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* indicates literature cited by the examiner

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Total Number of Claims: Total 18 claims Examiner: Yoo Joo-ho

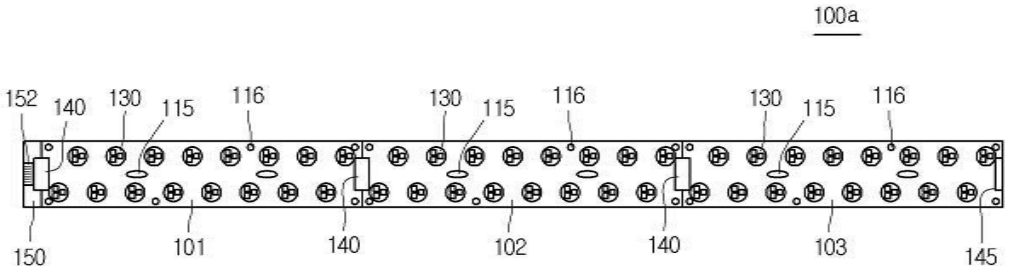
(54) Light source device and display device using the same

(57) Abstract Summary

The present invention relates to a light source device and a display device using the same.

Light source devices according to embodiments of the present invention include one or more light-emitting diodes; one or more light-emitting diode substrates equipped with the light-emitting diode; first and second connector terminals formed on both ends of the light-emitting diode substrates; and one or more connection PCBs electrically connected with the connector terminals.

Representative Drawing - FIG. 5



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Scope of Claims

Claim 1

A light source device comprising a light-emitting diode;

a plurality of light-emitting diode substrates, including a first connector terminal on one end and a second connector terminal on the other end, wherein the light-emitting diode is mounted;

a first intermediate connection PCB including a third connector terminal mounted on a first connector terminal and a second connector terminal corresponding to each other on adjacently arranged light-emitting diode substrates.

Claim 2

A light source device comprising a light-emitting diode;

a plurality of light-emitting diode substrates, including a first connector terminal on one end and a second connector terminal on the other end, wherein the light-emitting diode is mounted;

a first intermediate connection PCB electrically connected to first connector terminals and second connector terminals corresponding to each other on the adjacently arranged light-emitting diode substrates;

a terminal connection PCB including a fourth connector terminal electrically connected to the second connector terminal arranged on the other side of the light-emitting diode substrate on the terminal side, and a closed circuit pattern forming a closed circuit between the fourth connector terminals.

Claim 3

A light source device comprising a light-emitting diode;

a plurality of light-emitting diode substrates, including a first connector terminal on one end and a second connector terminal on the other end, wherein the light-emitting diode is mounted;

a first intermediate connection PCB electrically connected to first connector terminals and second connector terminals corresponding to each other on the adjacently arranged light-emitting diode substrates;

a fifth connector terminal electrically connected to the first connector terminal disposed on one side of the light-emitting diode substrate on the starting side, and an external connection PCB including a connector connected to a driver.

Claim 4

A light source device comprising a light-emitting diode;

at least one light-emitting diode substrate including a first connector terminal on one end and a second connector terminal on the other end, wherein the light-emitting diode is mounted;

a fourth connector terminal electrically connected to the second connector terminal disposed on the other side of the light-emitting diode substrate, and a terminal connection PCB including a closed circuit pattern that connects the fourth connector terminals in a closed loop.

Claim 5

A light source device comprising a light-emitting diode;

at least one light-emitting diode substrate comprising a first connector terminal on one end and a second connector terminal on the other end, wherein the light- emitting diode is mounted;

a fifth connector terminal electrically connected to the first connector terminal disposed on one side of the light-emitting diode substrate, and an external connection PCB including a connector connected to a driver.

Claim 6

A light source device comprising a light-emitting diode including a light-emitting diode chip;

at least one light-emitting diode substrate including a first connector terminal and a second connector terminal at both ends, wherein the light-emitting diode is mounted;

a connection PCB electrically connected to at least one of the first connector terminal and the second connector terminal of the light-emitting diode substrate, and

characterized in that a circuit pattern is formed on the light-emitting diode substrate, and a test pad terminal is formed on the circuit pattern to individually test the light-emitting diode chip.

Claim 7

A light source device comprising a light-emitting diode;

at least one light-emitting diode substrate including a first connector terminal and a second connector terminal at both ends, wherein the light-emitting diode is mounted;

a connection PCB electrically connected to at least one of the first connector terminal and the second connector terminal of the light-emitting diode substrate, and

characterized in that a portion of the light-emitting diode substrate other than the area where the light-emitting diode is mounted is coated with white ink.

