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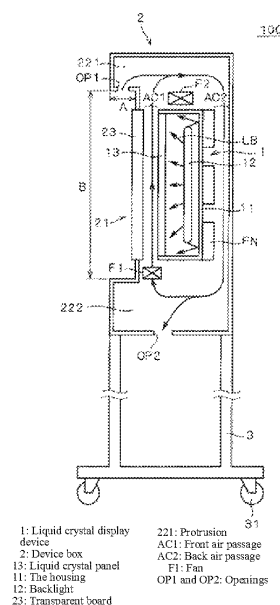
(54) [Name of Invention] Outdoor display device

(57) [Summary]

[Issues] A display device is provided that can efficiently dissipate heat generated from a flat panel type display device.

[Means for solving the problems] In the device box 2, the liquid crystal display device 1 is arranged such that the liquid crystal panel 13 of the liquid crystal display device 1 and the transparent plate 23 do not adhere, and there is a gap (front air passage AC1) between the two. In addition, the liquid crystal display 1 is arranged such that a gap exists between the back side of the liquid crystal panel 13 of the liquid crystal display 1 and the wall surface of the device box 2 facing it (back air passage AC2), and a fan F1, which is a means of generating air flow in the front air passage AC1, is arranged near the opening on the lower side of the front air passage AC1, and it is configured to pump air from the lower side into the front air passage AC1.

[Selection drawing] FIG. 1



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[Scope of Claims]

[Claim 1]

An outdoor display device comprising of a flat panel display device whereby the flat panel display device is housed in a device box, which consists of a transparent plate fitted in a wall surface facing the display panel of the flat panel display device.

An airflow generating means is used for generating airflow in the front air passage, which is a gap provided between at least the transparent plate and the display panel.

[Claim 2]

An outdoor display device according to Claim 1,

wherein the device box has an eaves-like protrusion on the upper side of the transparent plate on the side on which the transparent plate is fitted.

[Claim 3]

An outdoor display device according to Claim 2,

wherein the device box has a side surface on which the transparent plate is fitted, and the periphery of the transparent plate protrudes outward to form an overall concave shape.

[Claim 4]

An outdoor display device according to Claim 2,

wherein the device box includes a first opening provided on the lower surface of the protrusion, a second opening provided on the bottom surface of the device box, and a back air passage which is a gap provided between the rear surface of the flat panel display device opposite to the side on which the display panel is provided and the wall surface of the device box facing the rear surface.

[Claim 5]

An outdoor display device according to Claim 4,

wherein the airflow generating means includes a fan that is disposed near the opening on the lower side of the front air passage and generates an upward air flow by sending air into the front air passage from below.

[Claim 6]

An outdoor display device according to Claim 4,

wherein the airflow generating means includes a first fan disposed near an upper opening of the front air passage and generates a downward air current by sending air into the front air passage from above.

A second fan is disposed in the vicinity of the upper opening of the rear air passage and generates a downdraft by

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sending air into the back air passage from above.

[Claim 7]

An outdoor display device according to Claim 4,

wherein the airflow generating means is disposed in the vicinity of the second opening, and includes a fan that forcibly discharges air from the second opening to the outside of the device box, thereby generating downward air currents in the front air passage and the back air passage.

[Claim 8]

and the airflow generating means

wherein the airflow generating means is disposed in the vicinity of the first opening, and includes a fan that forcibly draws air into the device box from the first opening to generate downward air currents in the front air passage and the back air passage.

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[Claim 9]

and the airflow generating means

wherein the airflow generating means is disposed near the opening on the lower side of the front air passage, and includes a fan that forcibly draws the air in the front air passage from the lower opening to generate a downward air current in the front air passage.

[Claim 10]

An outdoor display device according to Claim 1,

wherein the device box consists of a back air passage, which is a gap provided between the rear surface of the flat panel display device opposite to the side on which the display panel is provided and the wall surface of the device box facing the rear surface,

a first opening provided at a position closer to the front air passage than a central portion of the bottom surface of the device box,

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a second opening provided at a position closer to the back air passage,

a partition extending vertically upward from the bottom surface between the first and second openings and reaching to the bottom surface of the flat panel display device,

and an airflow generating means

which includes a fan disposed near the opening on the lower side of the front air passage and generates an upward air current by sending air into the front air passage from below.

[Claim 11]

An outdoor display device according to Claim 2,

wherein the device box consists of an eaves-shaped rear protrusion that protrudes outward at a position corresponding to the protrusion on a side surface opposite to the side on which the protrusion is provided,

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a first opening provided on the lower surface of the rear protrusion,

a second opening provided on the bottom surface of the device box,

and the airflow generating means

which includes a fan disposed near the opening on the lower side of the front air passage and generates an upward air current by sending air into the front air passage from below.

[Claim 12]

An outdoor display device according to Claim 2,

wherein the flat panel display device consists of

a liquid crystal display device, which includes

a liquid crystal panel corresponding to the display panel,

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a backlight installed facing the back surface of the liquid crystal panel, and a housing for housing the backlight.

[Claim 13]

An outdoor display device according to Claim 12, wherein the device box consists of

a panel front preheating heater for heating the liquid crystal panel of the liquid crystal display device,

and a temperature measuring means for measuring the temperature of the liquid crystal panel, which controls the temperature of the liquid crystal panel by controlling the airflow generating means and the panel front surface preheating heater based on the measurement result of the temperature measuring means.

[Claim 14]

An outdoor display device according to Claim 13,

wherein the panel front surface preheating heater is disposed in the vicinity of the upper opening of the front air

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passage,

and the airflow generating means is disposed on the opposite side of the panel front surface preheating heater across the front air passage, which includes a fan for generating a downward air current in the front air passage by discharging the air in the front air passage from an opening on the lower side of the front air passage.

[Claim 15]

An outdoor display device according to Claim 13,

wherein the device box further comprises of a housing preheating heater for heating the housing of the liquid crystal display device.

[Claim 16]

An outdoor display according to Claim 1, which further comprises of a photocatalyst thin film disposed on a front surface of the display panel and a face-to-face surface of the display panel of the transparent plate.

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[Detailed description of invention]

[Technical field]

[0001]

The present invention relates to a display device, and more particularly to an outdoor display device using a flat panel type display device as a display section.

[Background technology]

[0002]

Conventional advertising media include printed materials such as posters and stickers, but in and of itself, the display content does not change, so it was not necessarily eye-catching. There is also a method of drawing attention by lighting or blinking a light emitting element such as a light bulb or a light emitting diode, but there is a problem that the power consumption is large.

