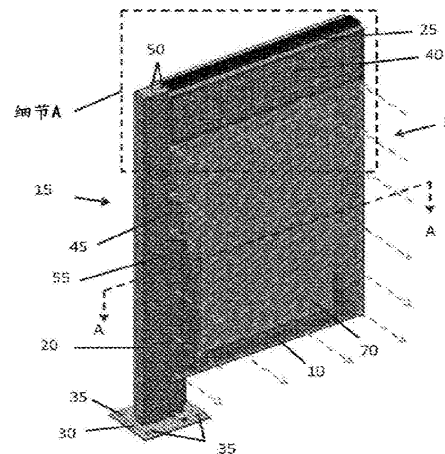
权利要求书2页 说明书10页 附图26页

(54)发明名称

电子显示器周边通风系统

(57)摘要

本发明的示例性实施例提供了一种电子显示组件，其具有由前面板和外壳包围的电子显示器。注入间隙可以放置在前面板的周边的一部分附近，而排气间隙可以放置在前面板的周边的相对部分附近。可以在注入间隙和排气间隙之间限定缓冲区。风扇可以被定位成带动开环流体进入注入间隙，穿过电子显示器之后的通道，并排出排气间隙。该风扇还可以带动开环流体穿过可选的热交换器。循环风扇可以迫使循环空气穿过可选的热交换器。



1. 一种电子显示组件,包括:
电子显示器;
围绕所述电子显示器的壳体和前面板;
沿着所述前面板的周边定位的注入间隙;
沿着所述前面板的周边的一部分定位的排气间隙;
位于所述电子显示器之后的通道;
用于使开环流体从注入间隙行进到所述通道的第一气体路径;
用于使开环流体从所述通道行进到所述排气间隙的第二气体路径;以及
被定位从而引起所述开环流体流动的风扇。
2. 根据权利要求1所述的电子显示组件,其中进一步包括:位于所述注入间隙与所述排气间隙之间的缓冲区。
3. 根据权利要求1所述的电子显示组件,其中,所述注入间隙允许环境空气注入到所述壳体中。
4. 根据权利要求2所述的电子显示组件,其中进一步包括:位于所述缓冲区中的中央隔膜。
5. 根据权利要求1所述的电子显示组件,其中进一步包括:
第一侧通道,被垂直定位并形成所述第一气体路径的至少一部分;以及
第二侧通道,被垂直定位并形成所述第二气体路径的至少一部分。
6. 根据权利要求5所述的电子显示组件,其中进一步包括:通道隔膜,位于所述第一侧通道中。
7. 根据权利要求6所述的电子显示组件,其中,所述通道隔膜实质上防止所述开环流体的垂直流动。
8. 根据权利要求1所述的电子显示组件,其中,所述注入间隙及所述排气间隙面向所述电子显示器的主动观察者。
9. 一种电子显示组件,包括:
电子显示器;
围绕所述电子显示器的壳体;
注入间隙,在所述壳体上被定位为面向所述电子显示器的主动观察者;
排气间隙,在所述壳体上被定位为面向所述电子显示器的主动观察者;
通道,位于所述电子显示器之后;
第一侧通道,被垂直定位并允许所述注入间隙与所述通道之间的气体连通;
第二侧通道,被垂直定位并允许所述通道与所述排气间隙之间的气体连通;以及
风扇,被定位从而引起开环流体流动进入所述注入间隙,穿过所述第一侧通道,穿过所述通道,穿过所述第二侧通道,并排出所述排气间隙。
10. 根据权利要求9所述的电子显示组件,其中进一步包括:通道隔膜,位于所述第一侧通道中。
11. 根据权利要求9所述的电子显示组件,其中进一步包括:缓冲区,位于所述注入间隙与所述排气间隙之间。
12. 根据权利要求11所述的电子显示组件,其中进一步包括:中央隔膜,位于与所述缓

冲区相同的垂直高度。

13. 根据权利要求9所述的电子显示组件, 其中进一步包括:

热交换器, 具有用于开环流体的第一路径以及用于循环气体的第二路径; 以及
循环风扇, 被定位以迫使循环气体穿过所述热交换器。

14. 根据权利要求9所述的电子显示组件, 其中, 所述通道被LED背光与板之间的空间所限定。

15. 根据权利要求9所述的电子显示组件, 其中,

所述注入间隙位于所述组件的第一垂直半部上, 而所述排气间隙位于所述组件的相对的垂直半部上。

16. 根据权利要求9所述的电子显示组件, 其中进一步包括:

门腔, 位于所述电子显示器之后, 用于从所述第一侧通道接收开环流体, 并将其引导向位于所述电子显示器之后的所述通道。

17. 一种电子显示组件, 包括:

电子显示器;

围绕所述电子显示器的壳体和面板;

注入间隙, 位于所述电子显示器的垂直中心的上方, 并位于所述前面板和所述壳体之间;

排气间隙, 位于所述电子显示器的垂直中心的下方, 并位于所述前面板和所述壳体之间;

热交换器, 具有用于开环流体的第一路径和用于循环气体的第二路径;

循环风扇, 被定位以迫使所述循环气体穿过所述热交换器;

中央隔膜, 位于所述注入间隙与所述排气间隙之间, 且靠近所述电子显示器的垂直中心; 以及

风扇, 被定位从而引起开环流体流动进入所述注入间隙, 穿过所述热交换器, 并离开所述排气间隙。

18. 根据权利要求17所述的电子显示组件, 其中进一步包括:

第一侧通道, 被垂直定位并允许所述注入间隙与所述热交换器之间的气体连通; 以及
第二侧通道, 被垂直定位并允许所述热交换器与所述排气间隙之间的气体连通。

19. 根据权利要求18所述的电子显示组件, 其中进一步包括:

位于所述第一侧通道中的第一侧通道隔膜; 以及

位于所述第二侧通道中的第二侧通道隔膜。

20. 根据权利要求19所述的电子显示组件, 其中, 所述第一侧通道隔膜和所述第二侧通道隔膜实质上阻止开环流体的垂直流动。

电子显示器周边通风系统

相关申请的交叉引用

[0001] 本申请要求2015年2月17日提交的美国申请号14/624,268的优先权,其全部内容通过引用并入本文。

技术领域

[0002] 本发明的实施例一般涉及用于电子显示器的安装和冷却系统。

背景技术

[0003] 电子显示器有时用于室外环境或其他周围温度可能较高的区域,或者可能会有其他热源(如太阳能负载)导致显示器内的温度升高。然而,显示器的某些部分可能难以冷却,因为仅是简单地将环境空气注入到显示器的某些部分可能会将灰尘和污染物引入显示器的敏感部分,这可能导致过早的故障。

发明内容

[0004] 示例性实施例可以包括显示组件和自立显示器外壳。显示组件可以安装在自立显示壳体内。显示组件可以包括沿着前面板的周边定位的注入间隙以及沿着前面板的周边的相对部分定位的排气间隙。可以放置一风扇迫使开环流体经由电子显示器之后的通道进入注入间隙并排出排气间隙。

[0005] 可以使用相同的风扇或附加的风扇来强制开环流体通过任选的热交换器。也可以使用另外的循环风扇来使闭环流体循环通过热交换器。

[0006] 可以在注入间隙和排气间隙之间放置缓冲区,并且优选地包含一个或多个隔膜,其基本上限制或禁止一旦注入到壳体中的开环流体的垂直流动。隔膜通常水平放置在显示组件的垂直中心附近(尽管不是必需的)。

附图说明

[0007] 除了上述特征之外,通过以下对附图和示例性实施例的描述,本发明的其它方面将是显而易见的,其中跨越多个视图的相同附图标记表示相同或等同的特征,并且其中:

[0008] 图1是容纳在自立外壳中的电子显示组件的示例性实施例的前透视图,并表示出剖面线A-A和细节A。

[0009] 图2是图1所示实施例的正视图,并表示细节N。

[0010] 图3是图2所示的细节N的详细正视图。

[0011] 图4是图1的示例性实施例的后透视图,并表示剖面线B-B和细节C。

[0012] 图5是图1所示的细节A的前透视图,前面板被拆下。

[0013] 图6是图1所示的示例性实施例的后透视图,其中后面板已被移除,并表示细节D和细节E。

[0014] 图7是沿图1的剖面线A-A截取的顶部透视剖视图,并表示细节F。

- [0015] 图8是图7所示的细节F的顶部平面剖视图。
- [0016] 图9是沿图4的剖面线B-B截取的底部透视剖视图,并表示细节K。
- [0017] 图10是图9所示的细节K的底部平面剖视图,并表示细节L。
- [0018] 图11是图1所示的示例性实施例的前视平面图,并表示剖面线F-F,G-G和H-H。
- [0019] 图12A是沿图11的剖面线F-F截取的顶部平面剖视图,并表示细节O和细节P。
- [0020] 图12B是沿图11的剖面线G-G截取的顶部平面剖视图,并表示细节Q。
- [0021] 图12C是沿图11的剖面线H-H截取的顶部平面剖视图,并表示细节R。
- [0022] 图13A是图12A中的细节O的俯视图详细剖视图。
- [0023] 图13B是图12B中的细节Q的俯视图详细剖视图。
- [0024] 图13C是图12C中的细节R的俯视图详细剖视图。
- [0025] 图14是图12A中的细节P的俯视图详细剖视图。
- [0026] 图15是图6所示的细节D的后透视图,其中的自立显示外壳被拆除。
- [0027] 图16是后面板的图4所示细节C的前透视图,与周围部件隔离显示。
- [0028] 图17是图10所示的细节L的底部平面剖视图。
- [0029] 图18是图6所示的细节E的后透视图,其中的审计自立显示外壳被拆除。
- [0030] 图19A是图1的组件的后透视图,其中的自立显示外壳被拆除,并表示细节S。
- [0031] 图19B是图1的组件的前透视图,自立显示外壳和前面板被拆除,并表示细节T。
- [0032] 图20是图19A所示的细节S的后透视细节视图。
- [0033] 图21是图19B所示的细节T的前透视细节视图。
- [0034] 图22是沿图4的剖面线B-B截取的底部透视剖视图。
- [0035] 图23是图1的组件的前透视图,仅示出后面板,自立显示壳体和显示组件的与所有其它周围部件隔离的选择部分。
- [0036] 图24是图1的组件的俯视图,仅显示后面板以及显示组件的与所有其他周围部件隔离的选择部分,并表示细节M。
- [0037] 图25是图23所示的细节M的前透视图。
- [0038] 图26A是隔膜的前透视图,仅示出了自立显示器壳体和显示组件的与所有其它周围部件隔离的选择部分。
- [0039] 图26B是隔膜的另一前透视图,再次仅示出了自立显示壳体和显示组件的与所有其它周围部件隔离的选择部分。

具体实施方式

- [0040] 在下文中将参考附图更全面地描述本发明,在附图中示出了本发明的示例性实施例。然而,本发明可以以许多不同的形式实施,并且不应被解释为限于本文阐述的示例性实施例。而是提供这些实施例,使得本公开将是彻底和完整的,并且将向本领域技术人员充分地传达本发明的范围。在附图中,为了清楚起见,层和区域的尺寸和相对尺寸可能被夸大。
- [0041] 本文使用的术语仅用于描述特定实施例的目的,而不意在限制本发明。如本文所使用的,单数形式“a”,“an”和“the”也旨在包括复数形式,除非上下文另有明确指示。将进一步理解,当在本说明书中使用术语“包括”和/或“包括”指定所述特征,整体,步骤,操作,元件和/或部件的存在,但不排除存在或添加一个或多个其它特征,整体,步骤,操作,元

件,组件和/或其组合。

[0042] 本文参照作为本发明的理想化实施例(和中间结构)的示意图的说明来描述本发明的实施例。因此,作为例如制造技术和/或公差的图示结果的形状变化是可预期的。因此,本发明的实施例不应被解释为限于本文所示的区域的特定形状,而是包括例如由制造导致的形状偏差。

[0043] 除非另有定义,本文使用的所有术语(包括技术和科学术语)具有与本发明所属领域的普通技术人员通常理解的相同的含义。还将进一步理解,诸如常用词典中定义的术语应被解释为具有与其在相关领域的背景下的含义一致的意义,并且不会以理想化或过度正式的方式解释,除非明确如此定义。

[0044] 图1是电子显示组件5(以下也称为“组件”)的示例性实施例。电子显示组件5包括可以覆盖组件5的大部分前表面的前面板10。前面板10可以是透明的并且位于电子显示器70的前面,电子显示器70优选地固定在前面板10的后面。在示例性实施例中,前面板10是触摸屏。周边壁55可围绕前面板10。

[0045] 自立显示器壳体15可以围绕组件5并且可以被配置为允许将组件5附接到地面。在示例性实施例中,自立显示壳体15可以是标记形状。在另外的其它实施例中,自立显示壳体15的尺寸和构造可以被集成到总线遮蔽物中。