Claim 8

According to Claim 1,

a light source device comprising a terminal connection PCB including a fourth connector terminal mounted on the second connector terminal arranged on the other side of the light-emitting diode substrate on the terminal side, and a closed circuit pattern forming a closed circuit between the fourth connector terminals;

an external connection PCB including a fifth connector terminal corresponding to the first connector terminal arranged on one side of the light-emitting diode substrate and a connector connected to a driver;

a second intermediate connection PCB including a third connector terminal that connects the first connector terminal of the light-emitting diode substrate and the fifth connector terminal of the external connection PCB to each other.

Claim 9

According to Claim 4,

a light source device comprising an external connection PCB including a fifth connector terminal electrically connected to the first connector terminal disposed on one side of the light-emitting diode substrate, and a connector connected to a driver;

a second intermediate connection PCB including a third connector terminal that connects the first connector terminal of the light-emitting diode substrate and the fifth connector terminal of the external connection PCB to each other.

Claim 10

According to any one of Claims 1, 2, 3 or 8,

a light source device wherein the first intermediate connection PCB is mounted on the upper surface of both ends of the one side and the other side light-emitting diode substrate.

Claim 11

According to any one of Claims 1, 2, 3, 4, 5, 7 or 8,

a light source device wherein the light-emitting diode comprises at least one of a Red light-emitting diode chip, a Green light-emitting diode chip, and a blue light-emitting diode chip.

Claim 12

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According to any one of Claims 1, 2, 3, 4, 5, 7 or 8,
a light source device characterized in that at least one copper foil layer is formed on the light-emitting diode substrate for heat dissipation.

Claim 13

According to any one of Claims 1, 2, 3, 4, 5, 7 or 8,

a light source device wherein the lower surface of the light-emitting diode substrate has a silver plating layer formed thereon.

Claim 14

According to any one of Claims 2, 3, 4, 5 or 8,

a light source device characterized in that a portion of the light-emitting diode substrate other than the area where the light-emitting diode is mounted is coated with white ink.

Claim 15

According to any one of Claims 1, 2, 3, 4, 5 or 8,

a light source device wherein the light-emitting diodes are arranged in at least one row on the light-emitting diode substrate.

Claim 16

According to any one of Claims 1, 2, 3, 4, 5 or 8,

a light source device wherein the light-emitting diode substrates are arranged in at least one row.

Claim 17

According to any one of Claims 1, 2, 3, 4, 5 or 8,

a light source device characterized by including a bottom cover in which the light-emitting diode substrate is disposed.

Claim 18

A display device comprising a light source device according to any one of Claims 1, 2, 3, 4, 5 or 8.

Specification

Detailed Description of Invention

Purpose of the Invention

The Technology to Which the Invention Belongs and the Prior Art of That Field

<16> The present invention relates to a light source device and a display device using the same.

<17> As the electronics industry develops, various types of display devices that are small and consume less energy are being developed, and video devices, computers, and mobile communication terminals that utilize these devices are being developed. Liquid crystal displays (LCDs), which emerged to reflect this trend, are currently in the spotlight as display devices for monitors and mobile communication terminals.

<18> Since these LCDs cannot spontaneously generate light, they are usually equipped with a backlight consisting of a light source and a light guide plate that generates light from the back or side of the LCD panel. At this time, the backlight generates white light so that the color of the image implemented by the LCD panel can be reproduced close to the actual color.

<19> As described above, the backlight of the LCD used conventional Cold Cathode Fluorescent Lamps (‘CCFLs’), or External Electrode Fluorescent Lamps (‘EEFLs’) and the like as light sources. However, conventional light sources such as Cold Cathode Fluorescent Lamps (CCFLs) or External Electrode Fluorescent Lamps (EEFLs) had the following problems. Most of the Cold Cathode Fluorescent Lamps (CCFLs) and External Electrode Fluorescent Lamps (EEFLs) use the plasma principle, and in this case, as the gas pressure of the plasma changes, the lifespan becomes shorter, and an inverter is required to obtain a high operating voltage of several hundred volts required for plasma discharge.

<20> In addition, when applied to portable products such as mobile communication terminals, most of the power is consumed by the backlight, and conventional light sources such as CCFL or EEFL have poor power consumption efficiency, so there was a problem of consuming excessive power.

<21> A backlight unit using a light-emitting diode ('LED') has been proposed to address the problems described above.

<22> FIG 1 is a drawing showing the structure of a conventional LED package for backlight.

<23> Referring to FIG. 1, a conventional LED package (10) for backlight consists of a body portion (11) having a cavity in the center, two lead electrodes (12, 13) formed within the cavity, and an LED chip (14).

<24> Here, the main body (11) has a cavity formed therein in which an LED chip (14) can be mounted, and is filled with transparent resin. Here, the portion where the cavity is formed can be formed into a structure capable of gathering light by being inclined at a certain angle.

<25> The above lead electrodes (12, 13) are formed as thin plates in the cavity and each one is exposed to the outside and the other one is formed by being inserted into the body portion (11).

