

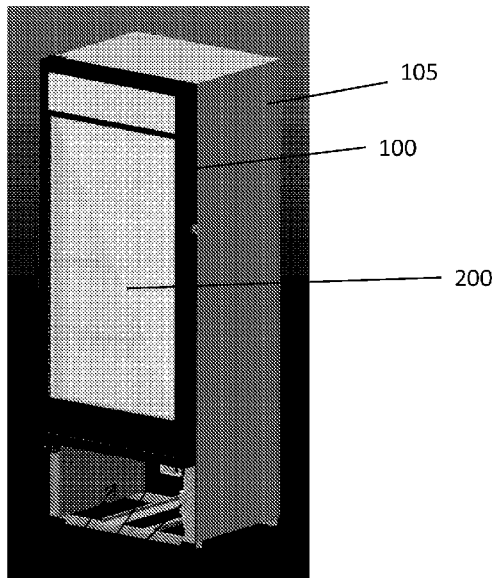


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[Continued on next page]

(54) Title: TRANSPARENT LCD ASSEMBLY WITH DISPLAY CASE



110 111 FIG - 1

(57) Abstract: The exemplary embodiments herein provide a transparent liquid crystal display (LCD) assembly having a glass panel with an LCD panel placed in front of the glass panel. A light guide may be positioned between the LCD panel and the glass panel and the light guide may have an edge. A substrate containing a plurality of LEDs is preferably positioned adjacent to the edge of the light guide and a thermal plate is preferably attached to both the substrate and the glass panel. The thermal plate may contain two portions which are substantially perpendicular to each other, where one of the portions is substantially parallel to the glass panel. In some embodiments, the LCD may be sandwiched in between a pair of glass panels, held opposite one another by a spacer. Further embodiments provide a system for tracking the opening and closing of a display case door along with identifying data for the video/image being shown when the door is opened or closed.



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## Transparent LCD Assembly With Display Case

### Cross-Reference to Related Applications

**[0001]** This application claims priority to US Provisional Application No. 62/012,785 filed on June 16, 2014 which is herein incorporated by reference in its entirety. This application also claims priority to US Provisional Application No. 62/012,559 filed on June 16, 2014 which is herein incorporated by reference in its entirety. This application claims priority to US Provisional Application No. 62/012,572 filed on June 16, 2014 which is herein incorporated by reference in its entirety. This application claims priority to US Provisional Application No. 62/013,917 filed on June 18, 2014 which is herein incorporated by reference in its entirety. This application claims priority to US Provisional Application No. 62/013,225 filed on June 17, 2014 which is herein incorporated by reference in its entirety.

### Technical Field

**[0002]** Embodiments generally relate to cooling systems for transparent liquid crystal displays (LCD) and traditional LCDs.

### Background of the Art

**[0003]** Display cases are used in a number of different retail establishments for illustrating the products that are available for sale. In some instances these display cases may be coolers or freezers which are placed in grocery stores, convenience stores, gas stations, restaurants, or other retail establishments. In other instances these display cases may be non-refrigerated transparent containers used in a jewelry or watch store, bakery, deli, antique shop, sporting goods store, electronics store, or other retail establishments. While the design and appearance of the product itself does provide some point-of-sale (POS) advertising, it has been found that additional advertising at the POS can increase the awareness of a product and in turn create additional sales.

**[0004]** Most retail establishments already contain some POS advertising, and depending on the type of establishment the proprietor may want to limit the amount of 'clutter' in the retail area – resulting in a very limited space for additional POS advertising. It has now become desirable to utilize the transparent glass that is typically placed in display cases with additional POS advertising. Most notably, it has been considered that transparent LCDs may be positioned along with the transparent glass and could display additional advertising materials while still allowing a patron to view the products inside the display case.

#### Summary of the Exemplary Embodiments

**[0005]** An exemplary embodiment provides a cooling system for a transparent LCD assembly. LEDs are preferably arranged along the top and bottom edges of a two way light guide which permits the light to exit both the front and rear surface of the light guide. The top LEDs are preferably placed in thermal communication with a top thermal plate which is preferably placed in conductive thermal communication with the rear glass. Similarly, the bottom LEDs are preferably placed in thermal communication with a bottom thermal plate which is also placed in conductive thermal communication with the rear glass. The top and bottom thermal plates permit the heat to spread out and transfer to the rear glass where it can be removed by forced or natural convection. In some embodiments the light guide is permitted to move parallel to the LCD but is constrained from movement towards or away from the LCD, preferably by a front a rear bracket sandwiching the light guide.

**[0006]** An exemplary embodiment provides a system for tracking and analyzing display case usage. An exemplary display case contains a CPU and door sensor, as well as a connection to the internet or cellular network. Some display cases may also contain a temperature sensor. When the door is opened, an identifier for the image/video being currently shown is preferably stored at the CPU along with the date and time the door was opened. This data can be collected and transmitted via an internet/cellular network to an operations center having a CPU. In this way, the data can be analyzed to determine the traffic through the display case as well as the effectiveness of the images/videos being shown. By using the system and method

described herein, the energy efficiency can be increased as well as the effectiveness of the advertisements.

**[0007]** 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

**[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 perspective view of a display case having an exemplary sealed transparent LCD assembly.

**[0010]** **FIGURE 2** is a perspective view of the display case of Figure 1 where the door has been opened.

**[0011]** **FIGURE 3** is a perspective view of the sealed transparent LCD assembly of Figures 1-2.

**[0012]** **FIGURE 4** is a front planar view of the sealed transparent LCD assembly, showing the section lines A-A and B-B.

**[0013]** **FIGURE 5** is a section view taken along the section line A-A shown in Figure 4 and indicating Detail A and Detail B.

**[0014]** **FIGURE 6** is a section view taken along the section line B-B shown in Figure 4 and indicating Detail C.

**[0015]** **FIGURE 7** is a detailed section view of Detail A shown in Figure 5.

**[0016]** **FIGURE 8** is a detailed section view of Detail B shown in Figure 5.

**[0017]** **FIGURE 9** is a detailed section view of Detail C shown in Figure 6.

**[0018]** **FIGURE 10** is a perspective view of a partially assembled exemplary embodiment of a sealed transparent LCD assembly.

**[0019]** **FIGURE 11** is a simplified partial view of an exemplary embodiment of the lower thermal plate.

**[0020]** **FIGURE 12** is a simplified partial view of an exemplary embodiment of the upper thermal plate.

[0021] **FIGURE 13** is a perspective view of the refrigerated display case of Figure 1 showing the cavity for electronic devices as well as the location of Detail A.

[0022] **FIGURE 14** is a front view of Detail A shown in Figure 3.

[0023] **FIGURE 15** is a perspective view of the display case where a video is being shown on the transparent LCD.

[0024] **FIGURE 16** is a logic flow chart for operating the hardware and software within the display case.

[0025] **FIGURE 17** is a graphical representation of the data collected by the hardware and software described above.

[0026] **FIGURE 18** is an electrical schematic representation of an exemplary embodiment of the system for tracking and analyzing display case usage.

[0027] **FIGURE 19** is a logical flowchart that can be performed by the operations center and the computing devices utilized therein.

#### Detailed Description

[0028] 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.

[0029] 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.

**[0030]** 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.

**[0031]** 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.

**[0032]** **FIGURE 1** is a perspective view of a display case having an exemplary sealed transparent LCD assembly 200. Generally, the display case includes a housing 105, to which a door frame assembly 100 is fastened. In this embodiment, a cavity 110 is provided below the door frame assembly 100 where various electronic devices 111 for operating the transparent LCD assembly 200 can be located. The electrical devices 111 may include any or all of the following: timing and control board (TCON), video player, hard drive/storage, microprocessor/CPU, wireless transmitter/receiver, cellular data transmitter/receiver, and internet connectivity. At least some of the electrical devices 111 are in electrical communication with the transparent LCD 230.

**[0033]** **FIGURE 2** is a perspective view of the display case of Figure 1 where the door has been opened.

**[0034]** **FIGURE 3** is a perspective view of the sealed transparent LCD assembly 200 of Figures 1-2. Generally speaking, the assembly includes a spacer 300 which is sandwiched between a front glass 225 and rear glass 205. These components are preferably sealed together with an inert gas filling the sealed enclosure. Although not required for every embodiment, argon gas has been found to be preferred in the exemplary embodiments. For sealing these components together, it is preferable to use

a hot melt polyurethane. Preferably, the spacer 300 is the Super Spacer® Standard from Quanex in Cambridge, OH. [www.quanex.com](http://www.quanex.com). In an exemplary embodiment, the spacer 300 would be a flexible foam that contains a desiccant and has a pressure sensitive acrylic adhesive on the front and back edges of the spacer which would be used to bond with the front and rear glass.

**[0035]** **FIGURE 4** is a front planar view of the sealed transparent LCD assembly, showing the section lines A-A and B-B. **FIGURE 5** is a section view taken along the section line A-A shown in Figure 4 and indicating Detail A and Detail B. **FIGURE 6** is a section view taken along the section line B-B shown in Figure 4 and indicating Detail C.

**[0036]** **FIGURE 7** is a detailed section view of Detail A shown in Figure 5. A top thermal plate 216 is preferably bonded to the rear glass 205. In an exemplary embodiment, the top thermal plate 216 is preferably bonded to the rear glass 205 through adhesive transfer tape. An exemplary adhesive transfer tape for this purpose would be 468 MP, available commercially from 3M™ of St. Paul, MN. [www.3M.com/converter](http://www.3M.com/converter). A printed circuit board (PCB) 246 containing a plurality of LEDs 276 is preferably attached to the top thermal plate 216 and is preferably in conductive thermal communication with the top thermal plate 216 as well. In this way, heat that is generated by the LEDs 276 can be transmitted to the PCB 246, top thermal plate 216, and eventually transferring to the rear glass 205 where the heat can dissipate through natural or forced convection.

**[0037]** The LEDs 276 are placed adjacent to the edge of a light guide 220 which is sandwiched between a rear bracket 211 and a front bracket 236. Generally speaking, the light guide 220 is only constrained from movement towards the front or back of the assembly, but is not constrained from movement towards the top or sides of the assembly. In other words, the light guide 220 is secured such that it is capable of thermal expansion/contraction in the X-Y direction (horizontal and vertical when observing the LCD), but is fixed in the Z direction (into/out of the assembly when observing the LCD). It could also be said that the light guide 220 is constrained so that it cannot move towards the front or rear glass but otherwise is permitted to float between the rear bracket 211 and front bracket 236. In an exemplary embodiment, the

light guide 220 would be the Acrylite® LED Endlighten product available from Evonik Industries. [www.acrylite-shop.com](http://www.acrylite-shop.com).