[0046] 自立显示壳体15可以包括柱20,上梁25和基部30。在示例性实施例中,基部30可以包括如圆形孔等允许如螺栓等紧固件穿过的选择孔35,从而将基部30固定在地面上。所示的孔35的数量和位置仅仅是一个例子。柱20的底部可以被埋置从而将自立显示器固定在地面上。在一些实施例中,这可以通过将柱20的所述底部部分打碎在混凝土中来实现。自立显示壳体15和相关部件可以由诸如不锈钢或铝等金属构成。

[0047] 上光束25还可以包括覆盖上光束25的一侧的大部分的第二级显示器40。在示例性实施例中,该第二级显示器40是液晶显示器(LCD)。在其他实施例中,第二级显示器40可以是静态显示器,其包括诸如背光的照明装置和用于容纳诸如海报的静态显示器的空腔。

[0048] 一对细长构件50可以从柱20的顶部延伸。细长构件50可以被配置为进一步将自立显示壳体15从而将组件5固定就位。可以考虑任何数量和形状的细长构件50。在示例性实施例中,这些细长构件50的尺寸和构造可以与公共汽车候车亭一体化。

[0049] 如后续图中更详细地讨论的,组件5还可以包括在周边壁55和前面板10之间的间隙45,该间隙被配置为允许诸如环境空气的流体流入和流出组件5。在示例性实施例中,组件5可以被构造使得组件5的上半部允许流体进入,而组件5的下半部分允许排出所述流体,如流动线所示。这只是一个例子,因为其它实施例可被配置为使得组件5的上半部分允许排出流体,同时组件5的下半部分允许所述流体进入。

[0050] 图2和图3示出了间隙45沿着组件5的周边延伸,并进一步用放大的交叉阴影区域进行显示,以显示细节。间隙45还可以包括缓冲区46。缓冲区46可以优选是在不允许外部空气流动的间隙45的注入和排出部分之间的区域。在其他实施例中,缓冲区46可以基本上限制外部空气的流动。在示例性实施例中,间隙45被定位在围绕前面板10的周边,但是在缓冲区46内不会找到。在示例性实施例中,缓冲区46位于显示组件5的垂直中心线附近,并且通常在组件的右侧有一个第一缓冲区,在组件的左侧有一个第二缓冲区。

[0051] 在图4中,组件5还可以包括覆盖组件5的大部分后表面的后面板60。后周边壁54可

围绕后面板60的侧面。在示例性实施例中,后周边壁54可以与周边壁55基本相同。上梁25还可以包括类似于二级显示器40的三级显示器41,其可以包含背光和图形。可以在后面板60的后面放置诸如背光的照明单元。空腔可以位于后面板60的后表面后面,并且可以被配置为容纳放置在后面板60内或后面的静态显示器,例如海报。在替代实施例中,电子显示组件(例如LCD)可以放置在后面板60的后面。

[0052] 如后续图中更详细地讨论的,类似于图1,组件5还可以包括位于后周边壁54和后面板60之间的后间隙44,其被配置成允许诸如环境空气的流体流入和流出组件5。在示例性实施例中,组件5可被构造使得组件5的上半部允许流体进入,而组件5的下半部分允许排出所述流体,如流动线所示(但这可以颠倒)。

[0053] 在本发明的示例性实施例中,开环流体400的注入和排出可以不沿着后间隙44的选择部分(例如上边缘和下边缘)发生。在其他实施例中,开环流体400的注入和排出可以沿着整个后间隙44进行,除了缓冲区46之外。

[0054] 图5示出了去除的前面板10,揭示了可以固定在前面板10后面和周边壁55内的电子显示器70。组件5还可以包括位于电子显示器70上方的一系列进气孔65,在显示器70和二级显示器40之间。所示出的进气孔65仅仅是示例性的,可以考虑任何数量和形状的进气孔65。进气孔65可以被配置为便于将流体(例如环境空气)注入到在电子显示器70后面流动的开环中。一对侧内部通道21和22可以运行在电子显示器70的每一边的大部分长度。

[0055] 图6示出了去除的后面板60,露出固定在后面板60后面的内部后面板80。内部后面板80可以覆盖组件5的大部分后表面。组件5可以包含一系列后进气孔75位于内部后板80上方,有时位于后周边壁54内。所示的后进气孔75仅仅是示例性的,可以考虑任何数量和形状的所述孔75。如后续图中将更详细地解释的,孔75可以被配置为便于注入开环流体。

