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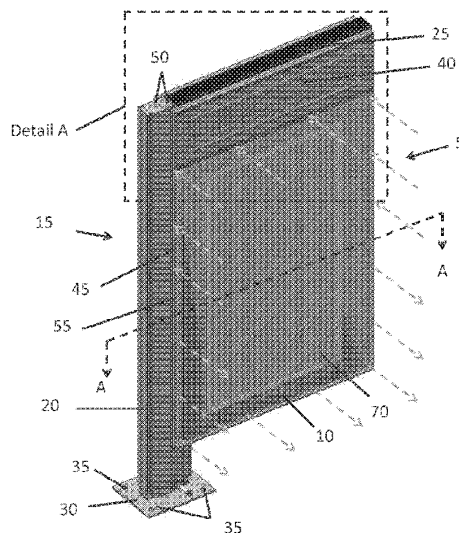


Figure 1

(57) Abstract: 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 exhaust 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 exhaust 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 exhaust 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.

WO 2016/133852 A1

Perimeter Ventilation System for Electronic Display

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application claims priority to US Application No. 14/624,268 filed on February 17, 2015 which is herein incorporated by reference in its entirety.

TECHNICAL FIELD

[0002] Embodiments of the present invention generally relate to mounting and 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

[0003a] It is an object of the present invention to substantially overcome or at least ameliorate one or more disadvantages of existing arrangements.

[0003b] According to a first aspect of the present invention, there is provided an electronic display assembly comprising: an electronic display; a housing and front panel which surround the electronic display; an ingestion gap for ingesting open loop fluid positioned along a portion of a perimeter of the front panel; an exhaustion gap for exhausting open loop fluid 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; a fan positioned to cause the flow of the open loop fluid; a buffer zone positioned between the ingestion gap and the exhaustion gap; and a central septum placed within the buffer zone.

[0003c] According to another aspect of the present invention, there is also provided 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; a second side channel positioned vertically and permitting gaseous communication between the channel and the exhaustion gap; 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; a buffer zone positioned between the ingestion gap and the exhaustion gap; and a central septum placed at the same vertical height as the buffer zone.

[0003d] According to another aspect of the present invention, there is also provided 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; 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; a first side channel positioned vertically and permitting gaseous communication between the ingestion gap and the heat exchanger; a second side channel positioned vertically and permitting gaseous communication between the heat exchanger and the exhaustion gap; a first side channel septum placed within the first side channel; and a second side channel septum placed within the second side channel.

[0004] Exemplary embodiments may comprise a display assembly and a free standing display housing. The display assembly may be mounted within the free standing display housing. The display assembly may comprise an ingestion gap that is positioned along the perimeter of a front panel, as well as an exhaustion gap that is positioned along an opposing portion of the perimeter of the front panel. A fan may be positioned to force open loop fluid into the ingestion gap, through a channel behind the electronic display, and out of the exhaustion gap.

[0005] The same fan or an additional fan may be used to force open loop fluid through an optional heat exchanger as well. An additional circulating fan may be used to circulate a closed loop fluid through the heat exchanger as well.

[0006] A buffer zone may be placed between the ingestion gap and the exhaustion gap and preferably contains one or more septums which substantially limit or prohibit the vertical flow of open loop fluid once ingested into the housing. The septums are generally positioned horizontally and near the vertical center of the display assembly (although not required).

BRIEF DESCRIPTION OF THE DRAWINGS

[0007] 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:

[0008] **FIGURE 1** is a front perspective view of an exemplary embodiment of the electronic display assembly housed in a free standing housing, and indicating section line A-A and Detail A.

[0009] **FIGURE 2** is a front elevation view of the embodiment shown in FIG. 1 and indicating Detail N.

[0010] **FIGURE 3** is a detailed front elevation view of Detail N shown in FIG. 2.

[0011] **FIGURE 4** is a rear perspective view of the exemplary embodiment of FIG. 1, and indicating section line B-B as well as Detail C.

[0012] **FIGURE 5** is a front perspective view of Detail A shown in FIG. 1, shown with a front panel removed.

[0013] **FIGURE 6** is a rear perspective view of the exemplary embodiment shown in FIG. 1, where a rear panel has been removed, and indicating Detail D and Detail E.

[0014] **FIGURE 7** is a top perspective section view taken along section line A-A of FIG. 1, and indicating Detail F.

[0015] **FIGURE 8** is a top plan section view of Detail F shown in FIG. 7.

- [0016] **FIGURE 9** is bottom perspective section view taken along section line B-B of FIG. 4, and indicating Detail K.
- [0017] **FIGURE 10** is a bottom plan section view of Detail K shown in FIG. 9, and indicating Detail L.
- [0018] **FIGURE 11** is a front plan view of the exemplary embodiment shown in FIG. 1 and indicating section lines F-F, G-G, and H-H.
- [0019] **FIGURE 12A** is a top plan section view taken along section line F-F of FIG. 11, and indicating Detail O and Detail P.
- [0020] **FIGURE 12B** is a top plan section view taken along section line G-G of FIG. 11, and indicating Detail Q.
- [0021] **FIGURE 12C** is a top plan section view taken along section line H-H of FIG. 11, and indicating Detail R.
- [0022] **FIGURE 13A** is a top plan detailed section view of Detail O in FIG. 12A.
- [0023] **FIGURE 13B** is a top plan detailed section view of Detail Q in FIG. 12B.
- [0024] **FIGURE 13C** is a top plan detailed section view of Detail R in FIG. 12C.
- [0025] **FIGURE 14** is a top plan detailed section view of Detail P in FIG. 12A.
- [0026] **FIGURE 15** is a rear perspective view of Detail D shown in FIG. 6, shown with the free standing display housing removed.
- [0027] **FIGURE 16** is a front perspective view of Detail C shown in FIG. 4 of the rear panel, shown in isolation from the surrounding components.
- [0028] **FIGURE 17** is a bottom plan section view of Detail L shown in FIG. 10.
- [0029] **FIGURE 18** is a rear perspective view of Detail E shown in FIG. 6, shown with the free standing display housing removed.
- [0030] **FIGURE 19A** is a rear perspective view of the assembly of FIG. 1, shown with the free standing display housing removed, and indicating Detail S.
- [0031] **FIGURE 19B** is a front perspective view of the assembly of FIG. 1, shown with the free standing display housing and front panel removed, and indicating Detail T.
- [0032] **FIGURE 20** is a rear perspective detail view of Detail S shown in FIG. 19A.
- [0033] **FIGURE 21** is a front perspective detail view of Detail T shown in FIG. 19B.

[0034] **FIGURE 22** is bottom perspective section view taken along section line B-B of FIG. 4

[0035] **FIGURE 23** is a front perspective view of the assembly of FIG. 1 showing only the rear panel, free standing display housing, and a select portion of the display assembly in isolation from all other surrounding components.

[0036] **FIGURE 24** is a top view of the assembly of FIG. 1, showing only the rear panel and select portions of the display assembly in isolation from all other surrounding components, and indicating detail M.

[0037] **FIGURE 25** is a front perspective view of Detail M shown in FIG. 23.

[0038] **FIGURE 26A** is a front perspective view of a septum shown with only the free standing display housing and select portions of the display assembly in isolation from all other surrounding components.

[0039] **FIGURE 26B** is another front perspective view of the septum, again shown with only the free standing display housing and select portions of the display assembly in isolation from all other surrounding components.

DETAILED DESCRIPTION OF EXEMPLARY EMBODIMENT(S)

[0040] 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.

[0041] 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.

[0042] 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.

[0043] 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.

[0044] **FIGURE 1** is an exemplary embodiment of an electronic display assembly 5 (hereinafter also the “assembly”). The electronic display assembly 5 comprises a front panel 10 that may cover the majority of the front surface of the assembly 5. The front panel 10 may be transparent and positioned in front of an electronic display 70, which is preferably secured behind the front panel 10. In exemplary embodiments, the front panel 10 is a touch screen. A perimeter wall 55 may surround the front panel 10.

[0045] A free standing display housing 15 may surround the assembly 5 and may be configured to permit affixing the assembly 5 to the ground. In exemplary embodiments the free standing display housing 15 may be flag shaped. In still other embodiments, the free standing display housing 15 may be sized and configured to be integrated into a bus shelter.

[0046] The free standing display housing 15 may comprise a post 20, an upper beam 25, and a base 30. In exemplary embodiments, the base 30 may comprise select apertures 35, such as circular holes, that permit a fastener, such as a bolt, to pass through and thereby affix the base 30 to the ground. The number and location of the apertures 35 shown are merely an example. A bottom portion of post 20 may be buried to affix the free standing display to the ground. In some embodiments, this may be accomplished by burring said bottom portion of post 20 in concrete. The free standing display housing 15 and related components may be comprised of a metal, such as stainless steel or aluminum.

[0047] The upper beam 25 may further comprise a secondary display 40 that covers a majority of one side of the upper beam 25. In exemplary embodiments this secondary display 40 is a liquid crystal display (LCD). In other embodiments, the secondary display 40 may be a static display comprising an illumination device, such as a backlight, and a cavity to accommodate a static display, such as a poster.

[0048] A pair of elongate members 50 may extend from the top of the post 20. The elongate members 50 may be configured to further secure the free standing display housing 15, and thereby the assembly 5, in place. Any number and shape of elongate members 50 is contemplated. In exemplary embodiments, these elongate members 50 may be sized and configured to be integrated with a bus shelter.

[0049] As discussed in greater detail in the subsequent figures, the assembly 5 may further comprise a gap 45 between the perimeter wall 55 and the front panel 10 configured to permit the flow of a fluid, such as ambient air, in and out of the assembly 5. In exemplary embodiments, the assembly 5 may be configured such that the upper half of the assembly 5 permits the intake of a fluid, while the lower half of the assembly 5 permits the exhaust of said fluid, as illustrated by the flow lines. This is only an example as other embodiments may be configured such that the upper half of the assembly 5 permits the exhaust of a fluid, while the lower half of the assembly 5 permits the intake of said fluid.

[0050] **FIGURE 2** and **FIGURE 3** illustrates the gap 45, further indicated by the cross hatched area which has been enlarged in order to show the detail, extends along the perimeter of the assembly 5. The gap 45 may further comprise a buffer zone 46. The buffer zone 46 may be an area, preferably between the ingestion and exhaust portions of the gap 45 that does not permit the flow of external air. In other embodiments, the buffer zone 46 may substantially limit the flow of external air. In an exemplary embodiment, the gap 45 is positioned around the perimeter of the front panel 10 but is not found within the buffer zones 46. In an exemplary embodiment, the buffer zones 46 are located near the vertical centerline of the display assembly 5 and typically there is a first buffer zone on the right hand side of the assembly with a second buffer zone on the left hand side of the assembly.

[0051] In **FIGURE 4** the assembly 5 may further comprise a rear panel 60 that covers a majority of the rear surface of assembly 5. A rear perimeter wall 54 may surround the sides of rear panel 60. In exemplary embodiments, the rear perimeter wall 54 may be substantially the same as the perimeter wall 55. The upper beam 25 may further comprise a tertiary display 41 that may contain a backlight and graphic, similar to the secondary display 40. An illumination unit, such as a backlight, may be placed behind the rear panel 60. A cavity may be located behind the rear surface of rear panel 60 and may be configured to accommodate a static display, such as a poster, placed within or behind the rear panel 60. In alternate embodiments, an electronic display assembly (such as an LCD) may be placed behind the rear panel 60.

[0052] As discussed in greater detail in the subsequent figures, similarly to FIG. 1 the assembly 5 may further comprise a rear gap 44 between the rear perimeter wall 54 and the rear panel 60 configured to permit the flow of a fluid, such as ambient air, in and out of the assembly 5. In exemplary embodiments, the assembly 5 may be configured such that the upper half of the assembly 5 permits the intake of a fluid, while the lower half of the assembly 5 permits the exhaust of said fluid, as illustrated by the flow lines (but this could be reversed).

[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 or 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

1. An electronic display assembly comprising:
 - an electronic display;
 - a housing and front panel which surround the electronic display;
 - an ingestion gap for ingesting open loop fluid positioned along a portion of a perimeter of the front panel;
 - an exhaustion gap for exhausting open loop fluid 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;
 - a fan positioned to cause the flow of the open loop fluid;
 - a buffer zone positioned between the ingestion gap and the exhaustion gap; and
 - a central septum placed within the buffer zone.
2. The electronic display assembly of claim 1 wherein:
 - the ingestion gap permits the ingestion of ambient air into the housing.
3. 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.
4. The electronic display assembly of claim 3 further comprising:
 - a channel septum placed within the first side channel.
5. The electronic display assembly of claim 4 wherein:
 - the channel septum substantially prevents the vertical flow of open loop fluid.
6. The electronic display assembly of claim 1 wherein:
 - the ingestion gap and the exhaustion gap face an intended observer of the electronic display.

7. 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 exhaust 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;
 - a second side channel positioned vertically and permitting gaseous communication between the channel and the exhaust gap;
 - 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 exhaust gap;
 - a buffer zone positioned between the ingestion gap and the exhaust gap; and
 - a central septum placed at the same vertical height as the buffer zone.
8. The electronic display assembly of claim 7 further comprising:
 - a channel septum placed within the first side channel.
9. The electronic display assembly of claim 7 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.
10. The electronic display assembly of claim 7 wherein:
 - the channel is defined by the space between an LED backlight and a plate.
11. The electronic display assembly of claim 7 wherein:
 - the ingestion gap is positioned on a first vertical half of the assembly, while the exhaust gap is positioned on the opposing vertical half of the assembly.
12. The electronic display assembly of claim 7 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.

13. 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;
 - 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;
 - a first side channel positioned vertically and permitting gaseous communication between the ingestion gap and the heat exchanger;
 - a second side channel positioned vertically and permitting gaseous communication between the heat exchanger and the exhaustion gap;
 - a first side channel septum placed within the first side channel; and
 - a second side channel septum placed within the second side channel.
14. The electronic display assembly of claim 13 wherein:
 - the first and second side channel septums substantially block the vertical flow of open loop fluid.

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Patent Attorneys for the Applicant/Nominated Person
SPRUSON & FERGUSON

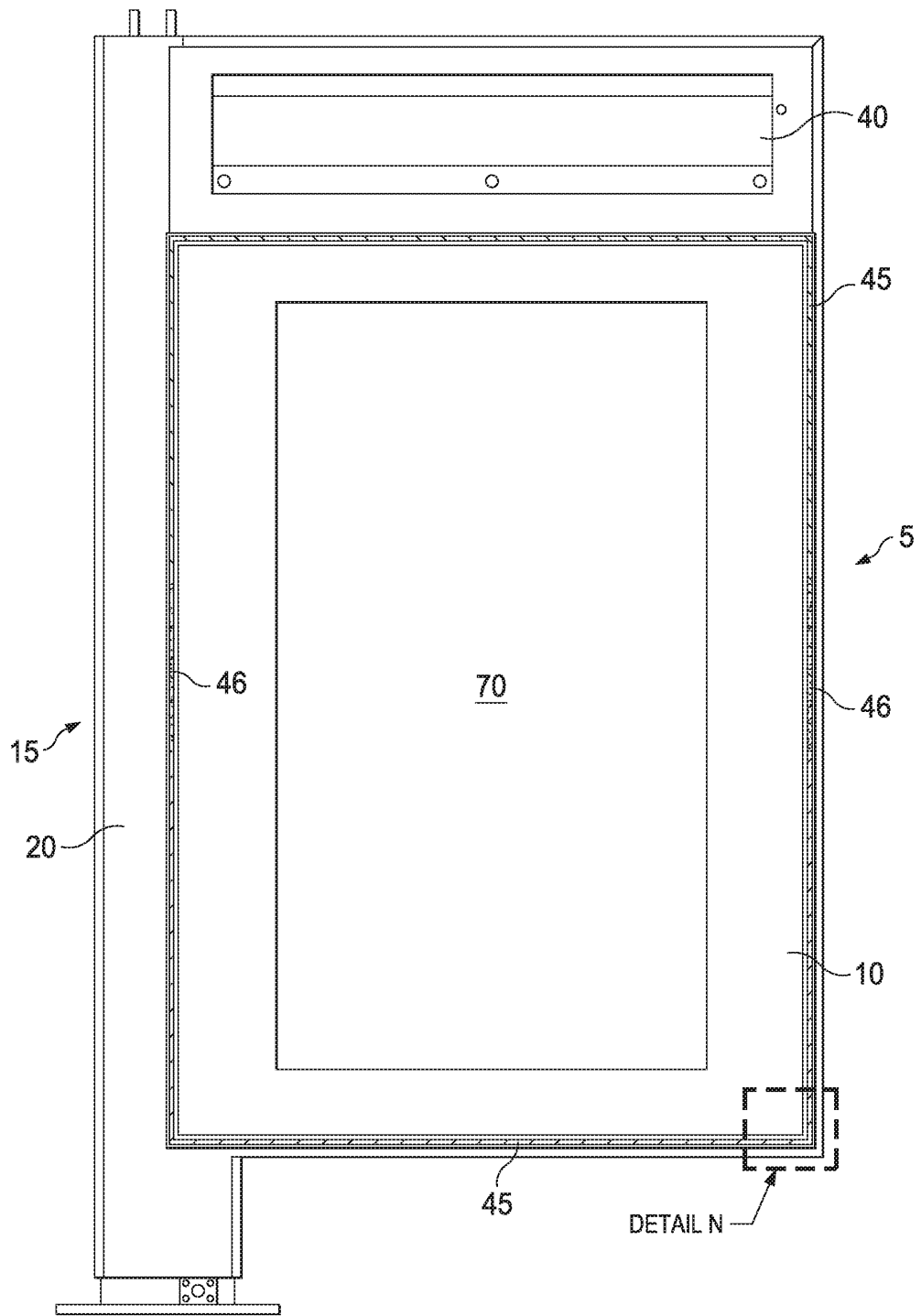


FIG. 2

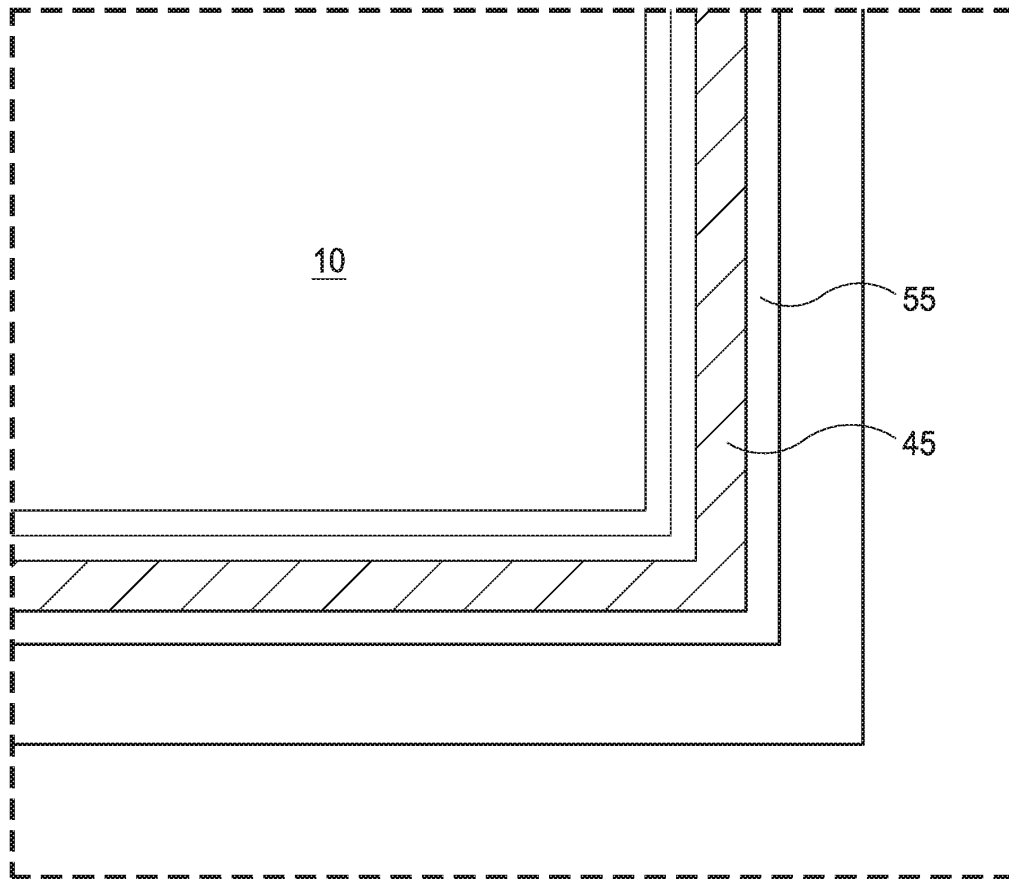


FIG. 3

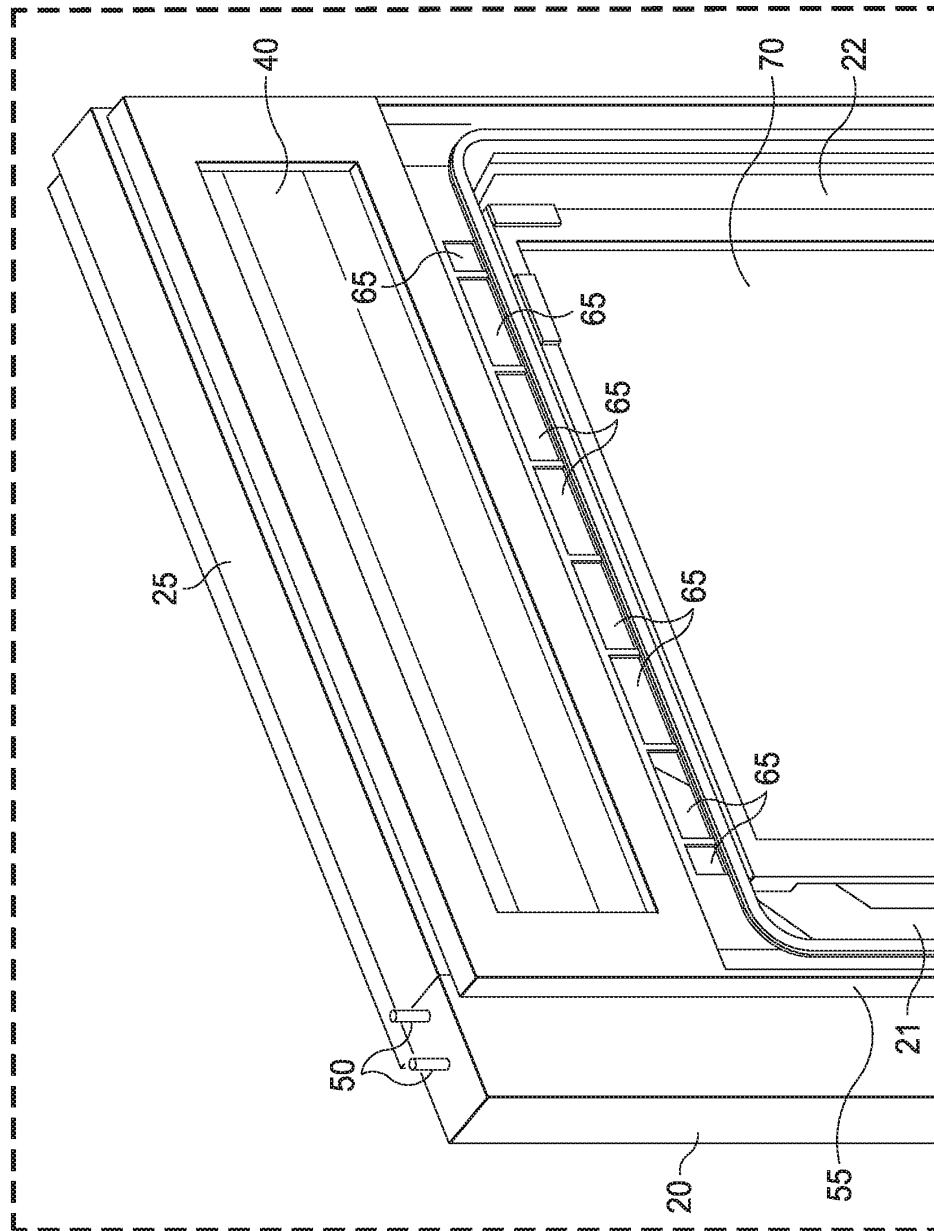
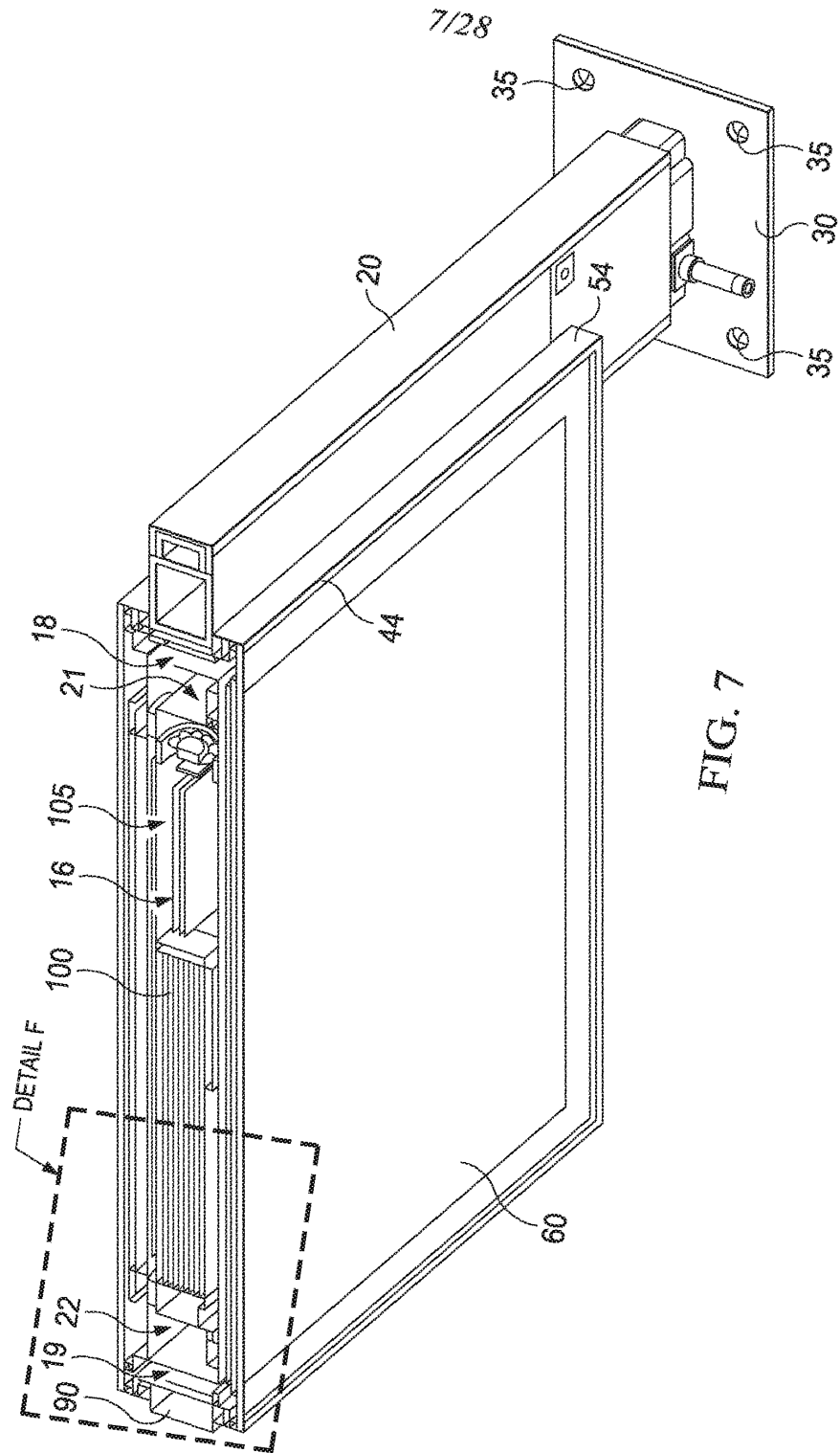


Fig. 5



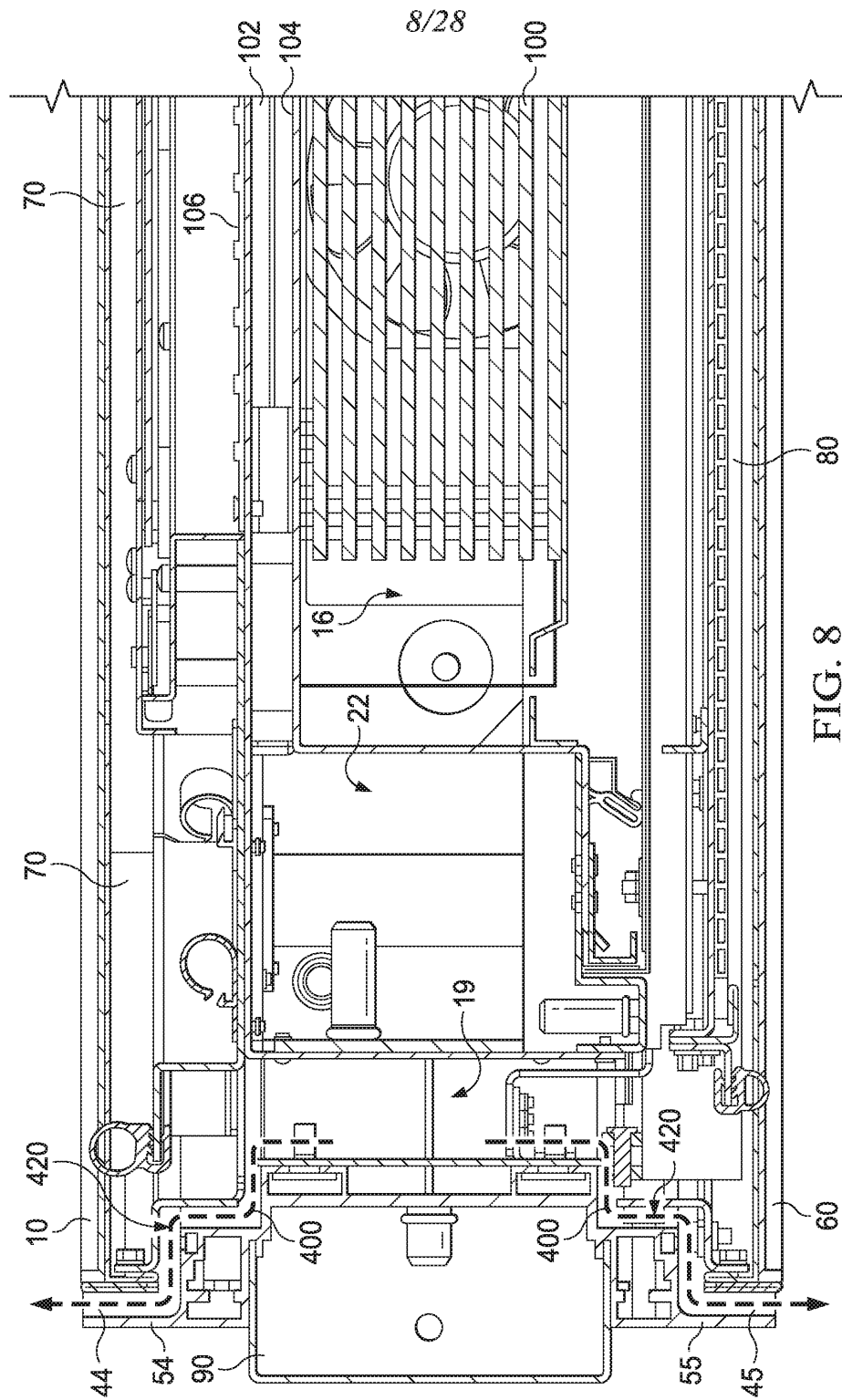
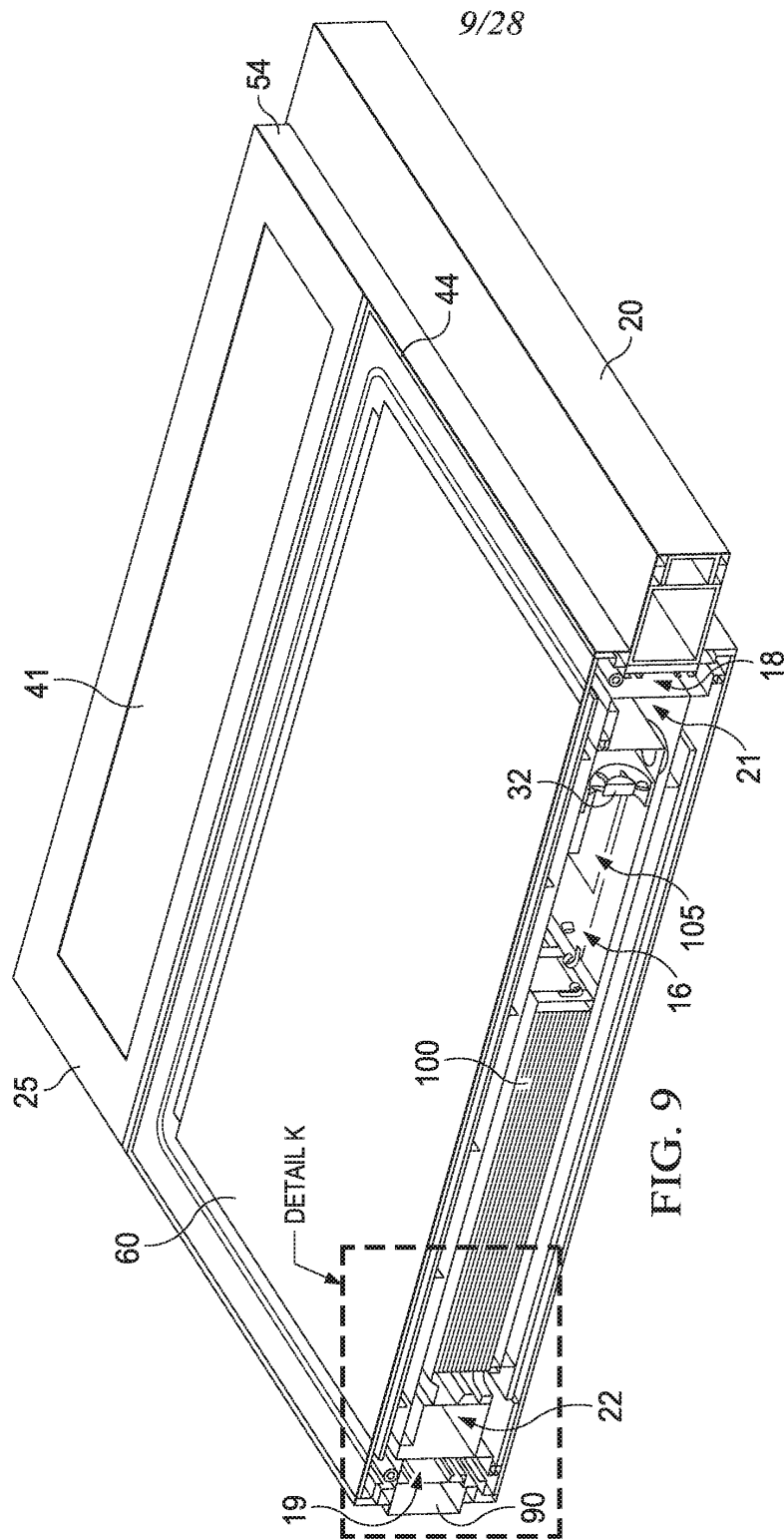


FIG. 8



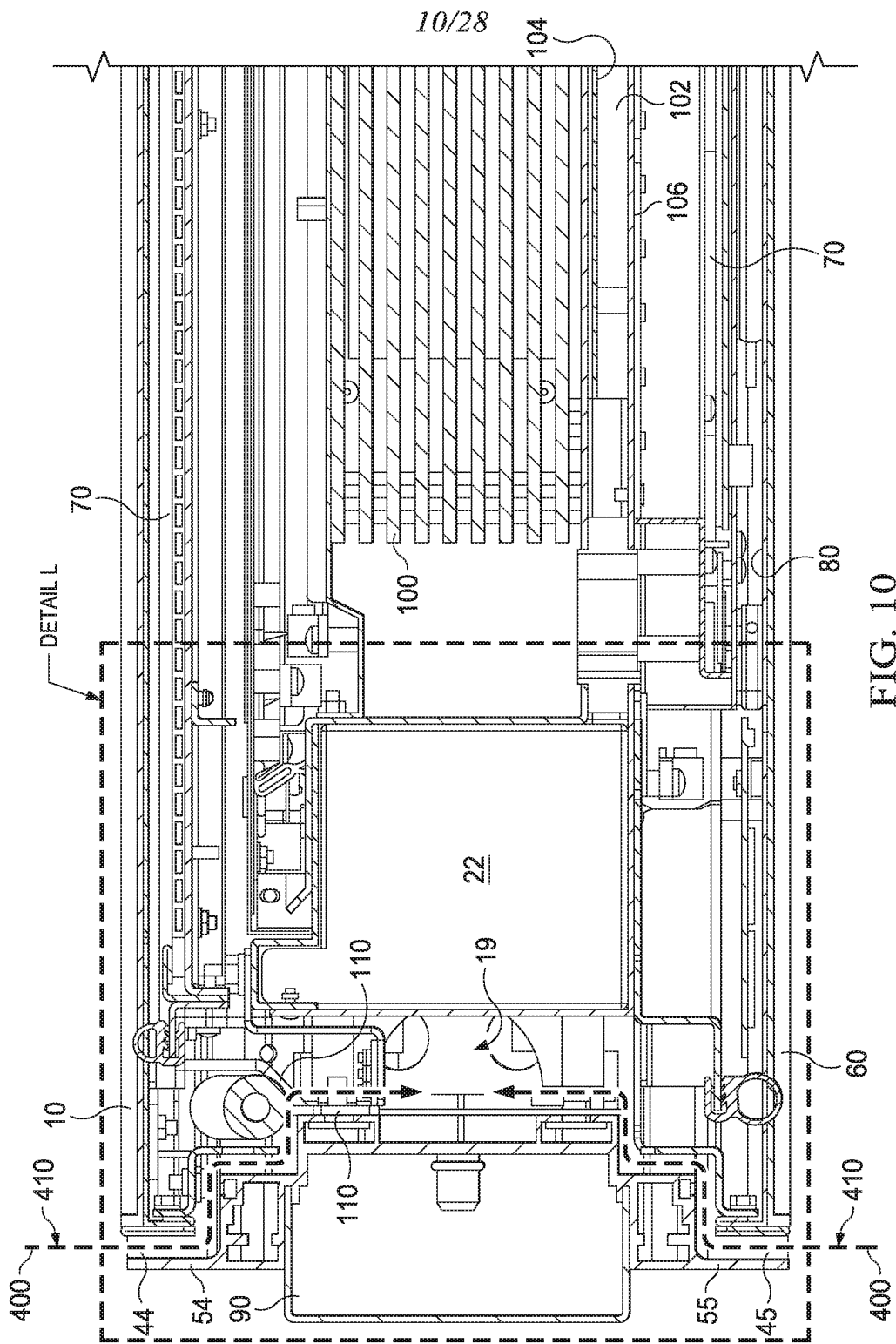


FIG. 10

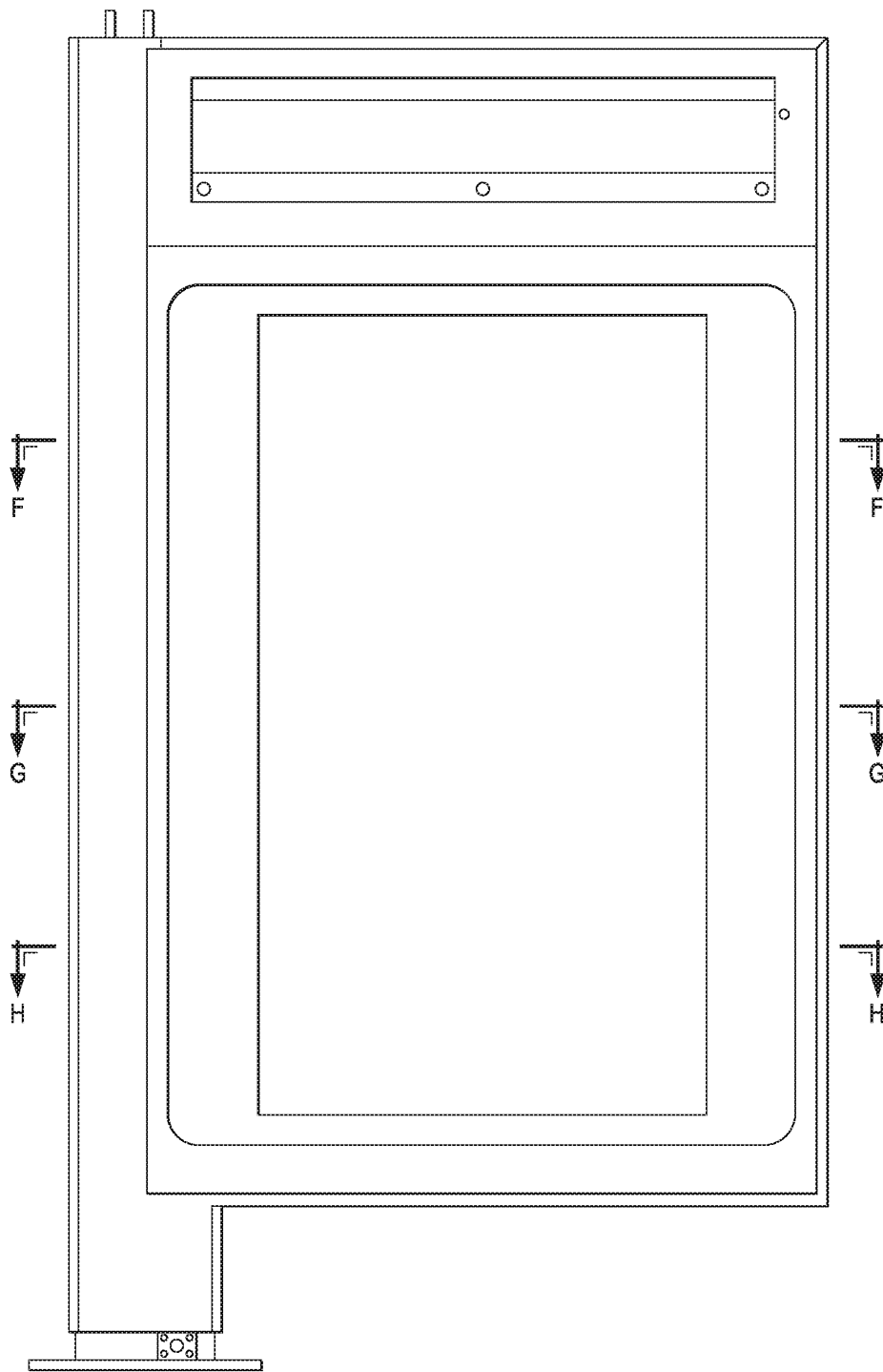
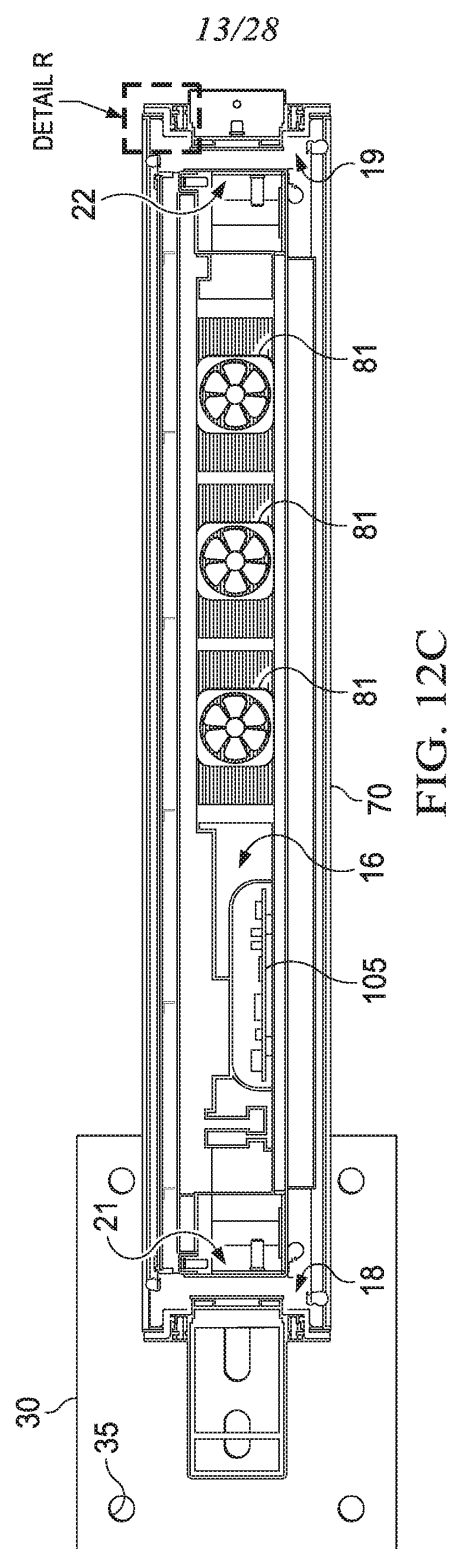