<26> And the LED chip (14) may be mounted on one of the lead electrodes (12, 13). At that time, each of the positive and negative terminals of the LED chip (14) is selectively connected to one of the lead electrodes (12, 13), and it can operate by connecting to an external circuit through the lead electrode (12, 13). For example, the LED chip (14) is mounted on the first lead electrode (12), and the positive terminal of the LED chip (14) is wire bonded to the first lead electrode (12), and the negative terminal is wire bonded to the second lead electrode (13), thereby allowing connection to an external circuit through the first and second lead electrodes (12, 13).

<27> This LED package may be applied to a backlight unit used as a light-emitting light source of a display device, such as a liquid crystal display.

<28> In particular, backlight units that use light-emitting diodes as light sources are divided into edge-type and direct-type depending on how the light-emitting diodes are arranged. The above edge-type is installed on the side of a light guide plate that guides light, and is applied to relatively small liquid crystal displays such as monitors for laptop computers and desktop computers. It has good light uniformity, long durability, and is advantageous for making the liquid crystal display thinner.

<29> The above direct-type was developed intensively as the size of liquid crystal displays began to increase, and it involves arranging multiple lamps in a row on the lower surface of a diffuser plate to directly illuminate the front of the LCD panel. This direct-type is used primarily in large-screen liquid crystal displays that require high brightness because of the higher efficiency of the use of light compared to the edge-type.

<30> As the size of display devices using backlight units increases, mounting a large number of LED packages on the substrate of such backlight units presents many difficulties in electrical and mechanical configuration.

Technical Challenges the Invention Wants to Overcome

<31> The present invention provides a light source device having a light-emitting diode substrate and a display device using the same.

<32> The present invention provides a light source device that enables substrates having one or more light-emitting diodes mounted thereon to be electrically connected to an external or other substrate via a connection PCB, and a display device using the same.

<33> The present invention provides a light source device in which one or more rows of light-emitting diodes are mounted on a substrate and each LED chip is connected in a closed loop, and a display device using the same.

<34> The present invention provides a light source device having one or more LED bars connected to one or more substrates by a connection PCB arranged on a bottom cover, and a display device using the same.

Composition and Operation of the Invention

<35> A light source device according to an embodiment of the present invention includes: one or more light-emitting diodes; one or more light-emitting diode substrates on which the light-emitting diodes are mounted; first and second connector terminals formed at both ends of the light-emitting diode substrates; and one or more connection PCBs electrically connected to the connector terminals.

<36> A light source device according to an embodiment of the present invention is described with reference to the attached drawings as follows:

<37> FIG. 2 is a side view showing a light source device according to an embodiment of the present invention, and FIG. 3 is a front view of FIG. 2.

<38> Referring to FIGS. 2 and 3, the light source device (100) is an LED bar composed of a single light-emitting diode substrate (101), and can be used as a light source device such as a lighting device or a display device.

<39> The light-emitting diode substrate (101) includes a connector terminal (111, 112), a guide hole (115), a bolt hole (116), and a light-emitting diode (130).

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<40> The above light-emitting diode substrate (101) may be composed of a single-layer or multi-layer substrate, and in the case of a multi-layer substrate, may be composed by laminating multiple copper foil layers on the inside and outside. The light-emitting diode substrate (101) can be used as Resin and Ceramic-based materials such as FR4 or CEM-3 (CEM: Composite Epoxy Materials Grade 3).

<41> On the light-emitting diode substrate (101), first and second connector terminals (111, 112) are formed for connection with another substrate. The first and second connector terminals (111, 112) are formed with the same number of pins on both ends of the light-emitting diode substrate (101), and the number of pins may be changed depending on the number of light-emitting diode chips (131) mounted on the light- emitting diode (130).

<42> And the above guide hole (115) is used to enable the light-emitting diode substrate (101) to be maintained and supported at a predetermined interval on another object (e.g., a heat sink, a bottom cover) when combined with another object, and one or more of them may be formed on the light-emitting diode substrate (101). The guide hole (115) can solve the problem of a specific part of the substrate being bent downward when used with one or more substrates connected together. Additionally, the shape of the guide hole (115) can be formed in various shapes such as circular, oval, etc.

<43> The above bolt hole (116) is intended to allow attachment to another object, and can be fastened to an object such as a bottom cover or a heat sink using a screw, etc.

<44> And on the light-emitting diode substrate (101), a circuit pattern and lead electrode are formed, and the LED chip (131) can be mounted to the lead electrode formed within the region of the light-emitting diode (130) using surface mounting (SMD) technology.

<45> The light-emitting diode (130) is equipped with one or more LED chips. For example, one or more LED chips can be mounted among Red/Green/Blue LED chips to emit light of a desired color (e.g., white), and a mold member is molded on the LED chips. Here, the mold member may be a transparent mold member or a mold member containing a fluorescent substance. And the same colored LED chips mounted on the light-emitting diode substrate (101) can be connected in series.