[0056] 类似地,组件5还可以包括位于内部后面板80下方并且有时位于后周边壁54内的一系列后排气孔85。所示的后排气孔85仅仅是示例性的,可以考虑任何数量和形状的后排气孔85。如将在下面的附图中更详细地解释的,后排气孔85可以构造成为便于开环流体的排气。可选的风扇81可以固定在内部后面板80后面和后排气孔85之上。风扇81可以被配置成控制开环流体的流动。可以考虑任何数量的风扇81。在其他实施例中,风扇81可以位于沿着开环流动路径的任何数量的位置处,或者位于进气孔75与排气孔85之间的任何位置。

[0057] 图7和图8示出了组件5和自立显示壳体15的下半部分。侧梁90可以位于柱20的相对侧上,并且可以运行组件5的长度的大部分。侧梁90可以由金属构成并且被构造成为组件5提供结构支撑和刚性。电子室16可以放置在组件5的内部。可选的热交换器100可以固定在电子室16内或附近。在示例性实施例中,热交换器100可以是横流式热交换器,但也可以使用其他类型的热交换器,特别是逆流热交换器等。一系列电子部件105也可以固定在电子室16内。如将在下面的附图中更详细地说明的那样,诸如外部空气的开环流体400可循环通过热交换器100。闭环流体,例如循环气体700可以循环通过电子空腔,以及在电子部件105上并通过热交换器100。

[0058] 如后续图中将更详细地解释的,在该实施例中,开环流体400可以经由间隙45和可选的后间隙44排出组件5。如流线所示,开环流体可以遵循之字形路径从右侧通道19排出组件5。或者,可以利用且明确地考虑其他路线形状。

[0059] 当使用液晶显示器作为电子显示器70时,背光源106可以放置在电子显示器70的

后面,并且优选地是直接点亮的LED背光,但是可以在示例性实施例中使用其他照明源。板104或其他基本上平面的物体可以被放置在背光源106的后面,以便形成用于接受开环流体400的通道102。优选地,通道102被密封以防止开环流体400进入显示组件的其它部分,特别是电子室16。

[0060] 图9和图10示出了组件5和自立显示壳体15的上半部分,其分别类似于图7和图8所示的下半部分,除了一对可选的加强件110之外。在随后的附图中将更详细地解释可选的加强件110。如在下面的附图中将更详细地解释的,在该实施例中,开环流体400可经由间隙45和可选的后间隙44进入组件5。如流线所示,开环流体400可以遵循之字形路径到达右侧通道19。可选地,可以利用且明确考虑其他路线形状。

[0061] 图11是图1的组件的前视平面图,表示剖面线F-F,G-G,H-H。

[0062] 图12A和图12B示出了如在下面的附图中将更详细说明的那样,一对通道隔膜130和中央隔膜140优选地基本上水平放置在组件5的垂直中心线附近,但实施例可以也将它们放置在组件5的顶部或底部附近,远离垂直中心线。

[0063] 在该实施例中,图12A示出了被指定为开环流体400的入口的间隙45(和可选的后间隙44)的区域。

[0064] 这些图中还示出了,以及图12C是风扇81,其被定位成使开环流体400流入间隙45(和可选的后间隙44)的部分,其通常如进入环境空气(过滤或未过滤),沿着左侧内部通道21(进气通道),跨过/穿过通道102,沿着右侧内部通道22下降,并且从间隙45的部分(和可选的后部44)中排出间隙,其用作流体400的排气。应当注意,左侧和右侧内部通道21和22是可选的,因为替代实施例将包括开环流体400的以下路径:进入间隙45(和可选的后间隙44),其通常用于环境空气(过滤或未过滤)的入口中,跨过/穿过通道102,并从间隙45(和可选的后间隙44)的部分排出,用作流体400的排气。

[0065] 图12C是沿图11的剖面线H-H截取的顶部剖视图。在该实施例中,该图示出了被指定为开环流体400的排气的间隙45(和可选的后间隙44)的区域。

[0066] 图13A示出了经由后间隙44注入开环流体400。开环流体400可以经由孔122穿过可选的门加强件115。

[0067] 图13B示出了在可选缓冲区46的区域内的组件的示例性实施例。在该实施例中,缓冲区46可以包括基本上在间隙45(和可选的后间隙44)附近或之内的区域,其包含沿着开环流体400的路径放置的一个或多个流体阻挡塞,使得其不能以任何实质的量通过。在示例性实施例中,缓冲区46将与中央隔膜140一起包含通道隔膜130,但是一些实施例将仅使用通道隔膜130(如果该实施例不允许流体400流过门加强件)。在一些实施例中,缓冲区46不是将通道隔膜130放置在左侧通道18和左侧通道19内,而是可以包含位于间隙44附近或端部处的插塞。一般来说,缓冲区是水平的且放置在组件5的垂直中心线附近,尽管它可以放置在组件5的顶部或底部附近。

