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(54) Title: BACK TO BACK ELECTRONIC DISPLAY ASSEMBLY

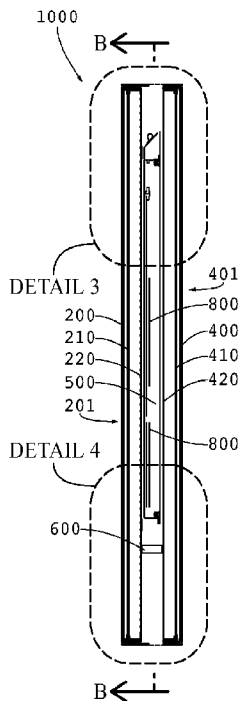


Fig. 2

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

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## **Back To Back Electronic Display Assembly**

### Cross-Reference to Related Applications

**[0001]** This application claims priority to U.S. Application No. 61/986,724 filed on April 30, 2014 and is herein incorporated by reference in its entirety.

### Technical Field

**[0002]** Embodiments generally relate to cooling systems and methods for installing 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. In some spaces, only a small footprint is available, such that placing electronic displays in a back to back orientation is desirable.

### 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:

**[0007]** **FIGURE 1** is a front planar view of an exemplary back to back display assembly showing the vertical section line A-A.

**[0008]** **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.

**[0009]** **FIGURE 3** is a detailed section view showing Detail 3.

**[0010]** **FIGURE 4** is a detailed section view showing Detail 4.

**[0011]** **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.

**[0012]** **FIGURE 6** is a detailed section view showing Detail 6.

[0013] **FIGURE 7** is a perspective view showing an alternate embodiment where the first display assembly is rotated away from the second display assembly.

[0014] **FIGURE 8** is a perspective view taken along the line B-B and indicating Detail 9.

[0015] **FIGURE 9** is a detailed perspective view of Detail 9 showing the post.

[0016] **FIGURE 10** is a detailed perspective view of the corresponding hook on the second display assembly.

#### Detailed Description

[0017] 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.

[0018] 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.

**[0019]** 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.

**[0020]** 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.

**[0021]** **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.

**[0022]** **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.

**[0023]** 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 10000. Still further, although shown at the bottom of the display assembly 1000, it could instead be placed at the top.

**[0024]** **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.

**[0025]** 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.

**[0026]** 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.

**[0027] 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.

**[0028] 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.

**[0029] 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.

**[0030]** **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.

**[0031]** 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.

**[0032]** 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.

**[0033]** **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).

**[0034]** **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.

**[0035]** Having shown and described a preferred embodiment of the invention, those skilled in the art will realize that many variations and modifications may be made to affect the described invention and still be within the scope of the claimed invention. Additionally, many of the elements indicated above may be altered or replaced by different elements which will provide the same result and fall within the spirit of the claimed invention. It is the intention, therefore, to limit the invention only as indicated by the scope of the claims.

## CLAIMS

We claim:

1. A back to back electronic display assembly comprising:

a first display assembly positioned back to back with a second display assembly;

a plenum positioned in between the first and second display assemblies;

a first gap defined between the plenum and the first display assembly;

a second gap defined between the plenum and the second display assembly;

and

a fan positioned to force air through the first and second gaps.

2. The assembly of claim 1 further comprising:

a plenum fan positioned within the plenum.

3. The assembly of claim 1 wherein:

the plenum is sealed to prevent air being forced by the fan from entering the plenum.

4. The assembly of claim 1 wherein:

one or more electronic components for operating the first display positioned within the plenum.

5. The assembly of claim 4 wherein:

the electronic component is a power module.

6. The assembly of claim 1 wherein:

the plenum comprises a first wall and second wall which oppose each other, a top wall, bottom wall, and a pair of sidewalls.

7. The assembly of claim 6 further comprising:

a gasket positioned between the top wall and the second wall.

8. The assembly of claim 1 wherein:

the second display assembly is permitted to move relative to the first display assembly.

9. The assembly of claim 1 wherein:

the second display assembly hangs from the first display assembly.