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[0003]

Therefore, a method of using a liquid crystal display device as an advertising medium has been devised. In the case of liquid crystal display devices, the display contents can be changed arbitrarily, and it is possible to respond to the demand for attracting attention.

[0004]

One example of this includes liquid crystal advertising media disclosed in Patent Reference 1.

In Patent Literature 1, a liquid crystal advertising medium is proposed that enables pop-up display by combining a plastic liquid crystal display panel controlled by ON/OFF driving that does not display intermediate colors by static driving and a pattern layer drawn by printing.

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[0005]

[Patent Literature 1] Japanese Unexamined Patent Application Publication No. 8-15665 (FIG. 1)

[Disclosure of Invention]

[Problems to be solved by the invention]

[0006]

Since conventional liquid crystal advertising media are configured as above, if the device is installed on an outdoor road, etc., the liquid crystal surface may be touched by a passerby, and the liquid crystal panel may be damaged, and if a transparent plate is installed on the front of the liquid crystal panel so that it cannot be directly touched, the transparent plate suppresses the heat dissipation from the front of the liquid crystal panel, and the temperature of the liquid crystal panel increases and it will not function normally.

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[0007]

In addition, for outdoor use, it is necessary to surround the liquid crystal display device in some kind of enclosure so that rainwater and dust do not directly reach the liquid crystal display device, but in such a case, it was difficult to efficiently dissipate heat emitted from the liquid crystal display device.

[0008]

In addition, such a problem is not limited to liquid crystal display devices, but is a common problem when so-called flat panel type display devices such as plasma display devices are used as outdoor display devices.

[0009]

The present invention is made to resolve such problems, and is intended to provide a display device capable of efficiently dissipating heat generated from a flat panel display device.

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[Means for solving the problems]

[0010]

The outdoor display device according to Claim 1 of the present invention is an outdoor display device using a flat panel display device, wherein the flat panel display device is housed in a device box, wherein the device box comprises of a transparent plate inserted into a wall face-to-face with a display panel of the flat panel display device, and an airflow generating means for generating an airflow in a front air passage that is at least a gap provided between the transparent plate and the display panel.

[Effects of the present invention]

[0011]

Based on the outdoor display device according to Claim 1 of the present invention, because airflow is generated in the front air passage, which is a gap provided between the transparent plate and the display panel by means of an airflow generating means, the display panel can be cooled by the airflow to greatly suppress the temperature rise of the display panel.

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[Detailed Description of the Preferred Embodiments]

[0012]

<A. Embodiment 1>

<A-1. Device Configuration>

As Embodiment 1 of the present invention, the configuration of an outdoor display 100 using a liquid crystal display device is described using FIG. 1.

[0013]

As shown in FIG. 1, the outdoor display 100 is broadly divided into a liquid crystal display 1, a device box 2 in which it is stored, and a leg 3 supporting the device box 2.

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[0014]

In FIG. 1, the legs 3 are provided with moving means such as casters 31 to facilitate horizontal movement of the outdoor display device 100, but the moving means is not essential.

[0015]

The liquid crystal display device 1 comprises a liquid crystal panel 13 (display panel), a backlight thereof (e.g., a fluorescent light) 12, and a housing 11 that houses the backlight 12 and also the drive circuit, etc. of the liquid crystal panel 13. The desired image is displayed in the liquid crystal panel 13 when the light LB emitted from the backlight 12 is partially transmitted or blocked from the liquid crystal panel 13. In the following description, the lower direction of the image displayed on the liquid crystal panel 13 is treated as the lower side, and the upper direction of the image is treated as the upper side.

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[0016]

The length-to-width ratio of the liquid crystal panel 13 is not limited to the length-to-width ratio used in so-called television receivers, and may be, for example, the length-to-width ratio of a personal computer display, or a square. It can also be in a vertical shape.

[0017]

The wall facing the liquid crystal panel 13 of the device box 2 is then fitted with, for example, a polycarbonate transparent plate 23, and the image displayed on the liquid crystal panel 13 can be viewed externally through the transparent plate 23. Needless to say, the planar size of the transparent plate 23 is comparable to the liquid crystal panel 13. The side of the side on which the transparent plate 23 is provided is referred to as the window side 21. After conducting a simple test, it was found that the thickness of the polycarbonate plate was 3 mm to 10 mm or less, which was desirable from the viewpoint of visibility and impact resistance.

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[0018]

The polycarbonate plate is used here because it has high ability to withstand impact for protection of the liquid crystal panel 13 and UV shielding for prevention of deterioration of the liquid crystal panel 13, despite transparency. Therefore, a material with equivalent performance is not limited to polycarbonate plates, and a transparent material with equivalent impact resistance to the polycarbonate plates may be used with a UV shielding film applied. It should be noted that, for example, an acrylic plate may be used as an alternative to a polycarbonate plate, and a commercially available UV shield film may be used.

[0019]

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The device box 2 is configured to surround the liquid crystal display 1 and prevent the liquid crystal display 1 from being directly exposed to rainwater or dust. However, once the liquid crystal display 1 is completely sealed within the device box 2, heat emitted from the liquid crystal display 1 is transferred into the device box 2, so a vent is provided. In the example of FIG. 1, the openings OP1 (first opening) and OP2 (second opening) are provided as vents.

[0020]

Here, within the device box 2, the liquid crystal display 1 is arranged such that the liquid crystal panel 13 of the liquid crystal display 1 and the transparent plate 23 do not adhere, and there is a gap between the two, and the gap is referred to as the front air passage AC1.

[0021]

The liquid crystal display 1 is also arranged such that there is a gap between the side (back side) opposite the liquid crystal panel 13 of the liquid crystal display 1 and the wall surface of the device box 2 facing it, and the gap is referred to as the back air passage AC2. The air cooling fins FN are arranged on the rear surface of the liquid crystal display device 1. The air cooling fins FN may be arranged multiple times at the back of the liquid crystal display device 1 as shown in FIG. 1, but only one display element having the same area as the rear surface may be arranged.

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[0022]

A fan F1, which is a means of generating airflow in the front air passage AC1, is arranged in the vicinity of the opening on the lower side of the front air passage AC1, and is configured to pump air from the lower side into the front air passage AC1. The fan F1 is not limited to one, and a plurality of fans may be arranged in parallel along the lower opening of the front air passage AC1. Also, a fan F2 is arranged above the liquid crystal display device 1 to facilitate the inflow of air from the opening OP1. It should be noted that the fan F2 is not limited to one, but a plurality of them may be arranged in parallel along the horizontal direction of the liquid crystal display device 1. In addition, it is acceptable not to arrange the fan F2 if sufficient air flow from the opening OP1 can be obtained without the fan F2.

