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Application Number	
Filing Date	October 20, 2017
First Named Inventor	Dunn et al.
Title	ELECTRONIC DISPLAY WITH COOLING
Art Unit	N/A
Examiner Name	N/A
Attorney Docket Number	MAN2241-045P

SIGNATURE of Applicant or Patent Practitioner

Signature	/Eric M. Gayan/	Date (Optional)	October 20, 2017
Name	Eric M. Gayan	Registration Number	46,103
Title (if Applicant is a juristic entity)	Attorney of Record		
Applicant Name (if Applicant is a juristic entity)	Manufacturing Resources International, Inc.		
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☒ *Total of <u>1</u> forms are submitted.			

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SEC et al. v. MRI
SEC Exhibit 1031.1951
IPR2023-00254

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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:

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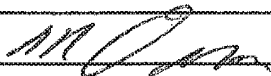
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- ☐ Inventor or Joint Inventor
- ☐ Legal Representative of a Deceased or Legally Incapacitated Inventor
- ☒ Assignee or Person to Whom the Inventor is Under an Obligation to Assign
- ☐ Person Who Otherwise Shows Sufficient Proprietary Interest (e.g., a petition under 37 CFR 1.46(b)(2) was granted in the application or is concurrently being filed with this document)

SIGNATURE of Applicant for Patent

Signature		Date	11/16/2012
Name	William Dunn		
Title	President		
Company	Manufacturing Resources International, Inc.		

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**COMBINED ASSIGNMENT AND DECLARATION (37 CFR 1.63) FOR UTILITY OR
DESIGN APPLICATION USING AN APPLICATION DATA SHEET (37 CFR 1.76)**

**Title of
Invention**

Heat Exchanger for an Electronic Display

DECLARATION

As the below named inventor, I hereby declare that:

This declaration ☐ is directed to: The attached application, or

☒ United States application or PCT international application number
14/050,464 filed on 10-OCT-2013

The above-identified application was made or authorized to be made by me.

I believe that I am the original inventor or an original joint inventor of a claimed invention in the application.

I hereby acknowledge that any willful false statement made in this declaration is punishable under 18 U.S.C. 1001 by fine or imprisonment of not more than five (5) years, or both.

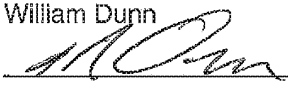
ASSIGNMENT

For at least one U.S. dollar (\$1.00) and for other good and valuable consideration, the receipt of which is hereby acknowledged, I hereby sell, assign and transfer to Manufacturing Resources International, Inc., a corporation organized under the law of the State of Georgia having an office at 6415 Shiloh Road East, Alpharetta, GA 30005, (hereinafter referred to as the Assignee) my entire right, title and interest, together with all rights of priority, in and to the invention set forth in the above-identified application. I further hereby sell, assign and transfer to the Assignee my entire right, title and interest, together with all rights of priority, in and to my invention as described and/or claimed in any and all applications for patents based on the invention, including divisionals, continuations, renewals, substitutes and reissues thereof, and all rights of priority resulting from any of these patent applications, as well as all foreign counterparts and extensions thereof, together with all patents issuing on any of these applications for the full terms of all of the patents which may be granted on the invention.

I authorize the Assignee to make applications for, to prosecute such applications, and to receive patents for the invention in the United States and any foreign countries, in the Assignee's name.

I promise and agree that I will execute or procure any further necessary assurance of title to the invention and any patents which may issue on the invention. I will, at any time, upon the request and without further consideration, but at the expense of the Assignee, deliver any testimony in any legal proceedings and execute all papers and do all other things that may be necessary or desirable to perfect the title to the invention, or any patents which may be granted therefor, to the Assignee, its successors, assigns, or other legal representatives. I will, at any time, upon the request and at the expense of the Assignee, execute any continuations, divisionals, reissues, or any other additional applications for patents for the invention or any part or parts thereof and any patents issuing thereon are hereby assigned to the Assignee. I will make all rightful oaths, and do all lawful acts required for procuring and enforcing any of the patents, without further compensation, but at the expense of the Assignee, its successors, assigns or other legal representatives.

I authorize and request the Commissioner of Patents and Trademarks to issue any and all Letters Patent of the

United States for the invention, resulting from any of the aforesaid applications to the Assignee.	
LEGAL NAME OF INVENTOR	
Inventor:	William Dunn
Signature:	 Date: 12-2-13
Note: An application data sheet (PTO/SB/14 or equivalent), including naming the entire inventive entity, must accompany this form or must have been previously filed. Use an additional form for each additional inventor.	

Advice from Standley Law Group LLP: It is advisable to obtain two witness signatures to the above inventor signature in the places indicated below, OR in the alternative, it is advisable to obtain a notarization of the above inventor signature in the notary section set forth below. With or without the witness signatures or the notarization, this assignment is a legally binding agreement to assign the invention to the assignee.

Optional (but advisable) witness signatures:

Witness One

Printed Full Legal Name: _____

Signature: _____

Date: _____

Witness Two

Printed Full Legal Name: _____

Signature: _____

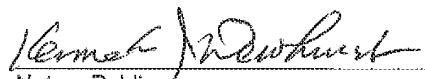
Date: _____

Or, optional (but advisable) notarization:

STATE OF Georgia :
COUNTY OF _____ : SS.

Before me personally appeared William Dunn, to me known to be the same person described in and who executed the foregoing instrument, and acknowledged that he/she executed the same, of his/her own free will and for the purposes set forth. Sworn to before me and subscribed in my presence this 2nd day of December, 2013.