10. The assembly of claim 6 wherein:

the first wall is fixed relative to the first display assembly; and  
the second wall is fixed relative to the second display assembly.

11. The assembly of claim 6 wherein:

the first gap is further defined between the first wall of the plenum and an LED backlight for the first display assembly; and

the second gap is further defined between the second wall of the plenum and an LED backlight for the second display assembly.

12. The assembly of claim 1 further comprising:

a first dividing wall positioned within the plenum; and

a second dividing wall positioned within the plenum and oriented substantially perpendicular to the first dividing wall.

13. The assembly of claim 12 further comprising:

a plenum fan positioned within the first or second dividing wall.

14. A back to back electronic display assembly comprising:

a first LED backlit display positioned back to back with a second LED backlit display;

a plenum positioned in between the first and second LED backlit displays; and

a fan positioned to force air around the plenum and along the first and second LED backlights.

15. The assembly of claim 14 wherein:

the second LED backlit display is permitted to move relative to the first LED backlit display.

16. The assembly of claim 15 wherein:

moving the second LED backlit display relative to the first LED backlit display permits access to an interior portion of the plenum.

17. The assembly of claim 14 further comprising:

a dividing wall positioned within the plenum; and

a plenum fan attached to the dividing wall so as to cause circulating air to flow through the dividing wall.

18. A back to back electronic display assembly comprising:

a first LED backlit display positioned back to back with a second LED backlit display;

a plenum positioned in between the first and second LED backlit displays and comprising:

a first wall which faces the first LED backlight,

a second wall which faces the second LED backlight,

a top wall,

a bottom wall, and

a pair of sidewalls;

a first gap defined by the space between the first wall and the first LED backlight;

a second gap defined by the space between the second wall and the second LED backlight;

an electronic component attached to the first wall or second wall;

a first fan positioned to force air through the first gap and the second gap;



a dividing wall positioned within the plenum that connects between the first wall and second wall of the plenum; and  
a second fan positioned on the dividing wall.

19. The assembly of claim 18 wherein:

the first wall is fixed relative to the first display; and  
the second wall is fixed relative to the second display.

20. The assembly of claim 18 further comprising:

an additional dividing wall within the plenum which is connected to the first dividing wall and connects between the first wall and second wall of the plenum.

