US 20060132699A1

(19) United States

(12) Patent Application Publication (10) Pub. No.: US 2006/0132699 A1

Cho et al. (43) Pub. Date: Jun. 22, 2006

(54) COOLING APPARATUS AND LIQUID CRYSTAL DISPLAY DEVICE HAVING THE SAME

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(21) Appl. No.: **11/313,151**

(22) Filed: **Dec. 20, 2005**

(30) **Foreign Application Priority Data**

Dec. 20, 2004 (KR) 2004-0108831

Publication Classification

(51) **Int. Cl.**
G02F 1/1333
(2006.01)

(52) **U.S. Cl.** **349/161**

(57) **ABSTRACT**

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

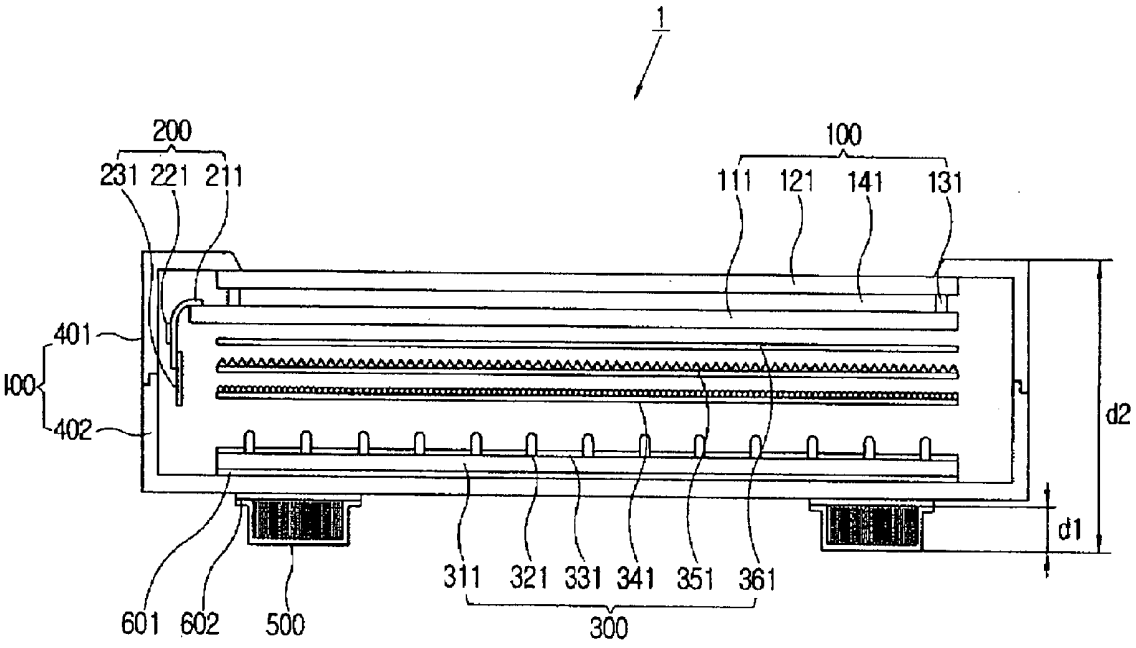


FIG. 1A

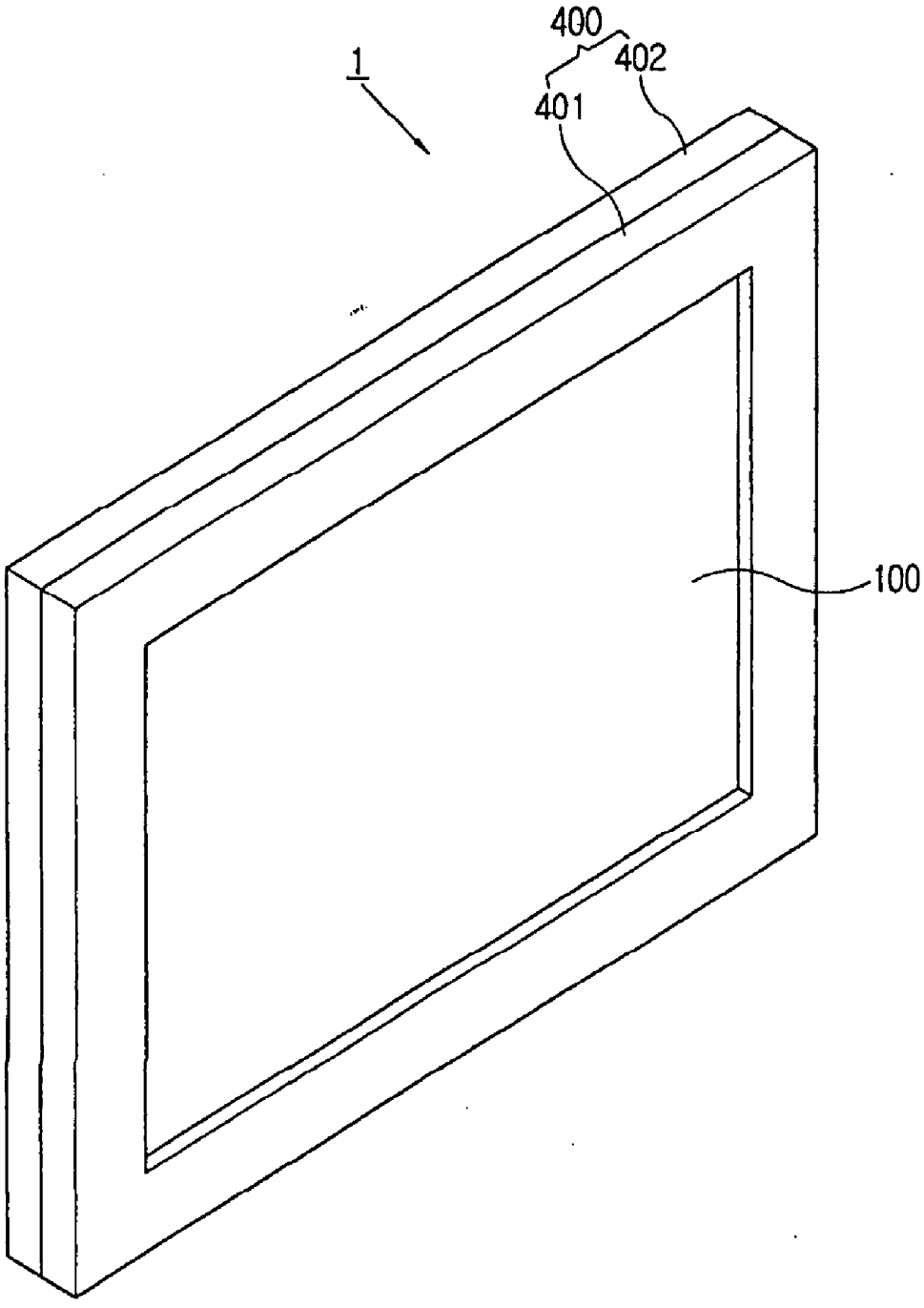


FIG. 1B

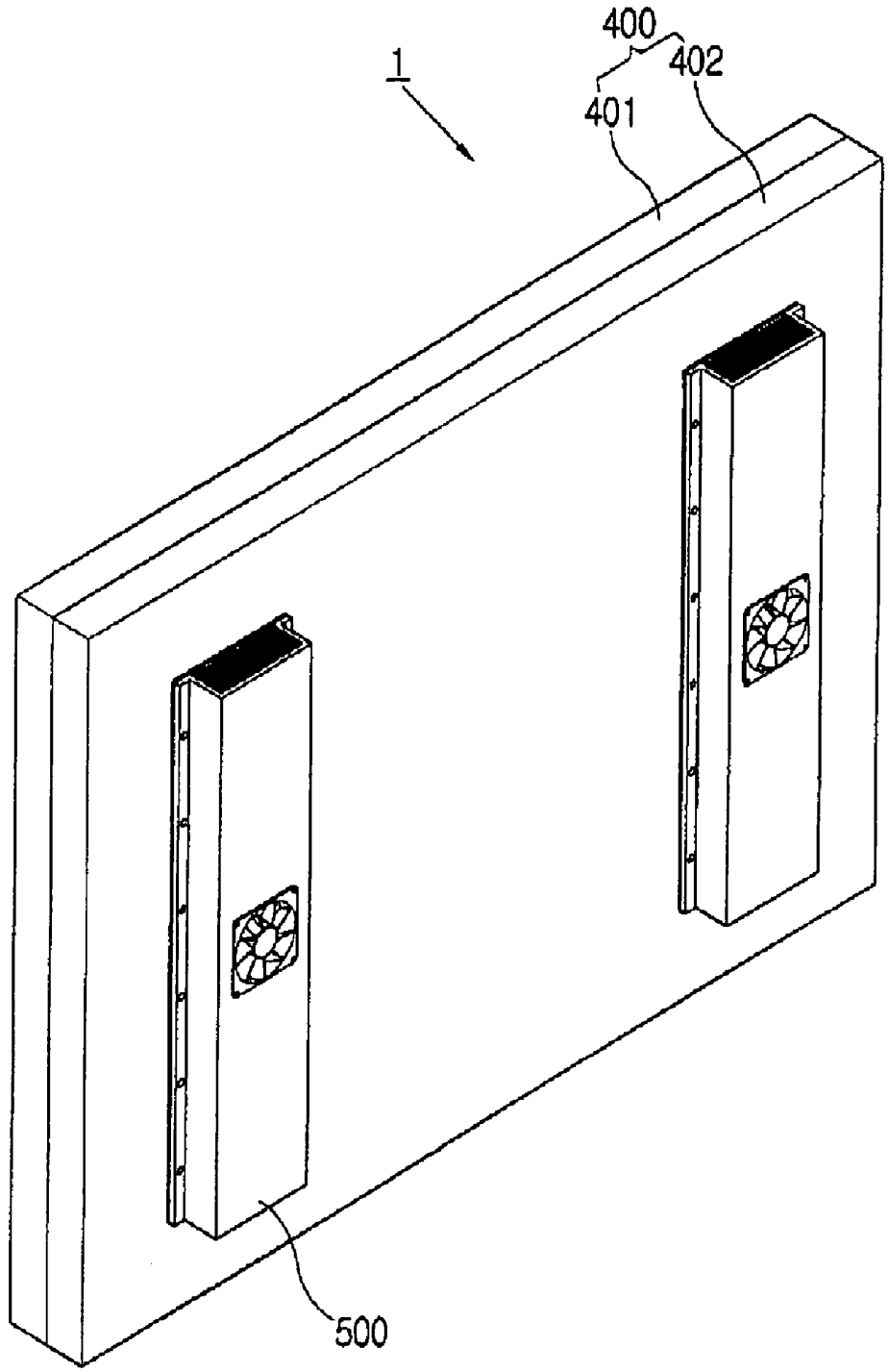


FIG. 2

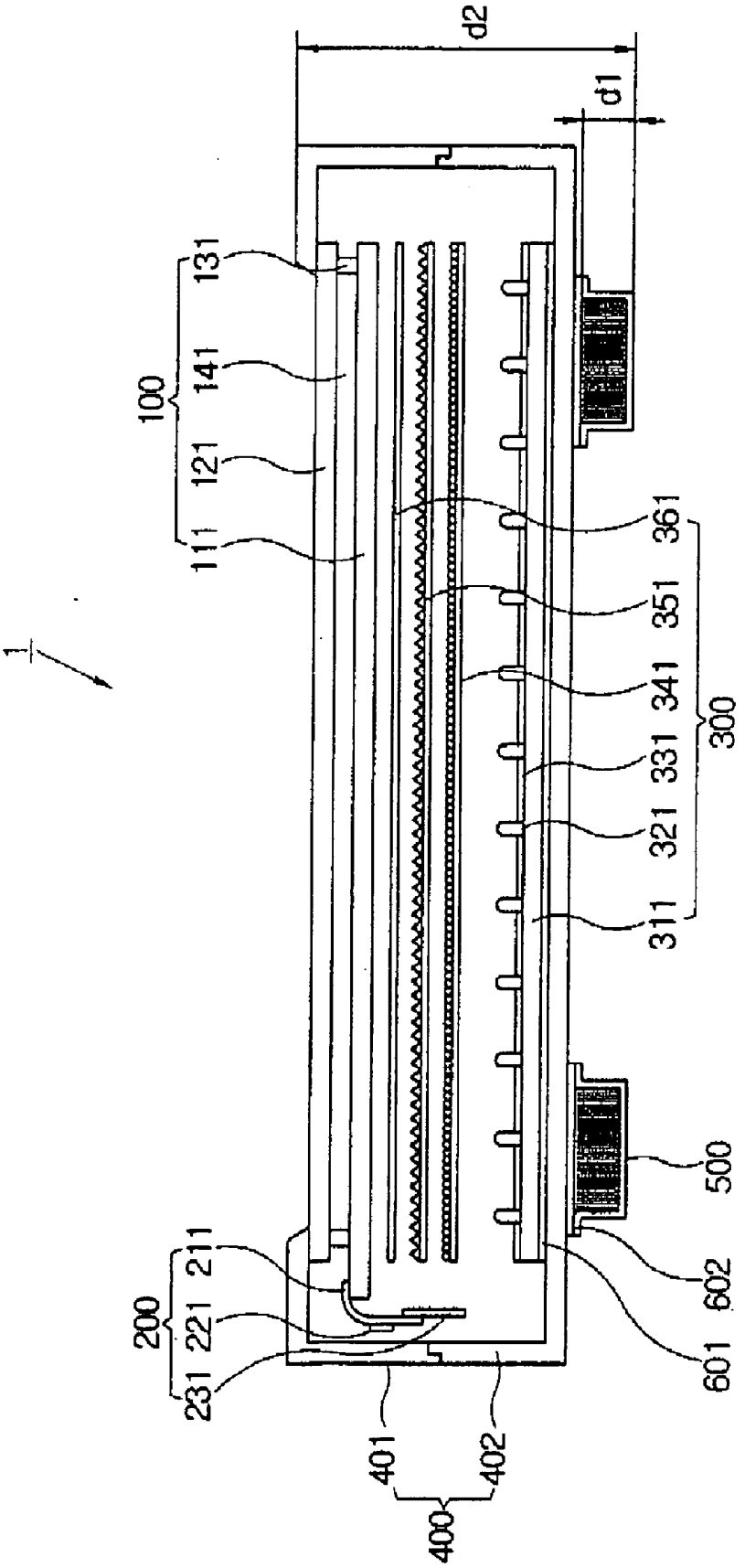

1
d2
d1
100
131
141
121
111
361
351
341
331
321
311
300
500
602
601
200
211
221
231
401
402
400