<46> The above light-emitting diode (130) can be arranged one or more times in one or more rows on the light-emitting diode substrate (101), and when arranged in two or more rows, the light-emitting diode (130) in adjacent rows can be arranged in a zigzag pattern.

<47> Such a light source device (100) can have a connection PCB connected to the connector terminals (111, 112) at both ends of the light-emitting diode substrate (101). Here, the connection PCB is electrically connected to the connector terminals (111, 112) to connect the light-emitting diode substrate (101) to another substrate or to configure a closed loop circuit.

<48> FIG. 4 and FIG. 5 are a side view and a front view of a light source device according to an embodiment of the present invention.

<49> Referring to FIGS. 4 and 5, the light source device (100a) is a single row of LED bars in which n number of light-emitting diode substrates are connected in series, and a number of such single row of LED bars can be used to form two or more rows. The present invention will be described by way of example in a configuration in which three light-emitting diode substrates (101, 102, 103) are connected in series.

<50> The light source device (100a) includes multiple light-emitting diode substrates (101, 102, 103), an intermediate connection PCB (140) as a connection PCB, a terminal connection PCB (145), and an external connection PCB (150).

<51> The above light-emitting diode substrates (101, 102, 103) are manufactured with the same pattern, and the connection PCB (140, 145, 150) is a substrate on which circuit patterns, diodes, etc. predefined for each connector function are formed, and can be mounted on the first or second connector terminal (111, 112) of the light-emitting diode substrates (101, 102, 103). These connection PCBs can enhance the electrical connection and mechanical strength between the light- emitting diode substrates.

<52> When multiple light-emitting diode substrates (101, 102, 103) are arranged in the longitudinal direction, the first connector terminal (111) of the second light-emitting diode substrate (102) corresponds one-to-one to the second connector terminal (112) of the first light-emitting diode substrate (101) on the starting side, and the first connector terminal (111) of the third light-emitting diode substrate (103) on the ending side corresponds one-to-one to the second connector terminal (112) of the second light-emitting diode substrate (102). In this way, multiple light-emitting diode substrates can be arranged in series.

<53> And, an intermediate connection PCB (140) is mounted between the two light-emitting diode substrates (101, 102) (102, 103), a terminal connection PCB (145) is mounted at the end of the third light-emitting diode substrate (103), which is the terminal side substrate of the LED bar, and an external connection PCB (150) is placed at the beginning of the first light-emitting diode substrate (101) on the starting side of the LED bar. Here, an intermediate connection PCB (140) is mounted between the first light-emitting diode substrate (101) and the external connection PCB (150).

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<54> On the back surface of the intermediate connection PCB (140), a third connector terminal (141) is formed, as shown in (a) of FIG. 6. This intermediate connection PCB (140) is mounted on the upper surface of the connecting portion of two adjacent substrates, that is, the portion where the connector terminals correspond, thereby electrically connecting the connector terminals of the two substrates to each other.

<55> The third connector terminal (141) of the intermediate connection PCB (140) electrically connects the connector terminals (111, 151) of the first light-emitting diode substrate (101) and the external connection PCB (150) on the starting side, the connector terminals (111, 112) of the first and second light-emitting diode substrates (101, 102), and the connector terminals (111, 112) of the second and third light-emitting diode substrates (102, 103). Accordingly, the external connection PCB (150) and the first light-emitting diode substrate (101), the first light- emitting diode substrate (101) and the second light- emitting diode substrate (102), and the second light- emitting diode substrate (102) and the third light-emitting diode substrate (111, 112) can be connected in series by the intermediate connection PCB (140).

<56> And, as shown in (b) of FIG. 6, the terminal connection PCB (145) has a fourth connector terminal (146) formed on the back surface and a closed circuit pattern (147, 148, 149) to form a closed circuit with the fourth connector terminal (146). Here, the closed circuit pattern (147, 148, 149) connects identical LED chip terminals (R1, R2) (G1, G2) (B1, B2) in series with each other.

<57> The fourth connector terminal (146) of the terminal connection PCB (145) is mounted on the second connector terminal (112) of the third light-emitting diode substrate (103) on the last terminal side, and the second connector terminal (112) is configured as a closed circuit by the closed circuit pattern (147, 148, 149) of the terminal connection PCB (145). Accordingly, the ends of the light-emitting diode chips of the entire light-emitting diode substrate (101, 102, 103) can be configured as a closed circuit. Here, by using a connection PCB with a closed circuit to configure the termination of the light-emitting diode substrate into the closed circuit, it is not necessary to make a separate light-emitting diode substrate with a closed circuit pattern at the termination.

<58> In addition, On one side of the external connection PCB (150), a fifth connector terminal (151) corresponding to the first connector terminal (111) of the first light-emitting diode substrate (101) is formed, and a connector (152) connected to the external driver is formed on the other side. Such an external connection PCB (150) may be configured with a flexible substrate.