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[0023]

Here, the window side surface 21 of the device box 2 protrudes outwardly around the transparent plate 23 and is generally concave in shape, and the opening OP1 is provided on the lower surface of the convex protrusion 221 on the upper side of the transparent plate 23, so that rainwater, etc., is prevented from entering under normal conditions. In addition, the opening OP2 is provided on the bottom surface of the device box 2, and as with the opening OP1, it is configured to prevent rainwater, etc. from entering under normal conditions.

[0024]

Here, the protrusion 221 also has a function as a canopy for preventing sunlight from entering the liquid crystal panel 13 and lowering the visibility. A confirmation test of visibility with respect to the length of the convexity showed that if the protruding length of the protrusion 221 is set to A and the length between the protrusion 221 and the lower side of the transparent plate 23 is set to B, the visibility can be ensured in most conditions by setting the A:B = 1:3 to 1:5 range.

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[0025]

In the above description, the circumference of the transparent plate 23 of the window side surface 21 of the device box 2 protrudes outwardly and is generally concave in shape, but it may also be a configuration in which only the convex protrusion corresponding to the protrusion 221 is provided on the upper side of the transparent plate 23. Needless to say that the same effect as described above can be obtained in this case as well.

[0026]

<A-2. Cooling operation>

Referring now to FIG. 1, the cooling operation of the liquid crystal display 1 in the outdoor display 100 is described using FIG. 2.

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As shown in FIG. 1, the light LB exiting the backlight 12 (which may be multiple) is applied directly to the liquid crystal panel 13 or reflected by a mirror (not shown) or a diffuse reflector (not shown) provided inside the housing 11. The illuminated light LB forms an image by being partially transmitted through or blocked by the liquid crystal panel 13.

[0027]

In this way, by arranging the backlight 12 opposite the back surface of the liquid crystal panel 13 and adopting a configuration that reflects light with a mirror or a diffuse reflector, the display image of the liquid crystal panel 13 can be brightened, and a display device suitable for outdoor display can be obtained.

[0028]

The liquid crystal panel 13 is heated by heat emitted by the backlight 12 (e.g., a fluorescent light). In a normal liquid crystal display, the heat entering the liquid crystal panel is escaped to the housing by the heat conduction of the liquid

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crystal panel, and the overheating of the liquid crystal panel is suppressed. However, because outdoor display 100 is provided for bright outdoor use, the brightness of the fluorescent light will be increased in order to increase the visibility of the display, in which case the heat input from the fluorescent light may increase and the operating temperature of the liquid crystal panel 13 may be exceeded.

[0029]

Therefore, a gap is provided between the liquid crystal panel 13 and the transparent plate 23 to form the front air passage AC1, and a configuration is adopted to cool the front surface of the liquid crystal panel 13 by sending air to the front air passage AC1 by the fan F1.

[0030]

The fan F1 rotates so as to send air into the front air passage AC1 from below, and the sent air becomes an upward current and is discharged from the upper opening of the front air passage AC1. The air is mixed with fresh air that flows in from the opening OP1, is cooled, and passed through the back air passage AC2, and is again sent into the front air passage AC1 by the fan F1. FIG. 1 shows the flow of air with arrows.

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[0031]

In this way, a circulation path of air is formed within the device box 2, but air corresponding to the inflow from the opening OP1 is expelled from the opening OP2 to prevent excessively high pressure within the device box 2. Therefore, the opening OP1 serves as an air intake and the opening OP2 serves as an air outlet.

[0032]

In addition, since an air current is also generated in the rear air passage AC2, the cooling ability of the air cooling fins FN provided on the rear surface of the liquid crystal display device 1 is increased, and the housing 11 can be efficiently cooled. If the housing 11 is efficiently cooled, heat generated at the back surface of the liquid crystal panel 13 (the side surface of the backlight 12) becomes easier to flow to the housing 11, leading to suppression of temperature rise of the liquid crystal panel 13.

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[0033]

<A-3. Effect>

By taking the above described configuration, the temperature rise of the liquid crystal panel 13 can be greatly suppressed as described below.

[0034]

FIG. 2 is a diagram showing the temperature rise characteristics of the surface of the liquid crystal panel 13. The horizontal axis represents measurement steps (constant time intervals), and the vertical axis represents temperature (°C). The temperature rise characteristic on the panel surface is represented by C1, the temperature rise characteristic on the panel surface when the front surface is not cooled is represented by C2, and the temperature characteristic within the device box 2 is represented by C0.

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[0035]

As shown in Fig. 2, the temperature of the liquid crystal panel 13 (panel temperature) is about 65 °C at maximum when cooling is not performed, and it is suppressed to about 55 °C at maximum when cooling is performed. Therefore, it can be seen that the panel temperature can be lowered by 10 °C or more by providing the front air passage AC1 to cool the front surface of the panel.

[0036]

In the outdoor display 100, the fan F1 is provided in the vicinity of the opening on the lower side of the front air passage AC1, so the cooling efficiency of the front surface of the liquid crystal panel 13 is high, and the cooling capacity can be adjusted sensitively by adjusting the wind speed.

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[0037]

In this case, direct air cooling such as blowing wind on the back surface of the liquid crystal panel 13 or blowing wind on the backlight 12 is not employed because static electricity induced by the backlight 12, etc., makes it easier for dust in the air to adsorb to the fluorescent light, and reduces the illuminance of the backlight 12 in a short time, and shortens the life of the backlight 12. For this reason, it is desirable to store electronic devices such as the backlight 12 and the drive circuit of the liquid crystal panel 13 in the housing 11, and seal the housing 11 with packings, fillers, etc. so that there is no gap.

[0038]

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In addition, it is desirable to adopt a support structure with a cushioning material sandwiched between the housing 11 of the liquid crystal display 1 and the inner wall of the device box 2 in order to mitigate shocks caused by a fall, etc. of the outdoor display 100.

[0039]

In addition, in order to improve reliability, a filter shall be provided in the opening OP1, which is the air intake port, to prevent dust from entering the device. In this case, it is desirable to have a removable structure on the top surface and the back surface of the device box 2 (the side opposite the window side surface 21) to ensure maintenance, and to have a structure that makes it easy to clean the filter.

