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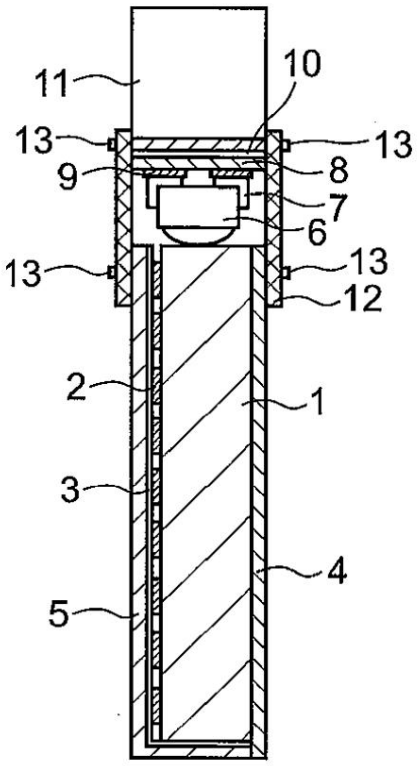
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(57) [Abstract]

[Problem] To obtain a surface lighting device in which chip-type LEDs are mounted at a high density and which has a high ratio of light source luminous flux to a given light source installation space.

[Solution] In a surface illumination device comprising a light guide plate 1 made of a translucent material through which light propagates, and a light source unit disposed at any position in the light propagation direction of the light guide plate, the light source unit is mounted on a metal substrate 8 having a plurality of chip-shaped LEDs 6 whose light propagation direction is perpendicular to the electrode mounting surface, and an electrode pattern 9 that supplies power to the LEDs.



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1

[Claims] [Claim 1] A surface illumination device comprising a light guide plate made of a light-transmitting member through which light propagates, and a light source unit arranged at any position in the light propagation direction of the light guide plate, wherein the light source unit comprises a plurality of chip-shaped LEDs mounted on a metal substrate so that the light emission direction is perpendicular to an electrode attachment surface, and the metal substrate has an electrode pattern for supplying power to the LEDs. [Claim 2] A surface illumination device comprising a light guide plate made of a light-transmitting member through which light propagates, and a light source unit arranged at any position in the light propagation direction of the light guide plate, wherein the light source unit comprises a plurality of chip-shaped LEDs mounted on a metal substrate so that the light emission direction is parallel to an electrode attachment surface, and the metal substrate has an electrode pattern for supplying power to the LEDs.

[Claim 3] A surface illumination device comprising: a light guide plate made of a light-transmitting member through which light propagates, a light source unit including a plurality of chip-shaped LEDs and disposed at an arbitrary position in the light propagation direction of the light guide plate, and a metal case covering the light guide plate and the light source except for at least the light-emitting surface side of the light guide plate, the light source unit being mounted on an electrode pattern formed on an end face of the metal case facing the light-receiving end face of the light guide plate or on an inner side of the metal case positioned perpendicular to the light-receiving end face of the light guide plate. [Claim 4] The surface illumination device according to any one of claims 1 to 3, characterized in that the light guide plate is provided with a diffusion pattern for diffusing light on a surface opposite to the light-emitting surface.

[Claim 5] The surface lighting device according to any one of claims 1 to 4, characterized in that a plurality of heat dissipation fins are attached to the rear surface of the metal substrate. [Claim 6] The surface lighting device according to any one of claims 5, characterized in that the metal substrate and the heat dissipation fins are integrally formed. [Claim 7] The surface lighting device according to any one of claims 1 to 6, characterized in that the arbitrary position in the light propagation direction is one end surface of the light guide plate. [Claim 8] The surface lighting device according to any one of claims 1 to 7, characterized in that a light reflecting member is formed so as to surround the surface of the light guide plate excluding the light incident end surface and the light emitting surface.

[Claim 9] A surface lighting device as described in claim 5 or claim 6, characterized in that the surface of the lighting device storage section, which stores the lighting device and has at least an outer casing made of metal, is joined to or integrally formed with some or all of the multiple heat dissipation fins.

[Claim 10] A large-sized surface lighting device, characterized in that a plurality of surface lighting devices according to any one of claims 1 to 9 are connected as a lighting device module. [Description of the Invention]

[0001] [Technical Field to which the Invention Pertains] The present invention relates to a display lighting device, a space lighting device, and the like.

2

The present invention relates to a surface lighting device for use in a vehicle, for example, as an emergency exit lighting device, an emergency exit lighting device, an advertising light, a backlight for a liquid crystal display, or a general lighting device .

As a means for realizing light guide plate illumination using LEDs, for example, there is a method described in a surface emission display device of Japanese Patent Laid-Open Publication No. 8-160892 shown in Figures 26 and 27. According to the above document, the above display device uses a bullet-type LED molded with a resin lens and having a long lead electrode 28, and is realized by providing a dot pattern luminous layer 23 on the surface of a light guide plate 1 made of a light-transmitting plate such as acrylic resin, which has a higher ratio of light emitted to the outside as it is farther from an LED 25 arranged on one side of the light guide plate 1, and once the light from the LED 25 is uniformly diffused and emitted over the entire surface of the display section A of the light guide plate 1, unnecessary light is returned into the light guide plate 1 according to the pattern of characters and designs drawn on the pattern film on the luminous layer 23, thereby making the necessary characters and designs stand out on the surface. In addition, 21 is an LED fixing holder, 22 is a pattern filter, 24 is a dot portion, 26 is an LED board, and 27 is a frame.

