

PATENT SPECIFICATION (11)

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 (72) Inventors TAKEO CHIDA
 and HIROSHI FUJITA

(54) LIGHT-EMITTING DISPLAY DEVICE

(71) We, TOKYO SHIBAURA ELECTRIC COMPANY LIMITED, a Japanese corporation, of 72 Horikawa-cho, Saiwai-ku, Kawasaki-shi, Japan, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to a light-emitting display device for visibly indicating numerals, characters and notations.

The prior art light-emitting display device comprises, for example, a printed wiring board impressed with the prescribed patterns of wiring; a light-emitting element prepared from, for example, GaP or GaAsP and mounted on the printing wiring board; and a reflector bored with a penetrating hole for receiving the light-emitting element, with the inner wall of the penetrating hole designed to act as a reflection plane for reflecting upward a light given off from the light-emitting element. The upper opening of the penetrating hole of the reflector is closed with a light-permeable film containing light-scattering material. The light-permeable film is enclosed in a casing fixed to the printing wiring board and pressed against the reflector to be kept at rest.

The conventional light-emitting display device is expensive and bulky due to the necessity of providing the above-mentioned casing. Further disadvantages of the known light-emitting display device are that although the light-permeable film is pressed against the reflector by the casing, gaps nevertheless arise between the light-permeable film and reflector; light from the light-emitting element leaks through the gaps with the resultant decline in the desired shade contrast of an image indicated by the display device; the fitting of the casing consumes a great deal of time; and once the light-emitting display device is set on a panel, great difficulties are presented in taking off the case from the light-emitting display device and also again fitting the case after removal.

play device and also again fitting the case after removal.

It is accordingly an object of this invention to provide a compact light-emitting display device which can efficiently give off light rays of uniform intensity.

According to one aspect of this invention, there is provided a light-emitting display device which comprises a printed wiring board impressed with patterns of wiring; a light-emitting element mounted on the printed wiring board so as to be electrically connected to the corresponding patterned wiring impressed on the printed wiring board; a member which is provided with a through hole for receiving the light-emitting element in one of its open ends and disposed on the printed wiring board; and a thin light-permeable film which contains light-scattering material and is bonded, by an adhesive layer, to the surface of said member to close the other open end of the hole.

According to another aspect of this invention, there is provided a light-emitting display device, which comprises a printed wiring board impressed with patterns of wiring; a light-emitting element mounted on the printed wiring board so as to be electrically connected to the corresponding patterned wiring impressed on the printing wiring board; a member which is provided with a through hole for receiving the light-emitting element in one of its open ends and disposed on the printed wiring board, a thin light-permeable film bonded to the surface of said bored member to close the other open end of the hole; and an adhesive layer which contains a light-scattering material and is applied substantially all over the underside of the light-permeable film, thereby bonding the light-permeable film to said member.

According to a further aspect of this invention, there is provided a light-emitting display device, which comprises a printed

wiring board impressed with patterns of wiring; a light-emitting element mounted on the printed wiring board so as to be electrically connected to the corresponding patterned wiring; a member which is provided with a through hole for receiving the light-emitting element in one of its open ends and disposed on the printed wiring board; and a thin light-permeable film which is bonded, by an adhesive layer, to the surface of said member to close the other open end of the hole, and whose surface facing said hole is sufficiently roughened for effective scattering of a light sent forth from the light-emitting element.

Embodiments of this invention will now be described with reference to the accompanying drawings, in which:—

Figure 1 is a fractional sectional view of a light-emitting display device embodying this invention; and

Figure 2 is a fractional sectional view of a modification of the light-emitting display device of Figure 1.

Referring to Figure 1, the light-emitting display device of this invention comprises a printed wiring board 10 impressed with the prescribed patterns 12 of wiring and a light-emitting element 14 prepared, as is well known, from, for example, GaP or GaAsP and mounted on the printing wiring board 10 for electrical connection to the corresponding patterned wiring 12. The patterned wiring 12 is connected to a power source (not shown) through external leads 16, causing the light-emitting element 14 to be energized by the power source.