FIG. 3

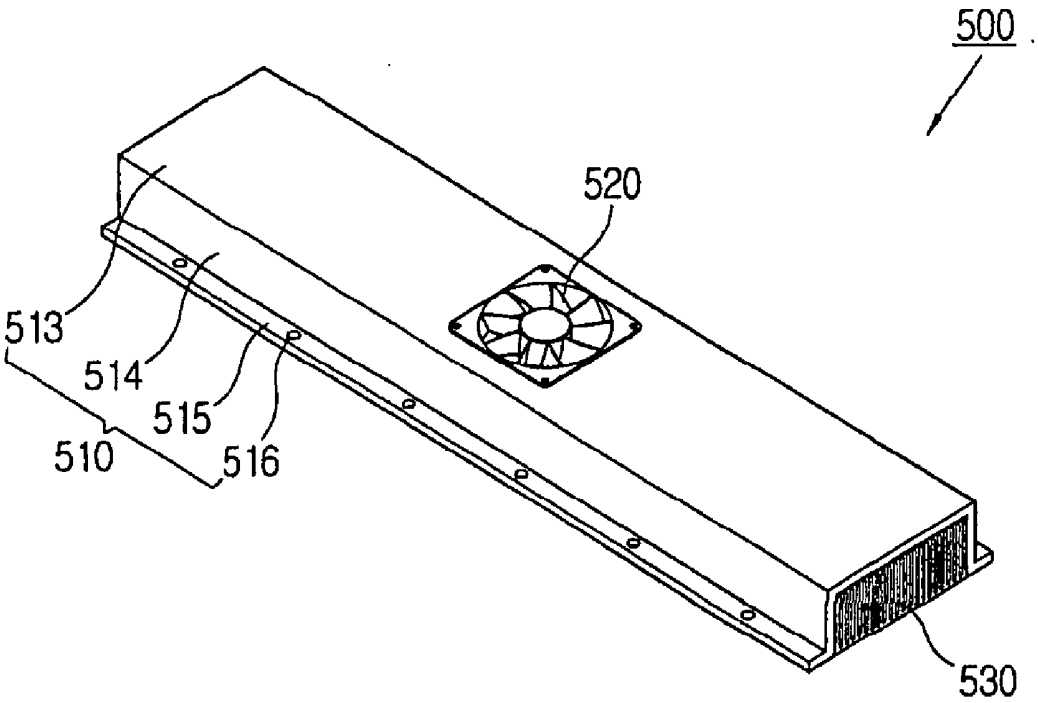


FIG. 4

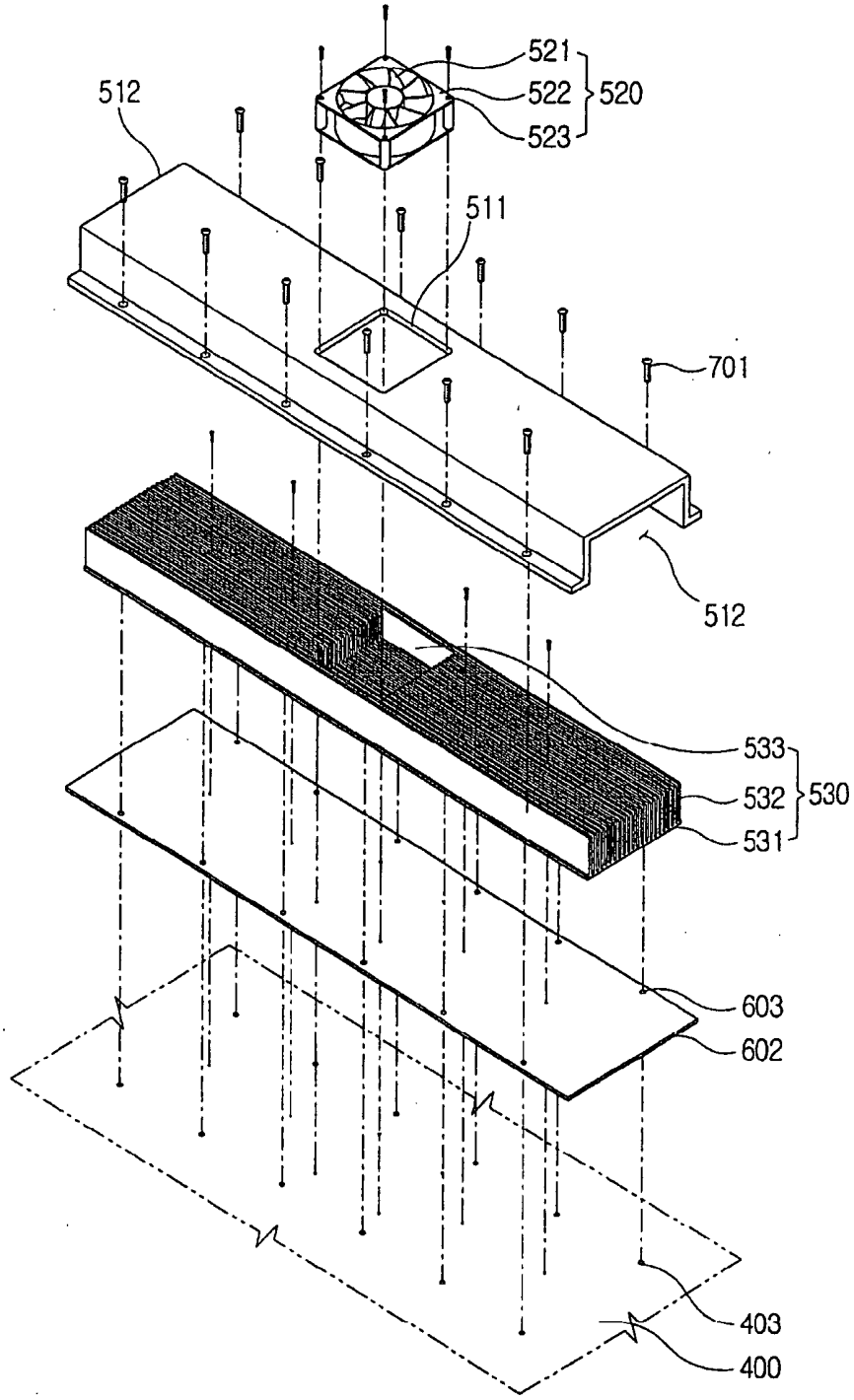


FIG. 5

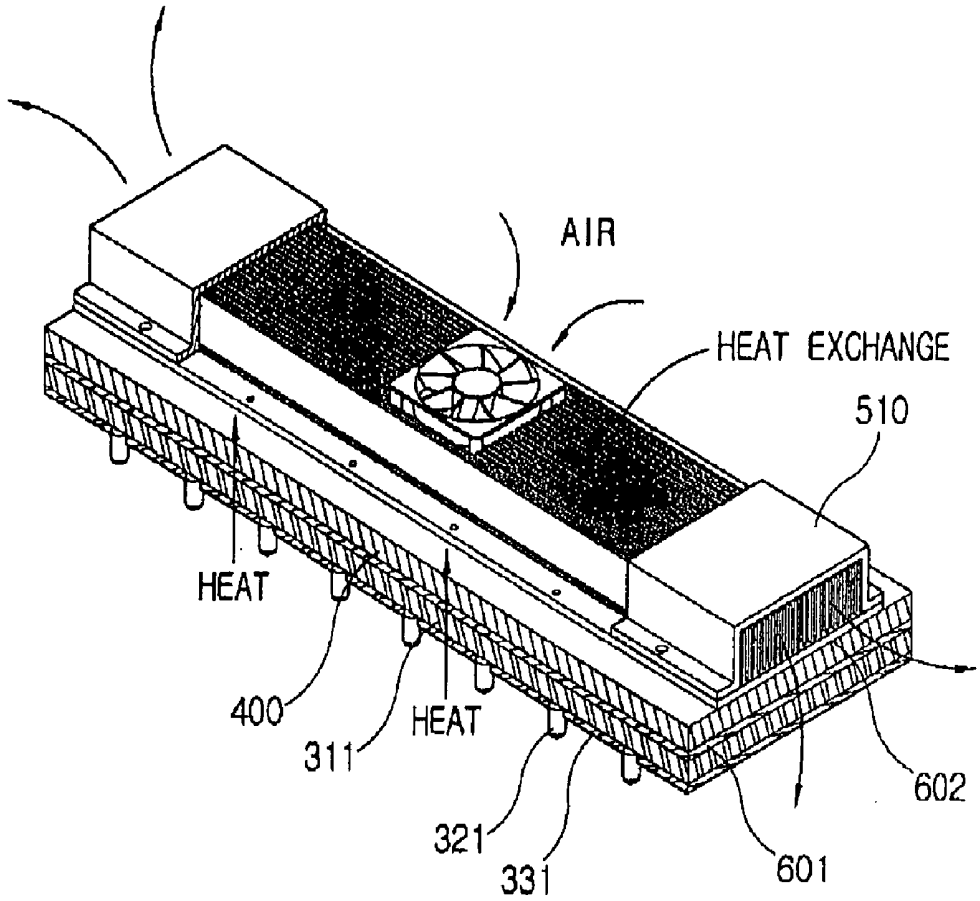


FIG. 6

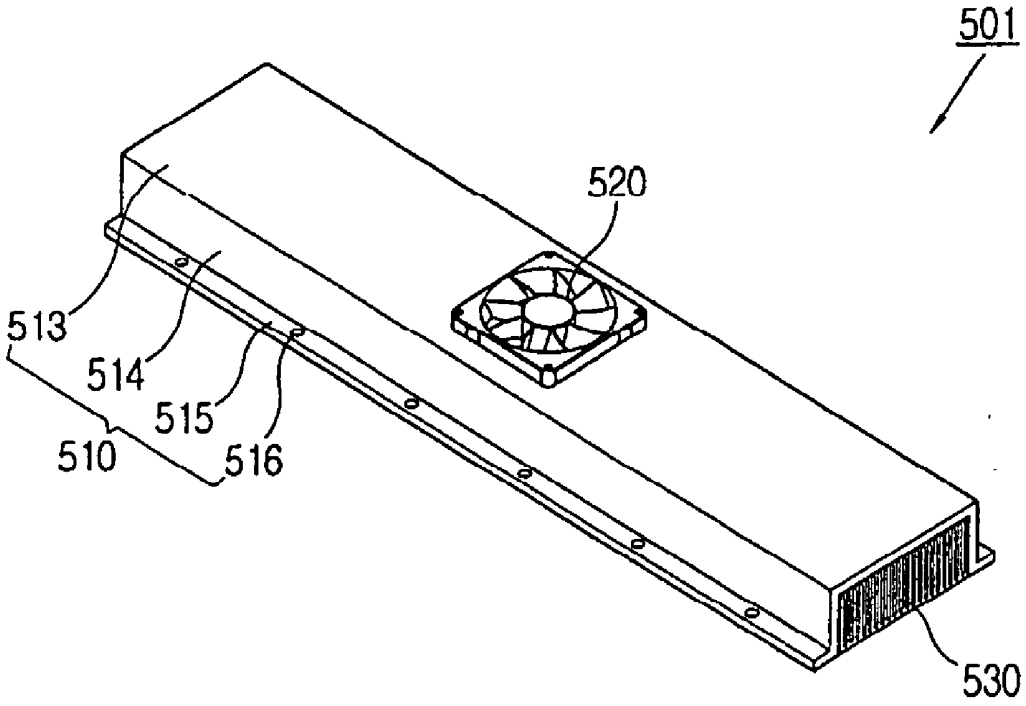


FIG. 7A

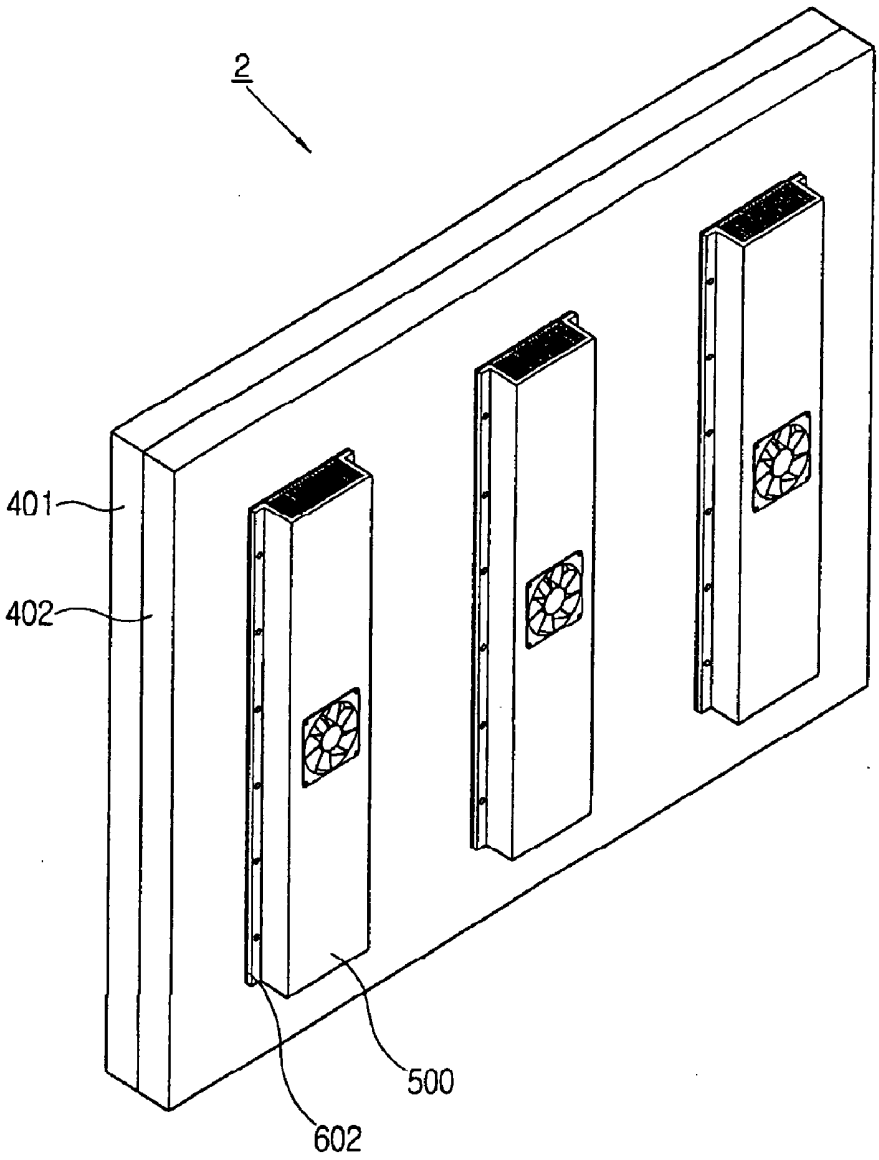


FIG. 7B

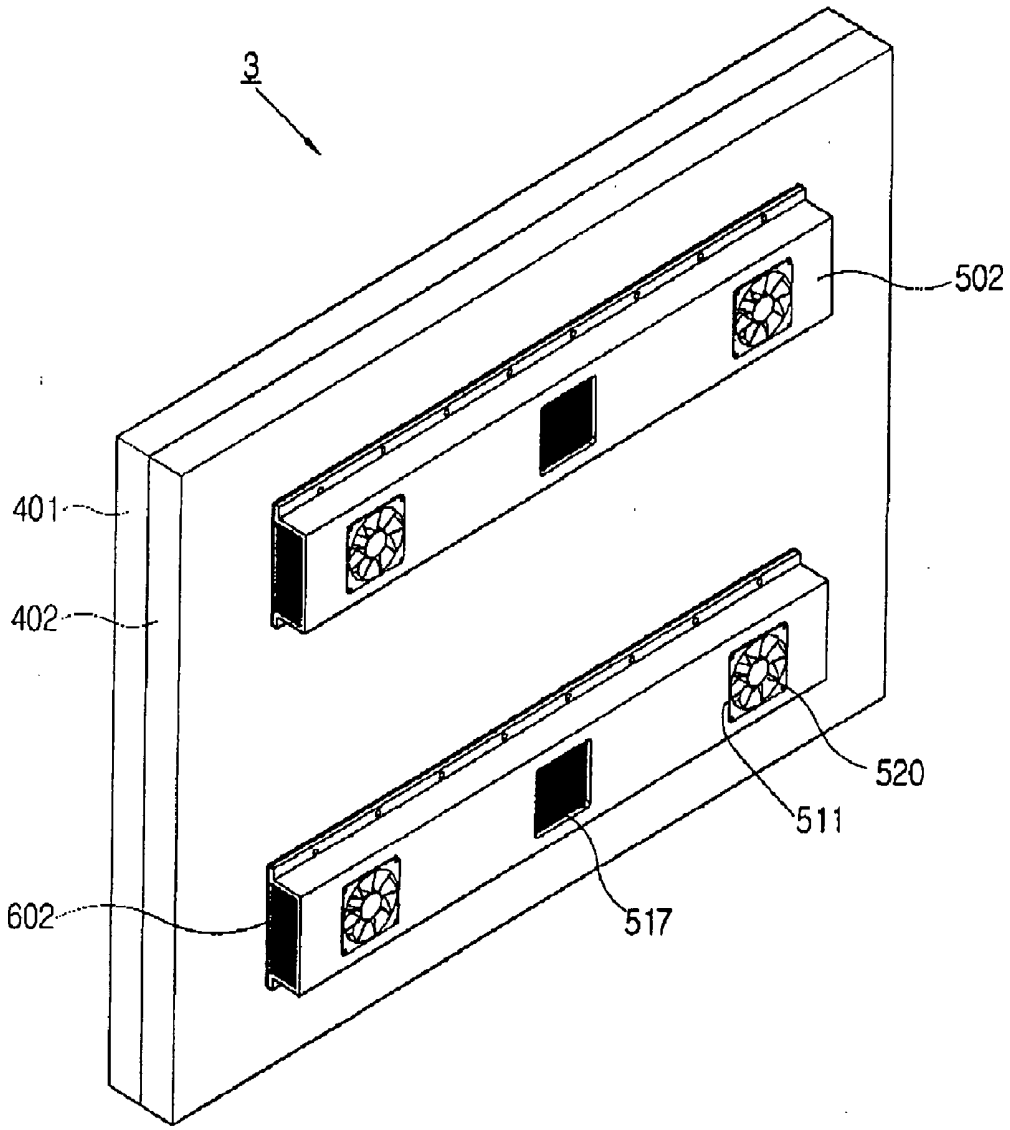
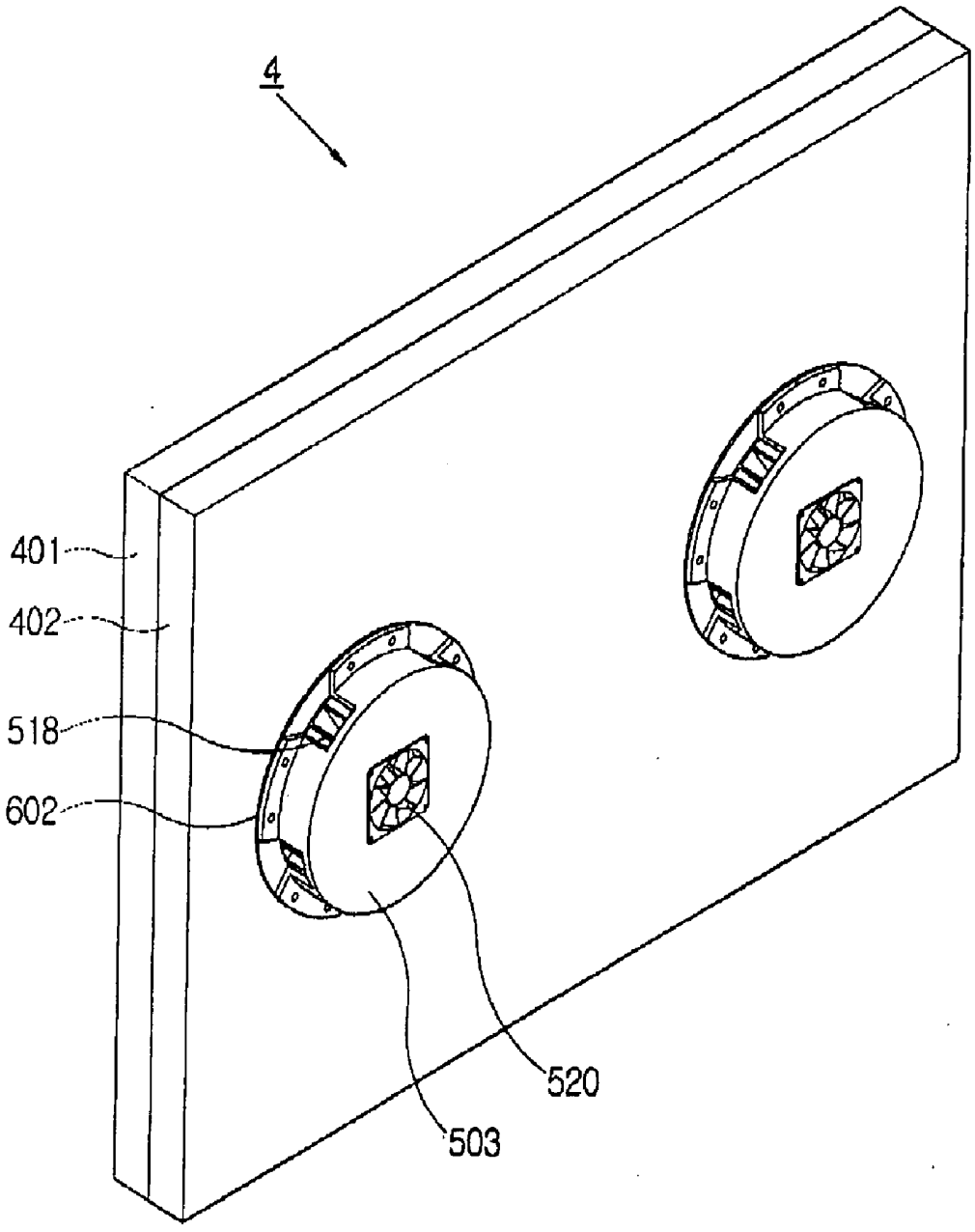


FIG. 7C



COOLING APPARATUS AND LIQUID CRYSTAL DISPLAY DEVICE HAVING THE SAME

[0001] This application claims priority to Korean Patent Application No.2004-0108831, filed on Dec. 20, 2004 and all the benefits accruing therefrom under 35 U.S.C § 119, and the contents of which in its entirety are herein incorporated by reference.

BACKGROUND OF THE INVENTION

[0002] 1. Field of the Invention

[0003] The present invention relates to a cooling apparatus and a liquid crystal display device having the same.

[0004] 2. Description of the Related Art

[0005] Recently, there has been a demand for replacement of conventional CRT (cathode ray tube) display devices with flat panel display devices such as, for example, LCD (liquid crystal display) devices, PDP (plasma display panel) devices, or OLED (organic light emitting diode) devices.

