US006104451A

United States Patent [19]

Matsuoka et al.

[11] **Patent Number: 6,104,451**

[45] **Date of Patent: Aug. 15, 2000**

[54] **THIN DISPLAY HOUSING WITH MULTIPLE CHAMBERS AND FANS**

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[21] Appl. No.: **09/267,595**

[22] Filed: **Mar. 15, 1999**

[30] **Foreign Application Priority Data**

Mar. 16, 1998 [JP] Japan 10-064961

[51] **Int. Cl.**[7] **G02F 1/1333**

[52] **U.S. Cl.** **349/58**; 349/59; 349/60; 361/681; 361/682

[58] **Field of Search** 349/58, 59, 60; 361/681, 682

[56] **References Cited**

U.S. PATENT DOCUMENTS

5,363,227	11/1994	Ichikawa et al.	359/83
5,831,816	11/1998	Johns et al.	361/681
5,867,148	2/1999	Komimaki et al.	345/169
6,008,870	12/1999	Yun	349/58

FOREIGN PATENT DOCUMENTS

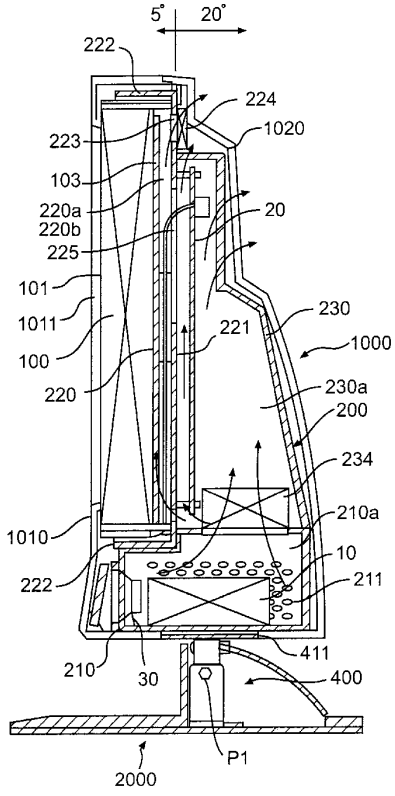
9-238293	9/1997	Japan .
9-274444	10/1997	Japan .
1002223	2/1998	Japan .

Primary Examiner—Kenneth Parker
Assistant Examiner—Mike Qi
Attorney, Agent, or Firm—Mattingly, Stanger & Malur

[57] **ABSTRACT**

A large thin display unit has a chassis structure with a first horizontally or vertically disposed enclosure, a second vertically extending enclosure mounted to the upper side of the first enclosure, and a third vertically extending enclosure mounted above the first enclosure behind the second enclosure. The second enclosure has an opening that opens toward a front of the unit and has a margin along the perimeter of the opening. The thin display section is fixed to the margin in a vertical position. Further, an air route is formed between the third enclosure and a planar portion of the second enclosure, and an air route is formed between the thin display section and the planar portion of the second enclosure. Also, a wiring space is formed between the thin display section and the planar portion of the second enclosure. Preferably, the thin display section is a large liquid-crystal display provided with a plurality of backlights.

10 Claims, 12 Drawing Sheets



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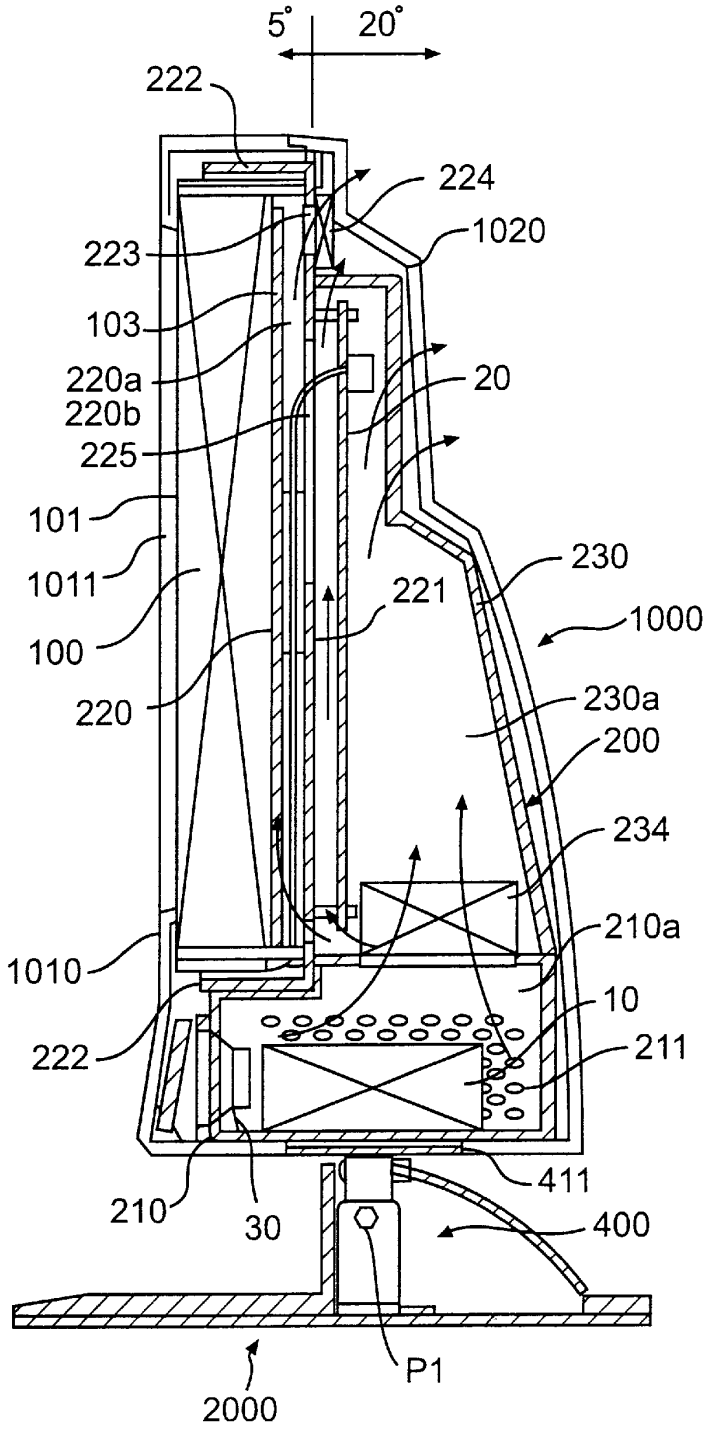

5°
20°
222
224
1020
223
103
220a
220b
225
20
101
1011
100
220
221
230
1000
230a
200
234
210a
1010
10
222
211
411
210
30
400
P1
2000

FIG. 1

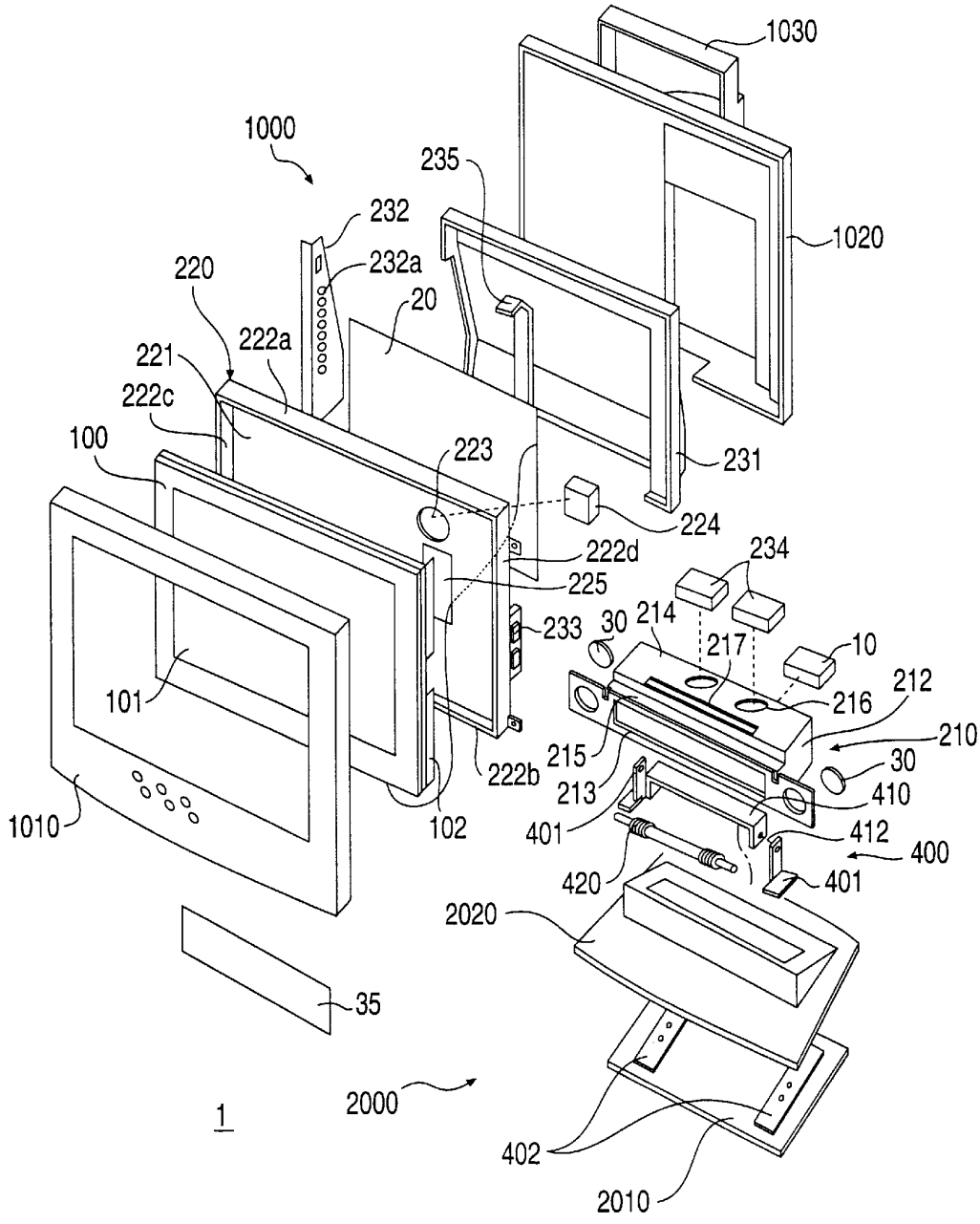

1030
1000
235
232
1020
232a
220
20
222a
221
222c
100
223
231
224
222d
234
225
214
233
30
217
10
212
101
216
210
215
30
222b
213
410
1010
102
401
412
400
420
401
2020
35
2000
1
402
2010