(seal)


Notary Public

**COMBINED ASSIGNMENT AND DECLARATION (37 CFR 1.63) FOR UTILITY OR
DESIGN APPLICATION USING AN APPLICATION DATA SHEET (37 CFR 1.76)**

**Title of
Invention**

Heat Exchanger for an Electronic Display

DECLARATION

As the below named inventor, I hereby declare that:

This declaration
is directed to:

☐

The attached application, or

☒

United States application or PCT international application number
14/050,464 filed on 10-OCT-2013.

The above-identified application was made or authorized to be made by me.

I believe that I am the original inventor or an original joint inventor of a claimed invention in the application.

I hereby acknowledge that any willful false statement made in this declaration is punishable under 18 U.S.C. 1001 by fine or imprisonment of not more than five (5) years, or both.

ASSIGNMENT

For at least one U.S. dollar (\$1.00) and for other good and valuable consideration, the receipt of which is hereby acknowledged, I hereby sell, assign and transfer to Manufacturing Resources International, Inc., a corporation organized under the law of the State of Georgia having an office at 6415 Shiloh Road East, Alpharetta, GA 30005, (hereinafter referred to as the Assignee) my entire right, title and interest, together with all rights of priority, in and to the invention set forth in the above-identified application. I further hereby sell, assign and transfer to the Assignee my entire right, title and interest, together with all rights of priority, in and to my invention as described and/or claimed in any and all applications for patents based on the invention, including divisionals, continuations, renewals, substitutes and reissues thereof, and all rights of priority resulting from any of these patent applications, as well as all foreign counterparts and extensions thereof, together with all patents issuing on any of these applications for the full terms of all of the patents which may be granted on the invention.

I authorize the Assignee to make applications for, to prosecute such applications, and to receive patents for the invention in the United States and any foreign countries, in the Assignee's name.

I promise and agree that I will execute or procure any further necessary assurance of title to the invention and any patents which may issue on the invention. I will, at any time, upon the request and without further consideration, but at the expense of the Assignee, deliver any testimony in any legal proceedings and execute all papers and do all other things that may be necessary or desirable to perfect the title to the invention, or any patents which may be granted therefor, to the Assignee, its successors, assigns, or other legal representatives. I will, at any time, upon the request and at the expense of the Assignee, execute any continuations, divisionals, reissues, or any other additional applications for patents for the invention or any part or parts thereof and any patents issuing thereon are hereby assigned to the Assignee. I will make all rightful oaths, and do all lawful acts required for procuring and enforcing any of the patents, without further compensation, but at the expense of the Assignee, its successors, assigns or other legal representatives.

I authorize and request the Commissioner of Patents and Trademarks to issue any and all Letters Patent of the

United States for the invention, resulting from any of the aforesaid applications to the Assignee.	
LEGAL NAME OF INVENTOR	
Inventor: Tim Hubbard	
Signature: <u><i>Tim Hubbard</i></u>	Date: <u>12.02.13</u>
Note: An application data sheet (PTO/SB/14 or equivalent), including naming the entire inventive entity, must accompany this form or must have been previously filed. Use an additional form for each additional inventor.	

Advice from Standley Law Group LLP: It is advisable to obtain two witness signatures to the above inventor signature in the places indicated below, OR in the alternative, it is advisable to obtain a notarization of the above inventor signature in the notary section set forth below. With or without the witness signatures or the notarization, this assignment is a legally binding agreement to assign the invention to the assignee.

Optional (but advisable) witness signatures:

Witness One

Printed Full Legal Name: _____

Signature: _____

Date: _____

Witness Two

Printed Full Legal Name: _____

Signature: _____

Date: _____

Or, optional (but advisable) notarization:

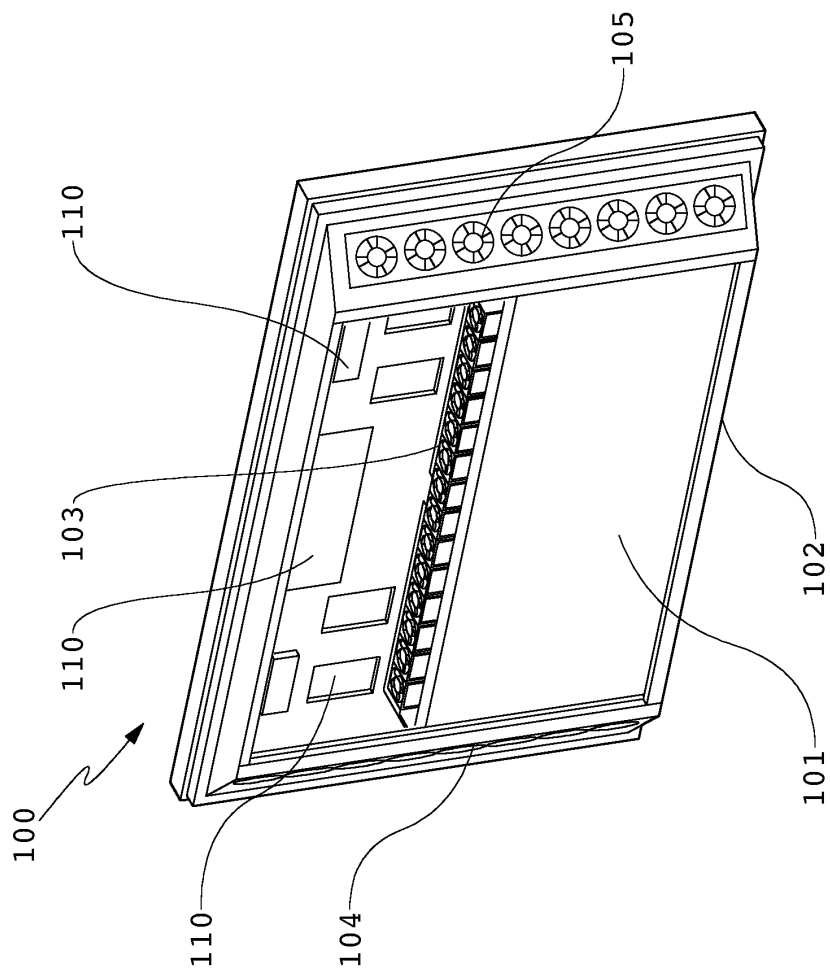
STATE OF Georgia :
COUNTY OF Cobb : SS.