Further effects of the above-mentioned device include the ability to reduce the overall thickness of the display device, the ability to reduce running costs, and the ability to reduce the trouble of maintenance due to the expiration of the lamp life.

[0005] [Problems to be Solved by the Invention] However, in this device, the lens diameter of the current bullet-type LED is large, and there is a limit to how many can be arranged in an array, so the luminous flux obtained for a certain light source installation space is not necessarily large enough for surface illumination. Also, since the lead electrode 28 of the bullet-type LED is mounted on the LED substrate 26, the spatial distance to the apex of the bullet-type LED 25 is large, and there is a drawback in that the device light source unit lacks compactness.

The present invention has been made to solve the above problems, and has as its object to provide a surface lighting device that can mount chip-type LEDs at a high density as necessary and has a high ratio of light source luminous flux to a given light source installation space.

[0007] Another object of the present invention is to provide a surface illumination device that efficiently dissipates heat generated by lighting chip LEDs to the outside of the device without forced cooling means, prevents a decrease in LED luminous efficiency by suppressing temperature rises in the elements and their surroundings, and realizes long-life illumination, which is an inherent advantage of LEDs.

[Means for solving the problems] The surface illumination device of the present invention is made of a light-transmitting member, a light guide plate through which light propagates, and a light guide plate for detecting light at any position in the light propagation direction of the light guide plate.

BOE - Exhibit 1019 - Page 2

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In the surface lighting device, the light source unit is mounted on a metal substrate with a plurality of chip-shaped LEDs whose light emission direction is perpendicular to the electrode mounting surface, and the metal substrate has an electrode pattern for supplying power to the LEDs.

[0009] In addition, in a surface illumination device comprising a light guide plate made of a translucent member through which light propagates, and a light source section disposed at any position in the light propagation direction of the light guide plate, the light source section comprises a plurality of chip-shaped LEDs mounted on a metal substrate so that the light-emitting direction is parallel to the electrode mounting surface, and the metal substrate has an electrode pattern for supplying power to the LEDs. [0010] The device also includes a light guide plate made of a light-transmitting member through which light propagates, a light source unit including a plurality of chip-shaped LEDs and arranged at any position in the light propagation direction of the light guide plate, and a metal case covering the light guide plate and the light source except for at least the light-emitting surface side of the light guide plate, and the light source unit is mounted on an electrode pattern formed on the end face of the metal case facing the light-receiving end face of the light guide plate, or on the inside of the metal case positioned perpendicular to the light-receiving end face of the light guide plate.

[0011] The light guide plate also diffuses light to the surface opposite to the light emitting surface. The metal substrate is provided with a diffusion pattern that disperses heat. A plurality of heat dissipation fins are attached to the rear surface of the metal substrate. The metal substrate and the heat dissipation fins are integrally formed. This was accomplished.

[0014] Also, the arbitrary position in the light propagation direction is one end face of the light guide plate.

[0015] Also, a light reflecting member is formed to surround the light guide plate's surface excluding the light-receiving end face and the light-emitting surface. [0016] Also, the surface lighting device is stored in a lighting device storage section, at least the outer casing of which is made of metal, and the surface of the lighting device storage section is joined to or integral with some or all of the multiple heat dissipation fins. [0017] Also, a plurality of surface lighting devices are connected to form a lighting device module.

[0018] The embodiment of the present invention will be described with reference to the drawings. First embodiment Fig. 1 is a cross-sectional view showing the configuration of a surface illumination device according to a first embodiment of the present invention, and Fig. 2 is a front view. This surface illumination device has a high light transmittance and is made up of a light guide plate 1 for realizing surface illumination, a light guide plate case 5 for housing the light guide plate 1, a surface cover 4 attached to the light emitting surface of the light guide plate 1, and a light source unit disposed on one end surface of the light guide plate 1.

A light guide plate (5 mm thick, 8 mm wide, 210 mm long) 1 is provided with a diffusion pattern 2 for changing the refraction state of light based on Snell's law of reflection and for surface emission.

In this embodiment, the diffusion pattern 2 is formed by silk printing a highly reflective white paint in a dot shape so that the spatial density decreases as it moves away from the light source, i.e. the area of the painted part increases. The light that passes through the light guide plate 1 and is diffused by the diffusion pattern 2 is output uniformly from the light emitting surface. This diffusion pattern 2 can be realized by directly processing the light guide plate 1 into a concave-convex shape or by sandblasting, in addition to silk printing, and the same results can be obtained. This light guide plate 1 is placed in a light guide plate case 5 made of resin and having a thickness of 2 mm, and a white reflection sheet 3 having a high reflectivity and a thickness of about 0.1 mm is installed between the case and the light guide plate 1 so as to surround the surface except the light-entering end surface and the light-emitting surface in order to increase the lighting efficiency. In this embodiment, the display cover 4 is a 2 mm thick milky white acrylic plate, but if this surface lighting device is used as an advertising lamp or an indicator lamp, a pattern may be printed on this surface.