**[0038]** Preferably, the light guide 220 would contain microscopic diffuse particulate that is homogeneously scattered throughout the sheet. Also preferably, the light emitted from the LEDs 276 and 275 is permitted to exit both the front and rear surfaces of the light guide 220 (in this way, the light guide 220 could be referred to as a 'two way light guide'). In an exemplary embodiment, the light is permitted to exit the rear of the light guide 220 so as to illuminate the products within the display case. Thus, it is preferable that the amount of light permitted to exit the rear surface of the light guide 220 is at least 20% of the amount of light permitted to exit the front surface of the light guide 220.

**[0039]** The transparent LCD 230 is preferably attached to a front surface of the front bracket 236 through a layer of adhesive 241 which would preferably be applied around the perimeter of the LCD 230. In an exemplary embodiment, the adhesive 241 would be VHB tape and preferably 5052 VHB Tape available commercially from 3M™ of St. Paul, MN. [www.3M.com](http://www.3M.com).

**[0040]** **FIGURE 8** is a detailed section view of Detail B shown in Figure 5. A bottom thermal plate 215 is preferably bonded to the rear glass 205. In an exemplary embodiment, the bottom thermal plate 215 is preferably bonded to the rear glass 205 through adhesive transfer tape. An exemplary adhesive transfer tape for this purpose would be 468 MP, available commercially from 3M™ of St. Paul, MN. [www.3M.com/converter](http://www.3M.com/converter). A printed circuit board (PCB) 245 containing a plurality of LEDs 275 is preferably attached to the bottom thermal plate 215 and is preferably in conductive thermal communication with the bottom thermal plate 215 as well. In this way, heat that is generated by the LEDs 275 can be transmitted to the PCB 245, bottom thermal plate 215, and eventually transferring to the rear glass 205 where the heat can dissipate through natural or forced convection.

**[0041]** The LEDs 275 are placed adjacent to the edge of a light guide 220 which is sandwiched between a rear bracket 211 and a front bracket 236. As discussed at length above, the light guide 220 is preferably only constrained from movement towards the front or back of the assembly, but is not contained from movement towards the top or sides of the assembly.

**[0042]** FIGURE 9 is a detailed section view of Detail C shown in Figure 6.

**[0043]** FIGURE 10 is a perspective view of a partially assembled exemplary embodiment of a sealed transparent LCD assembly. Here, the front glass 225 has been removed to show the interior of the sealed assembly 200. This view shows the rear glass 205 with the spacer 300 attached around the perimeter of the glass 205. The various electronic devices 400 as well as the second wireless transmitter/receiver 455 are shown attached to the bottom plate 215 and sealed between the rear glass 205 and front glass 225 (not shown here). Also shown is the rear bracket 211 which may be attached to the rear glass 205 as well.

**[0044]** FIGURE 11 is a simplified partial view of an exemplary embodiment of the lower thermal plate 215. In a preferred embodiment, the lower thermal plate 215 would extend horizontally as far as possible, preferably to the same horizontal width as the LCD 230 and may extend 4-14 inches in vertical width, depending on the application. In this embodiment, electrical devices 400 are mounted to the thermal plate 215 and can include, but are not limited to: power modules, wireless or satellite receiver/transmitter, video player, hard drive, microprocessor, and printed circuit boards. Although shown attached to the lower thermal plate 215, electrical devices 400 could also be mounted to the upper thermal plate 216. Preferably, the electrical devices 400 are also in conductive thermal communication with the thermal plate 215/216 so that heat which is generated by the electrical devices 400 can be transferred to the thermal plate 215/216 and eventually to the rear glass 205, where it can be removed by natural or forced convection.

**[0045]** A second wireless transmitter/receiver 455 is also preferably positioned on the lower mounting plate 215 and may communicate electronically with the wireless transmitter/receiver 450 shown within the cavity 110. A plurality of different signals can be transmitted between the two wireless devices 450/455 including but not limited to: image/video data, identifying data for the content being displayed on the LCD, visual alerts, image inspection/test patterns, temperature of the display case, and feedback data from the LCD 200 such as brightness, color saturation, color temperature, gamma, and contrast ratio.

**[0046] FIGURE 12** is a simplified partial view of an exemplary embodiment of the upper thermal plate. Again, in a preferred embodiment, the upper thermal plate 216 would extend horizontally as far as possible, preferably to the same horizontal width as the LCD 230. The upper thermal plate 216 may also extend 4-14 inches in vertical width, depending on the application. While not required, it is also preferred that the lower thermal plate 215 and the upper thermal plate 216 are within 15% of the same surface area. In other words, it is preferred that the plates 215/216 are substantially the same surface area. This is not required, however, as some embodiments may require a larger surface area for the plate which would contain the electrical devices 400, or a larger surface area for the top plate 216 as compared to the bottom plate 215. It is preferred that the thermal plates are both metallic, and most preferably aluminum, but they can be any material that has good thermal conductivity.

**[0047] FIGURE 13** is a perspective view of the refrigerated display case of Figure 1 showing the cavity for electronic devices as well as the location of Detail A. Also shown in this figure is the temperature sensor 620 which is in electrical communication with the CPU 455. The term CPU as used herein would preferably contain a microprocessor capable of executing software logic along with RAM storage as well as hard drive electronic storage. **FIGURE 14** is a front view of Detail A shown in Figure 3. Here, a wireless transmitter/receiver 450 is shown within the cavity 110 as well as a CPU 455. Also shown here is a door sensor 600 which is positioned to determine whether the door is currently open or not. The door sensor 600 is preferably in electrical communication with the CPU 455, which contains an electrical connection to either an internet or satellite network.

**[0048]** The wireless devices 450/455 can operate under any form of wireless networking technology, including but not limited to: WPAN, WLAN, a wireless mesh network, or GAN. Specifically regarding the architecture for a WLAN network, these could include but are not limited to stations, basic service set, extended service set, and a distribution system. Further regarding the types of wireless LANs, these could include but are not limited to peer-to-peer, bridge, and a wireless distribution system. Any form of general encryption method can be used with the exemplary embodiments herein.

**[0049]** The embodiments of the wireless communication and transparent LCD system described herein can be used with any number of display case designs, either temperature controlled or not, and with doors that open or glass that remains stationary. Although shown here with a transparent LCD, the wireless system could be used with a traditional backlit LCD as well.

**[0050]** **FIGURE 15** is a perspective view of the display case where a video is being shown on the transparent LCD 200.

**[0051]** **FIGURE 16** is a logic flow chart for operating the hardware and software within the display case, specifically the CPU 455 and door sensor 600. By operating with this logic, the date/time as well as an identifier for the particular video/image being shown can be stored.

**[0052]** **FIGURE 17** is a graphical representation of the data collected by the hardware and software described above. Once the data is collected, low traffic and high traffic throughout the day can be analyzed. This traffic data can be useful in many ways. For example, it may be determined that it is preferred to hold the temperature of the display case at 32 degrees F when the door is opened more than 100 times per hour, but only 35 degrees F when the door is opened less than 50 times per hour. In this way, the usage rate and temperature of the display case can be correlated in order to save energy costs. For example, we know that we can now raise the temperature of the display case to 35 degrees F from hours 0-6, 18, and 23-24 without risking damage to the contents. This requires less energy and can provide enormous cost savings when used for thousands of display cases.

**[0053]** **FIGURE 18** is an electrical schematic representation of an exemplary embodiment of the system for tracking and analyzing display case usage. Here, a plurality of display cases 50 are in communication with an internet/cellular network 70. Here, an operations center contains at least one CPU 40 which can communicate with the plurality of display cases 50 through the internet/cellular network 70. Generally speaking, if the internet/cellular network 70 is only internet, the CPU 455 and CPU 40 should each have some type of modem. Also generally speaking, if the internet/cellular network 70 is only cellular, the CPU 455 and CPU 40 should each have some type of cellular transmitter/receiver, and preferably a 4G cellular transmitter/receiver.

**[0054]** **FIGURE 19** is a logical flowchart that can be performed by the operations center and the computing devices utilized therein. Initially, the number of door openings per hour for each day can be averaged over the last X days (where X could be any number of days) to get an hourly average (AVG). Then, the number of openings per hour for any sample day can be compared with their corresponding AVG for that hour. Next, the logic can determine if the openings during any of the hours during the sample day exceed the hourly average by Y% or more (where Y can be set at any significant percentage depending on the data, but generally should be 15% or higher). If so, the identifier for the video/image being shown during that time is stored as a successful advertisement. In this way, advertisements that appear to create the most traffic within the cooler can be tracked or recorded so that these advertisements can be shown more often or so that future advertisements can be designed around the successful advertisements of the past. This provides the content providers with an unprecedented amount of control over their advertising, and specifically the effectiveness of their advertising.

**[0055]** It should be noted that although the above embodiments deal mostly with the number of door openings per hour this could be performed by the number of openings during any time interval, either in minutes, hours, full days, or any combination. The system could also be used to determine the number of openings during each video segment, average these values (optionally), standardize the averages based on how long the video's were to obtain a number of openings per second/minute, and/or determine which videos created the highest number of openings.

**[0056]** The embodiments of the cooling system described herein can be used with any number of display case designs, either temperature controlled or not, and with doors that open, or glass that remains stationary. Although shown here with a transparent LCD, the cooling system could be used with a traditional backlit LCD as well.

**[0057]** 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 transparent liquid crystal display (LCD) assembly comprising:
  - a glass panel;
  - an LCD panel placed in front of the glass panel;
  - a light guide positioned between the LCD panel and the glass panel, the light guide having an edge;
  - a substrate containing a plurality of LEDs placed adjacent to the edge of the light guide; and
  - a thermal plate attached to the glass panel as well as the substrate.
2. The transparent LCD assembly of claim 1 wherein:
  - the thermal plate is in conductive thermal communication with the glass panel as well as the substrate.
3. The transparent LCD assembly of claim 1 wherein:
  - the thermal plate contains a first portion attached to the glass panel and a second portion attached to the substrate where the first portion is substantially perpendicular to the second portion.
4. The transparent LCD assembly of claim 1 further comprising:
  - an electronic component for operating the LCD placed in electrical connection with the LCD and attached to the thermal plate.
5. The transparent LCD assembly of claim 1 further comprising:
  - a front bracket contacting a front surface of the light guide; and
  - a rear bracket contacting a rear surface of the light guide.
6. The transparent LCD assembly of claim 1, wherein:
  - the light guide is a two way light guide.