[0040]

In addition, it goes without saying that a sealing member such as a packing is arranged in the connection portion between the transparent plate 23 and the device box 2 to prevent rainwater and dust from entering through the gap.

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[0041]

<A-4. Deformation Example 1>

The outdoor display 100 shown in FIG. 1 took the configuration of a fan F1 in the vicinity of the opening on the lower side of the front air passage AC1, but it may also be a configuration such as the outdoor display 100A shown in FIG. 3. In FIG. 3, the same configuration as the outdoor display device 100 shown in FIG. 1 is marked with the same sign, and duplicate explanations are omitted.

[0042]

As shown in FIG. 3, in the outdoor display 100A, a fan F11 (first fan) is arranged in the vicinity of the upper opening of the front air passage AC1 and a fan F12 (second fan) is arranged in the vicinity of the upper opening of the back air passage AC2.

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[0043]

By using fans F11 and F12 arranged in this way, air entering through opening OP1 is fed by fan F11 to the front air passage AC1 and by fan F12 to the back air passage AC2. The delivered air is then discharged into a downward airflow from the opening on the lower side of each of the front and back air passages AC1 and AC2 and out of the opening OP2 on the bottom side of the device box 2.

[0044]

Here, the fan F11 can be referred to as a liquid crystal panel cooling fan because it mainly cools the front surface of the liquid crystal panel 13, and the fan F12 can be referred to as a housing cooling fan because it cools the housing 11.

[0045]

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In this way, the fan F11 and fan F12 can independently pump air into the front and back air passages AC1 and AC2 without circulating air within the device box 2, allowing the front and the housing 11 of the liquid crystal panel 13 to be cooled together with high flow rate ambient air, further increasing the cooling efficiency of the liquid crystal panel 13.

[0046]

<A-5. Deformation Example 2>

In the outdoor display 100A described above, the configuration was made to independently pump air into the front and back air passages AC1 and AC2 without circulating air within the device box 2, but to achieve this, the configuration may also be such as the outdoor display 100B shown in FIG. 4 or the outdoor display 100C shown in FIG. 5. In FIG. 4 and FIG. 5, the same configuration as the outdoor display device 100 shown in FIG. 1 is marked with the same sign, and duplicate explanations are omitted.

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[0047]

In the outdoor display 100B shown in FIG. 4, a fan F21, which is an airflow generating means, is arranged proximate the opening OP2 at the bottom of the device box 2, and by rotating the fan F21 to force air in the device box 2 out of the opening OP2, air entering the opening OP1 is divided through the front and back air passages AC1 and AC2, respectively, and air passing through the front and back air passages AC1 and AC2 in a downward airflow is discharged externally by the fan F21.

[0048]

Such a configuration may also allow the front surface of the liquid crystal panel 13 and the housing 11 to cool together with outside air, thus increasing the cooling efficiency of the liquid crystal panel 13.

[0049]

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In addition, in the outdoor display 100C shown in Fig. 5, a fan F31, which is an airflow generating means, is arranged in the vicinity of the opening OP1 provided in the protrusion 221 of the device box 2, and by rotating the fan F31 to force the outside air into the device box 2, air entering from the opening OP1 is divided through the front and back air passages AC1 and AC2, respectively, and air passing through the front and back air passages AC2 as a downward airflow is discharged externally from the opening OP2 at the bottom of the device box 2.

[0050]

Such a configuration may also allow the front surface of the liquid crystal panel 13 and the housing 11 to cool together with outside air, thus increasing the cooling efficiency of the liquid crystal panel 13.

[0051]

<A-6. Deformation Example 3>

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In the Embodiments 1 and Deformation 1 and 2 described above, cooling of the back surface of the liquid crystal panel 13 used indirect cooling to heat conduct heat generated in the liquid crystal panel 13 to the housing 11 and cool the housing 11 by air cooling, but may also be configured as outdoor display 100D shown in FIG. 6. In FIG. 6, the same configuration as the outdoor display device 100 shown in FIG. 1 is marked with the same sign, and duplicate explanations are omitted.

[0052]

In the outdoor display 100D shown in FIG. 6, the liquid crystal display 1A has a configuration for pumping cooling air therein.

[0053]

That is, the housing 11A of the liquid crystal display device 1A has an opening OP11 in its top surface and an opening OP12 in its bottom surface. The opening OP11 is then covered with a high performance filter HFL that can remove dust in μm units such as a high efficiency particulate air (HEPA) filter, and a fan F42 is arranged in the vicinity of the opening OP12. A fan F41 is then arranged as an airflow generating means in the vicinity of the opening on the lower side of the front air passage AC1.

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[0054]

The fan F41 rotates to force the air in the front air passage AC1 from the lower opening, and the exhausted air is discharged externally from the opening OP2 at the bottom of the device box 2, but new air flowing through the opening OP1 by rotation of the fan F41 flows into the front air passage AC1 and into the housing 11A through the filter HFL by rotation of the fan F42 to directly cool the back surface of the liquid crystal panel 13 and the backlight 12. Then, it is forcibly discharged to the outside of the housing 11A by the fan F42, and further discharged to the outside through the opening OP2.

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[0055]

In this way, the rear surface of the liquid crystal panel 13 and the backlight 12 can be directly air-cooled to further increase the cooling efficiency of the liquid crystal panel 13.

[0056]

In addition, since the air guided into the housing 11A is passed through the high-performance filter HFL, dust in the air is removed, and reduction in the life of the backlight 12 can be suppressed.

[0057]

In Fig. 6, the rear of the liquid crystal display device 1A does not have a cooling fin arranged, and the back air passage AC2 shows a configuration in which a bulkhead PW1 is provided in the device box 2 so that air does not flow directly from the opening OP1, but it may be in a configuration in which a bulkhead PW1 is not provided, or it may be in a configuration in which a cooling fin is arranged in the back of the liquid crystal display device 1A.

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[0058]

<A-7. Deformation Example 4>

In the Embodiment 1 and Deformation 1-3 described above, a configuration is shown in which an air inlet is provided at the protrusion 221 of the device box 2 and an air outlet is provided at the bottom surface of the device box 2, but the arrangement position of the air inlet is not limited to this, and may be provided at the side, back, or bottom surface of the device box 2.

[0059]

Such a configuration may be such as the outdoor display 100E shown in FIG. 7 or the outdoor display 100F shown in FIG. 8. In FIG. 7 and FIG. 8, the same configuration as the outdoor display device 100 shown in FIG. 1 is marked with

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the same symbol, and duplicate explanations are omitted.