FIG. 11



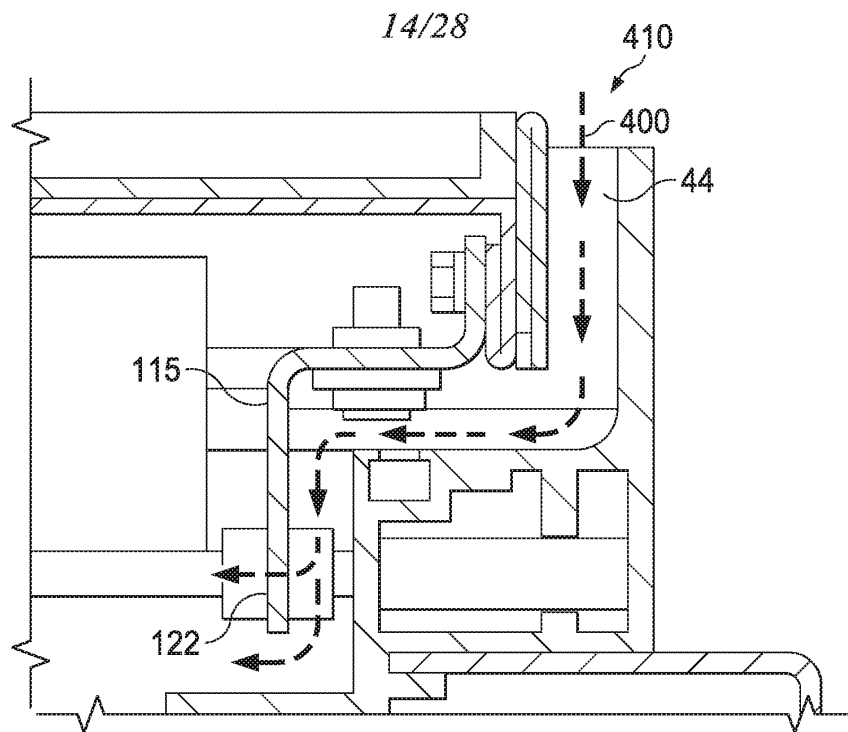


FIG. 13A

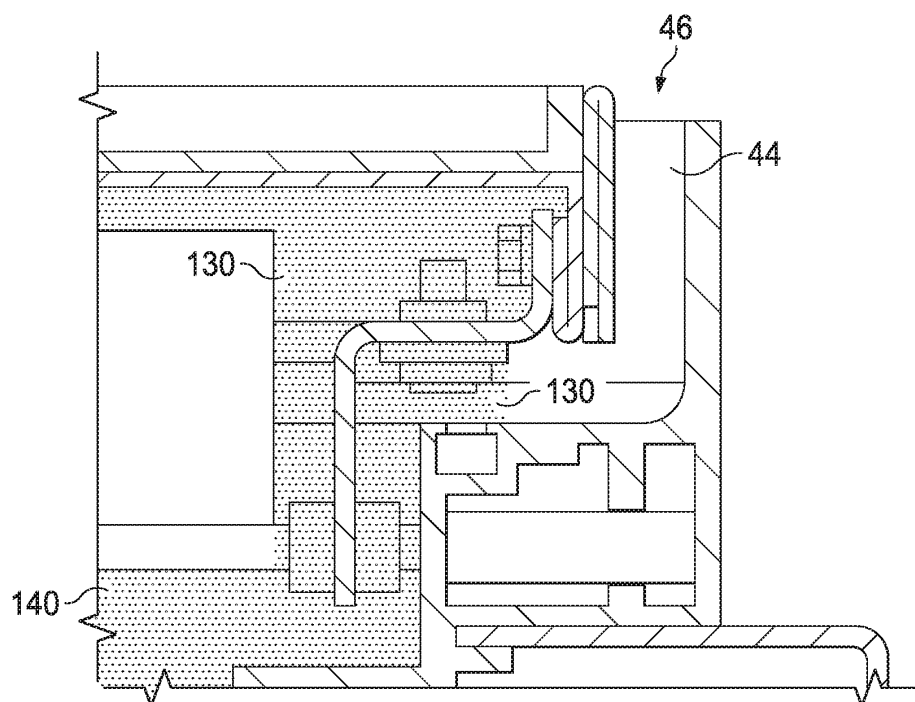


FIG. 13B

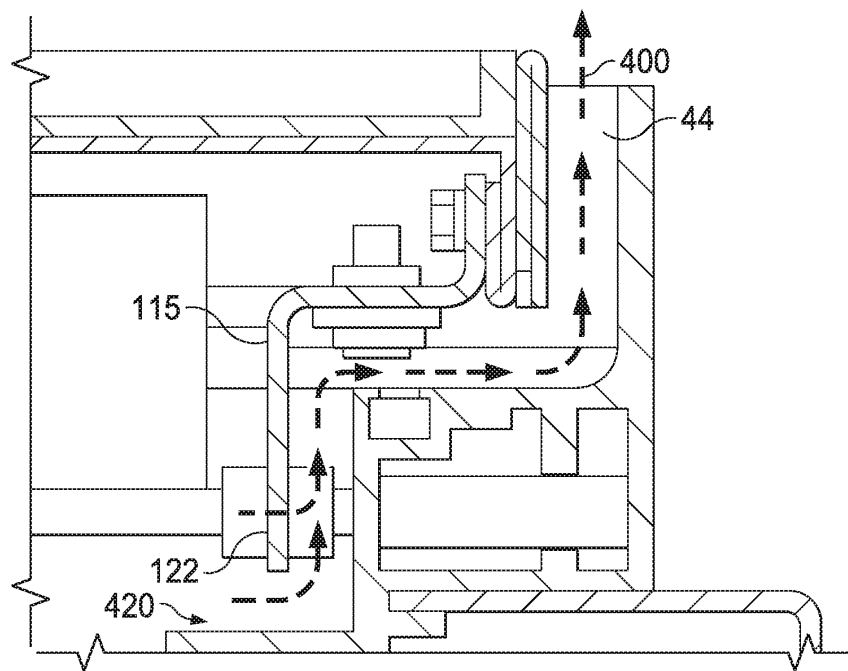


FIG. 13C

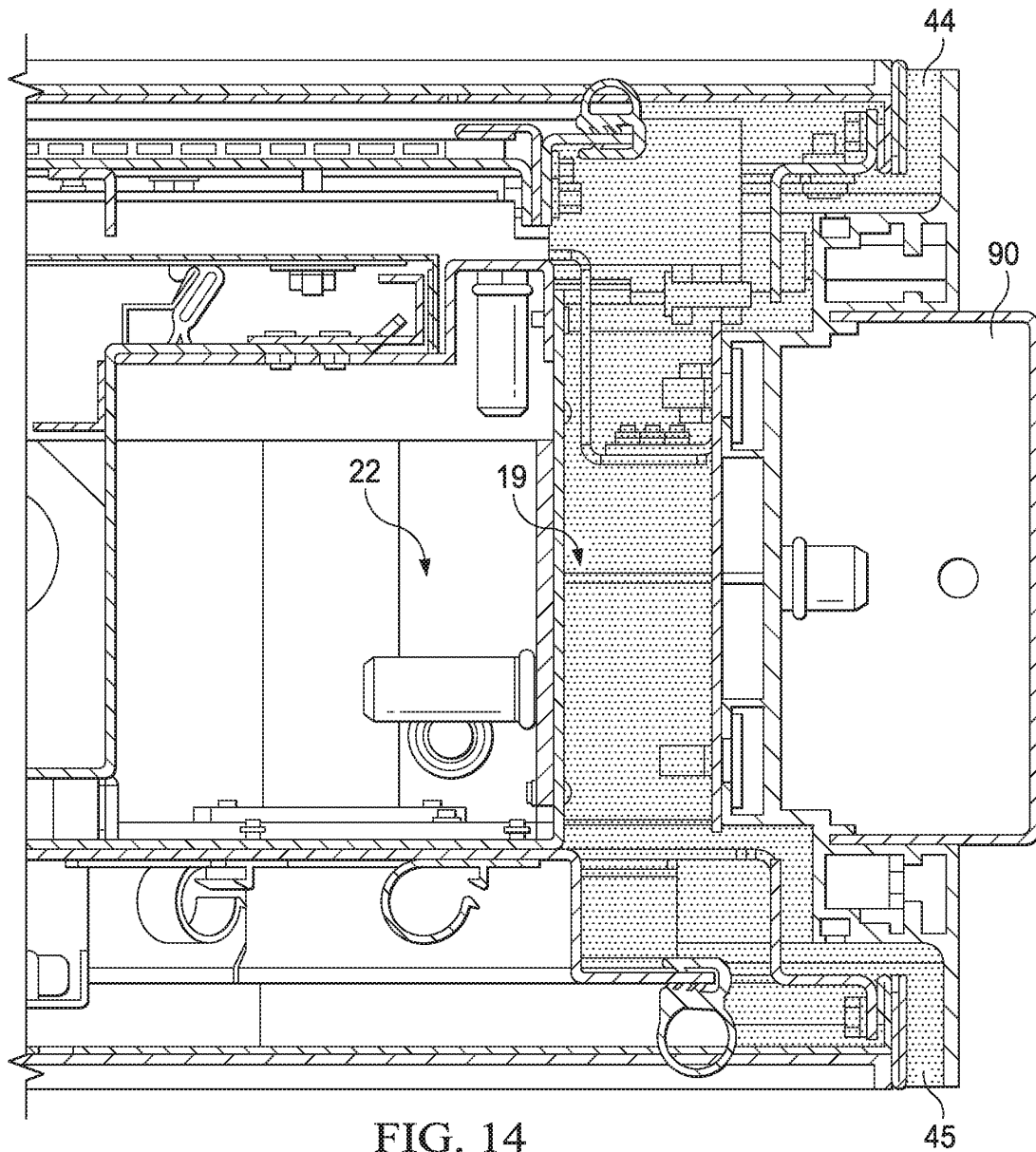


FIG. 14

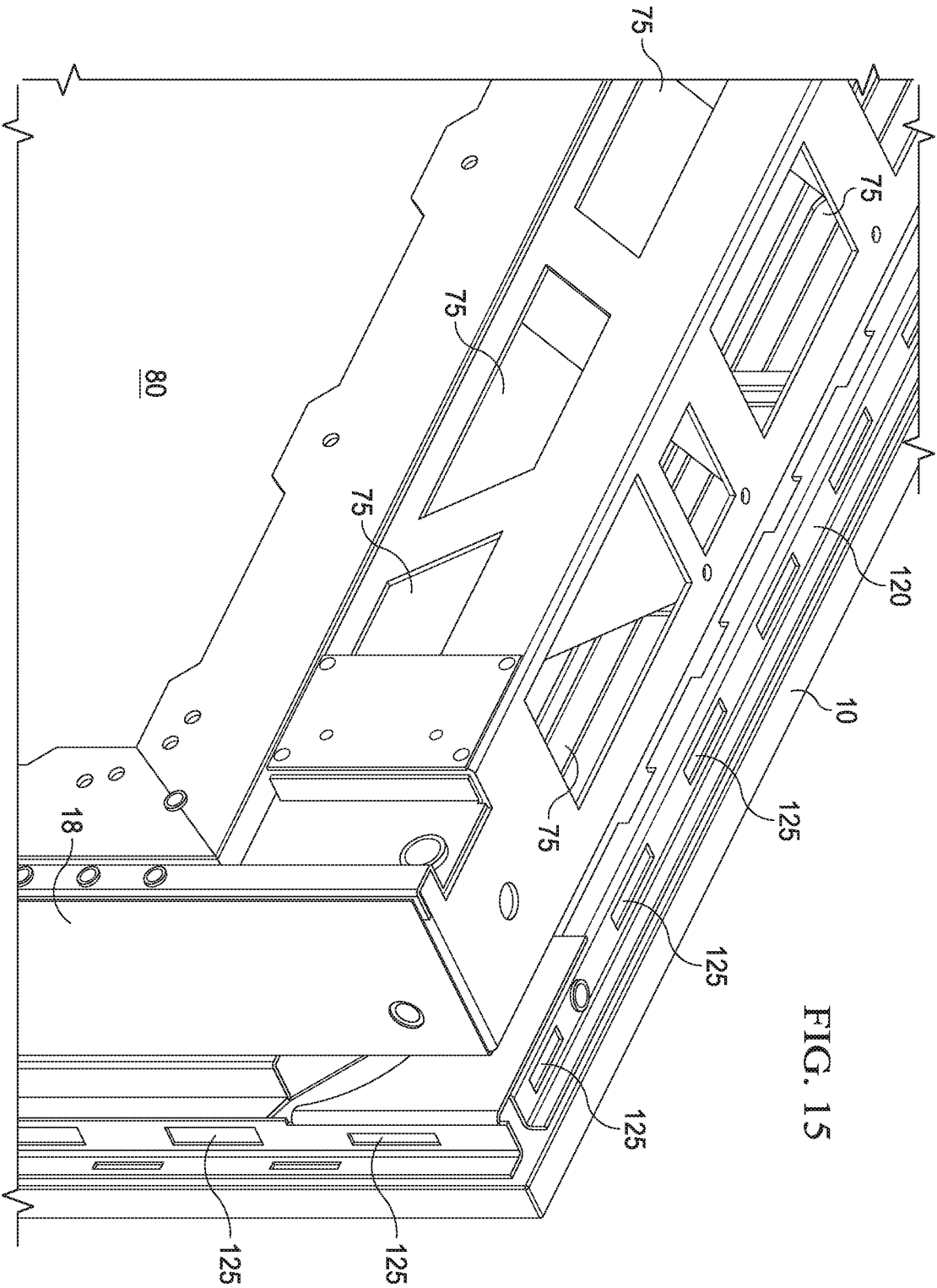
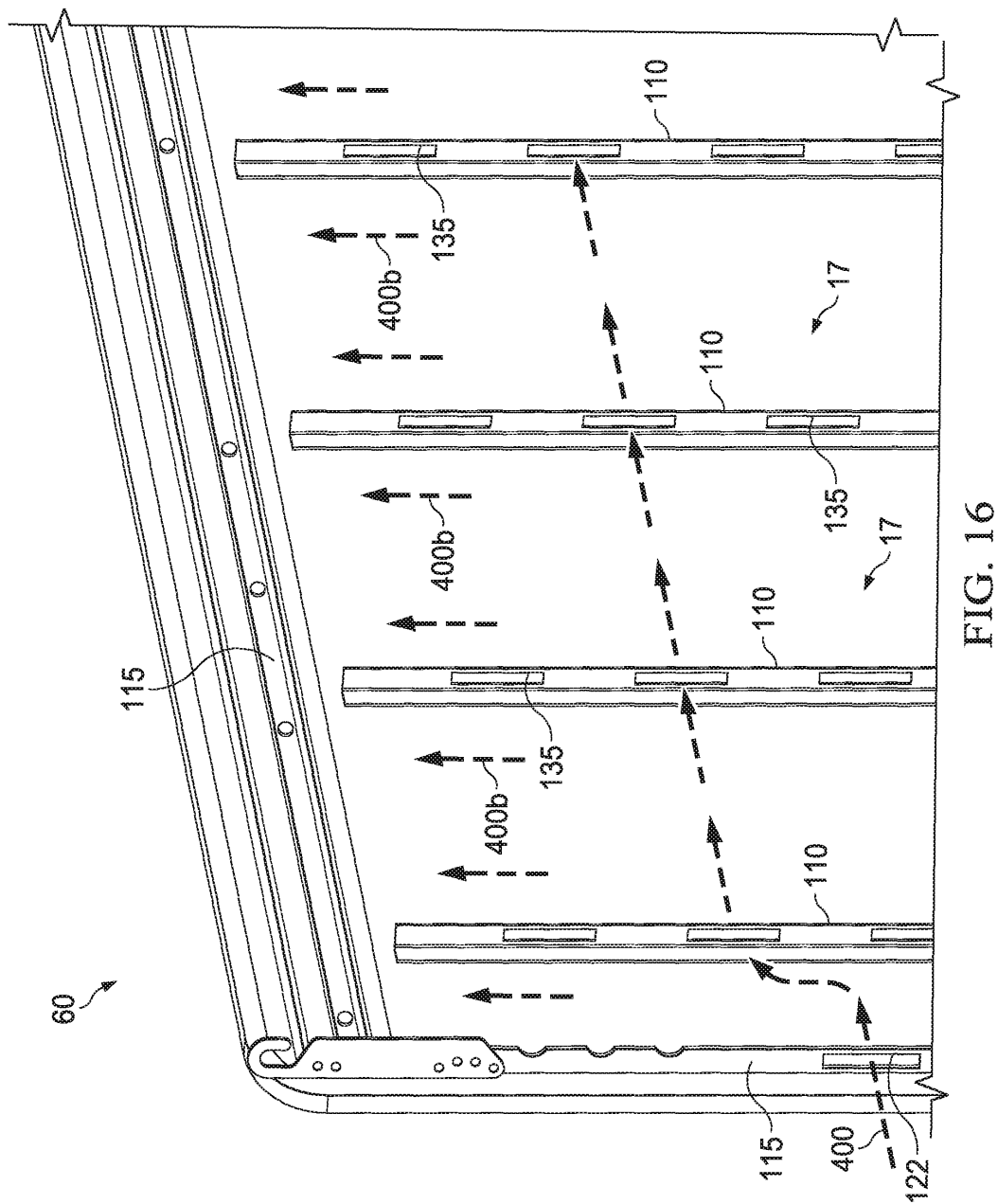
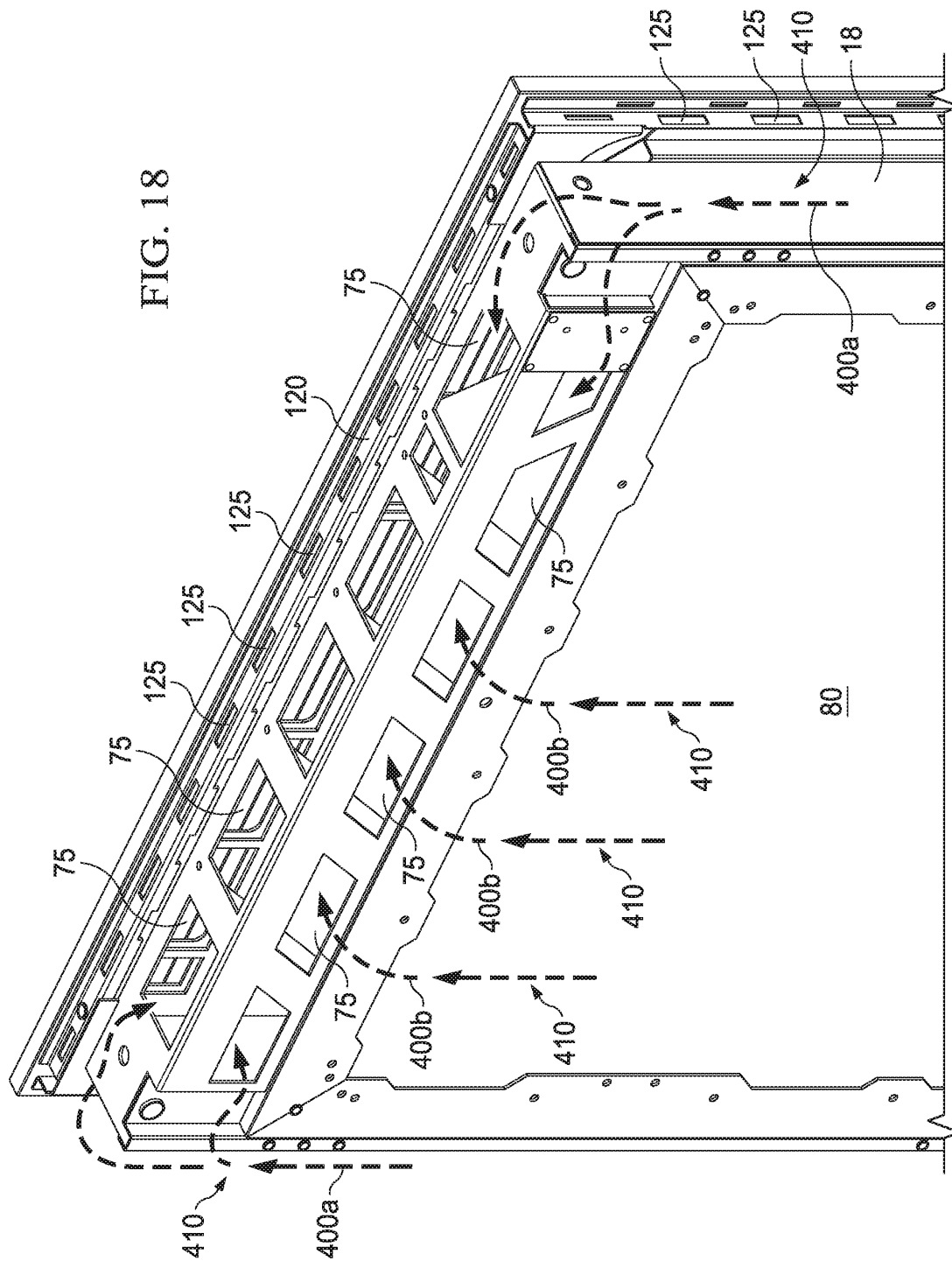
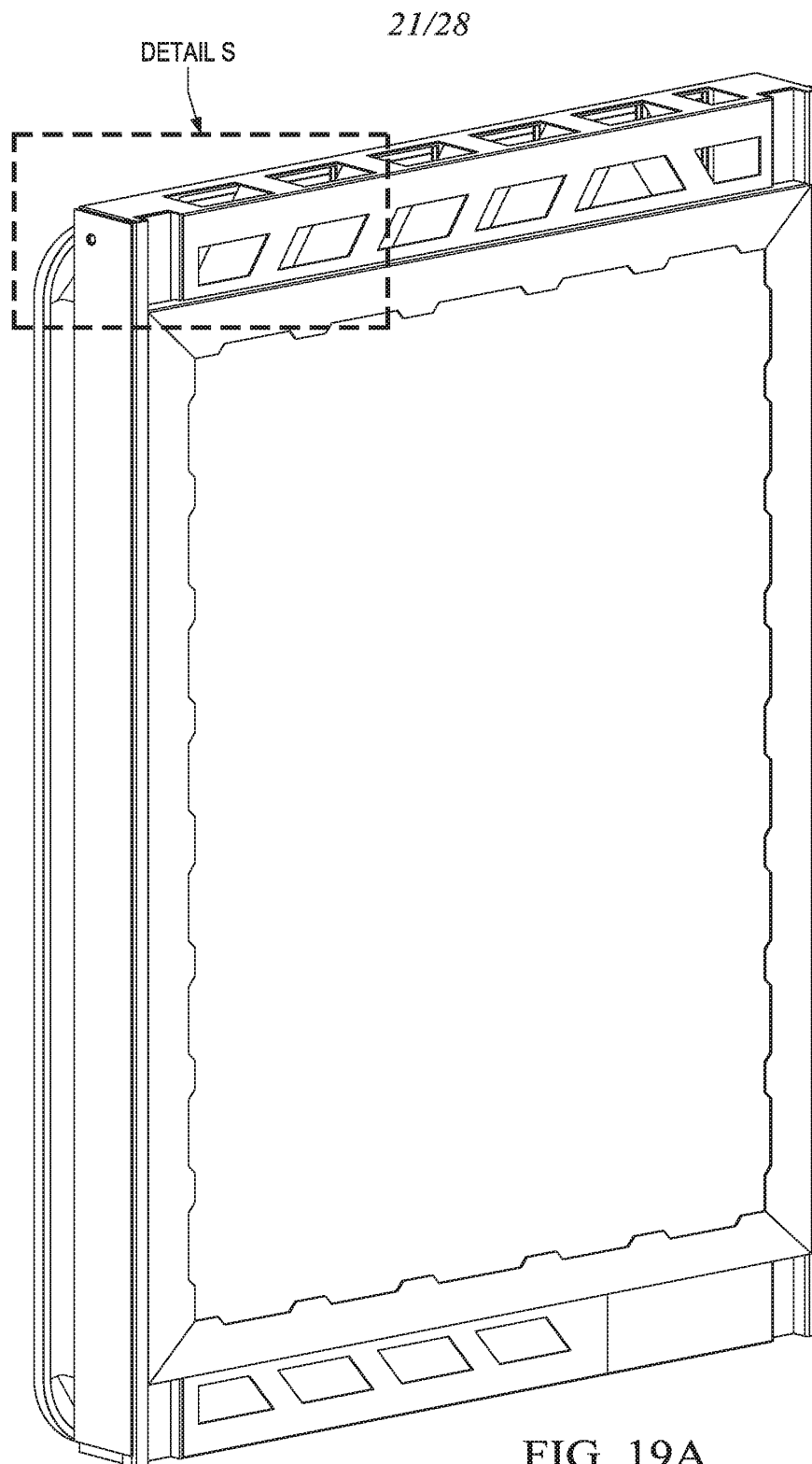


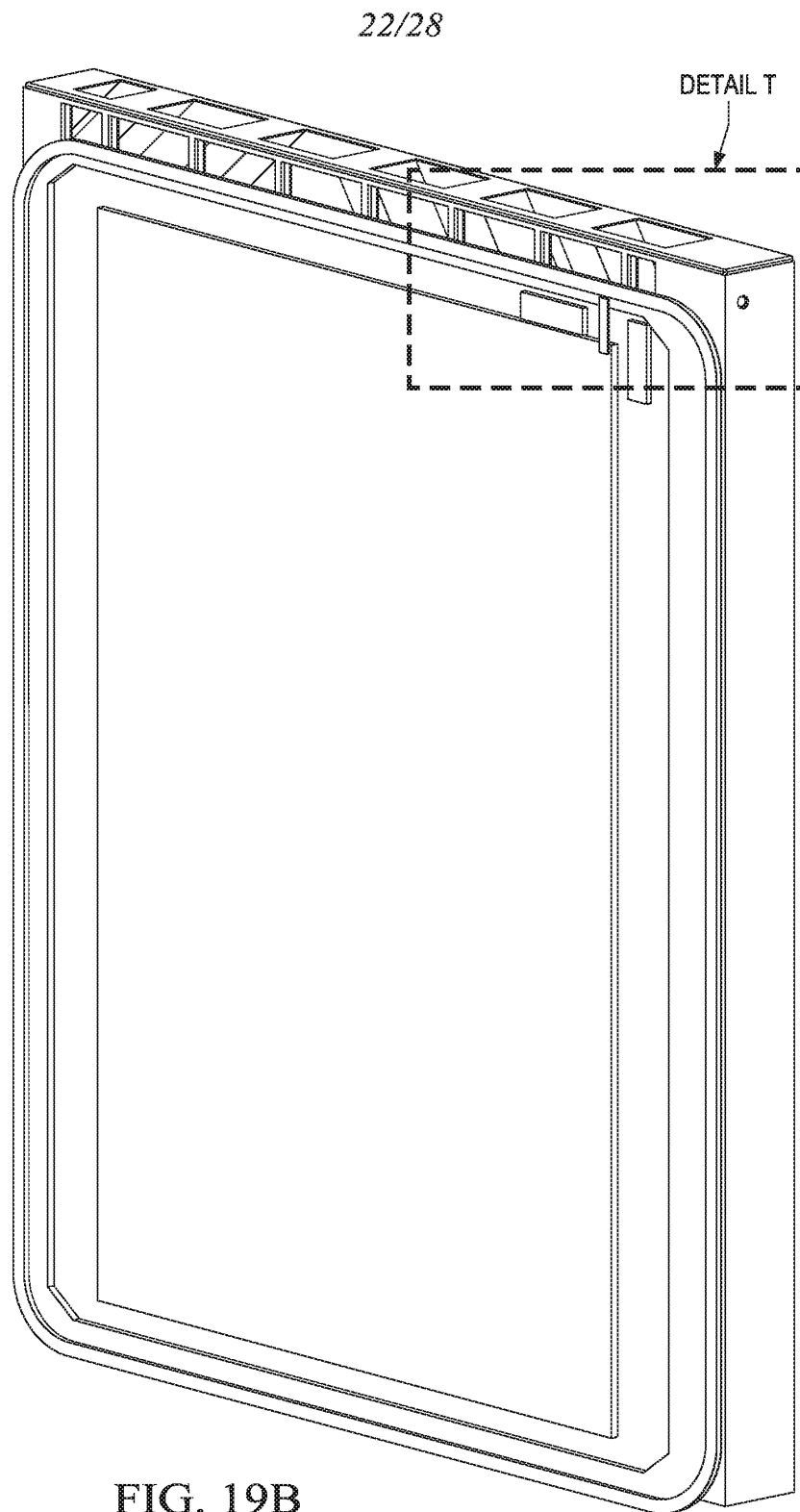
FIG. 15

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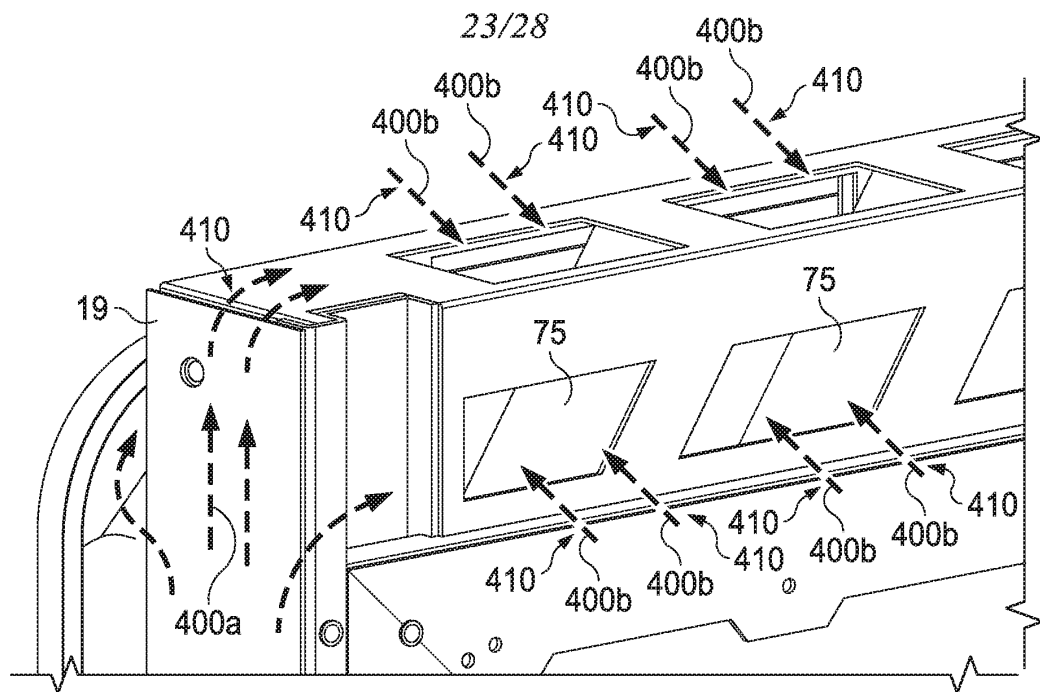


FIG. 20

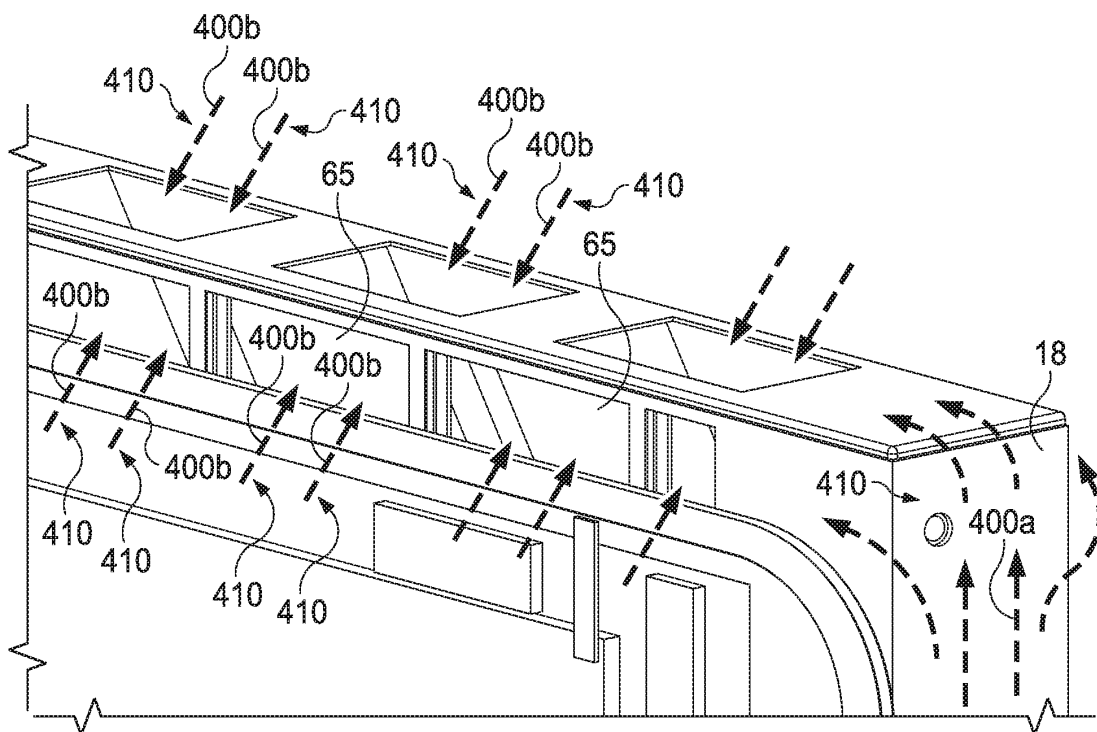
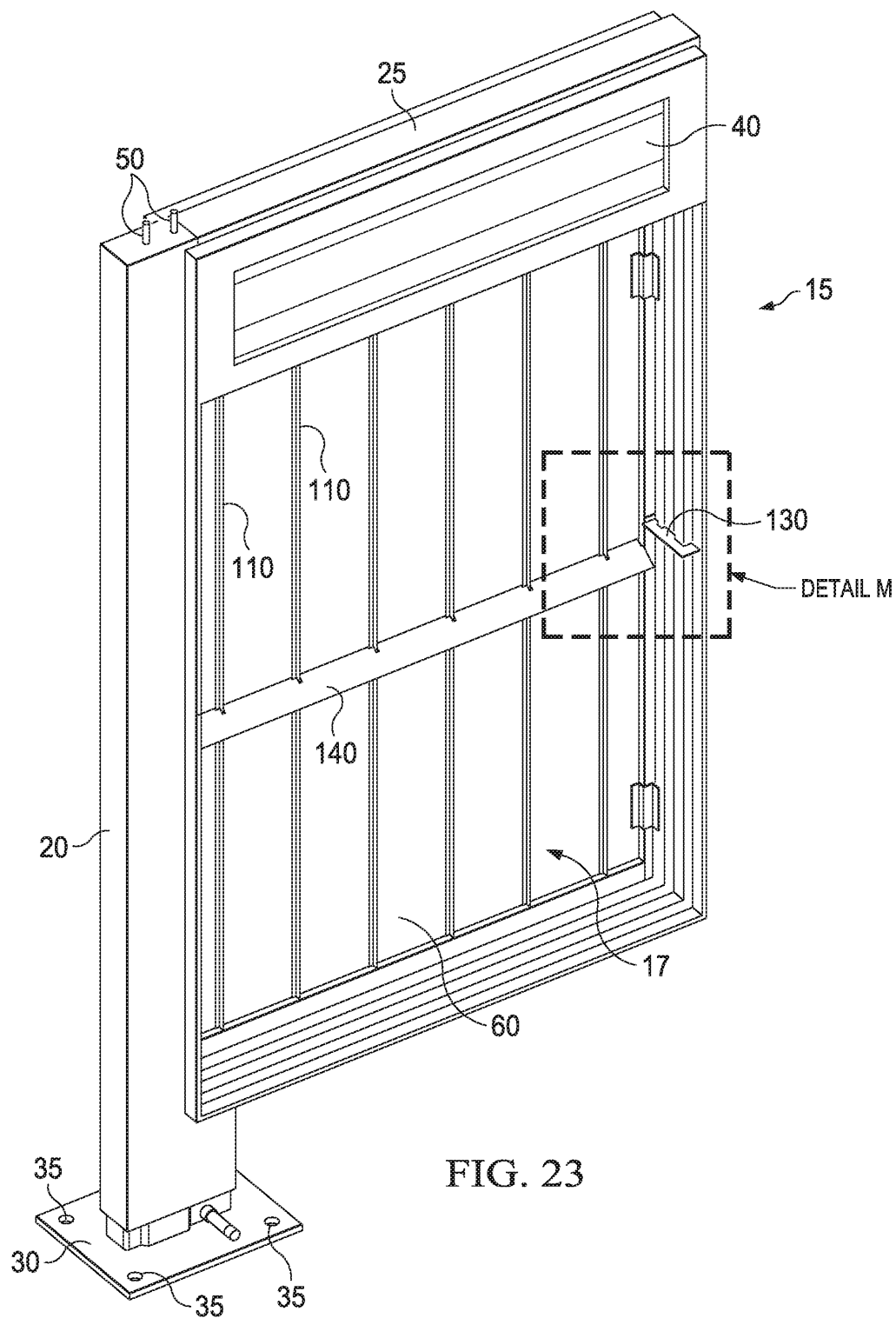
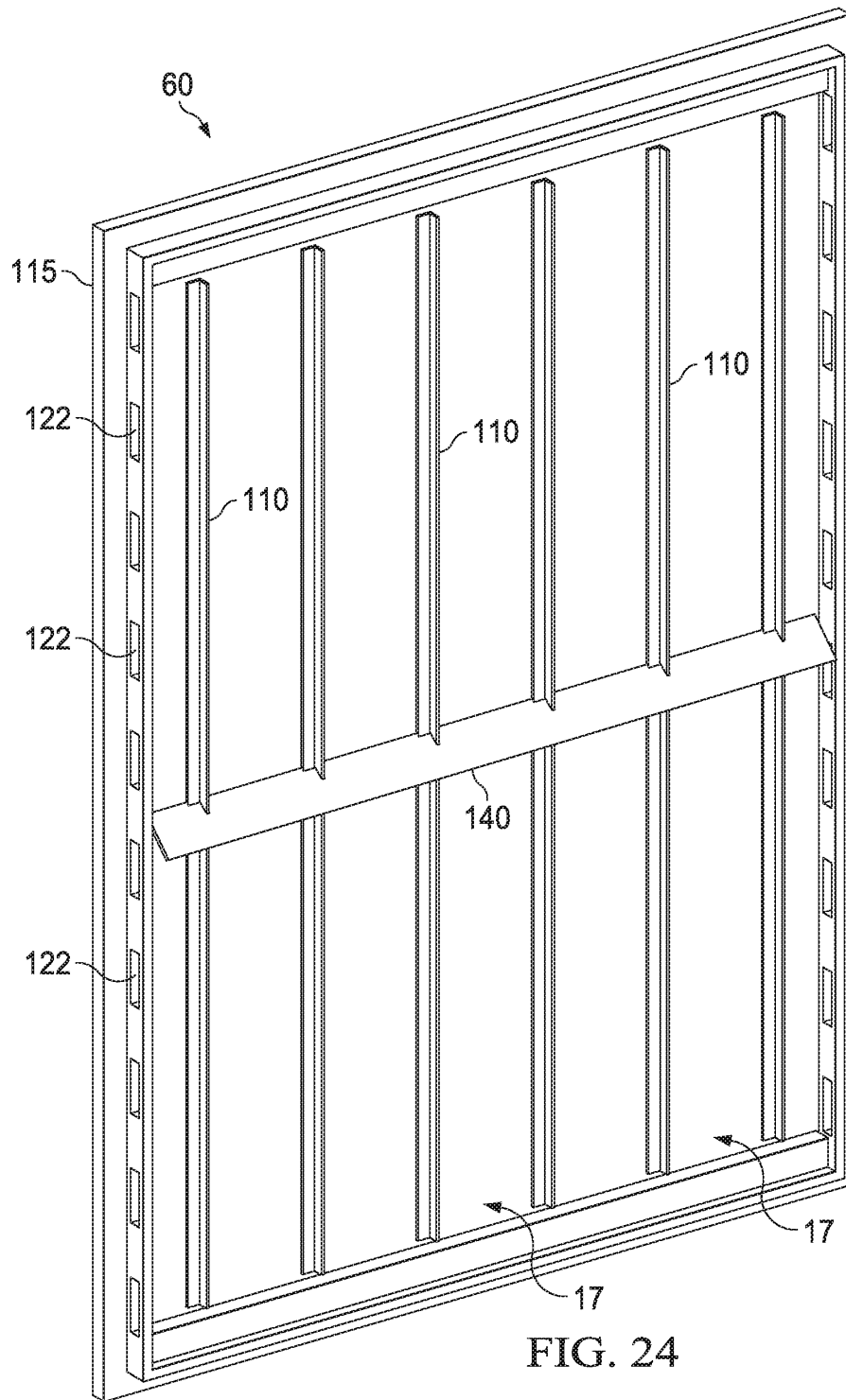


FIG. 21





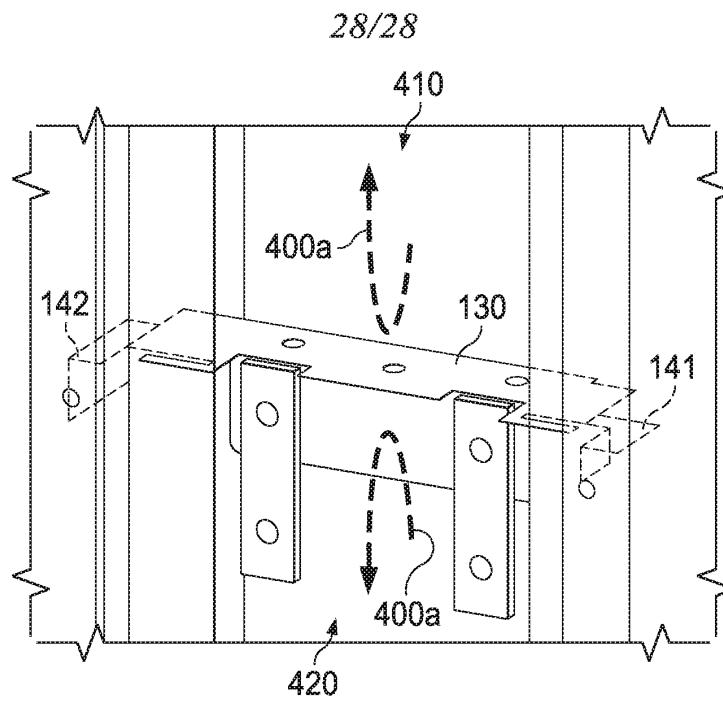


FIG. 26A

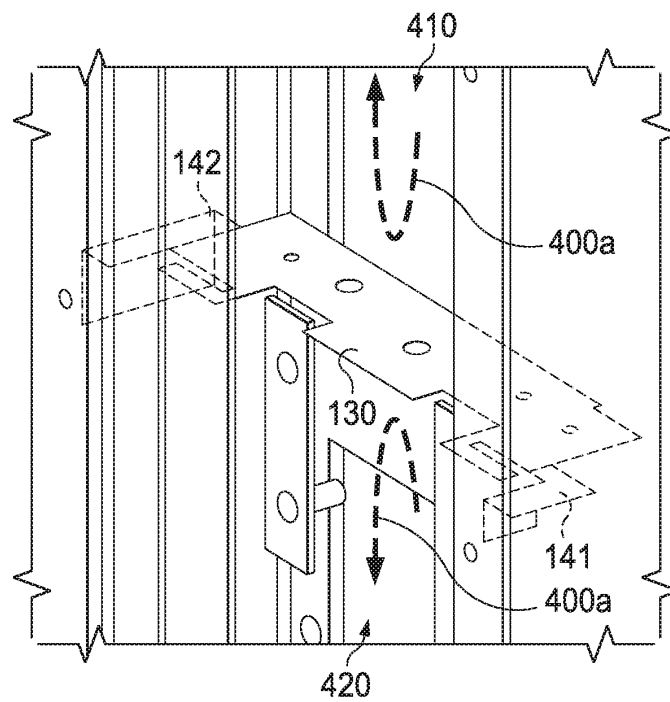


FIG. 26B



Australian Government

IP Australia

CERTIFICATE OF GRANT STANDARD PATENT

Patent number: 2015229457

The Commissioner of Patents has granted the above patent on 7 March 2019, and certifies that the below particulars have been registered in the Register of Patents.

Name and address of patentee(s):

Manufacturing Resources International, Inc. of 6415 Shiloh Road East Alpharetta GA 30005 United States of America

Title of invention:

Hybrid Rear Cover and Mounting Bracket for Electronic Display

Name of inventor(s):

Dunn, William; Diaz, Marcos and Azevedo, Kyle

Term of Patent:

Twenty years from 11 March 2015

Priority details:

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Date
11 March 2014

Filed with
US



Dated this 7th day of March 2019

Commissioner of Patents

PATENTS ACT 1990

The Australian Patents Register is the official record and should be referred to for the full details pertaining to this IP Right.

SEC et al. v. MRI
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IPR2023-00221

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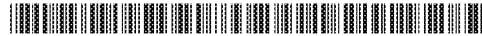
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AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IR, IS, JP, KE, KG, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

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(54) Title: ELECTRONIC DISPLAY REAR COVER AND MOUNTING BRACKET

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

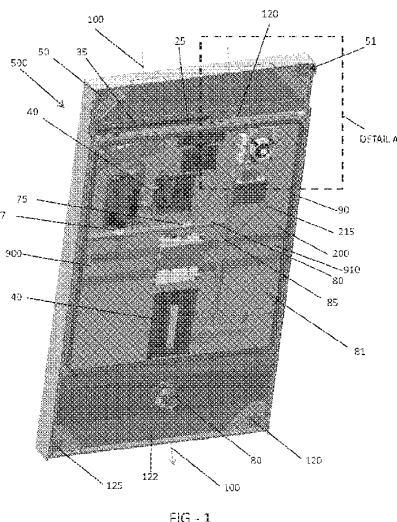


FIG. 1

WO 2015/138609 A3

Hybrid Rear Cover and Mounting Bracket for Electronic Display

Inventors: William Dunn, Marcos Diaz, Kyle Azevedo

Cross-Reference to Related Applications

[0001] This application claims priority to co-pending US Application No. 61/951,344 filed on March 11, 2014 and is herein incorporated by reference in its entirety.

Technical Field

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

Background of the Art

[0003] Electronic displays are sometimes used in outdoor environments or other areas where the surrounding temperatures may be high or there may be other sources of heat such as solar loading causing the temperatures within the display to rise. However, some portions of the display can be difficult to cool as simply ingesting ambient air into some portions of the display can introduce dust and contaminates into sensitive portions of the display, which can lead to premature failures. Further, it is now desirable to provide an improved system for installing large electronic displays in public area.

Summary of the Exemplary Embodiments

[0004] A system and method for mounting an electronic display is disclosed herein. A rear cover mounting bracket may contain a rear plate and a sidewall which surrounds a perimeter of the plate. A plurality of mounting holes may be placed within the plate to allow fastening the rear plate to a vertical surface. An electronic display assembly module may contain a thermal plate where the attachment of the rear cover mounting bracket to the module creates a plenum which can house one or more electronic components. In a preferred embodiment, the rear plate contains a pair of hooks and the module contains a pair of corresponding cylinders which can be engaged with the hooks so that the module can hang from the hooks.

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

Brief Description of the Drawings

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

[0007] **FIGURE 1** is a rear perspective view of an exemplary electronic display assembly module showing Detail A.

[0008] **FIGURE 2** is a detailed rear perspective view of Detail A shown in Figure 1.

[0009] **FIGURE 3** is a front perspective view of an exemplary hybrid rear cover and mounting bracket, once fastened to a vertical surface and connected to service wiring.

- [0010] **FIGURE 4** is a detailed front perspective view of Detail B shown in Figure 3.
- [0011] **FIGURE 5** is a detailed front perspective view of Detail C shown in Figure 3.
- [0012] **FIGURE 6** is a front perspective view of the exemplary method for attaching the electronic display assembly module to the hybrid rear cover and mounting bracket.
- [0013] **FIGURE 7** is a front elevation view of the hybrid rear cover and mounting bracket once assembled with the electronic display assembly module and indicating the section line A-A.
- [0014] **FIGURE 8** is a partial section view taken along the section line A-A and showing the top portion of the assembly.
- [0015] **FIGURE 9** is a partial section view taken along the section line A-A and showing the bottom portion of the assembly.

Detailed Description

[0016] 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.

[0017] 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.

[0018] 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.

[0019] 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.

[0020] **FIGURE 1** is a rear perspective view of an exemplary electronic display assembly module 500 showing Detail A. A thermal mounting sheet 81 is placed behind the electronic display and contains a plurality of electrical assemblies 40 which may

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include but are not limited to: power supplies, video players, hard drives, microprocessors, printed circuit boards, and input/output electronics. A narrow channel 120 is preferably defined by the space between the thermal sheet 81 and the rear surface of the electronic display. External air 100 may be forced through the channel 120 by fan 80, which can then extract heat from both the rear surface of the electronic display as well as the thermal mounting sheet 81.

[0021] A gasket 90 is preferably attached to the thermal mounting sheet 81 and surrounds a portion of the perimeter of the thermal mounting sheet 81. When combined with the hybrid rear cover mounting bracket 550, the gasket 90 and sheet 81 define a gaseously-sealed plenum 91 which may contain the electrical assemblies 40. One or more fans 75/77 may cause the air within the plenum 91 to circulate around. Preferably, a pair of dividing walls 83/85 are used to define a loop around the plenum 91 which passes through only one of the dividing walls (here 83). In an exemplary embodiment, dividing wall 83 is perpendicular to dividing wall 85. Even more preferably, dividing wall 83 is arranged horizontally and contains the fan(s) while dividing wall 85 is connected to the end of dividing wall 83 but is arranged vertically and does not contain a fan. For exemplary airflow, it has been discovered that placing the first fan 75 near the center of the display assembly and the second fan 77 near the perimeter of the display assembly, causes a pair of circulating gas loops 215 and 200 respectfully. Preferably, the plenum 91 is sealed so that external air cannot enter the plenum 91 (and preferably prevents air, or any other gaseous matter with or without particulate, from exiting the plenum 91).

[0022] A plurality of input/output electrical connections 25 are preferably placed at the top of the module 500 and underneath a water guard 35. Also, a pair of mounting pins 50 and 51 are arranged at the top of the module 500. A trio of latches 120, 122, 125 are preferably arranged at the bottom of the module 500, although embodiments can be practiced within one or two latches only. Also shown in this figure are the attachment brackets 900 and 910 for gas springs 250 or other supporting resistive elements.

[0023] **FIGURE 2** is a detailed rear perspective view of Detail A shown in Figure 1. Here, the details of the mounting pin (or rod or cylinder) 51 may be observed. In this embodiment, this can be described as a cylinder which travels horizontally and may be divided by two locating walls 53 (closest to the perimeter of the module 500) and 54 (closest to the center of the module 500). The cylinder can then be identified by the mounting portion 55 (located between walls 53/54) and the interior portion 52 (starting at the wall 54 and travelling towards the center of the module 500). The mounting pins can be solid or hollow and are preferably cylindrical.

[0024] **FIGURE 3** is a front perspective view of an exemplary hybrid rear cover and mounting bracket 550 (herein cover/bracket 550), once fastened to a vertical surface and connected to service wiring 281. The cover/bracket 500 preferably contains a substantially flat rear plate 220 with a sidewall 225 which surrounds the plate 220. A plurality of mounting holes 275 are preferably placed near the top of the cover/bracket 500 while another plurality of mounting holes 276 are placed near the bottom of the cover/bracket 500. In this way, the cover/bracket 500 can easily be mounted on a vertical surface where the service wiring 281 can be routed through the sidewall 225 and into a junction box 280 by a designated electrician. A second service line 283 may

also exit the junction box 280 and could run to a second display module, allowing several cover/brackets to be installed and wired together in a daisy chain fashion. Generally, this electrical work requires permits, licenses, and/or approval by an electrical inspector. With this exemplary embodiment, this work can be completed and approved before the electronic display modules 500 are even shipped to the location.

[0025] A pair of gas springs 250 or other resistive device may be attached to the rear plate 220 and correspond with the attachment plates 900/910 on the electronic display module 500. A trio of latches 130, 132, and 135 may be placed at the bottom of the cover/bracket 550 and correspond to the latches 120, 122, and 125 on the module 500 respectively. Of course, as noted above, only a single latch or a pair of latches may be used in some embodiments. A pair of mounting hooks 300 and 301 are preferably placed at the top of the cover/bracket 550 and correspond to the mounting pins 50 and 51 respectively. Preferably, the hook 300 would wrap around a portion of the circumference of the mounting portions 55, where the hook 300 is stabilized laterally between the walls 54 and 53.

[0026] **FIGURE 4** is a detailed front perspective view of Detail B shown in Figure 3. A fitting 285 may permit conduit (not shown) to seal with the sidewall 225 and allow the service wire 281 to pass through the sidewall 225 to meet the junction box 280.

[0027] **FIGURE 5** is a detailed front perspective view of Detail C shown in Figure 3.

[0028] **FIGURE 6** is a front perspective view of the exemplary method for attaching the electronic display assembly module 500 to the hybrid rear cover and mounting bracket 550. Once the cover/bracket 550 has been mounted to a vertical surface (and preferably after the service wiring has been ran to the junction box) the module 500 may

hang from the interaction of the hooks 300/301 with the pins 51/50. At this point the bottom of the module 500 can be rotated outwardly so that the gas springs 250 can be attached to the module 500. Once these are attached, the hooks 300/301 remain within the pins 51/50 but the bottom of the module 500 is held away from the cover/bracket 550 so that the module 500 can be electrically connected with the junction box 280. Once the module 500 is electrically connected, the bottom of the module 500 is rotated towards the cover/bracket 550 until the latches at the bottom of the two assemblies can be engaged.

[0029] FIGURE 7 is a front elevation view of the hybrid rear cover and mounting bracket 550 once assembled with the electronic display assembly module 500 and indicating the section line A-A.

[0030] FIGURE 8 is a partial section view taken along the section line A-A and showing the top portion of the assembly. When the latches at the bottom of the two assemblies engage, the gasket 90 is preferably compressed against the rear plate 220 to define the plenum 91. A front cover transparent plate 410 is preferably placed in front of the electronic display and a flow of external air 100 is shown travelling behind the electronic display and through the channel 120. Although any type of flat panel electronic display could be used, this particular embodiment uses an LCD display 400 with a direct LED backlight 430. Thus, in this embodiment, the channel 120 is defined between the rear surface of the LED backlight 430 and the thermal mounting plate 81. However, alternative embodiments may utilize any type of flat panel electronic display, including but not limited to plasma, OLED, electroluminescent polymers, or similar

where the channel 120 is defined between the rear surface of these displays and the thermal plate 81.

[0031] **FIGURE 9** is a partial section view taken along the section line A-A and showing the bottom portion of the assembly. The fan 80 is preferably positioned to draw the external air 100 through the channel 120, along the rear portion of the backlight 430 (or electronic display), and exhausted out of the bottom of the assembly. Of course, the external air 100 could also be ingested at the bottom and exhausted out of the top. The fan 80 is preferably placed within a cavity defined between the backlight 430 and the rear plate 220 and is preferably not immediately adjacent to the exhaust port on the housing, although this is not required. Generally speaking, a portion 201 of the housing may connect between the rear surface of the backlight 430 (or electronic display) and the rear plate 220, where the fan 80 is mounted on this portion 201 of the housing.

[0032] 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

1. A system for mounting an electronic display comprising:
 - a rear cover mounting bracket having a rear plate and sidewall which surrounds a perimeter of the plate;
 - a plurality of mounting holes placed within the rear plate;
 - an electronic display assembly module having a thermal plate where the electronic display assembly module attaches to the rear cover mounting bracket to define a plenum between the thermal plate and the rear plate, the electronic display assembly module having four sides including a bottom and top side;
 - a power module placed within the plenum;
 - wherein the electronic display assembly module is adapted to allow one side of the electronic display assembly module to be rotated outwardly away from the rear cover mounting bracket when the electronic display assembly module is attached to the rear cover mounting bracket;
 - a first partition within the plenum; and
 - a circulating fan positioned within the plenum for circulating gas around the plenum.
2. The system of claim 1, wherein:
 - the mounting holes are placed outside of the plenum.
3. The system of claim 1, wherein:
 - the sidewall is substantially perpendicular to the rear plate.
4. The system of claim 1, wherein:
 - the rear plate is adapted to fit against a vertical surface.
5. The system of claim 1, further comprising:
 - a channel defined by the space between an electronic display and the thermal plate; and
 - a fan positioned to draw external air through the channel but not through the plenum.
6. The system of claim 1, further comprising:
 - a pair of hooks positioned near a top of the rear cover mounting bracket; and

a pair of horizontal pins placed near a top of the electronic display assembly module where the pins are sized to fit within the hooks.

7. The system of claim 1, further comprising:

a pair of hooks attached to the rear plate; and

a pair of round posts attached to the electronic display assembly module which fit within the hooks and allow the electronic display assembly module to hang from the hooks.

8. The system of claim 1, further comprising:

a pair of horizontal cylinders attached to the electronic display assembly module;

a pair of hooks attached to the rear cover mounting bracket, each hook being sized to accept a portion of a horizontal cylinder; and

a latch having a first portion attached to the electronic display assembly module and a corresponding second portion attached to the rear cover mounting bracket.