Provided on the printed wiring board 10 is a reflector 18 bored with a through hole 20 for receiving the light-emitting element 14. The reflector 18 is formed of a white board 4 to 10mm thick prepared from a resin, for example, polycarbonate, Acrylonitrile - chlorinated polyethylene - styrene (ACS), or Polybutylene-terephthalate (PBT). The reflector 18 is fixed to the printed wiring board 10 by depressing the tips of projections 22 which are integrally formed with the reflector 18 and extend downward through the through holes bored in the printed wiring board 10, so as to cause the edges of the depressed tip portions to spread over the underside of the printed wiring board 10 near the holes. The inner wall 24 of the hole 20 of the reflector 18 acts as a reflection plane. The upper open end of the hole 20 of the reflector 18 is closed with a light-permeable film 26 bonded to the upper part of the reflector 18 by an adhesive layer 28. The light-permeable film is formed of light-permeable resin, for example, polyester resin containing or contact with fine granular or fibrous light-scattering material such as titanium (Ti), titanium oxide (TiO), mag-

nesium oxide (MgO) and calcium carbonate (CaCO₃).

The light-permeable film 26 is desired to have a thickness of 25 to 250 microns, preferably 75 microns, and sufficient flexibility and bear the prescribed color, for example, a red color to make a display in good shade contrast. The adhesive layer 28, for example, of acrylic series type is applied on the underside of the light-permeable film 26. This light-permeable film 26 can be easily adhered to or removed from the reflector 18 substantially in the same manner as the ordinary adhesive tape.

Light given off from the light-emitting element 14 energized by a power source (not shown) through a patterned wiring 12 is reflected upward by the reflection plane 24 of the reflector 18, and sent forth to the outside through the adhesive layer 28 and light-permeable film 26.

What deserves notice in this case is that since the light-permeable film 26 is tightly bonded to the reflector 18, light from the light-emitting element 14 is prevented from leaking through the interstice lying between the light-permeable film and reflector 18 which might otherwise be left sufficiently a gap to allow the passage of light; and that since the light-permeable film 26 is made as thin as 25 to 250 microns, light which has entered the light-permeable film 26 from the light-emitting element 14 is effectively prevented from being carried in a lateral direction of the light-permeable film 26 and passes outwardly through the light permeable film 26.

Fig. 2 shows a modification of the light-emitting display device of Fig. 1. This modification has substantially the same construction as the display device of Fig. 1, excepting that an adhesive layer 30 for bonding the light-permeable film 26 to the surface of the reflector 18 is only mounted on the surface of the reflector 18.

Description was only given of the above-mentioned embodiment of this invention. However, the invention is not limited thereto. For instance, it is possible to use the ordinary light-permeable film free from light-scattering material and include the material in the adhesive layer 28 instead of in the light-permeable film 26 used in the aforesaid embodiment of Figure 1. It is also possible, in Figure 1, to use an adhesive layer containing light-scattering material as the adhesive layer 28.

Referring to Figure 2, the light-permeable film 26 may be replaced by another type of light-permeable film, whose underside, that is, the surface being bonded to the reflector 18 is sufficiently roughened for effective scattering of the light received.

For briefness, description by reference to Figures 1 and 2 refers to a single light-

emitting display device comprising a light-emitting element. However, a plurality of such light-emitting display devices may be assembled, as is well known, in the form of the numeral "8", thereby easily indicating numerals, characters and notations.

WHAT WE CLAIM IS:—

1. A light-emitting display device which comprises a printed wiring board impressed with patterns of wiring; a light-emitting element mounted on the printed wiring board so as to be electrically connected to the corresponding patterned wiring impressed on the printed wiring board; a member which is provided with a through hole for receiving the light-emitting element in one of its open ends and disposed on the printed wiring board; and a thin light-permeable film which contains light-scattering material and is bonded, by an adhesive layer, to the surface of said member to close the other open end of the hole.