[0068] 值得注意的是,缓冲区46应该存在于组件5的两个侧面以及组件5的前部和后部(如果使用后部间隙44),使得缓冲区46阻挡组件5的左右两侧的前间隙45(和后间隙44)的一部分。

[0069] 图13C示出了经由后间隙44对开环流体400的排出。开环流体400可以经由孔122穿过门加强件115。

[0070] 应当注意,尽管图13A-13C示出了后间隙44,但是在示例性实施例中,前间隙45具有与后间隙44相似的取向。这里未示出,因为它将基本上是重复的。

[0071] 图14示出了间隙45和后间隙44的组合区域,如交叉阴影区域所示。在示例性实施例中,在缓冲区46的外部,交叉阴影区域允许开环流体400进入或离开间隙45(和可选的后间隙44)。

[0072] 图15示出了与自立显示壳体15隔离的组件5。门加强件120可以紧紧地固定在前面板10的后面。在一些实施例中,门加强件120可以固定到前面板10的后表面。门加强件120可以基本上延伸到前面板10的周边。门加强件120可以由适当刚性的金属或其他材料构成,从而为组件5提供结构刚度和强度。门加强件120可以包括允许开环流体400流动的一系列孔125,所示的门加强件孔125仅仅是示例性的。可以考虑任何数量和形状的孔125。

[0073] 图16以隔离方式示出了后面板60。在示例性实施例中,后门加强件115可以固定在后面板60的周边边缘周围,从而构成后面板60。门腔17可以由后面板60、后门加强件115的内表面和内部后面板80(图中未示出)之间的空间限定。经由后间隙44注入的开环流体400可以被认为开环流体400b,其穿过后门加强件115经由孔122进入门腔17。所示的孔122仅仅是示例性的,可以考虑任何数量和形状的孔。细长构件形式的可选加强件110可基本延伸后面板60的长度。可选的加强件110可由金属、聚合物或其它适当刚性的材料构成,以便向后面板60提供结构刚度和强度。可选的加强件110可以包括一系列孔135,其便于开环流体400b流过任选的加强件110。所示的可选加强件110和孔135仅仅是示例性的,可以考虑任选数量和形状的可选加强件110和孔135。

[0074] 在门腔17中行进的开环流体400的部分被称为开环流体400b。如图所示,开环流体400b可以途经内部面板80的后面并且经由进气孔75被注入,从而被引向通道102。在示例性实施例中,流体400b将流过进气孔75并被引导到左侧通道18,其将流体400b分配在通道102上,并从右侧通道19排出。

[0075] 图17通过流动线图示出开环流体400a通过组件5的前部和后部的循环。开环流体可以经由间隙45被注入,经由孔125行进穿过门加强件120,并且垂直地穿过右侧通道19,有时由右侧内部通道22和侧梁90限定。类似地,开环流体400a可以经由后间隙44,经由孔122穿过门加强件115,并经由孔135穿过可选的加强件110,并进入右侧通道19。在组件5的相对侧上,类似的路线可以是由此开环流体最终进入左侧通道18,有时由左侧内部通道21和柱20限定。

[0076] 相反的基本相同的流动路径可以用于在组件5的相对端上的开环流体的排出。再次,在示例性实施例中,注入发生在组件5的上半部分中,而排出发生在组件5的下半部分中。在其他实施例中,注入发生在组件5的下半部分而排出发生在上半部分中。在其它实施例中,注入可以在右侧进行,而排出在左侧进行,缓冲区46放置在组件的顶部和底部边缘,以防止两个流动路径的交叉吸入。

[0077] 图18示出了经由间隙45和后间隙44注入之后开环流体400的示例性流动路径。经由后间隙44注入的开环流体400可以沿着可选的门加强件110之间的门腔17行时,并可以被称为开环流体400b。然后,开环流体400b可以沿着后内部面板80垂直行进并且经由后部进气孔75被注入。开环流体400的其它部分可以沿着左侧通道18和右侧通道19行进,并被称作开环流体400a。在垂直穿过侧通道18和19行进之后,开环流体400a可以在所述通道的顶部