9. A system for mounting an electronic display comprising:

a rear cover mounting bracket having a rear plate;

an electronic display assembly module containing an electronic display and having a pair of horizontal posts, each post sized to fit within a respective hook such that the electronic display assembly module can hang from the hooks, the electronic display assembly module having a thermal plate wherein the electronic display assembly module attaches to the rear cover mounting bracket to define a plenum between the thermal plate and the rear plate;

a power module placed within the plenum;

a latch positioned near the bottom of the electronic display assembly module;

wherein the electronic display assembly module is adapted to allow the bottom of the electronic display assembly module to rotate outwardly away from the rear cover mounting bracket when the electronic display assembly module is attached to the rear cover mounting bracket;

a first partition within the plenum;

a second partition within the plenum that is oriented substantially perpendicular to the first partition; and

a circulating fan positioned on either the first or the second partition for circulating gas around the plenum;

wherein the gas within the plenum circulates in a loop pattern when the plenum is sealed.

10. The system of claim 9, further comprising:
 - a pair of locating walls positioned on each post where the space between the locating walls defines an area of each post that is accepted by the hook.
11. The system of claim 9, further comprising:
 - a channel within the electronic display assembly module that is defined by the space between the electronic display and a thermal plate;
 - a fan positioned to force external air through the channel.
12. A method for mounting an electronic display to a vertical surface comprising the steps of:
 - attaching a rear cover mounting bracket to the vertical surface, said rear cover mounting bracket having a pair of hooks positioned near a top of the rear cover mounting bracket;
 - presenting an electronic display assembly module having a thermal plate and a pair of horizontal rods near a top of the electronic display assembly module;
 - engaging the horizontal rods with the hooks so that the electronic display assembly module can hang from the hooks;
 - rotating a bottom portion of the electronic display assembly module outwardly away from the rear cover mounting bracket when the electronic display assembly module is attached to the rear cover mounting bracket;
 - attaching a bottom portion of the rear cover mounting bracket to a bottom portion of the electronic display assembly module;
 - creating a plenum between the rear cover mounting bracket and the thermal plate;
 - placing a power module within the plenum;
 - placing a first partition within the plenum;
 - positioning a circulating fan on the first partition for circulating gas around the plenum;
 - and
 - circulating the gas in a loop pattern when the plenum is sealed.
13. The method of claim 12, further comprising the step of:
 - routing electrical service wiring through the rear cover mounting bracket after it has been fastened to the vertical surface but prior to hanging an electronic display assembly module from the rear cover mounting bracket.

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14. The method of claim 13, further comprising the step of:
electrically connecting a second service line to the electrical service wiring prior to
performing the step of hanging an electronic display assembly module from the rear cover
mounting bracket.

Manufacturing Resources International, Inc.
Patent Attorneys for the Applicant/Nominated Person
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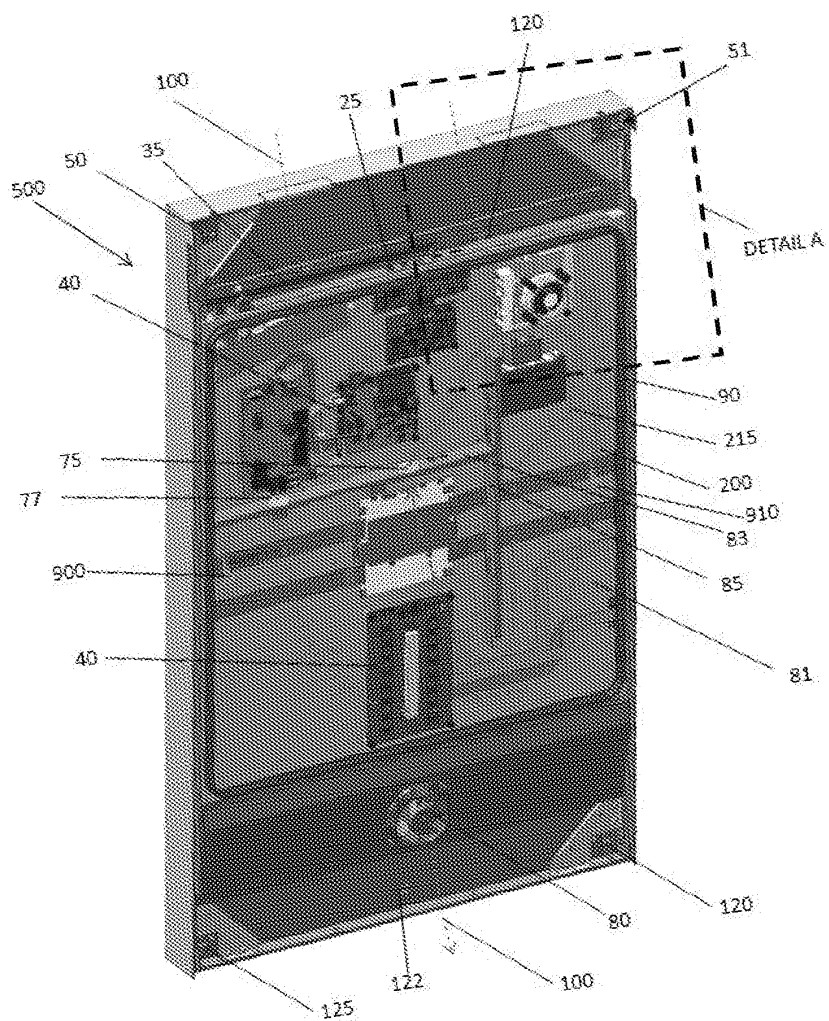


FIG - 1

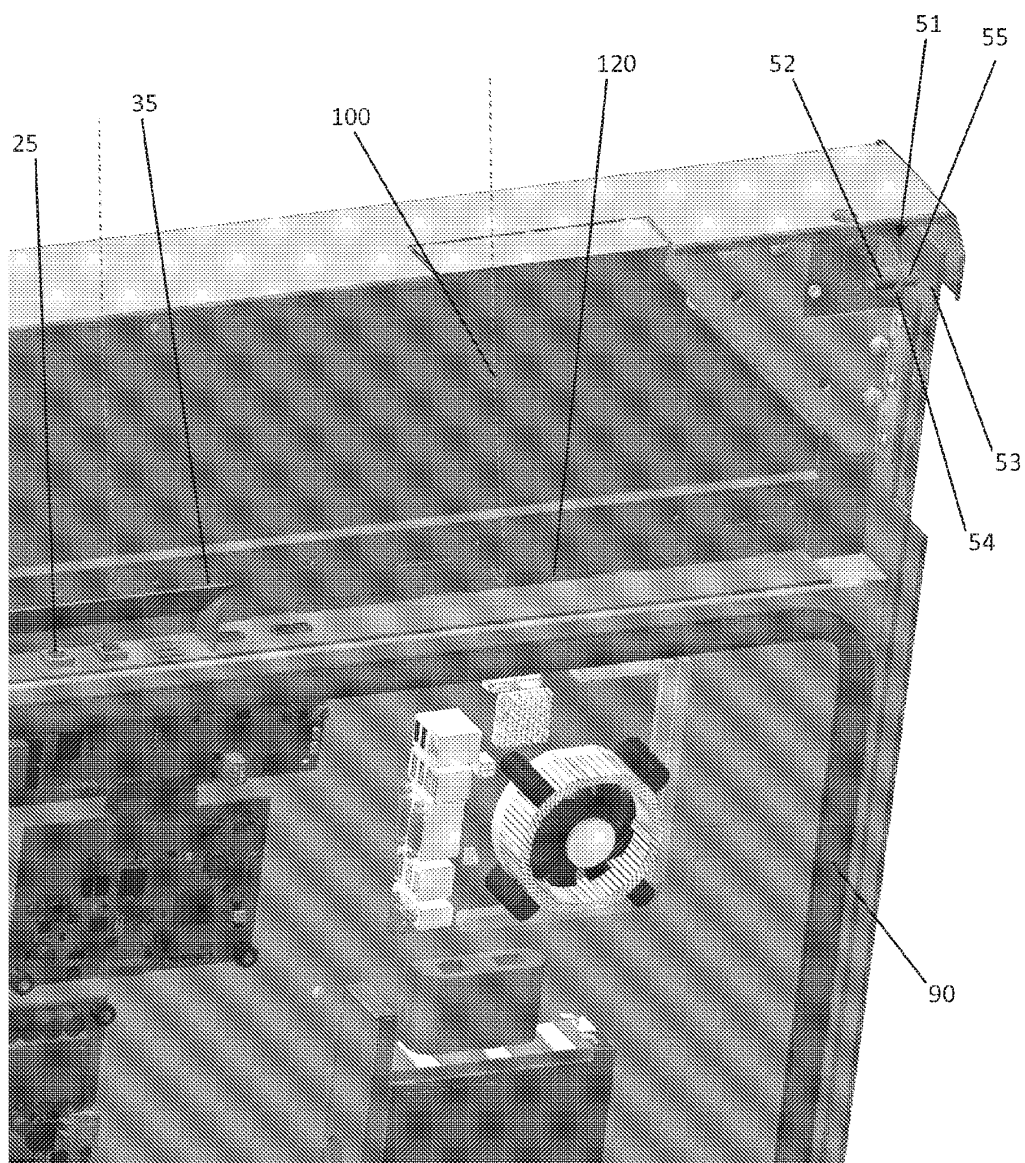
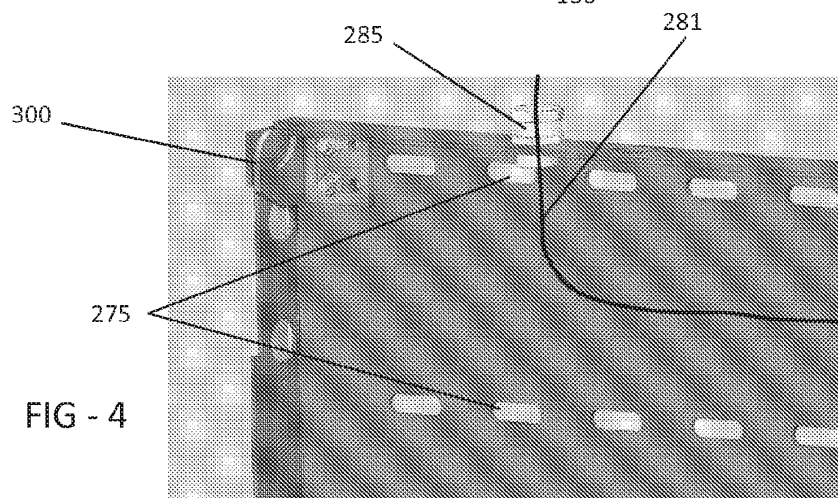
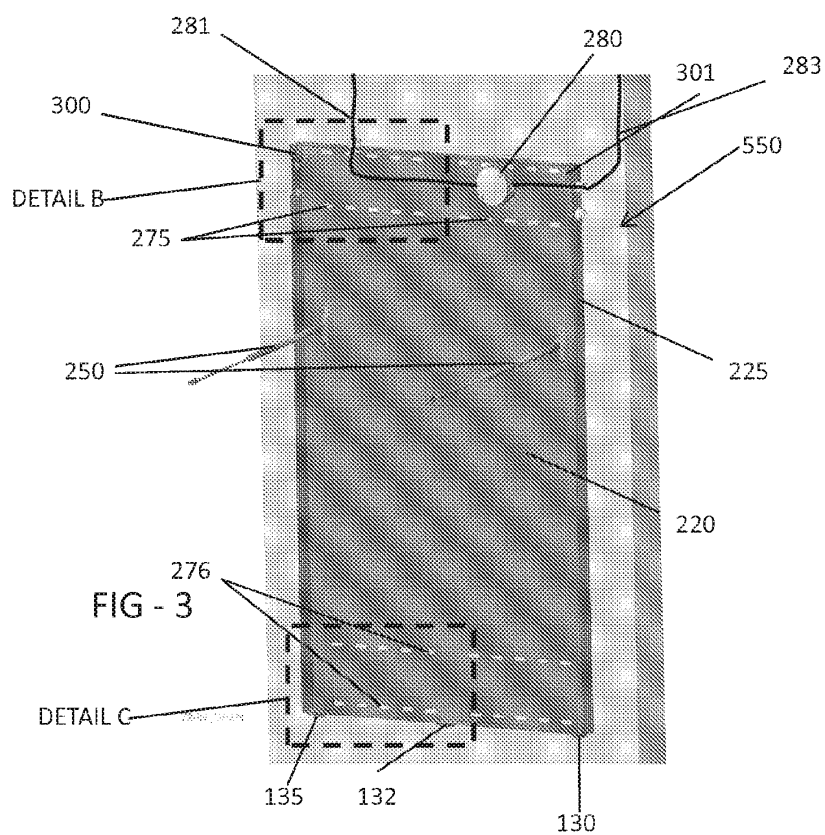
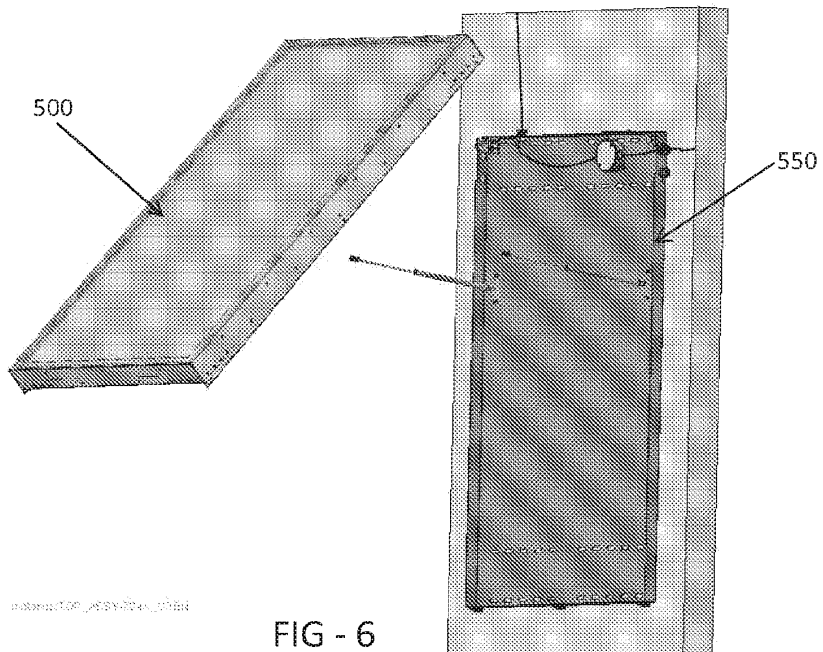
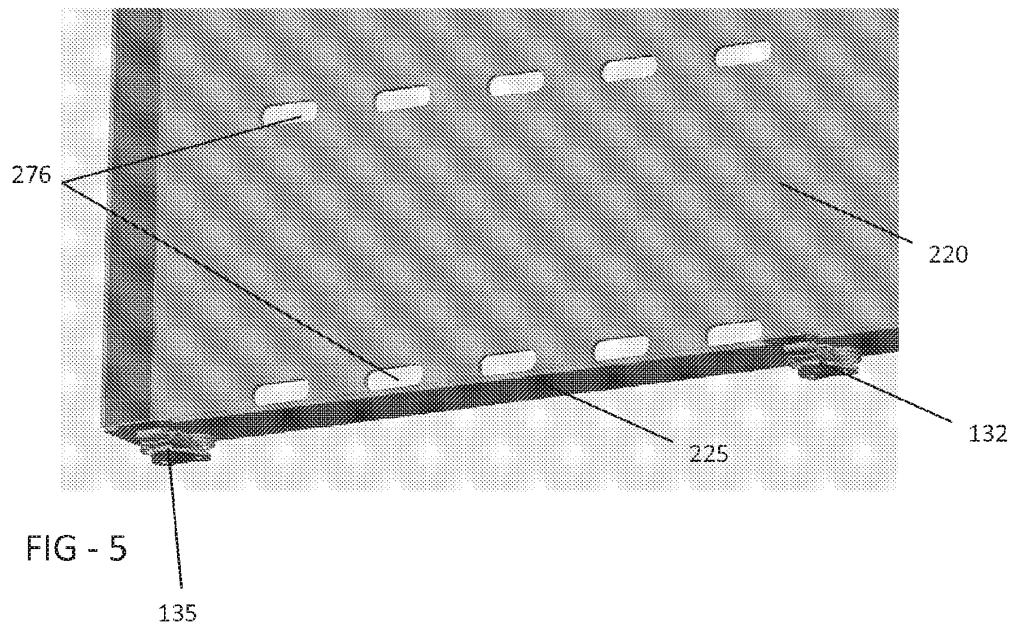


FIG - 2





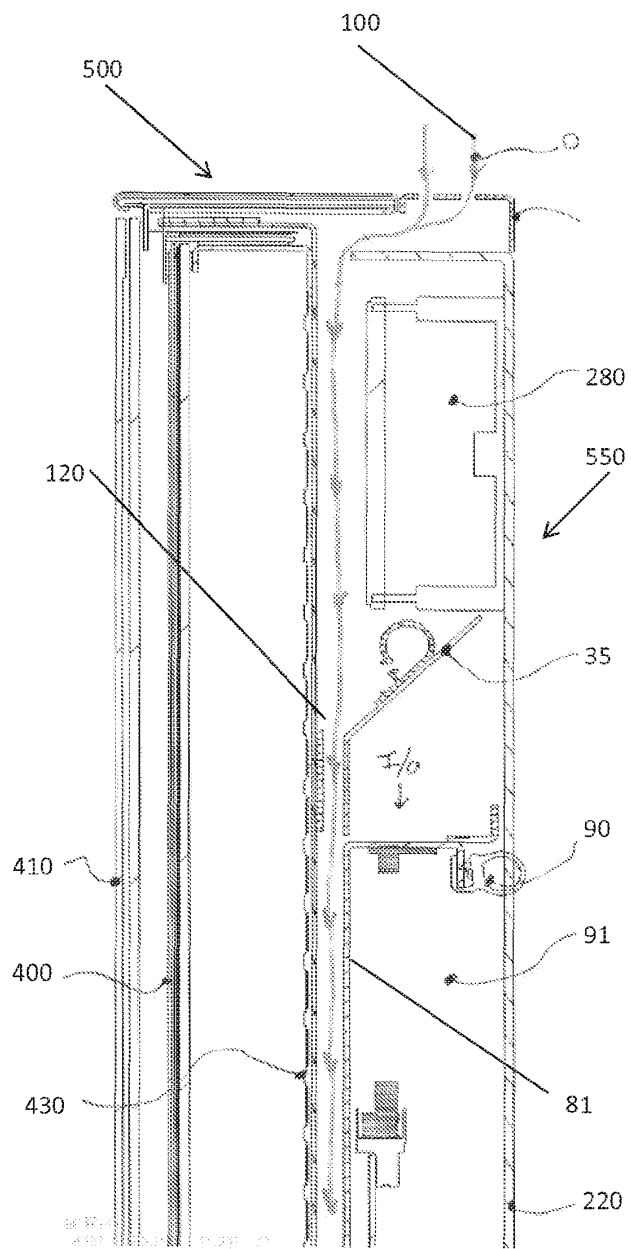
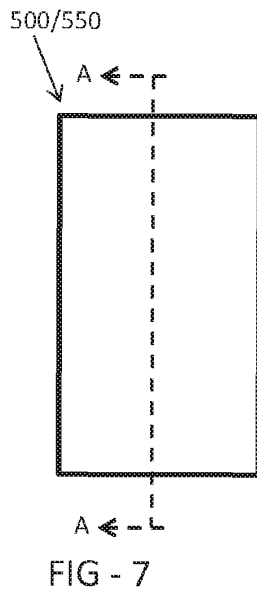
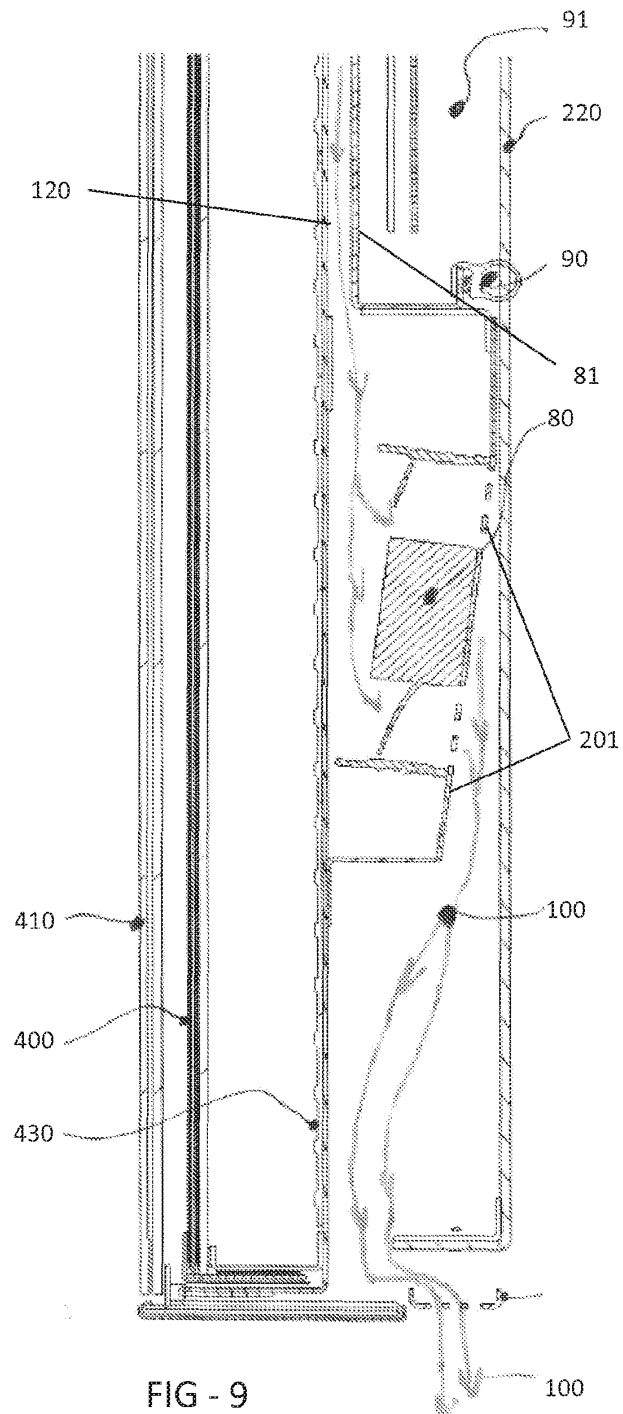


FIG - 8



[translation]

CERTIFICATE OF PATENT

Republic of Korea

PATENT NO.: 10-1958375

APPLICATION NO.: 2018-7011272

FILING DATE: April 20, 2018

REGISTRATION DATE: March 8, 2019

TITLE OF THE INVENTION: SYSTEM AND METHOD FOR THERMALLY
CONTROLLING AN ELECTRONIC DISPLAY

PATENTEE: MANUFACTURING RESOURCES INTERNATIONAL, INC.

INVENTOR(S): DUNN, William, R.

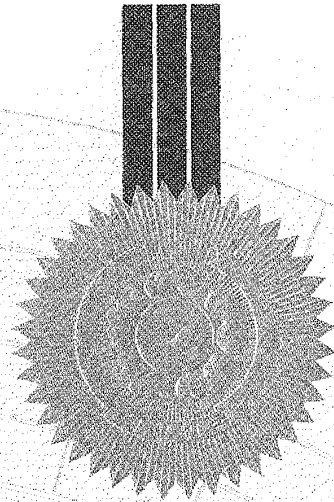
DURATION: November 17, 2028

SPECIAL REMARKS:

- (1) The first three years' annuities were paid as the registration fee.
- (2) To maintain the patent right, you must pay the annuities covering the 4th through 10th year either annually before the expiration of the preceding years' annuity, or in a lump sum before such expiration.
- (3) It is our custom to give timely notice in all cases of the steps to be taken to maintain the patent right but we cannot be responsible for the consequences of omitting to do this.

특허증

CERTIFICATE OF PATENT



특허

Patent Number

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특허권자 Patentee

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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

Korean Intellectual
Property Office

2019년 03월 08일



QR코드로 현재기준
등록사항을 확인하세요

특허청장

COMMISSIONER,

KOREAN INTELLECTUAL PROPERTY OFFICE

박원주



Espacenet

Bibliographic data: KR20180043849 (A) — 2018-04-30
SYSTEM AND METHOD FOR THERMALLY CONTROLLING AN ELECTRONIC DISPLAY
Inventor(s): DUNN WILLIAM R [US] ± (던 윌리엄 알.)

Applicant(s): MRI INC [US] ± (매뉴팩처링 리소시스 인터내셔널 인코포레이티드)

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Application number: KR20187011272 20081117 Global Dossier
Priority number(s): US20070941728 20071116 ; US20080033058P 20080303 ;
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US20080053713P 20080516 ; US20080057599P 20080530 ;
US20080076126P 20080626 ; US20080191834 20080814 ;
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KR101958375 (B1) KR20100119746 (A) KR20150139625 (A)
KR20170091176 (A) KR20190026976 (A) RU2010124380 (A)
RU2493575 (C2) WO2009065125 (A2) WO2009065125 (A3) less

Abstract not available for KR20180043849 (A)
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 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.

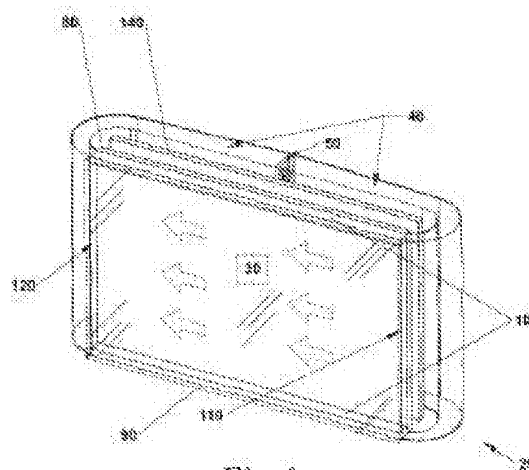


Fig. 4

[translation]

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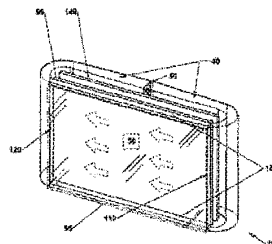
(54) 발명의 명칭 전자 디스플레이 장치의 열 제어 방법 및 시스템

(57) 요약

실시형태들은 일반적으로 전자 디스플레이 장치용의 여러 열 제어 피처들에 관한 것이다. 하나의 피처는 페루프 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



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

(30) 우선권주장

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명세서

청구범위

청구항 1

디스플레이의 후방 표면을 구비하고 하우징 내에 수용되어 있는 전자 디스플레이용 수축 대류 냉각 시스템으로, 상기 시스템은

전자 디스플레이를 둘러싸는 순환 냉각 가스의 폐쇄된 루프;

디스플레이의 후방 표면에 근접하게 위치하는 수축 대류관;

수축 대류관과 디스플레이의 후방 표면 사이에 형성되는 겹으로, 겹과 하우징이 디스플레이의 후방 표면을 따라 수축 대류 냉각 채널을 형성하는, 겹; 및

하우징의 외측으로부터 겹을 통해 공기를 이동시키게 구성 및 위치하는 적어도 하나의 팬;을 포함하는 것을 특징으로 하는 수축 대류 냉각 시스템.

청구항 2

제1항에 있어서,

전자 디스플레이가 LCD 디스플레이이고, 디스플레이의 후방 표면은 LED 백라이트 어셈블리의 후방 표면인 것을 특징으로 하는 수축 대류 냉각 시스템.

청구항 3

제2항에 있어서,

LED 백라이트 어셈블리가 열 저항 레벨이 낮은 금속 인쇄회로기판을 포함하는 것을 특징으로 하는 수축 대류 냉각 시스템.

청구항 4

제2항에 있어서,

LED 백라이트 어셈블리의 후방 표면이 열전도성 소재로 구성되어 있는 것을 특징으로 하는 수축 대류 냉각 시스템.

청구항 5

제4항에 있어서,

열전도성 소재가 금속판인 것을 특징으로 하는 수축 대류 냉각 시스템.

청구항 6

제1항에 있어서,

전자 디스플레이가 OLED 디스플레이 또는 플라스마 디스플레이인 것을 특징으로 하는 수축 대류 냉각 시스템.

청구항 7

제1항에 있어서,

순환 가스의 폐쇄된 루프가 전자 디스플레이의 전방에 위치하는 제1 가스 챔버 및 전자 디스플레이의 후방에 위치하는 제2 가스 챔버를 포함하는 것을 특징으로 하는 수축 대류 냉각 시스템.

청구항 8

제7항에 있어서,

수축 대류판이 제2 가스 챔버의 전방 벽인 것을 특징으로 하는 수축 대류 냉각 시스템.

청구항 9

제1항에 있어서,

외부 공기를 챔 안으로 향하게 구성되며, 상기 챔의 유입 측에 또는 유입 측 근방에 위치하는 가이드 장치를 추가로 포함하는 것을 특징으로 하는 수축 대류 냉각 시스템.

청구항 10

제1항에 있어서,

수축 대류판과 디스플레이의 후방 표면 사이의 갭이 0.25 인치 내지 3.5 인치 사이인 것을 특징으로 하는 수축 대류 냉각 시스템.

청구항 11

수축 대류 냉각되는 전자 디스플레이 어셈블리로,

디스플레이의 후방 표면을 구비하는 전자 디스플레이;

전자 디스플레이를 수용하는 하우징;

전자 디스플레이를 둘러싸는 순환 냉각 가스의 폐쇄된 루프;

디스플레이의 후방 표면에 근접하여 위치하는 수축 대류판;

수축 대류판과 디스플레이의 후방 표면 사이에 형성되는 갭으로, 상기 갭과 하우징이 디스플레이의 후방 표면을 따라 수축 대류 냉각 채널을 형성하는 갭; 및

하우징의 외측으로부터 갭을 통해 공기를 이동시키게 구성 및 위치하는 적어도 하나의 팬;을 포함하는 것을 특징으로 하는 전자 디스플레이 어셈블리.

청구항 12

제11항에 있어서,

전자 디스플레이가 LCD 디스플레이이고, 디스플레이의 후방 표면은 LED 백라이트 어셈블리의 후방 표면인 것을 특징으로 하는 전자 디스플레이 어셈블리.

청구항 13

제11항에 있어서,

LED 백라이트 어셈블리가 열 저항 레벨이 낮은 금속 인쇄회로기판을 포함하는 것을 특징으로 하는 전자 디스플레이 어셈블리.

청구항 14

제11항에 있어서,

LED 백라이트 어셈블리의 후방 표면이 열전도성 소재로 구성되어 있는 것을 특징으로 하는 전자 디스플레이 어셈블리.

청구항 15

제14항에 있어서,

열전도성 소재가 금속판인 것을 특징으로 하는 전자 디스플레이 어셈블리.

청구항 16

제11항에 있어서,

전자 디스플레이가 OLED 디스플레이 또는 플라즈마 디스플레이인 것을 특징으로 하는 전자 디스플레이 어셈블리.

청구항 17

제11항에 있어서,

순환 가스의 폐쇄된 루프가 전자 디스플레이의 전방에 위치하는 제1 가스 챔버 및 전자 디스플레이의 후방에 위치하는 제2 가스 챔버를 포함하는 것을 특징으로 하는 전자 디스플레이 어셈블리.

청구항 18

제17항에 있어서,

수축 대류판이 제2 가스 챔버의 전방 벽인 것을 특징으로 하는 전자 디스플레이 어셈블리.

청구항 19

제11항에 있어서,

수축 대류판과 디스플레이의 후방 표면 사이의 갭이 0.25 인치 내지 3.5 인치 사이인 것을 특징으로 하는 전자 디스플레이 어셈블리.

청구항 20

수축 대류 냉각되는 액정 디스플레이로,

액정 스택;

액정 스택 후방에 위치하며 후방 표면을 구비하는 백라이트 어셈블리;

액정 스택과 백라이트 어셈블리를 수용하는 하우징;

액정 스택과 백라이트 어셈블리를 둘러싸는 순환 냉각 가스의 폐쇄된 루프;

백라이트 어셈블리의 후방 표면에 근접하게 위치하는 수축 대류판;

수축 대류판과 백라이트 어셈블리의 후방 표면 사이에 형성되는 갭으로, 갭과 하우징이 디스플레이 후방 표면을 따라 수축 대류 냉각 채널을 형성하는, 갭; 및

하우징의 외측으로부터 갭을 통해 공기를 이동시키게 구성 및 위치하는 적어도 하나의 팬;을 포함하는 것을 특징으로 하는 액정 디스플레이.

청구항 21

제20항에 있어서,

백라이트 어셈블리가 복수의 LED들이 장착되어 있는 전방 표면을 구비하는 금속 코어 인쇄회로기판을 포함하는 것을 특징으로 하는 액정 디스플레이.

청구항 22

제20항에 있어서,

백라이트 어셈블리의 후방 표면이 열전도성 금속판으로 덮여 있는 것을 특징으로 하는 액정 디스플레이.

청구항 23

제20항에 있어서,

냉각 가스의 폐쇄된 루프가 액정 스택의 전방에 위치하는 제1 가스 챔버 및 백라이트 어셈블리의 후방에 위치하는 제2 가스 챔버를 포함하는 것을 특징으로 하는 액정 디스플레이.

청구항 24

제23항에 있어서,

수축 대류판이 제2 가스 챔버의 후방 벽인 것을 특징으로 하는 액정 디스플레이.

청구항 25

제20항에 있어서,

수축 대류판과 백라이트 어셈블리의 후방 표면 사이의 갭이 0.25 인치 내지 3.5 인치 사이인 것을 특징으로 하는 액정 디스플레이.

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 다량의 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 멀어질 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 피처(feature)들을 구비할 수 있다. 복수의 열 제어 피처들이 기재되어 있으며, 이들 피처들은 개별적으로 사용되거나, 임의로 서로 조합되어 사용될 수 있다. 이들 피처들의 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 피처(thermal feature)는 고립 가스 냉각 시스템에 관한 것이다. 가스 냉각 시스템은 투명 전방판을 포함하는 제1 가스 챔버와 냉각 플래튼을 포함하는 제2 가스 챔버를 포함하여 구성되는 폐쇄형 루프인 것이 바람직하다. 상기 제1 가스 챔버가 앞쪽에 있으며, 전자 디스플레이 장치의 가시 화면과 동연(held)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 안에 위치하여, 가스가 코릴 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, 코릴 가스 시스템을 가열 장치로서 사용한다. 코릴 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 가스를 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 코릴 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 코릴 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 장치용 백라이트 유닛을 냉각한다. 상기 수축 대류 시스템은 상기 백라이트 어셈블리에 근접되게 위치하여 겹을 형성하는 수축 대류관을 포함할 수 있다. 백라이트 어셈블리를 보다 용이하고 효율적으로 냉각하기 위해, 가스가 상기 겹을 통해 강제 유동한다. 일부 실시형태에서, 플레넘의 벽은 수축 대류관을 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 펌핑된다.

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 옥외 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 코릴 가스 냉각 시스템의 구성부품들을 보여주는, 예시적 실시형태의 분해 사시도이다.

도 3은 상기 냉각 챔버의 예시적 실시형태의 평면도이다.

- 도 4는 고립 냉각 챔버, 특히 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 면 피쳐들을 보여주는, 고립 냉각 챔버의 일 실시형태의 후방 사시도이다.
- 도 7은 상기 플레넘에 포함될 수 있는 면 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 챔버를 구비하는 선행 편광판을 사용하는 예시적 실시형태의 단면도이다.
- 도 15a 및 도 15b는 수축 대류판을 구비하는 수축 대류 냉각 시스템의 예시적 실시형태의 측면도이다.
- 도 16은 냉각 플레넘이 수축 대류판으로 사용되는, 예시적 실시형태의 평면도이다.
- 도 17a 내지 도 17c는 냉각 플레넘이 수축 대류판으로 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, 쿨러/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 동면(coextensive)되어 있다. 도시된 디스플레이 장치에는 옵션으로 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 코팅 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 빨아들일 수 있다.
- 0022] 도 3을 참조하면, 코팅 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. "코팅 가스"(isolated gas)란 용어는 코팅 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 악영향을 줄 수 있는, 먼지 또는 다른 오염물질이 실질적으로 없어야 한다. 오염을 방지하고 먼지가 제1 가스 챔버(30) 내로 들어오는 것을 방지하기 위해, 선택적 필터(미도시)가 사용될 수 있다.
- 0023] 상기 코팅 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, 코팅 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 코팅 가스 냉각 챔버(20) 주위로 가스를 추진시키는 데에 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 협폭 채널의 깊이를 정의한다. 이격 부재(100)는 장치의 다른 구성부품들과 독립된 별개의 부재일 수 있고, 선택적으로는 이들 부품들과 일체로 통합 구성될 수도 있다(일례로 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 코팅 가스가 디스플레이 장치를 지나감에 따라, 코팅 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. 후가의 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(일례로, 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) 스크의 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. 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 입구부를 형성한다.
- 0030] 도 5는 후방 냉각 플레넘(설명을 위해 투명하게 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, 거패시터, 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 먼 피쳐들(150)이 부가될 수 있다. 이들 먼 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 먼 피쳐들(150)과 독립하여 또는 먼 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 불어넣기 위해 팬(60)이 위치할 수 있다. 팬(60)은 공기 조화된 공기를 디스플레이 장치 하우징(70) 내로 빨아들이거나 단순히 주위 공기를 빨아들일 수 있다. 또한, 본 장치에서, 팬(60)은 공기가 전자 디스플레이 장치의 열 발생 부품(일례로, 디스플레이 스크(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 매우도록 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, 이

- 들만으로 한정되는 것은 아니다. 니크롬 와이어 또는 리본, 세라믹 절연 금속(일반적으로 강) 플레이트 상에 적층된 스크린 프린트 금속/세라믹 트랙, CalRod(일반적으로 텅스텐 금속 쉘 내에 세라믹 바인더가 밀봉되어 있는 니크롬 마세 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, 커패시터, 모터, 와이어 하니스 및 커넥터들 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 플레부위를 지나갈 수 있게 할 수도 있다.
- 0038] 디스플레이 장치가 작동하는 동안, 고립 가스 냉각 시스템이 연속적으로 작동할 수 있다. 그러나, 필요하다면, 온도 센서(비도시)와 스위치(비도시)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 형성한다. 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 위로부터 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 거울 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 또

는 후방면에 선행 편광판이 부착되어 있는 제1 전방판(90)만을 사용할 수도 있다. 반시방지 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. 플라즈마 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 장치에서도 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 대류판(300)과 백라이트(140)의 단면도로, 이들 물체들 사이의 공간은 좁은 갭(305)을 획정한다. 상기 갭의 크기는 디스플레이 장치의 크기, 디스플레이 장치의 작동 조건, 백라이트 어셈블리와 그 후방면 소재의 종류, 및 다양한 수축 대류 팬의 수량과 이들에 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 고립 가스 서스택의 평면도이다. 상기 고립 가스 시스템을 관통하는 단면라인 17-17이 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 인접하고 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 대류판으로 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 사이트에 장착되는 복수의 라이트를 구비한 인쇄회로기판(PCB)을 포함할 수 있다. 상기 백라이트 내의 상기 라이트들은 LED, 유기발광 다이오드(OLED), 전계 발광형 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 사이트와 제2 가스 챔버와 대면하는 사이트 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 금소 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 가동할 때에 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(플레넘) 내의 고된 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 조합되어서도 실시될 수 있다는 점을 주목해야 한다. 공기가 배플(114)을 향해 흐르도록 하기 위해, 캐비티(61) 내에 여러 내부 피쳐들(미도시)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 주위와 뜨거운 공기로 부터 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 성질을 얻기 위해 냉각 유체 통로를 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 저기압 영역을 생성할 수 있다. 이러한 방식으로, 유체는 화살표를 따라 냉각 챔버(4)를 통해 유동한다. 일부 냉각 유체들은 "미끄러짐성"(slipperiness)이 있기 때문에, 펌프(47)는 용적식 펌프(positive displacement pump)인 것이 바람직하다.

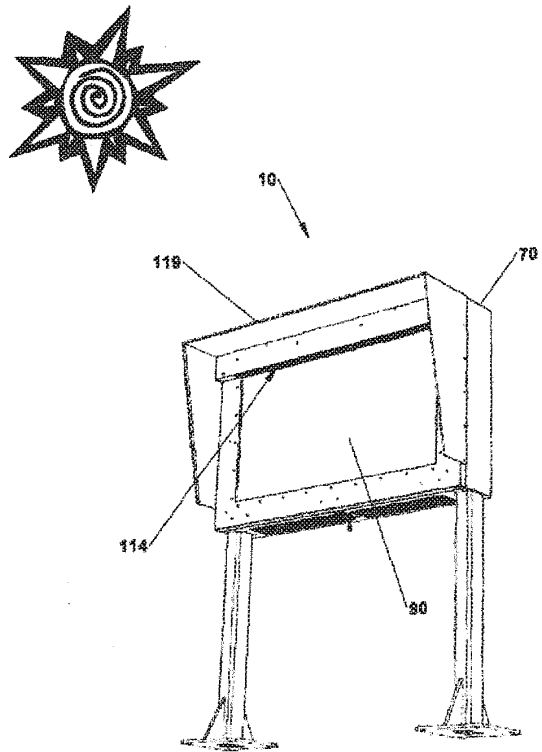
0061] 냉각 챔버를 통과하는 냉각 유체의 유량을 조절하기 위해, 밸브(634)를 구비하는 바이패스 라인이 제공될 수 있다. 상기 바이패스 라인은 냉각 유체가 냉각 챔버(4)를 우회하도록 하는 우회루트를 제공한다. 밸브(634)는 바이패스 라인을 통과하여 우회하는 냉각 유체의 양을 용이하게 조절할 수 있다. 바이패스 라인과 밸브(634)는 냉

각 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.

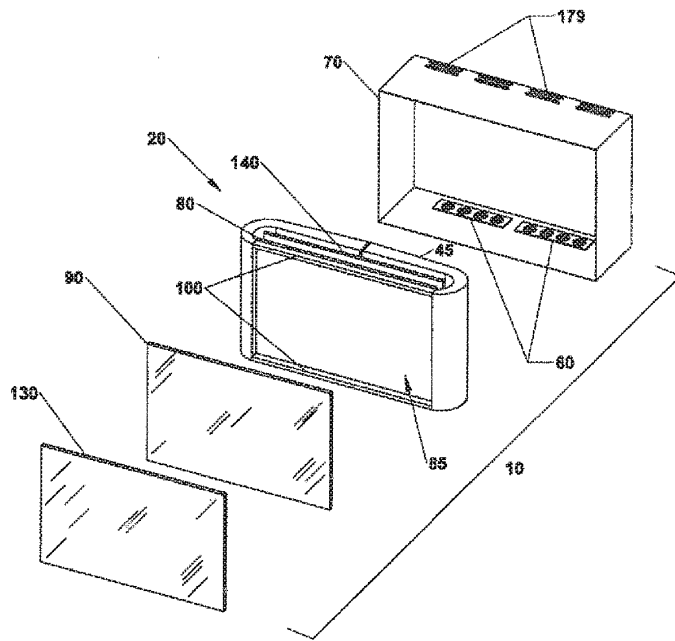
- 0062] 통상의 기술자라면 냉각 챔버를 통과하는 유동을 조절하기 위해 다른 방법 및 장치들이 사용될 수 있다는 점을 이해할 수 있을 것이다. 일례로, 펌프(47)의 크기와 펌프 속도는 주어진 환경에 따라 최적화될 수 있다. 선택적으로, 가변 속도 펌프가 사용될 수도 있다. 바람직하기로는, 가변 속도 펌프는 적어도 하나의 압력 트랜스듀서(미도시)와 전기적으로 연동되어 있다. 바람직하기로는, 압력 트랜스듀서는 냉각 챔버(4)의 상류부에 위치할 수 있고, 다른 압력 트랜스듀서는 냉각 챔버(4)의 하류부에 위치할 수 있다. 상기 적어도 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) 내에서 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 팬 유닛(94)이 포함될 수도 있다. 선택적으로, 시스템에 냉각 유체를 채우고 시스템에서 냉각 유체를 비우는 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 팬 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 최대한 냉각될 수 있도록 하기 위해, 복귀포트(14)는 출구포트(13)와 상당히 떨어진 곳에 위치할 수 있다.
- 0065] 필요에 따라, 팬 유닛이 디스플레이 장치(15)의 냉각 챔버(4) 바로 뒤의 하우징(75)의 배이스에 위치할 수 있다. 팬 유닛은 공기 종류가 하우징(75)의 내부를 통과하도록 할 수 있다. 바람직하기로는, 공기유동은 저장 탱크(37)의 적어도 하나의 외부 표면 위로 저항될 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