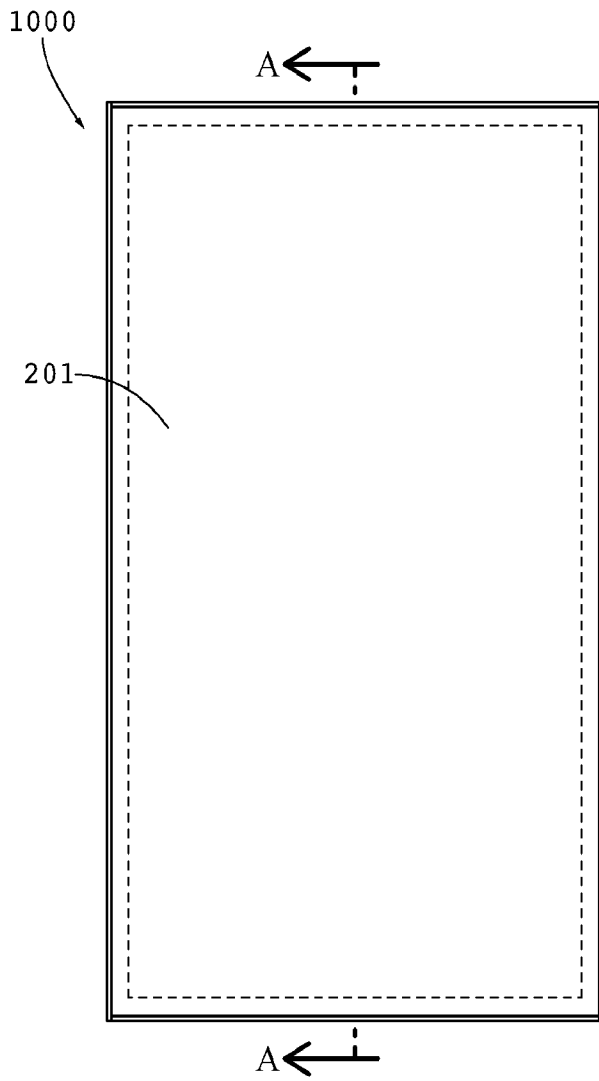


Fig. 1

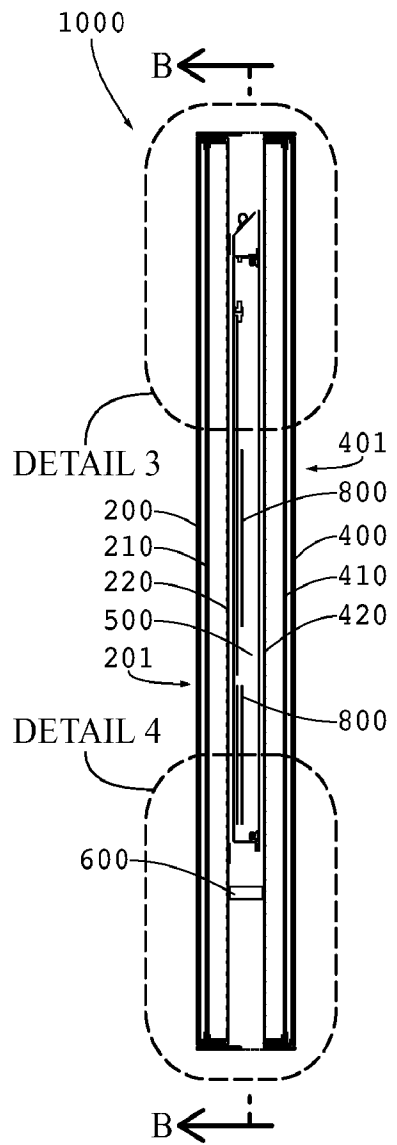


Fig. 2

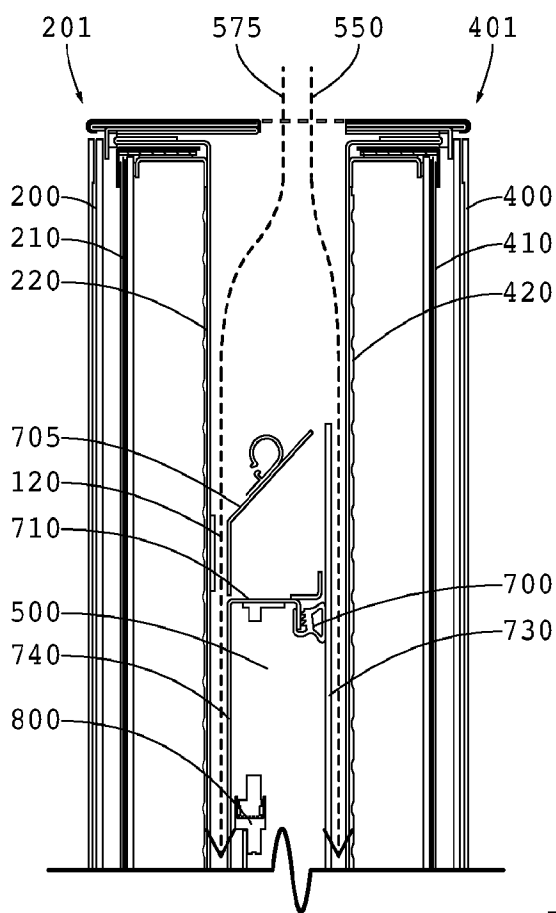


Fig. 3

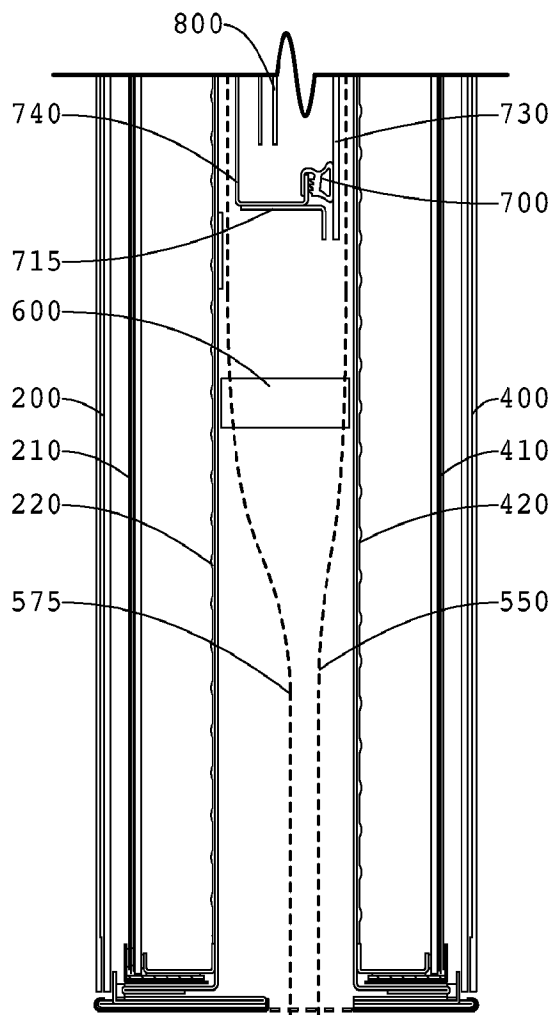


Fig. 4

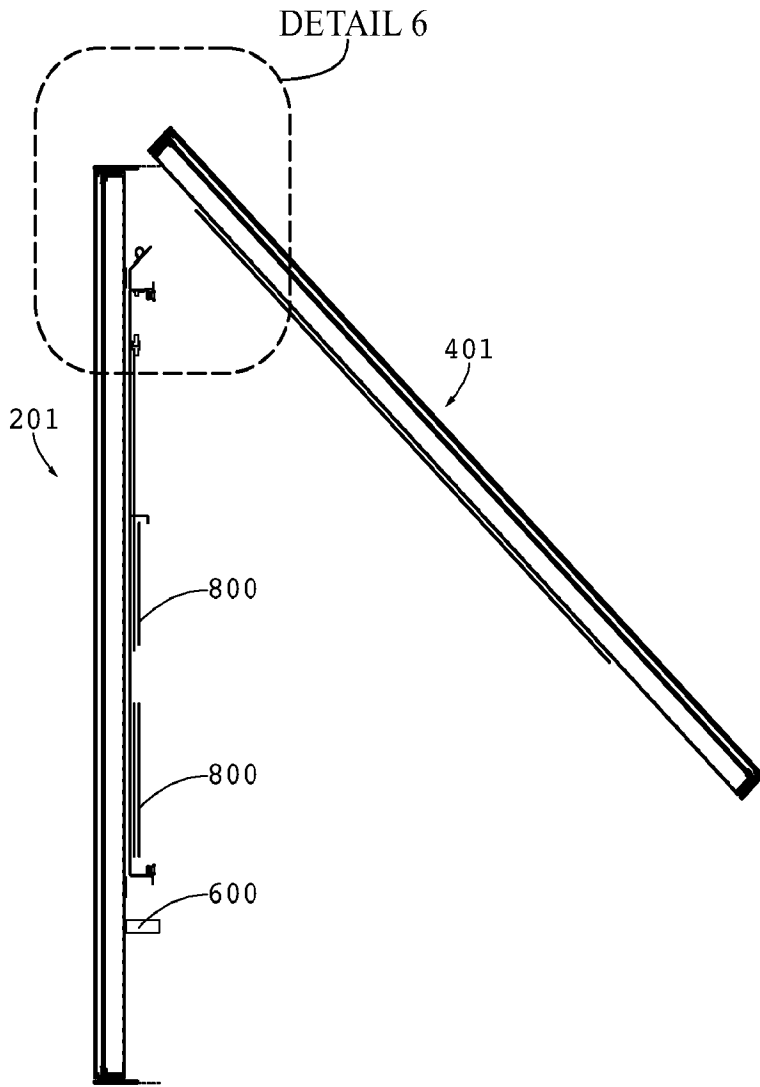


Fig. 5

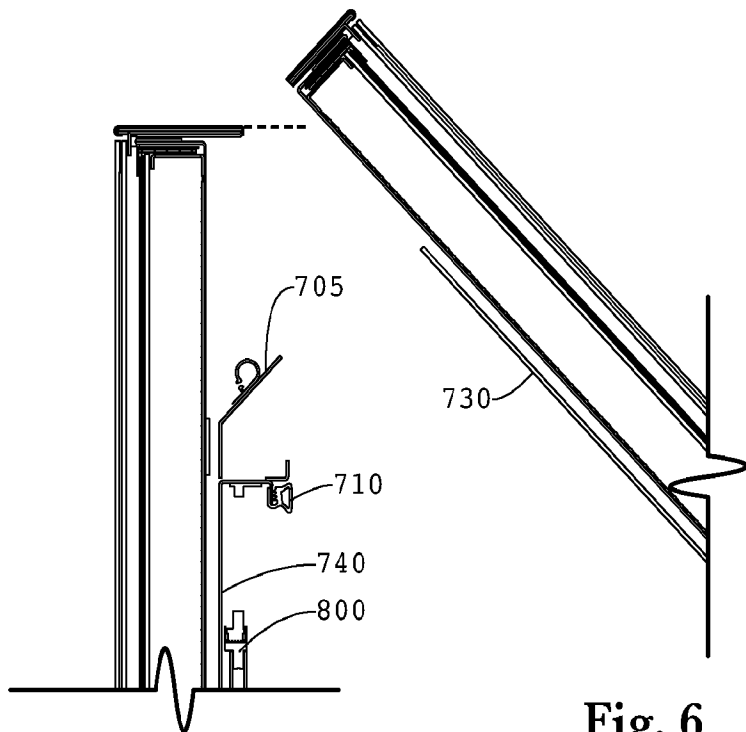


Fig. 6

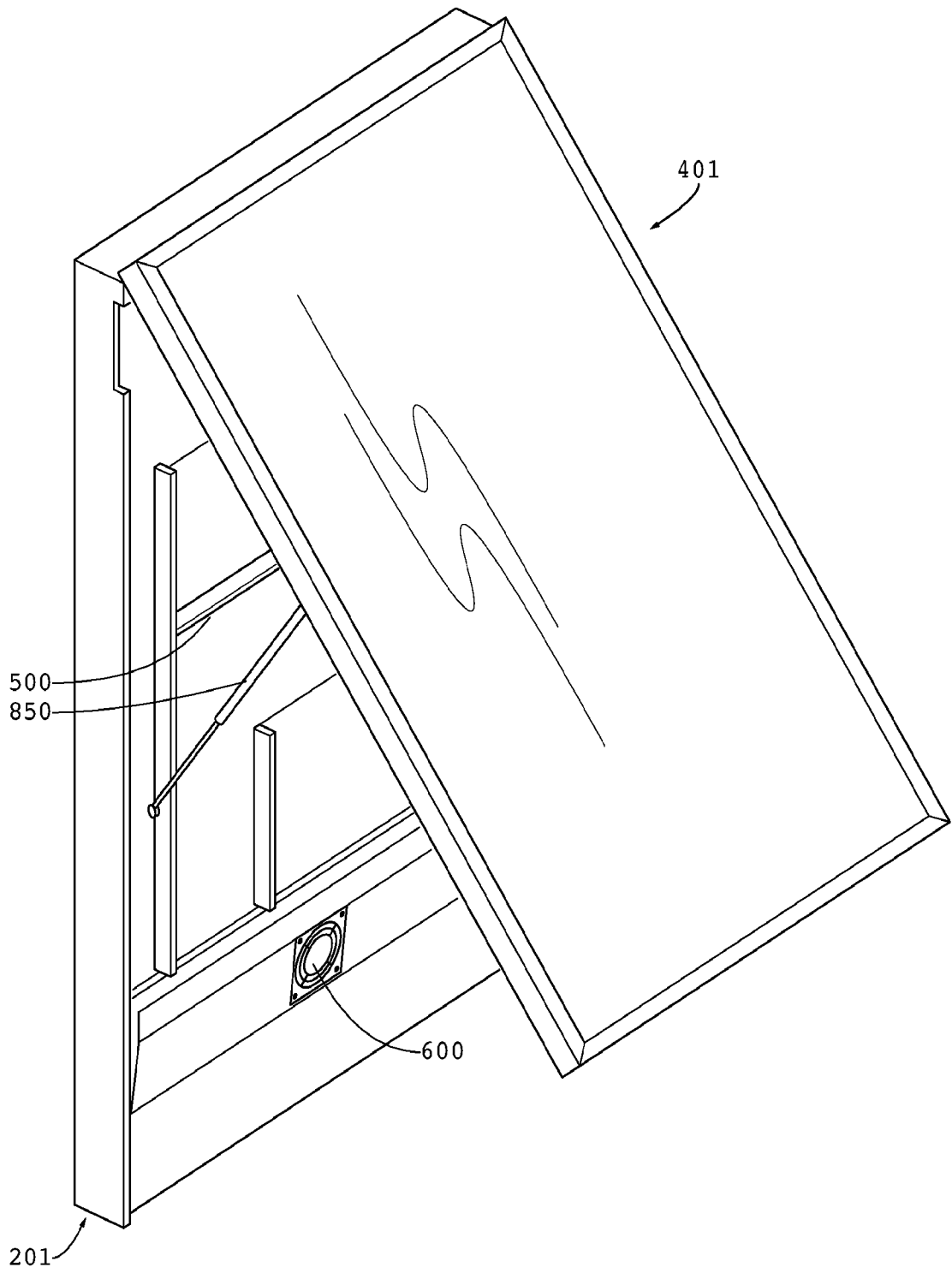


Fig. 7

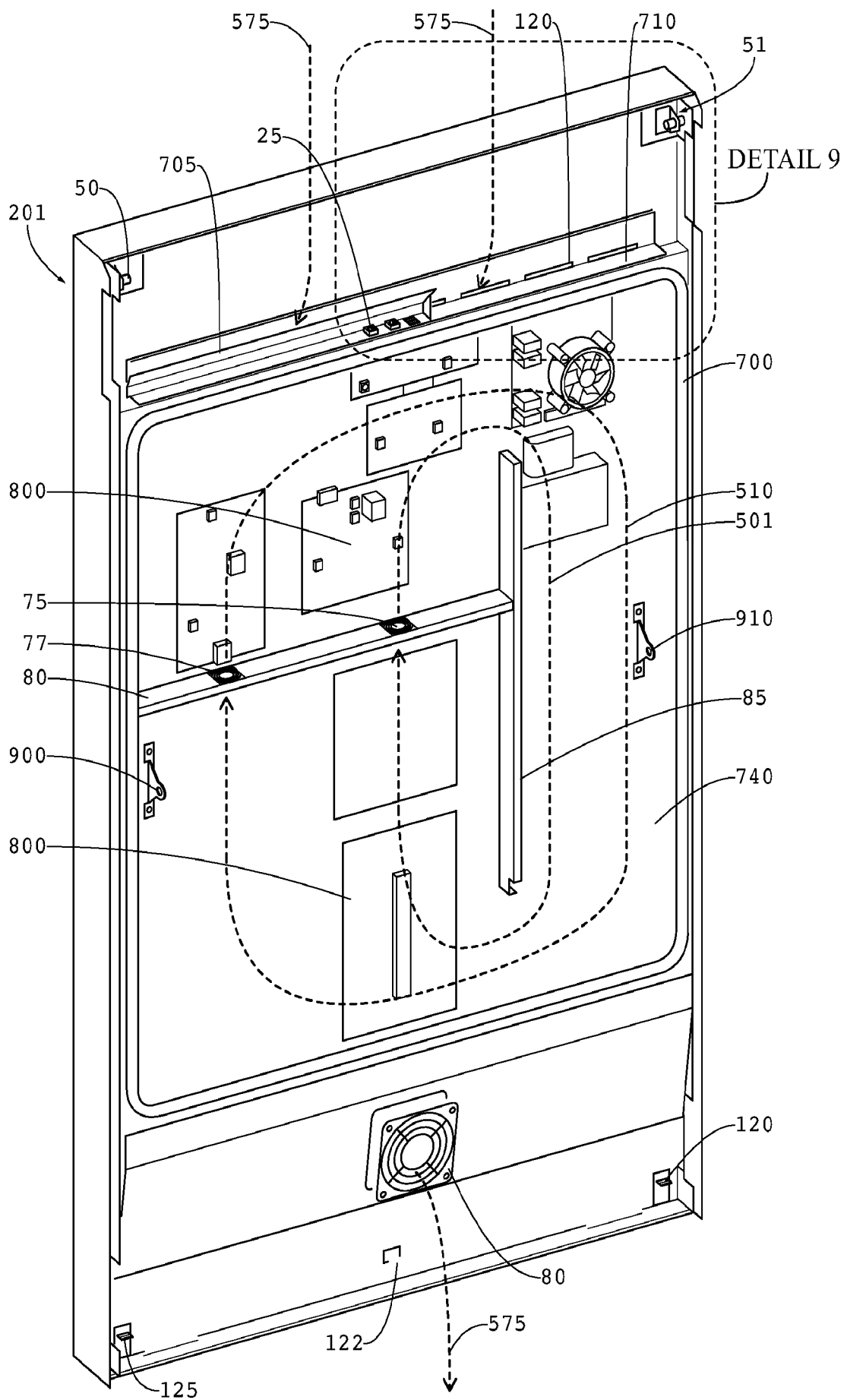