<59> The above external connection PCB (150) is placed on one side of the first light-emitting diode substrate (101) that can be connected to the driver for driving the light- emitting diode at the shortest distance. In addition, the fifth connector terminal (151) of the external connection PCB (150) and the first connector terminal (111) of the first light-emitting diode substrate (101) are connected in a one-to-one correspondence by mounting the third connector terminal (141) of the intermediate connection PCB (140).

<60> On the other hand, the process for mounting other connection PCBs on the light-emitting diode substrate is as follows. A cream solder is applied to each connector terminal (111, 112, 151) after several light-emitting diode substrates (101, 102, 103) and an external connection PCB (150) are placed in series.

<61> The intermediate connection PCB (140) and terminal connection PCB (145) are mounted on the connector terminals (111, 112, 151). In other words, the connection PCBs are attached using surface mounting technology (SMT).

<62> As the reflow soldering process is performed on these light-emitting diode substrates (101, 102, 103), a plurality of light-emitting diode substrates (101, 102, 103) and connection PCBs (140, 145, 150) can be electrically and mechanically connected to each other.

<63> FIG. 7 is a cross-sectional view of a light-emitting diode substrate according to an embodiment of the present invention.

<64> Referring to FIG. 7, the light-emitting diode substrate is a multilayer substrate (101a, 101b, 101c), and may include a multi-copper foil layer (122, 123, 125, 126) underneath a lead electrode (121) therein, and an LED chip (131) may be mounted on the lead electrode (121), and the first copper foil layer (122) primarily conducts heat generated from the LED chip, and the second and third copper foil layers (123, 125) are connected to a via hole (124), so that heat conducted from the first copper foil layer (122) is conducted to the second copper foil layer (123), and heat is dissipated from the second copper foil layer (123) through the via hole (124) to the third copper foil layer (125). This light-emitting diode substrate (101) will improve the heat dissipation properties of the light-emitting diode substrate by means of the above-mentioned multi-copper foil layer.

<65> In addition, a silver plating layer (not shown) is formed as a bottom layer on the bottom surface of the light-emitting diode substrate (101). By forming this silver plating layer on the bottom layer, it can reduce thermal resistance and improve heat conduction at the bottom of the substrate.

<66> FIG. 8 is a diagram detailing a circuit pattern of a light- emitting diode substrate according to an embodiment of the present invention.

<67> Referring to FIG. 8, a predetermined circuit pattern (105) is formed on the substrate, and multiple lead electrodes (121) are formed in the area where the LED chips (131a, 131b, 131c) will be mounted. These circuit patterns (105) and lead

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electrodes (121) are connected by plating lines (107) to form a closed plating line circuit, and at this time, power is supplied to the plating power lines (161, 162) to form a plating layer using electrolytic plating. At this time, a silver plating or gold plating layer are formed on the circuit pattern and lead electrode by the electrolytic plating method.

<68> Thereafter, one or more drilling points (106) are formed in each plating line (107). The drilling point (106) opens the closed circuit of the plating line by a drilling process. And the drilling point (106) of the above plating line plays a role in dispersing heat generated from the light-emitting diode substrate since a hole is created by drilling.

<69> Additionally, a test pad terminal (108) is formed in the circuit pattern of the light-emitting diode substrate of the present invention to test each individual light-emitting diode or light-emitting diode chip. Through these test pad terminals (108), individual light- emitting diodes or light-emitting diode chips are individually tested.

<70> In addition, the present invention improves reflection efficiency by forming a silver plating layer on a lead electrode formed in an internal area of a light-emitting diode and treating an area (136) other than the lead electrode (135) with white ink. That is, by coating the area other than the lead electrode inside the light-emitting diode with white ink, it is possible to reflect light generated by the light-emitting diode chip to increase reflection efficiency. The partition wall (137) outside of the light-emitting diode maintains the molding shape when molded into the molding member and prevents the molding member from overflowing outward.

<71> Here, the present invention is illustrated as a structure in which a light-emitting diode chip is mounted using a wire bonding structure, but it may also be mounted using other methods (e.g., flip chip).

<72> FIG. 9 is a diagram illustrating a light source device according to the present invention.

<73> Referring to FIG. 9, multiple light-emitting diode substrates (101, 102, 103) are connected in series. One-to-one connection between each light-emitting diode substrate (101,102, 103) is made by an intermediate connection PCB (140), and on one side, an external connection PCB (150) is connected by an intermediate connection PCB (140) to the light-emitting diode substrate (101), while on the other side, a terminal connection PCB (145) can configure the connector terminals into closed circuits.

<74> By arranging the LED bar, to which a plurality of light-emitting diode substrates (101, 102, 103) are connected, in parallel on the base (201) of the bottom cover (200), it can be used as a light source device for a lighting or display device.

<75> And a guide pin is inserted into a guide hole (115) formed in the light-emitting diode substrate (101, 102, 103) so that a certain distance can be maintained from the base (201), and is fixed to the bottom cover (200) by a bolt hole (116).