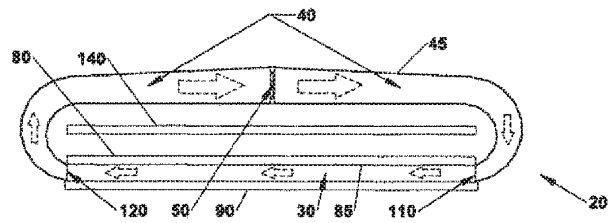
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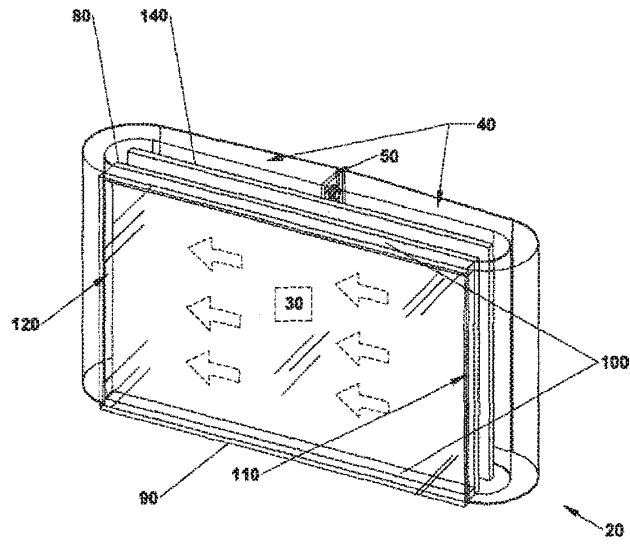
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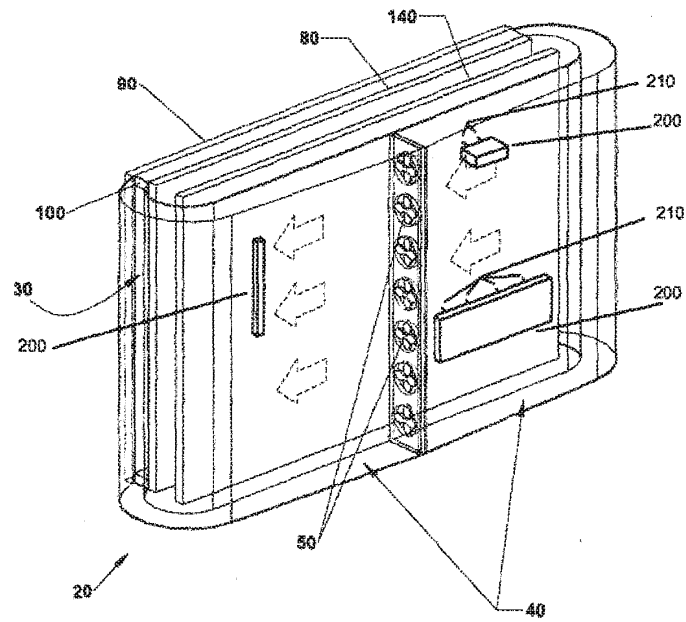
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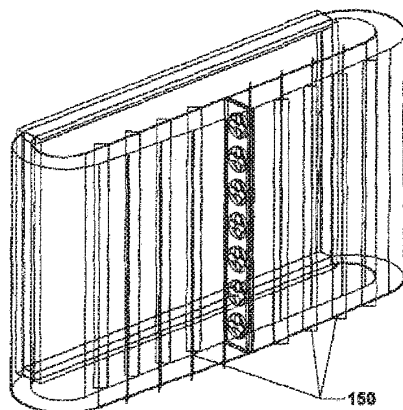
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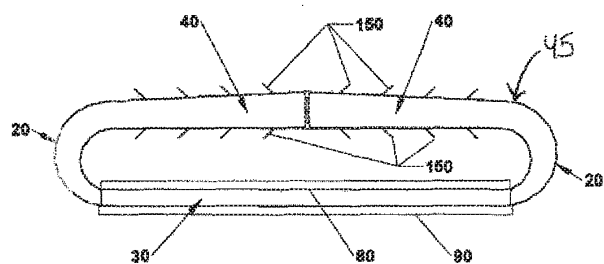
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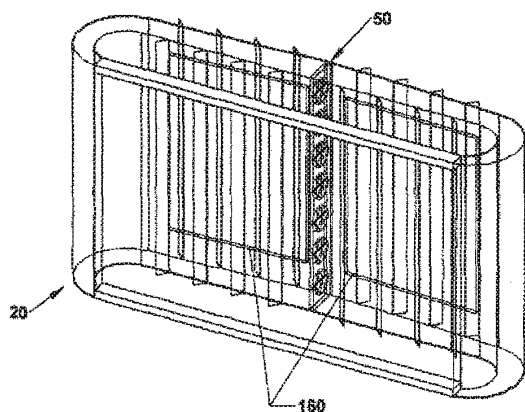
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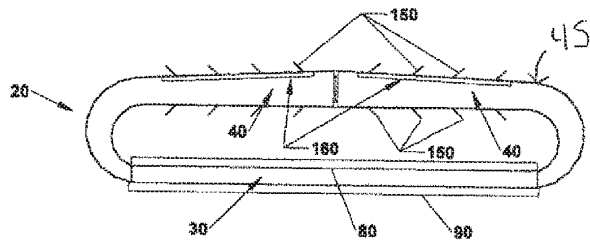
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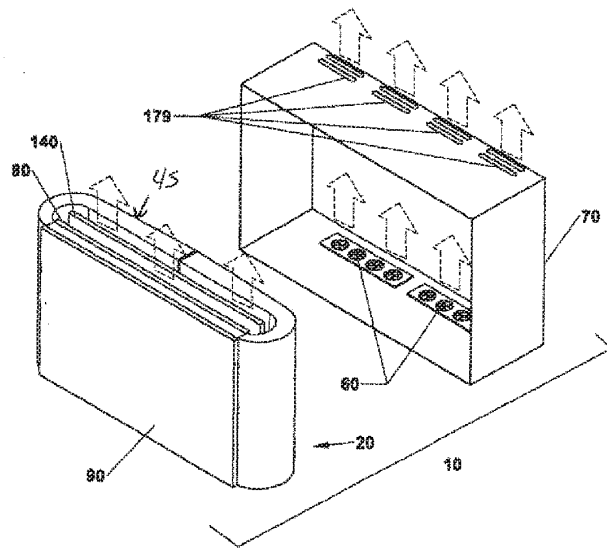
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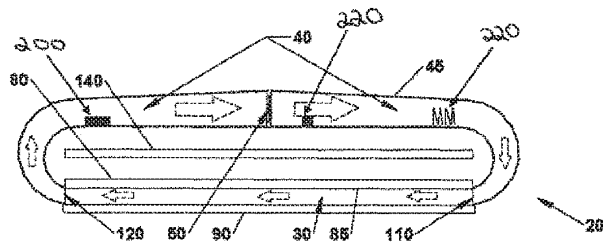
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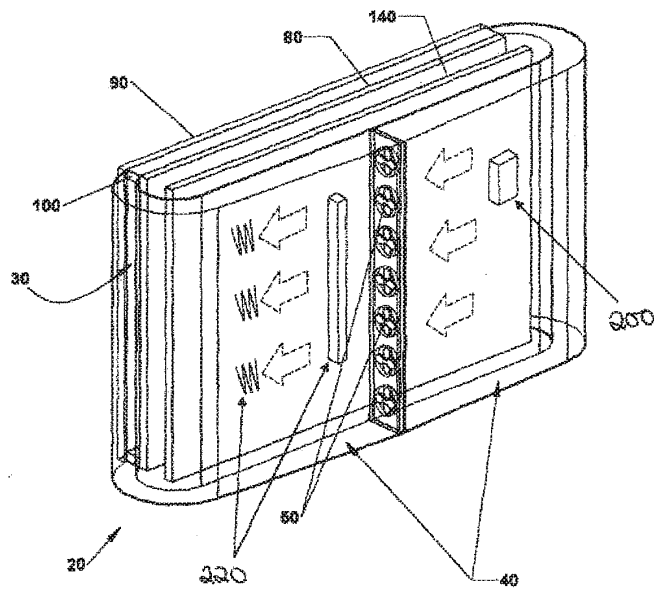
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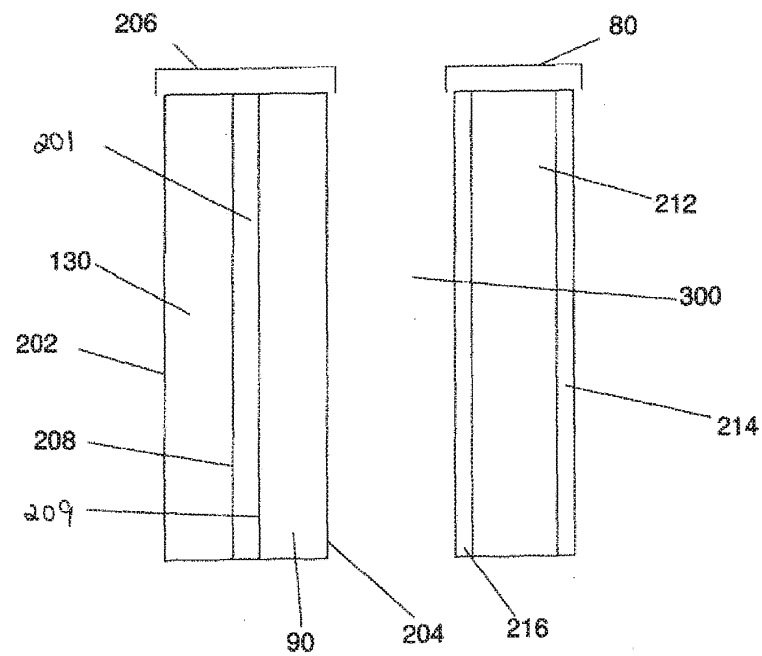
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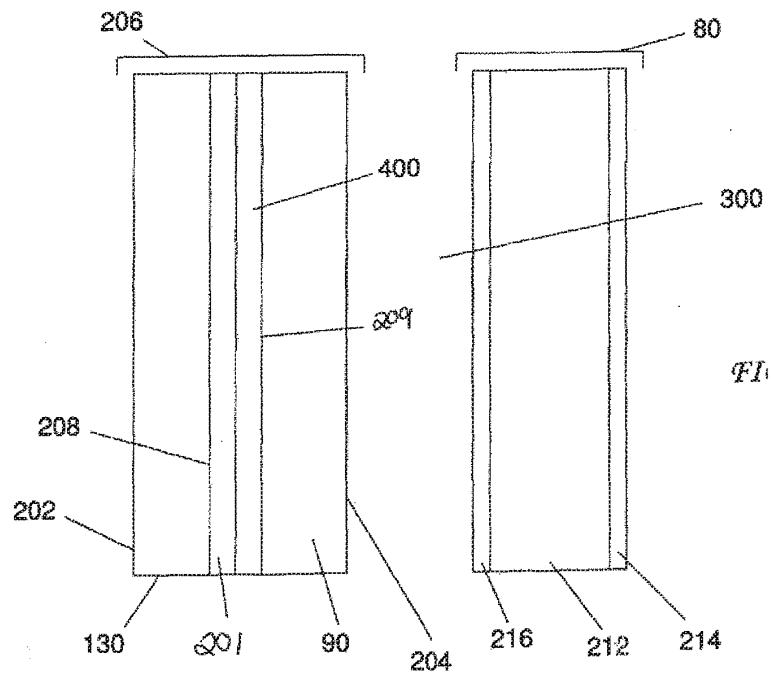
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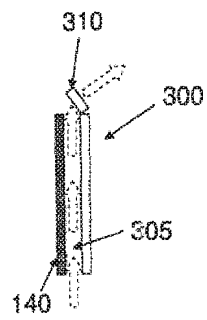
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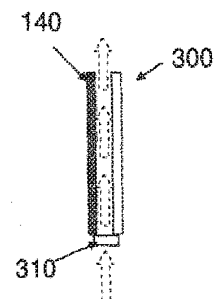
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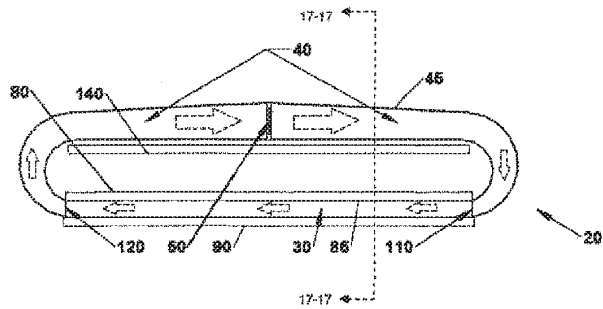
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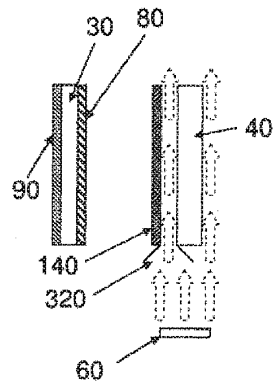
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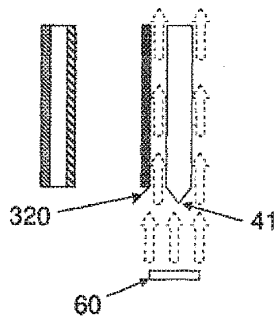
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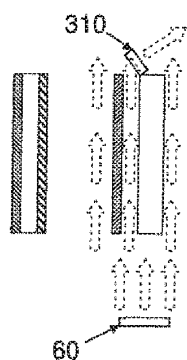
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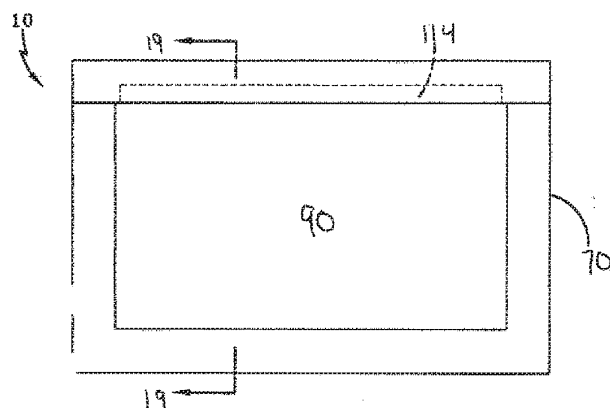
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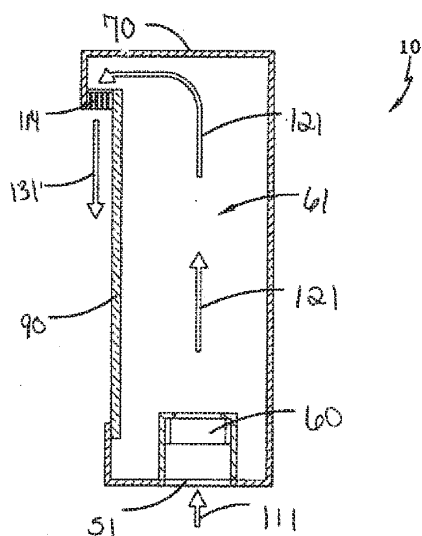
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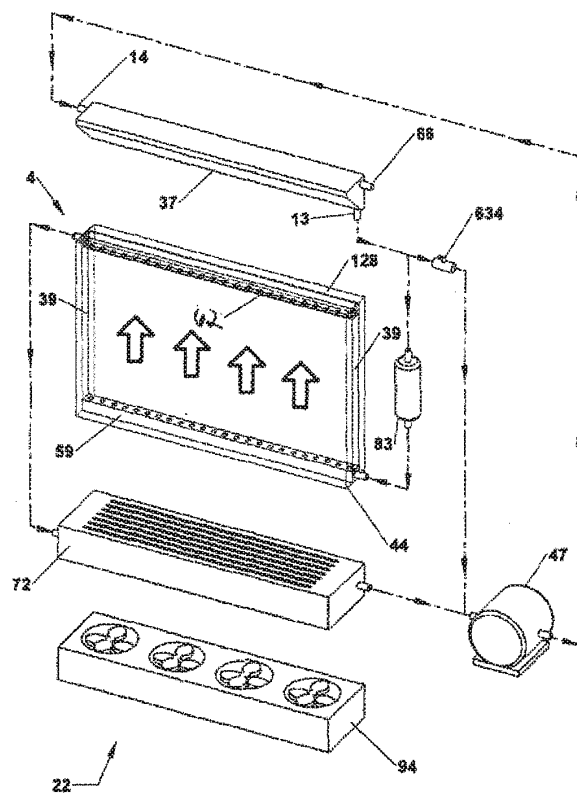
도면18



도면19



도면20





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(54) **METHOD FOR MOUNTING A DISPLAY TO A WALL**

(57) Exemplary embodiments provide a method for mounting an electronic display to a vertical surface comprising the steps of presenting an electronic display assembly module (500) having a pair of horizontal rods (50 and 51) near a top of the electronic display assembly module (500); attaching a rear cover mounting bracket (550) having hooks (300 and 301) located near a top of the rear cover mounting bracket (550) to a vertical surface; engaging the horizontal rods (50 and 51) with the hooks (300 and 301) so that the electronic display assembly module (500) can hang from the hooks (300 and 301); hanging an electronic display assembly module (500) from the rear cover mounting bracket (550); and attaching a bottom portion of the rear cover mounting bracket (550) to a bottom portion of the electronic display assembly module (500). Exemplary embodiments of the method may include the steps of routing electrical service wiring (281) through the rear cover mounting bracket (550) prior to hanging the electronic display assembly module (500).

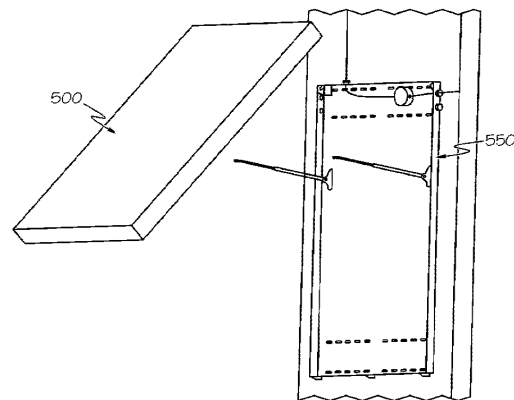


FIG. 6

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Description

Technical Field

[0001] The present invention relates to a method for mounting an electronic display to a vertical surface.

Background of the Art

[0002] 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 contaminates into sensitive portions of the display, which can lead to premature failures. Further, it is now desirable to provide an improved system for installing large electronic displays in public area.

Summary of the Exemplary Embodiments

[0003] According to the present invention there is provided a method for mounting an electronic display to a vertical surface as claimed in claim 1.

[0004] In one embodiment a rear cover mounting bracket may contain a rear plate and a sidewall which surrounds a perimeter of the plate. A plurality of mounting holes may be placed within the plate to allow fastening the rear plate to a vertical surface. An electronic display assembly module may contain a thermal plate where the attachment of the rear cover mounting bracket to the module creates a plenum which can house one or more electronic components. In a preferred embodiment, the rear plate contains a pair of hooks and the module contains a pair of corresponding cylinders which can be engaged with the hooks so that the module can hang from the hooks.

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

Brief Description of the Drawings

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

FIGURE 1 is a rear perspective view of an exemplary electronic display assembly module showing Detail A.

FIGURE 2 is a detailed rear perspective view of Detail A shown in Figure 1.

FIGURE 3 is a front perspective view of an exemplary

hybrid rear cover and mounting bracket, once fastened to a vertical surface and connected to service wiring.

FIGURE 4 is a detailed front perspective view of Detail B shown in Figure 3.

FIGURE 5 is a detailed front perspective view of Detail C shown in Figure 3.

FIGURE 6 is a front perspective view of the exemplary method for attaching the electronic display assembly module to the hybrid rear cover and mounting bracket.

FIGURE 7 is a front elevation view of the hybrid rear cover and mounting bracket once assembled with the electronic display assembly module and indicating the section line A-A.

FIGURE 8 is a partial section view taken along the section line A-A and showing the top portion of the assembly.

FIGURE 9 is a partial section view taken along the section line A-A and showing the bottom portion of the assembly.

Detailed Description

[0007] 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.

[0008] 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.

[0009] 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.

[0010] 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.

[0011] FIGURE 1 is a rear perspective view of an exemplary electronic display assembly module 500 showing Detail A. A thermal mounting sheet 81 is placed behind the electronic display and contains a plurality of electrical assemblies 40 which may include but are not limited to: power supplies, video players, hard drives, microprocessors, printed circuit boards, and input/output electronics. A narrow channel 120 is preferably defined by the space between the thermal sheet 81 and the rear surface of the electronic display. External air 100 may be forced through the channel 120 by fan 80, which can then extract heat from both the rear surface of the electronic display as well as the thermal mounting sheet 81.

[0012] A gasket 90 is preferably attached to the thermal mounting sheet 81 and surrounds a portion of the perimeter of the thermal mounting sheet 81. When combined with the hybrid rear cover mounting bracket 550, the gasket 90 and sheet 81 define a gaseously-sealed plenum 91 which may contain the electrical assemblies 40. One or more fans 75/77 may cause the air within the plenum 91 to circulate around. Preferably, a pair of dividing walls 83/85 are used to define a loop around the plenum 91 which passes through only one of the dividing walls (here 83). In an exemplary embodiment, dividing wall 83 is perpendicular to dividing wall 85. Even more preferably, dividing wall 83 is arranged horizontally and contains the fan(s) while dividing wall 85 is connected to the end of dividing wall 83 but is arranged vertically and does not contain a fan. For exemplary airflow, it has been discovered that placing the first fan 75 near the center of the display assembly and the second fan 77 near the perimeter of the display assembly, causes a pair of circulating gas loops 215 and 200 respectfully. Preferably, the plenum 91 is sealed so that external air cannot enter the plenum 91 (and preferably prevents air, or any other gaseous matter with or without particulate, from exiting the plenum 91).

[0013] A plurality of input/output electrical connections 25 are preferably placed at the top of the module 500 and underneath a water guard 35. Also, a pair of mounting pins 50 and 51 are arranged at the top of the module 500. A trio of latches 120, 122, 125 are preferably arranged at the bottom of the module 500, although embodiments can be practiced within one or two latches only. Also shown in this figure are the attachment brackets 900 and 910 for gas springs 250 or other supporting resistive elements.

[0014] FIGURE 2 is a detailed rear perspective view of Detail A shown in Figure 1. Here, the details of the

mounting pin (or rod or cylinder) 51 may be observed. In this embodiment, this can be described as a cylinder which travels horizontally and may be divided by two locating walls 53 (closest to the perimeter of the module 500) and 54 (closest to the center of the module 500). The cylinder can then be identified by the mounting portion 55 (located between walls 53/54) and the interior portion 52 (starting at the wall 54 and travelling towards the center of the module 500). The mounting pins can be solid or hollow and are preferably cylindrical.

[0015] FIGURE 3 is a front perspective view of an exemplary hybrid rear cover and mounting bracket 550 (herein cover/bracket 550), once fastened to a vertical surface and connected to service wiring 281. The cover/bracket 550 preferably contains a substantially flat rear plate 220 with a sidewall 225 which surrounds the plate 220. A plurality of mounting holes 275 are preferably placed near the top of the cover/bracket 550 while another plurality of mounting holes 276 are placed near the bottom of the cover/bracket 550. In this way, the cover/bracket 550 can easily be mounted on a vertical surface where the service wiring 281 can be routed through the sidewall 225 and into a junction box 280 by a designated electrician. A second service line 283 may also exit the junction box 280 and could run to a second display module, allowing several cover/brackets to be installed and wired together in a daisy chain fashion. Generally, this electrical work requires permits, licenses, and/or approval by an electrical inspector. With this exemplary embodiment, this work can be completed and approved before the electronic display modules 500 are even shipped to the location.

[0016] A pair of gas springs 250 or other resistive device may be attached to the rear plate 220 and correspond with the attachment plates 900/910 on the electronic display module 500. A trio of latches 130, 132, and 135 may be placed at the bottom of the cover/bracket 550 and correspond to the latches 120, 122, and 125 on the module 500 respectively. Of course, as noted above, only a single latch or a pair of latches may be used in some embodiments. A pair of mounting hooks 300 and 301 are preferably placed at the top of the cover/bracket 550 and correspond to the mounting pins 50 and 51 respectively. Preferably, the hook 300 would wrap around a portion of the circumference of the mounting portions 55, where the hook 300 is stabilized laterally between the walls 54 and 53.

[0017] FIGURE 4 is a detailed front perspective view of Detail B shown in Figure 3. A fitting 285 may permit conduit (not shown) to seal with the sidewall 225 and allow the service wire 281 to pass through the sidewall 225 to meet the junction box 280.

[0018] FIGURE 5 is a detailed front perspective view of Detail C shown in Figure 3.

[0019] FIGURE 6 is a front perspective view of the exemplary method for attaching the electronic display assembly module 500 to the hybrid rear cover and mounting bracket 550. Once the cover/bracket 550 has been

mounted to a vertical surface (and preferably after the service wiring has been ran to the junction box) the module 500 may hang from the interaction of the hooks 300/301 with the pins 51/50. At this point the bottom of the module 500 can be rotated outwardly so that the gas springs 250 can be attached to the module 500. Once these are attached, the hooks 300/301 remain within the pins 51/50 but the bottom of the module 500 is held away from the cover/bracket 550 so that the module 500 can be electrically connected with the junction box 280. Once the module 500 is electrically connected, the bottom of the module 500 is rotated towards the cover/bracket 550 until the latches at the bottom of the two assemblies can be engaged.

[0020] FIGURE 7 is a front elevation view of the hybrid rear cover and mounting bracket 550 once assembled with the electronic display assembly module 500 and indicating the section line A-A.

[0021] FIGURE 8 is a partial section view taken along the section line A-A and showing the top portion of the assembly. When the latches at the bottom of the two assemblies engage, the gasket 90 is preferably compressed against the rear plate 220 to define the plenum 91. A front cover transparent plate 410 is preferably placed in front of the electronic display and a flow of external air 100 is shown travelling behind the electronic display and through the channel 120. Although any type of flat panel electronic display could be used, this particular embodiment uses an LCD display 400 with a direct LED backlight 430. Thus, in this embodiment, the channel 120 is defined between the rear surface of the LED backlight 430 and the thermal mounting plate 81. However, alternative embodiments may utilize any type of flat panel electronic display, including but not limited to plasma, OLED, electroluminescent polymers, or similar where the channel 120 is defined between the rear surface of these displays and the thermal plate 81.

[0022] FIGURE 9 is a partial section view taken along the section line A-A and showing the bottom portion of the assembly. The fan 80 is preferably positioned to draw the external air 100 through the channel 120, along the rear portion of the backlight 430 (or electronic display), and exhausted out of the bottom of the assembly. Of course, the external air 100 could also be ingested at the bottom and exhausted out of the top. The fan 80 is preferably placed within a cavity defined between the backlight 430 and the rear plate 220 and is preferably not immediately adjacent to the exhaust port on the housing, although this is not required. Generally speaking, a portion 201 of the housing may connect between the rear surface of the backlight 430 (or electronic display) and the rear plate 220, where the fan 80 is mounted on this portion 201 of the housing.

[0023] 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 scope of the claimed invention. It is the intention, therefore, to limit the invention only as indicated by the scope of the claims.

Claims

1. A method for mounting an electronic display to a vertical surface comprising the steps of:

presenting an electronic display assembly module (500) having a pair of horizontal rods (50 and 51) near a top of the electronic display assembly module (500);
attaching a rear cover mounting bracket (550) having hooks (300 and 301) located near a top of the rear cover mounting bracket (550) to a vertical surface;
engaging the horizontal rods (50 and 51) with the hooks (300 and 301) so that the electronic display assembly module (500) can hang from the hooks (300 and 301);
hanging an electronic display assembly module (500) from the rear cover mounting bracket (550); and
attaching a bottom portion of the rear cover mounting bracket (550) to a bottom portion of the electronic display assembly module (500).

2. The method of claim 1 wherein:

the step of engaging the horizontal rods (50 and 51) with the hooks (300 and 301) comprises placing each hook (300 and 301) on a portion of the rod (50 and 51) which is defined by the space between a pair of locating walls (53 and 54).

3. The method of any preceding claim, further comprising the step of:

routing electrical service wiring (281) through the rear cover mounting bracket (550) and into a junction box (280) after it has been fastened to the vertical surface but prior to hanging an electronic display assembly module (500) from the rear cover mounting bracket (550).

4. The method of claim 3 further comprising the step of:

electrically connecting a second service line (283) to the electrical service wiring (281) by way of the junction box (280) prior to performing the step of hanging an electronic display assembly module (500) from the rear cover mounting bracket (550).

5. The method of any preceding claim wherein:

the step of attaching a bottom portion of the rear cover mounting bracket (550) to a bottom portion of the electronic display assembly module (500) comprises engaging a first portion of a latch (130/132/135) which is attached to the rear cover mounting bracket (550) with a second portion of a latch (130/132/135) which is attached to the electronic display assembly module (500).

6. The method of any preceding claim wherein:

the step of attaching the rear cover mounting bracket (550) to the electronic display assembly module (500) creates a plenum (91) which is sealed from the exterior air.

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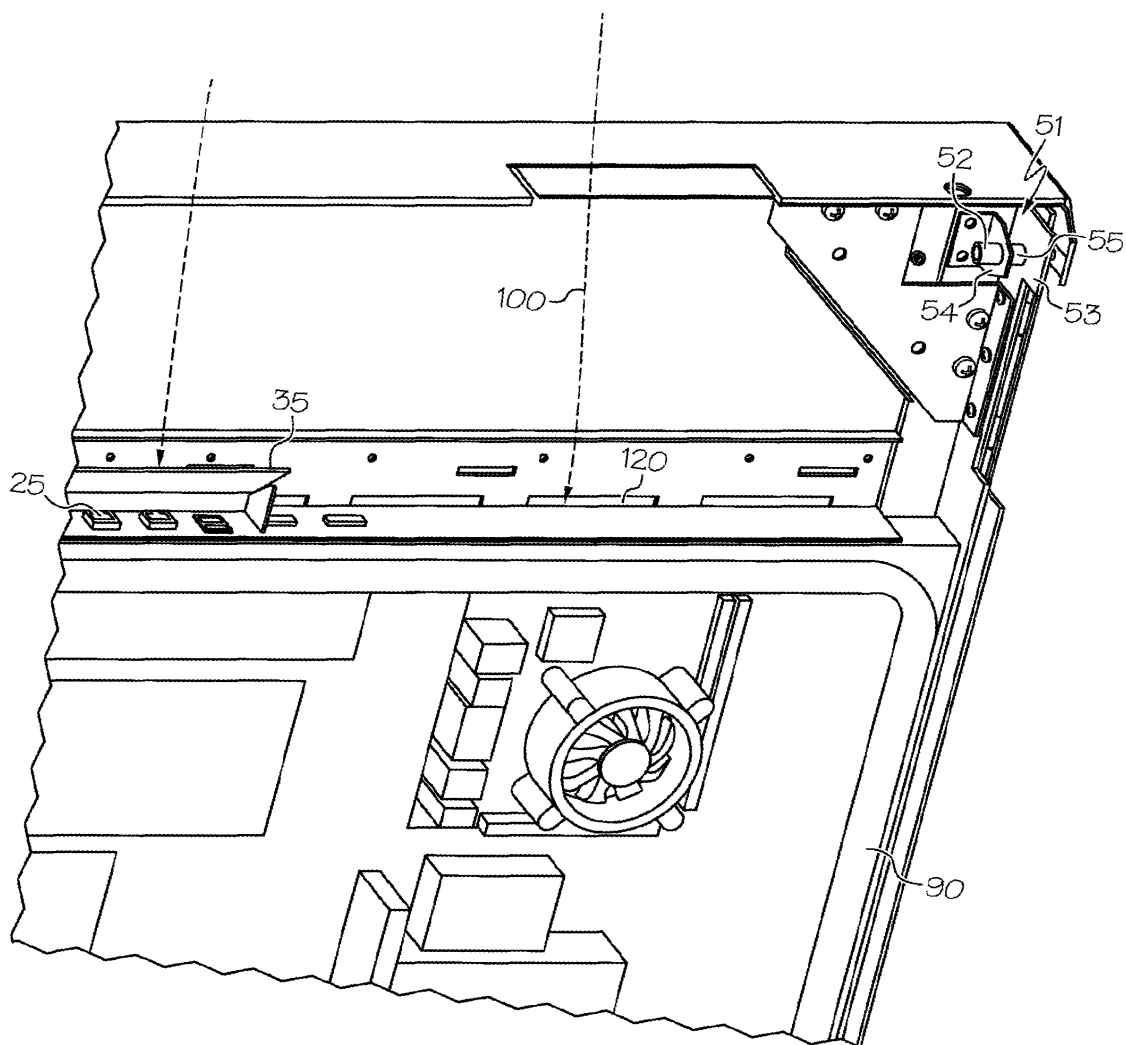


FIG. 2

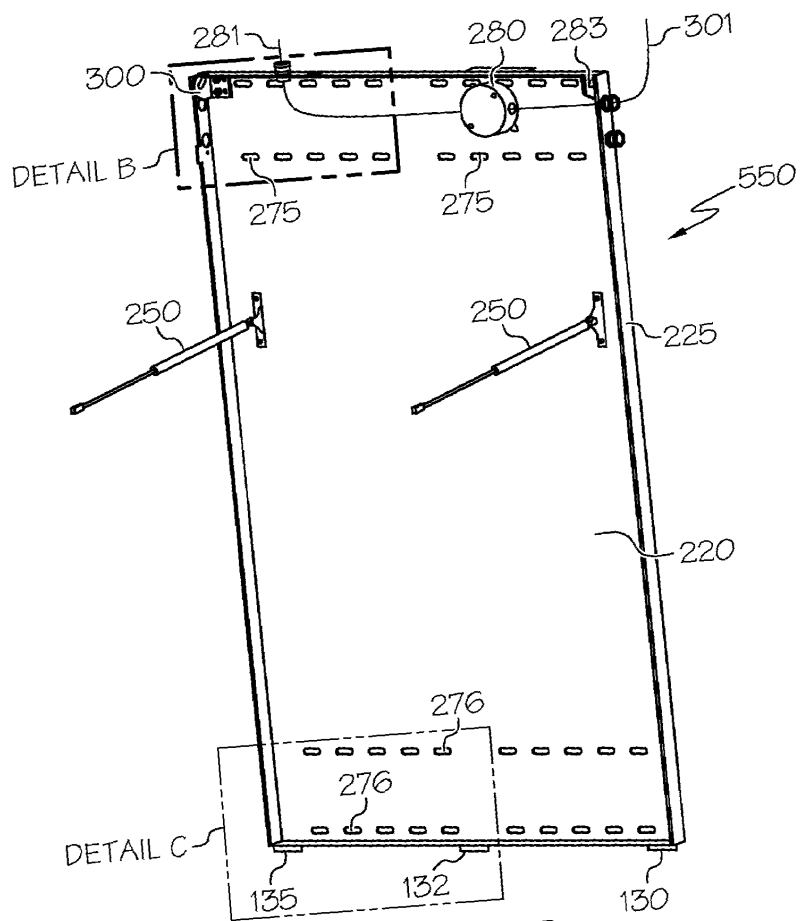


FIG. 3

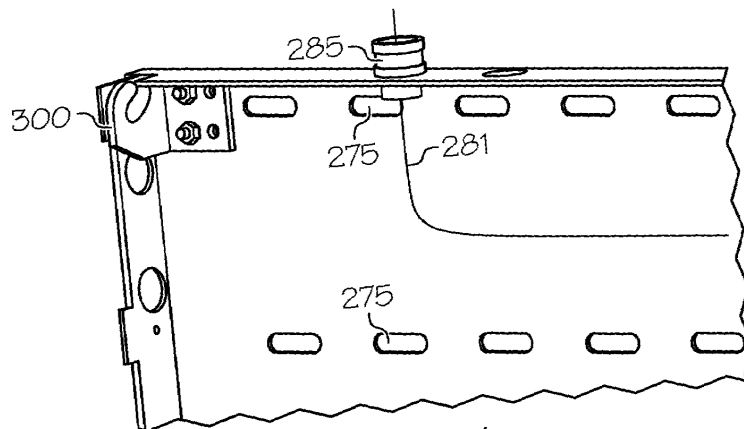
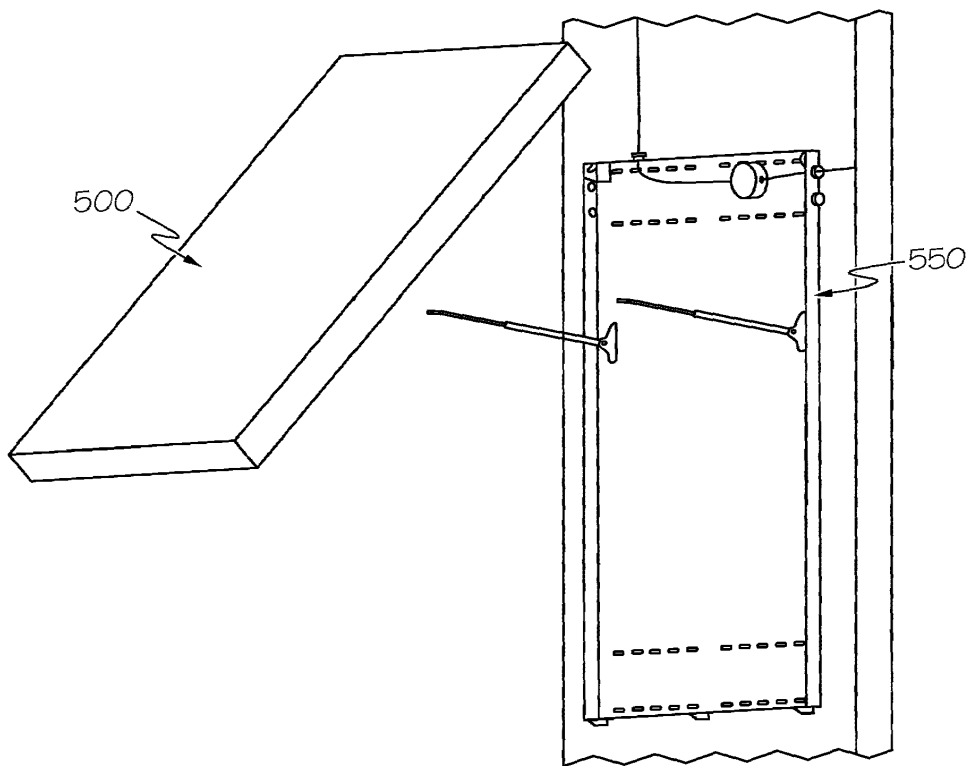
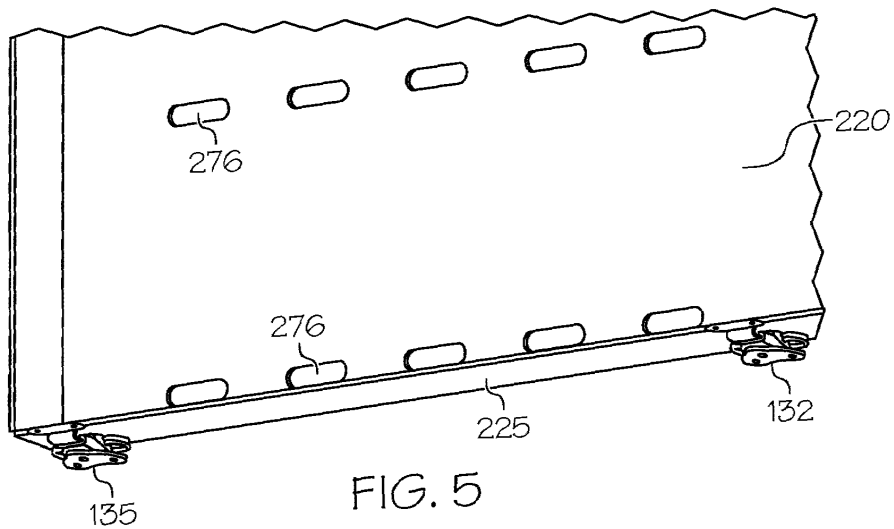


FIG. 4



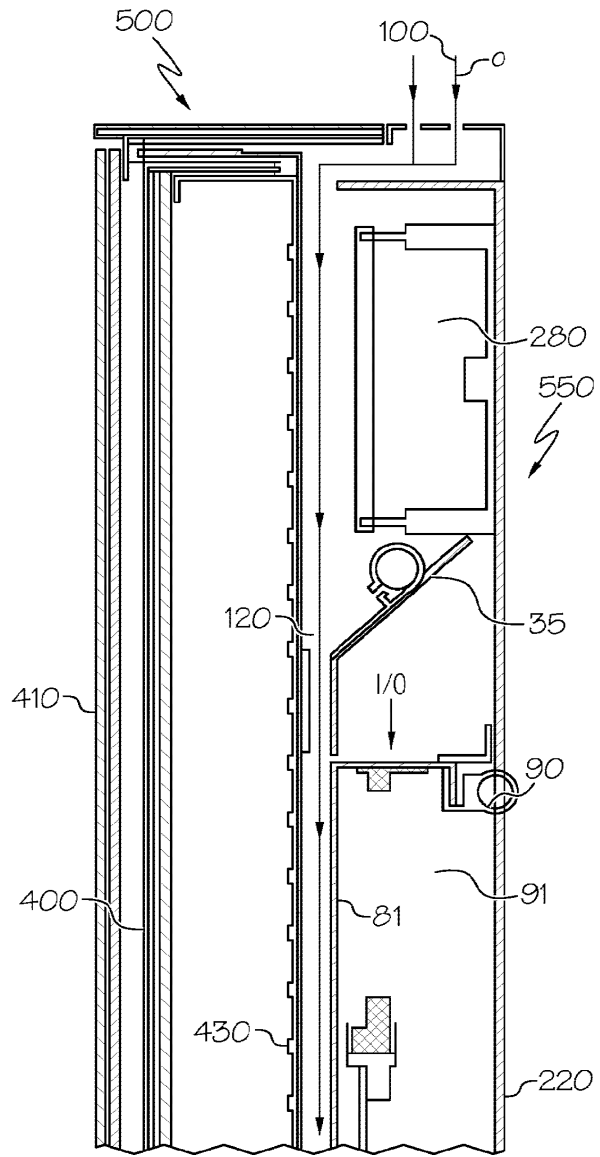
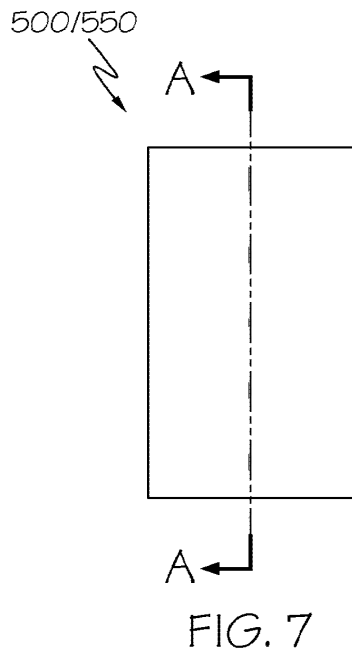


FIG. 8

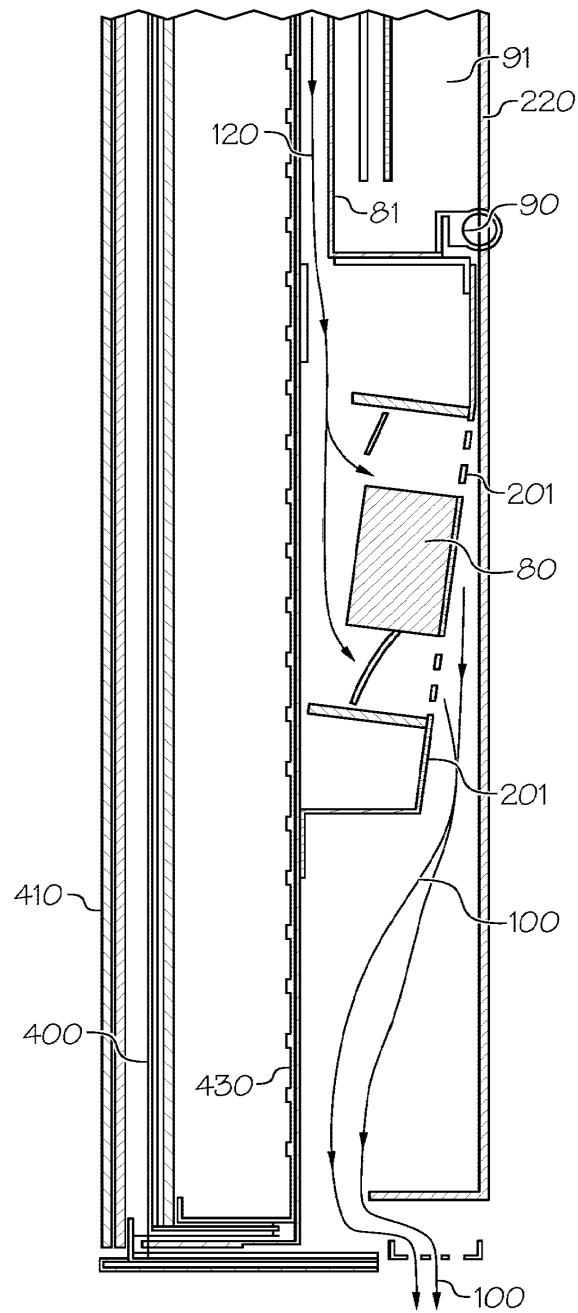


FIG. 9



EUROPEAN SEARCH REPORT

 Application Number
 EP 18 20 6810

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A	US 2009/241437 A1 (STEINLE WOLFGANG [DE] ET AL) 1 October 2009 (2009-10-01) * paragraphs [0032] - [0035]; figures 2,3 *	1-6	
A	US 2008/054144 A1 (WOHLFORD JIM [US]) 6 March 2008 (2008-03-06) * paragraph [0038]; figures 1-7 *	1-6	
A	US 2011/141672 A1 (FARLEY JR JAMES E [US] ET AL) 16 June 2011 (2011-06-16) * abstract; figures 1-4 *	1-6	
			TECHNICAL FIELDS SEARCHED (IPC)
			H04N F16M G02F G06F F16P
The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 12 February 2019	Examiner Queneuille, Julien
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

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EP 18 20 6810

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The members are as contained in the European Patent Office EDP file on
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EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82



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(54) **BACK TO BACK ELECTRONIC DISPLAY ASSEMBLY**
ELEKTRONISCHE BACK-TO-BACK-ANZEIGEVORRICHTUNG
ENSEMBLE D'AFFICHAGE ÉLECTRONIQUE DOS À DOS

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EP 3 138 372 B1

SEC et al. v. MRI
SEC Exhibit 1022.5871
IPR2023-00221

Description

Technical Field

[0001] Embodiments generally relate to cooling systems and methods for installing electronic displays.

Background of the Art

[0002] 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 contaminates into sensitive portions of the display, which can lead to premature failures. In some spaces, only a small footprint is available, such that placing electronic displays in a back to back orientation is desirable. US2011/085301, US2010/226091, US5748269, US2010/232107, US2011/116231, US2011/114384 and US2011/122162 disclose known electronic displays.

Summary of the Invention

[0003] The present invention provides a back to back electronic display as claimed in claim 1.

Summary of the Exemplary Embodiments

[0004] Exemplary embodiments provide a back to back electronic display assembly where the electronic components are contained within a sealed plenum. External air is ingested and passed between the walls of the plenum and the rear surfaces of the electronic display assemblies. The two electronic display assemblies are permitted to move relative to one another, such that the plenum can be easily opened with the electronics made available for servicing and/or replacement.

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

Brief Description of the Drawings

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

FIGURE 1 is a front planar view of an exemplary back to back display assembly showing the vertical section line A-A.

FIGURE 2 is a section view taken along the section

line A-A and showing Detail 3 and Detail 4 as well as vertical section line B-B.

FIGURE 3 is a detailed section view showing Detail 3.

FIGURE 4 is a detailed section view showing Detail 4.

FIGURE 5 is a section view taken along the section line A-A and showing the second display assembly rotated away from the first display assembly and also showing Detail 6.

FIGURE 6 is a detailed section view showing Detail 6.

FIGURE 7 is a perspective view showing an alternate embodiment where the first display assembly is rotated away from the second display assembly.

FIGURE 8 is a perspective view taken along the line B-B and indicating Detail 9.

FIGURE 9 is a detailed perspective view of Detail 9 showing the post.

FIGURE 10 is a detailed perspective view of the corresponding hook on the second display assembly.

Detailed Description

[0007] 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.

[0008] 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.

[0009] 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.

[0010] 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.

[0011] FIGURE 1 is a front planar view of an exemplary back to back display assembly 1000 showing the vertical section line A-A. In this orientation the first display assembly 201 is the only display that is viewable.

[0012] FIGURE 2 is a section view taken along the section line A-A and showing Detail 3 and Detail 4 as well as vertical section line B-B. A first display assembly 201 is positioned back-to-back with a second display assembly 401. In an exemplary embodiment, the two display assemblies 201 and 401 are substantially parallel with the rear surfaces of each display assembly facing each other. The first display assembly 201 preferably contains a front cover glass 200, LCD panel 210, and LED backlight 220. The second display assembly 401 preferably contains a front cover glass 400, LCD panel 410, and LED backlight 420. Although shown and described herein with LED backlight LCD technology, the exemplary embodiments herein can be practiced with any form of flat panel display, including but not limited to OLED, LED, plasma, and any luminescent polymers. In these embodiments, the rear surface of the LED backlight would simply be the rear surface of an OLED, LED, plasma, or a luminescent polymer display.

[0013] An enclosed plenum 500 preferably contains the electronics 800 for operating the two displays and is positioned between the two display assemblies 201 and 401. A fan 600 is also positioned between the two display assemblies 201 and 401 and is positioned to draw surrounding external air through the assembly 1000, preferably without permitting any of the external air to enter the plenum 500. Although only a single fan 600 is shown, multiple fans may be used in some embodiments, either in the same or a different location than the fan 600 which is shown. Further, while the fan 600 is shown pulling the external air through the assembly 1000, it could also be positioned to push the external air through the assembly 1000. Still further, although shown at the bottom of the display assembly 1000, it could instead be placed at the top.

[0014] FIGURE 3 is a detailed section view showing Detail 3. FIGURE 4 is a detailed section view showing Detail 4. The plenum 500 is preferably enclosed by a first wall 740 which faces the first display assembly 201, a second wall 730 which faces the second display assembly 401, a top wall 710, bottom wall 715, and a pair of opposing sidewalls (not shown in this view). In this embodiment, the first wall 740, a top wall 710, bottom wall 715, and opposing sidewalls are fixed relative to one another while the second wall 730 is movable relative to

these pieces. While this is shown here, other embodiments could fix the second wall 730 relative to the top wall 710, bottom wall 715, and opposing sidewalls while the first wall 740 is movable relative to these pieces. Preferably, the walls 740, 710, 715, 730, and the sidewalls are metallic and preferably aluminum.

[0015] The second wall 730 seals the plenum 500 when the gasket 700 is compressed between the second wall 730 and the top wall 710, bottom wall 715, and opposing sidewalls. The electronics 800 contained within the plenum are protected from the external air flows 575 and 550 and any possible contaminants, particulate, or water vapor that may be present. The electronics can include, but are not limited to: power supplies, microprocessors, printed circuit boards, electronic memory, transmitting/receiving devices, and video players. Preferably the electronics 800 are also in thermal communication (preferably conductive) with either the first wall 740, second wall 730, or both. In this way, heat from the electronics 800 can be transferred to the first wall 740 to be removed by first external air flow 575 or the second wall 730 to be removed by the second external air flow 550.

[0016] A first gap is preferably defined between the first display assembly 201 and the first wall 740 of the plenum 500. A second gap is defined between the second display assembly 401 and the second wall 730 of the plenum 500. In this particular embodiment where an LCD with an LED backlight is being used, the first gap is between the rear surface of the LED backlight 220 and the first wall 740 and the second gap is between the rear surface of the LED backlight 420 and the second wall 730. A first external airflow 575 is ingested into the housing through an inlet aperture, forced through the first gap, and then exhausted out of the housing through an exhaust aperture. A second external airflow 550 is ingested into the housing through an inlet aperture, forced through the second gap, and then exhausted out of the housing through an exhaust aperture. In this way, airflow 575 can remove heat simultaneously from the LED backlight 220 and the first wall 740 while airflow 550 can remove heat simultaneously from the LED backlight 420 and the second wall 730.

[0017] FIGURE 5 is a section view taken along the section line A-A and showing the second display assembly rotated away from the first display assembly and also showing Detail 6. In this embodiment, the first display assembly 201 remains fixed while the second display assembly 401 is permitted to move or rotate away from the first display assembly 201, providing access to the interior of the plenum and the electronics 800 inside.

[0018] FIGURE 6 is a detailed section view showing Detail 6. Here, a sloped rain catcher 705 is placed below the inlet aperture and above the plenum so as to collect any condensation and direct it down the first gap. This figure also shows the movement of the second wall 730 along with the second display assembly 401, as they move away from the first wall 740, a top wall 710, bottom wall 715, and opposing sidewalls to provide access to

the interior of the plenum.

[0019] FIGURE 7 is a perspective view showing an alternate embodiment where the first display assembly 201 is rotated away from the second display assembly 401 (which remains fixed). Here, a pair of gas springs 850 are used to help rotate the display assembly 201 and hold it in an open position while the interior of the plenum 500 is being serviced.

[0020] FIGURE 8 is a perspective view taken along the line B-B and indicating Detail 9. In this embodiment, the first wall 740 is used to mount the various electronics 800, although these could instead be mounted to the rear wall 730. In some embodiments, electronics 800 may be mounted to both the first wall 740 and the second wall 730. The top wall 710 substantially prohibits airflow from entering the plenum. An opening 120 is preferably placed on or near the top wall 710 to allow airflow 575 to enter the gap defined by the opening of the space between the first wall 740 and the rear of the LED backlight 220. In a similar manner, another opening (not shown here) is preferably provided on or near the top wall 710 to allow airflow 550 to enter the gap defined by the opening of the space between the second wall 730 and the rear of the LED backlight 420.

[0021] A gasket 700 is preferably positioned around the perimeter of the first wall 740 so that the gasket 700 is compressed between the plenum walls (top wall 710, bottom wall 715, and pair of opposing sidewalls) and the second wall 730 when the unit is closed. Preferably, a pair of dividing walls 80/85 are used to define a loop around the plenum 500 which passes through only one of the dividing walls (here 80). Generally speaking, the dividing walls 80/85 should connect between the first wall 740 and second wall 730 of the plenum. In an exemplary embodiment, dividing wall 80 is perpendicular to dividing wall 85. Even more preferably, dividing wall 80 is arranged horizontally and contains the fan(s) while dividing wall 85 is connected to the end of dividing wall 80 but is arranged vertically and does not contain a fan. Although fans are only shown within the dividing wall 80, they could instead be placed within the dividing wall 85, or only within the dividing wall 85 with no fans placed within dividing wall 80. For exemplary airflow, it has been discovered that placing the first fan 75 near the center of the display assembly and the second fan 77 near the perimeter of the display assembly, causes a pair of circulating gas loops 501 and 510 respectfully.

[0022] A plurality of input/output electrical connections 25 are preferably placed at the top of the display assembly 201 and underneath a sloped rain catcher 705. Also, a pair of mounting pins 50 and 51 are arranged at the top of the display assembly 201. A plurality of latches 120, 122, 125 are preferably arranged at the bottom of the display assembly 201, although shown with three latches embodiments can be practiced with one or two latches only. Also shown in this figure are the attachment brackets 900 and 910 for gas springs 850 or other supporting resistive elements.

[0023] FIGURE 9 is a detailed perspective view of Detail 9 showing the post. Here, the details of the post 51 may be observed. In this embodiment, a cylinder travels horizontally and is divided by two locating walls 53 (closest to the perimeter of the display assembly 201) and 54 (closest to the center of the display assembly 201). The cylinder can then be identified by the mounting portion 55 (located between walls 53/54) and the interior portion 52 (starting at the wall 54 and travelling towards the center of the module 500).

[0024] FIGURE 10 is a detailed perspective view of the corresponding hook 450 on the second display assembly 401. A pair of mounting hooks 450 are preferably placed at the top of the second display assembly 401 and correspond to the mounting posts 50 and 51 respectively. Preferably, the hook 450 would wrap around the circumference of the mounting portions 55, where the hook 300 is stabilized between the walls 54 and 53.