FIG. 2

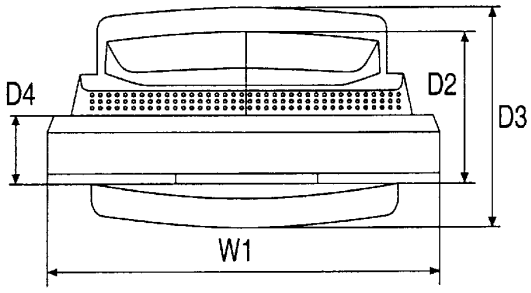


FIG. 3a

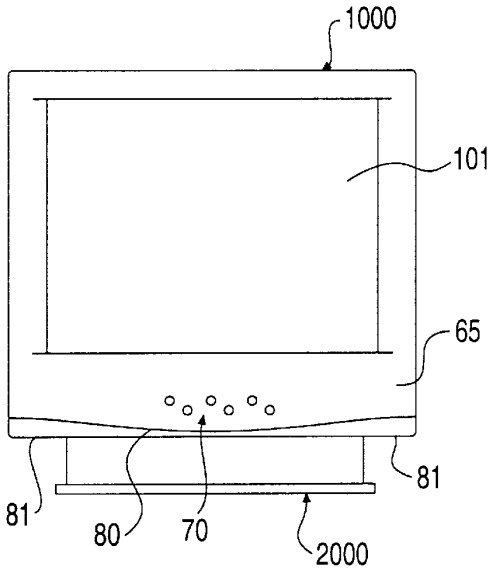


FIG. 3b

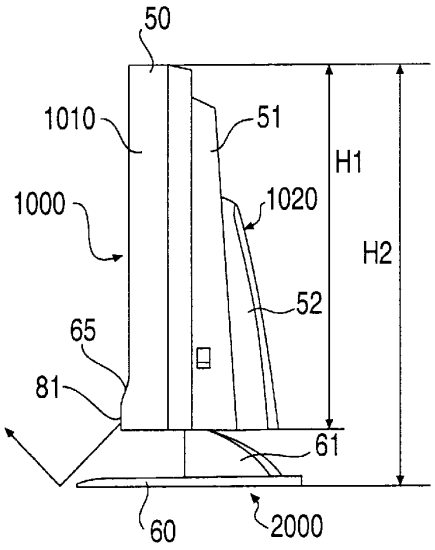


FIG. 3c

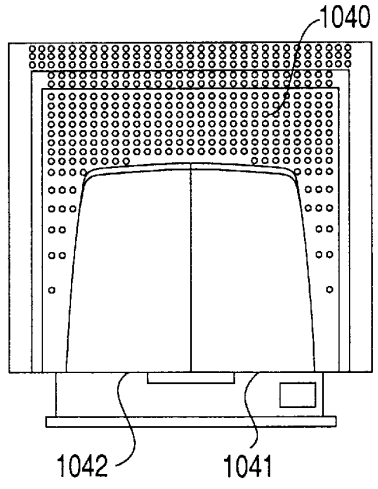


FIG. 3d

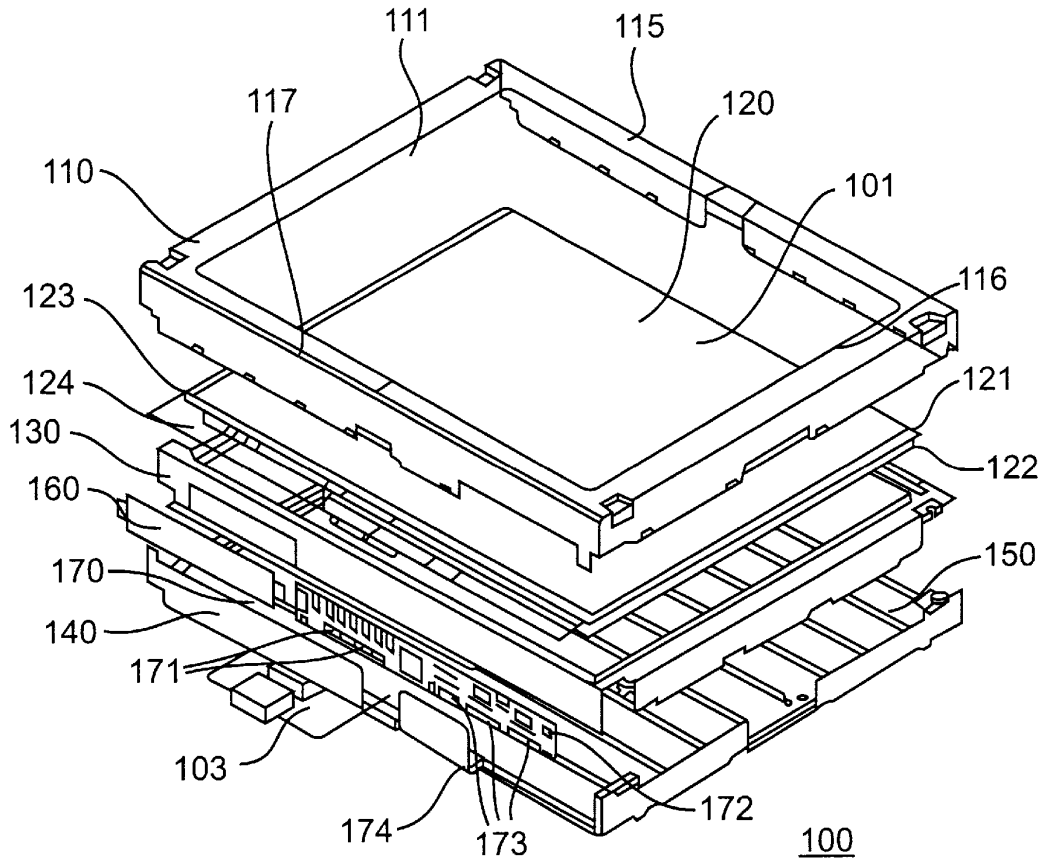

111
115
117
120
110
101
116
123
121
124
130
122
160
150
170
140
171
103
174
173
172
100

FIG. 4

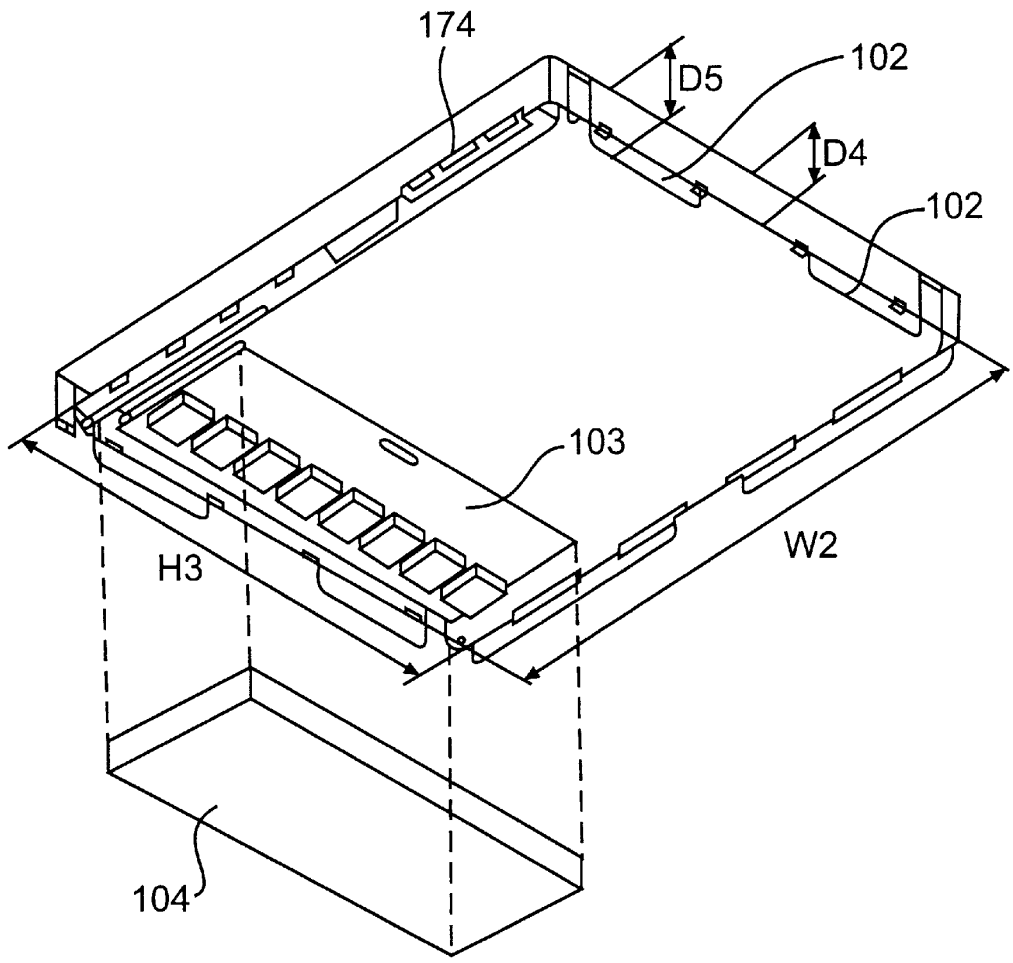


FIG. 5

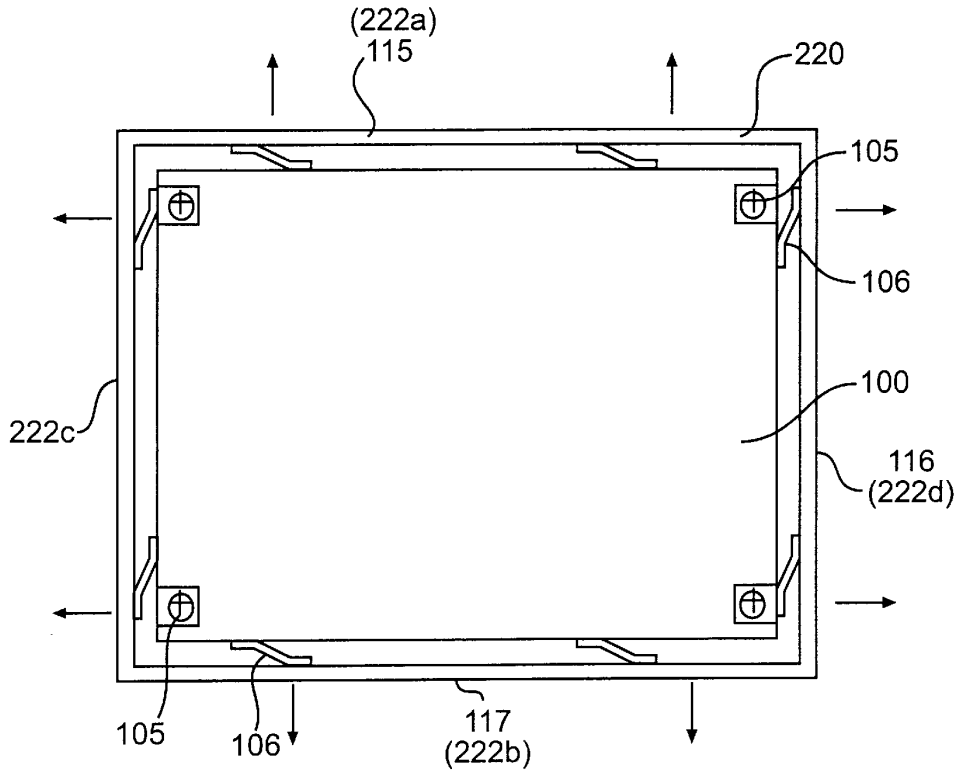

(222a)
115
220
105
106
100
222c
116
(222d)
105
106
117
(222b)

FIG. 6(a)

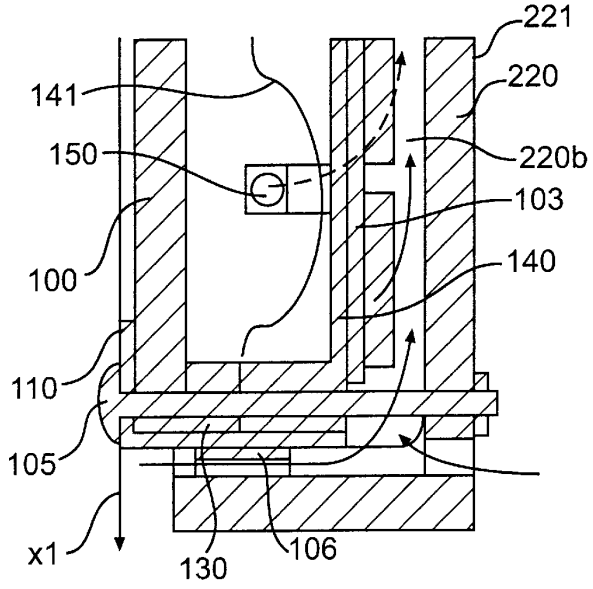

221
220
141
150
220b
103
140
100
110
105
x1
130
106

FIG. 6(b)