[0060]

In the outdoor display 100E shown in FIG. 7, an opening OP3 (first opening) is provided at a location proximate to the front air passage AC1 than at a center portion of the bottom surface of the device box 2, and an opening OP4 (second opening) is provided at a location proximate to the back air passage AC2. A partition wall PW2 extending vertically upward from the bottom surface of the device box 2 and reaching the bottom surface of the liquid crystal display device 1 is provided between the openings OP3 and OP4. A fan F1 is then arranged in the vicinity of the opening on the lower side of the front air passage AC1.

[0061]

The fan F1 is rotated to pump air from the lower side into the front air passage AC1, the air is pumped out of the upper opening of the front air passage AC1 and out of the opening OP4 through the back air passage AC2. 10

[0062]

The rotation of the fan F1 draws new ambient air from the opening OP3, but the presence of the partition wall PW2 does not directly supply the ambient air to the rear air path AC2, which is first fed to the front air path AC1 to cool the front surface of the liquid crystal panel 13.

[0063]

By adopting such a configuration, fresh outside air first cools only the front surface of the liquid crystal panel 13, so that the cooling efficiency of the front surface of the crystal panel 13 can be enhanced.

[0064]

In addition, in this configuration, the opening OP3 provided in the bottom surface of the device box 2 serves as an air intake, and it increases the degree of freedom in the arrangement position of the air intake and facilitates changes in the design of the device. 20

[0065]

In the outdoor display 100F shown in FIG. 8, the top of the back of the box 24, which is opposite the window side 21 of the device box 2, has a receptively protruding rear protusions 223 and an opening OP5 (first opening) is provided on the lower surface of the protrusion 221. Therefore, the opening OP5 is configured to prevent rainwater, etc. from entering under normal conditions. A fan F1 is then arranged in the vicinity of the opening on the lower side of the front air passage AC1.

[0066]

The fan F1 rotates to pump air from the lower side into the front air passage AC1, the air being pumped out of the upper opening of the front air passage AC1 is cooled with the new air coming in from the opening OP5, and again fed into the front air passage AC1 by the fan F1 through the back air passage AC2. 30

[0067]

In this way, it is advantageous that the air intake opening OP5 is provided in the back of the box 24 opposite the window side 21 of the device box 2 to facilitate the design change of the window side 21 of the device box 2.

[0068]

It should be noted that in the case of a configuration comprising a front air passage and a back air passage, it is not surprising that it is possible to efficiently cool the liquid crystal display device, other than the combination of air inlet, air outlet, and fan arrangement as shown in Embodiments 1 and Deformations 1-4.

[0069]

<B. Embodiment 2>

<B-1. Device Configuration>

As Embodiment 1 of the present invention, the configuration of an outdoor display 100 using a liquid crystal display device is described using FIG. 1. In FIG. 9, the same configuration as the outdoor display device 100 shown in FIG. 1 is marked with the same sign, and duplicate explanations are omitted.

[0070]

In the outdoor display device of Embodiment 1 of the present invention and its Deformations described using FIGS. 1 to 8, a configuration is described from the perspective of cooling the liquid crystal panel in order to suppress temperature rise, but if the operating temperature of the liquid crystal panel is maintained appropriately and power consumption is 50

reduced, not only cooling but heating may be necessary.

[0071]

In the outdoor display 200 shown in FIG. 9, a liquid crystal panel front preheating heater H1 is arranged in the vicinity of the opening on the upper side of the front air passage AC1, and a housing preheating heater H2 is arranged on the back of the liquid crystal display 1. A temperature sensor TS (temperature measurement means) is attached to the back surface of the liquid crystal panel 13. The heater H1 for preheating the front face of the liquid crystal panel may be configured to extend along the upper opening of the front air passage AC1, or may be arranged in parallel along the opening. It should be constructed so that the airflow can pass through it without being slowed down.

[0072]

In addition, a fan F71 is arranged in the vicinity of the opening on the lower side of the front air passage AC1 and a fan F72 is arranged in the vicinity of the opening OP2 on the bottom side of the device box 2.

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[0073]

The liquid crystal panel front surface preheating heater H1, housing preheating heater H2, temperature sensor TS, and fans F71 and F72 are controlled by the liquid crystal panel temperature control board TC. The connection relationship between the liquid crystal panel temperature control board TC and the controlled device is shown in FIG. 10.

[0074]

<B-2. Temperature control operation>

Next, with reference to FIG. 9, temperature control operation of the liquid crystal display device 1 at the outdoor display device 200 is described using FIGS. 11-13.

When information about the temperature of the liquid crystal panel 13 measured using a temperature sensor TS attached to the back surface of the liquid crystal panel 13 is given to the liquid crystal panel temperature control board TC, the liquid crystal panel temperature control board TC controls the fans F71, F72 and heaters H1, H2 to achieve a preset temperature.

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[0075]

Since the fan F71 is used to create an air flow from below when cooling the liquid crystal panel 13, the liquid crystal panel front preheating heater H1 does not interfere with the air flow when cooling, and the cooling efficiency does not decrease when providing the liquid crystal panel front preheating heater H1. The fan F72 also operates when using the front preheating heater H1 and rotates to create an air flow from top to bottom when heating the liquid crystal panel 13.

[0076]

<B-2-1. Temperature Control by Fan ON/OFF Control>

First, temperature control by ON/OFF control of the fan will be described.

FIG. 11 is a characteristic diagram illustrating a temperature change when controlling panel temperature by ON/OFF control of fan F71.

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[0077]

In FIG. 11, the time is shown on the horizontal axis and the temperature is shown on the vertical axis, representing the ON and OFF periods of the fan F71 and the change in the temperature (panel temperature) of the liquid crystal panel 13 in each period. In addition, the lower limit of the LCD panel operable temperature is expressed as TL, the lower limit of the temperature control setting is expressed as T0, the upper limit of the temperature control setting is expressed as T1, and the upper limit of the LCD panel operable temperature is expressed as TH.

[0078]

When the liquid crystal display device 1 is activated, the panel temperature begins to rise due to heat input from the backlight 12, etc. At this stage, the fan F71 is off.

[0079]

The panel temperature is detected by the temperature sensor TS and temperature information is provided to the liquid crystal panel temperature control board TC.

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[0080]

In the liquid crystal panel temperature control board TC, when the panel temperature reaches a predetermined temperature T1, the fan F71 is operated (ON).

[0081]

The panel temperature begins to drop due to the operation of the fan F71, and when the temperature drops to T0, the fan F71 is stopped. When the fan F71 is stopped, the panel temperature starts to rise again, so the fan F71 is operated after the temperature reaches T1.