Claims

1. A back to back electronic display assembly comprising:
 - a first display assembly (201) positioned back to back with a second display assembly (401);
 - an enclosed plenum (500) positioned entirely between the first and second display assemblies (201,401);
 - a first gap defined between the enclosed plenum (500) and the first display assembly (201);
 - a second gap defined between the enclosed plenum (500) and the second display assembly (401); and
 - a fan positioned (600) to force external air through the first and second gaps;
 - wherein the plenum (500) is sealed to prevent circulating air located within the enclosed plenum (500) from exiting the enclosed plenum (500).
2. The assembly of claim 1 further comprising:
 - a plenum fan (75,77) positioned within the enclosed plenum.
3. The assembly of claim 1 wherein:
 - one or more electronic components (800) for operating the first display assembly (201) are positioned within the enclosed plenum (500).
4. The assembly of claim 3 wherein:
 - the electronic component (800) is a power module.
5. The assembly of claim 1 wherein:
 - the enclosed plenum (500) comprises a first wall (740) and second wall (730) which oppose each other, a top wall (710), bottom wall (715), and a pair of

- sidewalls.
6. The assembly of claim 5 further comprising:
a gasket (700) positioned between the top wall (710)
and the second wall (730). 5
7. The assembly of claim 1 wherein:
the second display assembly (401) is permitted to
move relative to the first display assembly (201). 10
8. The assembly of claim 5 wherein:
the first wall (740) is fixed relative to the first display
assembly (201); and the second wall (730) is fixed
relative to the second display assembly (401). 15
9. The assembly of claim 5 wherein:
the first gap is further defined between the first
wall (740) of the enclosed plenum (500) and an
LED backlight (220) for the first display assem- 20
bly (201); and
the second gap is further defined between the
second wall (730) of the enclosed plenum (500)
and an LED backlight (220) for the second dis- 25
play assembly (401).
10. The assembly of claim 1 further comprising:
a first dividing wall (80,85) positioned within the
enclosed plenum (500); and 30
a second dividing wall (80,85) positioned within
the enclosed plenum (500) and oriented sub-
stantially perpendicular to the first dividing wall
(80,85). 35
11. The assembly of claim 10 further comprising:
a plenum fan (75,77) positioned within the first or
second dividing wall (80,85). 40
12. The assembly of claim 5 wherein:
the pair of sidewalls extend between the first wall
(740) and the second wall (730). 45
13. The assembly of claim 5 wherein:
the pair of sidewalls extend between the top wall
(710) and the bottom wall (715). 50
- Patentansprüche**
1. Elektronische Rücken-an-Rücken-Displayanord-
nung, die Folgendes umfasst:
eine erste Displayanordnung (201) die Rücken
an Rücken mit einer zweiten Displayanordnung 55
(401) positioniert ist; einen umschlossenen Luft-
raum (500), der vollständig zwischen der ersten
und der zweiten Displayanordnung (201, 401)
positioniert ist;
einen ersten Spalt, der zwischen dem um-
schlossenen Luftraum (500) und der ersten Dis-
playanordnung (201) definiert ist;
einen zweiten Spalt, der zwischen dem um-
schlossenen Luftraum (500) und der zweiten
Displayanordnung (401) definiert ist; und
ein Gebläse, das positioniert (600) ist, um Au-
ßenluft durch den ersten und den zweiten Spalt
zu zwängen;
wobei der Luftraum (500) versiegelt ist, um zu
verhindern, dass in dem umschlossenen Luft-
raum (500) befindliche zirkulierende Luft aus
dem umschlossenen Luftraum (500) austritt.
2. Anordnung nach Anspruch 1, die weiter Folgendes
umfasst:
ein Luftraumgebläse (75, 77), das in dem umschlos-
senen Luftraum positioniert ist.
3. Anordnung nach Anspruch 1, wobei:
eine oder mehrere Elektronikkomponenten (800)
zum Betreiben der ersten Displayanordnung (201)
in dem umschlossenen Luftraum (500) positioniert
sind.
4. Anordnung nach Anspruch 3, wobei:
es sich bei der Elektronikkomponente (800) um ein
Leistungsmodul handelt.
5. Anordnung nach Anspruch 1, wobei:
der umschlossene Luftraum (500) eine erste Wand
(740) und eine zweite Wand (730), die einander ge-
genüberliegen, eine obere Wand (710), eine untere
Wand (715) und ein Paar Seitenwände umfasst.
6. Anordnung nach Anspruch 5, die weiter Folgendes
umfasst:
eine Dichtung (700), die zwischen der oberen Wand
(710) und der zweiten Wand (730) positioniert ist.
7. Anordnung nach Anspruch 1, wobei:
es der zweiten Displayanordnung (401) ermöglicht
ist, sich relativ zu der ersten Displayanordnung (201)
zu bewegen.
8. Anordnung nach Anspruch 5, wobei:
die erste Wand (740) relativ zu der ersten Dis-
playanordnung (201) fest ist; und
die zweite Wand (730) relativ zu der zweiten Dis-
playanordnung (401) fest ist.
9. Anordnung nach Anspruch 5, wobei:
der erste Spalt weiter zwischen der ersten Wand
(740) des umschlossenen Luftraums (500) und
einer LED-Hintergrundbeleuchtung (220) für die

- erste Displayanordnung (201) definiert ist; und der zweite Spalt weiter zwischen der zweiten Wand (730) des umschlossenen Luftraums (500) und einer LED-Hintergrundbeleuchtung (220) für die zweite Displayanordnung (401) definiert ist.
10. Anordnung nach Anspruch 1, die weiter Folgendes umfasst:
- eine erste Trennwand (80, 85), die in dem umschlossenen Luftraum (500) positioniert ist; und eine zweite Trennwand (80, 85), die in dem umschlossenen Luftraum (500) positioniert ist und im Wesentlichen senkrecht zu der ersten Trennwand (80, 85) orientiert ist.
11. Anordnung nach Anspruch 10, die weiter Folgendes umfasst:
- ein Luftraumgebläse (75, 77) das in der ersten oder der zweiten Trennwand (80, 85) positioniert ist.
12. Anordnung nach Anspruch 5, wobei:
- sich das Paar Seitenwände zwischen der ersten Wand (740) und der zweiten Wand (730) erstreckt.
13. Anordnung nach Anspruch 5, wobei:
- sich das Paar Seitenwände zwischen der oberen Wand (710) und der unteren Wand (715) erstreckt.
- Revendications**
1. Ensemble d'affichage électronique du type dos à dos comportant :
- un premier ensemble d'affichage (201) positionné dos à dos avec un deuxième ensemble d'affichage (401) ; un caisson clos (500) positionné entièrement entre les premier et deuxième ensembles d'affichage (201, 401) ; un premier espace défini entre le caisson clos (500) et le premier ensemble d'affichage (201) ; un deuxième espace défini entre le caisson clos (500) et le deuxième ensemble d'affichage (401) ; et un ventilateur positionné (600) pour forcer de l'air externe au travers des premier et deuxième espaces ; dans lequel le caisson (500) est scellé pour empêcher l'air de circulation se trouvant à l'intérieur du caisson clos (500) de sortir du caisson clos (500).
2. Ensemble selon la revendication 1, comportant par ailleurs :
- un ventilateur de caisson (75, 77) positionné à l'intérieur du caisson clos.
3. Ensemble selon la revendication 1, dans lequel : un ou plusieurs composants électroniques (800) servant à faire fonctionner le premier ensemble d'affichage (201) sont positionnés à l'intérieur du caisson clos (500).
4. Ensemble selon la revendication 3, dans lequel : le composant électronique (800) est un module de puissance.
5. Ensemble selon la revendication 1, dans lequel : le caisson clos (500) comporte une première paroi (740) et une deuxième paroi (730) qui sont opposées l'une par rapport à l'autre, une paroi supérieure (710), une paroi inférieure (715), et une paire de parois latérales.
6. Ensemble selon la revendication 5, comportant par ailleurs :
- un joint d'étanchéité (700) positionné entre la paroi supérieure (710) et la deuxième paroi (730).
7. Ensemble selon la revendication 1, dans lequel : le deuxième ensemble d'affichage (401) peut se déplacer par rapport au premier ensemble d'affichage (201).
8. Ensemble selon la revendication 5, dans lequel :
- la première paroi (740) est fixe par rapport au premier ensemble d'affichage (201) ; et la deuxième paroi (730) est fixe par rapport au deuxième ensemble d'affichage (401).
9. Ensemble selon la revendication 5, dans lequel :
- le premier espace est par ailleurs défini entre la première paroi (740) du caisson clos (500) et un rétroéclairage DEL (220) pour le premier ensemble d'affichage (201) ; et le deuxième espace est par ailleurs défini entre la deuxième paroi (730) du caisson clos (500) et un rétroéclairage DEL (220) pour le deuxième ensemble d'affichage (401).
10. Ensemble selon la revendication 1, comportant par ailleurs :
- une première paroi de séparation (80, 85) positionnée à l'intérieur du caisson clos (500) ; et une deuxième paroi de séparation (80, 85) positionnée à l'intérieur du caisson clos (500) et orientée de manière sensiblement perpendiculaire par rapport à la première paroi de séparation (80, 85).
11. Ensemble selon la revendication 10, comportant par ailleurs :

un ventilateur de caisson (75, 77) positionné à l'intérieur de la première ou deuxième paroi de séparation (80, 85).

12. Ensemble selon la revendication 5, dans lequel : 5
la paire de parois latérales s'étendent entre la première paroi (740) et la deuxième paroi (730).
13. Ensemble selon la revendication 5, dans lequel : 10
la paire de parois latérales s'étendent entre la paroi supérieure (710) et la paroi inférieure (715).

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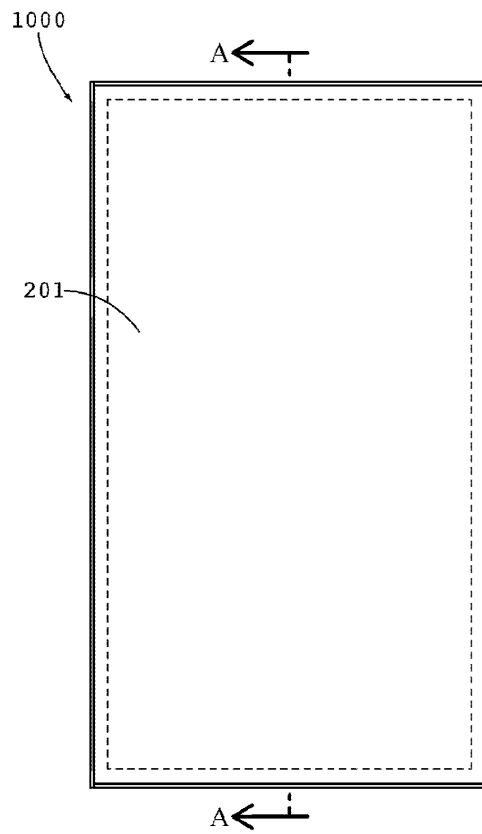


Fig. 1

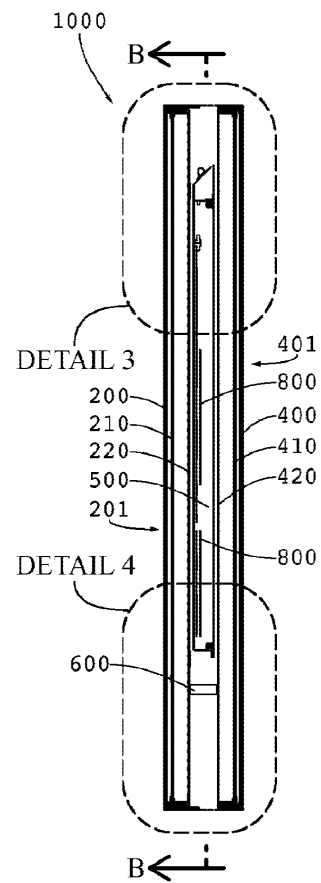


Fig. 2

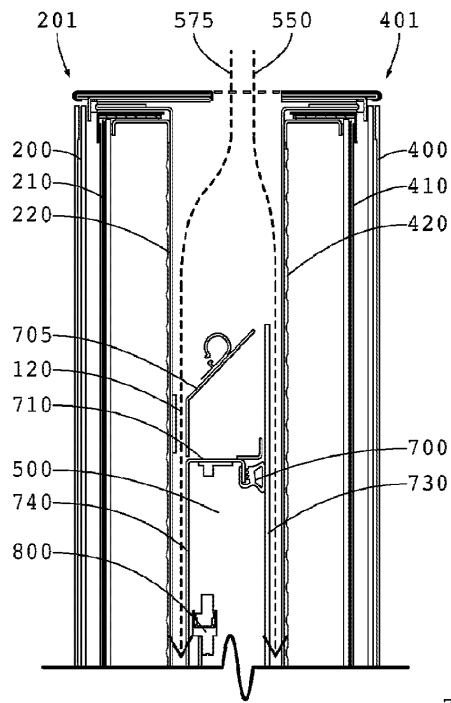


Fig. 3

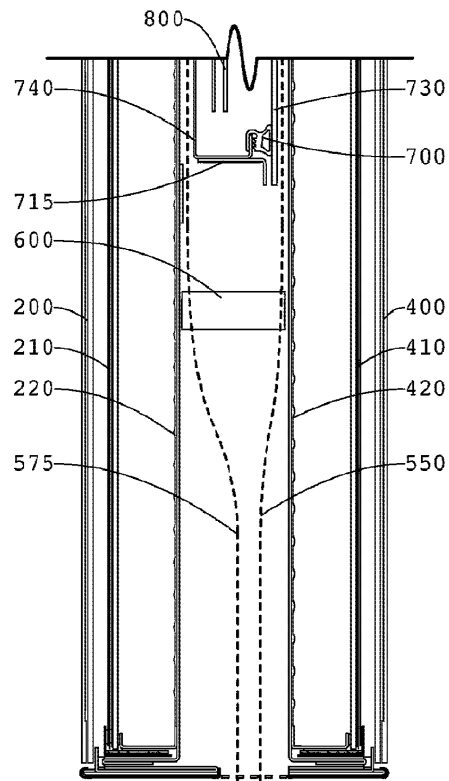


Fig. 4

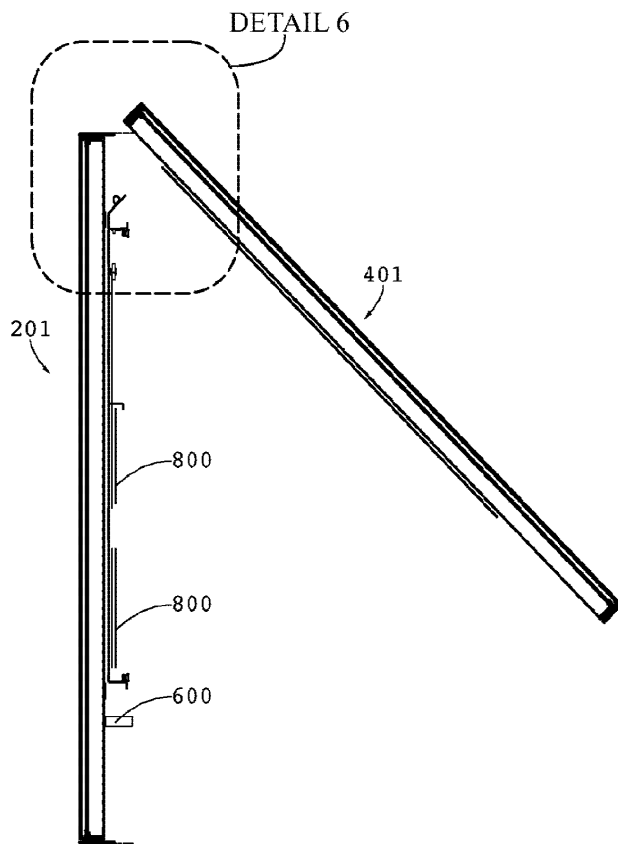


Fig. 5

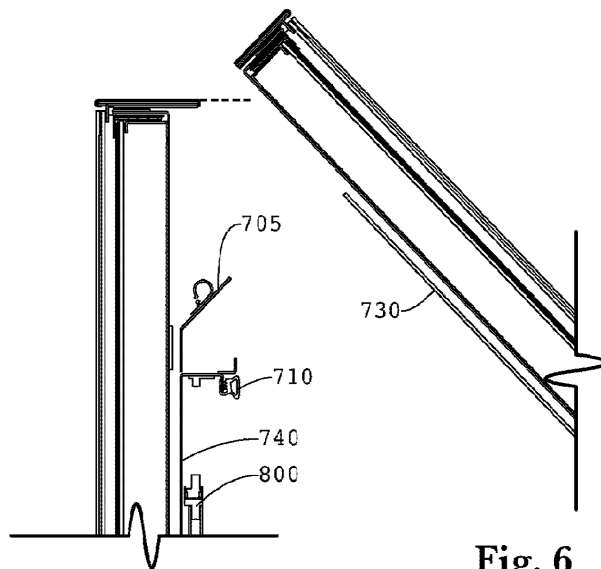


Fig. 6

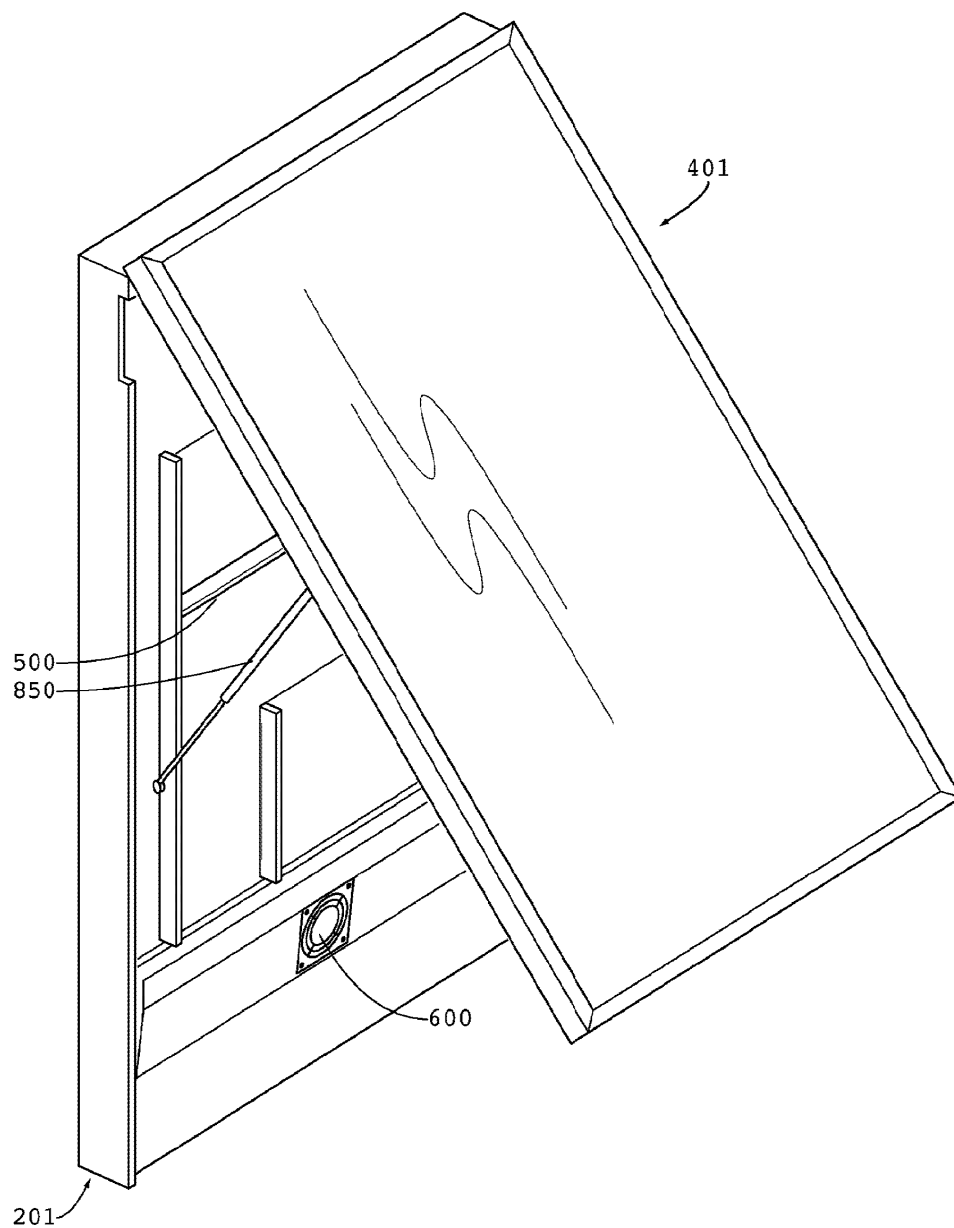


Fig. 7

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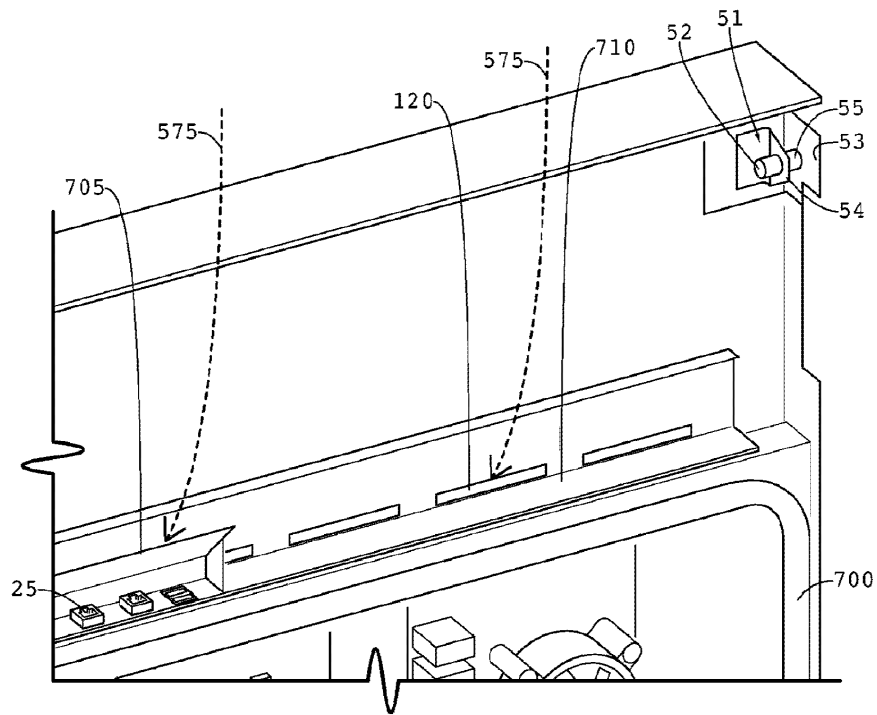


Fig. 9

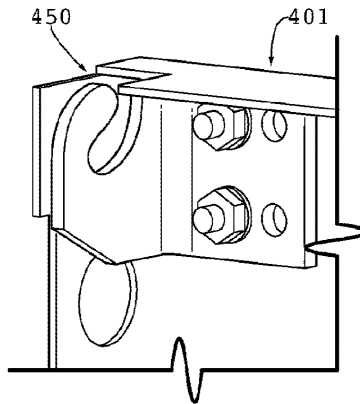


Fig. 10

REFERENCES CITED IN THE DESCRIPTION

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COOLING SYSTEM FOR DOUBLE SIDED DISPLAY ASSEMBLY

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Classification: - international: G09F9/00; G09F9/40; H04N5/64; H05K7/20
 - cooperative: B60R11/0229; H05K7/20145; H05K7/20154; H05K7/20972; B60R2011/004

Application number: JP20180545188 20170306 Global Dossier

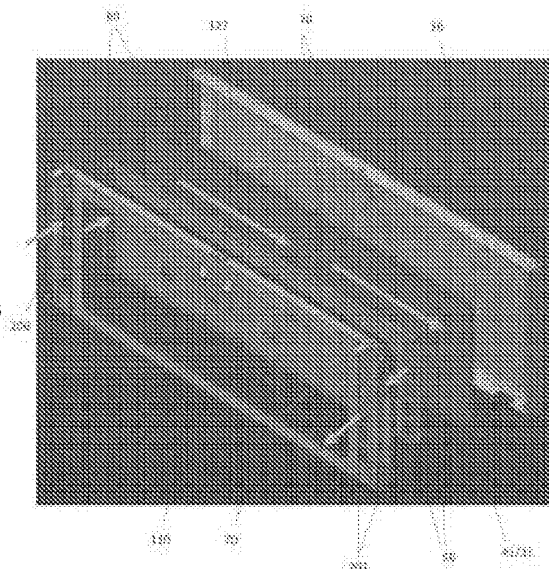
Priority number (s): US201662303806P 20160304 ; WO2017US20884 20170306

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Abstract not available for JP2019512721 (A)

Abstract of corresponding document: US2017257978 (A1)

A pair of electronic displays are placed back to back and are configured for mounting to a vehicle. A pair of thermal plates are located behind the electronic displays and a pair of transparent plates 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.



(19) 日本国特許庁(JP)

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G02F 1/1337 (2006.01)	H05K 7/20 H	
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(85) 翻訳文提出日	平成30年9月27日 (2018.9.27)		ンターナショナル・インコーポレーテッド
(86) 国際出願番号	PCT/US2017/020884		アメリカ合衆国 30005 ジョージア
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(87) 国際公開日	平成29年9月8日 (2017.9.8)		スト 6415
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最終頁に続く

(54) 【発明の名称】 両側面ディスプレイ・アセンブリ用の冷却システム

(57) 【要約】

一対の電子ディスプレイ (30及び31) は、背合わせで配置され、且つ、車両にマウントされるように構成される。一対の熱プレート (126及び127) は、電子ディスプレイの後に配置され、一対の透過パネル (35及び36) は、電子ディスプレイの後に配置される。閉ループの空気は、電子ディスプレイと透過パネルとの間のスペースを介して、また、閉ループ・プレナムを介して、垂直に移動する。開ループの空気は、熱プレートと電子ディスプレイの背面との間のスペースを介して、水平に移動する。

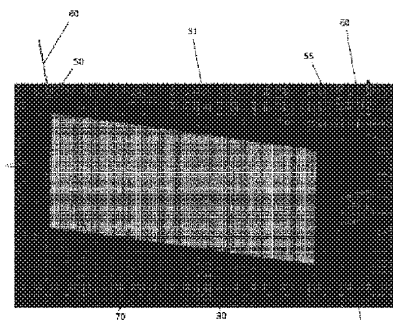


FIG. 1

【特許請求の範囲】

【請求項1】

車両の上にマウントされるディスプレイ・アセンブリであって、
背合わせで配置される第1及び第2の電子ディスプレイと、
各々が前記第1及び第2の電子ディスプレイのうちの一つの前に配置される、第1及び第2の透過パネルと、
前記第1及び第2の電子ディスプレイの間に配置され、且つ、周辺空気を受け取るように構成される、開ループ進路と、
循環ガスを受け取るように構成される閉ループ進路であって、
前記第1及び第2の透過パネル並びに前記第1及び第2の電子ディスプレイによって、それぞれ、規定される第1及び第2のチャンネルと、
前記第1及び第2の電子ディスプレイの間に配置され、且つ前記チャンネルにガスで連絡されるプレナムと、
を含む前記閉ループ進路と、
車両ルーフに取り付けられるように適合されるハウジングと、
を備え、
前記ハウジング及び前記第1及び第2の透明パネルは、前記第1及び第2の電子ディスプレイ、前記開ループ進路、及び、前記閉ループ進路を実質的に囲む囲みを形成し、
前記閉ループ進路及び前記開ループ進路は、実質的な手法で前記循環ガスと前記周辺空気との混合を防止しながら、前記循環ガスから前記周辺空気に熱エネルギーを移動させるように構成される、
ディスプレイ・アセンブリ。

【請求項2】

請求項1に記載のディスプレイ・アセンブリであって、
各々が前記第1及び第2の電子ディスプレイのうちの一つの背面の後に配置される、第1及び第2の熱プレートと
更に備えるディスプレイ・アセンブリ。

【請求項3】

請求項2に記載のディスプレイ・アセンブリであって、
前記熱プレートの少なくとも1つの背面に取り付けられる複数の電子コンポーネントを更に備えるディスプレイ・アセンブリ。

【請求項4】

請求項2に記載のディスプレイ・アセンブリであって、
各々が前記第1及び第2の熱プレート並びに前記第1及び第2の電子ディスプレイの前記背面によって規定される第1及び第2の開ループ・チャンネルを更に備えるディスプレイ・アセンブリ。

【請求項5】

請求項4に記載のディスプレイ・アセンブリであって、
前記開ループ進路は、前記第1及び第2の開ループ・チャンネルを含む、
ディスプレイ・アセンブリ。

【請求項6】

請求項5に記載のディスプレイ・アセンブリであって、
前記開ループ進路は、前記周辺空気が前記前記第1及び第2の開ループ・チャンネルを通じて水平に移動するように、構成される、
ディスプレイ・アセンブリ。

【請求項7】

請求項1に記載のディスプレイ・アセンブリであって、
前記閉ループ進路は、閉ループ空気が前記第1及び第2のチャンネル及び前記プレナムを通じて垂直に移動するように、構成される、
ディスプレイ・アセンブリ。

【請求項 8】

請求項 1 に記載のディスプレイ・アセンブリであって、

前記開ループ進路は、

周辺空気を取り込むために前記ハウジング内に配置される吸入開口と、

周辺空気を取り出すために前記ハウジング内に配置される排出開口と、

を更に含む、

ディスプレイ・アセンブリ。

【請求項 9】

請求項 8 に記載のディスプレイ・アセンブリであって、

前記開ループ進路は、

前記吸入開口並びに前記第 1 及び第 2 の開ループ・チャネルにガスで連絡される、複数の入口開口と、

前記第 1 及び第 2 の開ループ・チャネル並びに前記排出開口にガスで連絡される、複数の出口開口と、

を更に含む、

ディスプレイ・アセンブリ。

【請求項 10】

請求項 5 に記載のディスプレイ・アセンブリであって、

前記閉ループ進路は、第 1 及び第 2 の流れを含み、

前記第 1 及び第 2 の流れは、それぞれ、前記第 1 及び第 2 の電子ディスプレイを垂直に囲む、

ディスプレイ・アセンブリ。

【請求項 11】

請求項 10 に記載のディスプレイ・アセンブリであって、

前記第 1 及び第 2 の開ループ・チャネルは、前記第 1 及び第 2 の流れの中間を通過する、

ディスプレイ・アセンブリ。

【請求項 12】

請求項 1 に記載のディスプレイ・アセンブリであって、

前記開ループ進路内に配置され、且つ、前記開ループ進路を介して周辺空気を進ませるように構成される、少なくとも 1 つの開ループ・ファンを

更に備えるディスプレイ・アセンブリ。

【請求項 13】

請求項 1 に記載のディスプレイ・アセンブリであって、

前記閉ループ進路内に配置され、且つ、前記閉ループ進路を介して循環ガスを進ませるように構成される、少なくとも 1 つの閉ループ・ファンを

更に備えるディスプレイ・アセンブリ。

【請求項 14】

車両の上にマウントされるディスプレイ・アセンブリであって、

背合わせで配置され、且つ、前面及び背面を有する、一対の電子ディスプレイと、

各々が前記電子ディスプレイのうちの一つの前記前面の前に配置される一対の透明パネルと、

各々が前記透明パネルうちのひとつと前記電子ディスプレイのうちのひとつとの間に配置される一対の閉ループ・チャネルと、

前記電子ディスプレイのうちのひとつの前記背面の後に配置される一対の熱プレートと、

前記熱プレートのうちのひとつと前記ディスプレイのうちのひとつとの間に配置される一対の開ループ・チャネルであって、そこを水平に通る周辺空気を許可するように構成される前記一対の開ループ・チャネルと、

前記一対の熱プレートによって規定される閉ループ・プレナムであって、前記一対の開ループ・チャネルにガスで連絡される前記閉ループ・プレナムと、

を備え、
前記閉ループ・チャンネル及び前記閉ループ・プレナムは、そこを垂直に通る循環ガスを許可するように構成される、
ディスプレイ・アセンブリ。

【請求項15】

請求項14に記載のディスプレイ・アセンブリであって、
前記熱プレートの中の少なくとも1つの背面にマウントされる複数の電子コンポーネントを
更に備えるディスプレイ・アセンブリ。

【請求項16】

請求項14に記載のディスプレイ・アセンブリであって、
間をあけて配置され、且つ、前記閉ループ・プレナム及び前記閉ループ・チャンネルを通じて循環ガスが進むように構成される、一対の閉ループ・ファンを
更に備えるディスプレイ・アセンブリ。

【請求項17】

請求項14に記載のディスプレイ・アセンブリであって、
前記閉ループ・チャンネルを通じて周辺空気が進むように配置される開ループ・ファンを
更に備えるディスプレイ・アセンブリ。

【請求項18】

請求項14に記載のディスプレイ・アセンブリであって、
前記車両のルーフの上にマウントされるように適合されたハウジングを
更に備えるディスプレイ・アセンブリ。

【請求項19】

車両の上にマウントされるディスプレイ・アセンブリであって、
背合わせに配置され一対の電子ディスプレイであって、前記電子ディスプレイ間のスペースがギャップを規定する、前記一対の電子ディスプレイと、
前記電子ディスプレイを囲むように構成され、且つ、前記車両のルーフにマウントされる、ハウジングと、

前記電子ディスプレイの各々を囲み、且つ、前記ギャップを通じて移動する、閉ループ進路と、

前記ギャップを通じて移動する一対の開ループ進路と、
を備え、
前記開ループ進路と前記閉ループ進路とが交差しない、
ディスプレイ・アセンブリ。

【請求項20】

請求項19に記載のディスプレイ・アセンブリであって、
前記電子ディスプレイの間に配置され、且つ、前記閉ループ進路から前記開ループ進路を隔てる、一対の熱プレートを
更に備えるディスプレイ・アセンブリ。

【発明の詳細な説明】

【技術分野】

【0001】

(関連出願の相互参照)

[0001] 本発明は、2016年3月4日付けで出願された米国仮特許出願第62/303,806の優先権を主張し、その参照によってその全体を本明細書に組み込むものとする。

【0002】

(技術分野)

[0002] 本発明の実施形態は、概して、電子ディスプレイ用の冷却システムに関連する。

【背景技術】

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【0003】

(背景)

【0003】電子ディスプレイは、時には、アウトドア環境、又は、周囲温度が高い他のエリア若しくは太陽光負荷等のディスプレイ内温度を上昇させる他の熱源がある他のエリアに使用される。しかしながら、そのディスプレイの幾つかの部分は、冷却するのが難しい。それは、その部分に周辺空気を単に吸入するだけでは、早期の故障に繋がりがねないディスプレイの敏感な部分にちりを導入しその部分を汚染してしまうからである。

【発明の概要】

【課題を解決するための手段】

【0004】

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(発明的な概念の概要)

【0004】例示的な実施形態は、電子ディスプレイ・ハウジングを通過する例えば空気等の流体の多様な流路を備えている。少なくとも1つの流路は、閉ループであり、他の幾つかの流路は、開ループを提供することができる。閉ループの流路は、好ましくは、密閉された電子機器区画を通して循環するとともに、電子ディスプレイとフロント透明パネルとの間を通過する。周辺空気からなる第1開ループは、第1電子ディスプレイの背後を通過する一方、周辺空気からなる第2流路は、第2ディスプレイの背後を通過することができる。幾つかの実施形態において、開ループの空気はまた、電子コンポーネントを有する熱プレートからの熱を取り去ることができ、幾つかの実施形態において、開ループの空気はまた、LEDバックライト(LEDディスプレイ)からの熱を取り去ることができる。

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【図面の簡単な説明】

【0005】

(図面の簡単な説明)

【0005】上述の特徴に加えて、本発明の他の態様は、後続の、図面及び例示的な実施例の記述から明らかになるであろう。なお、図面において、いくつかの図に共通する同様の参照符号は、同一の又は均等の特徴を表している。

【図1】【0006】図1は、両側面ディスプレイ・アセンブリの例示的な実施形態の正面斜視図であり、切断線A-A、B-B及びC-Cも示している。

【図2】【0007】図2は、切断線A-Aに沿って得られる図1の実施形態の側断面図である。

【図3】【0008】図3は、切断線B-Bに沿って得られる図1の実施形態の正面断面図である

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【図4】【0009】図4は、切断線C-Cに沿って得られる図1の実施形態の頂面断面図であり、Detail(細部)Aの位置も示している。

【図5】【0010】図5はDetail Aの詳細斜視図である。

【図6】【0011】図6は、図1の実施形態の一部の分解図である。

【発明を実施するための形態】

【0006】

(例示的な実施形態の詳細な説明)

【0012】本発明は、本発明の例示的な実施形態が示されている添付の図面を参照することによって、より完全に理解することができる。しかしながら、本発明は、本明細書に記載された例示的な実施形態に限定されるものではない。むしろ、例示的な実施形態の提供により、本開示は、全くの完全なものとなり、また、当該技術分野の当業者は、発明の範囲を完全に理解することができる。但し、図面においては、層及び領域の大きさ、相対的な大きさは、明確化のために誇張されている場合がある。

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【0007】

【0013】本明細書での用語は、特定の実施形態のみを説明するために使用され、本発明を限定する意図はない。また、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／又は要素の存在を明示していることを理解す

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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。

【0008】

【0014】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。

【0009】

【0015】他に定義しない限り、本明細書で使用される用語（技術用語及び科学用語を含む）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。

【0010】

【0016】図1は、両側面ディスプレイ・アセンブリの例示的な実施形態の正面斜視図であり、切断線A-A、B-B及びC-Cも示している。一般的に、例示的な実施形態は、背合わせでハウジング25内に配置される2つのディスプレイ30及び31を備えている。吸入開口50は、周辺空気60の流れをハウジング25内に入れてハウジング25を通過させることを許容する。周辺空気60は、好ましくは、排出開口55を通してハウジング25から排出される。循環ガス70の閉ループは、同様にハウジング25内を移動するが、好ましくは、実質的な手法で周辺空気60と混合されることはない。

【0011】

【0017】本明細書において、周辺空気60の用語は、単に、アセンブリを取り囲む環境を提供する普通の大気からなる空気を意味する。この周辺空気60は、異なる型のガス要素の混合と、ちり、ほこり、花粉、水蒸気、その他の微粒子と、を含むことが知られている。また、本明細書において、循環ガス70は、異なる型のガスの混合であってもよく、或いは、純粋なガス物質であってもよく、従って、任意のガス物質ということの意味することができる。好ましくは、循環ガス70は、実質的な量のちり、ほこり、花粉、水蒸気、又は、その他の型の微粒子を含まない。

【0012】

【0018】本発明の例示的な実施形態は、車両に、好ましくはそのルーフに、マウントされるように構成される。ハウジング25は、車両ルーフの頂上に取り付けられるように構成され、そのサイズが決定される。更に、ハウジング25は、空気力学的抗力を最小限に抑えるように適合され、そのサイズが決定されてもよい。ハウジング25は、ハウジング25を車両にマウントするための一対の脚部26を備えることができる。脚部26は、車両ルーフに固定されるか、又は車両の上若しくは車両の内に配置される内部支持部に固定されるように構成され、そのサイズが決定される。このような実施形態において、ハウジング25は、好ましくは、薄く、空気力学的抗力を最小限に抑えるように丸い角及び他の特徴構造を有することができる。ハウジング25は、移動中の車両に起因する力に適應する構造上の剛性及び強度を提供するために、様々な補強部材を備えることができる。同様に、ディスプレイ・アセンブリの様々な構成は、移動中の車両に起因する力に適應するのに十分な剛性材料で構成され又はその材料からなる。更に、ハウジングとディスプレイ・アセンブリの様々な構成要素とは、車両に搭載される時の力、振動、その他の厳格性に対抗できるように構成することができる。例えば、限定されるものではないが、脚部26及びディスプレイ・アセンブリの様々な構成要素は、ラバー・パッド、その他の振動衝撃吸収部を備えることができる。

【0013】

【0019】図示されるように、切断線A-Aは、アセンブリの中心を水平に下方に配置され、アセンブリを垂直に切断する。切断線B-Bは、垂直に向き、アセンブリを水平に切断する

。最後に、切断線C-Cは、水平に向き、アセンブリを同様に水平に切断する。図1における切断線の矢印は、切断図を得るように仮想的な切断方向を示している。

【0014】

【0020】図2は、切断線A-Aに沿って得られる図1の実施形態の側断面図である。周辺空気60は、吸入開口50を通過してハウジング25に入り、そこでは、その後に入口プレナム(plenum)内に導かれ、以下に詳細に説明するように、開ループ・チャンネルに接続する複数の入口開口200のうちの一つを通過する。周辺空気60は、好ましくは、一又は複数のファン100によって引かれるが、ファン100はまた、周辺空気60を押すように配置することができ、或いは、幾つかのファンは、押す／引くの組み合わせで使用することができる。この特定の実施形態において、ファン100は、出口プレナムの近くに配置され、そこでは、周辺空気60は、複数の出口開口201のうちの一つを通して移動することによって開ループ・チャンネルから集められ、出口プレナムから集められ、排出開口55を介してハウジング25から出るように導かれる。

【0015】

【0021】以下詳細に説明するように、入口開口200及び出口開口201は、電子ディスプレイ31の背後を走る第1開ループ・チャンネルにガスで連絡されている。好ましくは、アセンブリの反対側にもう1組の入口開口及び出口開口が存在し(図示せず)、これらは、電子ディスプレイ30の背後を走る第2開ループ・チャンネルに連絡されている。開口200及び201は、好ましくは、電子ディスプレイ30/31の幅の中に、互いに実質的に等距離で分布している。開口200/201は、循環ガス70との実質的な混合なしで、又は、シールされた電子機器区画125への侵入なしで、周辺空気60によるハウジング25及び開ループ・チャンネルの通過を可能にする。

【0016】

【0022】複数の電子コンポーネント110は、好ましくは、循環ガス70用の開ループの一部を形成する密閉された電子機器区画125内に配置される。電子コンポーネント110は、以下の一又は複数を備えることができる：電源モジュール、ビデオ・プレーヤ、電子データ・ストレージ、マイクロプロセッサ、衛生／無線／受信機／送信機、及び、タイミング制御ボード。電子コンポーネント110の少なくとも幾つかは、ディスプレイ30及び31と電氣的に接続することができる。

【0017】

【0023】一又は複数のファン90は、開ループの循環ガス70を電子コンポーネント110上に強制することができる。2つのファン90で示されているが、これが必須ではない。加えて、図示されるように電子コンポーネント110上の循環ガス70を押し込む一方、これに限定されないが、ファン90が循環ガス70を引くように配置することもでき、或いは、幾つかのファン90が循環ガス70を押す／引くの組み合わせで使用することができる。

【0018】

【0024】図3は、切断線B-Bに沿って得られる図1の実施形態の正面断面図である。ここでは、閉ループの循環ガス70が明確に示されている。上述したように、循環ガス70は、好ましくは、シールされた電子機器区画125内の電子コンポーネント110の上を移動し、その後、ディスプレイ30及び31の各々を包むように分割される。第1ディスプレイ30に関して、透明パネル35は、好ましくは、循環ガス70を受け入れるためにディスプレイ30と透明パネル35との間の閉ループ・チャンネルを規定するように、ディスプレイ30の前に配置される。循環ガス70が一旦ディスプレイ30を横切って超えて移動すると、再び閉ループを開始するために、シールされた電子機器区画125へと戻される。

【0019】

【0025】同様に、第2ディスプレイ31に関して、透過パネル36は、好ましくは、循環ガス70を受け入れるためにディスプレイ31と透過パネル36との間の閉ループ・チャンネルを規定するように、ディスプレイ31の前に配置される。循環ガス70が一旦ディスプレイ31を横切って超えて移動すると、再び閉ループを開始するために、シールされた電子機器区画125へと戻される。

【0020】

【0026】図示されるように、周辺空気60の流れは、好ましくは、少なくとも2つのチャネルに分割されて、各ディスプレイの背後を1つの開ループ・チャネルが移動する。ディスプレイ30に関して、周辺空気60の経路は、好ましくは、ディスプレイ30の背面とシールされた電子機器区画125の熱壁126との間を移動する。限定されないが、ディスプレイ30としてダイレクトLEDバックライトLCDを使用する場合、周辺空気60は、好ましくは、LEDバックライト40の背面と熱壁126との間を移動する。上述したように、複数の電子コンポーネント110は、好ましくは、熱壁126及び127の一つ又は両方に、或いはその近くに、取り付けることができる。このように、電子コンポーネント110からの熱は、壁126及び127に移動し（好ましくは、伝導を介するが、同時に対流及び放熱が少し起きてもよい）、周辺空気60の流れによって除去される。

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【0021】

【0027】同様に、ディスプレイ31に関して、周辺空気60の経路は、好ましくは、ディスプレイ31の背面とシールされた電子機器区画125の熱壁127との間を移動する。限定されないが、ディスプレイ31としてダイレクトLEDバックライトLCDを使用する場合、周辺空気60は、好ましくは、LEDバックライト41の背面と熱壁127との間を移動する。実施形態としてダイレクトLEDバックライトLCDが図示されているが、この型のディスプレイ及びこれに関連するバックライトは、各実施形態において必須ではないことに、特に留意されたい。ディスプレイ30及び31は、次の中からの任意の一つとすることができる：プラズマ、OLED、LCD（直接照明又はエッジ照明）、LED、及び、任意の型のエレクトロルミネッセンス・ポリマー・ディスプレイ。

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【0022】

【0028】図4は、切断線C-Cに沿って得られる図1の実施形態の頂面断面図であり、Detail（細部）Aの位置も示している。この図を参照すれば、ディスプレイ30及び31の各々の背後に、周辺空気60用の2つのチャネルが示されている。再び、好ましくは、周辺空気60の2つの経路は、電子ディスプレイ30及び31並びに電子装置110からの熱を（熱壁126及び127を介して）取り除くことができる。

【0023】

【0029】図5はDetail Aの詳細斜視図である。周辺空気60が一旦開ループ・チャネルの各々を通過して移動すると、出口プレナムによって集められ、ファン100によってディスプレイ・ハウジング25の外部に押し出されるようになる。

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【0024】

【0030】図6は、図1の実施形態の一部の分解図である。ここには、アセンブリの片側の構成要素、すなわちディスプレイ31を囲むコンポーネントの積み重ねが示されている。周辺空気60は、好ましくは、入口開口200を通過して導入され、熱プレート127と電子ディスプレイ31の背後（この実施形態において、LEDバックライト41の背面）との間を通過することができる。開ループ・チャネルを一旦通過すると、周辺空気60は、好ましくは、出口開口201の外に導かれ、結果として、出口プレナムに集めてディスプレイ・ハウジングの外に出すことができる。循環ガス70は、概して、周辺空気60を有する開ループ・チャネルを取り囲むことができる。言い換えれば、開ループ周辺空気60は、循環ガス70の開ループの中心を通過する。

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【0025】

【0031】上述したように、循環ガス70は、好ましくは、電子コンポーネント110の上を通過し、シールされた電子機器区画125を出て、透明プレート36と電子ディスプレイ31の前との間を移動し、最終的には、シールされた電子機器区画125に戻る。再び、実施形態の半分だけが部分分解図に図示されていることに留意されたい。一般的には、図示し、上述したように、対向するディスプレイ30の周りを移動する第2開ループ循環ガス70と、ディスプレイ30の後を通る周辺空気60用の第2開ループ・チャネルと、が存在する。

【0026】

【0032】図面において様々な開及び閉の冷却ループが水平又は垂直の配置で示されたこ

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とに留意すべきであるが、特定の実施形態に依存して、逆にするか変更できることは、明確に意図されている。したがって、閉ループは、水平方向又は垂直方向に、また、時計回り方向又は半時計回り方向に、流れることができる。

【0027】

【0033】本発明の好ましい実施形態を示し、説明したが、当業者は、特許請求の範囲に記載された発明の範囲内で、説明した発明に変化をもたらす多くの変形及び修正を理解することができるであろう。加えて、上述の要素の多くは、特許請求の範囲に記載された発明の精神に含まれ、同じ結果を提供することができる異なる要素によって、変更又は置換されることができる。したがって、発明の範囲は、特許請求の範囲の記載のみによって規定されることが意図されている。

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【図1】

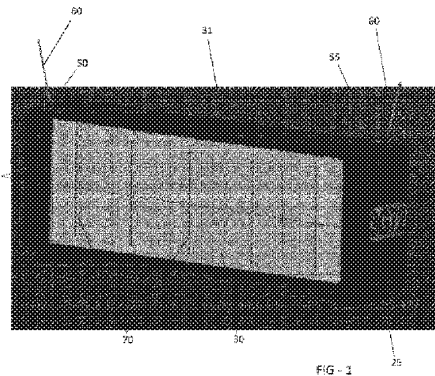


FIG - 1

【図2】

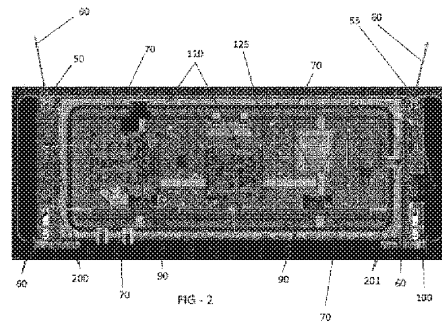
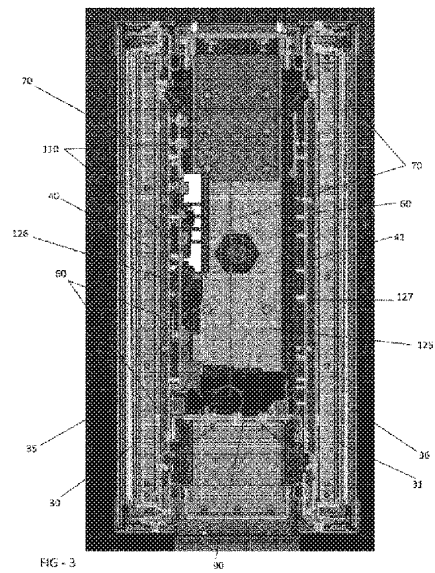
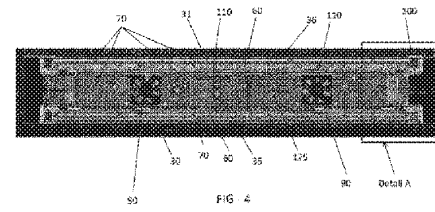


FIG - 2

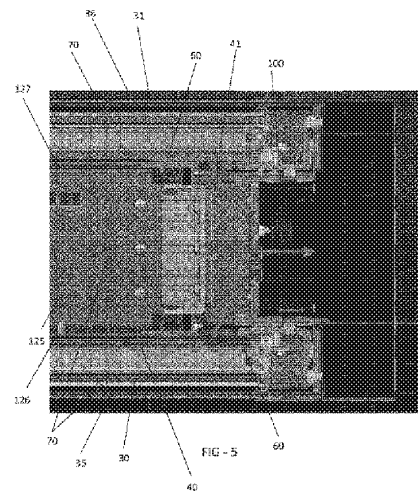
【図 3】



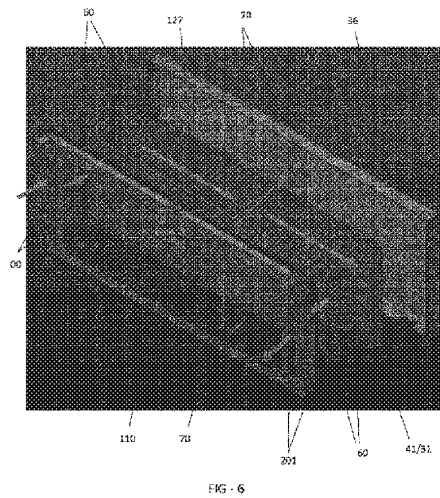
【図 4】



【図 5】



【図 6】



【国際調査報告】

INTERNATIONAL SEARCH REPORT		International application No. PCT/US17/20854
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 2011/0068301 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 2005/0253689 A1 (MACONIA, 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 "Z" 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/ 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 OEP: 571-272-7774

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

INTERNATIONAL SEARCH REPORT

International application No.

PCT/US17/25884

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/US17/20684

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 88a, 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.

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COOLING APPARATUS AND LIQUID CRYSTAL DISPLAY DEVICE HAVING THE SAME

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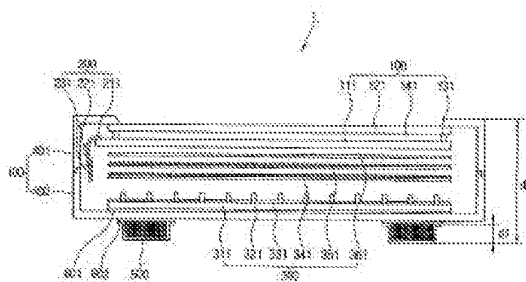
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A cooling apparatus comprises a casing, a heat sink and a cooling fan. The casing comprises a first opening and a second opening to provide an air path. The heat sink is received in the casing. The heat sink includes a recession part. The cooling fan is disposed in the recession part.



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(54) 냉각장치와 이를 포함하는 액정표시장치

요약

본 발명은 냉각장치와 이를 포함하는 액정표시장치에 관한 것이다. 본 발명에 따른 냉각장치는 공기 유로를 형성하는 제1 개구와 제2개구를 가지는 케이싱과, 상기 케이싱에 수용되어 있으며 함몰부가 형성되어 있는 히트 싱크와, 상기 함몰부에 위치하는 냉각팬을 포함하는 것을 특징으로 한다. 이에 의하여 냉각효율이 우수한 냉각장치가 제공된다.