[0006] An LCD device comprises a liquid crystal panel having a thin film transistor board, a color filter board, and liquid crystal interposed between the thin film transistor board and the color filter board. The LCD device further comprises a chassis accommodating the liquid crystal panel and the backlight unit.

[0007] Since the LCD device is a non-light emitting device, the LCD device needs a backlight unit disposed proximate to the liquid crystal panel to supply light to the liquid crystal panel. An amount of transmission of the light provided to the liquid crystal panel by the backlight unit is controlled according to an array state of the liquid crystal.

[0008] The backlight unit is classified as either an edge type backlight or a direct type backlight according to a position of a light source. The edge type backlight has a structure in which the light source is disposed proximate to a sidewall of a light guide plate. The edge type backlight is applied to relatively small LCD devices, which are generally used in laptop and desktop computers. The edge type backlight is advantageous for having high uniformity of luminance, long lifetime, thin thickness and light weight.

[0009] The direct type backlight has been developed in response to a market tendency toward an increase in a size of LCD devices. The direct type backlight has a structure in which light is transmitted to an entire surface of the liquid crystal panel by at least one light source disposed under the liquid crystal panel. Thus, the direct type backlight achieves a high brightness by using several light sources, but may suffer from low uniformity of luminance.

[0010] Furthermore, the backlight unit, especially the direct type backlight unit using several light sources, generates a large amount of heat that lowers brightness and causes color shifts. Thus it is desirable to provide an apparatus to remove heat generated by the backlight unit.

SUMMARY OF THE INVENTION

[0011] Accordingly, it is an aspect of the present invention to provide a cooling apparatus having a good cooling efficiency. Another aspect of the present invention is to provide a liquid crystal display device having an effectively cooled backlight unit.

[0012] Additional aspects and/or advantages of the present invention will be set forth in part in the description which follows and, in part, will be obvious from the description, or may be learned by practice of the present invention.

[0013] The foregoing and/or other aspects of the present invention are also achieved by providing a cooling apparatus comprising a casing, a heat sink and a cooling fan. The casing comprises a first opening and a second opening to provide an air path. The heat sink is received in the casing and includes a recession part. The cooling fan is disposed in the recession part.