[0021] Compared to the conventional example shown in Fig. 26, which uses a bullet-shaped LED with a certain luminous flux, the chip-shaped LED 6 has a rectangular shape on the top and a small light source width, but has the same luminous flux as the bullet-shaped LED, and is configured to increase the mounting density on the board and increase the ratio of luminous flux to the mounting board area ratio. However, as mentioned above, the lead electrode 7 of the chip-shaped LED element is short, so it has the disadvantage of poor heat dissipation, especially in a narrow mounting space. Therefore, although the element life is considerably longer than that of general fluorescent lamps, if this chip-shaped LED is mounted at a high density without taking measures to dissipate heat, the ambient temperature and element temperature will rise, causing a decrease in life characteristics and luminous efficiency. (An example is shown in Fig. 27. In the vicinity of the LED semiconductor element PN junction and element side lead electrode, there is a temperature rise of about 10 to 15°C in addition to the ambient temperature in the figure). [0022] Therefore, in the light source part of this embodiment, a metal substrate 8 made of aluminum with high thermal conductivity is used as the LED light source mounting substrate, and a heat dissipation fin 11 (fin width 1mm, pitch 6mm, substrate dimensions 12mm x 200mm x thickness 1.5mm) is attached to the back surface to enhance the heat dissipation effect. A thin layer of thermal conductive grease 10 (thermal conductivity 0.09W/mK) is applied between the metal substrate 8 and the heat dissipation fin 11 to eliminate the air gap and increase the thermal conductivity .

[0023] The orientation of the multiple fins does not need to follow this example, and they can be shaped in a direction and shape that enhances the heat dissipation characteristics according to the style of use of the device. Also, the thermal conductive grease 10 can be, for example, a thermal conductive sheet, and the heat dissipation fins 11 do not need to use any intermediate material if there is almost no air space.

[0024] As shown in Fig. 1, in order to increase the efficiency of light entering the light guide plate 1, the side of the light source portion is covered with a reflector 12 with a white inner surface and fixed with a set screw 13. As a structure having the same performance, for example, the structure shown in Fig. 3 may be used.

BOE - Exhibit 1019 - Page 3

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The length of the light source is set to surround the display cover, and the reflective sheet 3 on the diffusion pattern 2 side is adjusted to the length of the reflective sheet 3. A reflective sheet 3 is also added to the light source side on the back side of the display cover. This structure does not require the preparation of a separate reflector 12, and simplifies the manufacturing process in addition to reducing the number of parts. The light source in Fig. 1 is a vertical LED chip (Nichia Chemical NSSW440, 2mm x 4mm x 3.15mm high) whose light emission direction is perpendicular to the electrode mounting surface. The light source mounting board is shown in Figs. 4 and 5, and is a metal board 8 (board dimensions 200mm x 8mm x 1.5mm thick) on which a copper foil electrode pattern 9 is printed, and the part other than the electrode pattern 9 is insulated. The electrode pattern 9 is made slightly thicker on the cathode side than on the anode side because the LED element generates more heat on the cathode side than on the anode side, and 74 chip-shaped LEDs 6 are mounted on it at intervals of 0.7mm. In this case, for example, 54 3ÿ bullet-type LEDs (Nichia Chemical NSPW300) having the same luminous flux, such as LED 25 in Fig. 26, can be mounted at most, and the luminous flux ratio when using chip-type LEDs can be approximately 1.37 times with the same light source mounting area. Note that in this embodiment, in order to increase the light incidence efficiency, the lens surface of the chip-type LED 6 is in contact with the light incidence end face of the light guide plate 1, but the lens surface is disposed with a space between it and the light incidence end face of the light guide plate 1, that is, the light propagation direction of the light guide plate 1 is 1.37 times that of the chip-type LED 6.

ÿ The position may be any position.

[0026] Here, the chip LED 6 may be mounted in a manner as shown in Fig. 6, for example. By connecting several LEDs in series (total resistance R), serially connecting a chip resistor 14 larger than R to the LEDs, and then connecting the resistors in parallel, the current flowing through each LED can be made almost constant regardless of the variation in the resistance of each chip LED 6. [0027] Next, the results of measuring the temperature distribution on the rear surface of the metal substrate 8 as one method of evaluating the heat dissipation of this embodiment are shown. The light source was turned on at rated power (each element was driven by 3.5V 20mA DC, voltage was applied to the electrode patterns 9a and 9b in Fig. 5), and in order to confirm the effect of the absence of fins, measurements were taken not only on the metal substrate 8 but also on a glass epoxy substrate (substrate thickness 1.6mm) of similar dimensions that is used as a general-purpose substrate for mounting electronic components (see Fig. 8 for the measurement points). The structure of the device without fins is shown in Fig. 7, and the results are shown in Table 1. In the table, A to C are the temperatures at the points shown in Figure 8. As can be seen from the table, in the case of the aluminum board, the peripheral temperature is higher than in the glass epoxy board, but the temperature distribution is uniform overall, and in particular, there is a difference of about 17°C in the center of the board, demonstrating the great effect of reducing temperatures. Table 1. Metal board back side temperature measurement results

測定種類	基板裏側位置			周囲温度
	A基板端部	B	C基板中央	
アルミ基板	57.5	66.5	66	27.2
ガラスエポキシ基板	53.8	72.8	83.5	27.2
放熱フィン装着	41.7	---	42.8	27.2

Next, we will discuss the actual measurement results when the heat dissipation fins 11 are attached. The test results in this case are also shown in Table 1. By attaching the heat dissipation fins 11, the temperature on the back side of the board was reduced by about 20 to 25°C. At this time, the temperature at the tip of the central fin was 41.5°C, and the temperature at the base of the fin was 41.7°C, so the temperature was uniform over the entire fin.

[0030] As described above, by adopting this embodiment, it is possible to obtain a heat dissipation effect without using a forced cooling device, and it is possible to realize a large luminous flux surface lighting that takes advantage of the long life characteristics. According to this embodiment, for example, it is possible to use it by embedding it in the ceiling indoors or directly attaching it to the wall surface.