배경도

도 2

명세서

도면의 간단한 설명

도 1a와 도 1b는 각각 본발명의 제1실시예에 따른 액정표시장치의 정면과 배면을 나타낸 사시도이고,

도 2는 본발명의 제1실시예에 따른 액정표시장치의 단면도이고,

도 3은 본발명의 제1실시예에 따른 냉각장치의 사시도이고,

도 4는 본발명의 제1실시예에 따른 냉각장치의 분해조립도이고,

도 5는 본발명의 제1실시예에 따른 냉각장치의 냉각원리를 설명하기 위한 도면이며,

도 6은 본발명의 제2실시예에 따른 냉각장치의 사시도이고,

도 7a 내지 도 7c는 각각 본발명의 제3실시예 내지 제5실시예에 따른 액정표시장치의 사시도이다.

* 도면의 주요부분의 부호에 대한 설명 *

100 : 액정패널 200 : 구동부

311 : 엘이디 회로기판 321 : 엘이디

331 : 반사판 341 : 확산필름

351 : 프리즘 필름 361 : 보호필름

510 : 케이싱 520 : 냉각팬

530 : 히트 싱크

발명의 상세한 설명

발명의 목적

발명이 속하는 기술 및 그 분야의 종래기술

본 발명은, 냉각장치와 이를 포함하는 액정표시장치에 관한 것이다.

최근 종래의 CRT를 대신하여 액정표시장치(LCD), PDP(plasma display panel, OLED(organic light emitting diode) 등의 평판표시장치가 많이 개발되고 있다.

이 중 액정표시장치는 박막트랜지스터 기판, 컬러필터 기판 그리고 양 기판 사이에 액정이 주입되어 있는 액정패널을 포함한다. 액정표시장치는 비발광소자이기 때문에 박막트랜지스터 기판의 후면에는 빛을 공급하기 위한 백라이트 유닛이 위치한다. 백라이트 유닛에서 조사된 빛은 액정의 배열상태에 따라 투과량이 조정된다. 이 밖에 액정패널과 백라이트 유닛을 수용하는 사시를 더 포함한다.

상기 백라이트 유닛은 광원의 위치에 따라 에지형과 직하형으로 구분된다. 에지형은 도광판의 측면에 광원이 설치되는 구조로, 주로 랩탑형 및 데스크탑 컴퓨터와 같이 비교적 크기가 작은 액정표시장치에 적용된다. 이러한 에지형 백라이트 유닛은 빛의 균일성이 좋고, 내구 수명이 길며, 액정표시장치의 박형화에 유리하다.

직하형은 액정표시장치의 크기가 대형화되면서 중점적으로 개발된 구조로, 액정패널의 하부면에 하나 이상의 광원을 배치시켜 액정패널에 전면적으로 광을 조사하는 구조이다. 이러한 직하형 백라이트 유닛은 에지형 백라이트 유닛에 비해 여러 개의 광원을 이용할 수 있어 높은 휘도를 확보할 수 있는 장점이 있는 반면, 휘도가 균일하지 않은 단점이 있다.

한편 백라이트 유닛, 특히 복수의 광원을 사용하는 직하형 백라이트 유닛에서는 많은 열이 발생한다. 이러한 열은 휘도 저하와 칼라 시프트(color shift) 현상을 일으키는 문제가 있다.

발명이 이루고자 하는 기술적 과제

본 발명의 목적은, 냉각효율이 우수한 냉각장치를 제공하는 것이다.

본 발명의 또 다른 목적은, 백라이트 유닛이 효율적으로 냉각되는 액정표시장치를 제공하는 것이다.

발명의 구성 및 작용

상기의 목적은 공기 유로를 형성하는 제1개구와 제2개구를 가지는 케이싱과, 상기 케이싱에 수용되어 있으며 합몰부가 형성되어 있는 히트 싱크와, 상기 합몰부에 위치하는 냉각팬을 포함하는 냉각장치에 의하여 달성된다.

상기 케이싱은, 상기 제1개구가 형성되어 있는 상판부와, 상기 상판부에서 절곡 연장되어 있는 측면부와, 상기 측면부에서 절곡 연장되어 있으며 상기 상판부와 평행한 결합부를 포함하는 것이 바람직하다.

상기 결합부에는 결합공이 형성되어 있는 것이 바람직하다.

상기 상판부는 직사각형 형상인 것이 바람직하다.

상기 상판부는 원형인 것이 바람직하다.

상기 케이싱은 일체로 형성되어 있는 것이 바람직하다.

상기 히트 싱크는, 상기 상판부와 평행하게 배치되어 있는 열전달판과, 상기 열전달판에 연결되어 있는 핀을 포함하는 것이 바람직하다.

상기 합몰부에 위치한 상기 핀은 주위의 핀에 비하여 높이가 낮은 것이 바람직하다.

상기 본발명의 또 다른 목적은, 액정패널과, 상기 액정패널의 배면에 위치하여 상기 액정패널에 빛을 공급하는 백라이트 유닛과, 상기 액정패널과 상기 백라이트 유닛을 수용하는 샤시와, 상기 백라이트 유닛과 상기 샤시를 사이에 두고 위치하며, 합몰부가 형성되어 있는 히트 싱크와, 상기 합몰부에 위치하는 냉각팬과, 공기 유로를 형성하는 제1개구와 제2개구를 포함하며 상기 히트 싱크를 수용하는 케이싱을 포함하는 액정표시장치에 의하여 달성될 수 있다.

상기 냉각팬은 상기 제1개구에 위치하는 것이 바람직하다.

상기 제1개구는 공기가 유입되는 유입구이며, 상기 제2개구는 공기가 유출되는 유출구인 것이 바람직하다.

상기 히트 싱크는, 상기 샤시와 평행하게 배치되어 있는 열전달판과, 상기 열전달판에 연결되어 있는 핀을 포함하는 것이 바람직하다.

상기 샤시와 상기 열전달판 사이에 위치하는 하부 겹 패드를 더 포함하며, 상기 샤시, 상기 하부 겹 패드 그리고 상기 열전달판은 밀착되어 있는 것이 바람직하다.

상기 핀은 상기 제1개구와 상기 제2개구의 연장 방향과 평행하게 배치되는 것이 바람직하다.

상기 제1개구에 위치한 상기 핀은 주위의 핀에 비하여 높이가 낮은 것이 바람직하다.

상기 백라이트 유닛은 엘이디(LED)를 포함하는 것이 바람직하다.

상기 엘이디는 상기 액정패널 배면 전체에 균일하게 배치되어 있는 것이 바람직하다.

상기 액정패널과 평행하게 배치되어 있으며 상기 엘이디가 장착되는 엘이디 회로기판과, 상기 엘이디 회로기판과 상기 샤시 사이에 배치되는 상부 캡 패드를 더 포함하며, 상기 엘이디 회로기판, 상기 상부 캡 패드 그리고 상기 샤시는 밀착되어 있는 것이 바람직하다.

상기 냉각장치의 두께는 실질적으로 일정한 것이 바람직하다.

상기 케이싱은, 상기 액정패널과 평행하게 배치되어 있으며 상기 제1개구가 형성되어 있는 상판부와, 상기 상판부에서 절곡 연장되어 있는 측면부와, 상기 측면부에서 절곡 연장되어 있으며 상기 상판부와 평행한 결합부를 포함하는 것이 바람직하다.

상기 결합부에는 상기 샤시와의 결합을 위한 결합공이 형성되어 있는 것이 바람직하다.

상기 상판부는 직사각형 형상인 것이 바람직하다.

상기 상판부는 원형인 것이 바람직하다.

상기 케이싱은 일체로 형성되어 있는 것이 바람직하다.

상기 본발명의 목적은 공기 유로를 형성하는 제1개구와 제2개구를 가지는 케이싱과, 상기 케이싱에 수용되어 있는 히트싱크와, 상기 케이싱에 수용되어 있는 냉각팬을 포함하는 냉각장치에 의하여도 달성될 수 있다.

상기 본발명의 또 다른 목적은 액정패널과, 상기 액정패널의 배면에 위치하여 상기 액정패널에 빛을 공급하는 백라이트 유닛과, 상기 액정패널과 상기 백라이트 유닛을 수용하는 샤시와, 상기 백라이트 유닛과 상기 샤시를 사이에 두고 위치하며, 공기 유로를 형성하는 제1개구와 제2개구를 가지는 케이싱과, 상기 케이싱 내에 수용된 냉각팬을 가지는 냉각장치를 포함하는 액정표시장치에 의하여도 달성될 수 있다.

이하 첨부된 도면을 참조로 하여 본발명을 더욱 상세히 설명하겠다.

도 1a와 도 1b는 각각 본발명의 제1실시예에 따른 액정표시장치(1)의 정면과 배면을 나타낸 사시도이고, 도 2는 본발명의 제1실시예에 따른 액정표시장치(1)의 단면도이다.

액정표시장치(1)는 액정패널(100), 액정패널(100)에 구동신호를 인가하는 구동부(200), 액정패널(100)에 빛을 공급하는 백라이트 유닛(300), 액정패널(100)과 백라이트 유닛(300)을 수용하는 샤시(400), 샤시(400) 외부에 있으면서 백라이트 유닛(300)을 냉각시키는 한 쌍의 냉각장치(500)를 포함한다.

액정패널(100)은 박막트랜지스터가 형성되어 있는 박막트랜지스터 기판(111)과 박막트랜지스터 기판(111)과 대면하고 있는 컬러필터 기판(121), 양 기판(111, 121)을 접합시키는 실런트(131), 양 기판(111, 121)과 실런트(131)사이에 위치하는 액정층(141)을 포함한다. 액정패널(100)은 액정층(141)의 배열을 조정하여 화면을 형성하지만 비발광소자이기 때문에 백라이트 유닛(300)이 필요하다.

구동부(200)는 일측이 박막트랜지스터 기판(111)에 연결되어 있는 연성인쇄회로기판(FPC, 211), 연성인쇄회로기판(211)에 장착되어 있는 구동칩(221), 연성인쇄회로기판(211)의 타측에 연결되어 있는 회로기판(PCB, 231)을 포함한다. 도 2에 도시된 구동부(200)는 COF(chip on film) 방식을 나타낸 것이며, TCP(tape carrier package), COG(chip on glass) 등 공지의 다른 방식도 가능하다. 또한 구동부(200)가 박막트랜지스터 기판(111)에 실장되는 것도 가능하다.

백라이트 유닛(300)은 직하형으로서 액정패널(100)과 평행하게 배치되어 있는 엘이디 회로기판(311), 엘이디 회로기판(311)에 장착되어 있는 엘이디(LED, 321), 엘이디(321)의 빛을 액정패널(100)방향으로 반사시키는 반사판(331), 엘이디(321)와 액정패널(100)사이에 위치하는 확산필름(341), 프리즘필름(351), 보호필름(361)을 포함한다.

엘이디 회로기관(311)은 엘이디(321)를 작동시키는 동시에 엘이디(321)에서 발생한 열을 냉각장치(500)에 전달하는 역할을 한다. 엘이디 회로기관(311)과 샤시(400)사이에는 상부 겹 패드(601)가 존재한다. 상부 겹 패드(601)는 엘이디 회로기관(311)과 샤시(400) 사이에 공기가 존재하지 못하도록 한다. 공기는 열전달계수가 낮아 엘이디 회로기관(311)과 샤시(400)사이에서 공기가 존재하면 엘이디(321)에서 발생한 열이 냉각장치(500)로 잘 전달되지 않는다. 상부 겹 패드(601)는 열전달계수가 높은 물질로 이루어진 얇은 판이며, 엘이디 회로기관(311), 상부 겹 패드(601), 샤시(400)는 서로 밀착되어 있다.

엘이디 회로기관(311)에는 각각 적색, 녹색, 청색을 발광하는 엘이디(321)가 배치되어 액정패널(100)에 백색광을 제공한다. 엘이디(321)의 배치는 특별히 제한되지 않는다. 엘이디(321)는 색재현성과 휘도가 우수하여 백라이트 유닛(300)의 광원으로 많이 사용된다.

제1실시예에서는 백라이트 유닛(300)의 광원으로 엘이디(321)를 예시하였으나, 백라이트 유닛(300)의 광원으로는 냉음극형광램프(CCFL)나 외부전극형광램프(EEFL) 등과 같은 다른 광원이 사용될 수도 있다.

반사판(331)은 엘이디(321)에서 발생된 빛을 반사하여 액정패널(100)로 향하게 한다. 반사판(331)은 엘이디 회로기관(311)의 전면에 걸쳐 있으며, 엘이디(321)가 위치하는 부분만 제거되어 있다.

확산필름(341)은 베이스판과 베이스판에 형성된 구슬 모양의 코팅층으로 이루어져 있다. 엘이디(321)으로부터의 빛이 그대로 액정패널(100)에 공급될 경우, 엘이디(321)의 배치형태가 사용자에게 인식되고 휘도가 불균일해진다. 확산필름(341)은 이를 방지하기 위해 엘이디(321)으로부터의 빛을 골고루 확산시켜 액정패널(100)로 공급하는 역할을 한다. 확산필름(341)은 2장 또는 3장을 겹쳐서 사용할 수 있다.

프리즘필름(351)은 상부면에 삼각기둥 모양의 프리즘이 일정한 배열을 갖고 형성되어 있다. 프리즘필름(351)은 확산필름(341)에서 확산된 빛을 상부의 액정패널(100)의 평면에 수직한 방향으로 집광하는 역할을 수행한다. 프리즘필름(351)은 통상 2장이 사용되며 각 프리즘필름(351)에 형성된 마이크로 프리즘은 소경을 각도를 이루고 있다. 프리즘필름(351)을 통과한 빛은 거의 대부분 수직하게 진행되어 균일한 휘도 분포를 제공하게 된다.

가장 상부에 위치하는 보호필름(361)은 스크래치에 약한 프리즘필름(351)을 보호한다.

샤시(400)는 상부샤시(401)와 하부샤시(402)를 포함하며, 액정패널(100)과 백라이트 유닛(300)을 수용한다.

하부샤시(402)의 바깥면에는 한 쌍의 냉각장치(500)가 부착되어 있다. 백라이트 유닛(300)과 냉각장치(500)는 하부샤시(402)를 사이에 두고 서로 마주하고 있는 것이다. 냉각장치(500)와 샤시(400) 사이에는 하부 겹 패드(602)가 존재한다. 냉각장치(500), 하부 겹 패드(602), 샤시(400)는 서로 밀착되어 있다.

이하에서는 본발명의 제1실시예에 따른 냉각장치(500)를 설명하겠다.

도 3은 본발명의 제1실시예에 따른 냉각장치(500)의 사시도이고, 도 4는 본발명의 제1실시예에 따른 냉각장치(500)의 분해조립도이다.

냉각장치(500)은 케이싱(510), 케이싱(510) 내에 수용되어 있는 냉각팬(520)과 히트싱크(heat sink, 530)를 포함한다.

케이싱(510)은 대략 육면체를 형성하고 있으며 샤시(400)를 향한 부분과 양 단부는 뚫려 있다. 케이싱(510)은 금속판이나 플라스틱으로 만들 수 있으며, 바람직하게는 알루미늄판으로 제조된다. 샤시(400)와 평행한 직사각형 형태의 상판부(513)의 대략 중앙부에는 공기가 유입되는 사각형의 제1개구(511)가 형성되어 있다. 뚫려 있는 양 단부는 공기가 유출되는 제2개구(512)가 된다. 공기는 제1개구(511)를 통해 유입되어 제2개구(512)를 통해 유출되면서 백라이트 유닛(300)은 냉각하게 된다. 측면부(514)는 상판부(513)에서 절곡되어 형성되어 있으며, 결합부(515)는 측면부(514)에서 다시 절곡된 부분으로 상판부(513)와 평행하다. 결합부(515)에는 샤시(400)와의 결합을 위한 결합공(516)이 길이방향을 따라 복수개 마련되어 있다. 상판부(513), 측면부(514) 그리고 결합부(515)는 판금이나 플라스틱 사출 등으로 일체로 마련되는 것이 바람직하다.

냉각팬(520)은 케이싱(510)에 수용되어 있으며, 제1개구(511)에 위치한다. 공기는 냉각팬(520)의 작동에 의해 제1개구(511)로 유입되고 제2개구(512)로 유출된다. 냉각팬(520)은 팬 본체(521)와 팬케이싱(522)을 포함하며, 팬케이싱(522)에는 냉각팬(520)을 히트 싱크(530)에 고정하기 위한 결합공(523)이 형성되어 있다. 냉각팬(520)은 상부에서 공기를 유입하여 측면으로 공기를 배출한다. 도시하지는 않았지만 냉각팬(520)은 전원을 인가받기 위한 전원연결선을 더 포함한다.

히트 싱크(530)는 상판부(513)와 평행하게 배치되어 있는 열전달판(531)과, 열전달판(531)에 연결되어 있는 핀(fin, 532)을 포함하며 샤시(400)와의 결합을 위해 결합공(도시되지 않음)이 형성되어 있다. 히트 싱크(530)에는 함몰부(533)가 형성되어 있다. 함몰부(533)는 제1개구(511)에 대응하는 부분, 즉 냉각팬(520)이 설치되는 부분에 형성되어 있다. 함몰부(533)에 위치하는 핀(532)은 다른 부분에 위치한 핀(532)에 비하여 높이가 낮다. 열전달판(531)과 샤시(400) 사이에는 하부 겹 패드(602)가 위치하며, 열전달판(531), 하부 겹 패드(602) 그리고 샤시(400)는 밀착되어 있다. 핀(532)은 복수로 마련되며 케이싱(510)의 길이방향을 따라 서로 평행하게 배치되어 있다. 즉 제1개구(511)에서 제2개구(512)를 향하는 방향과 평행하게 배치된다. 열전달판(531)에 전달된 열이디(321)의 열은 핀(532)으로 전달되는데, 핀(532)은 공기와 접촉하는 표면적이 매우 크기 때문에 열교환능력이 우수하다.

하부 겹 패드(602)와 샤시(400)에는 각각 케이싱(510), 팬(520), 히트 싱크(530)와의 결합을 위해 결합공(603, 403)이 마련되어 있다. 결합에서는 결합나사(701)를 이용한다.

이하에서는 냉각장치(500)의 작용을 도 5를 참조하여 설명하겠다.

액정표시장치(1)가 작동하면 열이디(321)에서 열이 발생하며 동시에 냉각팬(520)도 작동하게 된다.

열이디(321)에서 발생한 열은 열이디 회로기판(321), 상부 겹 패드(601), 샤시(400), 하부 겹 패드(602)를 거쳐 히트 싱크(530)의 열전달판(531)으로 전달된다. 열이디 회로기판(321), 상부 겹 패드(601), 샤시(400), 하부 겹 패드(602)는 서로 밀착되어 있어 열 전달은 효과적으로 이루어지며, 특히 냉각장치(500)와 직접 접촉하지 않는 부분의 열도 냉각장치(500)로 전달된다. 열전달판(531)으로 전달된 열은 표면적이 넓은 핀(532)으로 전달된다.

냉각팬(520)의 작동에 의해 제1개구(511)를 통해 공기가 유입된다. 유입된 공기는 케이싱(510)과 히트 싱크(530)를 따라 형성된 공기 유로를 따라 유동하며, 제2개구(512)를 통해 외부로 유출된다. 핀(532)은 제1개구(511)와 제2개구(512)의 연장방향, 즉 공기 유로와 평행하게 배치되어 있다. 따라서 공기는 흐름에 저항을 받지 않고 유동하면서 핀(532)과 열교환을 한다. 여기서 공기 유로는 냉각팬(520)의 작동 방향에 따라 제2개구(512)로부터 제1개구(511)을 향해 형성될 수도 있다.

이상과 같은 본발명의 제1실시예에 따른 냉각장치(500)는 냉각팬(520)과 히트 싱크(530)의 작용에 의해 열이디(321)에서 발생하는 열을 효율적으로 제거한다. 한편, 냉각장치(500)의 냉각팬(520)은 케이싱(510) 내에 수용되어 있기 때문에 냉각장치(500)의 두께(d1)는 일정하다. 냉각장치(500)가 장착된 액정표시장치(1)의 두께(d2) 역시 냉각팬(520)의 장착에 의해 증가하지 않는다.

이상에서는 냉각장치(500)가 액정표시장치(1)에 적용되는 것을 예시하였으나, 냉각장치(500)는 다른 발열장치, 특히 PDP나 OLED와 같은 평판표시장치의 열을 제거하는데 사용될 수 있다.

도 6은 본발명의 제2실시예에 따른 냉각장치(501)의 사시도이다. 냉각팬(520)의 상부는 제1실시예와 달리 케이싱(510) 외부로 돌출되어 있다. 그러나 냉각팬(520)의 상당부분은 케이싱(510) 내부에 위치하고 있어 냉각장치(500)의 높이는 낮게 형성되어 있다.

이하에서는 본발명의 제3실시예 내지 제5실시예에 대하여 설명한다.

도 7a 내지 도 7c는 각각 본발명의 제3실시예 내지 제5실시예에 따른 액정표시장치의 사시도이다.

도 7a에 도시한 제3실시예를 따른 액정표시장치(2)는 3개의 냉각장치(500)를 가지고 있다. 냉각장치(500)의 개수와 설치 위치는 냉각장치(500)의 크기 백라이트 유닛(300)에서 발생하는 열의 정도에 따라 다양하게 변형될 수 있다.

도 7b에 도시한 제4실시예를 따른 액정표시장치(3)의 냉각장치(501)는 제1실시예와 그 배치방향이 다르다. 즉 냉각장치(501)가 액정패널(100)의 장변과 평행하게 배치되어 있다. 또한 하나의 냉각장치(501)에는 제1개구(511)가 2개가 마련되어 있으며, 냉각팬(520)도 2개가 마련되어 있다. 한 쌍의 제1개구(511) 중간에는 추가의 제2개구(517)가 마련되어 있어 양방향에서 오는 공기가 유출된다.

도 7c에 도시한 제5실시예를 따른 액정표시장치(4)의 냉각장치(502)는 원기둥의 형태를 가지고 있다. 냉각팬(520)은 중앙에 위치하며 제2개구(512)는 냉각장치(502)의 가장자리를 따라 복수개가 배치되어 있다. 냉각팬(520)의 작동에 의해 모든 방향으로 균일하게 공기 흐름이 생성되므로, 제4실시예와 같이 냉각장치(502)를 원기둥 형태로 하면 공기 흐름을 최

발명의 효과

이상 설명한 바와 같이, 본 발명에 따르면, 냉각효율이 우수한 냉각장치를 제공된다. 또한, 백라이트 유닛이 효율적으로 냉각되는 액정표시장치가 제공된다.

(57) 청구의 범위

청구항 1.

공기 유로를 형성하는 제1개구와 제2개구를 가지는 케이싱과;

상기 케이싱에 수용되어 있으며 함몰부가 형성되어 있는 히트 싱크와;

상기 함몰부에 위치하는 냉각팬을 포함하는 것을 특징으로 하는 냉각장치.

청구항 2.

제 1항에 있어서,

상기 케이싱은,

상기 제1개구가 형성되어 있는 상판부와;

상기 상판부에서 절곡 연장되어 있는 측면부와;

상기 측면부에서 절곡 연장되어 있으며 상기 상판부와 평행한 절합부를 포함하는 것을 특징으로 하는 냉각장치.

청구항 3.

제 2항에 있어서,

상기 절합부에는 절합공이 형성되어 있는 것을 특징으로 하는 냉각장치.

청구항 4.

제 2항에 있어서,

상기 상판부는 직사각형 형상인 것을 특징으로 하는 냉각장치.

청구항 5.

제 2항에 있어서,

상기 상판부는 원형인 것을 특징으로 하는 냉각장치.

청구항 6.

제 2항에 있어서,

상기 케이싱은 일체로 형성되어 있는 것을 특징으로 하는 냉각장치.

청구항 7.

제 2항에 있어서,

상기 히트 싱크는,

상기 상판부와 평행하게 배치되어 있는 열전달판과;

상기 열전달판에 연결되어 있는 핀을 포함하는 것을 특징으로 하는 냉각장치.

청구항 8.

제 7항에 있어서,

상기 함몰부에 위치한 상기 핀은 주위의 핀에 비하여 높이가 낮은 것을 특징으로 하는 냉각장치.

청구항 9.

액정패널과;

상기 액정패널의 배면에 위치하여 상기 액정패널에 빛을 공급하는 백라이트 유닛과;

상기 액정패널과 상기 백라이트 유닛을 수용하는 샤시와;

상기 백라이트 유닛과 상기 샤시를 사이에 두고 위치하며, 함몰부가 형성되어 있는 히트 싱크와, 상기 함몰부에 위치하는 냉각팬과, 공기 유로를 형성하는 제1개구와 제2개구를 포함하며 상기 히트 싱크를 수용하는 케이싱을 포함하는 것을 특징으로 하는 액정표시장치.

청구항 10.

제 9항에 있어서,

상기 냉각팬은 상기 제1개구에 위치하는 것을 특징으로 하는 액정표시장치.

청구항 11.

제 10항에 있어서,

상기 제1개구는 공기가 유입되는 유입구이며, 상기 제2개구는 공기가 유출되는 유출구인 것을 특징으로 하는 액정표시장치.

청구항 12.

제 9항에 있어서,

상기 히트 싱크는,

상기 샤시와 평행하게 배치되어 있는 열전달판과;

상기 열전달판에 연결되어 있는 핀을 포함하는 것을 특징으로 하는 것을 특징으로 하는 액정표시장치.

청구항 13.

제 12항에 있어서,

상기 샤시와 상기 열전달판 사이에 위치하는 하부 겹 패드를 더 포함하며,

상기 샤시, 상기 하부 겹 패드 그리고 상기 열전달판은 밀착되어 있는 것을 특징으로 하는 액정표시장치.

청구항 14.

제 12항에 있어서,

상기 핀은 상기 제1개구와 상기 제2개구의 연장 방향과 평행하게 배치되는 것을 특징으로 하는 액정표시장치.

청구항 15.

제 12항에 있어서,

상기 제1개구에 위치한 상기 핀은 주위의 핀에 비하여 높이가 낮은 것을 특징으로 하는 액정표시장치.

청구항 16.

제 9항에 있어서,

상기 백라이트 유닛은 엘이디(LED)를 포함하는 것을 특징으로 하는 액정표시장치.

청구항 17.

제 16항에 있어서,

상기 엘이디는 상기 액정패널 배면 전체에 균일하게 배치되어 있는 것을 특징으로 하는 액정표시장치.

청구항 18.

제 16항에 있어서,

상기 액정패널과 평행하게 배치되어 있으며 상기 엘이디가 장착되는 엘이디 회로기판과;

상기 엘이디 회로기판과 상기 샤시 사이에 배치되는 상부 겹 패드를 더 포함하며,

상기 엘이디 회로기판, 상기 상부 겹 패드 그리고 상기 샤시는 밀착되어 있는 것을 특징으로 하는 액정표시장치.

청구항 19.

제 9항에 있어서,

상기 냉각장치의 두께는 실질적으로 일정한 것을 특징으로 하는 액정표시장치.

청구항 20.

제 9항에 있어서,

상기 케이싱은,

상기 액정패널과 평행하게 배치되어 있으며 상기 제1개구가 형성되어 있는 상판부와;

상기 상판부에서 절곡 연장되어 있는 측면부와;

상기 측면부에서 절곡 연장되어 있으며 상기 상판부와 평행한 결합부를 포함하는 것을 특징으로 하는 액정표시장치.

청구항 21.

제 20항에 있어서,

상기 결합부에는 상기 샤시와의 결합을 위한 결합공이 형성되어 있는 것을 특징으로 하는 액정표시장치.

청구항 22.

제 20항에 있어서,

상기 상판부는 직사각형 형상인 것을 특징으로 하는 액정표시장치.

청구항 23.

제 20항에 있어서,

상기 상판부는 원형인 것을 특징으로 하는 액정표시장치.

청구항 24.

제 20항에 있어서,

상기 케이싱은 일체로 형성되어 있는 것을 특징으로 하는 액정표시장치.

청구항 25.

공기 유로를 형성하는 제1개구와 제2개구를 가지는 케이싱과;

상기 케이싱에 수용되어 있는 히트 싱크와;

상기 케이싱에 수용되어 있는 냉각팬을 포함하는 것을 특징으로 하는 냉각장치.

청구항 26.

액정패널과;

상기 액정패널의 배면에 위치하여 상기 액정패널에 빛을 공급하는 백라이트 유닛과;

상기 액정패널과 상기 백라이트 유닛을 수용하는 샤시와;

상기 백라이트 유닛과 상기 샤시를 사이에 두고 위치하며, 공기 유로를 형성하는 제1개구와 제2개구를 가지는 케이싱과,
상기 케이싱 내에 수용된 냉각팬을 가지는 냉각장치를 포함하는 것을 특징으로 하는 액정표시장치.

청구항 27.

백라이트 유닛과, 상기 백라이트 유닛과 샤시를 사이에 두고 배치되어 있으며 제1개구와 제2개구를 가지는 케이싱을 포함하는 액정표시장치의 냉각방법에 있어서,

상기 케이싱과 서로의 높이가 적어도 일부 겹치는 냉각팬을 구동하여 상기 제1개구와 상기 제2개구 사이에 공기 유로를 형성하는 것을 특징으로 하는 액정표시장치의 냉각방법.

청구항 28.

제 27항에 있어서,

상기 공기 유로에는 공기의 흐름방향으로 복수의 핀이 배치되어 있는 것을 특징으로 하는 액정표시장치의 냉각방법.

청구항 29.

제1개구와 제2개구를 가지는 케이싱과, 상기 제1개구와 제2개구 사이에 공기 유로를 형성시키는 냉각팬을 포함하는 냉각 장치의 조립방법에 있어서,

상기 냉각팬을 상기 케이싱과 서로의 높이가 적어도 일부 겹치도록 하는 것을 특징으로 냉각장치의 조립방법.

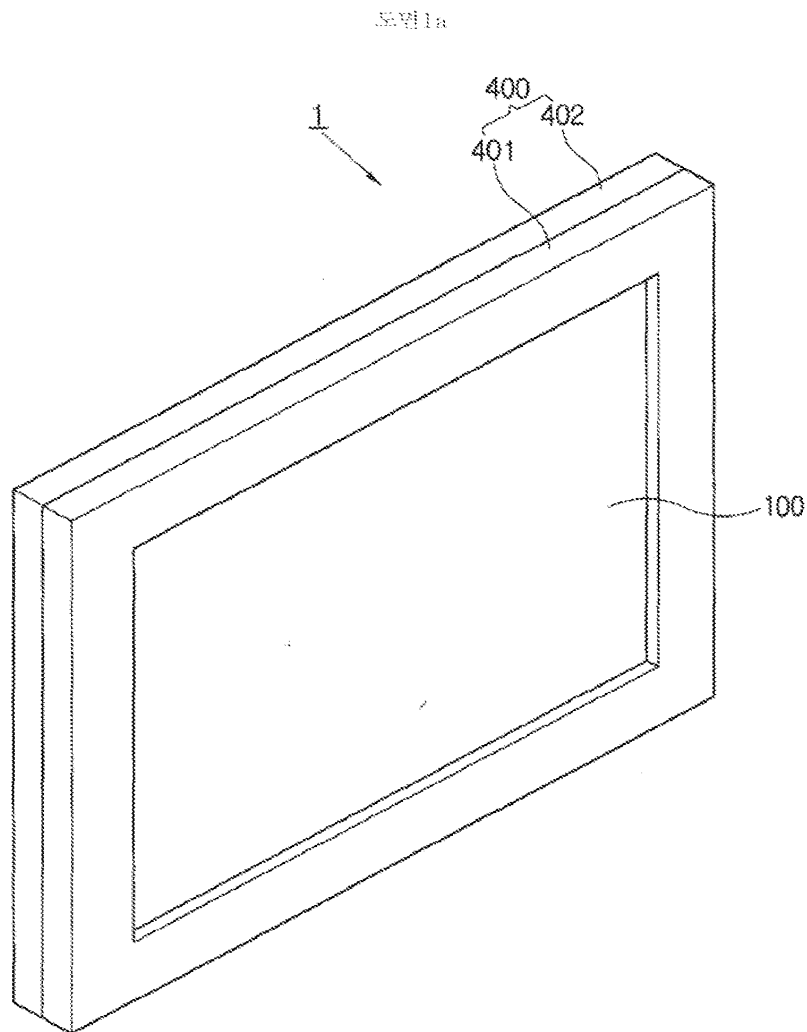
청구항 30.

제 29항에 있어서,

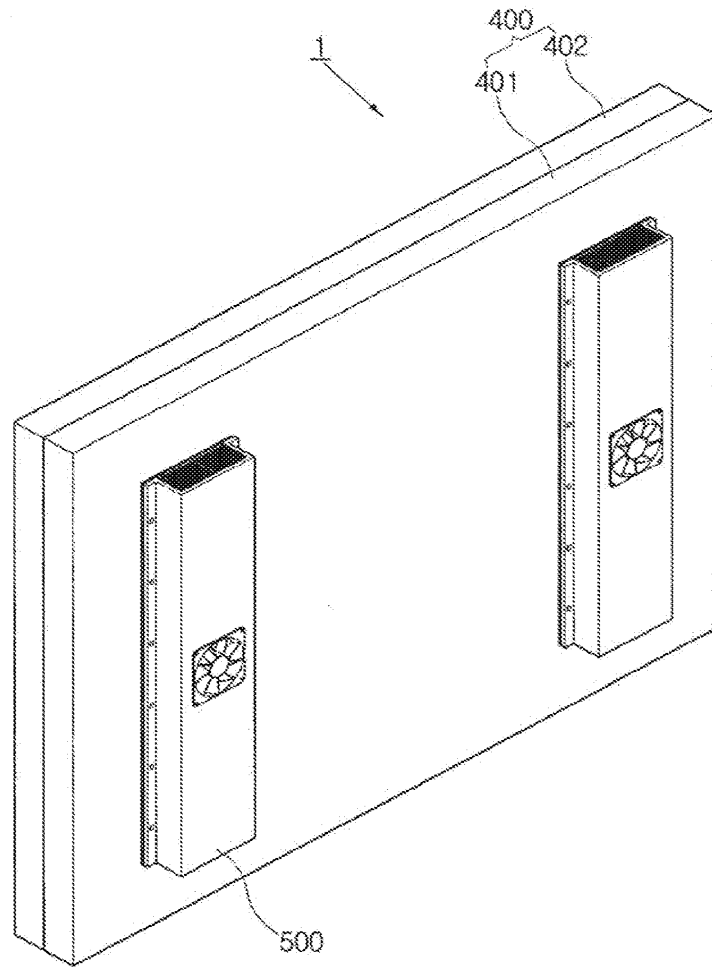
상기 냉각장치는 상기 케이싱에 수용되는 히트 싱크를 더 포함하며,

상기 냉각팬은 상기 히트 싱크에 결합되는 것을 특징으로 하는 냉각장치의 조립방법.

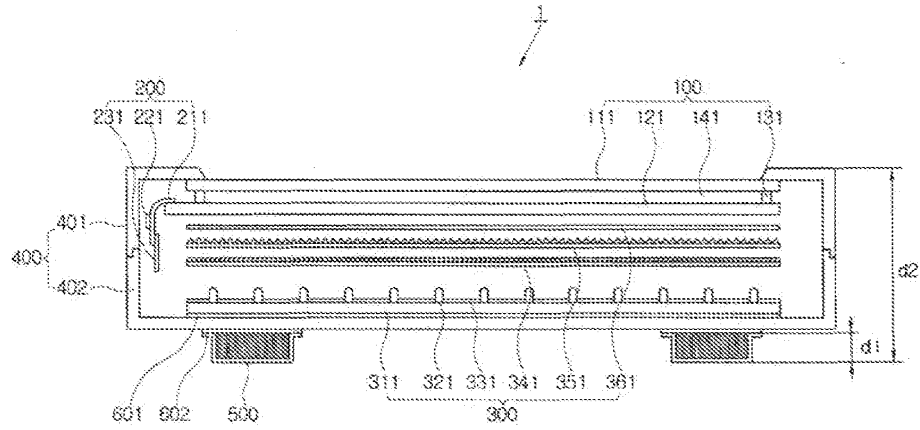
도면



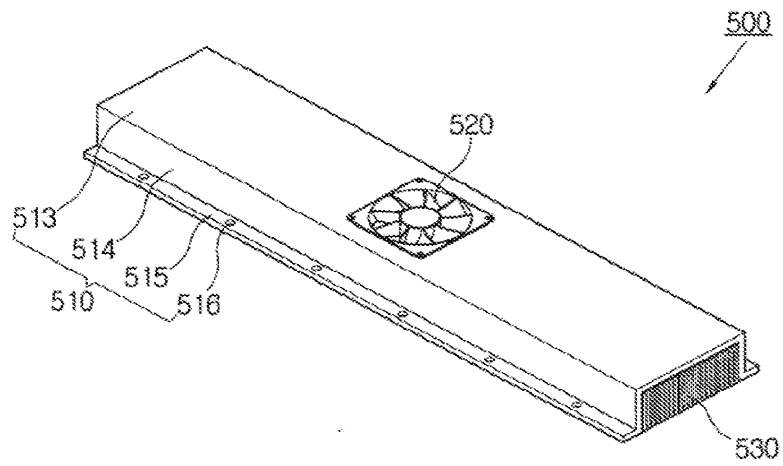
도면1b



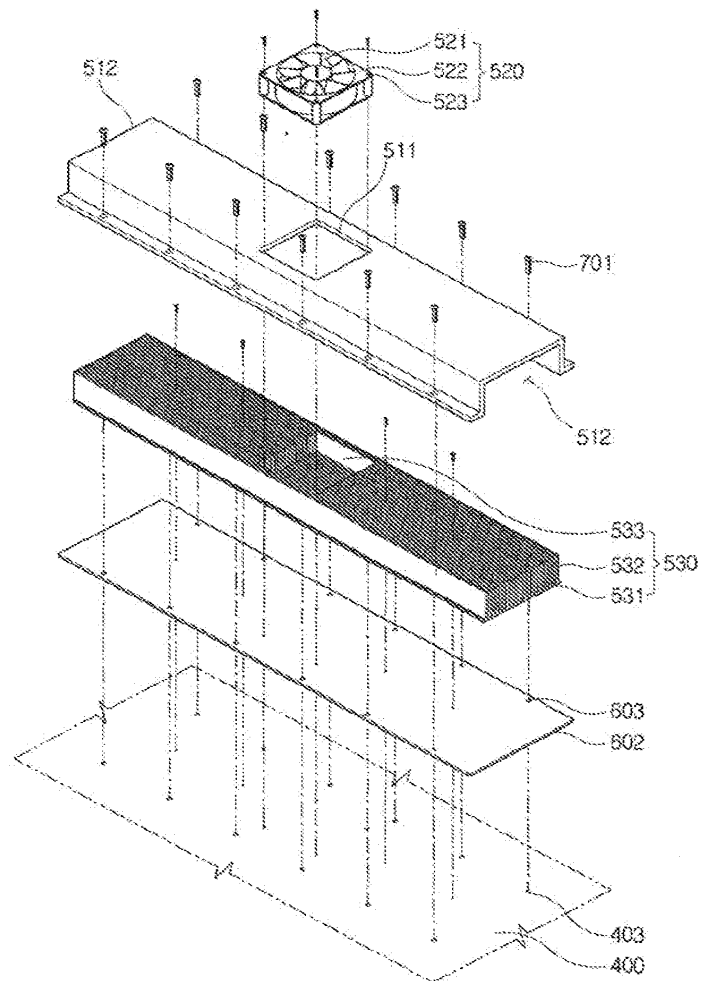
도면2



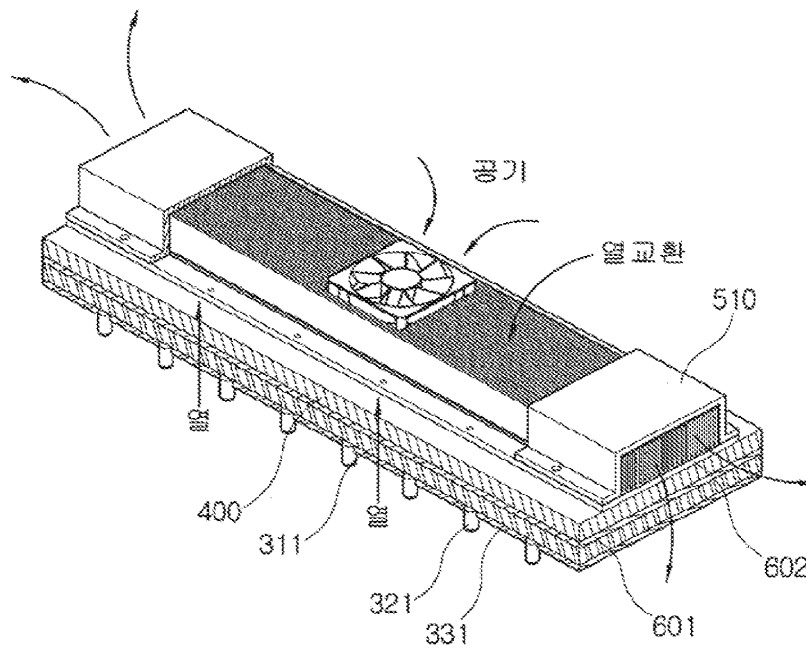
도면3



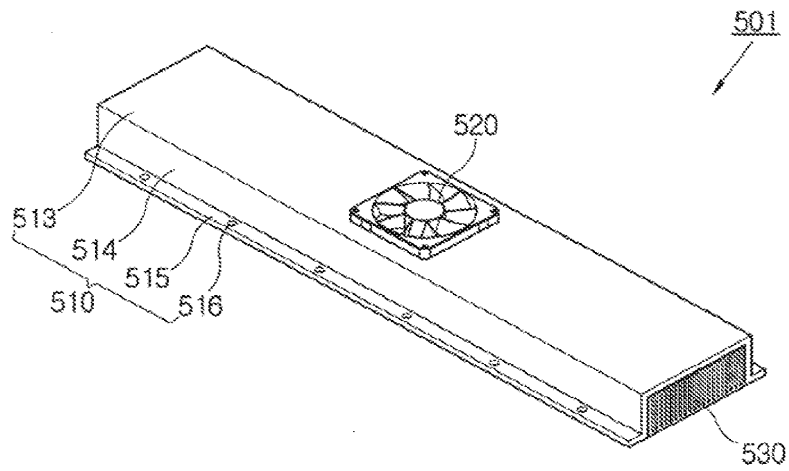
도면4



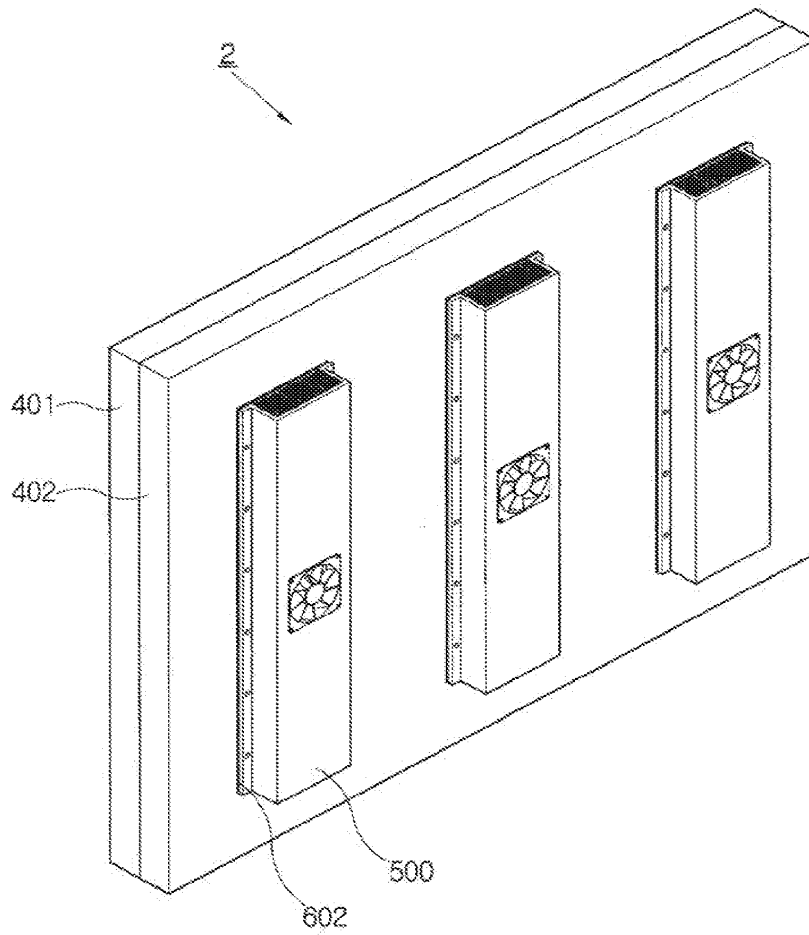
545



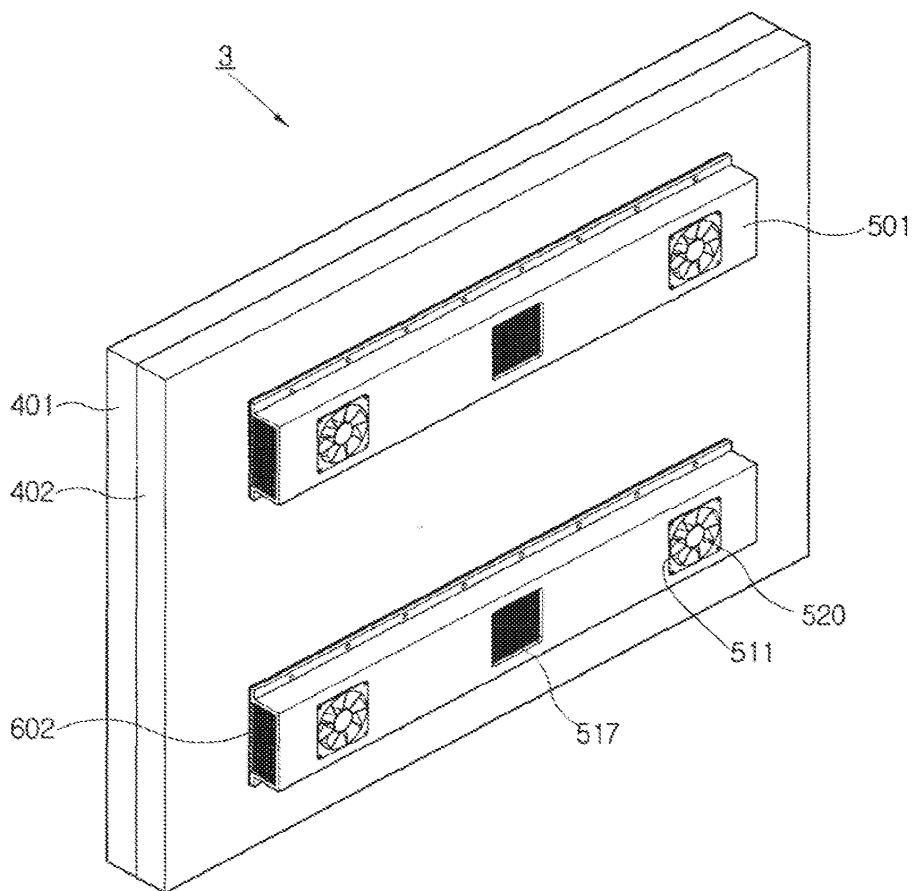
E 96



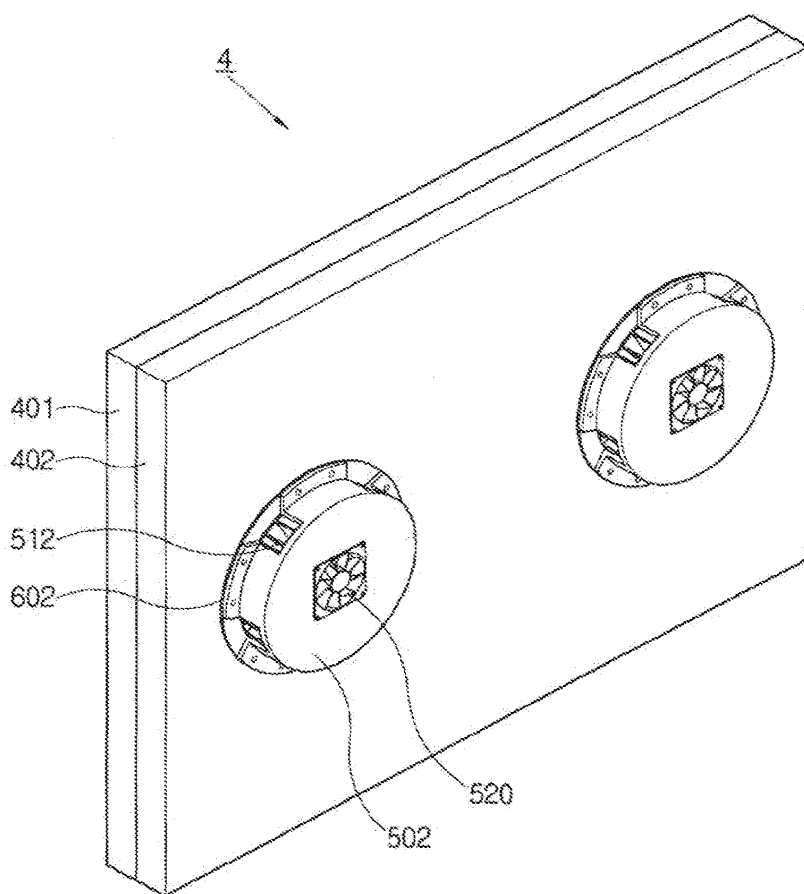
도면7a



도면 7b



도면7c



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(56) Related Art
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ABSTRACT

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

FIGURE EIGHT CLOSED LOOP COOLING SYSTEM FOR ELECTRONIC DISPLAY

Cross-Reference to Related Applications

[0001] The present application is a divisional application of Australian Patent Application No. 2014287438. The contents of Australian Patent Application No. 2014287438 are incorporated herein by reference in their entirety, for all purposes. This application claims priority to US Provisional Application No. 61/843,706 filed on July 8, 2013 which is herein incorporated by reference in its entirety.

Technical Field

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

Background of the Art

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

Summary

[0003a] It is an object of the present invention to substantially overcome or at least ameliorate one or more of the above disadvantages.

[0003b] According to one aspect of the present disclosure, there is provided herein a cooling assembly for an electronic display comprising: a closed loop of gas pathways for circulating gas comprising: a front channel placed in front of the electronic display, a rear channel placed behind the electronic display, a center channel placed between the front and rear channels and comprising a first and second plurality of subchannels, a first plurality of pass-through apertures connecting the first plurality of subchannels to only the front channel, and a second plurality of pass-through apertures connecting the

second plurality of subchannels to only the rear channel; a first open loop pathway for ambient air positioned between the electronic display and the center channel; and a second open loop pathway for ambient air positioned between the center channel and the rear channel.

[0003c] According to another aspect of the present disclosure, there is also provided herein a cooling assembly for an electronic display comprising: a front channel defined by the space between a front surface of the electronic display and a transparent plate; a first open loop pathway defined by the space between a rear surface of the electronic display and a front plate; a rear plate positioned behind the electronic display and having a first side forming part of a rear channel and an opposing side forming part of a second open loop pathway; a center channel placed between the first and second open loop pathways and comprising a first and second plurality of independent subchannels; a plurality of pass-through apertures connecting the first plurality of independent subchannels to only said front channel and connecting the second plurality of independent subchannels to only said rear channel; a closed loop fan positioned to force circulating gas through the front channel, rear channel, and center channel; and an open loop fan positioned to force ambient air through the first and second open loop pathways.