7. The transparent LCD assembly of claim 1, wherein:  
the light guide is constrained from movement towards or away from an intended viewer but is permitted to move vertically.
8. A transparent LCD assembly comprising:  
a rear glass panel;  
an LCD panel placed in front of the rear glass panel;  
a printed circuit board (PCB) containing a plurality of LEDs placed near the LCD panel; and  
a thermal plate having a first portion attached to the PCB and a second portion attached to the rear glass panel.
9. The transparent LCD assembly of claim 8, wherein:  
the first portion of the thermal plate is substantially perpendicular to the second portion.
10. The transparent LCD assembly of claim 8, wherein:  
the second portion of the thermal plate is substantially parallel to the rear glass panel and the first portion of the thermal plate is substantially perpendicular to the second portion.
11. A transparent liquid crystal display (LCD) assembly comprising:  
a front glass panel;  
a rear glass panel;  
a spacer sandwiched between the first and second glass panels to define a cavity;  
an LCD panel placed within the cavity;  
a light guide placed within the cavity and behind the LCD panel, the light guide having a top and bottom portion;  
a first substrate containing a plurality of LEDs and placed adjacent to the top portion of the light guide;

a top thermal plate attached to the rear glass panel as well as the first substrate;  
a second substrate containing a plurality of LEDs and placed adjacent to the  
bottom portion of the light guide; and  
a bottom thermal plate attached to the rear glass panel as well as the second  
substrate.

12. The transparent LCD assembly of claim 11 wherein:

the top thermal plate and bottom thermal plate are substantially the same width  
as the LCD panel.

13. The transparent LCD assembly of claim 11 wherein:

the top and bottom thermal plates each contain  
a first portion which is substantially parallel to the rear glass panel and  
the second portion which is substantially perpendicular to the first portion.

14. The transparent LCD assembly of claim 11 wherein:

the spacer provides a gaseous seal between the front glass panel and the rear  
glass panel.

15. A sealed transparent LCD assembly comprising:

a front glass panel;

a rear glass panel;

a spacer element positioned around a perimeter of the front and rear glass  
panels and sandwiched in between the front and rear glass panels to  
provide a gaseous seal between the front glass panel and the spacer  
element as well as between the rear glass panel and the spacer element;  
and

a liquid crystal display (LCD) panel positioned between the front and rear glass  
panels.

16. The sealed transparent LCD assembly of claim 15, further comprising:

- a light guide positioned between the LCD and the rear glass panel.
17. The sealed transparent LCD assembly of claim 16, wherein:  
said light guide is held between a front bracket and a rear bracket.
18. The sealed transparent LCD assembly of claim 16, wherein:  
the light guide is permitted to move vertically but cannot move towards or away  
from an intended viewer.
19. The sealed transparent LCD assembly of claim 16, wherein:  
the light guide is a two way light guide.
20. The sealed transparent LCD assembly of claim 15, wherein:  
the spacer element is a flexible foam comprising a desiccant and a pressure  
sensitive acrylic adhesive.
21. A sealed transparent LCD assembly comprising:  
a front glass panel;  
a rear glass panel;  
a liquid crystal display positioned between the front glass and rear glass panels;  
a spacer element which surrounds the liquid crystal display and is sandwiched in  
between the front and rear glass panels.
22. The sealed transparent LCD assembly of claim 21, wherein:  
the spacer element is bonded to the front and rear glass panels.
23. The sealed transparent LCD assembly of claim 21, wherein:  
the spacer element creates a gaseous seal between the front glass panel and  
the spacer element, as well as between the rear glass panel and the  
spacer element.

24. The sealed transparent LCD assembly of claim 21, wherein:  
the spacer element is a flexible foam comprising a desiccant and a pressure sensitive acrylic adhesive.
25. The sealed transparent LCD assembly of claim 23, wherein:  
the gaseous seal does not allow gas from outside the assembly to contact the LCD.
26. The sealed transparent LCD assembly of claim 21, further comprising:  
a two way light guide.
27. A sealed transparent LCD assembly comprising:  
a front glass panel;  
a rear glass panel;  
a spacer element positioned around a perimeter of the front and rear glass panels and sandwiched in between the front and rear glass panels to define a gaseously sealed cavity; and  
a liquid crystal display (LCD) panel positioned within the cavity.
28. The sealed transparent LCD assembly of claim 27, further comprising:  
an inert gas which substantially fills the cavity.
29. The sealed transparent LCD assembly of claim 27, wherein:  
the spacer element is a flexible foam comprising a desiccant and a pressure sensitive acrylic adhesive.
30. The sealed transparent LCD assembly of claim 27, further comprising:  
a two way light guide positioned between the rear glass and the LCD.
31. The sealed transparent LCD assembly of claim 30, further comprising:  
a plurality of LEDs arranged along an edge of the light guide.

32. A transparent liquid crystal display (LCD) assembly comprising:  
an LCD panel;  
a light guide positioned behind the LCD panel and having a front surface and a rear surface;  
a front bracket contacting the front surface of the light guide; and  
a rear bracket contacting the rear surface of the light guide.
33. The transparent LCD assembly of claim 32, wherein:  
the LCD panel is adhered to the front bracket.
34. The transparent LCD assembly of claim 32, wherein:  
the front bracket only contacts the front surface of the light guide and the rear bracket only contacts the rear surface of the light guide.
35. The transparent LCD assembly of claim 32, further comprising:  
a plurality of LEDs arranged to direct light into a perimeter of the light guide.
36. The transparent LCD assembly of claim 35, wherein:  
the light guide is configured such that light from the LEDs may escape from the front surface and the rear surface of the light guide.
37. The transparent LCD assembly of claim 35, wherein:  
the light guide is configured such that the amount of light permitted to exit the rear surface of the light guide is at least 20% of the amount of light permitted to exit the front surface of the light guide.
38. The transparent LCD assembly of claim 32, wherein:  
the light guide is constrained from movement towards or away from an intended viewer.

39. The transparent LCD assembly of claim 32, wherein:  
the light guide is free to move vertically.
40. The transparent LCD assembly of claim 32, wherein:  
the front bracket contains a portion which is substantially parallel to and  
contacting the front surface of the light guide.
41. A transparent LCD assembly comprising:  
an LCD panel; and  
a light guide positioned behind the LCD panel and substantially parallel to the  
LCD panel;  
wherein the light guide is permitted to move parallel to the LCD panel but  
constrained from movement towards the LCD panel.
42. The transparent LCD assembly of claim 41, further comprising:  
a front bracket having a front surface where the front bracket constrains the light  
guide from movement towards the LCD panel.
43. The transparent LCD assembly of claim 42, wherein:  
the LCD panel is attached to the front surface of the front bracket.
44. The transparent LCD assembly of claim 42, further comprising:  
a rear bracket which constrains the light guide from movement away from the  
LCD panel.
45. A transparent LCD assembly comprising:  
an LCD panel;  
a light guide positioned behind the LCD panel having a front and rear surface;  
a front bracket contacting the front surface of the light guide;  
a rear bracket contacting the rear surface of the light guide; and  
a plurality of LEDs arranged to direct light into a perimeter of the light guide.

46. The transparent LCD assembly of claim 45, wherein:  
the front bracket only prevents the light guide from moving towards the LCD panel,  
the rear bracket only prevents the light guide from moving away the LCD panel,  
and  
while the front bracket and rear bracket permit the light guide to move parallel to the LCD panel.
47. A system for tracking and analyzing display case usage comprising:  
a display case having a door;  
a transparent liquid crystal display (LCD) housed within the door;  
a sensor positioned to detect whether the door is open; and  
a CPU in electrical connection with the transparent LCD and the sensor;  
wherein the CPU stores data from the door sensor.
48. The system of claim 47, wherein:  
the CPU stores data representing content displayed on the transparent LCD.
49. The system of claim 47, wherein:  
the CPU is in electrical connection with a network to transmit door sensor data to a remote location.
50. The system of claim 47, further comprising:  
a temperature sensor in electrical connection with the CPU.
51. The system of claim 47, further comprising:  
a front glass; and  
a rear glass;  
wherein the transparent LCD is sandwiched between the front glass and the rear glass.

52. The system of claim 51, further comprising:  
an upper plate affixed to the rear glass and extending above the LCD; and  
a lower plate affixed to the rear glass and extending below the LCD.
53. The system of claim 52, wherein:  
the CPU is affixed to the lower plate.
54. The system of claim 47, wherein:  
the display case further comprises a first and second cavity;  
wherein the first cavity is configured to store a plurality of consumer products  
and the second cavity is configured to store a wireless  
transmitter/receiver.
55. The system of claim 54, wherein:  
the first cavity is refrigerated and the second cavity is not.
56. A system for tracking and analyzing display case usage comprising:  
a transparent liquid crystal display (LCD) affixed in a display case having a  
door;  
a CPU placed within the door and in electrical connection with the transparent  
LCD;  
a first wireless transmitter/receiver placed within the door and in electrical  
connection with the CPU;  
a second wireless transmitter/receiver in communication with the first wireless  
transmitter/receiver and a network; and  
a sensor in communication with the CPU and configured to detect  
if the door is open.
57. The system of claim 56, wherein:  
the CPU stores data regarding the content displayed on the transparent LCD

when the sensor detects that door is open.

58. The system of claim 56, further comprising:

a temperature sensor in electrical connection with the second wireless transmitter/receiver.

59. The system of claim 56, further comprising:

a front glass; and

a rear glass;

wherein the transparent LCD is located between the front and the rear glass.

60. The system of claim 59, further comprising:

a plate affixed to and in thermal communication with the rear glass.

61. The system of claim 60, wherein:

the CPU is attached to the plate.