[0014] The foregoing and/or other aspects of the present invention are also achieved by providing a display device comprising a liquid crystal panel, a backlight unit, a chassis and a cooling apparatus. The backlight unit is disposed at a back surface of the liquid crystal panel and supplies light to the liquid crystal panel. The chassis receives the liquid crystal panel and the backlight unit. The cooling apparatus is disposed in contact with the chassis. The cooling apparatus comprises a heat sink and a cooling fan. The heat sink includes a recession part. The cooling fan is disposed in the recession part. The casing includes a first opening and a second opening forming an air path through the heat sink.

[0015] The foregoing and/or other aspects of the present invention are also achieved by providing a cooling apparatus comprising a casing having a first opening and a second opening to form an air path, a heat sink received in the casing, and a cooling fan received in the casing.

[0016] The foregoing and/or other aspects of the present invention are also achieved by providing a display device comprising a liquid crystal panel, a backlight unit, a chassis, and a cooling apparatus. The backlight unit is disposed at a back surface of the liquid crystal panel and supplies light to the liquid crystal panel. The chassis receives the backlight unit and the liquid crystal panel. The cooling apparatus is disposed at an external surface of the chassis corresponding to a position of the backlight unit. The cooling apparatus comprises a casing having a first opening and a second opening to form an air path through the casing and a cooling fan received in the casing.

[0017] The foregoing and/or other aspects of the present invention are also achieved by providing a cooling method of a display device comprising a backlight unit, and a casing disposed at an external surface of the chassis corresponding to a position of the backlight unit and comprising a first opening and a second opening. The method comprises disposing a cooling fan in the first opening and operating the cooling fan to form an air path between the first opening and the second opening.

[0018] The foregoing and/or other aspects of the present invention are also achieved by providing an assembly method of a cooling apparatus comprising a casing having a first opening and a second opening forming an air path and a cooling fan. The method comprising disposing the cooling in the first opening such that the cooling fan does not protrude from the casing.

BRIEF DESCRIPTION OF THE DRAWINGS

[0019] The above and/or other aspects and advantages of the present invention will become apparent and more readily

appreciated from the following description of exemplary embodiments, taken in conjunction with the accompanying drawings in which:

[0020] **FIGS. 1A and 1B** are perspective views of a front surface and a back surface, respectively, of a liquid crystal display device according to an exemplary embodiment of the present invention;

[0021] **FIG. 2** is a sectional view of the liquid crystal display device of **FIGS. 1A and 1B**;

[0022] **FIG. 3** is a perspective view of a cooling apparatus according to an exemplary embodiment of the present invention;

[0023] **FIG. 4** is an exploded assembly view of the cooling apparatus of **FIG. 3**;

[0024] **FIG. 5** is a partially cut away perspective view of a cooling apparatus according to an exemplary embodiment of the present invention;

[0025] **FIG. 6** is a perspective view of a cooling apparatus according to another exemplary embodiment of the present invention;

[0026] **FIG. 7A** is a perspective view of a liquid crystal display device according to an exemplary embodiment of the present invention;

[0027] **FIG. 7B** is a perspective view of a liquid crystal display device according to another exemplary embodiment of the present invention; and

[0028] **FIG. 7C** is a perspective view of a liquid crystal display device according to yet another exemplary embodiment of the present invention.

DETAILED DESCRIPTION OF THE INVENTION

[0029] Reference will now be made in detail to exemplary embodiments of the present invention, which are illustrated in the accompanying drawings, wherein like reference numerals refer to like elements throughout.

[0030] **FIGS. 1A and 1B** are perspective views of a front surface and a back surface, respectively, of a liquid crystal display device according to an exemplary embodiment of the present invention. **FIG. 2** is a sectional view of the liquid crystal display device of **FIGS. 1A and 1B**.

[0031] Referring to **FIGS. 1A, 1B** and **2**, a liquid crystal display device **1** comprises a liquid crystal panel **100**, a driving part **200** applying a driving signal to the liquid crystal panel **100**, a backlight unit **300** supplying light to the liquid crystal panel **100**, a chassis **400** receiving the liquid crystal panel **100** and a cooling apparatus **500** disposed at an exterior surface of the chassis **400** and cooling the backlight unit **300**.

[0032] The liquid crystal panel **100** comprises a thin film transistor substrate **111** having thin film transistors, a color filter substrate **121** facing the thin film transistor substrate **111**, a sealant **131** bonding edge portions of the color filter substrate **121** and the thin film transistor substrate **111**, and a liquid crystal layer **141** disposed between the color filter substrate **121** and the thin film transistor substrate **111** in a space defined by the sealant **131**. The liquid crystal panel **100** displays images by controlling an alignment of liquid crystal molecules of the liquid crystal layer **141**. Because the liquid crystal panel **100** is a non-light emitting device, the backlight unit **300** provides light to the liquid crystal panel **100**.

[0033] The driving part **200** comprises a flexible print circuit (FPC) substrate **211** having a first side is connected with the thin film transistor substrate **111**, a driving chip **221** provided to the FPC substrate **211**, and a circuit board **231** connected with a second side of the FPC substrate **211**. The driving part **200** shown in **FIG. 2** is an example of a chip of film (COF) method of mounting the driving part **200**. However, other well known methods include, for example, a tape carrier package (TCP) and a chip on glass (COG), etc. Alternatively, the driving part **200** may be mounted on the thin film transistor board **111**.

[0034] The backlight unit **300** is a direct type backlight unit and comprises an LED circuit substrate **311** disposed parallel to the liquid crystal panel **100**, an LED **321** coupled to the LED circuit substrate **311**, a reflection substrate **331** reflecting light from the LED **321** toward a direction of the liquid crystal panel **100**, a diffusion film **341** disposed between the LED **321** and the liquid crystal panel **100**, a prism film **351**, and a protecting film **361**.

[0035] The LED circuit substrate **311** drives the LED **321**, and at a same time, transfers heat generated by the LED **321** to the cooling apparatus **500**. An upper gap pad **601** is disposed between the LED circuit substrate **311** and the chassis **400**. The upper gap pad **601** prevents air from existing between the LED circuit substrate **311** and the chassis **400**. Air has a low heat transfer coefficient, thus if air exists between the LED circuit substrate **311** and the chassis **400**, the heat generated from the LED **321** is not effectively transferred to the cooling apparatus **500**. The upper gap pad **601** is a thin board comprising a material having a high heat transfer coefficient. The LED circuit substrate **311**, the upper gap pad **601**, and the chassis **400** are closely adhered with each other.

[0036] The backlight unit **300** may include an array of LEDs disposed on the LED circuit substrate **311**. Each LED **321** of the array of LEDs may emit, for example, a red light, a green light, or a blue light to supply a white light to the liquid crystal panel **100**. The array of the LEDs is not limited to the red, green and blue lights. The LED **321** is commonly used as a light source due to the LED **321** having good color reproduction properties and good brightness.

[0037] Although in this exemplary embodiment, the LED **321** is used as the light source of the backlight unit **300**, other light sources such as, for example, a cold cathode fluorescent lamp (CCFL) and an external electrode fluorescent lamp (EEFL), etc. may be used for the light source of the backlight unit **300**.

[0038] The reflection substrate **331** guides the light generated by the LED **321** by reflecting the light toward the liquid crystal panel **100**. The reflection substrate **331** is disposed proximate to an entire surface of the LED circuit substrate **311** except for positions at which each LED **321** of the array of LEDs are disposed.

[0039] The diffusion film **341** comprises a base board and a coating layer including bead shaped members formed on the base board. If light from the LED **321** is directly supplied to the liquid crystal panel **100**, the array of the LEDs is

recognizable by a user and a brightness of a display of the liquid crystal display device **1** becomes non-uniform. To prevent the above-mentioned problem, the diffusion film **341** diffuses light from each LED **321** of the array of LEDs equally, and supplies the light to the liquid crystal panel **100**. The diffusion film **341** may include, for example, two sheets, or three sheets overlapped.