<76> The present invention may also be utilized as a light source for a backlight unit or/and front light unit of a liquid crystal display device using a light source device as described above.

<77> Although the present invention has been described above with reference to embodiments, these are merely examples and do not limit the present invention. Those skilled in the art will appreciate that various modifications and applications not exemplified above are possible without departing from the essential characteristics of the present invention.

<78> For example, each component specifically shown in the embodiments of the present invention can be modified and implemented. And the differences related to these modifications and applications should be construed as being included within the scope of the present invention as defined in the appended claims.

[Effect of the Invention]

<79> According to the light source device according to the present invention and the display device using the same, there is an effect that it is not necessary to manufacture a different type of light-emitting diode substrate by connecting one type of light-emitting diode substrate to an intermediate connection and a terminal closed loop circuit using a connection PCB.

<80> In addition, reliability can be improved by electrically connecting and mechanically supporting the light-emitting diode substrate using a connection PCB.

<81> In addition, by having several heat dissipation elements in the light-emitting diode substrate, heat dissipation issues in the light-emitting diode substrate can be resolved.

[Brief Description of Figures]

<1> FIG. 1 is a cross-sectional view showing a conventional light-emitting diode package.

<2> FIG 2 is a side cross-sectional view of a light source device according to an embodiment of the present invention.

<3> FIG. 3 is a front view of FIG. 2.

<4> FIG. 4 is a side cross-sectional view of a light source device according to embodiments of the present invention.

<5> FIG. 5 is a front view of FIG. 4 of the present invention.

<6> FIG 6 (a) is a diagram illustrating an intermediate connection PCB according to the present invention, and (b) is a diagram illustrating an terminal connection PCB.

<7> FIG. 7 is a detailed cross-sectional view of a light- emitting diode substrate according to an embodiment of the present invention.

<8> FIG. 8 is a schematic diagram illustrating a detailed circuit pattern of a light-emitting diode substrate according to an embodiment of the present invention.

<9> FIG. 9 is a front view of a light source device applied to a bottom cover in accordance with an embodiment of the present invention.

<10> <Description of Symbols for the Main Parts of the Drawing>

<11> 100, 100a : Light source device — 101, 102, 103: Light-emitting diode substrate

<12> 111, 112, 141, 146, 151: Connector terminal — 130: Light-emitting diode

<13> 131: LED chip — 140: Intermediate connection PCB

<14> 145: Terminal connection PCB — 150: External connection PCB

<15> 152: Connector — 200: Bottom cover

[Figure]