62. A system for tracking and analyzing display case usage comprising:

a transparent liquid crystal display (LCD) mounted in a display cabinet;

a CPU in electrical connection with the LCD and adapted to store data regarding content being displayed on the LCD;

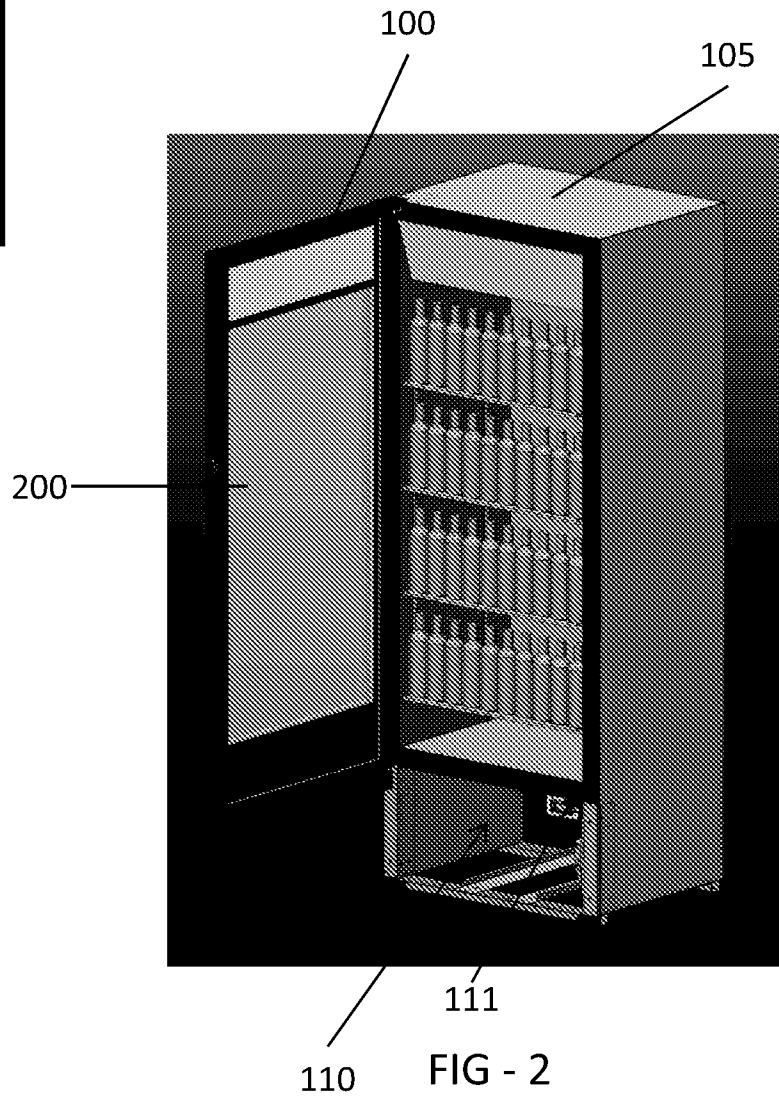
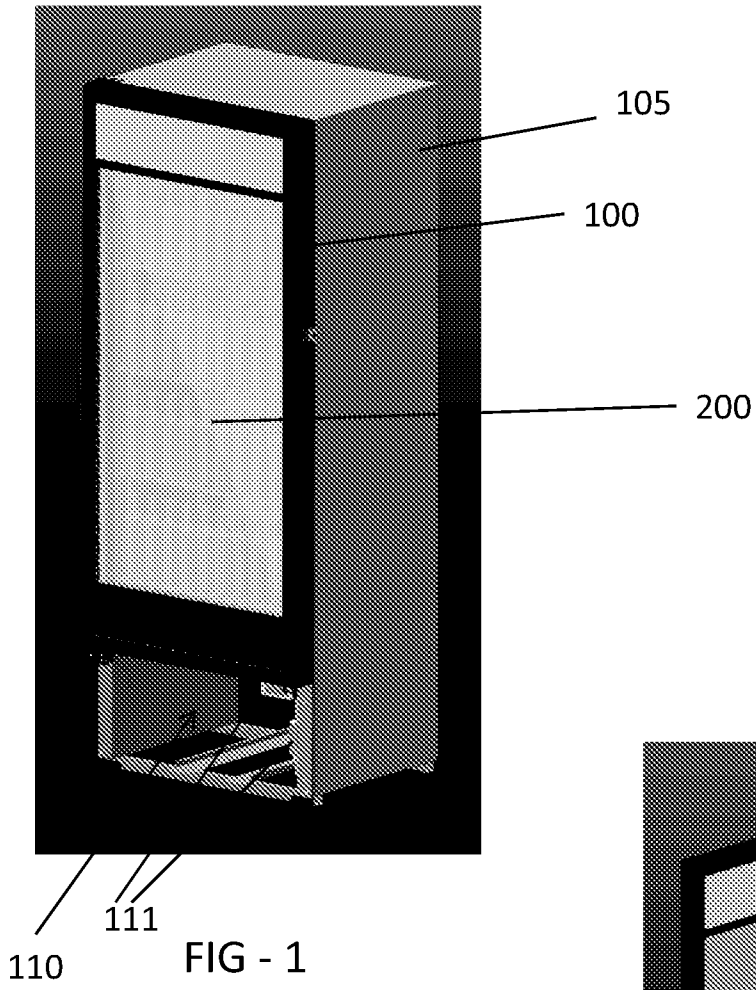
a sensor in electrical connection with the CPU and positioned to detect when the cabinet is open;

wherein the CPU collects data regarding the content being displayed on the LCD and whether the door has been opened while this content is being displayed.

63. The system of claim 62, further comprising:

a door having a front glass and a rear glass,

wherein the transparent LCD is located between the front and the rear glass.