[0082]

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By repeating ON and OFF of the fan F71 in this way, the temperature change of the liquid crystal panel 13 can be kept within the preset temperature control region (T0 to T1).

[0083]

The above explanation corresponds to the case of ON/OFF control of one fan F71 or the case of simultaneous ON/OFF control of a plurality of fans F71. When a plurality of fans F71 are used, by setting the ON/OFF conditions to different temperatures for each fan F71, it becomes possible to control the temperature with a smoother temperature change.

[0084]

For example, the operation conditions of the plurality of fans F71 are classified into first, second and third categories, and when the panel temperature begins to rise and reaches temperature T0, the fan F71 of the first category is first operated. Although the first category fan F71 alone does not reduce the panel temperature, the rate of increase can be reduced. Then, if the temperature rises further to reach between the temperature T0 and T1, the second category fan F71 is operated. The operation of the second category fan F71 further reduces the rate of temperature rise. Then, when the temperature T1 is reached, the third category fan F71 is operated.

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[0085]

The operation of the third category fan F71 causes the panel temperature to drop, but in this case, if the temperature T0 and T1 are reached, the third category fan F71 is stopped and the first and third category fan F71 is stopped when the temperature T0 is reached.

[0086]

It should be noted that the classification of multiple fans F71 is not limited to three, and the ON/OFF conditions are not limited to the above.

[0087]

In addition, in order to perform the above-described stepwise control, rather than the configuration in which the plurality of fans F71 send air directly into the front air passage AC1, it is desirable to provide an air pool in front of the front air passage AC1 and firstly, to send air into the air pool by the plurality of fans F71. Such a configuration allows air to be evenly pumped across the front airflow AC1, even if air is pumped from one fan F71.

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[0088]

<B-2-2. Temperature control by fan inverter control>

Next, temperature control by inverter control of the fan will be described.

FIG. 12 is a characteristic diagram illustrating a temperature change when controlling panel temperature by inverter control of fan F71.

[0089]

In FIG. 12, the frequency change of the inverter used to control the fan rotation is listed along with the panel temperature change, and the vertical axis shows the temperature and inverter frequency. The definition of each temperature is the same as in FIG. 11.

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[0090]

When the liquid crystal display 1 is activated and the panel temperature begins to rise and the panel temperature reaches a predetermined temperature T0, the fan F71 is activated, but the frequency of the control inverter at that time is low and the number of rotations of fan F71 is also low.

[0091]

The frequency of the control inverter increases as the panel temperature rises, and the number of revolutions of the fan F71 also increases, resulting in an increase in cooling efficiency. When the panel temperature is constant, the frequency of the control inverter is also constant.

[0092]

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Thus, by controlling the rotational speed of the fan F71 by the inverter, changes in the panel temperature can be controlled gently, and it is possible to maintain a constant state of the panel temperature.

[0093]

<B-2-3. Temperature control using heater>

Next, temperature control using a heater will be described.

Without the use of the liquid crystal display device 1 outdoors, the temperature of the liquid crystal panel 13 may be about the same as the outdoor temperature and may be lower than the lower limit of the operable temperature in cold regions.

[0094]

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In that case, the temperature of the liquid crystal panel 13 approaches the temperature control setting lower limit T0 over time even if only the heat input from the backlight 12 is applied. By using the panel front preheating heater H1 and the housing preheating heater H2, it is possible to shorten the time required for the panel temperature to reach the temperature control region defined as the region between the temperature control setting lower limit T0 and the temperature control setting upper limit T1.

[0095]

FIG. 13 is a characteristic diagram showing temperature changes when the panel front surface preheating heater H1 is used to control the panel temperature.

[0096]

In Fig. 13, the time is shown on the horizontal axis and the temperature is shown on the vertical axis, and the ON/OFF periods of the panel front surface preheating heater H1 and changes in the temperature of the liquid crystal panel 13 (panel temperature) during each period are shown as the characteristics of the "heater present" state. In addition, the change in panel temperature when the panel front surface preheating heater H1 is not used is represented as the characteristic of "no heater". The definition of each temperature is the same as in FIG. 11.

[0097]

As shown in FIG. 13, when the liquid crystal display 1 is not used, the panel temperature is lower than the lower limit of operable temperature TL, but when the liquid crystal display 1 is activated, the panel temperature begins to rise due to heat input from the backlight 12.

[0098]

Now, looking at the characteristics of "no heater", it is time t1 for the panel temperature to reach temperature T0. On the other hand, after activating the liquid crystal display device 1, when the panel front preheating heater H1 is turned on, the speed of increase of the panel temperature increases, as represented by the characteristic of "heater present", and the temperature T0 is reached at a time t0 shorter than time t1.

[0099]

After the temperature T0 is reached, the temperature rise continues just by the heat input from the backlight 12, so the panel front preheat heater H1 is stopped (OFF).

[0100]

In this way, by using the panel front surface preheating heater H1, the time required for the panel temperature to reach the temperature control range can be shortened, and the panel temperature can enter the temperature control range in a short period of time. The operation temperature of the liquid crystal panel is maintained properly, and the time until the operation of the liquid crystal panel 13 stabilizes can be shortened.

[0101]

In the above description, the case where only the panel front surface preheating heater H1 is used has been described, but by also using the housing preheating heater H2, the time required for the panel temperature to enter the temperature control range can be further shortened.

[0102]

Further, after the panel temperature reaches the temperature control region, the panel front surface preheating heater H1 and/or the housing preheating heater H2 are stopped, so power consumption can be reduced.

[0103]

In the above description, it is assumed that the panel temperature will enter the temperature control range even if only the heat input from the backlight 12 takes time. If the heat input from the backlight 12 alone does not reach the temperature control region, the outdoor temperature is considered to be extremely low. In that case, even after reaching the temperature control region using the panel front surface preheating heater H1 and/or the housing preheating heater H2, the heaters are not stopped so that the panel temperature remains constant within the temperature control region. This can be dealt with by adjusting the power.

[0104]

As described above, by monitoring the panel temperature and controlling the operation of the fans F71 and F72, the panel front preheating heater H1 and the housing preheating heater H2 as appropriate based on the panel temperature, the

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panel temperature can be efficiently controlled, and the display function can be stabilized by keeping the panel temperature constant, and the power consumption can be reduced by eliminating unnecessary cooling and heating.