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

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

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

Brief Description of the Drawings

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

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

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

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

[0010] FIGURE 4 is a detailed perspective section view of Detail 4.

[0011] FIGURE 5 is a detailed perspective section view of Detail 5.

[0012] **FIGURE 6** is a bottom rear perspective view showing the overall assembly of the display and indicating the section line 7-7.

[0013] **FIGURE 7** is a perspective section view taken from the section line 7-7.

Detailed Description

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

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

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

shapes of regions illustrated herein but are to include deviations in shapes that result, for example, from manufacturing.

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

[0018] **FIGURE 1** is a simplified illustration of an exemplary embodiment of the figure eight closed loop cooling system 400. This exemplary embodiment contains a plurality of channels in the assembly. The front channel 18 is placed in front of the display 160 and preferably allows closed loop circulating gas 20 to remove heat from the front of the display 160. The front open loop channel 16 is positioned behind the display 160 and preferably allows open loop air 15 to pass behind the display 160, removing heat at least from the rear portion of the display 160 and the center channel 13. The center channel 13 is preferably positioned between the front open loop channel 16 and the rear open loop channel 11 and allows closed loop circulating gas 20 to cross paths with itself (creating the figure eight) and to cross paths with the open loop air 10 and 15 without allowing the closed loop circulating gas and open loop air to mix.

[0019] The rear open loop channel 11 is preferably positioned immediately adjacent to the center channel 13, and allows open loop air 10 to flow through, thereby removing heat from the center channel 13 (and/or the closed loop circulating gas 13 contained within) and the rear channel 30. The rear channel 30 is positioned near the rear of the

display and may contain various electronic components 35 for operating the overall display assembly, fans, or the display 160 itself.

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

[0021] **FIGURE 2** is a side rear perspective view showing the overall assembly of the display with the rear cover removed and indicating the section line 3-3. In this particular embodiment, the display assembly is designed for a portrait orientation with the closed loop fans 100 positioned at the top of the assembly and the open loop fans 200 positioned at the bottom of the assembly. This is of course not required however, as the embodiments herein can be flipped or oriented for a landscape orientation if desired. Further, the open loop fans 200 do not have to be placed at the bottom of the assembly, but could be positioned anywhere so that the open loop air travels in the paths specified

in these exemplary embodiments. It of course goes without saying that additional fans could also be used to increase flow rates and/or pressure.

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

[0023] FIGURE 4 is a detailed perspective section view of Detail 4. Closed loop circulating gas 20 is permitted to pass through the rear open loop channel 11 without mixing with the open loop air 10 by use of pass-through apertures 200, which provide sealed gaseous communication between the rear channel 30 and the center channel 13, without permitting open loop air 10 to enter the channels 30 and 13. In an exemplary embodiment, rear open loop channel 11 may also contain cooling fins 400 for distributing heat from the adjacent channels (30 and 13) and/or electronic components 35 in order to be efficiently removed by the open loop air 10. Similarly, front open loop channel 16 may also contain cooling fins 450 for distributing heat from the adjacent channels (30 and 18) and/or the rear surface of the display 160 in order to be efficiently removed by the open loop air 15. In an exemplary embodiment, the

display 160 contains a direct lit LED backlight where the cooling fins 450 are placed in thermal communication with the LED backlight. The cooling fins 450 and 400 may be comprised of any thermally conductive material, but would preferably be comprised of metal and in an exemplary embodiment would be a thin sheet (or multiple thin sheets) of metal.

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

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

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

30, through another pass-through aperture to travel along the subchannel 300, and finally through another pass-through aperture to return to the front channel 18. In this way, the closed loop of circulating gas 20 performs the 'figure eight' through the assembly, as it weaves its way across the front channel 18, through the center channel 13, across the rear channel 30, again through the center channel 13, and returning to the front channel 18.

[0027] It should be noted that subchannels 300 and 305 may not be required in some embodiments as the center channel 13 could be completely open. It should also be noted that other embodiments may use the subchannels 300 and 305 but would not allow a single subchannel to communicate gaseously with both the front channel 18 and the rear channel 30. In other words, when viewing the end of the assembly as shown in Figure 7, the opposing end of the assembly would be substantially similar. Thus, subchannels 300 would only communicate with pass-through apertures 200 and the rear channel 30, while the subchannels 305 would only communicate with pass-through apertures 205 and front channel 18. Thus, in this embodiment there would be two separate closed loops.

[0028] Although there is preferably gaseous communication throughout the figure eight, subchannel 300 directs the flow of closed loop circulating gas 20 through rear channel 30 and center channel 13 while subchannel 305 directs the flow of closed loop circulating gas 20 through the center channel 13 and front channel 18. In this preferred embodiment, the subchannels 300 and 305 allow separate flow paths for closed loop circulating gas 20 within the center channel 13, without requiring additional fans. These separate flow paths which cross through the center and loop around the display in a single continuous flow, define the figure eight path for the closed loop circulating gas 20 (seen also in Figure 1). Further, in this preferred embodiment, the flow direction of

closed loop circulating gas 20 through the center channel 13 is opposite the flow direction of open loop air 15 and 10, creating a counter-flow heat exchanger between the center channel 13 and the front/rear open loop channels 11 and 16. However, this is not required, as a parallel flow or a cross flow design would work as well.

[0029] In an exemplary embodiment, the rear channel 30 would share a plate with the rear open loop channel 11, such that one side of the plate would be within the rear channel 30 while the opposing side of the plate would be within the rear open loop channel 11. This arrangement is illustrated in Figure 3 with the rear plate 31. Similarly, it may be preferable for the center channel 13 and the rear open loop 11 to share a plate, such that one side of the plate is within the center channel 13 while the other side of the plate is within the rear open loop 11. Similarly, it may be preferable for the center channel 13 and the front open loop 16 to share a plate. Finally, it may also be preferable for the rear surface of the display 160 to form the front wall of the front open loop 16, such that open loop ambient air 15 can remove heat from the electronic display 160. In some embodiments the rear surface of the display 160 would be the rear surface of a metallic PCB holding a plurality of LEDs for the backlight.

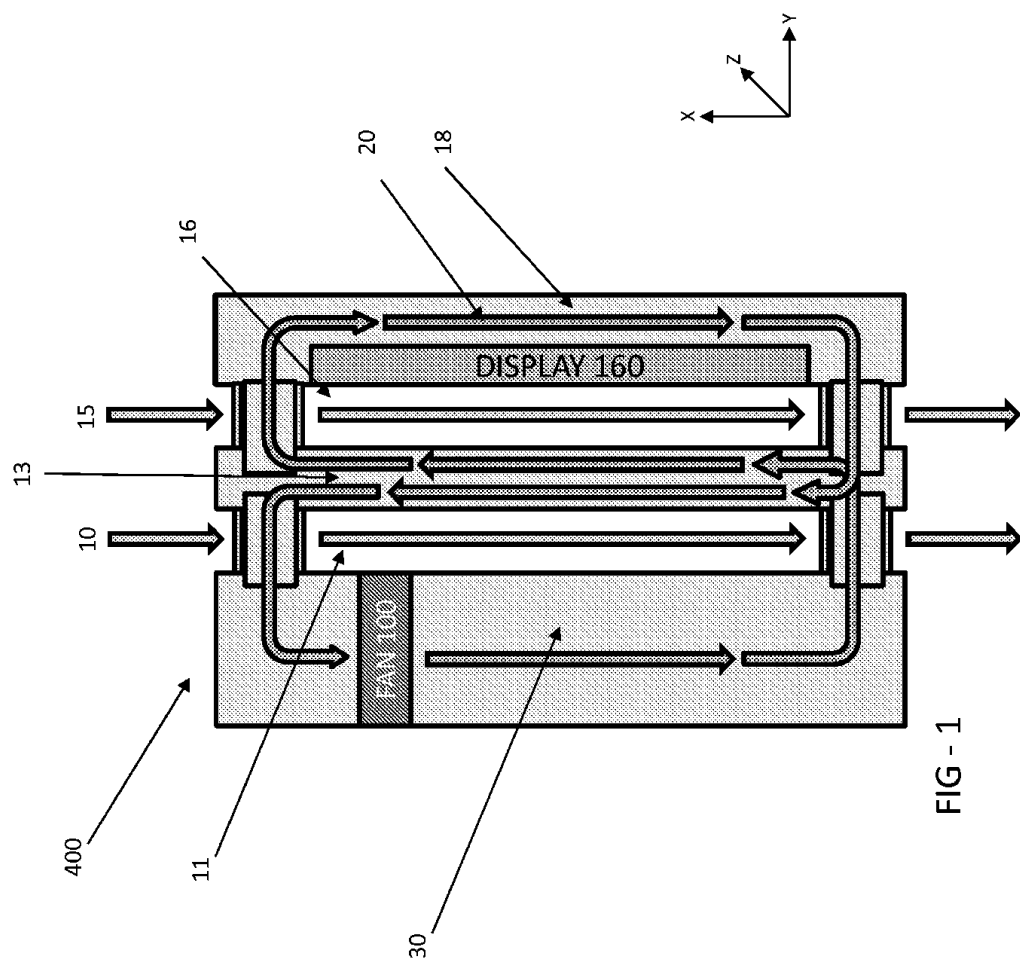
[0030] Having shown and described a preferred embodiment of the invention, those skilled in the art will realize that many variations and modifications may be made to affect the described invention and still be within the scope of the claimed invention. Additionally, many of the elements indicated above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

CLAIMS

1. A cooling assembly for an electronic display comprising:
a closed loop of gas pathways for circulating gas comprising:
a front channel placed in front of the electronic display,
a rear channel placed behind the electronic display,
a center channel placed between the front and rear channels and
comprising a first and second plurality of subchannels,
a first plurality of pass-through apertures connecting the first plurality of
subchannels to only the front channel, and
a second plurality of pass-through apertures connecting the second plurality
of subchannels to only the rear channel;
a first open loop pathway for ambient air positioned between the electronic
display and the center channel; and
a second open loop pathway for ambient air positioned between the center
channel and the rear channel.
2. The cooling assembly of claim 1 further comprising:
a closed loop fan positioned to force circulating gas through the closed loop of
gas pathways; and
an open loop fan positioned to force ambient air through the first and second
open loop pathways.
3. The cooling assembly of claim 1 further comprising:
a rear plate having a posterior and anterior side and placed within the rear
channel;
a plurality of electronic components attached to the posterior side of the rear
plate; and
wherein the anterior side of the rear plate forms a portion of the second open
loop pathway.
4. The cooling assembly of claim 1 wherein:
the first and second plurality of pass-through apertures contain a hole in the
center and are arranged such that the circulating gas travels through the
hole in the center while the ambient air travels around the pass-through
aperture.

5. The cooling assembly of claim 1 wherein:
the second open loop pathway and the rear channel share a plate such that a side of the plate is within the rear channel while an opposing side of the plate is within the second open loop pathway.
6. The cooling assembly of claim 1 wherein:
the center channel is placed between the first and second open loop pathways.
7. A cooling assembly for an electronic display comprising:
a front channel defined by the space between a front surface of the electronic display and a transparent plate;
a first open loop pathway defined by the space between a rear surface of the electronic display and a front plate;
a rear plate positioned behind the electronic display and having a first side forming part of a rear channel and an opposing side forming part of a second open loop pathway;
a center channel placed between the first and second open loop pathways and comprising a first and second plurality of independent subchannels;
a plurality of pass-through apertures connecting the first plurality of independent subchannels to only said front channel and connecting the second plurality of independent subchannels to only said rear channel;
a closed loop fan positioned to force circulating gas through the front channel, rear channel, and center channel; and
an open loop fan positioned to force ambient air through the first and second open loop pathways.
8. The cooling assembly of claim 7 further comprising:
a plurality of electronic components attached to the side of the rear plate forming part of the rear channel.
9. The cooling assembly of claim 7 further comprising:
a plurality of cooling fins placed within the first and second open loop pathways.

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Patent Attorneys for the Applicant/Nominated Person
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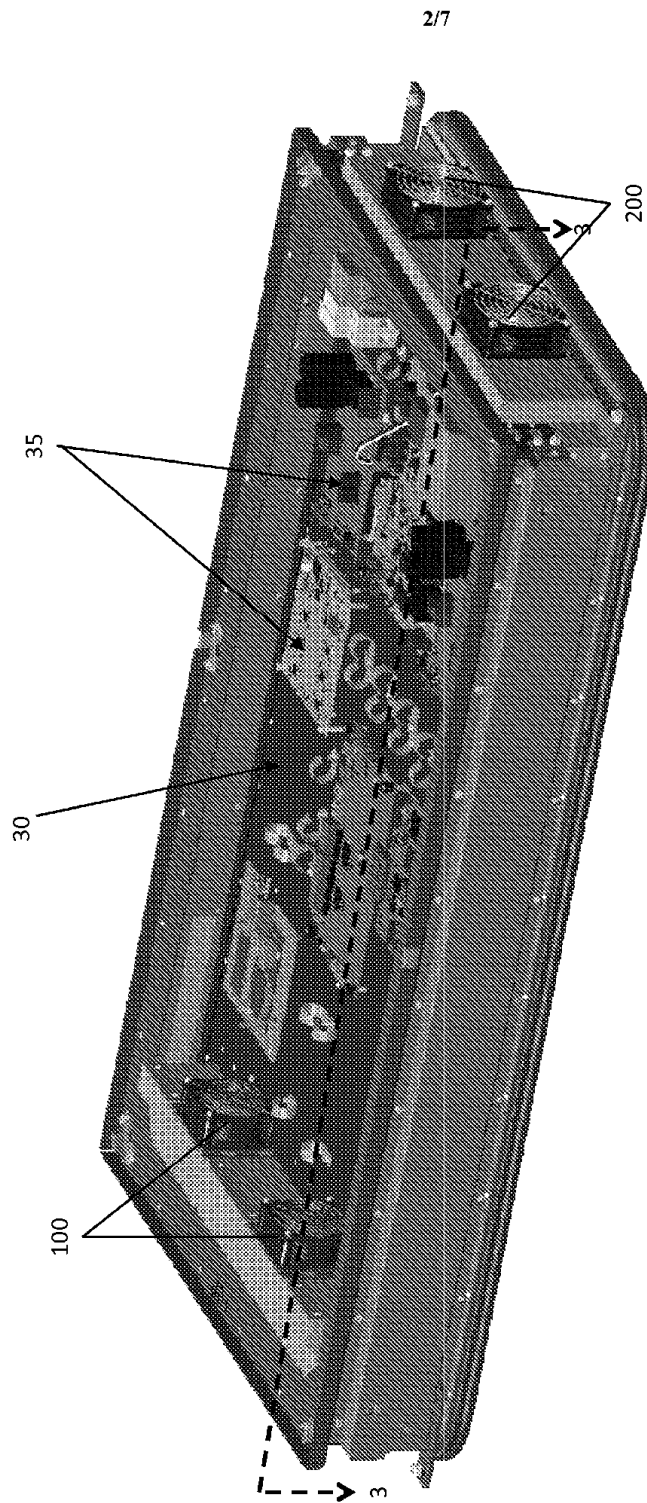


FIG - 2

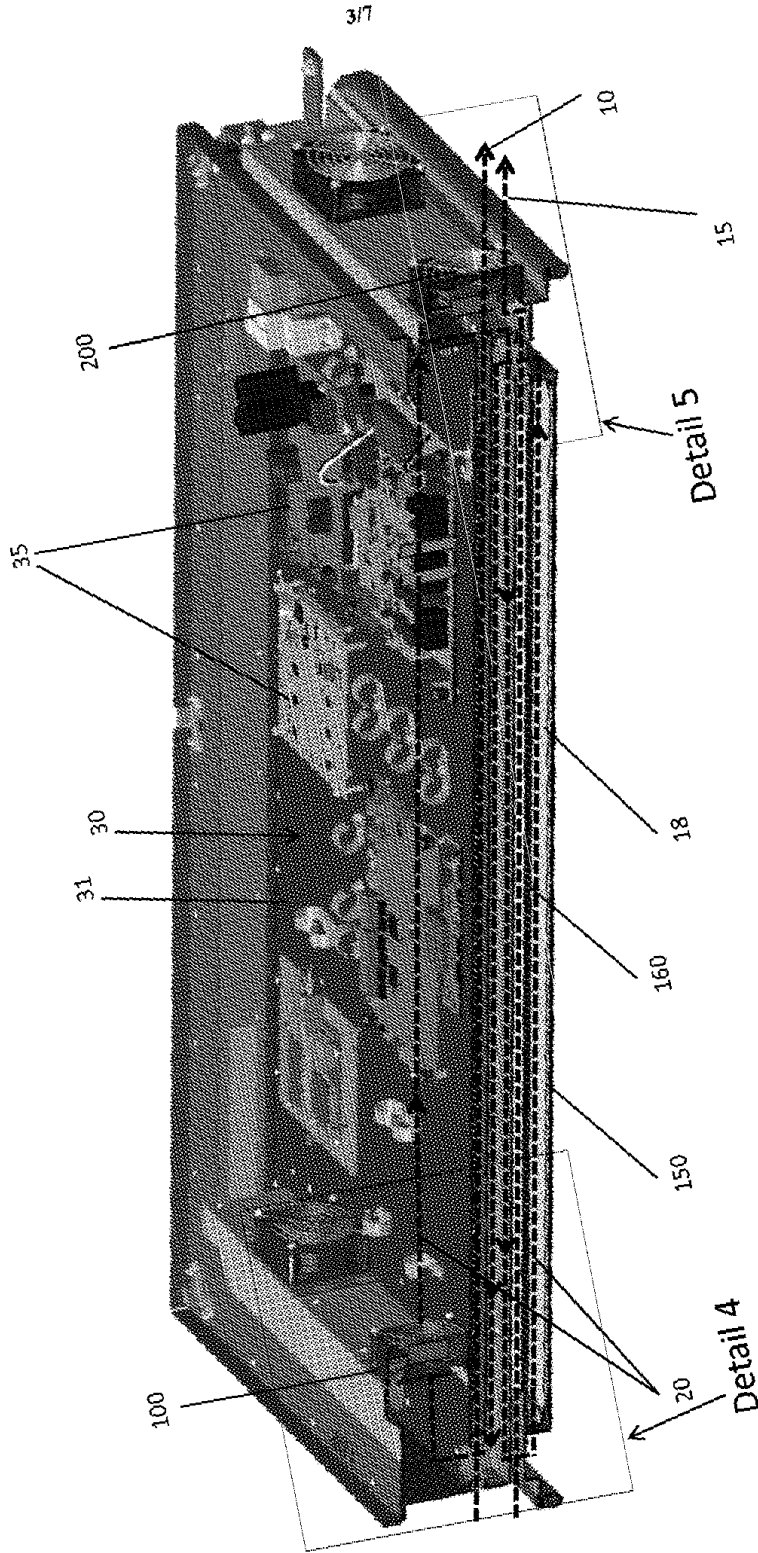


FIG - 3

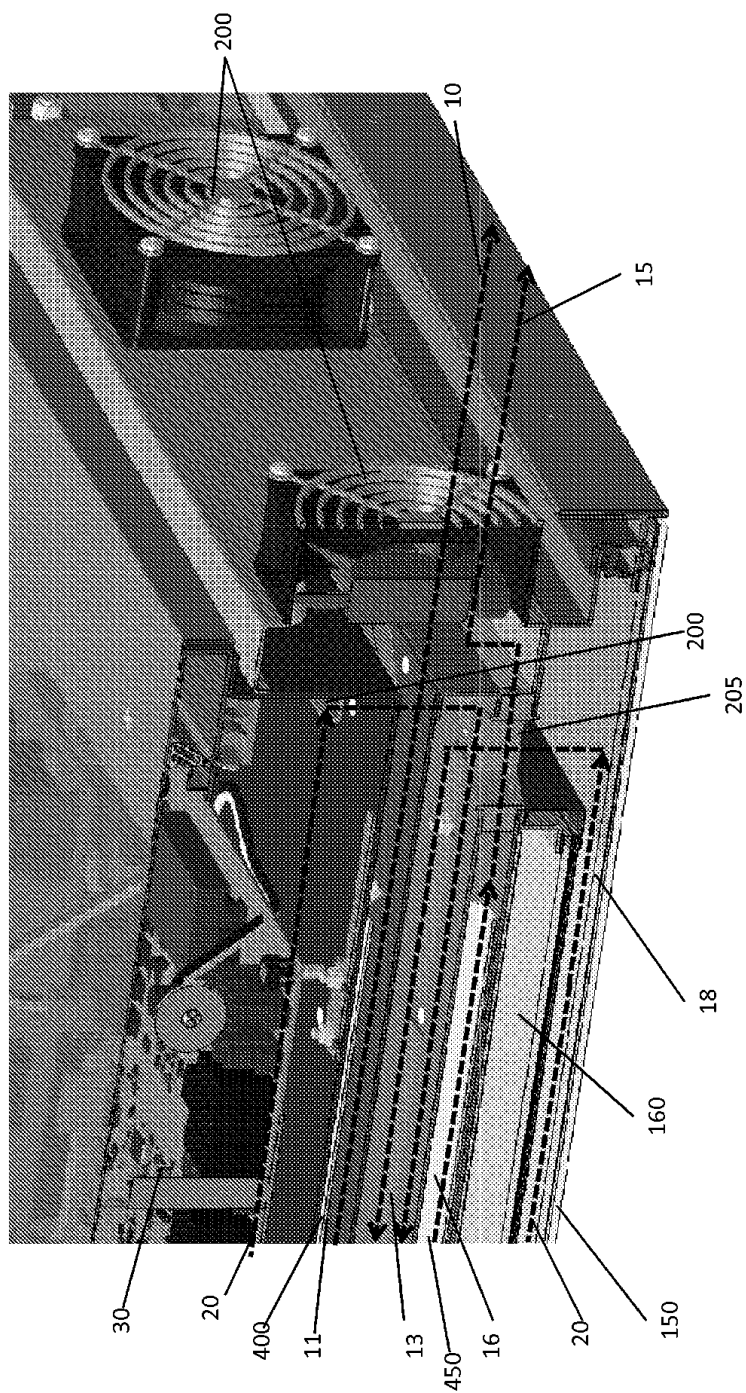


FIG - 5

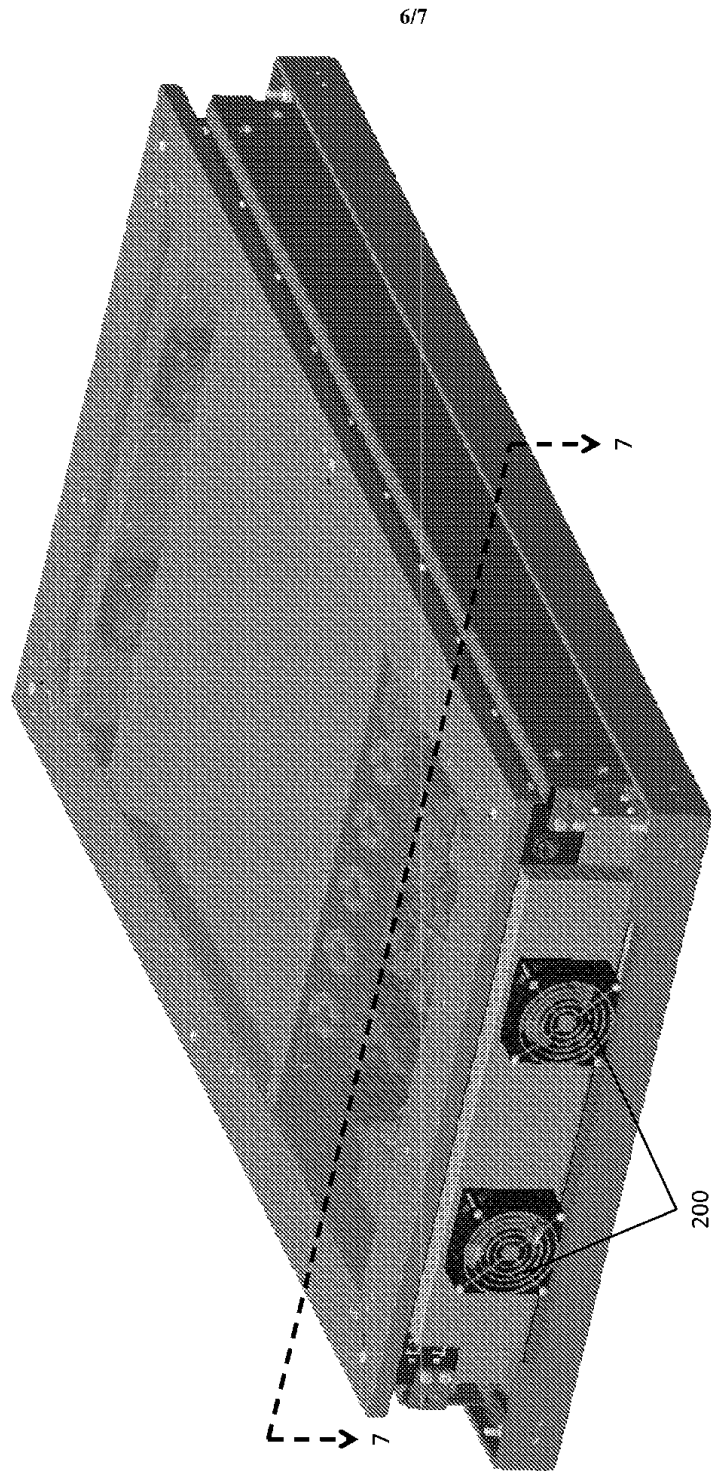


FIG - 6

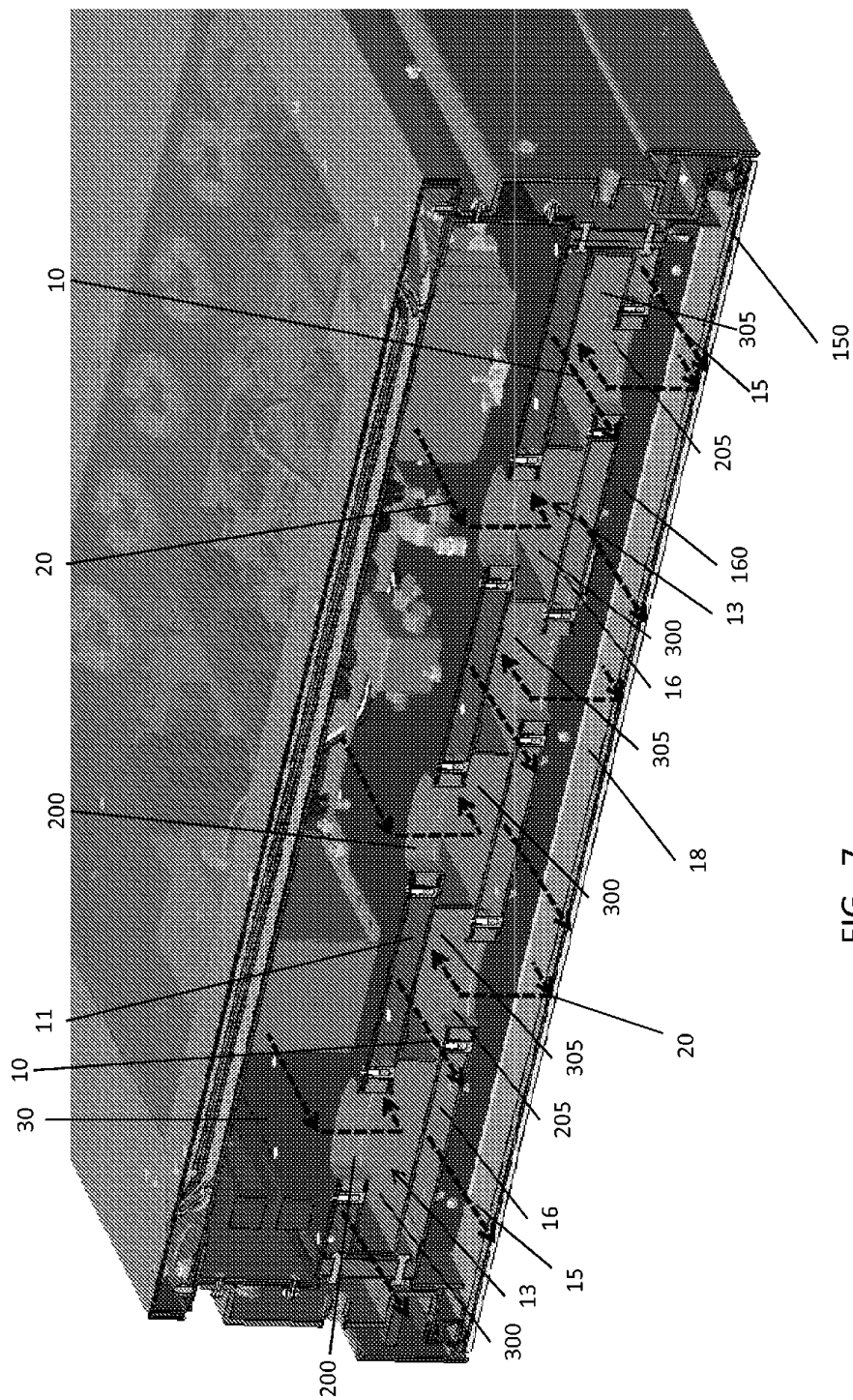


FIG - 7

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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
Receipt Date:	26-AUG-2020
Filing Date:	20-JUL-2020
Time Stamp:	10:12:41
Application Type:	Utility under 35 USC 111(a)

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File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
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39	Foreign Reference	WO2013182733.pdf	209968	no	22
			e11fd758d06cf4a61b92b86693f8ad8eab113113		
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40	Foreign Reference	KR101894027.pdf	1125055	no	20
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41	Foreign Reference	CA2915261.pdf	1666950	no	48
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42	Foreign Reference	AU2017216500_B2.pdf	3951679	no	22
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43	Foreign Reference	KR101904363B1.pdf	1261535	no	26
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Information:					

44	Foreign Reference	WO2018200260A1.pdf	2220422	no	51
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45	Foreign Reference	WO2018200905A1.pdf	398148	no	37
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48	Foreign Reference	JP2004286940A.pdf	631410	no	11
			553fca440426633de907341de0f423bc490836eb		
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49	Foreign Reference	EP3423886A1.pdf	2348615	no	27
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50	Foreign Reference	KR2020000000118U.pdf	1527869	no	18
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51	Foreign Reference	KR1020000047899A.pdf	587377	no	35
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53	Foreign Reference	AU2016220308.pdf	4879802	no	56
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56	Foreign Reference	EP3468321A1.pdf	140440	no	13
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58	Foreign Reference	JP2019512721_A.pdf	1456939	no	15
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59	Foreign Reference	KR20060070176A.pdf	835882	no	20
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Information:					
Total Files Size (in bytes):			99100993		
This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503. <u>New Applications Under 35 U.S.C. 111</u> If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application. <u>National Stage of an International Application under 35 U.S.C. 371</u> If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course. <u>New International Application Filed with the USPTO as a Receiving Office</u> If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.					

PATENT APPLICATION FEE DETERMINATION RECORD Substitute for Form PTO-875						Application or Docket Number 16/933,932					
APPLICATION AS FILED - PART I											
(Column 1)		(Column 2)		SMALL ENTITY		OR	OTHER THAN SMALL ENTITY				
FOR	NUMBER FILED	NUMBER EXTRA		RATE(\$)	FEE(\$)		RATE(\$)	FEE(\$)			
BASIC FEE (37 CFR 1.16(a), (b), or (c))	N/A	N/A		N/A			N/A	300			
SEARCH FEE (37 CFR 1.16(k), (l), or (m))	N/A	N/A		N/A			N/A	660			
EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))	N/A	N/A		N/A			N/A	760			
TOTAL CLAIMS (37 CFR 1.16(i))	20	minus 20 =	*			OR	x 100 =	0.00			
INDEPENDENT CLAIMS (37 CFR 1.16(h))	3	minus 3 =	*				x 460 =	0.00			
APPLICATION SIZE FEE (37 CFR 1.16(s))	If the specification and drawings exceed 100 sheets of paper, the application size fee due is \$310 (\$155 for small entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s).							0.00			
MULTIPLE DEPENDENT CLAIM PRESENT (37 CFR 1.16(j))								0.00			
* If the difference in column 1 is less than zero, enter "0" in column 2.				TOTAL			TOTAL	1720			
APPLICATION AS AMENDED - PART II											
(Column 1)		(Column 2)		(Column 3)		SMALL ENTITY		OR	OTHER THAN SMALL ENTITY		
AMENDMENT A	CLAIMS REMAINING AFTER AMENDMENT	HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA	RATE(\$)	ADDITIONAL FEE(\$)		RATE(\$)	ADDITIONAL FEE(\$)			
	Total (37 CFR 1.16(i))	*	Minus	**	=	x	=	OR	x	=	
	Independent (37 CFR 1.16(h))	*	Minus	***	=	x	=	OR	x	=	
	Application Size Fee (37 CFR 1.16(s))								OR		
	FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))								OR		
				TOTAL ADD'L FEE		OR	TOTAL ADD'L FEE				
(Column 1)		(Column 2)		(Column 3)		SMALL ENTITY		OR	OTHER THAN SMALL ENTITY		
AMENDMENT B	CLAIMS REMAINING AFTER AMENDMENT	HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA	RATE(\$)	ADDITIONAL FEE(\$)		RATE(\$)	ADDITIONAL FEE(\$)			
	Total (37 CFR 1.16(i))	*	Minus	**	=	x	=	OR	x	=	
	Independent (37 CFR 1.16(h))	*	Minus	***	=	x	=	OR	x	=	
	Application Size Fee (37 CFR 1.16(s))								OR		
	FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))								OR		
				TOTAL ADD'L FEE		OR	TOTAL ADD'L FEE				
* If the entry in column 1 is less than the entry in column 2, write "0" in column 3.											
** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20".											
*** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 3, enter "3".											
The "Highest Number Previously Paid For" (Total or Independent) is the highest found in the appropriate box in column 1.											



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APPLICATION NUMBER	FILING or 371(c) DATE	GRP ART UNIT	FIL FEE REC'D	ATTY. DOCKET NO	TOT CLAIMS	IND CLAIMS
16/933,932	07/20/2020	2844	1720	MAN2241-045R	20	3

CONFIRMATION NO. 5816

FILING RECEIPT



0000000118854844

8698
STANDLEY LAW GROUP LLP
6300 Riverside Drive
Dublin, OH 43017

Date Mailed: 07/31/2020

Receipt is acknowledged of this non-provisional utility patent application. The application will be taken up for examination in due course. Applicant will be notified as to the results of the examination. Any correspondence concerning the application must include the following identification information: the U.S. APPLICATION NUMBER, FILING DATE, NAME OF FIRST INVENTOR, and TITLE OF INVENTION. Fees transmitted by check or draft are subject to collection.

Please verify the accuracy of the data presented on this receipt. If an error is noted on this Filing Receipt, please submit a written request for a corrected Filing Receipt, including a properly marked-up ADS showing the changes with strike-through for deletions and underlining for additions. If you received a "Notice to File Missing Parts" or other Notice requiring a response for this application, please submit any request for correction to this Filing Receipt with your reply to the Notice. When the USPTO processes the reply to the Notice, the USPTO will generate another Filing Receipt incorporating the requested corrections provided that the request is grantable.

Inventor(s)

William Dunn, Alpharetta, GA;
Tim Hubbard, Alpharetta, GA;

Applicant(s)

Manufacturing Resources International, Inc., Alpharetta, GA;

Power of Attorney: The patent practitioners associated with Customer Number 08698

Domestic Priority data as claimed by applicant

This application is a CON of 16/708,260 12/09/2019 PAT 10721836
which is a CON of 15/789,331 10/20/2017 PAT 10506740
which is a CON of 14/834,034 08/24/2015 PAT 9801305
which is a CON of 14/050,464 10/10/2013 PAT 9119325
which is a CON of 12/641,468 12/18/2009 PAT 8654302
which claims benefit of 61/138,736 12/18/2008
and is a CIP of 12/411,925 03/26/2009 PAT 8854595
which claims benefit of 61/039,454 03/26/2008
and said 12/641,468 12/18/2009
is a CIP of 12/556,029 09/09/2009 PAT 8373841
which claims benefit of 61/095,615 09/09/2008
and said 12/641,468 12/18/2009
is a CIP of 12/234,307 09/19/2008 PAT 8767165
which claims benefit of 61/033,064 03/03/2008
and said 12/641,468 12/18/2009

is a CIP of 12/234,360 09/19/2008 ABN
which claims benefit of 61/053,713 05/16/2008
and said 12/641,468 12/18/2009
is a CIP of 12/237,365 09/24/2008 PAT 8879042
which claims benefit of 61/057,599 05/30/2008
and said 12/641,468 12/18/2009
is a CIP of 12/235,200 09/22/2008 ABN
which claims benefit of 61/076,126 06/26/2008
and said 12/641,468 12/18/2009
is a CIP of 12/620,330 11/17/2009 PAT 8274622
which claims benefit of 61/115,333 11/17/2008
and said 12/641,468 12/18/2009
is a CIP of 12/556,209 09/09/2009 PAT 8379182
which claims benefit of 61/095,616 09/09/2008

Foreign Applications for which priority is claimed (You may be eligible to benefit from the **Patent Prosecution Highway** program at the USPTO. Please see <http://www.uspto.gov> for more information.) - None.
Foreign application information must be provided in an Application Data Sheet in order to constitute a claim to foreign priority. See 37 CFR 1.55 and 1.76.

Permission to Access Application via Priority Document Exchange: Yes

Permission to Access Search Results: Yes

Applicant may provide or rescind an authorization for access using Form PTO/SB/39 or Form PTO/SB/69 as appropriate.

If Required, Foreign Filing License Granted: 07/30/2020

The country code and number of your priority application, to be used for filing abroad under the Paris Convention, is **US 16/933,932**

Projected Publication Date: 11/05/2020

Non-Publication Request: No

Early Publication Request: No

Title

ELECTRONIC DISPLAY WITH COOLING

Preliminary Class

315

Statement under 37 CFR 1.55 or 1.78 for AIA (First Inventor to File) Transition Applications: No

PROTECTING YOUR INVENTION OUTSIDE THE UNITED STATES

Since the rights granted by a U.S. patent extend only throughout the territory of the United States and have no effect in a foreign country, an inventor who wishes patent protection in another country must apply for a patent in a specific country or in regional patent offices. Applicants may wish to consider the filing of an international application under the Patent Cooperation Treaty (PCT). An international (PCT) application generally has the same effect as a regular national patent application in each PCT-member country. The PCT process **simplifies** the filing of patent applications on the same invention in member countries, but **does not result** in a grant of "an international

page 2 of 4

patent" and does not eliminate the need of applicants to file additional documents and fees in countries where patent protection is desired.

Almost every country has its own patent law, and a person desiring a patent in a particular country must make an application for patent in that country in accordance with its particular laws. Since the laws of many countries differ in various respects from the patent law of the United States, applicants are advised to seek guidance from specific foreign countries to ensure that patent rights are not lost prematurely.

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Title 37, Code of Federal Regulations, 5.11 & 5.15

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Doc Code: PA..

Document Description: Power of Attorney

PTO/AIA/82A (07-13)

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Application Number	
Filing Date	July 20, 2020
First Named Inventor	Dunn et al.
Title	ELECTRONIC DISPLAY WITH COOLING
Art Unit	n/a
Examiner Name	n/a
Attorney Docket Number	MAN2241-045R

SIGNATURE of Applicant or Patent Practitioner

Signature	/Adam J. Smith/	Date (Optional)	July 20, 2020
Name	Adam J. Smith	Registration Number	72,962
Title (if Applicant is a juristic entity)	Attorney of Record		
Applicant Name (if Applicant is a juristic entity)	Manufacturing Resources International, Inc.		
NOTE: This form must be signed in accordance with 37 CFR 1.33. See 37 CFR 1.4(d) for signature requirements and certifications. If more than one applicant, use multiple forms.			
☒ *Total of _____ forms are submitted.			

This collection of information is required by 37 CFR 1.131, 1.32, and 1.33. 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 1.11 and 1.14. This collection is estimated to take 3 minutes 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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SEC et al. v. MRI
SEC Exhibit 1022.5956
IPR2023-00221

GENERAL POWER OF ATTORNEY BY APPLICANT FOR UNITED STATES PATENT

I hereby revoke all previous powers of attorney given in the application identified in the attached transmittal letter (form PTO/AIA/82A or equivalent).

I hereby appoint the practitioners associated with the following Customer Number for Standley Law Group LLP:

08698

as my/our attorneys or agents, and to transact all business in the United States Patent and Trademark Office connected therewith for the application referenced in the attached transmittal letter (for PTO/AIA/82A or equivalent).

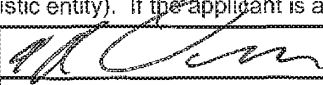
Please recognize or change the correspondence address for the application identified in the attached transmittal letter to the address associated with the above-mentioned Customer Number.

I am the Applicant:

- ☐ Inventor or Joint Inventor (title not required)
- ☐ Legal Representative of a Deceased or Legally Incapacitated Inventor (title not required)
- ☒ Assignee or Person to Whom the Inventor is Under an Obligation to Assign
(provide signer's title if applicant is a juristic entity)
- ☐ Person Who Otherwise Shows Sufficient Proprietary Interest (e.g., a petition under 37 CFR 1.46(b)(2) was granted in the application or is concurrently being filed with this document) (provide signer's title if applicant is a juristic entity)

SIGNATURE of Applicant for Patent

The undersigned (whose title is supplied below) is authorized to act on behalf of the applicant (e.g., where the applicant is a juristic entity). If the applicant is a juristic entity, provide the name of the juristic entity below.

Signature		Date	3/5/2019
Name	William Dunn		
Title	President & CEO		
Juristic Entity	Manufacturing Resources International, Inc.		

Note: Signature - this form must be signed by the applicant in accordance with 37 CFR 1.33. See 37 CFR 1.4 for signature requirements and certifications. Submit multiple forms for more than one signature, see below*.

*Total of ___ form(s) is/are submitted.

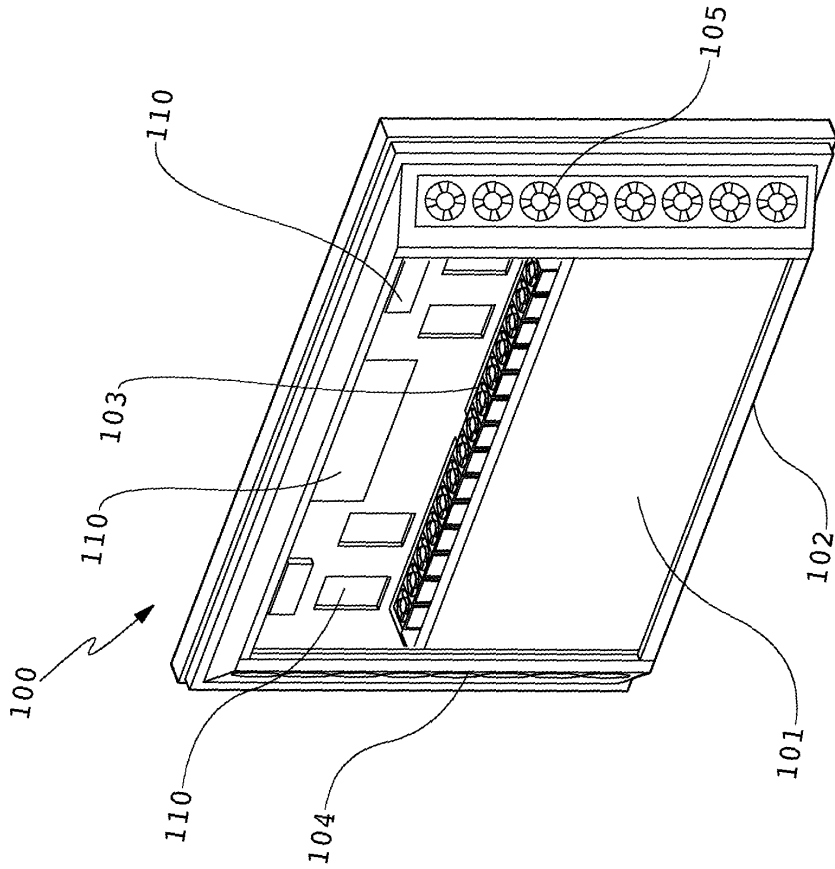


FIG-1

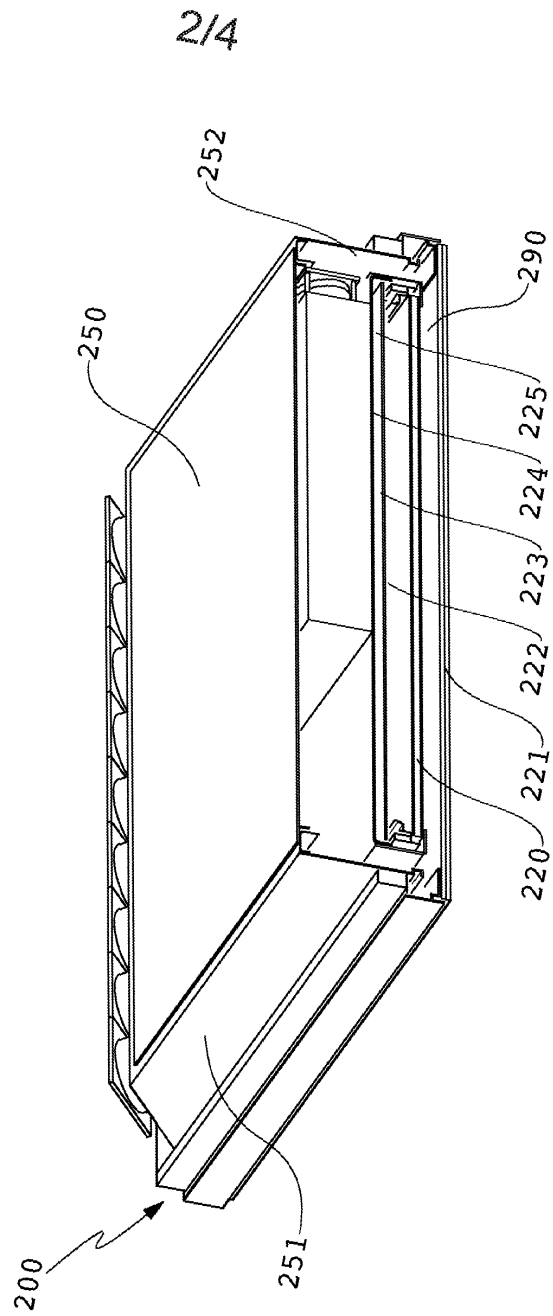
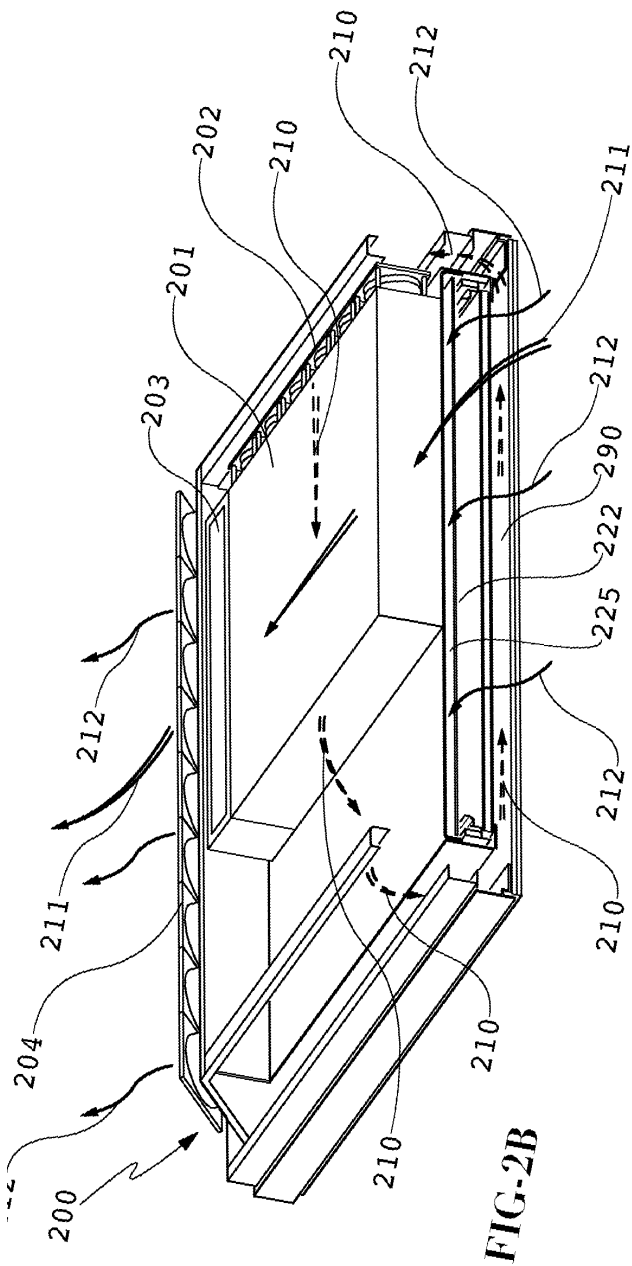
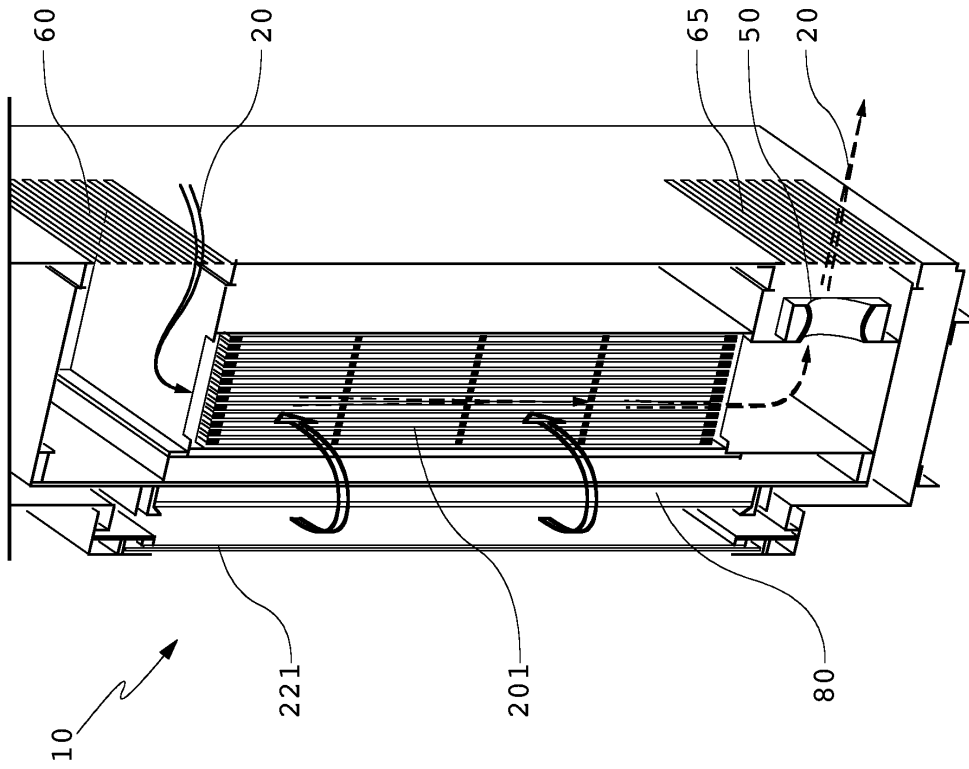


FIG-3



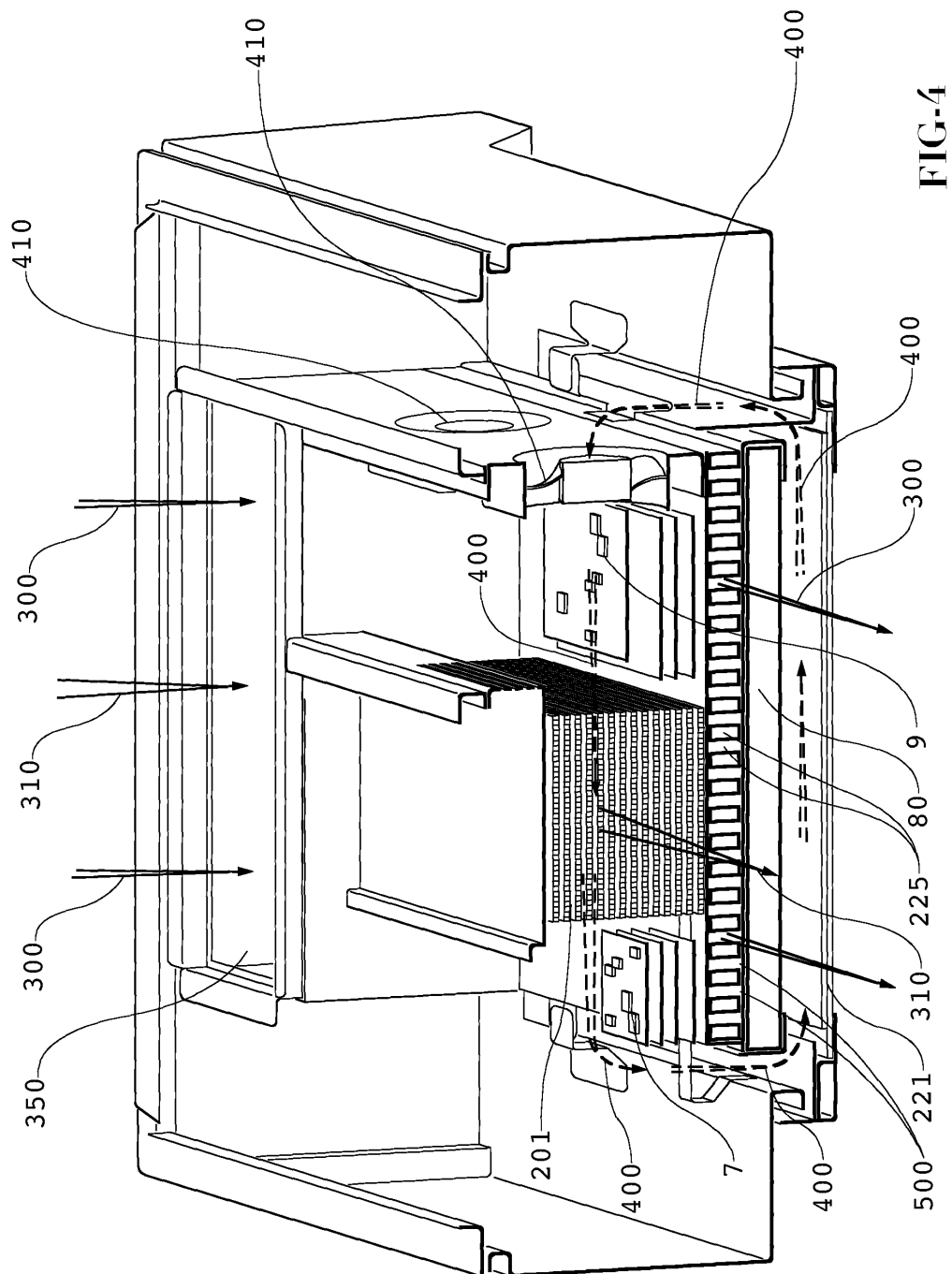


FIG-4

Application Data Sheet 37 CFR 1.76		Attorney Docket Number	MAN2241-045R
		Application Number	
Title of Invention	ELECTRONIC DISPLAY WITH COOLING		
The application data sheet is part of the provisional or nonprovisional application for which it is being submitted. The following form contains the bibliographic data arranged in a format specified by the United States Patent and Trademark Office as outlined in 37 CFR 1.76. This document may be completed electronically and submitted to the Office in electronic format using the Electronic Filing System (EFS) or the document may be printed and included in a paper filed application.			