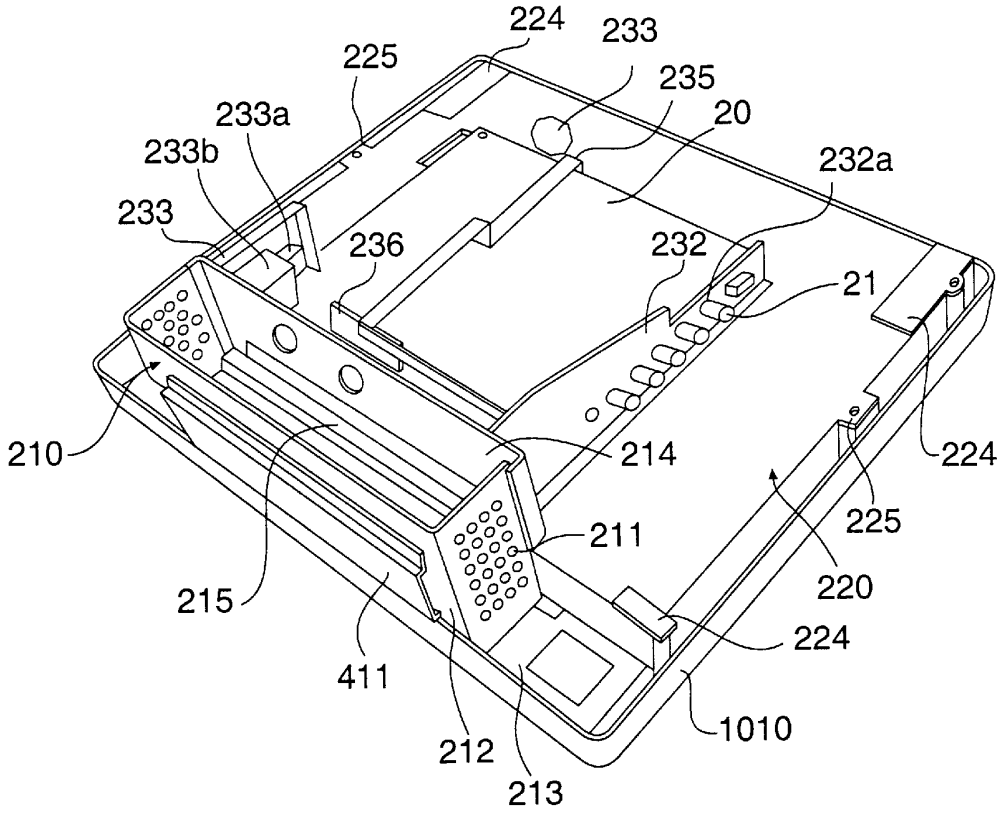

224
233
225
235
233a
20
233b
232a
233
236
232
21
210
214
224
225
211
220
215
224
411
1010
212
213

FIG. 7

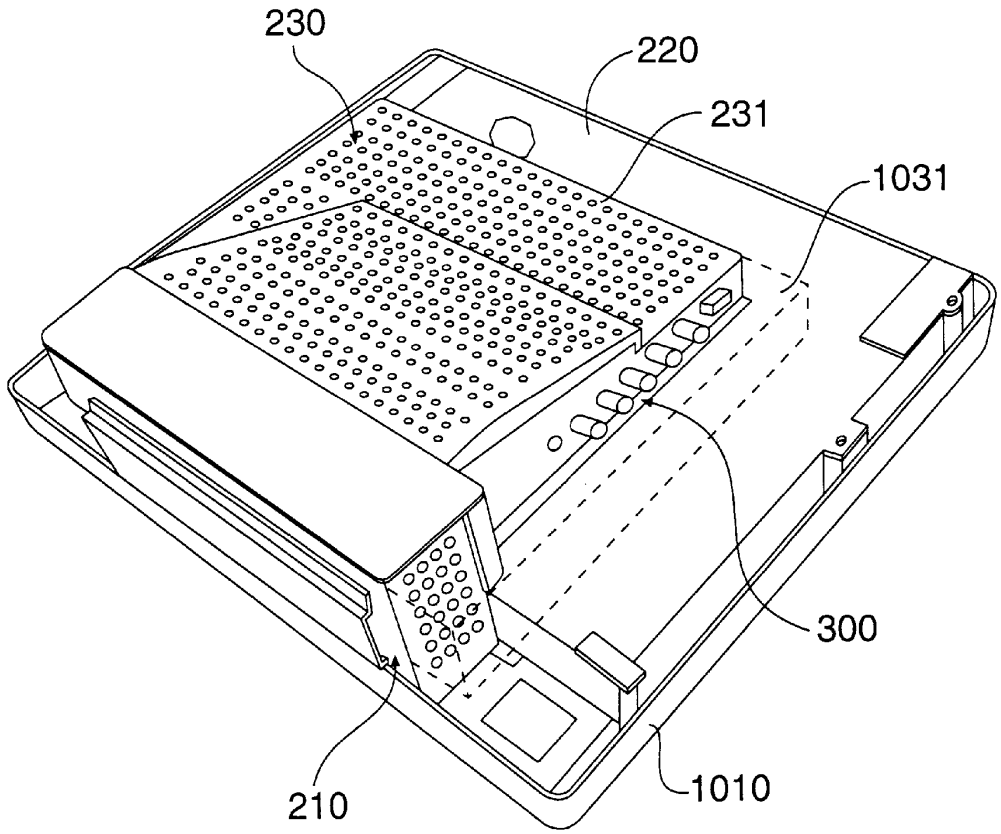


FIG. 8

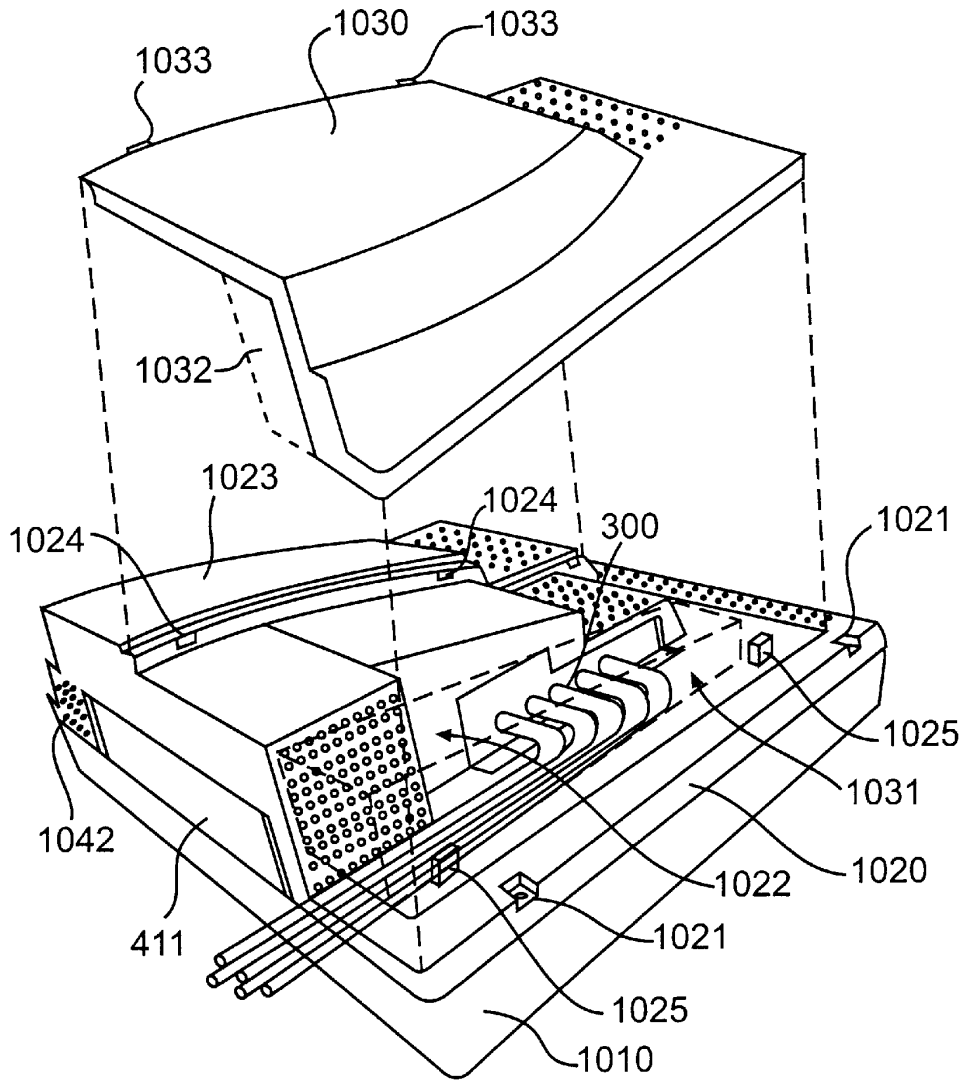

1030
1033
1033
1032
1023
1024
1024
300
1021
1025
1031
1042
1022
1020
411
1021
1025
1010

FIG. 9

FIG. 10(a)

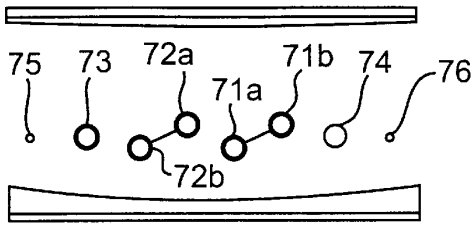


FIG. 10(b)

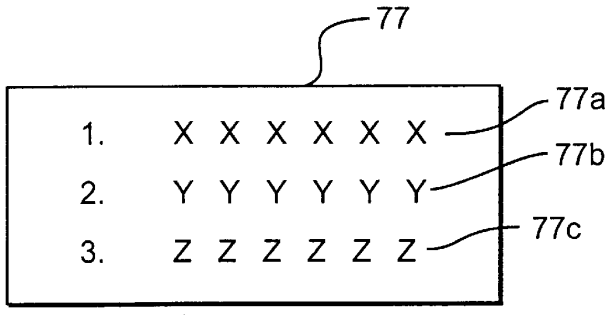


FIG. 10(c)

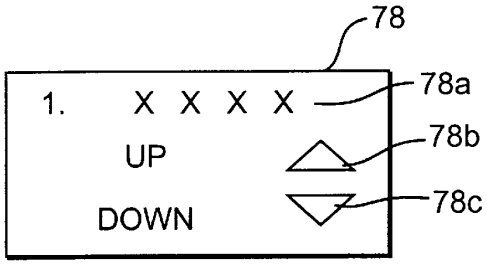
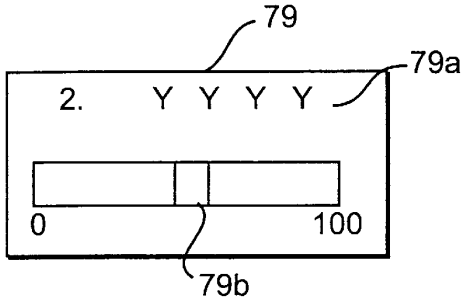


FIG. 10(d)