[0105]

<B-3. Condensation prevention measures>

When the outdoor display device is moved from a cold environment to a room or the like, dew condensation may occur on the front surface of the liquid crystal panel 13 or the inner surface of the transparent plate 23 depending on the conditions, resulting in deterioration of image visibility.

[0106]

Thus, as shown in FIG. 14, a configuration is adopted that suppresses the loss of visibility due to condensation by applying a surface treatment to the inner and outer surfaces of the transparent plate 23 and the front surface of the liquid crystal panel 13.

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[0107]

In FIG. 14, only the transparent plate 23 and the liquid crystal display device 1 are excerpted, and an outer surface coating 231 is arranged on the outer surface of the transparent plate 23, an inner surface coating 232 is arranged on the inner surface of the transparent plate 23, and a liquid crystal panel front coating 131 is arranged on the front surface of the liquid crystal panel 13.

[0108]

A photocatalyst thin film such as a titanium oxide film or a photocatalyst sheet is used for the inner surface coating 232 and the liquid crystal panel front surface coating 131, and a decrease in visibility due to dew condensation can be suppressed by a photocatalytic reaction.

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[0109]

Since the outer surface of the transparent plate 23 may reduce visibility due to irregular reflection due to fine scratches on the surface, as the outer coating 231, a transparent protective sheet having a high hardness may be attached or a protective film may be applied and replaced as necessary to suppress deterioration in visibility due to scratches or the like. Of course, a photocatalyst thin film or a photocatalyst sheet may be used, in which case it is possible to suppress deterioration in visibility due to adhesion of rainwater or the like.

[0110]

In the above description, the outdoor display device according to the present invention is made on the premise that it is used outdoors, it goes without saying that it may be used indoors, and in that case, the same effects as cooling, dust prevention, anti-glare, damage prevention, etc. can be obtained.

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[0111]

From the viewpoint of indoor use, it is not necessary to provide the eaves-like protrusion portion 221 on the upper side of the transparent plate 23. If the visibility may be sacrificed to some extent, the protrusion portion 221 may not be provided, and the window side surface 21 may have a flat structure. In this case, it is good to devise the position and shape of the vent so that rainwater and dust do not easily enter through the vent.

[0112]

The above explanation is based on the assumption that a liquid crystal display device is used, but since the temperature of the display surface may rise even when using a plasma display device, the present invention is also effective when using a plasma display device.

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[Brief Description of Drawings]

[0113]

[FIG. 1] A cross-sectional view that describes the configuration of Embodiment 1 of an outdoor display device according to the present invention.

[FIG. 2] A temperature characteristic diagram illustrating operation of Embodiment 1 of outdoor display device according to the present invention.

[FIG. 3] A cross-sectional view describing the configuration of the Deformation 1 of Embodiment 1 of an outdoor display device according to the present invention.

[FIG. 4] A cross-sectional view describing the configuration of the Deformation 2 of Embodiment 1 of an outdoor

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display device according to the present invention.

[FIG. 5] A cross-sectional view describing the configuration of the Deformation 2 of Embodiment 1 of an outdoor display device according to the present invention.

[FIG. 6] A cross-sectional view describing the configuration of the Deformation 3 of Embodiment 1 of an outdoor display device according to the present invention.

[FIG. 7] A cross-sectional view describing the configuration of the Deformation 4 of Embodiment 1 of an outdoor display device according to the present invention.

[FIG. 8] A cross-sectional view describing the configuration of the Deformation 4 of Embodiment 1 of an outdoor display device according to the present invention.

[FIG. 9] A cross-sectional view illustrating the configuration of Embodiment 2 of an outdoor display device according to the present invention. 10

[FIG. 10] A diagram illustrating the control relationship of the configuration of the Embodiment 2 of an outdoor display device according to the present invention.

[FIG. 11] A characteristic diagram showing the temperature change when controlling the panel temperature by fan ON/OFF control.

[FIG. 12] A characteristic diagram showing the temperature change when controlling the panel temperature by the fan inverter control.

[FIG. 13] A characteristic diagram representing the temperature change when controlling the panel temperature by heating.

[FIG. 14] A cross-sectional view illustrating a structure in which the inner and outer surfaces of the transparent plate and the front surface of the liquid crystal panel are surface treated. 20

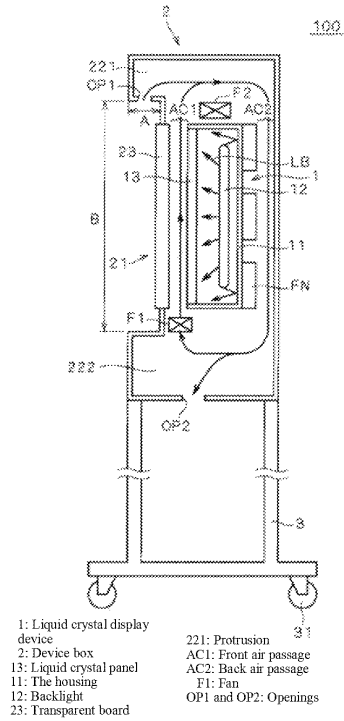
[Reference Signs List]

[0114]

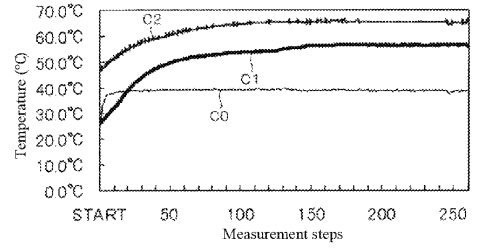
1 Liquid crystal display device, 2 Device box, 11 Housing, 12 Backlight, 13 Liquid crystal panel, 23 Transparent plates, 221 Protrusion, 223 Rear protrusion, AC1 Front air passage, AC2 Back air passage, OP1, OP2, OP3, OP4, OP5 Openings, F1, F11, F1 2, F21, F31, F41, F42, F71, F72 Fans, H1 Panel front preheat heater, H2 Housing preheat heater, TS Temperature sensor.

