

DISPLAY DEVICE FOR TELEPHONE OR
THE LIKE ELECTRIC APPLIANCE

5 The present invention relates to a display
device preferably employable for telephone or the
like electric appliance and more particularly to
improvement of or relating to a display device for
clearly displaying information means on a light
10 permeable member with the aid of light beam
transmitted through the latter from a light source
such as light emitting diode, small lamp or the like.

 To facilitate understanding of the present
15 invention a typical conventional display device
usable for a telephone will be described below with
reference to Figs. 1 and 2.

 To assure that the telephone 1 is operated by
depressing dial buttons 2 without any particular
20 difficulty in a dark room or the like location,
arrangement is made such that the dial buttons 2
constituted by light permeable member of translucent
resin are lightened from the one side by light beam
transmitted from a light emitting diode 4 which is
25 disposed in a casing 3 of the telephone 1 as
illustrated in Fig. 2, and informations 5 on the upper
surface of the dial buttons 2 (see Fig.1) are

visually recognized by an user with the aid of a part of light beam (emitted from the light emitting diode 4 in the direction as identified by arrow marks in Fig. 2), the part of light beam being dispersed upwardly in each of the dial buttons 2. It should of course be understood that the informations 5 in Fig. 1 are constituted by letter, figure, symbol or a combination thereof.

The conventional display device is constructed in the above-described manner such that the dial buttons 2 constituted by light permeable member of translucent resin are lightened from the light beam transmitted from the light emitting diode 4 so that the informations 5 on the upper surface of the dial buttons 2 are visually recognized by an user with the aid of a part of light beam (as identified by arrow marks A in Fig. 2). As a result, it has been pointed out as a drawback of the conventional display device that an intensity of light beam recognizable on the surface with informations 5 carried thereon is less than that of light beam (as identified by arrow marks A in Fig. 2) adapted to be transmitted to the side wall of the dial buttons 2, resulting in reduced lighting efficiency. Thus, the informations 5 often fail to be visually recognized clearly.

Further, in the conventional display device,

(16) the above-mentioned tendency of reduced lighting efficiency is remarkable particularly due to the fact that the telephone 1 is operated merely with power supply from a telephone cable, and therefore it is
5 difficult to supply the display device with high intensity of light beam from a light source enough to allow a user to operate the telephone 1 in a dark room or the like location.

With a view to mitigating the above described
10 disadvantages, the present invention provides a dial illuminator comprising; a plate-shaped light permeable member including an upper face, a lower face opposite to said upper face and a side face, said light permeable member having information to be illuminated formed on a
15 portion of said upper face, and a recess formed in said lower face at a location which avoids a location corresponding to said portion of the upper face; a light source disposed in said recess, for emitting light toward said upper face of the light permeable member
20 with the optical axis thereof being perpendicular to said upper face; first reflective means including a horn-shaped recess having a circumferential face, and formed in said upper face opposite to said light source such that a center axis of said horn-shaped recess is
25 co-axial with said optical axis, said circumferential face having a substantially inverted triangular shape with oblique sides being curved inwardly when sectioned by a _____

plane including said center axis, said first reflecting means being adapted to reflect light incident into said light permeable member from said light source in a direction radial to the direction of the incident light by means of said circumferential face; and second reflecting means formed on said side face of the light permeable member and having a wall portion of an arched configuration provided around said horn-shaped recess with a center axis thereof being co-axial with the center axis of said horn-shaped recess, said second reflective means being adapted to receive light which is reflected at the first reflective means in a direction away from said information and re-reflect said reflected light toward said information, so that the information is illuminated by light from the light source which is reflected at both the first and second reflective means.

The dial illuminator of the present invention assures that the light beam emitted from the light source is transmitted to the information carrying surface via both the first and second reflective portions at a high optical efficiency. Thus, a small capacity light source can be used. The high optical efficiency achievable with the present invention can readily compensate for small positional errors in the mounting of a directional light source.

Embodiments of the present invention will now be described by way of example only and with reference to the accompanying drawings, in which;

Fig. 1 is a perspective view of a telephone with the conventional display device employed therefor,

Fig. 2 is a fragmental vertical sectional view of an essential part in the conventional display device, shown in an enlarged scale,

Fig. 3 is a perspective view of a telephone with a display device according to the invention employed therefor,

Fig. 4 is a perspective view of various components of the display device in Fig. 3, shown in the disassembled state,

Fig. 5 is a fragmental vertical sectional view of the display device of the invention, particularly illustrating the light permeable member constituting the display device,

Fig. 6 is a plan view of the light permeable member in Fig. 5, and

Fig. 7(a) and (b) to 10(a) and (b) are combination of fragmental plan view and vertical sectional view respectively, particularly illustrating several examples of information means on the light permeable member.

Now, the present invention will be described in a greater detail hereunder with reference to Figs. 3 to 10(b) which illustrate a preferred embodiment thereof.

A telephone 20 with a display device according to the present invention used therefore is schematically illustrated in Fig. 3. A casing 21 constituting the telephone 20 includes an upper cover 22 on which a group of dial buttons 23, two lines of function buttons 24 performing abbreviated dial operation or the like and two lines of writing panel 25 for writing thereon informations such as abbreviated dial number, client name or the like are arranged in accordance with the illustrated layout. As is apparent from the drawing, one of the writing panel 25 is located on the lefthand side of the function buttons 24, the other one being on the righthand side of the same and they are covered with a layer of transparent cover 26. Further, the display device 30 of the invention is housed in the casing 21 at the position located below the writing panels 25, as illustrated in Fig. 4.