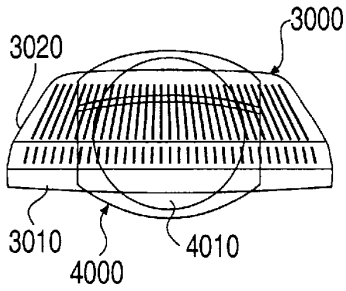


FIG. 11a

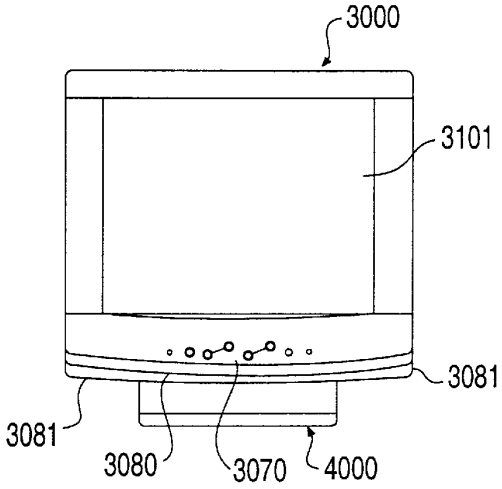


FIG. 11b

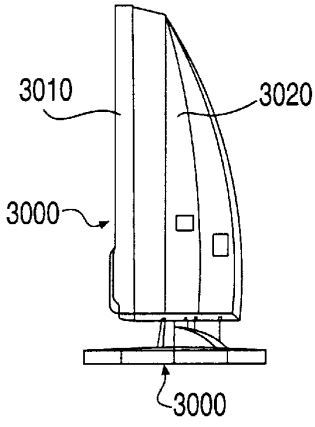


FIG. 11c

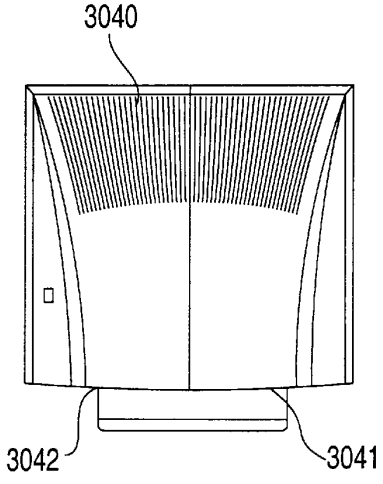


FIG. 11d

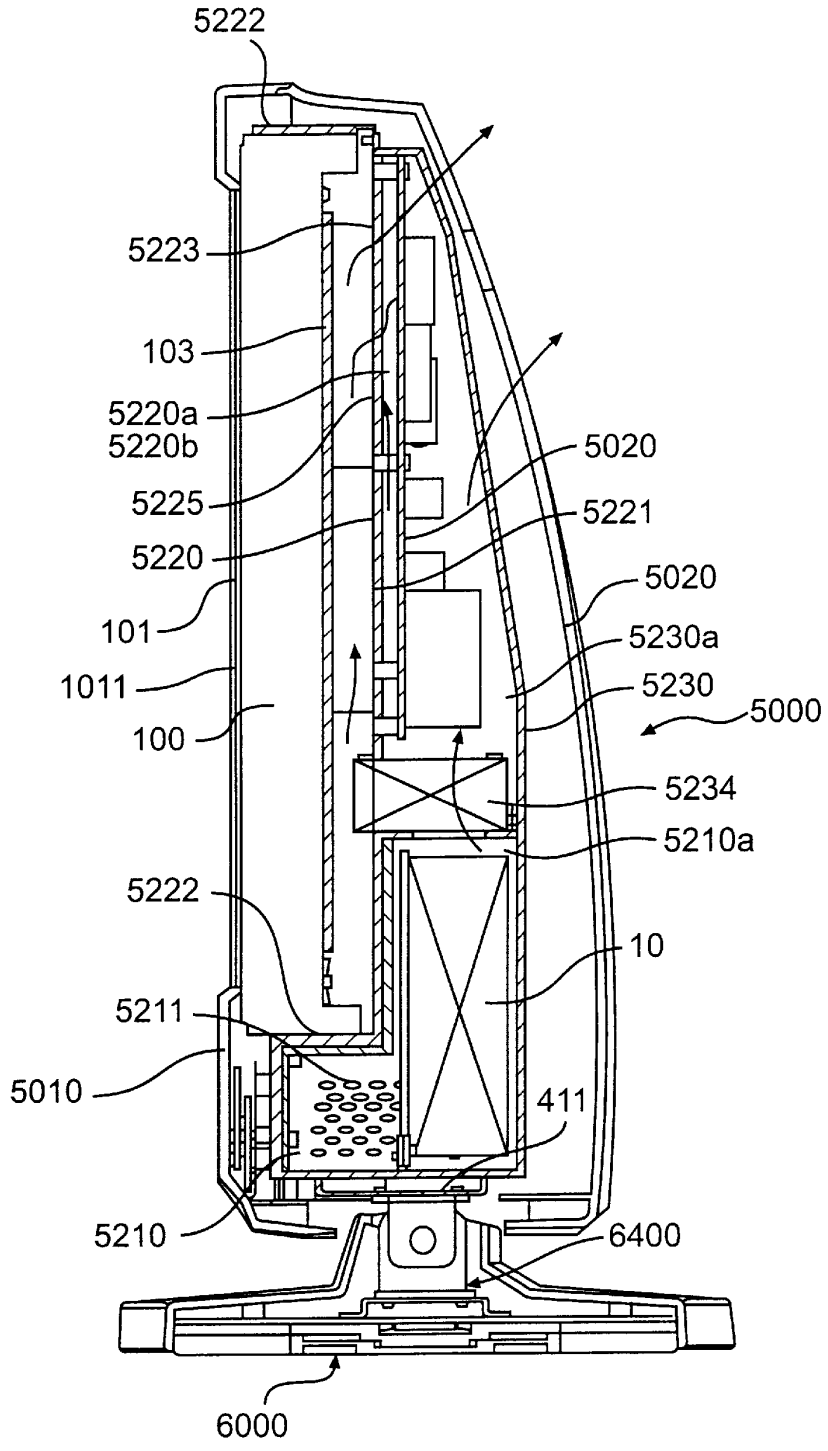

5222
5223
103
5220a
5220b
5225
5220
101
1011
100
5222
5211
5010
5210
6000
5020
5221
5020
5230a
5230
5000
5234
5210a
10
411
6400

FIG. 12

THIN DISPLAY HOUSING WITH MULTIPLE CHAMBERS AND FANS

FIELD OF THE INVENTION

The present invention relates to a thin display unit that receives picture signals supplied from an external unit and in particular to a thin display unit such as a liquid-crystal display provided with a backlight or a plasma display that receives picture signals and displays an image.

BACKGROUND OF THE INVENTION

Because a thin display unit, such as a liquid-crystal or plasma display, is thin and lightweight compared to a CRT display, it is widely used with portable computers such as notebook-type personal computers or portable terminals.

In particular, because of recent technical innovations, it is possible to manufacture liquid-crystal display units having a large display screen or a high-resolution LCD (Liquid-Crystal Display) unit at a low price. Accordingly, thin display units are likely to be widely used for desk-top personal computers and terminal processors. A typical thin display unit used with desk-top computers has a body provided with a liquid-crystal display unit and a stand for supporting the body so that it can be tilted.

A specific example of a conventional thin display unit is disclosed in Registered Design No. 1002223.

SUMMARY OF THE INVENTION

A conventional thin display unit has a structure in which a thin iron plate is used as the support member of the body and a liquid-crystal unit is secured to the front of the support structure member by screws. However, problems have resulted with this structure when used in recent thin display units having a large display screen. One problem is that the conventional structure is subject to being broken due to twisting because the unit is very thin. A further problem has resulted from an increase in weight due to an increase in display unit size. Therefore, a thin display unit having a thin structure that has high strength is in demand.

Yet another problem with liquid-crystal display units is that a backlight is provided at its back side, so a large amount of heat is produced. Particularly in the case of a high-resolution liquid-crystal display that has gained interest recently, a plurality of backlights are arranged at the back. Therefore, dissipation of the heat produced by the backlights and the heat produced by the circuit for driving the backlights poses a problem.

In the case of the above mentioned large LCD, it is also important to shield radio waves produced by the liquid-crystal display and control circuit while maintaining structural strength, while considering the significance of decreasing the weight of the unit. Still further, display units that are multimedia-compatible and that can be connected with an AV unit or other units are in demand. Thus, for a high-resolution LCD, the provision of various input/output terminals must be considered in order to accommodate various types of applications such as three-dimensional computer graphics (CG). Thus, it must be expected that an LCD will be connected with many other peripheral units and thus, the wiring processing can present a problem.

It is an object of the present invention to provide a thin display unit having a structural body suitable for large thin displays, such as a liquid crystal display unit.

To achieve the object, the body of a thin display unit of the present invention preferably has a horizontally or vertically disposed first enclosure, a vertical second enclosure located at the front of the first enclosure, and a vertical third enclosure located above the rear of the first enclosure and at the rear of the second enclosure. Preferably, a second unit-storing section opens to the front by forming a margin around the front of the planar portion of the second enclosure, the second enclosure being formed so as to vertically store a thin display section in the second unit-storing section.

Preferably, the thin display unit of the present invention has a stand separate from the body having a base and a tilting mechanism, and according to a preferred embodiment of the invention, the thin display unit is a liquid crystal display unit having at least one backlight.

Further, preferably, the thin display unit of the present invention has a power supply section disposed in one of a predominantly horizontal orientation or a predominantly vertical orientation corresponding with the orientation of the horizontally or vertically disposed first enclosure. Further, the first enclosure preferably has a step and the second enclosure is preferably is mounted to the first enclosure at the front thereof using the step as a support structure.

Still further, the thin display unit of the present invention preferably has ventilation ports for taking in fresh air that flows upwardly through the first, second and third enclosures that is exhausted out the cover of the unit, wherein a natural flow of radiated heat is maintained through the vertical second enclosure and wherein at least one exhaust fan is optionally provided for assisting in maintaining the air flow through either or both of the first and second enclosures.

According to a preferred embodiment of the invention, the first enclosure of the body of the thin display unit has a first unit-storing section made of a conductive material for storing the power supply section, the second enclosure has a second unit-storing section made of a conductive material to vertically store the thin display section at the front of the planar portion of the second enclosure, and the third enclosure is located to form a wiring space between the third enclosure and a wide planar portion of the second enclosure and moreover has a third unit-storing section made of a conductive material for storing a vertically disposed substrate.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a central longitudinal sectional view of an LCD of an embodiment of the present invention;

FIG. **2** is an expanded perspective view of part of the LCD shown in FIG. **1**;

FIGS. **3**(*a*) to **3**(*d*) are top, front, side and back views, respectively, of the LCD shown in FIG. **1**;

FIG. **4** is an expanded perspective view of the liquid-crystal unit **100** of the LCD shown in FIG. **1**;

FIG. **5** is a rear perspective view of the liquid-crystal unit of the LCD of the present invention shown in FIG. **1**;

FIGS. **6**(*a*) and **6**(*b*) are diagrams showing the mounting of the liquid-crystal unit of the LCD shown in FIG. **1**;

FIG. **7** is a rear perspective view with the back case and shield panel removed from the LCD shown in FIG. **1**;

FIG. **8** is a rear perspective view with the back case removed from the LCD shown in FIG. **1**;

FIG. **9** is a rear perspective view of the LCD shown in FIG. **1** with the wiring cover shown in an expanded view;

FIG. **10**(*a*) is a diagram showing an operation switch group of the LCD shown in FIG. **1** and FIGS. **10**(*b*) to **10**(*d*)

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are diagrams of screen displays associated with the operation and layout of the operation switches;

FIGS. **11**(*a*) to **11**(*d*) are top, front, side and back views, respectively, of an LCD according to a second embodiment of the present invention; and

FIG. **12** is a central longitudinal sectional view of an LCD according to a third embodiment of the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

First Embodiment

The first embodiment of the present invention is described by referring to FIGS. **1** to **10**. In particular, a schematic structure of an LCD unit that is of the first embodiment of the present invention is shown in a central longitudinal sectional view of the LCD, generally designated **1**.

The LCD has a body **1000** provided with a liquid-crystal unit **100** and a stand **2000** for movably supporting the body **1000**. LCD **1** receives picture signals from an external unit and reproduces them as an image. The LCD of this embodiment is preferably connected to a processor (not shown) for executing various programs, such as a personal computer that has other input/output units such as a keyboard and a mouse, a printer, and an external storage system. Moreover, the liquid-crystal unit **100** of this embodiment uses a high-image-quality TFT liquid-crystal display module having an 18" large screen using thin-film transistor (TFT) technology. The TFT LCD module is suitable for various monitors including three-dimensional computer graphics (CG), effectively using a wide viewing angle, high resolution, high brightness, and low reflection.

The LCD of this embodiment has a connecting terminal **300** (see FIG. **2**) provided with a plurality of input/output terminals at its back side. Moreover, it is possible to provide the connection terminal **300** with connection terminals that connect with an AV unit or other unit that is compatible with multimedia.

The body **1000** is formed into a thin shape, the front appearance of which is almost that of a rectangle and which has a small depth. A front case **1010**, preferably molded of resin, covers the front of the body and a back case **1020**, also preferably molded of resin, covers the rear of the body. In the center of front case **1010**, an aperture **1011** is formed having a wide planar portion about its circumference. A display screen **101** of the liquid-crystal unit **100** is mounted within the aperture **1011** so as to be exposed to the front of the LCD.