[**0040**] The prism film **351** is formed by disposing a series of linearly extended prisms at a base film. Each of the prisms has a shape of a triangular pillar and is extended parallel to each other at a regular interval. The prism film **351** concentrates light diffused by the diffusion film **341** in a vertical direction toward the liquid crystal panel **100**. The prism film may include two sheets, and has a predetermined angle with a micro prism formed in the prism film **351**. A majority portion of light passing through the prism film **351** passes vertically to produce a uniform brightness distribution.

[**0041**] The protection film **361** is disposed proximate to a surface of the prism film that faces the liquid crystal display panel **100**. The protection film **361** protects the prism film **351** from scratching.

[**0042**] The chassis **400** includes an upper chassis **401** and a lower chassis **402**, and receives the liquid crystal panel **100** and the backlight unit **300**.

[**0043**] The cooling apparatus **500** is attached to an exterior surface of the lower chassis **402**. It should be noted that any number of the cooling apparatuses **500** may be employed. Thus, although **FIGS. 1B and 2** show two cooling apparatuses **500**, more or less may be employed. The backlight unit **300** and the cooling apparatus **500** are disposed facing each other on opposite sides of the lower chassis **402**. A lower gap pad **602** is disposed between the cooling apparatus **500** and the lower chassis **402**. The cooling apparatus **500**, the upper and lower gap pads **601** and **602**, and the lower chassis **402** are closely adhered to each other.

[**0044**] The cooling apparatus **500** according to an exemplary embodiment of the present invention is described below.

[**0045**] **FIG. 3** is a perspective view of the cooling apparatus according to an exemplary embodiment of the present invention, and **FIG. 4** is an exploded assembly view of the cooling apparatus of **FIG. 3**.

[**0046**] The cooling apparatus **500** comprises a casing **510**, a cooling fan **520** and a heat sink **530** accommodated in the casing **510**.

[**0047**] The casing **510** is shaped like a hexahedron that is open at a side of the casing **510** that faces the chassis **400** and at sides of the casing **510** disposed at longitudinal ends of the casing **510**. The casing **510** may be made from a steel plate or plastic, and is preferably made of an aluminum plate.

[**0048**] The casing **510** includes an upper plate **513**, side surface parts **514**, and a combination part **515**. The upper plate **513** is disposed parallel to the external surface of the lower chassis **402** and the heat sink **530** is interposed between the upper plate **513** and the external surface of the lower chassis **402**. The side surface parts **514** extend toward the external surface of the lower chassis **402** from opposite edges of the upper plate **513** to create a receiving space to receive the heat sink **530**. The side surface parts **514** each extend substantially perpendicular to both the upper plate **513** and the external surface of the lower chassis **402**. The combination part **515** extends from an edge of each of the side surface parts that is proximate to the external surface of the lower chassis **402** in a direction substantially parallel to the external surface of the lower chassis **402**. The combination part **515** includes combination holes **516** disposed at intervals along a longitudinal length of the combination part **515**. The combination holes **516** are aligned with contact holes **403** of the lower chassis **402** to permit attachment of the casing **510** to the lower chassis **402** via a combination screw **701**. The upper plate **513**, the side surface parts **514**, and the combination part **515** are preferably formed integrally by a sheet metal working or an injection molding. It should be noted that although the upper plate **513** is shown to have a rectangular shape, other shapes are possible including, for example, a circle shape (see **FIG. 7C**).

[**0049**] A first opening **511** having a rectangular shape is disposed in a center portion of the upper plate **513** to allow an introduction of air to the heat sink **530**. Opened ends of the casing **510** each form a second opening **512** to allow an outflow of air. Air introduced at the first opening **511** cools down the backlight unit **300** and is then discharged at the second opening **512**.

[**0050**] The cooling fan **520** is received in the casing **510**, and disposed in the first opening **511** . Air is introduced through the first opening **511** by operation of the cooling fan **520** and discharged through the second opening **512**. The cooling fan **520** comprises a fan body **521** and a fan casing **522**. The fan casing **522** includes a combination hole **523** to fix the cooling fan **520** to the heat sink **530**. The cooling fan **520** exhausts air introduced from outside the cooling apparatus **500** to a side direction through the heat sink **530**. The cooling fan **520** further comprises a power connecting wire (not shown) to be supplied with power.

[**0051**] The heat sink **530** comprises a heat transmission plate **531** disposed parallel to the upper plate **513**, fins **532** connected to the heat transmission plate **531**, and is provided with a combination hole (not shown) to permit combining the heat sink **530** with the chassis **400**. A recession part **533** is disposed at a portion of the heat sink **530**. The recession part **533** is disposed in a position at which the cooling fan **520** is provided. In other words, the recession part **533** corresponds with the first opening **511**. The fins **532** disposed in the recession part **533** are lower than the other fins disposed in other parts of the heat sink **530**. The lower gap pad **602** is disposed between the heat transmission plate **531** and the lower chassis **402**. Each of the fins **532** is extended substantially perpendicular to a surface of the heat transmission plate **531** and parallel to each other along a longitudinal length of the casing **510**. In other words, each of the fins **532** is disposed parallel to a direction from the first opening **511** to the second opening **512**. Heat from the LED **321** transmitted to the heat transmission plate **531** is transmitted to each of the fins **532**. Since a surface area of the fins **532** in contact with air is very wide, the fins **532** have good heat transmission efficiency.

[**0052**] The heat transmission plate **531**, the lower gap pad **602**, and the lower chassis **402** are closely adhered to each other. The lower gap pad **602** includes through holes **603**. The combination screw **701** combines the casing **510** to chassis **400** via the combination holes **516**, the through holes **603** and the contact holes **403** sequentially.

[**0053**] Herein below, an operation of a cooling apparatus will be described by referring to **FIG. 5**. **FIG. 5** is a partially cut away perspective view of a cooling apparatus according to an exemplary embodiment of the present invention.

[0054] During operation of the liquid crystal display device **1**, heat is generated by the LED **321** and the cooling fan **520** operates.

[0055] The heat generated by the LED **321** is transmitted to the heat transmission plate **531** of the heat sink **530** through the LED circuit substrate **321**, the upper gap pad **601**, the chassis **400**, and the lower gap pad **602**. The LED circuit substrate **321**, the upper gap pad **601**, the chassis **400**, and the lower gap pad **602** are closely attached to each other so that heat transmission may be accomplished effectively. Thus, even heat generated by parts, which do not contact the cooling apparatus **500** directly is transmitted to the cooling apparatus **500**. The heat transmitted to the heat transmission plate **531** is transmitted to the fins **532** having a wide surface area.

[0056] By operation of the cooling fan **520**, air is introduced into the heat sink **530** through the first opening **511**. The introduced air flows along an air path formed by the casing **510** and the heat sink **530** and discharges through the second opening **512**. The fins **532** are disposed parallel to the air path, which is the direction from the first opening **511** and the second opening **512**. While air flows without being disturbed, the air absorbs heat from the fins **532**. Thus, the air path may be formed from the second opening **512** to the first opening **511** in accordance with an operating direction of the cooling fan **520**.

[0057] The cooling apparatus **500** according to exemplary embodiments of the present invention removes the heat generated by the LED **321** by operating the cooling fan **520** and the heat sink **530**. Meanwhile, referring to **FIG. 2**, as the cooling fan **520** of the cooling apparatus **500** is received in the casing **510**, a thickness d**1** of the cooling apparatus **500** is constant. A thickness d**2** of the liquid crystal display device **1** attached with the cooling apparatus **500** is not increased by attaching the cooling fan **520**.

[0058] Although, the cooling apparatus **500** shown is applied to the liquid crystal display device **1**, the cooling apparatus **500** may be used to eliminate heat from other heat generating apparatuses, especially a flat panel display device such as a PDP (plasma display panel) or an OLED (organic light emitting diode).