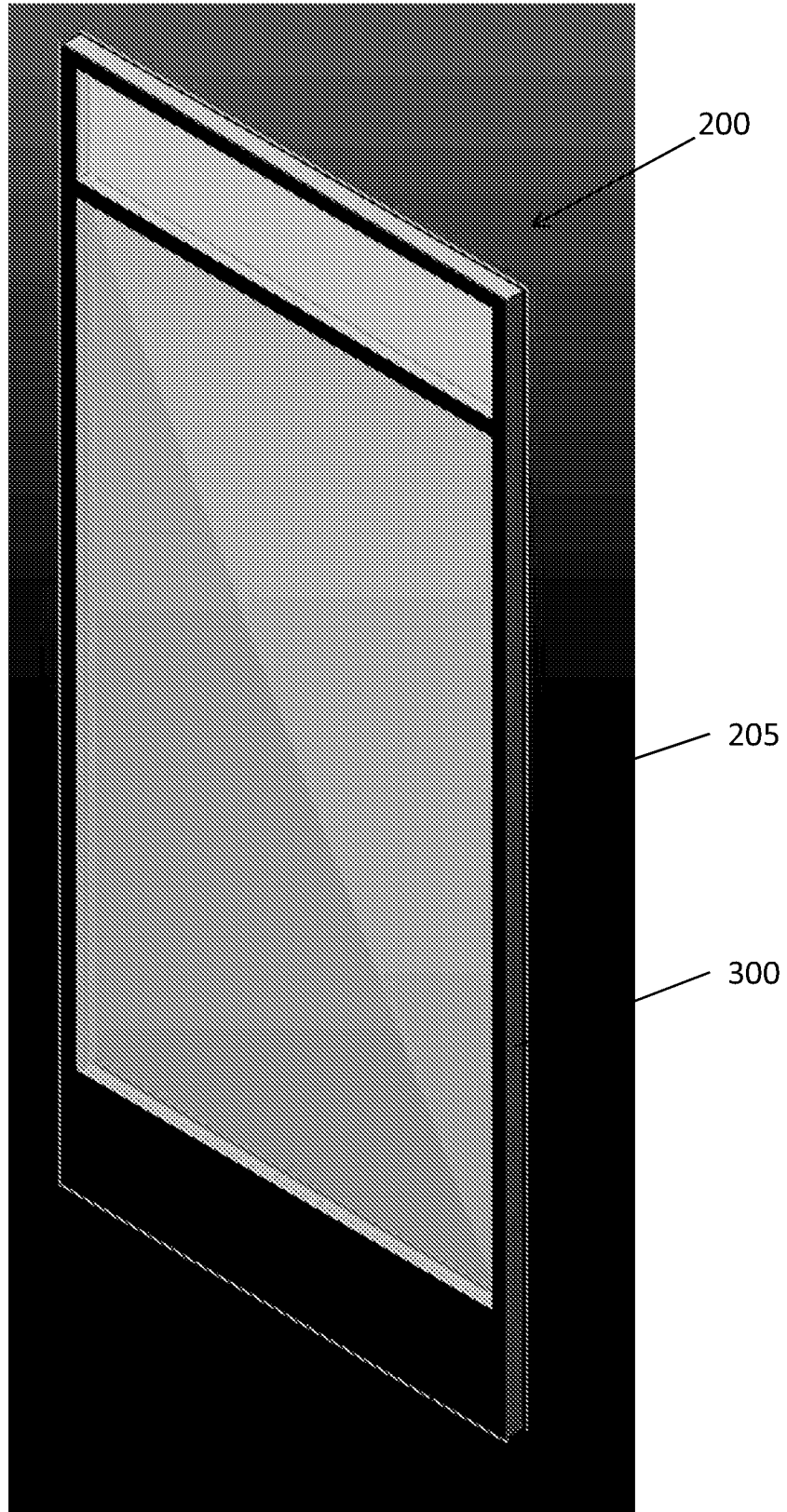


FIG - 3

225

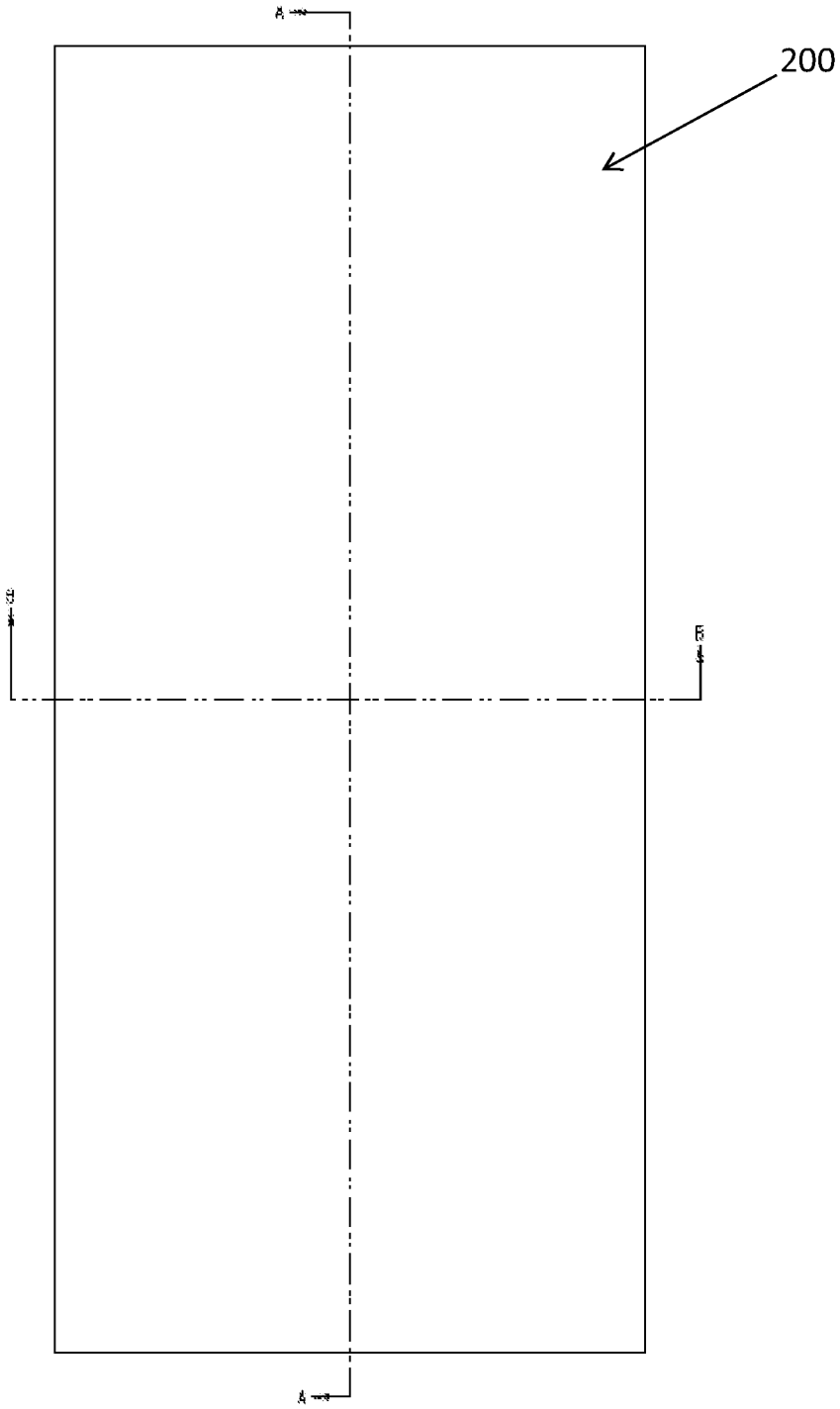
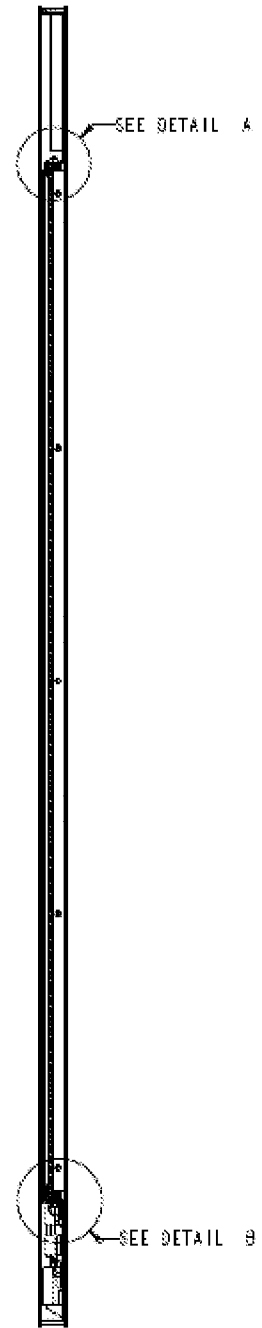
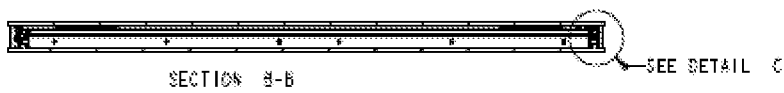


FIG - 4



SECTION A-A

FIG - 5



SECTION B-B

FIG - 6

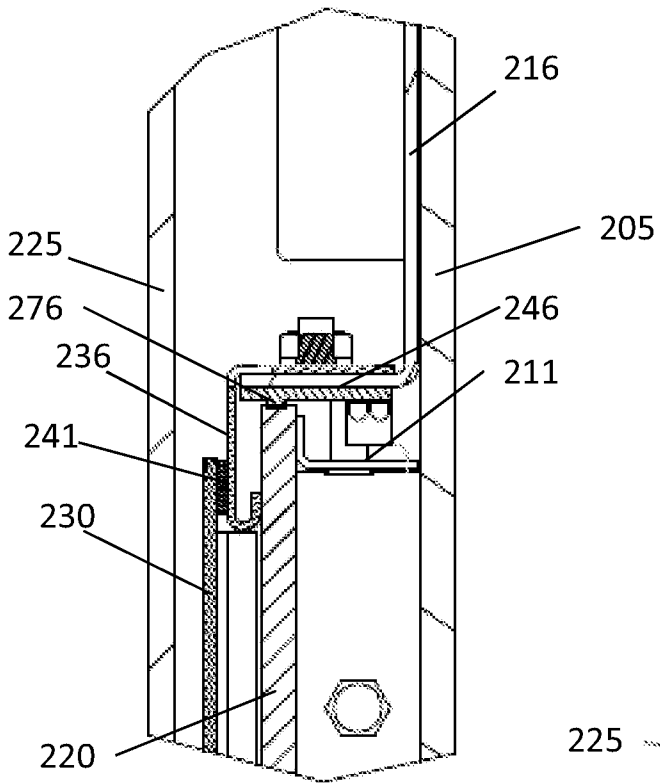


FIG - 7

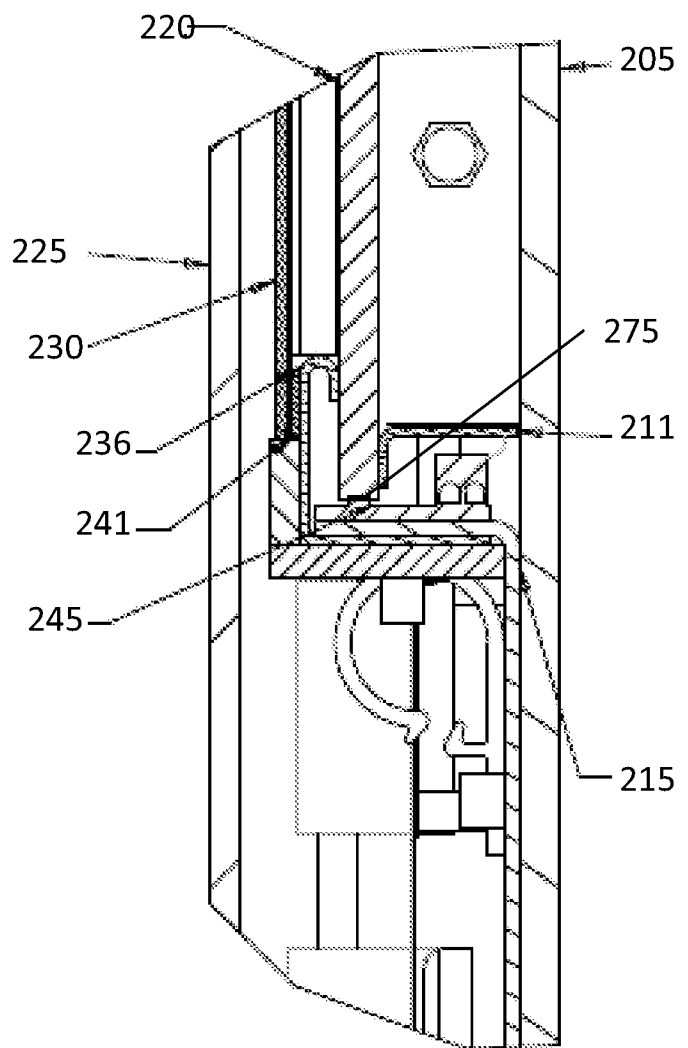
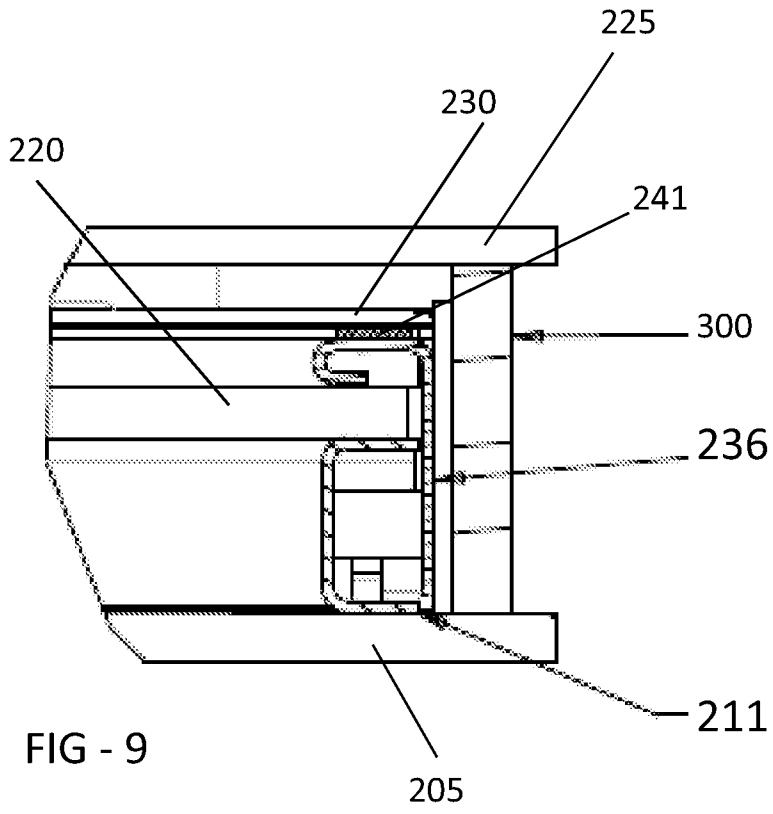