Before me personally appeared Tim Hubbard, to me known to be the same person described in and who executed the foregoing instrument, and acknowledged that he/she executed the same, of his/her own free will and for the purposes set forth. Sworn to before me and subscribed in my presence this 2nd day of December, 2013.

(seal)

Kemel Newhart
Notary Public

FIG-1



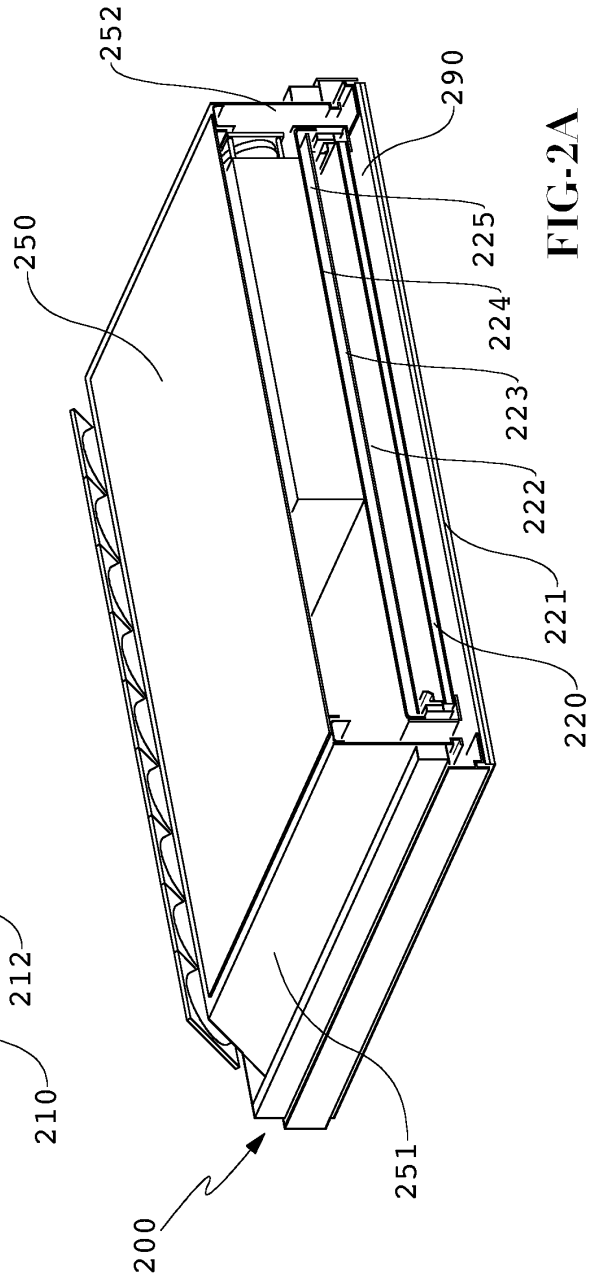
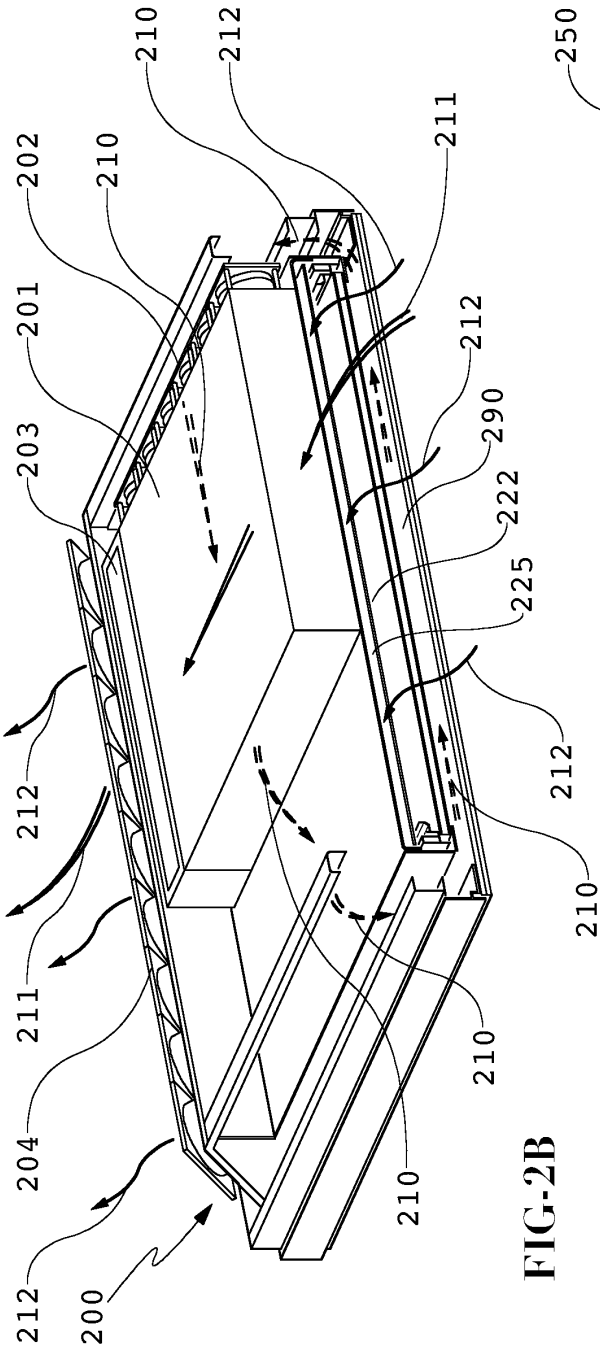
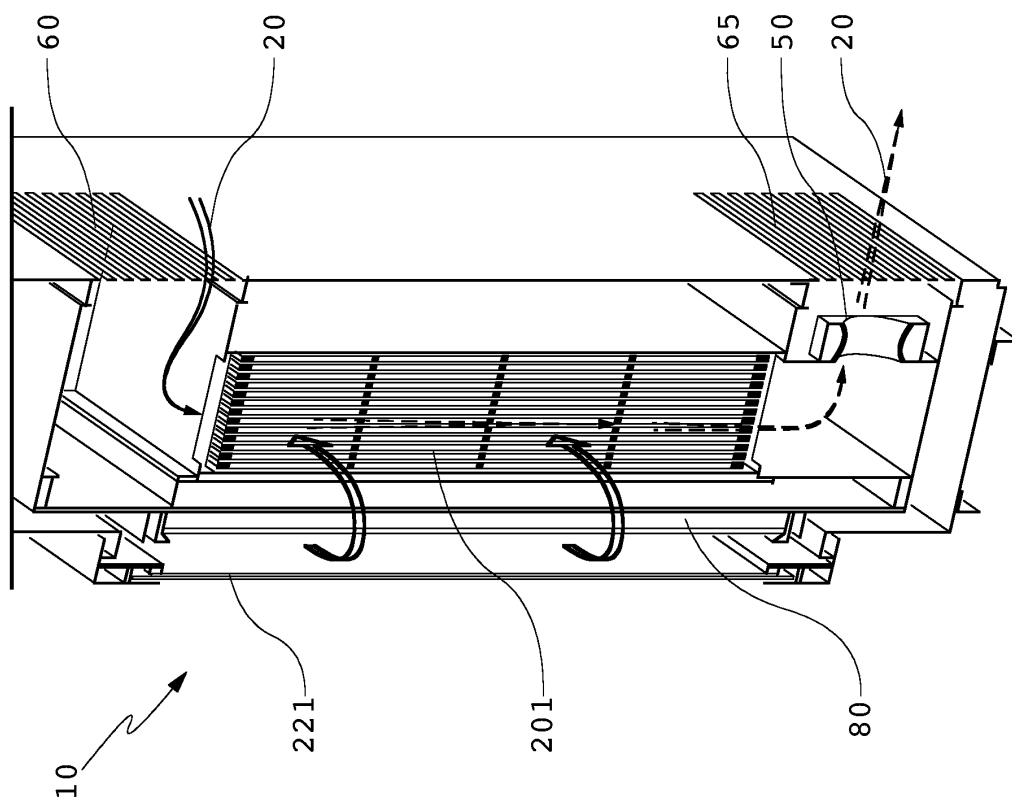