[0059] **FIG. 6** is a perspective view of a cooling apparatus **501** according to another exemplary embodiment of the present invention. A structure of the cooling apparatus **501** of this exemplary embodiment is substantially similar to a structure described above referring to **FIG. 3**, therefore only differences in the structure of the cooling apparatus **501** will be discussed. An upper portion of the cooling fan **520** is projected outside of the casing **510**. Meanwhile, a considerable portion of the cooling fan **520** is disposed inside of the casing **510**. Thus a height of the cooling apparatus **501** is only slightly increased.

[0060] **FIGS. 7A through 7C** are perspective views of liquid crystal display devices according to alternative exemplary embodiments of the present invention.

[0061] A liquid crystal display device **2** according to an exemplary embodiment shown in **FIG. 7A** comprises three cooling apparatuses **500**. Each of the three cooling apparatuses **500** is disposed at the lower chassis **402** such that they are substantially parallel to each other and substantially perpendicular to a longitudinal direction of the liquid crystal display device **2**. A number and an installed position of the cooling apparatuses **500** is variable according to a size of the liquid crystal display device **2** and an amount of heat generated by the backlight unit **300**.

[0062] A liquid crystal display device **3** according to another exemplary embodiment is shown in **FIG. 7B**. In this exemplary embodiment, cooling apparatuses **502** are disposed at the lower chassis **402** such that they are substantially parallel to each other and substantially parallel to a longitudinal direction of the liquid crystal display device **3**. Additionally, each of the cooling apparatuses **502** includes two first openings **511** and two cooling fans **520** disposed near opposite ends of the cooling apparatuses **502**. A second opening **517** is disposed at a center of each of the cooling apparatuses **502** to exhaust air coming from both directions toward the second opening **517**.

[0063] A cooling apparatus **503** of a liquid crystal display device **4** according to yet another exemplary embodiment is shown in **FIG. 7C**. The cooling apparatus **503** is shaped like a cylinder. The cooling fan **520** is disposed at a center portion of the cooling apparatus **503** and second openings **518** are provided along edges of the cooling apparatus **503**. Since air current is generated uniformly in all directions by operating the cooling fan **520**, the air current may be fully utilized by shaping the cooling apparatus **503** as the cylinder of the present exemplary embodiment.

[0064] Although a few exemplary embodiments of the present invention have been shown and described, it will be appreciated by those skilled in the art that changes may be made in these embodiments without departing from the principles and spirit of the invention, the scope of which is defined in the appended claims and their equivalents.

What is claimed is:

1. A cooling apparatus comprising:

a casing comprising a first opening and a second opening to provide an air path;

a heat sink that is received in the casing, the heat sink including a recession part; and

a cooling fan disposed in the recession part.

2. The cooling apparatus according to claim 1, wherein the casing further comprises;

an upper plate part including the first opening;

a side part extended and bent from the upper plate part; and

a combination part extended and bent from the side part to be substantially parallel to the upper plate part.

3. The cooling apparatus according to claim 2, wherein the combination part comprises a combination hole.

4. The cooling apparatus according to claim 2, wherein the upper plate part is shaped like a rectangle.

5. The cooling apparatus according to claim 2, wherein the upper plate part is shaped like a circle.

6. The cooling apparatus according to claim 2, wherein the casing is integrally formed.

7. The cooling apparatus according to claim 2, wherein the heat sink further comprises:

a heat transmission plate disposed substantially parallel to the upper plate part; and

a fin connected to the heat transmission plate.

8. The cooling apparatus according to claim 7, wherein the fin extends from the heat transmission plate to a first height at a first portion of the fin and a second height at a

second portion of the fin, the first height being less than the second height, and the first portion of the fin forming a portion of the recession part.

9. A display device comprising;

a liquid crystal panel;

a backlight unit disposed at a back surface of the liquid crystal panel and supplying light to the liquid crystal panel;

a chassis receiving the liquid crystal panel and the backlight unit; and

a cooling apparatus disposed in contact with the chassis, the cooling apparatus comprising a casing, a heat sink and a cooling fan, the heat sink including a recession part, the cooling fan disposed in the recession part, and the casing including a first opening and a second opening forming an air path through the heat sink.

10. The display device according to claim 9, wherein the cooling fan is disposed in the first opening.

11. The display device according to claim 10, wherein the first opening is an inlet to introduce air, and the second opening is an outlet to discharge air.

12. The display device according to claim 9, wherein the heat sink comprises;

a heat transmission plate disposed substantially parallel to the chassis; and

a fin connected to the heat transmission plate.

13. The display device according to claim 12, further comprising a lower gap pad disposed between the chassis and the heat transmission plate, wherein the chassis, the lower gap pad and the heat transmission plate are closely adhered to each other.

14. The display device according to claim 12, wherein the fin is disposed substantially parallel to a direction extended from the first opening to the second opening.

15. The display device according to claim 12, wherein the fin extends from the heat transmission plate to a first height at a first portion of the fin and a second height at a second portion of the fin, the first height being less than the second height, and the first portion of the fin forming a portion of the recession part.

16. The display device according to claim 9, wherein the backlight unit comprises light emitting diodes (LEDs).

17. The display device according to claim 16, wherein the LEDs are disposed at uniform intervals facing the back surface of the liquid crystal panel.

18. The display device according to claim 16, further comprising an LED circuit substrate disposed substantially parallel to the liquid crystal panel and coupled with the LEDs, and an upper gap pad disposed between the LED circuit substrate and the chassis and wherein the LED circuit substrate, the upper gap pad, and the chassis are closely adhered to each other.

19. The display device according to claim 9, wherein a thickness of the cooling apparatus is substantially constant.

20. The display device according to claim 9, wherein the casing comprises;

an upper plate part disposed substantially parallel to the liquid crystal panel and formed having the first opening;

a side part extended and bent from the upper plate part; and

a combination part extended and bent from the side part, and disposed substantially parallel to the upper plate part.

21. The display device according to claim 20, wherein the combination part comprises a combination hole to enable attachment of the casing to the chassis.

22. The display device according to claim 20, wherein the upper plate part is shaped like a rectangle.

23. The display device according to claim 20, wherein the upper plate part is shaped like a circle.

24. The display device according to claim 20, wherein the casing is integrally formed.

25. A cooling apparatus comprising;

a casing comprising a first opening and a second opening to form an air path;

a heat sink received in the casing; and

a cooling fan received in the casing.

26. A display device comprising;

a liquid crystal panel;

a backlight unit disposed at a back surface of the liquid crystal panel and supplying light to the liquid crystal panel;

a chassis receiving the backlight unit and the liquid crystal panel; and

a cooling apparatus disposed at an external surface of the chassis corresponding to a position of the backlight unit, the cooling apparatus comprising a casing having a first opening and a second opening to form an air path and a cooling fan received in the casing.

27. A method of cooling a display device comprising a backlight unit disposed in a chassis and a casing disposed at an external surface of the chassis corresponding to a position of the backlight unit and comprising a first opening and a second opening, the method comprising:

disposing a cooling fan in the first opening; and

operating the cooling fan to form an air path between the first opening and the second opening.

28. The method of claim 27, wherein the air path is defined by the casing and a plurality of fins are disposed in the air path substantially parallel to a direction of a current of air.

29. An assembly method of a cooling apparatus including a casing having a first opening and a second opening forming an air path through the casing, and a cooling fan, the method comprising:

disposing the cooling fan in the first opening such that the cooling fan does not protrude from the casing.

30. The method of claim 29, further comprising:

providing a heat sink received in the casing; and

combining the cooling fan with the heat sink.

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专利名称(译)	冷却装置和具有该冷却装置的液晶显示装置		
公开(公告)号	US20060132699A1	公开(公告)日	2006-06-22
申请号	US11/313151	申请日	2005-12-20
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IPC分类号	G02F1/1333		
CPC分类号	F04D29/582 F04D29/601 G02F1/133603 G02F2001/133628 H05K7/20972		
优先权	1020040108831 2004-12-20 KR		
外部链接	Espacenet USPTO		

摘要(译)

一种冷却装置，包括壳体，散热器和冷却风扇。壳体包括第一开口和第二开口，以提供空气路径。散热器容纳在壳体中。散热器包括凹陷部分。冷却风扇设置在凹陷部分中。