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☐	Portions or all of the application associated with this Application Data Sheet may fall under a Secrecy Order pursuant to 37 CFR 5.2 (Paper filers only. Applications that fall under Secrecy Order may not be filed electronically.)
--------------------------	---

Inventor Information:

Inventor 1					
Legal Name					
Prefix	Given Name	Middle Name	Family Name	Suffix	
	William		Dunn		
Residence Information (Select One)		☒ US Residency ☐ Non US Residency ☐ Active US Military Service			
City	Alpharetta	State/Province	GA	Country of Residence ⁱ	US
Mailing Address of Inventor:					
Address 1	c/o Manufacturing Resources International, Inc.				
Address 2	6415 Shiloh Road East				
City	Alpharetta	State/Province	GA		
Postal Code	30005	Country ⁱ	US		
Inventor 2					
Legal Name					
Prefix	Given Name	Middle Name	Family Name	Suffix	
	Tim		Hubbard		
Residence Information (Select One)		☒ US Residency ☐ Non US Residency ☐ Active US Military Service			
City	Alpharetta	State/Province	GA	Country of Residence ⁱ	US
Mailing Address of Inventor:					
Address 1	c/o Manufacturing Resources International, Inc.				
Address 2	6415 Shiloh Road East				
City	Alpharetta	State/Province	GA		
Postal Code	30005	Country ⁱ	US		
All Inventors Must Be Listed - Additional Inventor Information blocks may be generated within this form by selecting the Add button. Add 					

Correspondence Information:

Application Data Sheet 37 CFR 1.76		Attorney Docket Number	MAN2241-045R
		Application Number	
Title of Invention	ELECTRONIC DISPLAY WITH COOLING		

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For further information see 37 CFR 1.33(a).

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Application Information:

Title of the Invention	ELECTRONIC DISPLAY WITH COOLING		
Attorney Docket Number	MAN2241-045R	Small Entity Status Claimed	☐
Application Type	Nonprovisional		
Subject Matter	Utility		
Total Number of Drawing Sheets (if any)	4	Suggested Figure for Publication (if any)	1

Filing By Reference:

Only complete this section when filing an application by reference under 35 U.S.C. 111(c) and 37 CFR 1.57(a). Do not complete this section if application papers including a specification and any drawings are being filed. Any domestic benefit or foreign priority information must be provided in the appropriate section(s) below (i.e., "Domestic Benefit/National Stage Information" and "Foreign Priority Information").

For the purposes of a filing date under 37 CFR 1.53(b), the description and any drawings of the present application are replaced by this reference to the previously filed application, subject to conditions and requirements of 37 CFR 1.57(a).

Application number of the previously filed application	Filing date (YYYY-MM-DD)	Intellectual Property Authority or Country

Publication Information:

☐ Request Early Publication (Fee required at time of Request 37 CFR 1.219)
☐ Request Not to Publish. I hereby request that the attached application not be published under 35 U.S.C. 122(b) and certify that the invention disclosed in the attached application has not and will not be the subject of an application filed in another country, or under a multilateral international agreement, that requires publication at eighteen months after filing.

Representative Information:

Representative information should be provided for all practitioners having a power of attorney in the application. Providing this information in the Application Data Sheet does not constitute a power of attorney in the application (see 37 CFR 1.32). Either enter Customer Number or complete the Representative Name section below. If both sections are completed the customer Number will be used for the Representative Information during processing.			
Please Select One:	☒ Customer Number	☐ US Patent Practitioner	☐ Limited Recognition (37 CFR 11.9)
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Application Data Sheet 37 CFR 1.76		Attorney Docket Number		MAN2241-045R	
		Application Number			
Title of Invention	ELECTRONIC DISPLAY WITH COOLING				

Prefix	Given Name	Middle Name	Family Name	Suffix	Remove
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Registration Number					

Additional Representative Information blocks may be generated within this form by selecting the **Add** button.

Domestic Benefit/National Stage Information:

This section allows for the applicant to either claim benefit under 35 U.S.C. 119(e), 120, 121, 365(c), or 386(c) or indicate National Stage entry from a PCT application. Providing benefit claim information in the Application Data Sheet constitutes the specific reference required by 35 U.S.C. 119(e) or 120, and 37 CFR 1.78.

When referring to the current application, please leave the "Application Number" field blank.

Prior Application Status		Pending		Remove	
Application Number	Continuity Type	Prior Application Number	Filing or 371(c) Date (YYYY-MM-DD)		
	Continuation of	16708260	2019-12-09		

Prior Application Status		Patented		Remove	
Application Number	Continuity Type	Prior Application Number	Filing Date (YYYY-MM-DD)	Patent Number	Issue Date (YYYY-MM-DD)
16708260	Continuation of	15789331	2017-10-20	10506740	2019-12-10

Prior Application Status		Patented		Remove	
Application Number	Continuity Type	Prior Application Number	Filing Date (YYYY-MM-DD)	Patent Number	Issue Date (YYYY-MM-DD)
15789331	Continuation of	14834034	2015-08-24	9801305	2017-10-24

Prior Application Status		Patented		Remove	
Application Number	Continuity Type	Prior Application Number	Filing Date (YYYY-MM-DD)	Patent Number	Issue Date (YYYY-MM-DD)
14834034	Continuation of	14050464	2013-10-10	9119325	2015-08-25

Prior Application Status		Patented		Remove	
Application Number	Continuity Type	Prior Application Number	Filing Date (YYYY-MM-DD)	Patent Number	Issue Date (YYYY-MM-DD)
14050464	Continuation of	12641468	2009-12-18	8654302	2014-02-18

Application Data Sheet 37 CFR 1.76		Attorney Docket Number	MAN2241-045R
		Application Number	
Title of Invention	ELECTRONIC DISPLAY WITH COOLING		

Prior Application Status	Pending	Remove			
Application Number	Continuity Type	Prior Application Number	Filing or 371(c) Date (YYYY-MM-DD)		
12641468	Claims benefit of provisional	61138736	2008-12-18		
Prior Application Status	Patented	Remove			
Application Number	Continuity Type	Prior Application Number	Filing Date (YYYY-MM-DD)	Patent Number	Issue Date (YYYY-MM-DD)
12641468	Continuation in part of	12411925	2009-03-26	8854595	2014-10-07
Prior Application Status	Pending	Remove			
Application Number	Continuity Type	Prior Application Number	Filing or 371(c) Date (YYYY-MM-DD)		
12411925	Claims benefit of provisional	61039454	2008-03-26		
Prior Application Status	Patented	Remove			
Application Number	Continuity Type	Prior Application Number	Filing Date (YYYY-MM-DD)	Patent Number	Issue Date (YYYY-MM-DD)
12641468	Continuation in part of	12556029	2009-09-09	8373841	2013-02-12
Prior Application Status	Pending	Remove			
Application Number	Continuity Type	Prior Application Number	Filing or 371(c) Date (YYYY-MM-DD)		
12556029	Claims benefit of provisional	61095615	2008-09-09		
Prior Application Status	Patented	Remove			
Application Number	Continuity Type	Prior Application Number	Filing Date (YYYY-MM-DD)	Patent Number	Issue Date (YYYY-MM-DD)
12641468	Continuation in part of	12234307	2008-09-19	8767165	2014-07-01
Prior Application Status	Pending	Remove			
Application Number	Continuity Type	Prior Application Number	Filing or 371(c) Date (YYYY-MM-DD)		
12234307	Claims benefit of provisional	61033064	2008-03-03		
Prior Application Status	Abandoned	Remove			
Application Number	Continuity Type	Prior Application Number	Filing or 371(c) Date (YYYY-MM-DD)		
12641468	Continuation in part of	12234360	2008-09-19		

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SEC et al. v. MRI
SEC Exhibit 1022.5965
IPR2023-00221

Application Data Sheet 37 CFR 1.76		Attorney Docket Number	MAN2241-045R
		Application Number	
Title of Invention	ELECTRONIC DISPLAY WITH COOLING		

Prior Application Status		Pending		Remove	
Application Number		Continuity Type		Prior Application Number	Filing or 371(c) Date (YYYY-MM-DD)
12234360		Claims benefit of provisional		61053713	2008-05-16
Prior Application Status		Patented		Remove	
Application Number	Continuity Type	Prior Application Number	Filing Date (YYYY-MM-DD)	Patent Number	Issue Date (YYYY-MM-DD)
12641468	Continuation in part of	12237365	2008-09-24	8879042	2014-11-04
Prior Application Status		Pending		Remove	
Application Number		Continuity Type		Prior Application Number	Filing or 371(c) Date (YYYY-MM-DD)
12237365		Claims benefit of provisional		61057599	2008-05-30
Prior Application Status		Abandoned		Remove	
Application Number		Continuity Type		Prior Application Number	Filing or 371(c) Date (YYYY-MM-DD)
12641468		Continuation in part of		12235200	2008-09-22
Prior Application Status		Pending		Remove	
Application Number		Continuity Type		Prior Application Number	Filing or 371(c) Date (YYYY-MM-DD)
12235200		Claims benefit of provisional		61076126	2008-06-26
Prior Application Status		Patented		Remove	
Application Number	Continuity Type	Prior Application Number	Filing Date (YYYY-MM-DD)	Patent Number	Issue Date (YYYY-MM-DD)
12641468	Continuation in part of	12620330	2009-11-17	8274622	2012-09-25
Prior Application Status		Pending		Remove	
Application Number		Continuity Type		Prior Application Number	Filing or 371(c) Date (YYYY-MM-DD)
12620330		Claims benefit of provisional		61115333	2008-11-17
Prior Application Status		Patented		Remove	
Application Number	Continuity Type	Prior Application Number	Filing Date (YYYY-MM-DD)	Patent Number	Issue Date (YYYY-MM-DD)
12641468	Continuation in part of	12556209	2009-09-09	8379182	2013-02-19

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Application Data Sheet 37 CFR 1.76		Attorney Docket Number	MAN2241-045R
		Application Number	
Title of Invention	ELECTRONIC DISPLAY WITH COOLING		

Prior Application Status	Pending	Remove	
Application Number	Continuity Type	Prior Application Number	Filing or 371(c) Date (YYYY-MM-DD)
12556209	Claims benefit of provisional	61095616	2008-09-09
Additional Domestic Benefit/National Stage Data may be generated within this form by selecting the Add button.			

Foreign Priority Information:

This section allows for the applicant to claim priority to a foreign application. Providing this information in the application data sheet constitutes the claim for priority as required by 35 U.S.C. 119(b) and 37 CFR 1.55. When priority is claimed to a foreign application that is eligible for retrieval under the priority document exchange program (PDX) the information will be used by the Office to automatically attempt retrieval pursuant to 37 CFR 1.55(i)(1) and (2). Under the PDX program, applicant bears the ultimate responsibility for ensuring that a copy of the foreign application is received by the Office from the participating foreign intellectual property office, or a certified copy of the foreign priority application is filed, within the time period specified in 37 CFR 1.55(g)(1).

Application Number	Country ⁱ	Filing Date (YYYY-MM-DD)	Access Code ⁱ (if applicable)
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Statement under 37 CFR 1.55 or 1.78 for AIA (First Inventor to File) Transition Applications

This application (1) claims priority to or the benefit of an application filed before March 16, 2013 and (2) also contains, or contained at any time, a claim to a claimed invention that has an effective filing date on or after March 16, 2013. ☐ NOTE: By providing this statement under 37 CFR 1.55 or 1.78, this application, with a filing date on or after March 16, 2013, will be examined under the first inventor to file provisions of the AIA.
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Application Data Sheet 37 CFR 1.76		Attorney Docket Number	MAN2241-045R
		Application Number	
Title of Invention	ELECTRONIC DISPLAY WITH COOLING		

Authorization or Opt-Out of Authorization to Permit Access:

When this Application Data Sheet is properly signed and filed with the application, applicant has provided written authority to permit a participating foreign intellectual property (IP) office access to the instant application-as-filed (see paragraph A in subsection 1 below) and the European Patent Office (EPO) access to any search results from the instant application (see paragraph B in subsection 1 below).

Should applicant choose not to provide an authorization identified in subsection 1 below, applicant **must opt-out** of the authorization by checking the corresponding box A or B or both in subsection 2 below.

NOTE: This section of the Application Data Sheet is **ONLY** reviewed and processed with the **INITIAL** filing of an application. After the initial filing of an application, an Application Data Sheet cannot be used to provide or rescind authorization for access by a foreign IP office(s). Instead, Form PTO/SB/39 or PTO/SB/69 must be used as appropriate.

1. Authorization to Permit Access by a Foreign Intellectual Property Office(s)

A. Priority Document Exchange (PDX) - Unless box A in subsection 2 (opt-out of authorization) is checked, the undersigned hereby **grants the USPTO authority** to provide the European Patent Office (EPO), the Japan Patent Office (JPO), the Korean Intellectual Property Office (KIPO), the State Intellectual Property Office of the People's Republic of China (SIPO), the World Intellectual Property Organization (WIPO), and any other foreign intellectual property office participating with the USPTO in a bilateral or multilateral priority document exchange agreement in which a foreign application claiming priority to the instant patent application is filed, access to: (1) the instant patent application-as-filed and its related bibliographic data, (2) any foreign or domestic application to which priority or benefit is claimed by the instant application and its related bibliographic data, and (3) the date of filing of this Authorization. See 37 CFR 1.14(h)(1).

B. Search Results from U.S. Application to EPO - Unless box B in subsection 2 (opt-out of authorization) is checked, the undersigned hereby **grants the USPTO authority** to provide the EPO access to the bibliographic data and search results from the instant patent application when a European patent application claiming priority to the instant patent application is filed. See 37 CFR 1.14(h)(2).

The applicant is reminded that the EPO's Rule 141(1) EPC (European Patent Convention) requires applicants to submit a copy of search results from the instant application without delay in a European patent application that claims priority to the instant application.

2. Opt-Out of Authorizations to Permit Access by a Foreign Intellectual Property Office(s)

☐ A. Applicant **DOES NOT** authorize the USPTO to permit a participating foreign IP office access to the instant application-as-filed. If this box is checked, the USPTO will not be providing a participating foreign IP office with any documents and information identified in subsection 1A above.

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NOTE: Once the application has published or is otherwise publicly available, the USPTO may provide access to the application in accordance with 37 CFR 1.14.

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Application Data Sheet 37 CFR 1.76		Attorney Docket Number	MAN2241-045R
		Application Number	
Title of Invention	ELECTRONIC DISPLAY WITH COOLING		

Applicant Information:

Providing assignment information in this section does not substitute for compliance with any requirement of part 3 of Title 37 of CFR to have an assignment recorded by the Office.

Applicant 1

If the applicant is the inventor (or the remaining joint inventor or inventors under 37 CFR 1.45), this section should not be completed. The information to be provided in this section is the name and address of the legal representative who is the applicant under 37 CFR 1.43; or the name and address of the assignee, person to whom the inventor is under an obligation to assign the invention, or person who otherwise shows sufficient proprietary interest in the matter who is the applicant under 37 CFR 1.46. If the applicant is an applicant under 37 CFR 1.46 (assignee, person to whom the inventor is obligated to assign, or person who otherwise shows sufficient proprietary interest) together with one or more joint inventors, then the joint inventor or inventors who are also the applicant should be identified in this section.

- ☒ Assignee
 ☐ Legal Representative under 35 U.S.C. 117
 ☐ Joint Inventor
- ☐ Person to whom the inventor is obligated to assign.
 ☐ Person who shows sufficient proprietary interest

If applicant is the legal representative, indicate the authority to file the patent application, the inventor is:

Name of the Deceased or Legally Incapacitated Inventor:

If the Applicant is an Organization check here. ☒

Organization Name Manufacturing Resources International, Inc.

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Country ¹	US	Postal Code	30005
Phone Number		Fax Number	
Email Address			

Additional Applicant Data may be generated within this form by selecting the Add button.

Application Data Sheet 37 CFR 1.76		Attorney Docket Number	MAN2241-045R
		Application Number	
Title of Invention	ELECTRONIC DISPLAY WITH COOLING		

Assignee Information including Non-Applicant Assignee Information:

Providing assignment information in this section does not substitute for compliance with any requirement of part 3 of Title 37 of CFR to have an assignment recorded by the Office.

Assignee 1				
Complete this section if assignee information, including non-applicant assignee information, is desired to be included on the patent application publication. An assignee-applicant identified in the "Applicant Information" section will appear on the patent application publication as an applicant. For an assignee-applicant, complete this section only if identification as an assignee is also desired on the patent application publication.				
If the Assignee or Non-Applicant Assignee is an Organization check here. ☐				
Prefix	Given Name	Middle Name	Family Name	Suffix
Mailing Address Information For Assignee including Non-Applicant Assignee:				
Address 1				
Address 2				
City		State/Province		
Country i		Postal Code		
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Application Data Sheet 37 CFR 1.76		Attorney Docket Number	MAN2241-045R
		Application Number	
Title of Invention	ELECTRONIC DISPLAY WITH COOLING		

Signature:

NOTE: This Application Data Sheet must be signed in accordance with 37 CFR 1.33(b). **However, if this Application Data Sheet is submitted with the INITIAL filing of the application and either box A or B is not checked in subsection 2 of the "Authorization or Opt-Out of Authorization to Permit Access" section, then this form must also be signed in accordance with 37 CFR 1.14(c).**

This Application Data Sheet **must** be signed by a patent practitioner if one or more of the applicants is a **juristic entity** (e.g., corporation or association). If the applicant is two or more joint inventors, this form must be signed by a patent practitioner, **all** joint inventors who are the applicant, or one or more joint inventor-applicants who have been given power of attorney (e.g., see USPTO Form PTO/AIA/81) on behalf of **all** joint inventor-applicants.

See 37 CFR 1.4(d) for the manner of making signatures and certifications.

Signature	/Adam J. Smith/			Date (YYYY-MM-DD)	
First Name	Adam	Last Name	Smith	Registration Number	72962
Additional Signature may be generated within this form by selecting the Add button.					

ELECTRONIC DISPLAY WITH COOLING

Inventors: William Dunn and Tim Hubbard

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application is a continuation of U.S. Application No. 16/708,260 filed on December 9, 2019. U.S. Application No. 16/708,260 is a continuation of U.S. Application No. 15/789,331 filed on October 20, 2017, now U.S. Patent No. 10,506,740 issued on December 10, 2019. U.S. Application No. 15/789,331 is a continuation of U.S. Application No. 14/834,034 filed on August 24, 2015, now U.S. Patent No. 9,801,305 issued on October 24, 2017. U.S. Application No. 14/834,034 is a continuation of U.S. Application No. 14/050,464 filed on October 10, 2013, now U.S. Patent No. 9,119,325 issued on August 25, 2015. U.S. Application No. 14/050,464 is a continuation of U.S. Application No. 12/641,468 filed December 18, 2009, now U.S. Patent No. 8,654,302 issued on February 18, 2014, which is a non-provisional of U.S. Application No. 61/138,736 filed December 18, 2008. U.S. Application No. 12/641,468 is a continuation-in-part of U.S. Application No. 12/411,925 filed March 26, 2009, now U.S. Patent No. 8,854,595 issued on October 7, 2014, which is a non-provisional application of U.S. Application No. 61/039,454 filed March 26, 2008. U.S. Application No. 12/641,468 is a continuation-in-part of U.S. Application No. 12/556,029 filed September 9, 2009, now U.S. Patent No. 8,373,841 issued on February 12, 2013, which is a non-provisional application of U.S. Application No. 61/095,615 filed September 9, 2008. U.S. Application No. 12/641,468 is a continuation-in-part of U.S. Application No. 12/234,307 filed September 19, 2008, now U.S. Patent No. 8,767,165 issued on July 1, 2014, which is a non-provisional application of U.S. Application No. 61/033,064 filed March 3, 2008. U.S. Application No. 12/641,468 is a continuation-in-part of U.S. Application No. 12/234,360 filed September 19, 2008,

which is a non-provisional application of U.S. Application No. 61/053,713 filed May 16, 2008. U.S. Application No. 12/641,468 is a continuation-in-part of U.S. Application No. 12/237,365 filed September 24, 2008, now U.S. Patent No. 8,879,042 issued November 4, 2014, which is a non-provisional application of U.S. Application No. 61/057,599 filed May 30, 2008. U.S. Application No. 12/641,468 is a continuation-in-part of U.S. Application No. 12/235,200 filed September 22, 2008, which is a non-provisional of U.S. Application No. 61/076,126 filed June 26, 2008. U.S. Application No. 12/641,468 is a continuation-in-part of U.S. Application No. 12/620,330 filed November 17, 2009, now U.S. Patent No. 8,274,622 issued September 25, 2012, which is a non-provisional of U.S. Application No. 61/115,333 filed November 17, 2008. U.S. Application No. 12/641,468 is a continuation-in-part of U.S. Application No. 12/556,209 filed September 9, 2009, now U.S. Patent No. 8,379,182 issued February 19, 2013, which is a non-provisional of U.S. provisional application No. 61/095,616 filed September 9, 2008. All of said aforementioned applications are hereby incorporated by reference in their entirety as if fully recited herein.

TECHNICAL FIELD

[0002] The exemplary embodiments described herein generally relate to cooling systems and in particular to cooling systems for electronic displays.

BACKGROUND

[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. In order to do this, the systems of the past have relied primarily

on fans for moving internal air (or ingested ambient air) within the housing past the components to be cooled and out of the display. These components are typically power supplies. In some cases, the heated air is moved into convectively thermal communication with fins.

[0004] While such heat transfer systems have enjoyed a measure of success in the past, improvements to displays and new display applications require even greater cooling capabilities. Electronic displays are now being used in outdoor environments and other applications where they may be exposed to high ambient temperatures and even direct sunlight. In particular, cooling devices for electronic displays of the past have generally used convective heat dissipation systems that function to cool only the rear interior portion of the display. By itself, this is not adequate in many climates, especially when radiative heat transfer from the sun through a display window becomes a major factor. In many applications and locations 200 Watts or more of power through such a display window is common. Furthermore, the market is demanding larger screen sizes for displays. With increased electronic display screen size and corresponding display window size more heat will be generated and more heat will be transmitted into the displays. Also, when displays are used in outdoor environments the ambient air may contain contaminants (dust, dirt, pollen, water vapor, smoke, etc.) which, if ingested into the display for cooling the interior can cause damage to the interior components of the display.

[0005] A large fluctuation in temperature is common in the devices of the past. Such temperature fluctuation adversely affects the electronic components in these devices; both performance and lifetime may be severely affected. Thus, there exists a need for a cooling system for electronic displays which are placed within environments having high

ambient temperatures, possibly contaminates present within the ambient air, and even placed in direct sunlight.

SUMMARY

[0006] Exemplary embodiments may comprise two separate flow paths for gas through an electronic display. A first flow path may be a closed loop and a second flow path may be an open loop. The closed loop path travels across the front surface of the image assembly, continues to the rear of the display where it may enter a heat exchanger, finally returning to the front surface of the image assembly. The open loop path may draw ambient gas (ex. ambient air) through the rear of the display (sometimes through a heat exchanger, behind an image assembly, or both) and then exhausts it out of the display housing. A heat exchanger may be used to transfer heat from the circulating gas to the ambient gas. In alternative embodiments, the ambient gas may also be forced behind the image assembly (sometimes a backlight), in order to cool the image assembly and/or backlight assembly (if a backlight is necessary for the particular type of display being used). A cross-flow heat exchanger may be used in an exemplary embodiment.

[0007] The foregoing and other features and advantages of the exemplary embodiments will be apparent from the following more detailed description of the particular embodiments of the invention, as illustrated in the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0008] A better understanding of an exemplary embodiment will be obtained from a reading of the following detailed description and the accompanying drawings wherein identical reference characters refer to identical parts and in which:

[0009] FIGURE 1 is a rear perspective view of an embodiment where the rear cover of the display has been removed.

[0010] FIGURE 2A is a perspective section view of another embodiment showing the closed loop and open loop channels.

[0011] FIGURE 2B is a perspective section view similar to the view shown in Figure 2A where the rear and side covers have been removed.

[0012] FIGURE 3 is a perspective section of another embodiment where ambient gas is ingested only into the heat exchanger and not into optional additional channels.

[0013] FIGURE 4 is a perspective section view of an exemplary embodiment where a cross-flow heat exchanger is used to separate high power and low power electrical assemblies.

DETAILED DESCRIPTION OF THE EXEMPLARY EMBODIMENTS

[0014] FIGURE 1 shows the rear of an embodiment for an electronic display 100, where the rear cover for the display housing has been removed in order to show the internal components. In this embodiment, the fan assemblies 102 and 103 for the closed loop may be placed along two opposing edges of a heat exchanger 101. Preferably, fan assembly 102 is the inlet for the heat exchanger and fan assembly 103 is the exit for the heat exchanger 101. These assemblies can optionally be reversed however, where fan assembly 103 is the inlet and fan assembly 102 is the exit. Further, both assemblies 102 and 103 are not required. Some embodiments may use only one fan assembly for the closed loop. If only one fan assembly is used, it may be preferable to place the fan assembly at the inlet of the heat exchanger 101, so that the circulating gas is 'pulled' across the front of the image assembly and pushed through the heat exchanger 101. This

is not required however; other embodiments may pull the isolated gas through the heat exchanger 101. Other embodiments may push the isolated gas across the front of the image assembly. Fan assemblies 104 and 105 for the open loop may be placed along two opposing edges of the display housing. Again, both assemblies 104 and 105 are not required as some embodiments may use only one assembly and may use the open loop fan assemblies in a push or pull design. Because the various fan assemblies described herein can be placed in multiple orientations, when referring to the placement of the various fan assemblies, the terms 'push', 'pull', 'force', and 'draw' will be used interchangeably and any orientation may be used with the various embodiments herein.

[0015] The circulating gas which is being forced by the closed loop fan assemblies is primarily circulating around the display. For example, the gas travels in a loop where it passes through a channel, contacting the front surface of the image assembly (see Figures 2A-2B) and absorbs heat from the image assembly. The circulating gas is then preferably directed (or forced) into the heat exchanger 101 in order to transfer heat from the circulating gas to the ambient gas. Afterwards, the circulating gas exits the heat exchanger 101 and may eventually return to the channel and contact the front surface of the image assembly. The circulating gas may also pass over several electronic components 110 in order to extract heat from these devices as well. The electronic components 110 may be any components or assemblies used to operate the display including, but not limited to: transformers, circuit boards, resistors, capacitors, batteries, power modules, motors, inductors, illumination devices, wiring and wiring harnesses, lights, thermo-electric devices, and switches. In some embodiments, the electrical

components 110 may also include heaters, when the display assembly might be used in cold-weather environments.

[0016] In order to cool the circulating gas (as well as optionally cooling a backlight assembly or image assembly) ambient gas is ingested into the display housing by the open loop fan assembly 104 and/or 105. The ambient gas may simply be ambient air which is surrounding the display. In some embodiments, the ambient gas may be air conditioned (or otherwise cooled) prior to being drawn into the display. Once the ambient gas is ingested into the display, it may be directed (or forced) through the heat exchanger 101 and optionally also across the rear surface of the backlight assembly or image assembly (see Figures 2A-2B). By using the heat exchanger 101, heat may be transferred from the circulating gas to the ambient gas. The heated ambient gas may then be expelled out of the display housing.

[0017] Although not required, it is preferable that the circulating gas and ambient gas do not mix. This may prevent any contaminants and/or particulate that is present within the ambient gas from harming the interior of the display. In a preferred embodiment, the heat exchanger 101 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 101 may be a cross-flow, parallel flow, or counter-flow heat exchanger. In an exemplary embodiment, the heat exchanger 101 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, gas may enter the heat exchanger only through plates whose channels or pathways travel parallel to the path of the gas. Because the plates are alternated, the closed loop and ambient gases 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).

[0018] In an alternative design, 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).

[0019] 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.

[0020] 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 paths of gas. 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 the small material thickness, results in an overall thermal resistance that is very 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.

[0021] As mentioned above, both inlet and exit fan assemblies are not required for the embodiments. Alternatively, only a single fan assembly may be used for each loop. Thus, only an inlet fan assembly may be used with the closed loop and only an exhaust fan assembly may be used with the open loop. Alternatively, one of the loops may have both inlet and exit fan assemblies while the other loop only has either an inlet or exit assembly.

[0022] The gas used in both loops can be any number of gaseous matters. In some embodiments, air may be used as the gas for both loops. Preferably, the gas which travels through the closed loop should be substantially clear, so that when it passes in front of the image assembly it will not affect the appearance of the image to a viewer. The gas which travels through the closed loop would 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 damage to the internal electronic

components. It may also be preferable to keep the gas within the open loop from having contaminants. An optional filter may be used to ensure that the air (either in the closed or open loop) stays free of contaminants. However, in an exemplary embodiment the open loop may be designed so that contaminants could possibly be present within the ambient gas but this will not harm the display. In these embodiments, the heat exchanger (and the optional path behind the image assembly or backlight) is properly sealed so that any contaminants in the ambient gas would not enter sensitive portions of the display. Thus, in these exemplary embodiments, ingesting ambient air for the ambient gas, even if the ambient air contains contaminants, will not harm the display. This can be particularly beneficial when the display is used in outdoor environments or indoor environments where contaminants are present in the ambient air.

[0023] FIGURE 2A shows a cross-section of another embodiment of a display 200. In this figure, the rear cover 250 and side covers 251 and 252 are shown to illustrate one method for sealing the overall display 200. The image assembly 220 is shown near the front of the display 200. As discussed above, the image assembly 220 may comprise any form of electronic assembly for generating an image, including but not limited to: LCD, light emitting diode (LED), organic light emitting diode (OLED), field emitting displays (FED), light-emitting polymers (LEP), plasma displays, and any other flat/thin panel displays. The front display surface 221 is placed in front of the image assembly 220, defining a channel 290 through which the circulating gas may flow. The front display surface 221 may be any transparent material (glass, plastic, or composite) and may optionally comprise several layers for polarizing light, reducing glare or reflections, and protecting the internal display components. In an exemplary embodiment, the front

display surface 221 would comprise two panes of glass which are laminated together with index-matching optical adhesive. Further, a polarizing layer may be attached to one of the panes of glass in order to reduce the internal reflections and solar loading on the image assembly 220. It is most preferable that the polarizing layer be attached to the inner surface of the front display surface 221 (the one facing the closed loop channel 290) and also contain an anti-reflective (AR) coating. The front display surface may be a durable display panel as disclosed in co-pending U.S. Application No. 12/330041 filed on December 8, 2008, herein incorporated by reference in its entirety.

[0024] For the embodiment shown in Figure 2A, the image assembly 220 may be an LCD stack with a backlight assembly 222. Some backlights may use cold cathode fluorescent lamps (CCFLs) to produce the illumination necessary for generating an image. In an exemplary embodiment, the backlight assembly 222 would comprise a printed circuit board (PCB) with a plurality of LEDs (light emitting diodes) on the front surface. An exemplary embodiment would have a low level of thermal resistance between the front surface of the backlight assembly 222 and the rear surface 223 of the backlight. A metallic PCB may be used for this purpose. The rear surface 223 of the backlight may contain a thermally conductive material, such as a metal. Aluminum may be an exemplary material for the rear surface 223. A second surface 224 may be placed behind the rear surface 223 of the backlight assembly 222. The space between the rear surface 223 of the backlight and the second surface 224 may define an additional optional open loop channel 225 through which ambient gas may travel in order to cool the backlight assembly 222 (or image assembly 220 if no backlight is used).

[0025] FIGURE 2B shows the same cross section from Figure 2A with the rear cover 250 and side covers 251 and 252 removed and the closed and open loop air flows shown for explanatory purposes. The closed loop fan assembly 202 may be used to propel the circulating gas 210 around the closed loop. A first open loop fan assembly 203 may be used to draw ambient gas 211 through the heat exchanger 201. Optionally, a second open loop fan assembly 204 may be used to draw ambient gas 212 through the additional optional channel 225 for cooling the backlight assembly 222 (or image assembly 220 if no backlight is used). The optional second open loop fan assembly 204 can also be used to exhaust ambient gas which has traveled through the heat exchanger 201 and through the channel 225. If a second open loop fan assembly 204 is not used (perhaps because the additional optional channel 225 is not used), the first open loop fan assembly 203 may be used to exhaust the ambient gas 211 that has traveled through the heat exchanger 201.

[0026] As noted above, in an exemplary embodiment the ambient gas 211 and 212 does not mix with the circulating gas 210. It may be important for the image quality that the circulating gas remains free of particulate and contaminants as this gas travels in front of the image assembly 220. Since gas for the open loop may contain various contaminants, a preferable embodiment should be adequately sealed to prevent the gas from the two loops from mixing. This is not necessary however, as filters (either removable or permanent) may be used to minimize the effect of particulate for both the open and closed loops.

[0027] FIGURE 3 is a perspective section view of another embodiment of a display assembly 10 showing inlet 60 and exhaust 65 apertures for the ambient gas 20. The inlet

aperture 60 may contain a screen or filter (removable or permanent) to remove any particulate (although this may not be necessary). One or more fans 50 may be positioned so as to draw the ambient gas 20 into the inlet aperture 60 and through the heat exchanger 201. In this embodiment, the ambient gas 20 is only drawn through the heat exchanger 201 and not through any additional optional channels. This embodiment may be used when the image assembly 80 (or backlight assembly) does not require the additional cooling of an additional channel. For example, and not by way of limitation, this embodiment 10 may be used when an OLED is used as the image assembly 80. Further, this embodiment 10 may be used when the LCD backlight is not generating large amounts of heat because it is not required to be extremely bright (perhaps because it is not used in direct sunlight). Still further, this embodiment may be used when the ambient gas 20 contains particulate or contaminants which may damage the display. In these situations, it may be desirable to limit the exposure of the display to the ambient gas 20. Thus, in these situations it may be desirable to only ingest ambient gas 20 into the heat exchanger 201 and not through any additional cooling channels.

[0028] In some embodiments, the ambient gas 20 may be air conditioned (or otherwise cooled) before it is directed into the heat exchanger 201. A front display surface 221 may be used to create an anterior (front) wall of the channel 290 and/or protect the image assembly 80 from damage. An exemplary front display surface 221 may be glass. Another embodiment for the front display surface 221 may be two panes of glass which are laminated together using optical adhesive. Solar loading (radiative heat transfer from the sun through the front display surface 221 may result in a heat buildup on the image assembly 80 (ex. OLED or LCD assembly). This heat may be transferred to the circulating

gas as it passes through the channel between the front display surface 221 and the image assembly 80, where this heat may then be transferred to the ambient gas 20 and expelled from the display. The image assembly could be any one of the following: LCD, plasma display assembly, OLED, light emitting polymer (LEP) assembly, organic electro luminescence (OEL) assembly, LED display assembly, or any other flat/thin panel electronic display.

[0029] **FIGURE 4** shows another embodiment where a circulating gas 400 is forced between a front display surface 221 and an image assembly 80 and then through a heat exchanger 201 in order to remove at least a portion of the heat absorbed from the image assembly 80 and front display surface 221. Here, the circulating gas 400 may be propelled by a closed loop fan assembly 410. The heat exchanger 201 may accept circulating gas 400 in one direction while accepting ambient gas 310 in a substantially perpendicular direction such that heat may transfer between the two gases.

[0030] In this embodiment, an optional additional flow of ambient gas 300 is accepted through the inlet aperture 350 and directed along channel 225 in order to cool the rear portion of the image assembly 80 (possibly a backlight). When this optional additional flow of ambient gas 300 is used, it is preferable that the anterior (front) surface 500 of the channel 225 be thermally conductive and preferably in thermal communication with at least a portion of the image assembly 80. In this arrangement, the ambient gas 300 may also be used to absorb heat from the image assembly 80. In some embodiments, the image assembly may be an LCD with an LED backlight. Here, the LED backlight may be in thermal communication with surface 500 so that heat can be transferred from the LED backlight to the ambient gas 300. Alternatively, the image assembly 80 may be an OLED

assembly and the surface 500 may be in thermal communication with the OLED assembly. Inlet aperture 350 may accept both ambient gas 310 and 300, or there may be separate inlet apertures for each flow of gas 310 and 300.

[0031] For the embodiment shown in Figure 4, a plurality of ribs are shown placed within channel 225. These ribs may be thermally conductive and in thermal communication with surface 500. Thus, heat from surface 500 may be distributed throughout the ribs and removed by the ambient gas 300. It has been found, that this arrangement can provide improved cooling abilities for the image assembly 80 and/or backlight (if necessary). It can also provide greater structural rigidity to the overall assembly. It has been found that some image assemblies (especially LEDs and OLEDs) may have performance properties which vary depending on temperature. Thus, as the temperature of the image assembly increases, the luminance, color temperature, and other optical properties can vary. 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 some of the embodiments described herein, the heat which may be generated by the backlight assembly or image assembly can be distributed throughout the ribs and thermally-conductive surfaces to remove hot spots and cool the backlight or image assembly.

[0032] The ribs shown in this embodiment contain a hollow rectangular cross-section, but this is not required. Other embodiments may contain ribs with I-beam cross-sections, hollow square cross-sections, solid rectangular or solid square cross-sections, 'T' cross-sections, 'Z' cross-sections, corrugated or honeycomb cross-section, or any combination or mixture of these. Metal may be used to produce the ribs in some embodiments.

[0033] In other embodiments, additional heat-producing electronic assemblies may be placed in thermal communication with the ribs so that heat can be removed from these assemblies as well. In an exemplary embodiment, power modules may be placed in thermal communication with the ribs so that the heat from the power modules can be distributed throughout the ribs and removed by the ambient gas 300.

[0034] The circulating gas 400 may also pass over electronic assemblies in order to accept heat from these electronic assemblies. In this exemplary embodiment, the electronic assemblies have been separated by the heat exchanger 201 into two groups. The first group of electronic assemblies 9 may be considered the high power assemblies and may include but are not limited to: power modules, inductors, transformers, and other power-related devices. The second group of electronic assemblies 7 may be considered the low power assemblies and may include but are not limited to: timing and control boards, hard drives and other storage devices, video cards, software drivers, microprocessors, and other control devices. It is known to those skilled in the art that some high power electronic assemblies can cause electrical interference with other electronic assemblies that may be sensitive to electrical interference. Thus, in the exemplary embodiment shown, the heat exchanger 201 is used to separate the lower power electronic assemblies 7 from the high power electronic assemblies 9 to ensure a minimum amount of interference between the two. Further, some high power electronic assemblies 9 are known to also generate heat. This heat may be transferred to the circulating gas 400 prior to introducing this gas into the heat exchanger 201. In the exemplary embodiment shown, ambient air can be ingested as the ambient gas 310 and there is little risk of damage to the electrical assemblies 7 and 9 because the ambient gas

310 would preferably never contact these electrical assemblies. However, the electrical assemblies 7 and 9 will remain cool (as well as clean and dry) because of the cross-flow from the circulating gas 400.

[0035] The cooling system described herein 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. The speed of the various fan assemblies can also be varied depending on the temperature within the display.

[0036] It should be particularly noted that the spirit and scope of the disclosed embodiments provides for the cooling of any type of electronic display. 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 thin/flat panel 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 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, kitchens, bathrooms) where thermal stability of the display may be at risk.

[0037] 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 clock-wise 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.

[0038] Having shown and described various exemplary embodiments, those skilled in the art will realize that many variations and modifications may be made thereto without departing from the scope of the inventive concept. Additionally, many of the elements indicated above may be altered or replaced by different elements that will provide a like result and fall within the spirit of the inventive concept. It is the intention, therefore, to limit the inventive concept only as indicated by the scope of the claims.

WHAT IS CLAIMED IS:

1. A cooling system for an electronic image assembly, the cooling system comprising:
 - a housing for the electronic image assembly;
 - a transparent panel forming a front portion of the housing, wherein the transparent panel is located forward of, and at least some distance from, the electronic image assembly;
 - an airflow pathway passing through the housing between said electronic image assembly and said transparent panel;
 - an air circulation device positioned to force air through the airflow pathway; and
 - at least one polarizer located at said transparent panel and configured to reduce solar energy.
2. The cooling system of claim 1 wherein:
 - said at least one polarizer is located adjacent to an inward facing surface of said transparent panel.
3. The cooling system of claim 1 further comprising:
 - at least one film having anti-reflection properties located at said transparent panel.
4. The cooling system of claim 1 wherein:

said airflow pathway encircles said electronic image assembly and is configured to accommodate circulating gas.

5. The cooling system of claim 4 further comprising:

an open loop airflow pathway passing behind said electronic image assembly.

6. The cooling system of claim 5 further comprising:

a heat exchanger located rearward of the electronic image assembly, wherein a first portion of said heat exchanger forms part of said open loop airflow pathway, and wherein a second portion of said heat exchanger forms part of said airflow pathway.

7. The cooling system of claim 6 further comprising:

an inlet located at a first portion of said housing for ingesting ambient air into said open loop airflow pathway; and

an exhaust located at a second portion of said housing for exhausting ambient air from said open loop airflow pathway.

8. The cooling system of claim 1 wherein:

said at least one polarizer is configured to reduce solar energy received at said electronic image assembly.

9. The cooling system of claim 1 wherein:

said at least one polarizer is configured to reduce solar energy thermally interacting with air forced in said airflow pathway.

10. The cooling system of claim 1 wherein:

said at least one polarizer comprises a linear polarizer.

11. A cooling system for an electronic image assembly, the cooling system comprising:

a housing for the electronic image assembly;

a transparent cover panel forming a front portion of the housing, the transparent cover panel located forward of, and at least some distance from, the electronic image assembly;

an open loop airflow pathway passing through the housing behind the electronic image assembly;

a closed loop gas circulation pathway contained within the housing, wherein a portion of said closed loop gas circulation pathway passes between said transparent cover panel and said electronic image assembly;

an inlet located at a first portion of said housing for ingesting ambient air into said open loop airflow pathway;

an exhaust located at a second portion of said housing for exhausting ambient air from said open loop airflow pathway;

an air circulation device positioned along said open loop airflow pathway between said inlet and said exhaust, wherein said air circulation device is configured to force ambient air through the open loop air flow pathway;

a gas circulation device positioned along said closed loop gas circulation pathway to force circulating gas around the closed loop pathway;

a heat exchanger located rearward of the electronic image assembly, wherein a first portion of said heat exchanger forms part of said open loop airflow pathway, and wherein a second portion of said heat exchanger forms part of said closed loop gas circulation pathway; and

one or more solar energy reduction layers located at said transparent panel, wherein each of said one or more solar energy reduction layers is configured to prevent a portion of solar energy entering said transparent cover from thermally interacting with circulating gas at said portion of said closed loop gas circulation pathway passing between said transparent panel and said electronic image assembly or thermally interacting with said electronic image assembly.

12. The cooling system of claim 11 wherein:

said air circulation device comprises one or more fan assemblies; and

said gas circulation device comprises one or more fan assemblies.

13. The cooling system of claim 11 wherein:

at least one of said one or more solar energy reduction layers comprise a polarizer.

14. The cooling system of claim 13 wherein:

said polarizer comprises a linear polarizer.

15. The cooling system of claim 11 wherein:

at least one of said one or more solar energy reduction layers comprise a film having anti-reflection properties.

16. The cooling system of claim 11 wherein:

at least a first one of said one or more solar energy reduction layers comprise a polarizer; and

at least a second one of said one or more solar energy reduction layers comprise a film having anti-reflection properties.

17. A method for cooling an electronic image assembly, said method comprising the steps of:

placing said the electronic image assembly within a housing;

forcing air through an airflow pathway within said housing, wherein at least a portion of said airflow pathway extends between an electronic image assembly and a transparent panel forming a front portion of said housing and spaced apart from said electronic image assembly; and

providing one or more solar energy reduction layers at said transparent panel configured to reduce the amount of solar energy transferred to said air in said airflow pathway.

18. The cooling method of claim 17 wherein:

at least one of said one or more solar energy reduction layers comprise a polarizer.

19. The cooling method of claim 18 wherein:

at least one of said one or more solar energy reduction layers comprise a film having anti-reflection properties.

20. The cooling method of claim 17 further comprising the steps of:

forcing ambient air through a second airflow pathway within said housing, wherein said second airflow pathway extends behind said electronic image assembly; and

thermally transferring heat between said air in said airflow pathway and said ambient air in said second airflow pathway at a heat exchanger common to said airflow pathway and said second airflow pathway, wherein said airflow pathway defines a closed loop and said air in said airflow pathway comprises circulating gas.

ABSTRACT

Systems and methods for cooling an electronic image assembly are provided. A transparent panel forms a front portion of a housing for the electronic image assembly. The transparent panel is located forward of, and at least some distance from the electronic image assembly. An airflow pathway passes through the housing between said electronic image assembly and said transparent panel. An air circulation device forces air through the airflow pathway. At least one polarizer located at the transparent panel is configured to reduce solar energy entering said airflow pathway.

Electronic Patent Application Fee Transmittal				
Application Number:				
Filing Date:				
Title of Invention:		ELECTRONIC DISPLAY WITH COOLING		
First Named Inventor/Applicant Name:		William Dunn		
Filer:		Adam Jeffery Smith/Trisha Beachy-Bryant		
Attorney Docket Number:		MAN2241-045R		
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Filing Fees for Utility under 35 USC 111(a)				
Description	Fee Code	Quantity	Amount	Sub-Total in USD(\$)
Basic Filing:				
UTILITY APPLICATION FILING	1011	1	300	300
UTILITY SEARCH FEE	1111	1	660	660
UTILITY EXAMINATION FEE	1311	1	760	760
Pages:				
Claims:				
Miscellaneous-Filing:				
Petition:				
Patent-Appeals-and-Interference:				

Description	Fee Code	Quantity	Amount	Sub-Total in USD(\$)
Post-Allowance-and-Post-Issuance:				
Extension-of-Time:				
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Total in USD (\$)				1720

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The Director of the USPTO is hereby authorized to charge indicated fees and credit any overpayment as follows: 37 CFR 1.21 (Miscellaneous fees and charges) 37 CFR 1.20 (Post Issuance fees)	

37 CFR 1.16 (National application filing, search, and examination fees)					
File Listing:					
Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Oath or Declaration filed	SignedCombinedAssignmentAndDeclaration_MAN2241-045Q.pdf	356471 709cc3244d8dcb0418441071ed2d2233604cf4a2	no	4
Warnings:					
Information:					
2	Power of Attorney	POA_MAN2241-045R_7-20-20.pdf	284322 3a060758003e211cc52cb49b1d4f74c882c1c0e2	no	2
Warnings:					
Information:					
3	Drawings-only black and white line drawings	Drawings_MAN2241-045R_7-20-20.pdf	184881 c6844a1eb55c4549e9ae795adde1da02fa395a9b	no	4
Warnings:					
Information:					
4	Application Data Sheet	WebADS.pdf	199677 b60a3a70e3d608469cb04c461c0b0998ff95f64f	no	10
Warnings:					
Information:					
5		MAN2241-045R_App_7-20-20.pdf	106968 5d2e008f41d28b590c4899befd3dd3e61b5ae63	yes	25
	Multipart Description/PDF files in .zip description				
	Document Description		Start	End	
	Specification		1	18	
	Claims		19	24	
	Abstract		25	25	