Figure 1

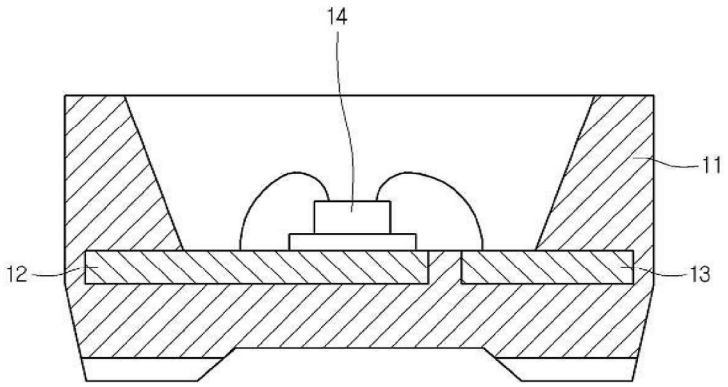

Figure 2

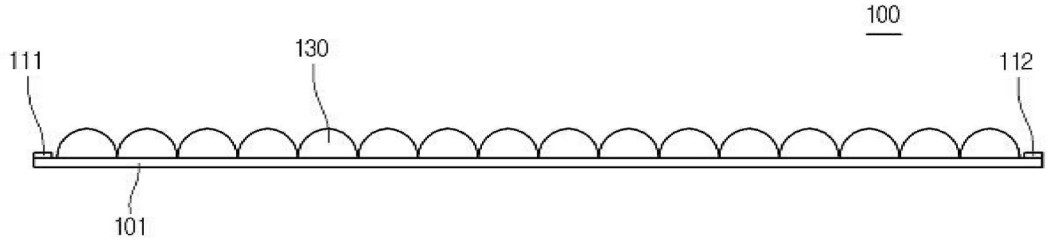

Figure 3

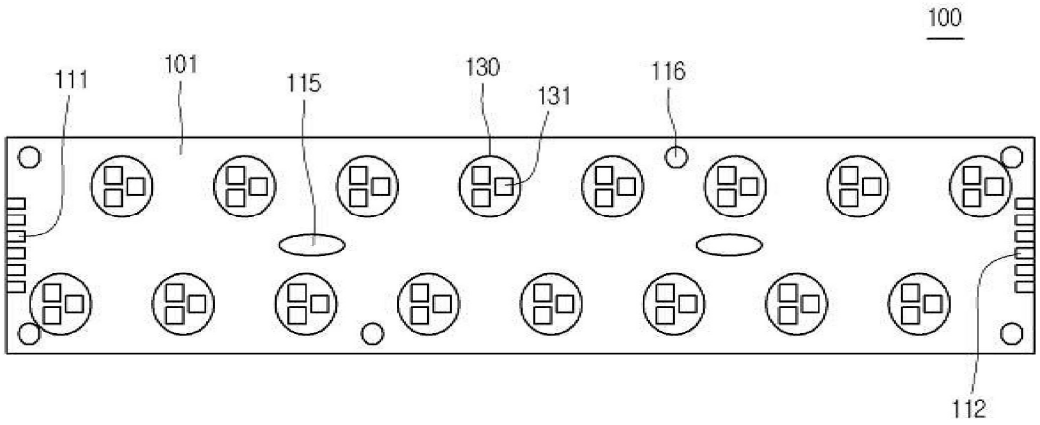

Figure 4

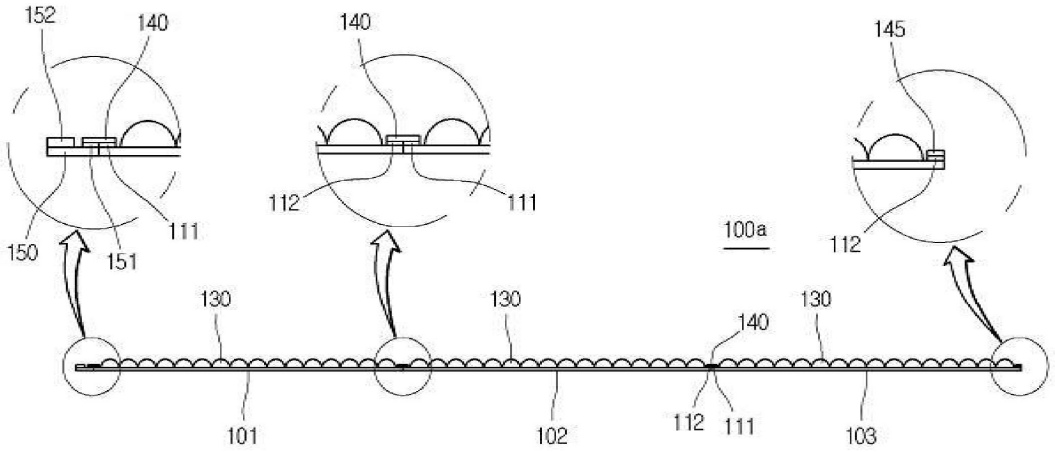