The front case **1010** and the back case **1020** are mounted on a chassis **200** constituting the framework of the thin display unit **1**, preferably through screws (not shown). The chassis **200** has a horizontal first enclosure **210** having, according to the first embodiment, a depth dimension larger than its height dimension. Chassis **200** also has a vertical second enclosure **220** located at the front of the upper side of the first enclosure **210** having a wide planar portion **221** extending in the longitudinal direction, and a vertical third enclosure **230** located above the rear of the upper side of the first enclosure at the rear of the second enclosure **220**. The front case **1010** includes the front of the first enclosure **210** and the second enclosure **220** and the back case **1020** includes the rear of the second enclosure **220** and the third enclosure **230**.

The first enclosure **210** has a flat thin boxy shape preferably formed by bending an iron plate and includes a first unit-storing section **210***a* for storing a power supply section **10**. The second enclosure **220** has a second unit-storing section **220***a* that opens forward and that has a margin **222** at the circumference of the front of the wide planar portion **221** of the second enclosure **220**. The vertical liquid-crystal unit **100** is stored in the second unit-storing section. The third enclosure **230** has a third unit-storing section **230***a* for storing a vertical board **20** for driving and controlling the liquid-crystal unit **100** and also for serving various interface functions.

The stand **2000** supports the body **1000** and has a tilt mechanism section **400** for longitudinally tiling the body **1000** about an axis of revolution P1. According to this embodiment, the tilt mechanism section is provided for longitudinally tilting the upper side of the body **1000** about the axis P1. Also, it is possible to use a turntable for laterally rotating the body **1000**.

The arrangement of the parts of the LCD unit **1** are described below while referring to FIG. **1** and FIGS. **7** to **10**, in accordance with FIG. **2**. FIG. **2** is an expanded view of parts of the LCD unit **1**. FIG. **7** is a rear perspective view with the back case and shield panel removed. FIG. **8** is a rear perspective view with the back case removed. FIG. **9** is a rear perspective view with the wiring cover removed, and FIG. **10** is a diagram for explaining a method for adjusting the LCD screen with a group of operating switches.

In FIG. **2**, the first enclosure **210** serves as a framework of the support structure of the chassis **200** for supporting the second enclosure **220** and third enclosure **230**. As shown in FIG. **7**, the first enclosure **210** has a bottom plate **212** with wall surfaces formed by bending the bottom plate, which have a plurality of apertures **211** formed therein, a front plate **213** provided at the front of the plate **212** and having protruding portions at the sides thereof for mounting loudspeakers **30**, and a top plate **214**, joined by welding to plates **212** and **213** or by connecting these plates together with screws, not shown. Moreover, the back is covered with a removable shield panel **231** as shown in FIG. **8**. Furthermore, the upper side of the first enclosure **210** is formed so that the front of the upper side is lower than the rear of the upper side at a stepped portion **215** and the bottom end of the second enclosure **220** is fixed to the stepped portion **215**. Still further, a ventilation aperture **216** and a wiring aperture are formed in the top plate **214**.

For the structure of the first enclosure **210**, a plurality of plates constitute a box. Therefore, it is possible to secure support for the second enclosure **220** and the third enclosure **230** which are on or otherwise fixed to the upper side of the box. Particularly, by forming the stepped portion **215** as part of the bottom plate **212** and the front plate **213** at the front of the first enclosure **210**, the heavy second enclosure **230** is firmly supported and convenient positioning during assembling is enabled. Moreover, because the rear of the first enclosure **210** includes the removable shield panel **231**, it is possible to ensure convenient assembly and maintainability of the internal components, such as a power supply section **10** stored in the first unit-storing section **210***a*.

The second enclosure **220** is a box shaped structure disposed vertically that opens toward the front and has a wide planar portion **221**, an upper margin **222***a* formed at the front of the portion **221**, a lower margin **222***b*, and side margins **222***c* and **222***d*. The above structure is preferably formed by cutting out four corners of, for example, a rectangular iron plate, bending all four sides frontward, and welding each corner. This structure makes it possible to support the liquid-crystal unit **100** stored in the second unit-storing section **220***a* through not only the lower margin **222***b* formed at the bottom of the enclosure but also through the sides and the wide planar portion **221** by distributing the load to the whole of the first enclosure **220**. Notably, this

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structure avoids the requirement of a separate reinforcement member, thereby making it possible to decrease the weight. Furthermore, it is possible to restrict the thickness (vertical dimension and lateral width dimension) of the margin portions **221***a–d* to the thickness of the plate. Therefore, it is possible to prevent the size of the unit from being increased by decreasing the size of the frame body around the display screen **101**. Still further, this structure makes it possible to form the second enclosure **220** into a structure that resists twisting forces. Therefore, this structure is quite advantageous for a liquid-crystal unit **100** having a large display screen **101**.

The liquid-crystal unit **100** is mounted to the second unit-storing section **220***a* from its front. The liquid-crystal unit **100** has a protrusion **102** protruding out from its back and a space **220***b* is formed between the back of the liquid-crystal unit **100** and the planar portion **221**. As shown in FIG. **1**, the space **220***b* provides mounting space for an inverter board **103** set at the back of the liquid-crystal unit **100**. Also, the space **220***b* serves as a wiring space for the liquid-crystal unit **100** and the inverter board **103**, a space for storing extra wiring, or a route for radiating the heat produced by the liquid-crystal unit **100** and inverter board **103**.

An aperture **223** for radiating the heat produced in the second unit-storing section **220***a* is formed in the upper side of the wide portion **221** of the second enclosure **220**. Further, because an aperture (a gap formed by a fixing rib) is formed at the lower side of the second unit-storing section **220***a* (FIG. **1**) and since a ventilation passage communicating with the aperture **223** to radiate heat are formed, it is possible to effectively radiate the heat from the second unit-storing section **220***a* by means of free convection heat flow assisted by a chimney effect. To more efficiently remove the heat from the second unit-storing section **220***a*, forced convection is performed by mounting a blower **224** in the aperture **223**. However, when the heat is sufficiently transferred by natural convection, it is unnecessary to use the blower **224**.

As shown in FIG. **2**, a rectangular shaped aperture **225** serving as a wiring route for connecting the second unit-storing section **220***a* with the third unit-storing section **230** is formed in the wide planar portion **221** of the second enclosure **220**. As a result, it is possible to connect the liquid-crystal unit **100** including the inverter board **103** with the board **20** mounted in the third unit-storing section **230***a* via a short distance.

An operating switch board **35** (FIG. **2**) and loudspeakers **30** are arranged below the second enclosure **220** at the front of the first enclosure **210**. In the case of this embodiment, the operating switch board **35** is preferably mounted to a rib (not shown) formed on the back of the front case **1010**. However, it is also possible to directly fix the board **35** to the front of the first enclosure **210** by screws. In this case, when fixing the board **35** to the front case **1010**, matching with a switch hole formed in the front case **1010** is improved. When fixing the board **35** to the first enclosure **210**, the ability to assemble and maintain the board is facilitated because no wiring is necessary for the front case **1010**. Moreover, in the case of this embodiment, the operating switch board **35** is set at the center of the body **1000** and each of a pair of loudspeakers **30** is set at one side of the body **1000**.

According to this embodiment, convenient manipulation of the operating switches is enabled by mounting the operating switch board **35** at an angle to vertical, which secures a wiring space for various elements behind the operating switch board **35**. Furthermore, the loudspeakers **30** preferably operate in stereo and are mounted in otherwise unused, dead spaces formed at both sides of the front case **1010**.

The third enclosure **230** is constituted by the wide planar portion **221** of the second enclosure **220**, top plate **214** of the first enclosure **210**, a terminal-setting-side plate **232** disposed to one side of the wide portion **221**, a power supply switch-setting side plate **233** disposed on the other side of portion **221**, and a shield panel **231** removably mounted on the wide planar portion **221**.

As shown in FIG. **1**, the board **20** is mounted in the third unit-storing section **230***a* and is set almost in parallel with the wide planar portion **221** by mounting the board with screws while leaving a space therebetween. Moreover, a blower **234** is mounted in the aperture **216** formed in the top plate **214** for separating the first unit-storing section **210***a* from the third unit-storing section **230***a*. In this embodiment, the blower **234** is mounted in the third unit-storing section **230***a*, which has a triangular sectional shape (as viewed from the side) and which otherwise serves as a dead space. However, it is also possible to mount the blower **234** in the first unit-storing section **210***a* adjacent the aperture **216**.

According to this embodiment, the third unit-storing section **230***a* is vertically divided into two parts by forming a step at the back of the enclosure. The lower part forms a deep wide space and the upper part a shallow narrow space. The blower **234** is housed in the lower space since it has a relatively large depth dimension when mounted. Various elements mounted on the board **20** are arranged in the lower wide space also, and elements having a small depth dimensions when mounted on the board **20** are arranged in the upper narrow space. Thereby, it is possible to form the back of the thin display unit **1** in a shape in which the depth dimension stepwise decreases from the lower side to the upper side. Therefore, it is possible to have a shape with a small dead space. Moreover, because the back case **1020** for covering the third enclosure **230** is not easily seen when viewed from the front, it is possible to convey a sense of thinness to a user viewing the unit from the front.

The shield panel **231** covers the back of the first enclosure **230** and that of the first enclosure **210** at the same time. Moreover, the shield panel **231** covers the back of the first enclosure **210** and that of the third enclosure **230** with a stepped shape. Thereby, the strength of the large shield panel **231** is maintained. In this embodiment, as shown in FIG. **8**, the back of the third enclosure **230** has a surface in which a plurality of apertures are formed, as by punching. The punched apertures are small holes having a diameter large enough to prevent radio waves from passing or leaking out of the unit and to prevent external radio waves from penetrating the unit and affecting the board **20**, while enabling radiating cooling. Moreover, in this embodiment, the diameter of the small holes is preferably set to 6 mm. However, in consideration of the radiating effect and shielding effect, it is possible to obtain both when the diameter ranges between 4 mm and 7 mm.

The structure of the third unit-storing section **230***a* is described below in more detail by referring to FIGS. **7** and **8**. In FIG. **7**, a plurality of terminal-setting holes **232***a* are formed in the terminal-setting side plate **232** in its longitudinal direction. Terminals **21** closely arranged on the board **20** are fitted to the holes **232***a*. Moreover, a power supply switch **233***a* and a power supply outlet **233***b* are provided for the power supply switch-setting side plate **233** and arranged closely to the board **20**. A protective bar **235** for protecting the board **20** is provided and has a reinforcement function for the shield panel **231** and also functions as a guide for mounting board **20** (at the rear of the board **20**). In this embodiment, the structure is reinforced by supporting the intermediate position of the protective bar **235** with a support member **236** provided on the board **20**.

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Moreover, in this embodiment, the board **20** is mounted so as to orient the wiring surface toward the side facing the planar portion **221** and the various element surfaces toward the side exposed in FIG. **7**. To use a plurality of boards, instead of the single one shown, it is also possible to mount a leg to the board **20** or to use a laminated board arrangement structure such as a two-layer structure through the terminal-setting side plate **232** or the protective bar **235**.

As shown in FIG. **7**, with the shield panel removed, it is possible to expose the third unit-storing section **230***a* and the first unit-storing section **210***a*. Therefore, convenient maintenance is ensured. Moreover, because the back stands upright with respect to a table surface, maintenance operations can be performed only by removing the back case **1020** and the shield panel **231** without laying the thin display unit **1** flat for such operations. Moreover, when the maintenance is completed, it is possible to mount the shield panel **231** using the protective bar **235** as shown in FIG. **8**. Therefore, it is possible to decrease the possibility that the shield panel **231** contacts and damages the board **20**.

Moreover, in this embodiment, as shown in FIGS. **7** and **8**, the front case **1010** can be mounted to the second enclosure **220**, and a mounting plate **224** can be provided for reinforcement at the four corners at the back of the planar portion **221**. Also, a mounting portion **225** can be formed flush with the planar portion **221** by cutting and bending the margin **222**. A protrusion provided with a tapped hole extending outwardly from the planar portion **221** is formed on the mounting plate **224** and a tapped hole is formed on the mounting portion **225**. Further, the fixing rib of the front case **1010** is provided for the position corresponding to the mounting plate **224** and the mounting portion **225**. Still further, as shown in FIG. **9**, a tapped hole **1021** for mounting is formed at the position corresponding to the tapped hole of the mounting plate **224**.