[0031] Embodiment 2 Fig. 9 is a cross-sectional view showing the configuration of a surface illumination device according to embodiment 2 of the present invention, and Fig. 10 is a front view. This surface illumination device has a high light transmittance and is made up of a light guide plate 1 for realizing surface light emission, a light guide plate case 5 for storing the light guide plate 1, and a surface cover attached to the light emitting surface.

The light guide plate 1 is composed of a light source 4 and a light source section 6 arranged on one end surface of the light guide plate 1. The light guide plate 1 has a diffusion pattern 2 similar to that of the first embodiment. The light source of the light source section uses parallel LED chips whose light emission direction is parallel to the electrode mounting surface, and is structured in such a way that a plurality of LED chips are arranged on an electrode pattern 9 on a metal (aluminum) substrate 8 as in the first embodiment. An aluminum heat dissipation fin 11 is attached to the back surface of the metal substrate 8 so that there is no air gap. At this time, a thermally conductive material may be interposed between the metal substrate 8 and the heat dissipation fin 11 as in the first embodiment. Figure 9 assumes that the light source is actually used facing upward as shown in the figure, and the fin shape is processed to have an oblique lower part.

By adopting such a structure, the metal base The plate 8 can be arranged in the light guide plate case 5, and the thickness of the light guide plate 1 can be reduced to about the height of the LED element.

BOE - Exhibit 1019 - Page 4

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Therefore, it is possible to obtain a thin surface illumination device that has the heat dissipation characteristics as in the first embodiment and realizes illumination with a large luminous flux and a long life.

[0035] In this embodiment, the device can be used, for example, embedded in a ceiling, directly attached, or embedded in a wall. Furthermore, if the light guide plate 1 is configured so that the diffusion pattern 2 surface faces the heat dissipation fin 11 as shown in Fig. 11, the fin side can be used as the light emitting surface, and the smooth back surface of the device can be directly attached (for example, pasted) to the wall. In this case, the device can be made very thin as mentioned above, which contributes to saving the space required for installation.
do.

[0036] Embodiment 3: Fig. 12 is an explanatory diagram showing the light source section in a surface illumination device according to embodiment 3 of the present invention. Fig. 12 shows, for example, the metal substrate 8 and heat dissipation fins 11 in the light source section of the surface illumination device of embodiment 1, which are integrally processed using the same material. An electrode pattern 9 is provided on one side of the same substrate, and a chip LED 6 is mounted, with the heat dissipation fins 11 directly provided on the back surface. Fig. 12 shows an example of the device structure when this type of light source section is applied to embodiments 1 and 2.
13 and 14.

[0037] By adopting such a structure, the number of parts constituting the light source section can be reduced, and the device assembly can be simplified. Furthermore, since there is no air layer or a material layer with a lower conductivity than metal between the metal substrate 8 and the heat dissipation fins 11 as in the first embodiment, a high heat dissipation effect can be achieved.
[0038] Embodiment 4. Fig. 15 is a cross-sectional

view showing the structure of a surface lighting device according to the fourth embodiment of the present invention, and Fig. 16 is a cross-sectional view taken along the broken line A-B in Fig. 15. In the surface lighting devices of the first to third embodiments, the lighting device storage section 17 for storing the lighting device is made of a metal material, and one side end surface of some or all of the heat dissipation fins 11 of the light source section is configured to contact the surface of the lighting device storage section 17.

[0039] This allows the heat transmitted through the fins to be transmitted to a metal plate with a large area, and the heat dissipation effect can be further improved. In this case, the surfaces of the heat dissipation fins 11 and the lighting device storage section 17 may be subjected to anodizing treatment or the like. This allows heat to be transferred by radiation to the lighting device storage section 17, which results in a further improvement in the heat dissipation effect around the light source element. [0040] Also, the heat dissipation fins 11 may be integrated

with the surface metal plate of the storage case as shown in Figure 16. Figures 17 and 18 show other application examples of this embodiment. Figure 17 shows a case where it is used by directly attaching it to a ceiling 18, and Figure 18 shows a case where it is used by directly attaching it to a wall surface 28. [0041] Embodiment 5 Figure 19 is a

cross-sectional view showing the configuration of a surface lighting device according to embodiment 5 of the present invention, and Figure 20 shows the configuration of a light guide plate case in the surface lighting device of Figure 19.

This surface lighting device shown in the development diagram is composed of a light guide plate 1 having a large light transmittance and realizing surface light emission, a light guide plate case 5 which is a metal case that houses the light guide plate 1, a surface cover 4 attached to the light emitting surface, and a vertical LED light source whose light emission direction is perpendicular to the electrode attachment surface. The light guide plate 1 has the same diffusion pattern 2 as in the first embodiment. The light guide plate case 5 in FIG. 19 uses a metal material such as aluminum, and as shown in the figure, all sides and the back except for the light emitting surface part of the light guide plate 1 are integrally formed with the same material. An example of the development diagram of the light guide plate case 5 is shown in FIG. 20. As shown in the figure, the light guide plate case 5 has an electrode pattern 9 by a method such as printing on the back side at a position that allows light from the LED light source to enter the light guide plate 1, and the LED light source is mounted on top of this. The light guide plate case 5 is formed into a shape as shown in FIG. 20, for example, by bending a metal plate on which an electrode pattern 9 has been formed.