Figure 5

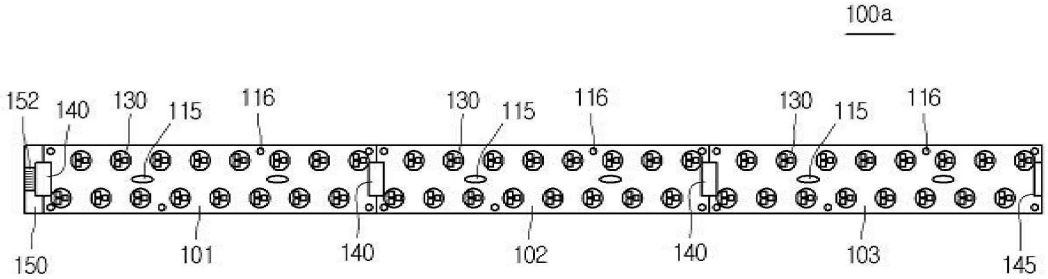

Figure 6

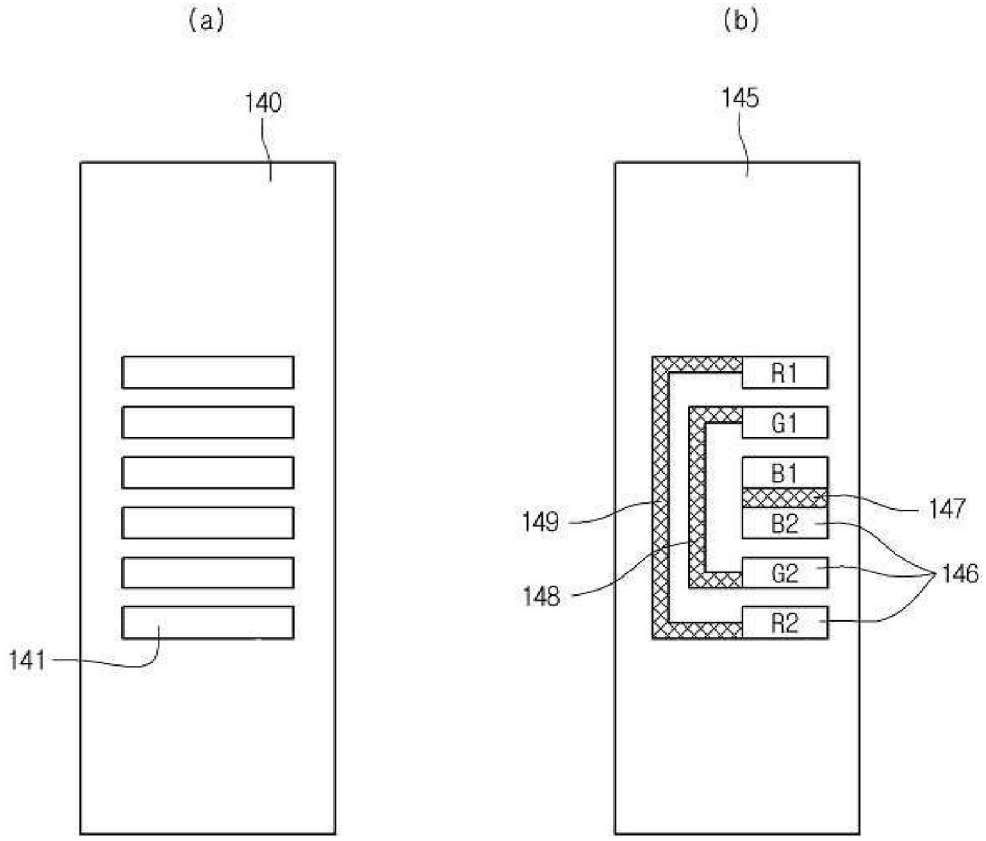

Figure 7

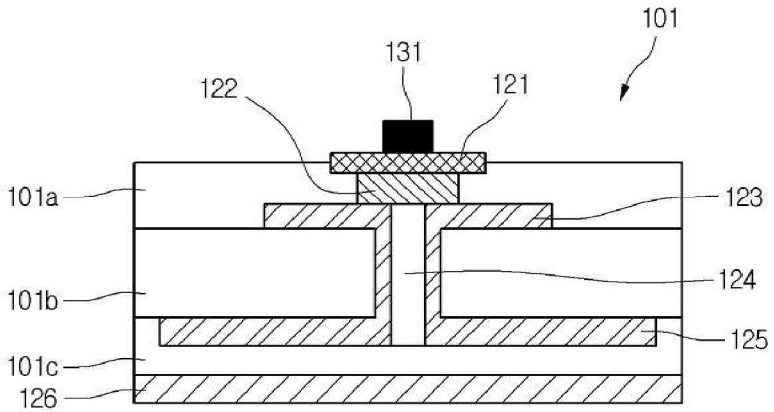

Figure 8

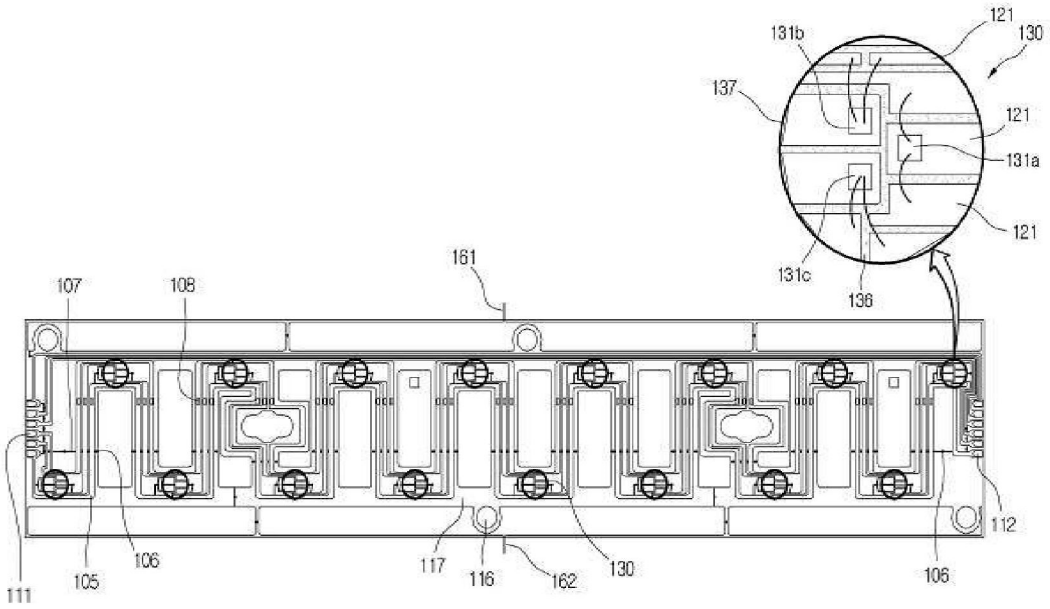

Figure 9