FIG-3



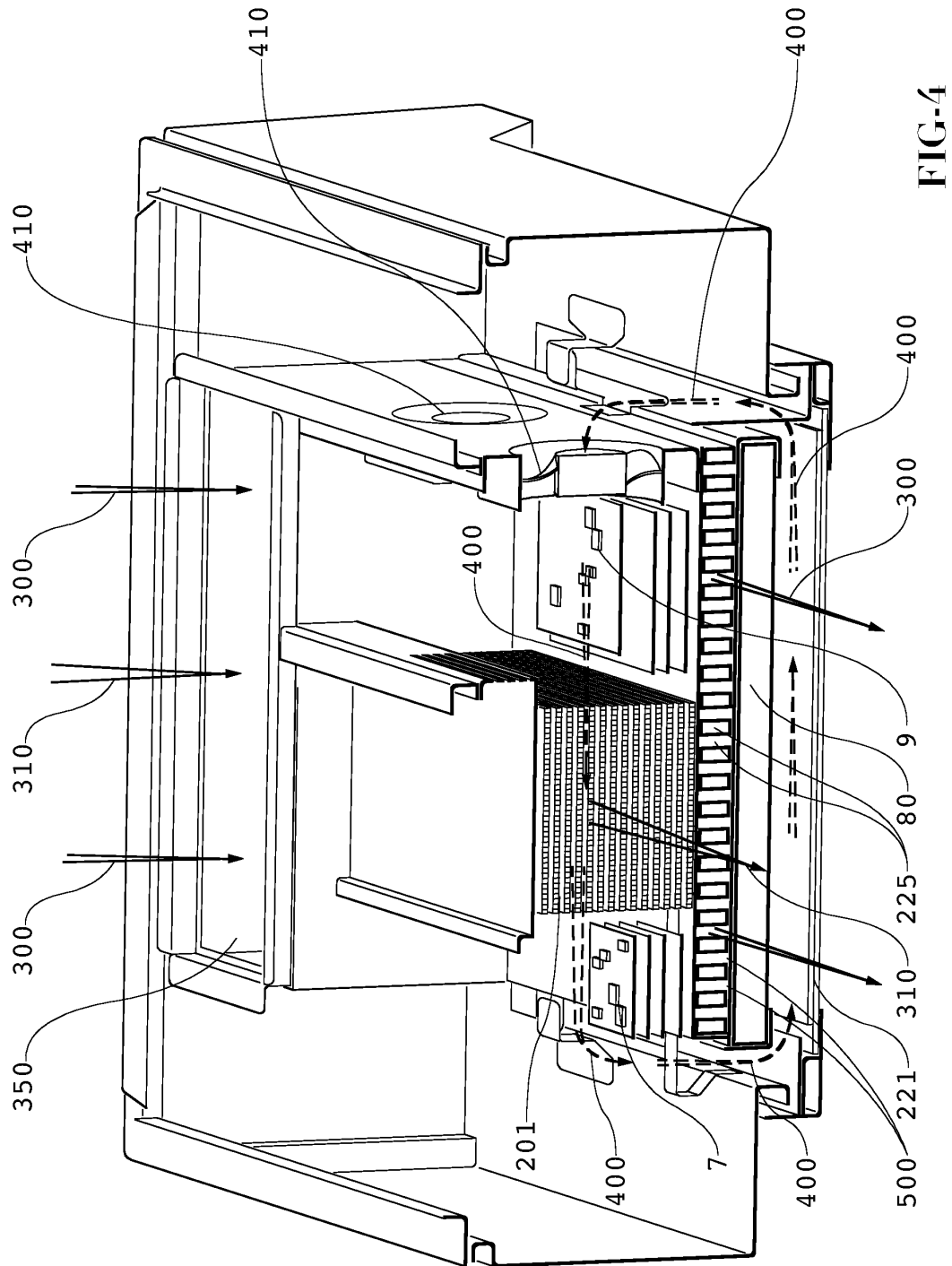


FIG-4

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. 14/834,034 filed on August 24, 2015. 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 contaminants 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 contaminates as this gas travels in front of the image assembly 220. Since gas for the open loop may contain various contaminates, 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. An electronic display comprising:
 - an electronic image assembly having a front portion and a rear portion;
 - an open loop ambient air flow path behind the rear portion of the electronic image assembly;
 - a closed loop gas circulation path about the electronic image assembly;
 - a common heat exchanger located in the pathway of both the closed loop gas circulation path and the open loop ambient air flow path;
 - a gas circulation device positioned to force circulating gas through the common heat exchanger; and
 - an air circulation device positioned to force ambient air through the common heat exchanger.
2. The electronic display of claim 1, further comprising:
 - a substantially planar surface located behind and spaced apart from the rear portion of the electronic image assembly; and
 - a space defined between the rear portion of the electronic image assembly and the substantially planar surface;
 - wherein the space is in gaseous communication with the open loop ambient air flow path.
3. The electronic display of claim 2, wherein the substantially planar surface is a plate.

4. The electronic display of claim 2, wherein the substantially planar surface is a portion of the heat exchanger.
5. The electronic display of claim 1, further comprising:
 - a front display surface spaced apart from the front portion of the electronic image assembly; and
 - a front channel defined by the space between the front display surface and the front portion of the electronic image assembly, the front channel forming part of the closed loop gas circulation path.
6. The electronic display of claim 1, further comprising at least one electronic component located in the pathway of the closed loop gas circulation path, the at least one electronic component selected from the group consisting of transformers, circuit boards, resistors, capacitors, batteries, power modules, motors, inductors, illumination devices, wiring, wiring harnesses, lights, thermo-electric devices, and switches.
7. The electronic display of claim 1, further comprising a cooling device placed near an entrance to the open loop ambient air flow path for reducing the temperature of ambient air entering the open loop ambient air flow path.
8. An electronic display comprising:
 - an electronic image assembly having a front portion and a rear portion;
 - a closed loop gas circulation path encircling the electronic image assembly;
 - an open loop ambient air flow path behind the rear portion of the electronic image assembly;

a substantially planar surface located behind and spaced apart from the rear portion of the electronic image assembly, the space between the substantially planar surface and the rear portion of the electronic image assembly defining a rear channel;