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[FIG. 1]



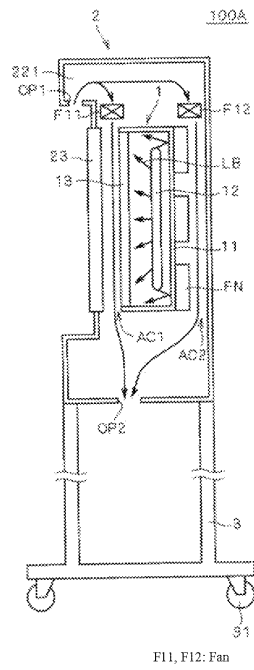
[FIG. 2]



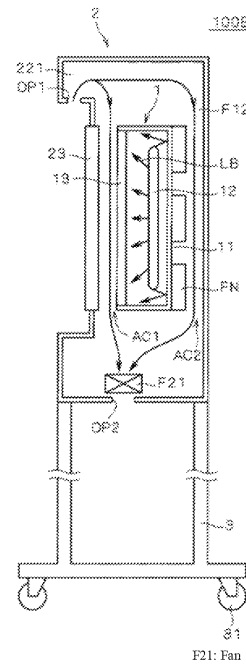
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[FIG. 3]

[FIG. 4]



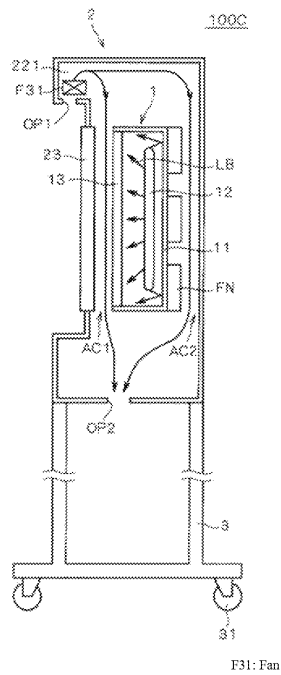
F11, F12: Fan



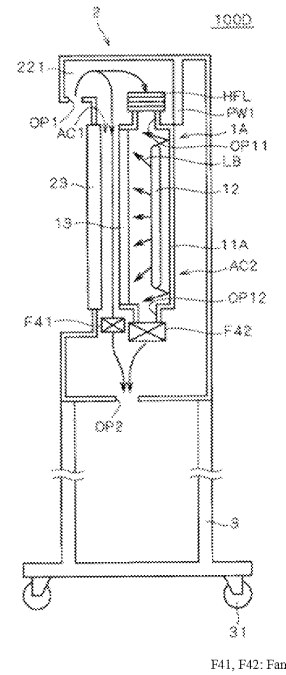
F21: Fan

[FIG. 5]

[FIG. 6]



F31: Fan



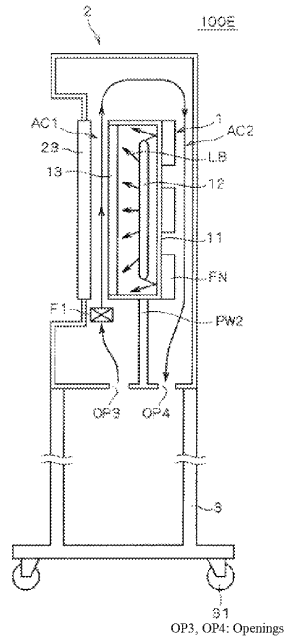
F41, F42: Fan

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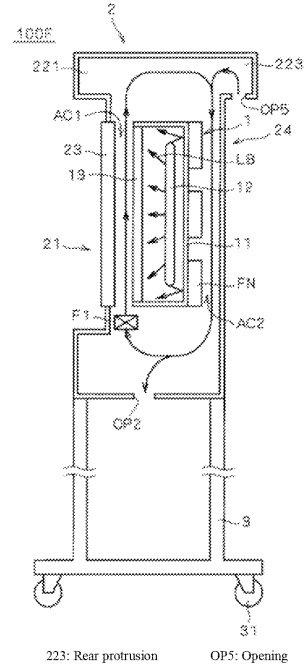
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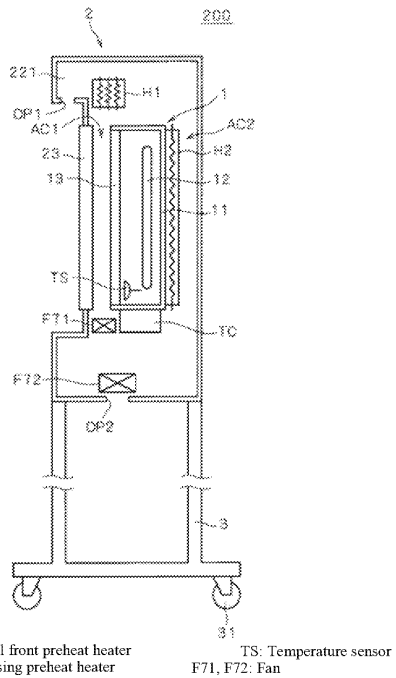
[FIG. 7]



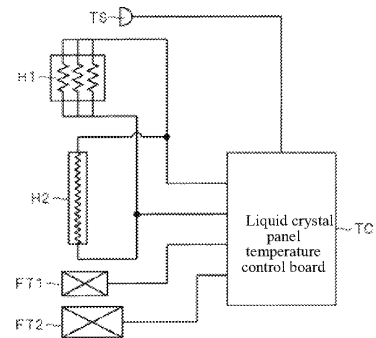
[FIG. 8]



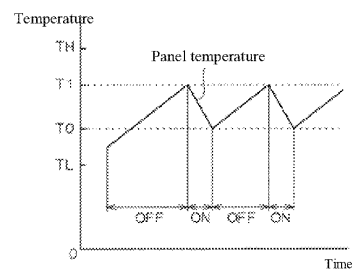
[FIG. 9]



[FIG. 10]

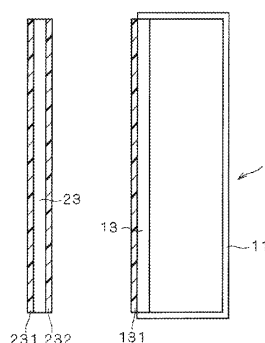
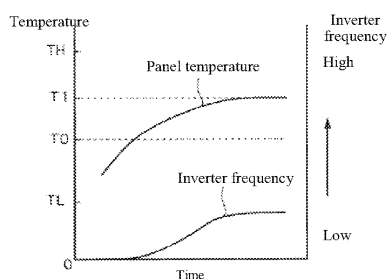


[FIG. 11]



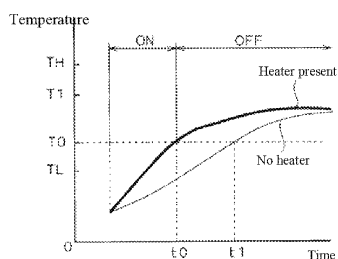
[FIG. 12]

[FIG. 14]



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[FIG. 13]



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Continuation of the front page

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HH18 LL19



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Dan McCourt

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February 28, 2023

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