In this embodiment, the front case **1010** is first mounted to the second enclosure **210** by a not-illustrated screw through the mounting portion **225**. Then, it is possible to screw in mounting plate **224** through the tapped hole **1021** of the back case **1020** by holding it between a fixing rib (not shown) of the back case **1020** and the fixing rib of the front case **1010**.

In FIG. **2**, a wiring cover **1031** is removably mounted to the back cover **1020** at one side of the back cover **1020**. The specific structure is described by referring to FIGS. **8** and **9**. First, in FIG. **8**, the third enclosure **230** is mounted to the second enclosure **220** at one side from the enclosure **220** so that the third enclosure **230** and a wiring space **1031** (virtual space shown by a dotted line) are arranged in parallel. In the third enclosure **230**, the connecting terminal **300** is mounted in a position adjacent to the wiring space **1031**. The specific structure is described below by referring to FIG. **9**.

FIG. **9** shows the wiring cover **1030** removed from the thin display unit **1**. In this embodiment, one side **1022** of the back case **1020** serves as the inside of the wiring space **1031** and is formed in a shape outlining the first enclosure **210**, second enclosure **220**, and third enclosure **230**. Also, the wiring cover **1030** is mounted so as to cover the one side **1022**, and the back of the thin display unit **1** is formed into a shape having right and left symmetry so that the outline of the wiring cover **1030** for covering the outside of the wiring space **1031** becomes the same as the shape of the other side **1023** of the back case **1020**. Thereby, the wiring space **1031** is formed between the one side **1022** of the back cover **1020** and the inner wall of the back cover **1030**.

Moreover, the connecting terminals **300** are mounted to face the one side of the back cover **1020**; and a recess **1032** shown by a dotted line is provided that is open to wiring space **1031**. Thereby, wiring space **1031** is formed for accommodating a connector mounted to the connecting terminal **300** to the lower side of the body **1000**.

As shown in FIG. **9**, the wiring cover **1030** has protrusions **1033** that fit in positioning holes **1024** formed on the back case **1020** and preferably a fixing rib (not shown) is provided for the inner wall of the other side of the wiring cover **1030** and further is removably mounted to the fixing rib **1026** provided for the back case **1020** by using the elasticity of the material (resin) so as to fit to the fixing rib **1025**.

According to the above structure, it is possible to greatly expose the wiring connecting terminal **300** by removing the wiring cover **1030**. Therefore, connections are made conveniently. Moreover, by simply mounting the wiring cover **1030** to the fixing rib, it is possible to conceal the connecting terminals **300** and allow a connection cord to extend downward along the back of the thin display unit to the inside of the wiring cover **1030**. Furthermore, because the back shape of the thin display unit **1** is formed symmetrically to the right and left, it is possible to store the wiring space **1031** in the body **1000** without adversely affecting the appearance of the unit.

In FIG. **2**, the stand **2000** is shown to have a base portion **2010** made of a thick iron plate, a resin-molded top case **2020** for covering the upper side of the base portion **2010**, and a tilt mechanism section **400**. One end of the tilt mechanism **400** is exposed through an aperture **2021** at the upper side of the top case **2020**. The tilt mechanism section **400** is provided along the lateral width direction of the body **1000** and has a pair of first support portions **401**, the ends of which are mounted to the base portion **2010** through a mount **402**. A second support portion **410** is mounted to the bottom of the first enclosure **210** through a mount **411** (see FIG. **1**). The ends of a pair of arms **412** are provided for the second support portion **410**, and a support body **420** rotatably supports one end of the first support portion **401** along the axis P1. The support body **420** is provided with a spring so that rotations of the arms **412** provided for the first support portion **401** and second support portion **410** are balanced and held at a predetermined position. Thereby, the body **1000** can be tilted in a range from approximately 5 forward to approximately 20 backward.

Preferably, the mount **411** is removably mounted to the first enclosure **210** and the second support body **410** by screws. As shown in FIG. **1**, mount **411** is mounted to the first enclosure **210** to be flush with the bottom of the body **1000** or so as not to protrude from the bottom. Thereby, even if the stand **2000** is removed from the body **1000**, it is possible to directly set the body **1000** on a flat surface because the bottom of the body **1000** is formed flat. Also, preferably, since the body **1000** is formed into a stable shape whose lower sectional area is larger than its upper sectional area, it is possible to stably mount the body **1000**. Moreover, it is possible to connect various types of stands such as a height-adjustable stand and a longitudinally-movable stand through screws.

The preferred shape of the LCD **1** of this embodiment is shown in FIGS. **3**(*a*)–**3**(*d*), wherein FIG. **3**(*a*) shows a top view, FIG. **3**(*b*) shows a front view, FIG. **3**(*c*) shows a right side view, and FIG. **3**(*d*) shows a back view of the LCD.

The views of FIGS. **3**(*a*)–**3**(*d*) show a basic shape of the body **1000** of the LCD **1**, which has a housing **50** having a small depth dimension; a thin housing **51** smaller than the housing **50** and provided below the back of the housing **50**; and a housing **52** smaller than the housing **51** and provided below the back of the housing **51** and the stand **2000**

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mounted below the LCD **1**. Also shown is a flat plate **60** with a protruded portion **61** formed behind the plate **60**. The body **1000** forms the housing **50** with the front case **1010** and forms the housings **51** and **52** with the back case **1020**. That is, the body **1000** according to this embodiment has only a small dead space. Further, high mounting efficiency is achieved by directly using the structure of the chassis **200** as a foundation for the overall shape. Thereby, the housings **51** and **52** are not easily seen from the front even when viewed diagonally from the front. Therefore, it is possible to provide a thin appearance of the housing **50** that is particularly remarkable. Moreover, because the appearance as viewed from the back has a shape that takes a large step, toward the center, it is possible to make the maximum depth dimension of the body **1000** unnoticeable.

In this embodiment, preferably an 18" liquid-crystal unit **100** is used. Further, the preferred dimensions include a lateral width W1 of the body **1000** set to 489 mm, a height H1 set to 440 mm, an upper depth D1 set to 73 mm, and a lower maximum depth D2 set to 187 mm, wherein the overall height H2 is set to 507 mm and the overall depth (depth of stand) D3 is set to 268 mm.

As shown in FIGS. **3**(*b*) and **3**(*c*), it is preferred that a quadrangular flat portion is left around the display screen **101** and that the lower side of the flat portion is formed into a slope **65** having a bottom end that projects toward the front of the unit. Furthermore, the stand portion **2000** is also preferably formed with a flat portion using a simple plane as the principal plane. As a result, it is possible to improve the visibility of the display screen by reducing the presence of interfering patterns and shapes continuous with the display screen **101** about its periphery.

As also shown in FIGS. **3**(*a*)–**3**(*d*), an operating switch group **70**, including a plurality of switches for adjusting the display screen and a power-supply indication lamp, etc., is provided at the center of the sloped portion **65** to make it convenient for a user to manipulate each of the operating switches and to see the indication lamp. Furthermore, a corner cutting (downwardly, inwardly sloping or slanting) surface **80**, which at its center is narrow and at its sides is wide, is formed at the bottom end of the sloped portion **65**. A sound-release portion **81** having a plurality of small holes is formed at the sides of the corner cutting surface **80**. As shown in FIG. **3**(*c*), the surface of the sound release portion **81** and the holes are oriented to diagonally downward, so that the sound emitted from the sound-release portion **81**, as shown by the arrow, is directed to reflect off the table surface on which the unit is standing and reach the ears of a user by reflection. In this way, it is possible to obtain a preferable sound effect. Further, because sound that is reflected off the table surface diffuses toward the ceiling, it is advantageously not heard so easily by persons other than the user. Moreover, the sound-release portion **81** on the surface **80** cannot be easily seen from the front. Therefore, it is possible to decrease adverse affects on the viewing of the display, even if the sound-release portion **81** is required to be increased in size in consideration of sound efficiency.

The manipulability of the operating switch group **70** is described below by referring to FIGS. **10**(*a*)–**10**(*d*). FIG. **10**(*a*) is a layout drawing of the operating switch group **70**, FIG. **10**(*b*) is a display-screen-adjusting menu window diagram displayed on a display screen, FIG. **10**(*c*) is a mounted window diagram of one functional window, and FIG. **10**(*d*) is a mounted window of other function.

In FIG. **10**(*a*), the operating switch group **70** includes a pair of setting switches (select **71***a* and back **71***b*) and a pair of up-down switches (up **72***a* and down **72***b*) at the center of the body **1000**, arranged symmetrically to the right and left. Also included are a a menu switch **73** and an automatic adjustment switch **74** at the sides of the switches **71***a*, **71***b* and **72***a*, **72***b*, arranged symmetrically to the right and left, and further a power-supply lamp **75** and a switching lamp **76** (e.g. energy-saving indication lamp) at both sides of the switches **73** and **74**, arranged symmetrically to the right and left. In this embodiment, the switches are mounted so as to perform operations from left to right.

The setting switches **71***a* and **71***b* and the up-down switches **72***a* and **72***b* are diagonally arranged so as to have longitudinal and lateral directivities so it is convenient to perform longitudinal or lateral operations depending on the displayed function being performed as indicated in a window. Moreover, the correlation between selector switches **71***a*, **71***b* and the up-down switches **72***a*, **72***b* can be exhibited by diagonal-pattern graphic indications in a window being displayed so that a functional pair of operating switches can be easily recognized among the plurality of operating switches.

A preferred method for operating the operating switch group **70** is described below by referring to FIGS. **10**(*b*) to **10**(*d*). First, by pressing the menu switch **73**, a menu window **77**, as shown in FIG. **10**(*b*), is displayed. A plurality of functions (**77***a*, **77***b*, **77***c*, . . .) are vertically displayed in the menu window **77** and the functions can be selected by the up-down switches **72***a*, **72***b*. A highlighted indication showing that a function has been selected moves upward by pressing the up switch **72***a* and the highlighted indication moves downward by pressing the down switch **72***b*. Thereby, the user sees that a switch located at an upper position is an upper switch and a switch located at a lower position is a switch for downward movement.

By pressing the selector switch **71***a* in accordance with a purposed function, it is possible to display the setting window **78** or **79** shown in FIGS. **10**(*c*) and **10**(*d*), respectively. Moreover, by pressing the back switch **71***b*, it is possible to perform an operation of going back to a previously displayed window, which causes deletion of the menu window **77** in this case.

The setting window **78** shown in FIG. **10**(*c*) is selected in accordance with the above operation. The setting window **78** displays a function title **78***a*, an up-function indication **78***b*, and a down-function indication **78***c*. In particular, the up-function indication **78***b* is selected by pressing the up switch **72***a* and the down-function indication **78***c* is selected by pressing the down switch **72***b*. This operation makes it possible to make adjustments in accordance with a selected function. After the adjustments have been made, it is possible to delete the menu window **77** by pressing the back switch **71***b* once to return the screen to the menu window **77** followed by pressing the switch one more time.

Moreover, the function setting window **79** in FIG. **10**(*d*) displays a function title **79***a* and a setting bar **79***b* showing that the left side is 0 and the right side is 100. In this example, the setting bar **79***b* moves rightward by pressing the up switch **72***a* and the setting bar **79***b* can be moved leftward by pressing the down switch **72***b*. Thereby, the right and left arrangement of the switches is matched with a corresponding increase/decrease of the setting bar **79**. The setting and deleting of the above functions is the same as those for the operations in FIG. **10**(*c*).

As described above, convenient manipulation of the switches of switch group **70** is ensured by arranging the switches to correspond with the tasks to be performed as displayed in the windows. In particular, the operating direction of the adjustments to be made with the paired switches

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that are diagonally arranged together correspond to the longitudinal or vertical and lateral or horizontal directions indicated in the windows that are displayed for the selected functions.

As discussed, in the LCD unit of the present invention, ventilation is preferably provided to remove the heat generated by the internal components, including the display panel, the backlights and the power supply section. As shown in FIG. **3**(*d*), a first ventilation port structure **1040** is provided with a plurality of small holes at the upper side of the back of the body **1000**. There is also a second ventilation port structure **1041** and a third ventilation port structure **1042** at the rear along both sides of the bottom of the body **1000** in order to allow internal heat to radiate to the outside of the enclosure. The second ventilation port **1041** is preferably an aperture formed with recess **1032** which the above mentioned connection cord passes through. Further, preferably the third ventilation port **1042**, as shown in FIG. **9**, has a plurality of small holes formed at a position symmetric to the aperture formed with the recess **1032**.