a common heat exchanger in gaseous communication with both the closed loop gas circulation path and the open loop ambient air flow path;

at least one fan positioned to force circulating gas through the closed loop gas circulation path;

at least one fan positioned to force ambient air through the open loop ambient air flow path.

9. The electronic display of claim 8, wherein the open loop ambient air flow path is also in gaseous communication with the rear channel.

10. The electronic display of claim 8, further comprising a second open loop ambient air flow path in gaseous communication with the rear channel.

11. The electronic display of claim 8, wherein:

the common heat exchanger includes first and second gas pathways, the first and second gas pathways being isolated from each other;

where the first gas pathway is in gaseous communication with the open loop ambient air flow path; and

where the second gas pathway is in gaseous communication with the closed loop gas circulation path.

12. The electronic display of claim 11, wherein the first gas pathway is also in gaseous communication with the rear channel.
13. The electronic display of claim 8, wherein the substantially planar surface is a plate.
14. The electronic display of claim 8, wherein the substantially planar surface is a portion of the heat exchanger.
15. The electronic display of claim 8, further comprising:
a front display surface spaced apart from the front portion of the electronic image assembly; and
a front channel defined by a space between the front display surface and the front portion of the electronic image assembly, the front channel forming part of the closed loop gas circulation path.
16. The electronic display of claim 8, further comprising at least one electronic component located in the pathway of the closed loop gas circulation path, the at least one electronic component selected from the group consisting of transformers, circuit boards, resistors, capacitors, batteries, power modules, motors, inductors, illumination devices, wiring, wiring harnesses, lights, thermo-electric devices, and switches.
17. A cooling system for an electronic image assembly, comprising:
an open loop ambient air flow path at a rear portion of the electronic image assembly;
a closed loop gas circulation path encircling the electronic image assembly;

a common heat exchanger in gaseous communication with both the closed loop gas circulation path and the open loop ambient air flow path;

a front channel defined by a space between a front portion of the electronic image assembly and a front display surface located forward of and spaced apart from the front portion of the electronic image assembly, the front channel forming a part of the closed loop gas circulation path;

a rear channel defined by a space between the rear portion of the electronic image assembly and a substantially planar surface located behind and spaced apart from the rear portion of the electronic image assembly, the rear channel forming a part of the open loop ambient air flow path;

at least one fan positioned to force circulating gas through the closed loop gas circulation path and the common heat exchanger; and

at least one fan positioned to force ambient air through the open loop ambient air flow path and the common heat exchanger.