2. A light-emitting display device according to claim 1, wherein the light-permeable film is bonded to said bored member by an adhesive applied all over the underside of said film.

3. A light-emitting display device according to claim 2, wherein the adhesive contains light-scattering material.

4. A light-emitting display device according to any of claims 1 to 3, wherein the light-permeable film has a thickness ranging from 25 microns to 250 microns.

5. A light-emitting display device according to claim 1, wherein the light-permeable film is prepared from polyester resin and contains titanium oxide as light-scattering material.

6. A light-emitting display device according to claim 1, wherein said member is a reflector whose inner wall defining the hole acts as a reflection surface which is curved to reflect a light from the light-emitting element toward the light-permeable film.

7. A light-emitting display device, which comprises a printed wiring board impressed with patterns of wiring; a light-emitting element mounted on the printed wiring board so as to be electrically connected to the corresponding patterned wiring impressed on the printed wiring board; a member which is provided with a through hole for receiving the light-emitting element in one of its open ends and disposed on the printed wiring board; a thin light-permeable film bonded to the surface of said board member

to close the other open end of the hole; and an adhesive layer which contains a light-scattering material and is applied substantially all over the underside of the light-permeable film, thereby bonding the light-permeable film to said member.

8. A light-emitting display device according to claim 7, wherein the light-permeable film has a thickness ranging from 25 microns to 250 microns.

9. A light-emitting display device according to claim 7, wherein the light-permeable film is prepared from polyester resin, contains titanium oxide and acts as a light-scattering material.

10. A light-emitting display device according to claim 7, wherein said member is a reflector whose inner wall defining the hole acts as a reflection surface which is curved to reflect a light from the light-emitting element toward the light-permeable film.

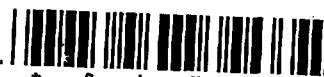
11. A light-emitting display device, which comprises a printed wiring board impressed with patterns of wiring; a light-emitting element mounted on the printed wiring board so as to be electrically connected to the corresponding patterned wiring, a member which is provided with a through hole for receiving the light-emitting element in one of its open ends and disposed on the printed wiring board; and a thin light-permeable film which is bonded, by an adhesive layer, to the surface of said member to close the other open end of the hole, and whose surface facing said hole is sufficiently roughened for effective scattering of light sent forth from the light-emitting element.

12. A light-emitting display device according to claim 11, wherein the light-permeable film has a thickness ranging from 25 microns to 250 microns.

13. A light-emitting display device according to claim 11, wherein said member is a reflector whose inner wall defining the hole acts as a reflection surface which is curved to reflect a light from the light-emitting element toward the light-permeable film.

14. A light-emitting display device, substantially as hereinbefore described with reference to the accompanying drawing.

MARKS & CLERK,
Chartered Patent Agents,
57—60 Lincoln's Inn Fields,
London, WC2A 3LS.
Agents for the Applicants.



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2. A light-emitting display device according to claim 1, wherein the light-permeable film is bonded to said bored member by an adhesive applied all over the underside of said film.

3. A light-emitting display device according to claim 2, wherein the adhesive contains light-scattering material.

4. A light-emitting display device according to any of claims 1 to 3, wherein the light-permeable film has a thickness ranging from 25 microns to 250 microns.

5. A light-emitting display device according to claim 1, wherein the light-permeable film is prepared from polyester resin and contains titanium oxide as light-scattering material.

6. A light-emitting display device according to claim 1, wherein said member is a reflector whose inner wall defining the hole acts as a reflection surface which is curved to reflect a light from the light-emitting element toward the light-permeable film.

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to close the other open end of the hole; and an adhesive layer which contains a light-scattering material and is applied substantially all over the underside of the light-permeable film, thereby bonding the light-permeable film to said member.

8. A light-emitting display device according to claim 7, wherein the light-permeable film has a thickness ranging from 25 microns to 250 microns.

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