[0043] With this structure, the number of parts can be significantly reduced and the manufacturing process can be simplified, and the metallic light guide plate case 5 itself acts as a large heat sink that conducts the heat generated by the LEDs and releases it to the outside, providing good heat dissipation characteristics without providing protrusions such as fins on the surface of the device. Of course, if a heat dissipation structure such as fins is provided on the back surface of the light guide plate case 5 corresponding to the position of the electrode pattern 9, it is possible to improve the heat dissipation characteristics.

[0044] Figure 21 shows an example of using a parallel LED light source whose light emission direction is parallel to the electrode mounting surface. This configuration makes it possible to obtain a large luminous flux, long life surface lighting device that is particularly thin and has good heat dissipation effect. In addition, as another example of this embodiment, as shown in Figures 22 and 23, the back side of the light guide plate case 5 is painted white and the side of the light emitting surface side light emitting part is also made of the same case, so that there is no need to provide a reflective sheet 3 around the light source part and the number of components can be reduced.

[0045] Embodiment 6. Fig. 24(a) is a front view showing the configuration of a surface lighting device according to embodiment 6 of the present invention, and Fig. 24(b) is a side view thereof. Fig. 25(a) is a front view showing another example of the configuration of a surface lighting device according to embodiment 6 of the present invention, and Fig. 25(b) is a side view thereof. A large surface lighting device can be realized by providing a multiple connection structure and connecting each device described in embodiments 1 to 5 as a module. Fig. 24 shows an example in which the surface lighting device 19 described in embodiment 5 is used as a module, and Fig. 25 shows an example in which four surface lighting devices 21 of embodiments 1 to 4 are combined as modules so that the light source parts are located on the left and right. The direction of the heat dissipation fins 11 in Fig. 25 is such that the fins are cut in the vertical direction in order to improve heat dissipation characteristics.

By configuring a large surface lighting device as described above, when a large surface lighting is required, it is possible to easily connect the surface lighting devices and realize it without having to manufacture a large device consisting of one module, which is not easy to manufacture. Furthermore, by using such a device, good heat dissipation efficiency can be achieved.

BOE - Exhibit 1019 - Page 5

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It is possible to obtain a thin, long-life, large-area, high-luminous-flux surface lighting device that has the effect of

realizing the above-mentioned effects. [0047] In this case, the surface cover 4 does not need to be the same size as the light-emitting surface of the module and attached to each module, but may be constructed of a single large display cover 20 having a light-emitting surface equivalent to that of four modules. In particular, when pattern information or pictures are printed on the surface of the surface cover 4 and the entire device is used as a display lighting device, the information patterns can be used as a single unit without being divided and processed, so that large display lighting can be easily realized.

[Effects of the

Invention] As described above, according to the present invention, the surface lighting device of the present invention is a surface lighting device comprising a light-transmitting member, a light guide plate through which light propagates, and a light source unit arranged at any position in the light propagation direction of the light guide plate, in which the light source unit comprises a plurality of chip-shaped LEDs mounted on a metal substrate so that the light emitting direction is perpendicular to the electrode mounting surface, and the metal substrate has an electrode pattern for supplying power to the LEDs, thereby ensuring a certain level of heat dissipation characteristics, and by high-density mounting of the LEDs, even in a limited space for installing the light source, a surface lighting device with high light emitting efficiency for that space can be obtained.

[0049] In addition, in a surface lighting device comprising a light guide plate made of a translucent material through which light propagates, and a light source section arranged at any position in the light propagation direction of the light guide plate, the light source section comprises a plurality of chip-shaped LEDs mounted on a metal substrate so that the light emission direction is parallel to the electrode mounting surface, and this metal substrate has an electrode pattern for supplying power to the LEDs, thereby ensuring a certain level of heat dissipation characteristics and enabling the thickness of the light guide plate to be reduced to approximately the height of the LED elements, thereby realizing a thin lighting device that contributes to space saving, while at the same time achieving a surface lighting device with high light emission efficiency for a limited light source installation space by high density mounting of the LEDs.

[0050] The device further comprises a light guide plate made of a light-transmitting member through which light propagates, a light source section including a plurality of chip-shaped LEDs and arranged at any position in the light propagation direction of the light guide plate, and a metal case covering the light guide plate and the light source except for at least the light-emitting surface side of the light guide plate, and the light source section is mounted on an electrode pattern formed on the end face of the metal case facing the light-receiving end face of the light guide plate or on the inside of the metal case positioned perpendicular to the light-receiving end face of the light guide plate, thereby realizing a thin lighting that contributes to space saving in use, and by high-density mounting of LEDs even in a limited light source installation space, a surface lighting device with high light-emitting efficiency for that space can be obtained, the number of parts can be significantly reduced, and the manufacturing process can be simplified. The metal case itself acts as a large heat sink that conducts heat generated by the LEDs and releases it to the outside, and good heat dissipation characteristics can be provided without providing protrusions such as fins on the surface of the device.

[0051] Furthermore, the light guide plate is provided with a diffusion pattern for diffusing light on the surface opposite to the light emitting surface, so that the light from the LED can be once uniformly diffused and radiated over the entire display area of the light guide plate.

[0052] In addition, by attaching multiple heat dissipation fins to the back surface of the metal substrate, heat dissipation characteristics can be improved without using a forced cooling device, and increases in the LED element and ambient temperature can be suppressed, making it possible to realize long-life lighting that takes advantage of the characteristics of the LED.