The exhaust structure is described below by referring to FIG. **1**. Outside air is taken in through the second ventilation port **1041** and the third ventilation port **1042**, and is exhausted through the first ventilation port **1041**. That is, air taken in through the second ventilation port **1041** and the third ventilation port **1042** passes through the apertures **211** formed in the sides of the first enclosure **210** and is taken into the first unit-storing section **210***a*. The air taken in cools the power supply section **10** mounted in the first unit-storing section **210***a* and thereafter, it is sent into the third unit-storing section **230***a* by the blower **234** mounted to the top plate **214** of the first enclosure **210**. As the air passes through, it cools the board **20** and then is exhausted through the first ventilation port **1040** through an aperture provided in the shield panel **231**.

Also, as shown in FIG. **1**, air is exhausted from the second enclosure **220**. Specifically, air in the second unit-storing section **220***a* is drawn in by the blower **224** mounted to the upper side of the planar portion **221** and exhausted through the first ventilation port **1040**. In this case, the air in the second unit-storing section **220***a* is supplied from the aperture formed with the mounting portion **225** described with respect to FIG. **7** or other gap to cool the back of the liquid-crystal unit **100** and the inverter board **103**. Such cooling air is then exhausted through the above route.

An electromagnetic-wave shielding structure is described below by referring to FIGS. **1** and **8**. In this embodiment, as described later, the exterior of the liquid-crystal unit **100** (shown in FIG. **4**) is formed with a conductive material. Therefore, by providing the liquid-crystal unit **100** for the second unit-storing section, it is possible to form the thin-box shaped second unit-storing section **210***a* with a conductive characteristic ensured by the planar portion **221**, margin **222**, and the exterior of the liquid-crystal unit **100**. Further, by storing various units in the first enclosure **210**, second enclosure **220**, and third enclosure **230**, each respectively formed of a conductive material, it is possible to reduce the influence of leakage of electromagnetic waves generated by the internal components on the human body and to prevent the influence of electromagnetic waves on the components from the outside. Moreover, in this embodiment, by using the planar portion **221** of the second enclosure **220** for separating the first unit-storing section **210***a*, second unit-storing section **220***a*, and third unit-storing section **230***a* from each other and the apertures **216**, **217**, **223**, and **225** for connecting each enclosure to the top plate **214** of the first enclosure **210**, it is possible to perform ventilation and provide sufficient space for main wiring connections in the chassis **200** in consideration of the objective to maintain shielding of electromagnetic waves such as radio waves. Therefore, it is possible to further ensure the radio-wave shielding effect of the chassis **200**.

In particular, the liquid-crystal unit **100** of this embodiment may generate strong electromagnetic waves from the cord connecting the inverter **103** mounted to the back of the unit **100** with the liquid-crystal unit **100**. However, because the inverter **103** and the liquid-crystal unit **100** are stored in the thin-box shaped second unit-storing section **210***a*, which is conductive or has a conductive characteristic, it is possible to shield them from the outside. Therefore, this embodiment is provided with a cover formed with a conductive material to be described later in order to shield the inverter **103** by considering that various types of components may be used in the actual construction. When using the above structure, it is unnecessary to use the cover **104** under normal usage. However, it is better to use the cover **104** when strict shielding is necessary.

The liquid-crystal unit **100** is described below in detail by referring to FIGS. **4** to **6**. FIG. **4** is a diagram of parts of the liquid-crystal unit **100**; FIG. **5** is a perspective view of the rear of a liquid-crystal unit; and FIGS. **6**(*a*) and **6**(*b*) are mounting arrangement diagrams of a liquid-crystal unit, in which FIG. **6**(*a*) is a front view and FIG. **6**(*b*) is a representative sectional view.

In FIG. **4**, as described above, the liquid-crystal unit **100** according to this embodiment has a high-image-quality TFT LCD module having an 18" screen using thin-film transistor TFT technology. In this case, as shown in FIG. **4**, the liquid-crystal unit **100** is mounted to the LCD **1** by orienting a side **115** as an upper side. Subsequent description is made by assuming the upper side **115** is so oriented.

The liquid-crystal unit **100** is preferably constructed by laminating a top frame (metallic frame) **110** formed with a metallic plate, a liquid-crystal panel **120**, a middle frame made of resin, and a bottom frame made of conductive aluminum to each other. The top frame **110** has a display window **111** for exposing the display screen **101** of the liquid-crystal panel **120** at its center and moreover has a side wall at its circumference to fix the liquid-crystal unit **100** by enclosing the middle frame **130** and bottom frame **140** and fitting a pawl provided at an end of the side wall into the recess of the circumferential wall of the bottom frame.

The liquid-crystal panel **120** has a gate driver **121** and a gate FPC **122** at its one minor side **116** and has a drain driver **123** and a drain FPC **124** at its bottom side **117**. Moreover, the surface of the display screen **101** of the liquid-crystal panel **120** is provided with a transparent sheet coated with a conductive material. Thereby, if a hand charged with static electricity touches the display screen **101**, it is possible to discharge the static electricity through the peripheral top frame **110**. Furthermore, this structure makes it possible to cover the front of the liquid-crystal unit with a conductive material.

The middle frame **130** has a frame-like shape formed with the peripheral wall surface to keep a constant distance between a fluorescent lamp **150**, functioning as a backlight, and the liquid-crystal panel **120**.

The bottom case **140** is formed with a peripheral wall surface and a bottom wall that become parallel with the planar portion **221**, in which a plurality of fluorescent lamps **150** are arranged so as to be parallel with the plane of the liquid-crystal panel **120**. This structure is described by referring to FIG. **6**(*b*).

FIG. **6**(*b*) is a representative longitudinal sectional view showing the mounting of the liquid-crystal unit **100** to the

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second enclosure **220**. Though not illustrated in FIG. **4**, a corrugated reflector **141** reflecting toward the liquid-crystal panel **120** is mounted in the bottom case **117** corresponding to each fluorescent lamp **150**. Moreover, the fluorescent lamp **150** is secured to the center of the surface of the corrugated circular arc. In this case, the fluorescent lamp **150** is mounted at its ends and supported by an insulating material, such as rubber for electrically separating the fluorescent lamp **150** from the reflector **141** and the bottom case **140**. Moreover, though not illustrated, a plurality of heat-radiating ventilation ports are provided for the bottom case **140**.

Though the reflector **141** is directly mounted in the bottom case **140** in FIG. **6**(*b*), it is preferable to mount the reflector **141** in the bottom case **140** by forming the reflector **141** into a unit. In this case, it is preferable to mount the reflector **141** in a thin box shaped case that opens toward the liquid-crystal panel **140** so as to cover the case and to mount the fluorescent lamp **150** to each front of the corrugated shapes of the reflector **141** so that the reflector **141** is located in the box shaped case. It is further preferable to mount the rubber for supporting the lamp to the box shaped case. The above structure makes maintenance easy because the above unit may be replaced in its entirety when replacing the fluorescent lamp **150**.

In this embodiment, the fluorescent lamp **150** is vertically mounted in parallel with the upper side **115**. Thereby, when the fluorescent lamp **150** is mounted to the LCD **1**, the ends of the fluorescent lamp **150** which produce the greatest amount of heat are vertically arranged at both sides of the liquid-crystal unit **100**. Therefore, as shown in FIG. **6**(*b*), the heat produced by the ends of the fluorescent lamp **150** are radiated upward along the sides of the liquid-crystal unit **100**. Thus, it is possible to reduce the influence of the heat that is generated on the display screen **101**, which is located in the middle, between the ends of the fluorescent lamp **150**.

The third enclosure **230** is mounted by leaving a flat portion at its sides. The flat portions at the sides coincide with the positions of the ends of the fluorescent lamp **150**. Therefore, because the board **20** is located at the center, separate from the portion producing the most heat, it is possible to reduce the effect of the heat that is produced.

Furthermore, because in this embodiment a large liquid-crystal panel **120** is used, the fluorescent lamps **150** are also increased in length. Therefore, a high voltage and high frequency are required to ensure proper discharge of the long fluorescent lamps **150**. Moreover, because this embodiment uses a high-resolution liquid-crystal panel **120**, a large number of fluorescent lamps **150** are arranged inside. These fluorescent lamps **150** produce much heat and generate substantial electromagnetic waves. In this embodiment, the bottom case **140** is made of conductive aluminum in order to achieve the electromagnetic wave shielding object as described above. Thereby, it is possible to disperse the heat produced inside by the bottom case **140**. Furthermore, because it is possible to enclose the exterior of the liquid-crystal unit **100** with the bottom case **140** and top case **10** made of a conductive material and the display screen **101** covered with a conductive transparent sheet, it is possible to reduce the influence of the electromagnetic waves.

In FIG. **4**, a DC/DC converter **160** and a TCON (TFT controller) board **170** having a width slightly smaller than the thickness of the liquid-crystal unit **100** and stored in the enclosure of the liquid-crystal unit **100** are arranged on the bottom side **117** of the liquid-crystal unit **100**. The TCON board **170** functions as a medium for connecting the liquid-crystal panel **120** with an external unit, which is provided with a drain FPC (Flexible Printer Connector) linkage connector **171** connected with the drain FPC **124**, a gate FPC linkage connector **172** connected with the gate FPC **122**, and an I/F (Interface) connector **173** for connection with an external unit. A recess **174** is formed at a position corresponding to the I/F connector **173** of the liquid-crystal unit **100**, which connects with an external connector.

In FIG. **5**, as described above, the inverter **103** is mounted to the back of the liquid-crystal unit **100** through a screw or the like. Moreover, the inverter **103** is covered with a cover **104** made of a conductive material. Furthermore, the inverter **103** is connected to the fluorescent lamp **150** through a cord to supply high-voltage (1,000 V), high-frequency power. According to the above structure, because the inverter board **103** is mounted to the bottom case **140**, which is made of aluminum having a high heat conductivity by closely contacting the case **140**, it is possible to radiate the heat produced by the inverter board **103** through the bottom case **140**. Therefore, it is possible to reduce adverse effects caused by the concentration of heat.

As shown in FIG. **5**, protrusion **102** is formed on the back of the liquid-crystal unit **100**, as described above. Though the protrusion **102** is formed from the peripheral wall of the top frame **110**, it is also possible to form a protrusion on the back of the bottom frame **140**. Moreover, in this embodiment, the bottom right side is mounted as the top side **115** as shown in FIG. **5**, and the lateral width W**2** of the liquid-crystal unit **100** when mounted is set to 415 mm, its height H**3** is set to **330**, the depth D**4** of its body is set to 35 mm, and the depth D**5** including the protrusion **102** is set to 45 mm.

FIG. **6**(*a*) is a schematic front view of the liquid-crystal unit **100** mounted to the second enclosure **220**. The liquid-crystal unit **100** is mounted to the second unit-storing section **220***a* by a screws **105** provided at the four corners of the liquid-crystal unit **100**. As shown in FIG. **6**(*b*), each screw **105** is mounted to the planar portion **221** of the second enclosure **220** by passing through the liquid-crystal unit **100**. Also, a buffering or shock absorbing member **106** is mounted between the side wall around the liquid-crystal unit **100** and the inner wall surface of the margin **222** of enclosure **220**. The buffering member makes it possible to stably mount the liquid-crystal unit **100** in a predetermined position of the second unit-storing section **220***a* and disperse any stress applied to the second enclosure **220** in the direction of the arrow X**1** shown in FIG. **6**(*b*). Particularly, in the case of the large high-resolution liquid-crystal unit **100** used for this embodiment, because the liquid-crystal unit **100** has a large weight, it is possible to completely support the load of the unit's weight, which acts in the direction of the arrow X**1** by the above structure. Moreover, the above structure protects the liquid-crystal unit **100** from horizontal and vertical shocks applied to the unit **100** during transportation.