18. The cooling system of claim 17, wherein the substantially planar surface is a plate.

19. The cooling system of claim 17, wherein the substantially planar surface is a portion of the common heat exchanger.

20. The cooling system of claim 17, further comprising at least one electronic component located in the pathway of the closed loop gas circulation path, the at least one electronic component selected from the group consisting of transformers, circuit boards, resistors, capacitors, batteries, power modules, motors, inductors, illumination devices, wiring, wiring harnesses, lights, thermo-electric devices, and switches.

ABSTRACT

An electronic display including an electronic image assembly and a cooling system for an electronic image assembly. A closed loop gas circulation path and an open loop ambient air flow path are provided to effectuate cooling. A common heat exchanger is located in gaseous communication with both the closed loop gas circulation path and the open loop ambient air flow path. The open loop ambient air flow path facilitates removal of heat from gas circulating within the closed loop gas circulation path. A cooling channel may be located behind a rear portion of the electronic image assembly to further enhance cooling via the circulation of ambient air therein.

Electronic Patent Application Fee Transmittal				
Application Number:				
Filing Date:				
Title of Invention:		ELECTRONIC DISPLAY WITH COOLING		
First Named Inventor/Applicant Name:		William Dunn		
Filer:		Eric Michael Gayan/Trisha Beachy-Bryant		
Attorney Docket Number:		MAN2241-045P		
Filed as Large Entity				
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	280	280
UTILITY SEARCH FEE	1111	1	600	600
UTILITY EXAMINATION FEE	1311	1	720	720
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 (\$)				1600

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EFS ID:	30674034
Application Number:	15789331
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Title of Invention:	ELECTRONIC DISPLAY WITH COOLING
First Named Inventor/Applicant Name:	William Dunn
Customer Number:	8698
Filer:	Eric Michael Gayan/Trisha Beachy-Bryant
Filer Authorized By:	Eric Michael Gayan
Attorney Docket Number:	MAN2241-045P
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The Director of the USPTO is hereby authorized to charge indicated fees and credit any overpayment as follows: 37 CFR 1.16 (National application filing, search, and examination fees) 37 CFR 1.17 (Patent application and reexamination processing fees)	

37 CFR 1.21 (Miscellaneous fees and charges)					
File Listing:					
Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Application Data Sheet	WebADS.pdf	192539	no	10
			310202e3772213e350c493f4c2bc69cbc9861ffa		
Warnings:					
Information:					
2	Power of Attorney	POA_MAN2241-045P_10-20-17.pdf	247602	no	2
			d7d728b23031c4650884bc4d17201515c4603bab		
Warnings:					
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3	Oath or Declaration filed	SignedCombinedAssignmentAndDeclaration_MAN2241-045P.pdf	356471	no	4
			709cc3244d8dcb0418441071ed2d2233604cf4a2		
Warnings:					
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4	Drawings-only black and white line drawings	Drawings_MAN2241-045P_10-20-17.pdf	184881	no	4
			c6844a1eb55c4549e9ae795adde1da02fa395a9b		
Warnings:					
Information:					
5		PatentApplication_MAN2241-045P_10-20-17.pdf	107326	yes	24
			0878453aa57fb5ed57aeb149c980fe7dcfbd7bcc		
	Multipart Description/PDF files in .zip description				
	Document Description		Start	End	
	Specification		1	18	
	Claims		19	23	
	Abstract		24	24	

Warnings:					
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6	Fee Worksheet (SB06)	fee-info.pdf	35008	no	2
			f27bc8056a45fad5b17ddce5bc7d5c8090ad200d5		
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Application Data Sheet 37 CFR 1.76		Attorney Docket Number	MAN2241-045P
		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.)
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		Application Number		
Title of Invention	ELECTRONIC DISPLAY WITH COOLING			
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Application Information:

Title of the Invention	ELECTRONIC DISPLAY WITH COOLING			
Attorney Docket Number	MAN2241-045P	Small Entity Status Claimed	☐	
Application Type				
Subject Matter				
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.			
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Application Data Sheet 37 CFR 1.76		Attorney Docket Number	MAN2241-045P	
		Application Number		
Title of Invention	ELECTRONIC DISPLAY WITH COOLING			

Prefix	Given Name	Middle Name	Family Name	Suffix	Remove
Registration Number					

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Registration Number					

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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 this 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 blank.

Prior Application Status		Pending		Remove	
Application Number	Continuity Type		Prior Application Number	Filing or 371(c) Date (YYYY-MM-DD)	
	Continuation of		14834034	2015-08-24	

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

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

Application Data Sheet 37 CFR 1.76		Attorney Docket Number	MAN2241-045P
		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)
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		Pending		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
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

WEB ADS 1.0

SEC et al. v. MRI
SEC Exhibit 1031.1993
IPR2023-00254

Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it contains a valid OMB control number.

Application Data Sheet 37 CFR 1.76		Attorney Docket Number	MAN2241-045P
		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)		
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
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:

Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it contains a valid OMB control number.

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

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 ¹	Filing Date (YYYY-MM-DD)	Access Code ¹ (if applicable)

Additional Foreign Priority Data may be generated within this form by selecting the **Add** button.

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.
--

Application Data Sheet 37 CFR 1.76		Attorney Docket Number	MAN2241-045P
		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.