FIG - 8



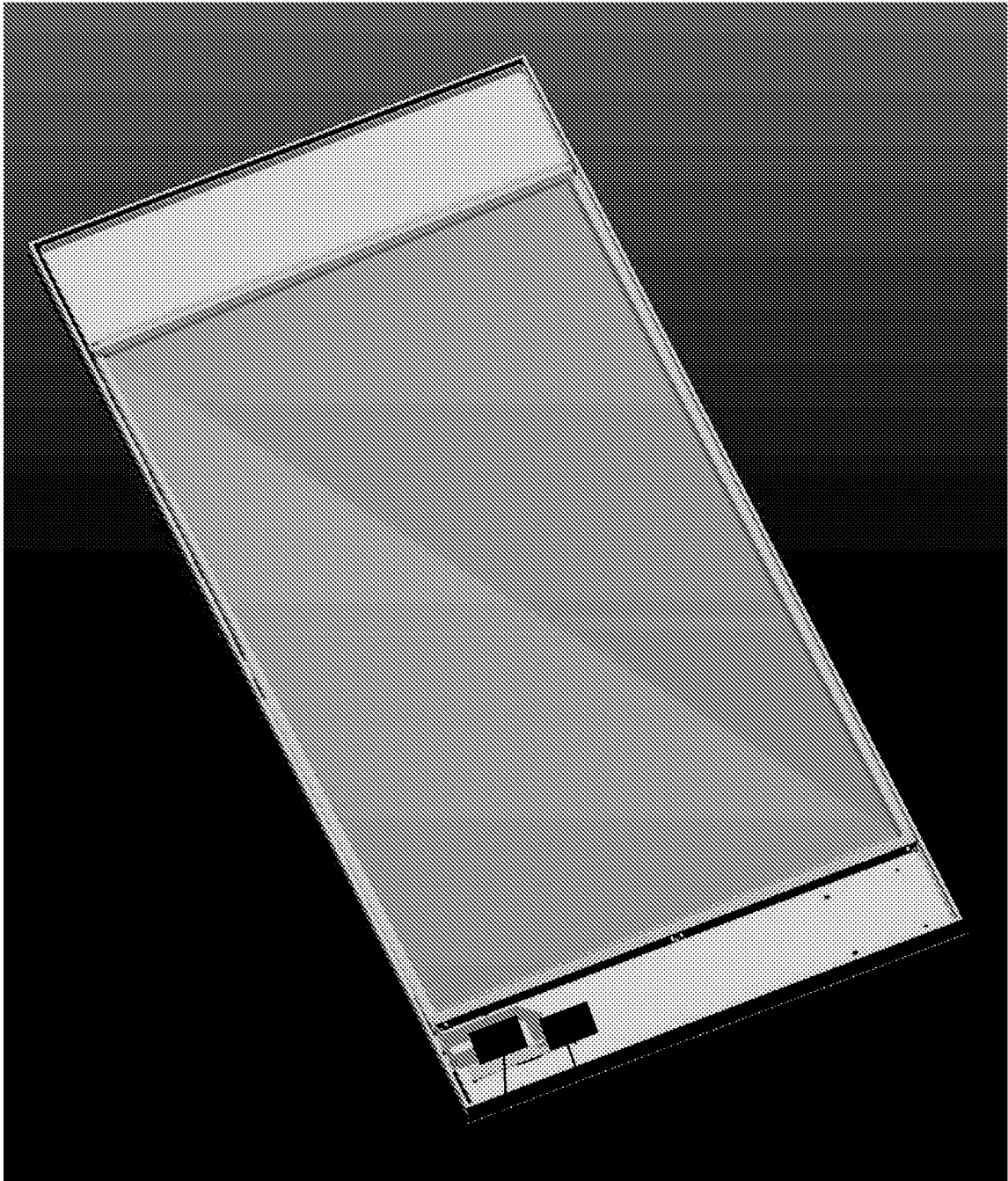


FIG - 10

300

455

400

205

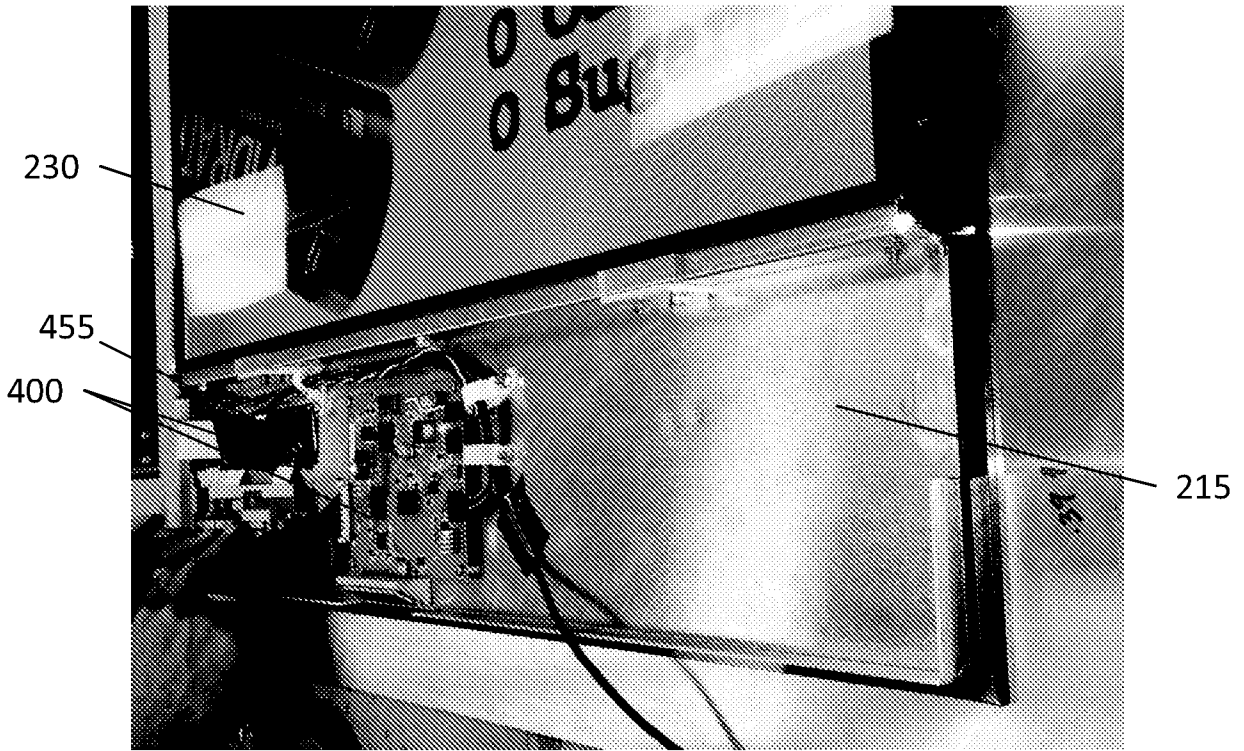


FIG - 11



FIG - 12

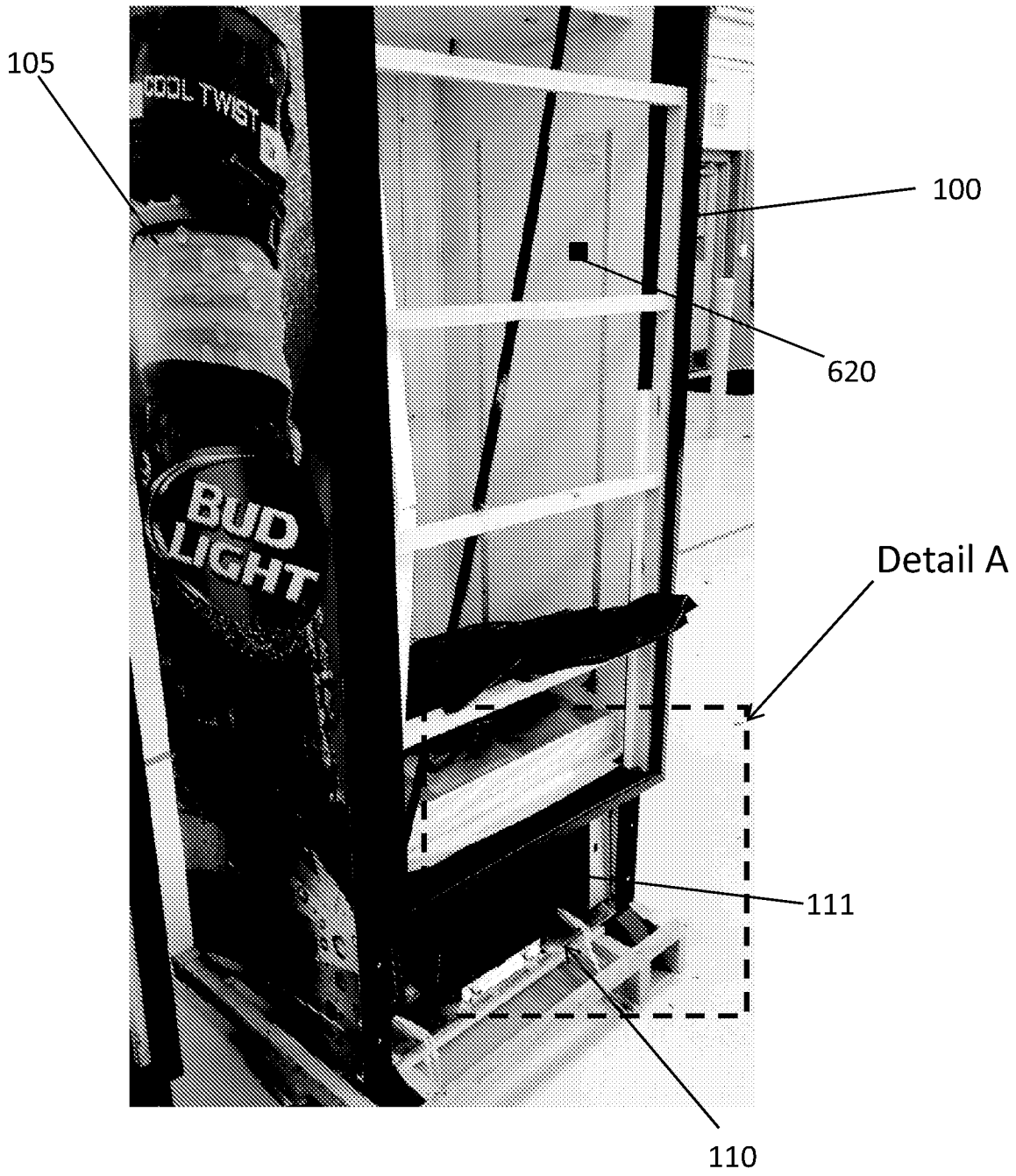


FIG - 13

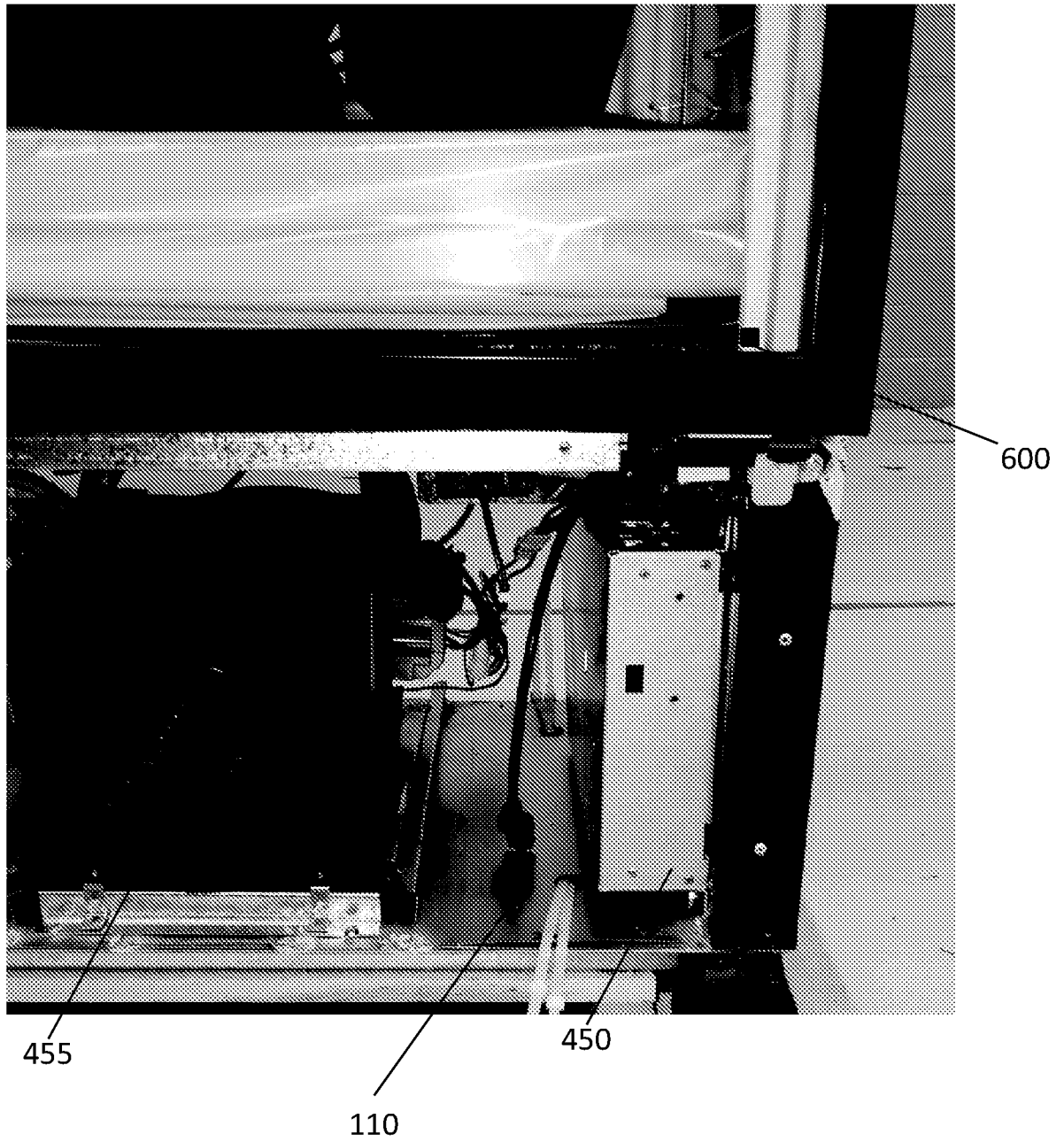


FIG - 14



FIG - 15

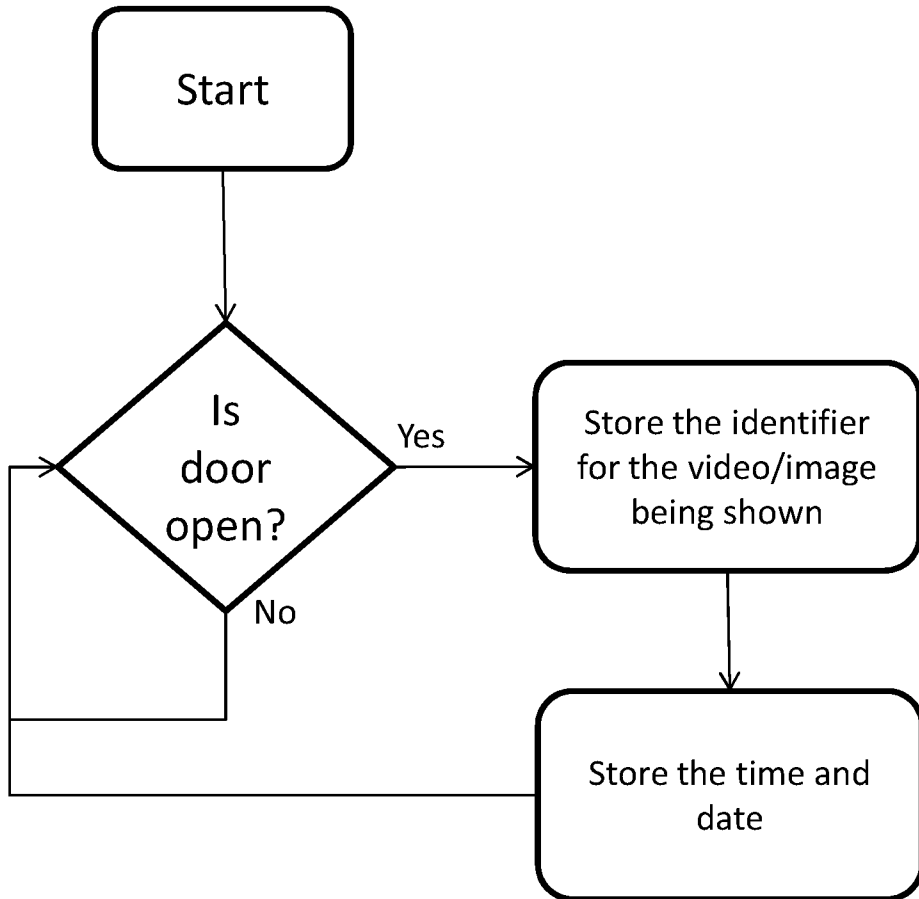


FIG - 16

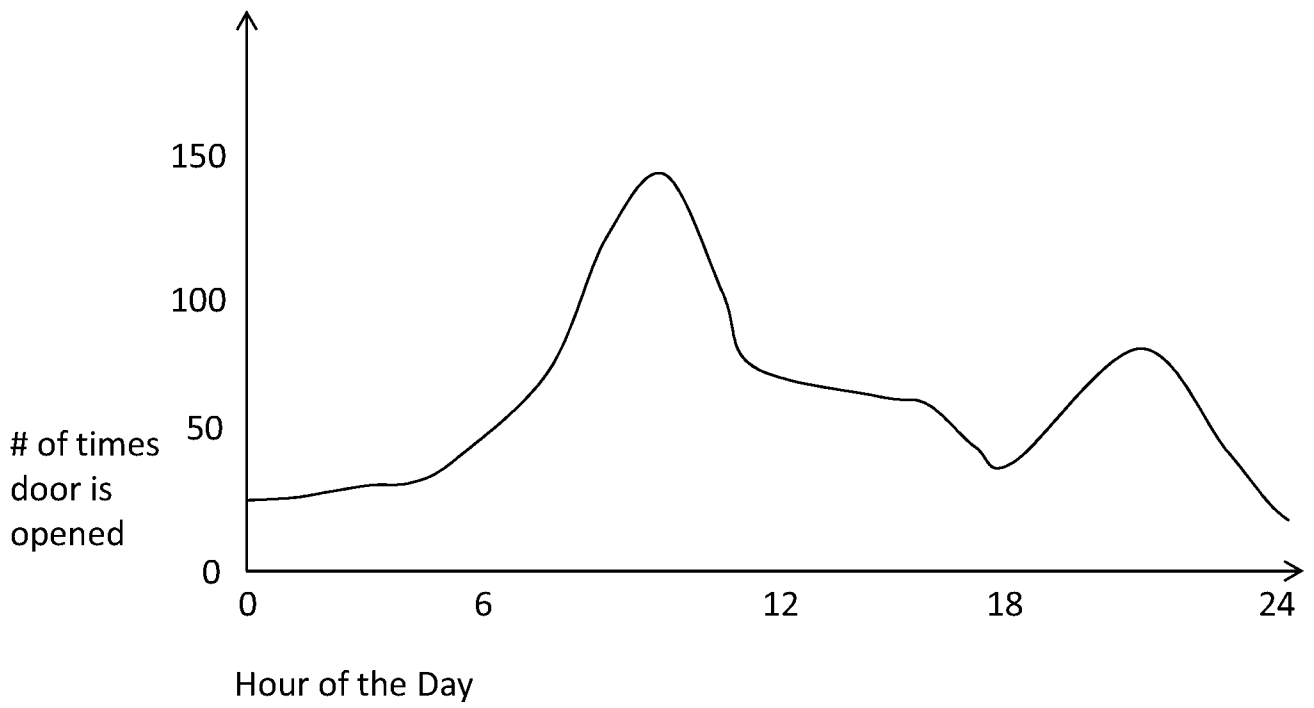


FIG - 17

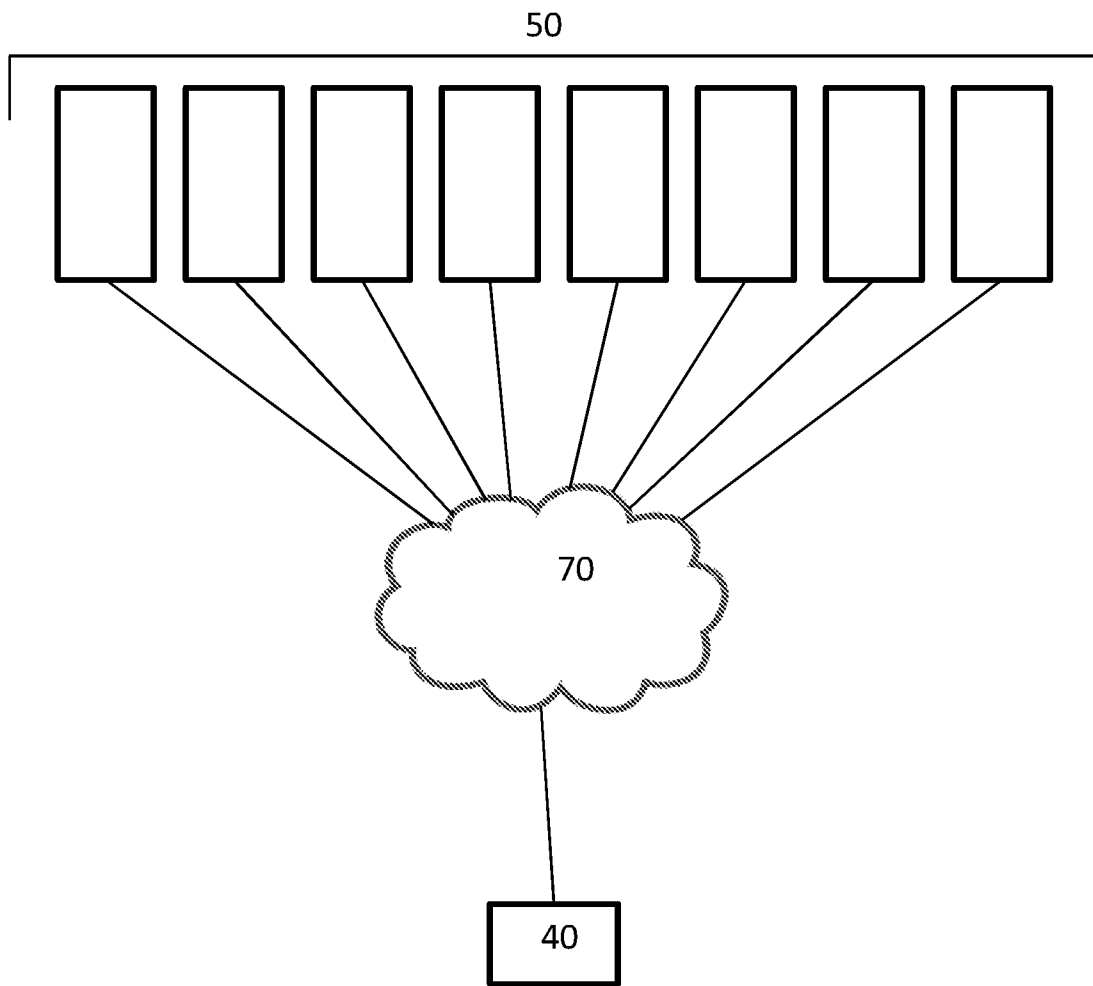


FIG - 18

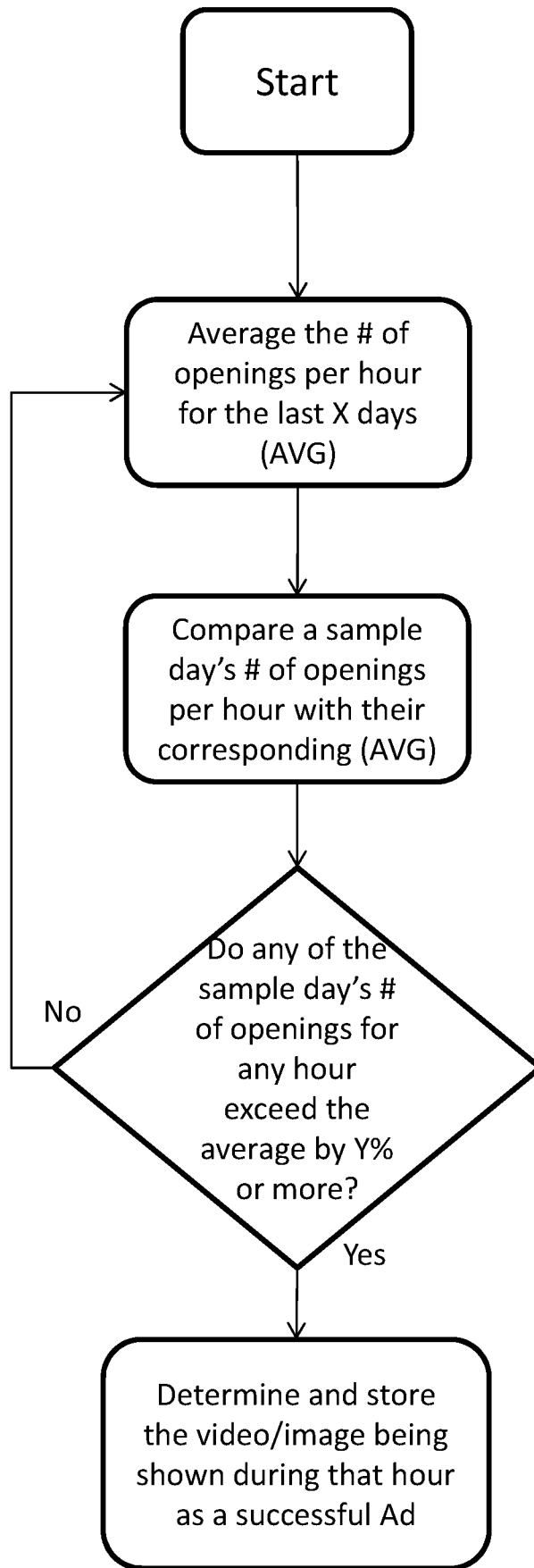


FIG - 19

INTERNATIONAL SEARCH REPORT

International application No.

PCT/US2015/036056

A. CLASSIFICATION OF SUBJECT MATTER  
 IPC(8) - G09F 23/00 (2015.01)  
 CPC - G09F 23/00 (2015.04)  
 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) - see last page  
 USPC -349/58, 61, 65, 161; 362/373, 611, 612, 613, 632

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched  
 CPC - F21V 8/00, F21V 23/06; G02B 6/0073, 6/0083; G02F 1/13; 1/1333, 1/1335, 1/1339, 1/133608, 2001/133612; G09F 23/00, 23/06 (2015.04) (keyword delimited)

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)  
 Orbit, Google Patents, Google Scholar, Google.  
 Search terms used: LCD, liquid crystal display, transparent, glass, panel, LED, light emitting diode, thermal, heat, light guide, PCB, circuit, spacers.

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2014/0144083 A1 (ANTHONY, INC.) 29 May 2014 (29.05.2012) entire document	1-14
A	US 2008/0284942 A1 (MAHAMA et al.) 20 November 2008 (20.11.2008) entire document	1-14
A	US 2014/0078407 A1 (PLANAR SYSTEMS, INC.) 20 March 2014 (20.03.2014) entire document	1-14
A	US 2013/0265525 A1 (MANUFACTURING RESOURCES INTERNATIONAL) 10 October 2013 (10.10.2013) entire document	1-14
A	CN 202815379 U (NINGBO YONGWANG ELECTRONIC TECHNOLOGY) 20 March 2013 (20.03.2013) entire document	1-14
A	US 7,922,381 B2 (HAN et al.) 12 April 2011 (12.04.2011) entire document	1-14
A	US 2014/0104538 A1 (SAMSUNG ELECTRONICS CO., LTD.) 17 April 2014 (17.04.2014) entire document	1-14
A	US 2008/0055534 A1 (KAWANO) 06 March 2008 (06.03.2008) entire document	1-14

Further documents are listed in the continuation of Box C.  See patent family annex.

\* Special categories of cited documents:  
 "A" document defining the general state of the art which is not considered to be of particular relevance  
 "E" earlier application or patent but published on or after the international filing date  