[0053] Furthermore, by constructing the metal substrate and the heat dissipation fins as one unit, the number of parts constituting the light source section can be reduced, and the device assembly can be simplified. Furthermore, since there is no air layer or a material layer with a lower conductivity than metal between the metal substrate and the heat dissipation fins, a high heat dissipation effect can be achieved. [0054] Furthermore, since an arbitrary position in the

light propagation direction is one end face of the light guide plate, the efficiency of light entering the light guide plate from the LED can be increased. [0055] Furthermore, by forming a light reflecting member to

surround the light guide plate's light entrance end face and the surface other than the light emitting surface, the lighting efficiency of the surface lighting device can be improved.

[0056] Furthermore, the surface of the lighting device storage section, which stores the lighting device and has at least an outer casing made of metal, is joined to or integral with some or all of the multiple heat dissipation fins, so that the heat transmitted through the heat dissipation fins can be dissipated to the large-area metal plate, further enhancing the heat dissipation effect of the heat generated around the element.

[0057] Furthermore, by connecting a plurality of surface lighting devices as a lighting device module, it is not necessary to manufacture a large device consisting of one module, which is difficult to manufacture, and a large surface lighting device can be easily realized by connecting the surface lighting devices. Furthermore, by using a lighting device having the above-mentioned performance, a thin, long-life, large-area, high-luminous flux surface lighting device with good heat dissipation effect can be obtained. Furthermore, when pattern information or pictures are printed on the surface and the entire device is used as a display lighting device, the information patterns can be used as a single unit without being divided, so that large display lighting can be easily realized. [Brief Description of the Drawings] Fig. 1 is a cross-sectional view showing the

configuration of a surface

lighting device according to embodiment 1 of the present invention. Fig. 2 is a front view of the surface lighting device of Fig.

1. Fig. 3 is a surface lighting device according to embodiment 1 of

the present invention.

11 is a cross-sectional view showing another example of the configuration of the light source periphery. FIG.

FIG. 4 is an explanatory diagram showing a light source unit of the surface illumination device of FIG. 1.

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Fig. 5 is a top view of the light source unit of the surface illumination device of Fig. 4. Fig. 6 is

an explanatory diagram showing another example of mounting of the light source unit of the surface illumination device according to the first embodiment of the present invention.

FIG. 7 is a planar illumination device according to a first embodiment of the present invention.

BOE - Exhibit 1019 - Page 6

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FIG 8 is a cross-sectional view showing the device structure when measuring the temperature of the substrate when there are no heat dissipation fins in the planar illumination device according to the second embodiment of the present invention. FIG.

Fig. 10 is a front view of the surface lighting device of Fig. 9. Fig. 11 is a cross-sectional view showing another example of the surface lighting device according to the second embodiment of the present invention. Fig. 12 is a cross-sectional view showing the surface lighting device according to the third embodiment of the present invention. 2 is an explanatory diagram showing a light source unit in the embodiment; FIG.

Fig. 13 is a cross-sectional view showing a configuration of a surface illumination device according to embodiment 3 of the present invention Fig.

14 is a cross-sectional view showing another example of the configuration of a surface illumination device according to embodiment 3 of the present invention.

FIG. 15 shows a surface illumination device according to a fourth embodiment of the present invention. FIG.

Fig. 16 is an explanatory diagram showing a cross-sectional view taken along line AB of the surface illumination device of Fig. 15. Fig. 17 is a cross-sectional view showing another example of the configuration of the surface illumination device according to the fourth embodiment of the present invention.

FIG. 18 shows a surface illumination device according to a fourth embodiment of the present invention. FIG. 11 is a cross-sectional view showing still another example of the configuration.

FIG 19 is a cross-sectional view showing the configuration (1) of a surface illumination device according to embodiment 5 of the present invention.

FIG 20 is a cross-sectional view showing a light guide plate case in the surface illumination device of FIG 19. FIG.

Fig. 21 is a cross-sectional view showing the configuration (2) of a surface lighting device according to embodiment 5 of the present invention; Fig. 22 is a cross-sectional view showing the configuration (3) of a surface lighting device according to embodiment 5 of the present invention; Fig. 23 is a cross-sectional view showing the configuration (4) of a surface lighting device according to embodiment 5 of the present invention; Fig. 24 (a) is a cross-sectional view showing the configuration (2) of a surface lighting device according to embodiment 5 of the present invention; FIG. 1B is a front view showing the configuration of the lighting device, and FIG. 25(a) is a diagram showing a surface illumination according to a sixth embodiment of the present invention; [Fig. 26] A diagram showing the configuration of a conventional surface illumination device. [Fig. 27] A diagram showing the life characteristics of an LED with respect to the ambient temperature. FIG.

[Explanation of symbols] 1 light guide plate, 2 diffusion pattern, 3 reflective sheet, 4 surface cover, 5 light guide plate case, 6 chip-shaped LED, 7 lead electrode, 8 metal substrate, 9 electrode pattern, 10 thermally conductive grease, 11 heat dissipation fin, 12 reflector, 13 locking screw, 14 chip resistor, 15 reflective material, 16 wall surface, 17 lighting device storage section, 18 ceiling surface, 19 surface lighting device, 20 large display cover, 21 surface lighting device, 21 LED fixing holder, 22 pattern filter, 23 light-emitting layer, 24 dot portion, 25 LED, 26 LED substrate, 27 frame.