It is also possible to form the buffering member **106** with a soft material such as rubber or to electrically connect the liquid-crystal unit **100** with the second enclosure **220** by forming the member **106** with a flat spring. Therefore, it is possible to discharge to earth the static electricity applied to the liquid-crystal unit **100** through the second enclosure **220**.

Furthermore, although the gap between the liquid-crystal unit **100** and the margin **222** is shown to be large for the sake of explanation, it is possible to reduce the amount of electromagnetic waves passing through the gap by making the size of the gap equal to the size of the small holes formed in the shield panel **1020**.

When a buffering member **106** is not used, it is also possible to form a protrusion on the periphery of the

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liquid-crystal unit **100** for the same purpose. Moreover, when the protrusion is not formed, it is necessary to bring the bottom (bottom side **117**) of the liquid-crystal unit **100** into close contact with the bottom margin **222***b* of the margin **222** of the second enclosure **220**. Thereby, it is possible to uniformly support the load of the weight of the unit in the direction of the arrow **X1** by the bottom margin **222***b* and support the load by the second enclosure **220** as a whole.

Second Embodiment

FIGS. **11**(*a*) to **11**(*d*) are external views of an LCD body **3000** and stand **4000** of a second embodiment of the thin display unit of the present invention. FIG. **11**(*a*) shows a top view, FIG. **11**(*b*) shows a front view, FIG. **11**(*c*) shows a right side view, and FIG. **11**(*d*) shows a back view of the LCD.

The LCD body **3000** of this embodiment has a back formed so as to be in a convex circular-arc tapering toward the upper side. Therefore, it can be easily cleaned. With respect to this embodiment, the structure of the chassis **200** and the arrangement of the internal components and enclosures are the same as those of the first embodiment, so further description thereof is omitted.

As shown in FIGS. **11**(*a*)–**11**(*d*), a front case **3010** is provided for covering the front of the body and a back case **3020** for covering the rear of the body. This embodiment is different from the first embodiment in that the shape of the back case **3020** is formed into a large circular-arc shape.

Specifically, the center of the rear of the upper-side, shaped as shown in FIG. **11**(*a*) extends rearwardly and the sides are formed into a curved surface having a large convex circular arc. The bottom of the back, as shown in FIG. **11**(*b*) extends rearwardly the most to provide the greatest depth dimension. Toward the top end of the back, the depth decreases. A large convex curved shape results from the top to the bottom of the back.

Because this structure makes it possible that the appearance of the back is slowly narrowed toward the upper side, it is possible to obtain the same advantage as that provided by the first embodiment, in which the bottom of the body **3000** is stable. It is also possible to ensure that cleaning of the covers is convenient because the entire back is formed in a uniform shape (not stepped). Moreover, because the back is partially dome shaped, it is strong structurally. Therefore, it is possible to decrease the number of reinforcement ribs causing ridges. Furthermore, in this embodiment, a first ventilation port structure **3040** is formed by providing a plurality of vertical slits instead of holes. The third ventilation port structure **3042** can also be similarly formed from slits or holes. Therefore, it is possible to obtain an opening ratio larger than that of the ventilation port structure formed from a plurality of holes. Further, the ventilation ports of this embodiment can be easily molded. On the other hand, the ventilation port structure **3041** is substantially similar to the second ventilation port **1041** of the first embodiment.

As another difference with respect to the first embodiment, the corner cutting surface **3080** at the front along the bottom of the unit is formed into a stepped shape (rather than slanted) that extends to the sound boards **3081** along the sides. However, the switch group **3070** is substantially unchanged with respect to the first embodiment. Furthermore, in this embodiment, the stand **4000** has a different, more compact shape formed with the upper side of the base portion **4010** being in the shape of a circle. As constructed, the stand is stable and supports the unit despite the modified stand construction with respect to the first embodiment.

Third Embodiment

The third embodiment of the present invention is described below by referring to FIG. **12**. FIG. **12** is a central longitudinal sectional view of a liquid crystal display **500** mounted on a stand **6000**. The same reference numbers as used in FIG. **1** are used in this figure to denote the same components.

The liquid crystal display of this embodiment has a front case **5010** and a back case **5020** mounted on a chassis that has a horizontal first enclosure **5210** having a height dimension larger than its depth dimension. The chassis also has a vertical second enclosure **5220** located at the front of the first enclosure **5210** that has a wide planar portion **5221** extending in the longitudinal direction, and a vertical third enclosure **5230** located above the rear of the upper side of the first enclosure and behind the second enclosure **5220**.

In this embodiment, the power supply section **10** is set in the longitudinal direction in the first enclosure **5210**, which has an L-type cross-sectional shape preferably formed in a similar manner as in the first embodiment by bending an iron plate. A first unit-storing section **5210***a* is provided for storing the power supply section **10** in a vertical orientation at the rear of the first unit storing section.

As shown in the third embodiment, the front of the upper side of the first enclosure **5210** is formed lower than its rear part. Thus, there is a stepped portion **5215** that supports the bottom end of the second enclosure **5220**, between the front and the rear portions of the enclosure. In this embodiment, the stepped portion **5215** is formed larger than in the first and second embodiments. Therefore, the second enclosure **5220**, which has a heavy weight load, is firmly supported and convenience of assembly is ensured as a result.

The second unit-storing section **5220***a* opens forward as in the first embodiment and has a margin **5222** in which is mounted vertical liquid-crystal unit **100**. The third enclosure **5230** has a third unit-storing section **5230***a* for storing a vertical board **5020** for driving and controlling the liquid-crystal unit **100** and also for serving various interface functions.

Air movement internally among the enclosures is similar in this embodiment to that provided in the first embodiment. The first enclosure **5210** has wall surfaces formed by bending the bottom plate, which have a plurality of apertures **5211** formed therein. An exhaust fan **5234** is mounted on top of the rear part of the enclosure to cause air to flow upward through the third enclosure **5230**. A space **5220***b* is formed between the back of the liquid-crystal unit **100** and the planar portion **5221** that provides mounting space for inverter board **103** set at the back of the liquid-crystal unit **100**. Also, space **5220***b* serves as a wiring space for the liquid-crystal unit **100** and the inverter board **103**, a space for storing extra wiring, or a route for radiating the heat produced by the liquid-crystal unit **100** and inverter board **103**. Also, an aperture **5223** is formed in the upper side of the wide portion **5221** of the second enclosure **5220** for radiating the heat produced in the second unit-storing section **5220***a*.

The overall shape of the body **5000** is similar to that of the second embodiment and is mounted on the stand **6000** through mounting plate **5411**. As in the first embodiment, the stand has a tilting mechanism **6400**. Further, in this embodiment, the third unit-storing section **5230***a* is formed so that it becomes gradually deeper from the upper side toward the lower side. Moreover, it is possible to decrease the depth of the first unit-storing section by longitudinally setting the power supply section **10** to the first unit-storing section **5210***a*. Therefore, it is possible to decrease the depth

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of the lower side of the liquid crystal display and thereby decrease the overall depth dimension of the unit.

According to each of the three embodiments of the present invention, it is possible to provide overall strength, air permeability, and radio-wave shielding in a thin display unit by using the chassis **200** constituted with the above three enclosures. Moreover, as described in the first and second embodiments, it is possible to form an outer case, particularly a back case **1020**, into various shapes, each of a thin type. Furthermore, because it is easy to form the bottom of the body to be flat, it is possible to set the unit on a flat surface without using the stand.

As described, each of the embodiments uses a structure having three enclosures. However, it is possible to decrease a power-supply section or board in size by constituting a chassis with the second and third enclosures, providing the power-supply section and the board for the third enclosure, and supporting a tilt mechanism section at the lower side of the back of the second enclosure. Thereby, it is possible to provide a compact thin display unit having a large display screen. Moreover, it is possible to provide a compact thin display unit having a thinner body and a large display screen by constituting a chassis with the second and third enclosures, supporting a tilt mechanism section at the lower side of the back of the second enclosure, and setting a power supply section to a stand.

Although each of the above embodiments is described in accordance with an LCD having a backlight, it is also possible to obtain the same advantage from a thin display unit such as a plasma display unit.

According to the present invention, a compact thin display unit is made thin while maintaining the strength of the enclosure for supporting the display section. Furthermore, as shown by the above embodiments, by setting a power supply section to a body section rather than the stand, it is possible to easily remove the body from the stand. Therefore, convenience in assembly and maintenance of the unit is ensured, according to the objects of the invention.

While preferred embodiments have been set forth with specific details, further embodiments, modifications and variations are contemplated according to the broader aspects of the present invention, all as determined by the spirit and scope of the following claims.

What is claimed is:

1. A thin display unit, comprising:

a body extending longitudinally having height and width dimensions that are greater than a depth dimension of the body, a first enclosure at a bottom portion of the body, a second enclosure in front of a portion of the first enclosure having a planar portion extending in the longitudinal direction, and a third longitudinally extending enclosure located above a rear portion of the first enclosure and behind the second enclosure;

a power supply section stored in the first enclosure,

a thin display section mounted in the second enclosure in front of the planar portion of the second enclosure, and

a vertical substrate having components for operating said thin display unit that is stored in the third enclosure,

wherein the second enclosure has an opening that opens toward a front of the body and a margin along the perimeter of the opening, and wherein the thin display section is fixed to the margin.

2. A thin display unit according to claim **1**, further including a shock buffer mounted between the margin and the thin display section.

3. A thin display unit according to claim **2**, wherein the shock buffer is one of a resilient material and a spring.

4. A thin display unit according to claim **1**, wherein

the thin display section is a liquid-crystal display provided with at least one backlight.

5. A thin display unit according to claim **4**, wherein

a plurality of the backlights are mounted at a side facing a display screen section of the liquid-crystal display in parallel with the display screen section.

6. A thin display unit according to claim **1**, further including a stand for supporting the body that is mounted to the first enclosure, said stand having a base section and a tilt mechanism section for supporting the body so that the body can be tilted by the tilt mechanism.

7. A thin display unit, comprising:

a body extending longitudinally having height and width dimensions that are greater than a depth dimension of the body, a first enclosure at a bottom portion of the body, a second enclosure in front of a portion of the first enclosure having a planar portion extending in the longitudinal direction, and a third longitudinally extending enclosure located above a rear portion of the first enclosure and behind the second enclosure;

a power supply section stored in the first enclosure,

a thin display section mounted in the second enclosure in front of the planar portion of the second enclosure, and

a vertical substrate having components for operating said thin display unit that is stored in the third enclosure,

an air route formed between the third enclosure and the planar portion of the second enclosure,

wherein the second enclosure has an opening that opens toward a front of the body and a margin along the perimeter of the opening and the thin display section is fixed to the margin, and

wherein an air route is formed between the thin display section and the planar portion of the second enclosure.

8. A thin display unit according to claim **4**, further including:

an upper side of the first enclosure having a first aperture and a first fan mounted adjacent the aperture for promoting air flow from the first enclosure to the third enclosure, a second aperture at an upper side of the planar portion of the second enclosure and a back case covering a rear of the body and having an exhaust port formed on the upper side of the back case for exhausting the heat passing through the first and second apertures to outside of the body.

9. A thin display unit according to claim **5**, further including a second fan mounted adjacent said second aperture for promoting air flow through said second enclosure.

10. A thin display unit comprising:

a body extending longitudinally having height and width dimensions that are greater than a depth dimension of the body, a first enclosure at a bottom portion of the body, a second enclosure in front of a portion of the first enclosure having a planar portion extending in the longitudinal direction, and a third longitudinally extending enclosure located above a rear portion of the first enclosure and behind the second enclosure;

a power supply section stored in the first enclosure,

a thin display section mounted in the second enclosure in front of the planar portion of the second enclosure, and

a vertical substrate having components for operating said thin display unit that is stored in the third enclosure,

wherein the third enclosure has a third unit-storing section arranged by having a wiring space between the third

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enclosure and the planar portion of the second enclosure to store a vertical substrate,

wherein the third enclosure is arranged to deviate to one side from the second enclosure so that the wiring space and the third enclosure are in parallel with each other, and

further including a connecting terminal at the wiring space side,

a back case covering the wiring space and opening downwardly, and a removable wiring cover concealing the connecting terminal.

* * * * *