 "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)  
 "O" document referring to an oral disclosure, use, exhibition or other means  
 "P" document published prior to the international filing date but later than the priority date claimed  
 "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention  
 "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone  
 "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art  
 "&" document member of the same patent family

Date of the actual completion of the international search 14 October 2015	Date of mailing of the international search report <b>24 NOV 2015</b>
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Name and mailing address of the ISA/ Mail Stop PCT, Attn: ISA/US, Commissioner for Patents P.O. Box 1450, Alexandria, Virginia 22313-1450 Facsimile No. 571-273-8300	Authorized officer Blaine Copenheaver PCT Helpdesk: 571-272-4300 PCT OSP: 571-272-7774
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## INTERNATIONAL SEARCH REPORT

International application No.

PCT/US2015/036056

**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:  
see last page.

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.:

1-14

- 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.

INTERNATIONAL SEARCH REPORT  
Information on patent family members

International application No.

PCT/US2015/036056

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

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 fees must be paid.

Group I, claims 1-14, drawn to a transparent liquid crystal display (LCD) assembly.

Group II, claims 15-31, drawn to a sealed transparent LCD assembly.

Group III, claims 32-40,45-46, drawn to a transparent liquid crystal display (LCD) assembly comprising: an LCD panel.

Group IV, claims 41-44, drawn to a transparent LCD assembly comprising: an LCD panel; and a light guide.

Group V, claims 47-63, drawn to a system for tracking and analyzing display case usage.

The inventions listed as Groups I, II, III, IV, or V 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 for the following reasons: the special technical feature of the Group I invention: a thermal plate attached to the glass panel as well as the substrate as claimed therein is not present in the invention of Groups II, III, IV, or V. The special technical feature of the Group II invention: a spacer