Fig. 8

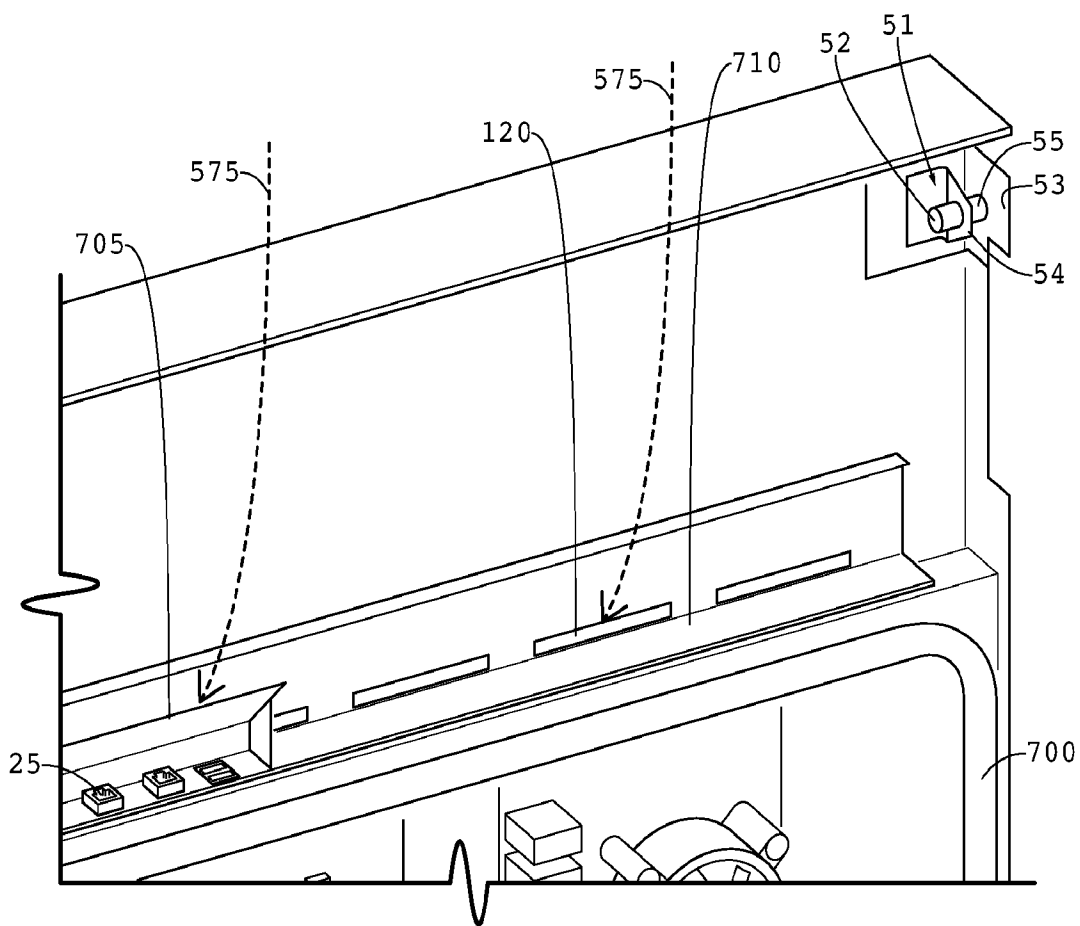


Fig. 9

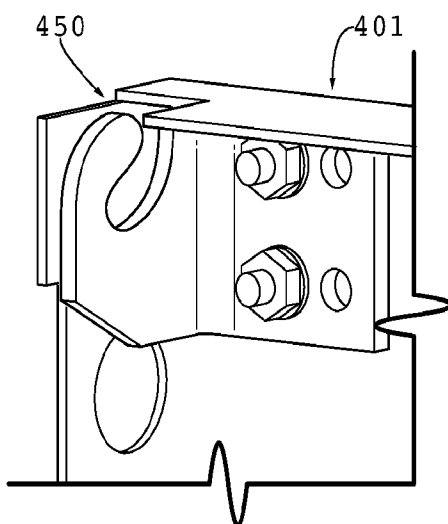


Fig. 10

**INTERNATIONAL SEARCH REPORT**

International application No.

PCT/US2015/028461

**A. CLASSIFICATION OF SUBJECT MATTER**

IPC(8) - H05K 7/20 (2015.01)

CPC - H05K 7/20954 (2015.07)

According to International Patent Classification (IPC) or to both national classification and IPC