☐ B. Applicant **DOES NOT** authorize the USPTO to transmit to the EPO any search results from the instant patent application. If this box is checked, the USPTO will not be providing the EPO with search results from the instant application.

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.

Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it contains a valid OMB control number.

Application Data Sheet 37 CFR 1.76		Attorney Docket Number	MAN2241-045P
		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.

Mailing Address Information For Applicant:

Address 1		6415 Shiloh Road East	
Address 2			
City	Alpharetta	State/Province	GA
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.

Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it contains a valid OMB control number.

Application Data Sheet 37 CFR 1.76		Attorney Docket Number	MAN2241-045P
		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		
Phone Number		Fax Number		
Email Address				
Additional Assignee or Non-Applicant Assignee Data may be generated within this form by selecting the Add button.				

Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it contains a valid OMB control number.

Application Data Sheet 37 CFR 1.76		Attorney Docket Number	MAN2241-045P
		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	/Eric M. Gayan/		Date (YYYY-MM-DD)		
First Name	Eric	Last Name	Gayan	Registration Number	46103
Additional Signature may be generated within this form by selecting the Add button.					

PATENT ASSIGNMENT COVER SHEET

Electronic Version v1.1
 Stylesheet Version v1.2

EPAS ID: PAT4650762

SUBMISSION TYPE:	NEW ASSIGNMENT		
NATURE OF CONVEYANCE:	ASSIGNMENT		
CONVEYING PARTY DATA			
	Name	Execution Date	
	WILLIAM DUNN	12/02/2013	
	TIM HUBBARD	12/02/2013	
RECEIVING PARTY DATA			
Name:	MANUFACTURING RESOURCES INTERNATIONAL, INC.		
Street Address:	6415 SHILOH ROAD EAST		
City:	ALPHARETTA		
State/Country:	GEORGIA		
Postal Code:	30005		
PROPERTY NUMBERS Total: 1			
	Property Type	Number	
	Application Number:	15789331	
CORRESPONDENCE DATA			
Fax Number:	(614)792-5536		
<i>Correspondence will be sent to the e-mail address first; if that is unsuccessful, it will be sent using a fax number, if provided; if that is unsuccessful, it will be sent via US Mail.</i>			
Phone:	6147925555		
Email:	standleydocketing@standleyllp.com		
Correspondent Name:	STANDLEY LAW GROUP LLP		
Address Line 1:	6300 RIVERSIDE DRIVE		
Address Line 4:	DUBLIN, OHIO 43017		
ATTORNEY DOCKET NUMBER:	MAN2241-045P		
NAME OF SUBMITTER:	ERIC M. GAYAN, REG. NO. 46,103		
SIGNATURE:	/Eric M. Gayan/		
DATE SIGNED:	10/20/2017		
	This document serves as an Oath/Declaration (37 CFR 1.63).		
Total Attachments: 4			
source=SignedCombinedAssignmentAndDeclaration_MAN2241-045P#page1.tif			
source=SignedCombinedAssignmentAndDeclaration_MAN2241-045P#page2.tif			
source=SignedCombinedAssignmentAndDeclaration_MAN2241-045P#page3.tif			
source=SignedCombinedAssignmentAndDeclaration_MAN2241-045P#page4.tif			

**COMBINED ASSIGNMENT AND DECLARATION (37 CFR 1.63) FOR UTILITY OR
DESIGN APPLICATION USING AN APPLICATION DATA SHEET (37 CFR 1.76)**

**Title of
Invention**

Heat Exchanger for an Electronic Display

DECLARATION

As the below named inventor, I hereby declare that:

This declaration ☐ is directed to: The attached application, or

☒ United States application or PCT international application number
14/050,464 filed on 10-OCT-2013

The above-identified application was made or authorized to be made by me.

I believe that I am the original inventor or an original joint inventor of a claimed invention in the application.

I hereby acknowledge that any willful false statement made in this declaration is punishable under 18 U.S.C. 1001 by fine or imprisonment of not more than five (5) years, or both.

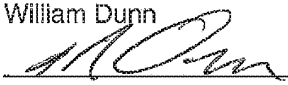
ASSIGNMENT

For at least one U.S. dollar (\$1.00) and for other good and valuable consideration, the receipt of which is hereby acknowledged, I hereby sell, assign and transfer to Manufacturing Resources International, Inc., a corporation organized under the law of the State of Georgia having an office at 6415 Shiloh Road East, Alpharetta, GA 30005, (hereinafter referred to as the Assignee) my entire right, title and interest, together with all rights of priority, in and to the invention set forth in the above-identified application. I further hereby sell, assign and transfer to the Assignee my entire right, title and interest, together with all rights of priority, in and to my invention as described and/or claimed in any and all applications for patents based on the invention, including divisionals, continuations, renewals, substitutes and reissues thereof, and all rights of priority resulting from any of these patent applications, as well as all foreign counterparts and extensions thereof, together with all patents issuing on any of these applications for the full terms of all of the patents which may be granted on the invention.

I authorize the Assignee to make applications for, to prosecute such applications, and to receive patents for the invention in the United States and any foreign countries, in the Assignee's name.

I promise and agree that I will execute or procure any further necessary assurance of title to the invention and any patents which may issue on the invention. I will, at any time, upon the request and without further consideration, but at the expense of the Assignee, deliver any testimony in any legal proceedings and execute all papers and do all other things that may be necessary or desirable to perfect the title to the invention, or any patents which may be granted therefor, to the Assignee, its successors, assigns, or other legal representatives. I will, at any time, upon the request and at the expense of the Assignee, execute any continuations, divisionals, reissues, or any other additional applications for patents for the invention or any part or parts thereof and any patents issuing thereon are hereby assigned to the Assignee. I will make all rightful oaths, and do all lawful acts required for procuring and enforcing any of the patents, without further compensation, but at the expense of the Assignee, its successors, assigns or other legal representatives.