element positioned around a perimeter of the front and rear glass panels as claimed therein is not present in the invention of Groups I, III, IV, or V. The special technical feature of the Group III invention: a front bracket contacting the front surface of the light guide; and a rear bracket contacting the rear surface of the light guide as claimed therein is not present in the invention of Groups I, II, IV, or V. The special technical feature of the Group IV invention: wherein the light guide is permitted to move parallel to the LCD panel but constrained from movement towards the LCD panel as claimed therein is not present in the invention of Groups I, II, III, or V. The special technical feature of the Group V invention: a sensor in electrical connection with the CPU and positioned to detect when the cabinet is open as claimed therein is not present in the invention of Groups I, II, III, or IV.

Groups I, II, III, IV, and V lack unity of invention because even though the inventions of these groups require the technical feature of a transparent liquid crystal display comprising: a glass panel; an LCD panel; a light guide positioned between the LCD panel and the glass panel; a plurality of LEDs, this technical feature is not a special technical feature as it does not make a contribution over the prior art.

Specifically, US 2008/0055534 A1 (KAWANO) 06 March 2008 (06.03.2008) teaches a transparent liquid crystal display (an LCD device 1 includes a back light unit 40, Para. 37) comprising: a glass panel (glass epoxy substrate an LCD panel, Para. 33); a light guide positioned between the LCD panel and the glass panel (the reflector 8 reflects the lights which are emitted from the light guide plate for color mixture 7. In front of the color-mixing plate 7, a second light guide plate for illumination, or illuminating plate 9 is provided in parallel with the color-mixing plate 7, Para. 39); a plurality of LEDs (the LEDs 5B are used as light sources of the LCD device 1, Para. 38).

Since none of the special technical features of the Group I, II, III, IV or V inventions are found in more than one of the inventions, unity of invention is lacking.

Continuation of Box B Fields Searched

IPC (8) Class/Subclass(es): A47F 3/04, 11/06; F21V 23/06; G02F 1/13, 1/133, 1/1333, 1/1335, 1/13357, 1/133603, 1/1339, 1/1345, 2001/133628; G09F 23/00, 23/06 (2015.01)