FIG. 1

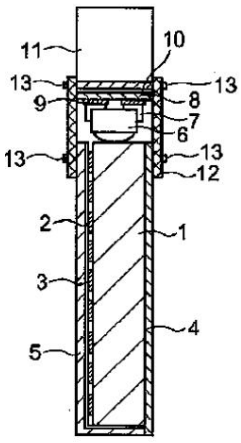


FIG2

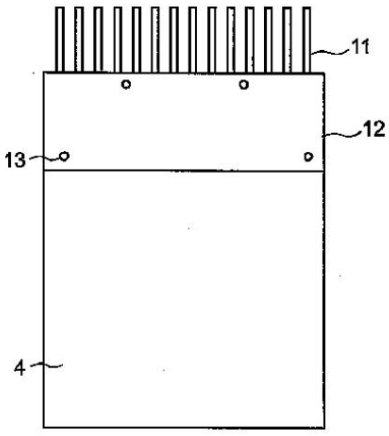


Figure 3

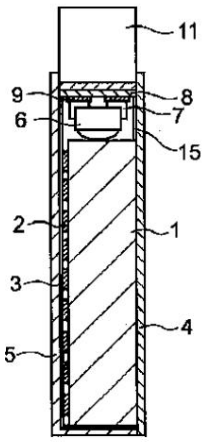


FIG. 7

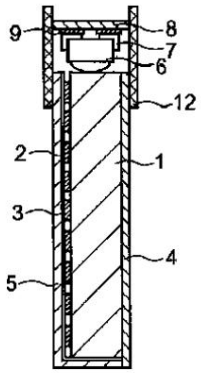


FIG. 9

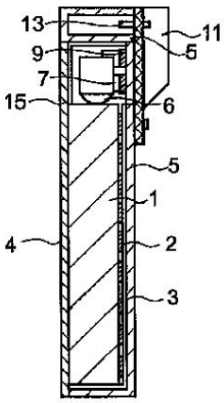
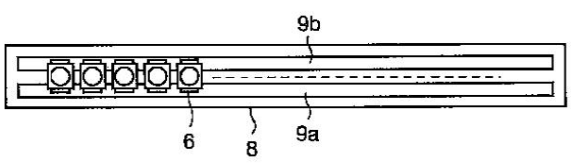