I authorize and request the Commissioner of Patents and Trademarks to issue any and all Letters Patent of the

United States for the invention, resulting from any of the aforesaid applications to the Assignee.	
LEGAL NAME OF INVENTOR	
Inventor: William Dunn	
Signature: 	Date: 12-2-13
Note: An application data sheet (PTO/SB/14 or equivalent), including naming the entire inventive entity, must accompany this form or must have been previously filed. Use an additional form for each additional inventor.	

Advice from Standley Law Group LLP: It is advisable to obtain two witness signatures to the above inventor signature in the places indicated below, OR in the alternative, it is advisable to obtain a notarization of the above inventor signature in the notary section set forth below. With or without the witness signatures or the notarization, this assignment is a legally binding agreement to assign the invention to the assignee.

Optional (but advisable) witness signatures:

Witness One

Printed Full Legal Name: _____

Signature: _____

Date: _____

Witness Two

Printed Full Legal Name: _____

Signature: _____

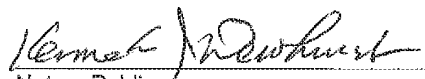
Date: _____

Or, optional (but advisable) notarization:

STATE OF Georgia :
COUNTY OF _____ : SS.

Before me personally appeared William Dunn, to me known to be the same person described in and who executed the foregoing instrument, and acknowledged that he/she executed the same, of his/her own free will and for the purposes set forth. Sworn to before me and subscribed in my presence this 2nd day of December, 2013.

(seal)


Notary Public

**COMBINED ASSIGNMENT AND DECLARATION (37 CFR 1.63) FOR UTILITY OR
DESIGN APPLICATION USING AN APPLICATION DATA SHEET (37 CFR 1.76)**

**Title of
Invention**

Heat Exchanger for an Electronic Display

DECLARATION

As the below named inventor, I hereby declare that:

This declaration
is directed to:

☐

The attached application, or

☒

United States application or PCT international application number
14/050,464 filed on 10-OCT-2013.

The above-identified application was made or authorized to be made by me.

I believe that I am the original inventor or an original joint inventor of a claimed invention in the application.

I hereby acknowledge that any willful false statement made in this declaration is punishable under 18 U.S.C. 1001 by fine or imprisonment of not more than five (5) years, or both.

ASSIGNMENT

For at least one U.S. dollar (\$1.00) and for other good and valuable consideration, the receipt of which is hereby acknowledged, I hereby sell, assign and transfer to Manufacturing Resources International, Inc., a corporation organized under the law of the State of Georgia having an office at 6415 Shiloh Road East, Alpharetta, GA 30005, (hereinafter referred to as the Assignee) my entire right, title and interest, together with all rights of priority, in and to the invention set forth in the above-identified application. I further hereby sell, assign and transfer to the Assignee my entire right, title and interest, together with all rights of priority, in and to my invention as described and/or claimed in any and all applications for patents based on the invention, including divisionals, continuations, renewals, substitutes and reissues thereof, and all rights of priority resulting from any of these patent applications, as well as all foreign counterparts and extensions thereof, together with all patents issuing on any of these applications for the full terms of all of the patents which may be granted on the invention.

I authorize the Assignee to make applications for, to prosecute such applications, and to receive patents for the invention in the United States and any foreign countries, in the Assignee's name.

I promise and agree that I will execute or procure any further necessary assurance of title to the invention and any patents which may issue on the invention. I will, at any time, upon the request and without further consideration, but at the expense of the Assignee, deliver any testimony in any legal proceedings and execute all papers and do all other things that may be necessary or desirable to perfect the title to the invention, or any patents which may be granted therefor, to the Assignee, its successors, assigns, or other legal representatives. I will, at any time, upon the request and at the expense of the Assignee, execute any continuations, divisionals, reissues, or any other additional applications for patents for the invention or any part or parts thereof and any patents issuing thereon are hereby assigned to the Assignee. I will make all rightful oaths, and do all lawful acts required for procuring and enforcing any of the patents, without further compensation, but at the expense of the Assignee, its successors, assigns or other legal representatives.

I authorize and request the Commissioner of Patents and Trademarks to issue any and all Letters Patent of the

United States for the invention, resulting from any of the aforesaid applications to the Assignee.	
LEGAL NAME OF INVENTOR	
Inventor: Tim Hubbard	
Signature: <u><i>Tim Hubbard</i></u>	Date: <u>12.02.13</u>
Note: An application data sheet (PTO/SB/14 or equivalent), including naming the entire inventive entity, must accompany this form or must have been previously filed. Use an additional form for each additional inventor.	

Advice from Standley Law Group LLP: It is advisable to obtain two witness signatures to the above inventor signature in the places indicated below, OR in the alternative, it is advisable to obtain a notarization of the above inventor signature in the notary section set forth below. With or without the witness signatures or the notarization, this assignment is a legally binding agreement to assign the invention to the assignee.

Optional (but advisable) witness signatures:

Witness One

Printed Full Legal Name: _____

Signature: _____

Date: _____

Witness Two

Printed Full Legal Name: _____

Signature: _____

Date: _____

Or, optional (but advisable) notarization:

STATE OF Georgia :
COUNTY OF Cobb : SS.

Before me personally appeared Tim Hubbard, to me known to be the same person described in and who executed the foregoing instrument, and acknowledged that he/she executed the same, of his/her own free will and for the purposes set forth. Sworn to before me and subscribed in my presence this 2nd day of December, 2013.

(seal)

Kemel Newhart
Notary Public