**B. FIELDS SEARCHED**

Minimum documentation searched (classification system followed by classification symbols)

IPC(8) - G02F 1/1335; H05K 7/16, 7/20 (2015.01)

CPC - G02F 1/133382, 1/133385; H05K 7/20009, 7/20136, 7/20145, 7/202, 7/20954, 7/20972 (2015.07)

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

USPC - 349/58, 161; 361/695 (keyword delimited)

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

Orbit, Google Patents, Google.

Search terms used: display, LCD, LED, multiple, dual, back-to-back, cooling, plenum, hinged

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2011/0085301 A1 (DUNN) 14 April 2011 (14.04.2011) entire document	1-2, 6, 10-14, 17-19
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Y		4-5, 7-9, 15-16
Y	US 2006/0269216 A1 (WIEMEYER et al) 30 November 2006 (30.11.2006) entire document	4-5
Y	US 5,748,269 A (HARRIS et al) 05 May 1998 (05.05.1998) entire document	7
Y	US 2010/0232107 A1 (DUNN) 16 September 2010 (16.09.2010) entire document	8-9, 15-16
A	US 2011/0058326 A1 (IDEMS et al) 10 March 2011 (10.03.2011) entire document	1-20

Further documents are listed in the continuation of Box C.

See patent family annex.

\* Special categories of cited documents:

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"E" earlier application or patent but published on or after the international filing date

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"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search

06 July 2015

Date of mailing of the international search report

29 JUL 2015

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