FIG4



FIG. 5



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FIG. 6

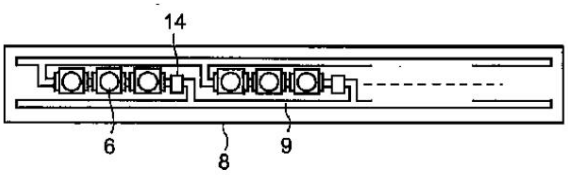


FIG. 8

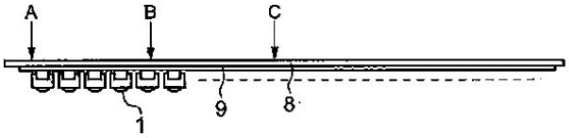


FIG. 12

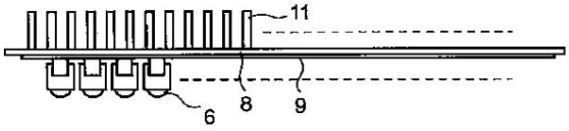


FIG. 10

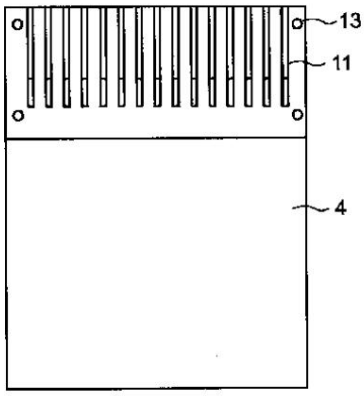


FIG. 11

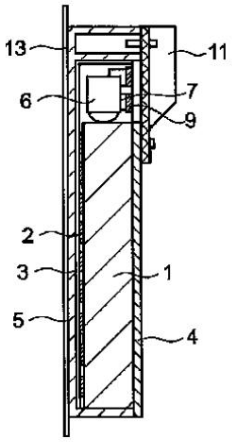


FIG. 16

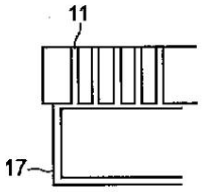


FIG. 13

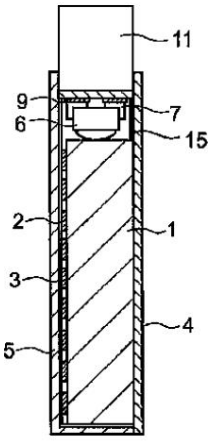


FIG. 14

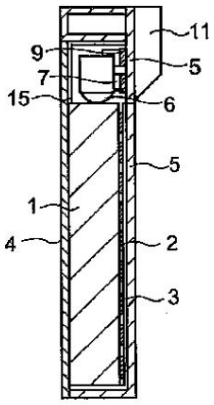


FIG. 15

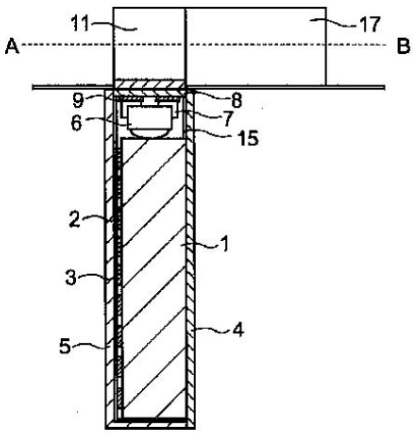


FIG. 17

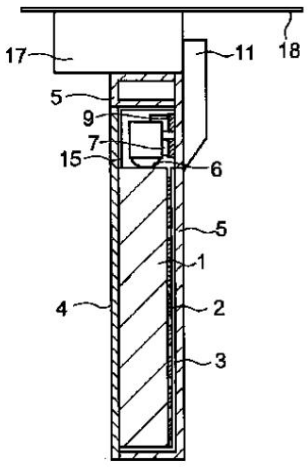


FIG. 19

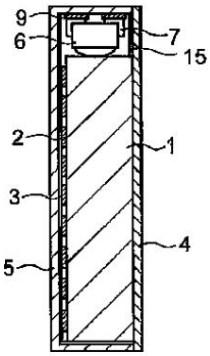


FIG. 20

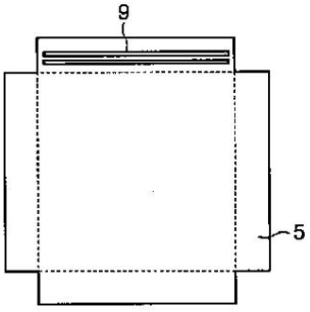


FIG. 21

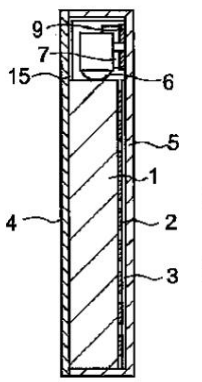
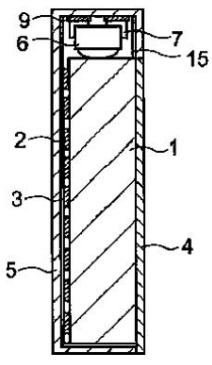


FIG. 22



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FIG. 18

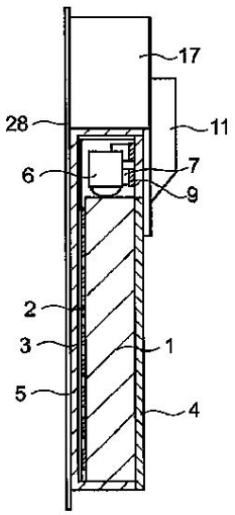


FIG. 23

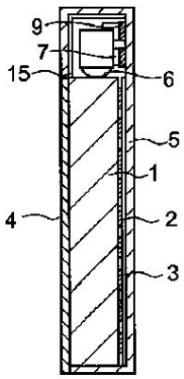


FIG. 24

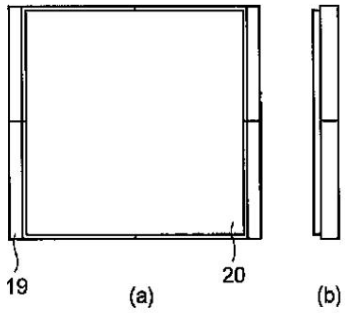


FIG. 25

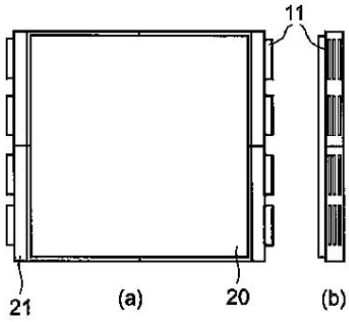


FIG. 26

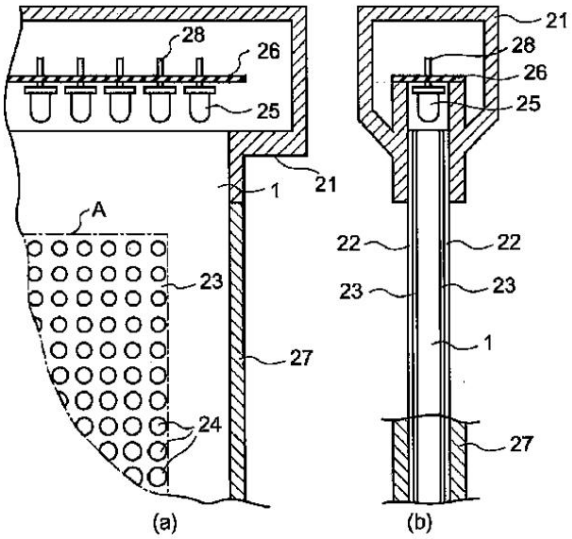
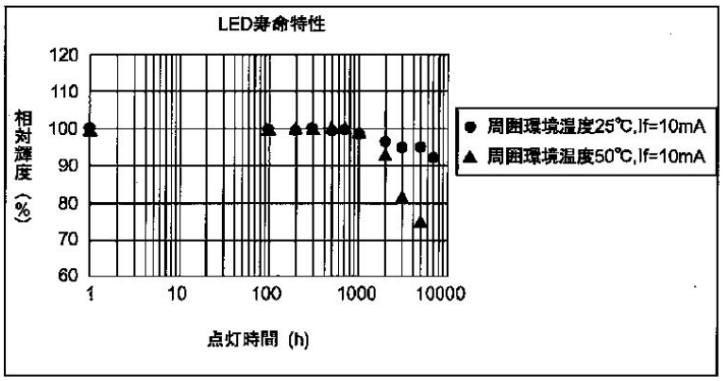


FIG. 27



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5F041 AA05 AA07 AA33 DB07 DC03
DC07 DC23 DC66 DC83 EE25
FF11