The display device 30 includes a light permeable member 31 made of transparent resin which is fitted into a slot 22a on the upper cover 22 to be firmly held therein. The upper cover 22 is formed with a recess 22b so as to allow the writing

panel 25 to be fitted into the recess 22b. As is apparent from Fig. 4, the writing panel 25 is firmly held in the recess 22b by engaging projections 25a into slots 22c. Further, a circuit board 32 is disposed below the upper cover 22 so that a light emitting diode 33 serving as an essential component for the display device 30, a plurality of function buttons 24 and others are arranged at predetermined positions on the circuit board 32 which is fixedly secured to the upper cover 22 by means of set screws 34. The light emitting diode 33 is immovably mounted on the circuit board 32 in such manner that its light emitting portion 33a is oriented upwardly. In Fig. 4, reference numeral 35 designates a sheet to be located on the bottom of the light permeable member 31 to create background color for the latter. The sheet 35 is usually made of paper or the like material. Alternatively, the sheet 35 may be replaced with a layer of resist coated on the circuit board 32. Further, reference numeral 36 designates a pattern made of copper foil which serves to define the boundary along which the sheet 35 is to be adhesively secured to the circuit board 32. The light permeable member 31 is formed with a reflective portion 31b at the position located opposite to the light emitting portion 33a of the

(21)

light emitting diode 33 so that light beam emitted from the light emitting portion 33a is transmitted to a plurality of informations 37, 38 and 39 via the reflective portion 31b at which light beam is
5 caused to reflect. In the illustrated embodiment, the informations 37, 38 and 39 are provided on the light permeable member 31 by silk printing process.

As illustrated in Fig. 5, the reflective portion 31b is provided on the bottom part of the
10 light permeable member 31 and essentially comprises a semi-spherical recess 31c adapted to house therein the light emitting portion 33a of the light emitting diode 33, a recess 31d having an inverted conical configuration and a side wall surface 31e
15 having an arched configuration as seen from the above. Specifically, the recess 31d serving as a first reflective portion is formed on the upper surface of the light permeable member 31 at the position located directly above the semi-spherical
20 recess 31c and has a center axis 31c' which extends coaxially relative to the axis of the spherical recess 31c. It should be noted that the diverged surface of the recess 31d is gradually curved toward the informations 37, 38 and 39 on the light
25 permeable member 31. On the other hand, the side wall surface 31e serving as a second reflective portion has a center axis identical to the center axis 31c' of the semi-spherical recess 31c, as is

best seen in Fig. 6.

Next, operation of the display device 30 as constructed in the above-described manner will be described below.

5 Referring to Fig. 5 again, light beam emitted in the upward direction from the light emitting diode 33 enters into the light permeable member 31 without any occurrence of reflection at the semi-spherical recess 31c and it is then
10 reflected in the radial direction relative to the optical axis of light beam emitted from the light emitting diode 33, that is, in the horizontal direction along the inverted conical surface of the recess 31d whereby the direction of transmission of
15 light beam is changed by 90 degrees (as represented by arrow marks B). A part of light beam reflected in the horizontal direction exclusive of the reflected light beam oriented toward the main body 31a of the light permeable member 31 is caused to
20 move toward the side wall surface 31e. Since the side wall surface 31e serving as the second reflective portion has an arched configuration as illustrated in Fig. 6, the direction of light beam is changed when the light beam is reflected on the
25 side wall surface 31e. Thus, owing to the arrangement of the first and second reflective portions made in that way, light beam which has

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entered into the light permeable member 31 is fully collected in the area as defined by the main body 31a. Light beam collected at the main body 31a is then caused to collide against the informations 37, 38 and 39 on the surface of the main body 31a of the light permeable member 31 whereby they are lightened.

Since light beam emitted from light source such as light emitting diode or the like means is oriented toward the main body constituting the light permeable member via reflective portions provided on a part of the light permeable member in the above-described manner, it is assured that light beam is transmitted to required position without fail irrespective of the fact that light source is mounted with some unintentional error during assembling, maintaining or inspecting operation. As a result, informations on the light permeable member are lightened at a high optical efficiency.

Finally, description will be briefly made as to the structure of the informations 37, 38 and 39 as illustrated in the foregoing drawings.

An information as typically identified by reference numeral 37 in Figs. 7(a) and (b) is provided on the light permeable member 31 by printing process such as silk printing process, pad printing process, hot stamping process or the like.

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An information 37 as illustrated in Figs. 8(a) and (b) is prepared by way of the steps of engraving grooves along the outer periphery of the information 37 and filling them with paint having a specific color.

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An information 37 as illustrated in Figs. 9(a) and (b) is prepared by way of the steps of engraving grooves along the outer periphery of the information 37 and covering the pattern of the latter defined inside the grooves with a layer of printed film.

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An information 37 as illustrated in Figs. 10(a) and (b) is prepared by way of the steps of recessing the whole pattern of the information 37 below the surface of the light permeable member 31 and coating it with paint having a specific color.

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As will be readily understood from the above description, arrangement of grooves along the outer periphery of an information and preparation of an information in the recessed structure cause reflection of light beam along the outer periphery of an information, resulting in each of the information being visually recognized clearly.

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While the present invention has been described above with respect to the illustrated embodiment in which the light emitting diode 33 and the reflective portion 31b are located on the

lefthand side of the light permeable member 31 as seen in Figs. 5 and 6, it should of course be understood the present invention should not be limited only to this, but they may be located at any
5 required position on the light permeable member 31 as far as they function properly. What is required with respect to the position where they are located on the light permeable member is that light beam emitted from the light emitting diode 33 is
10 oriented toward the main body of the light permeable member with information means carried thereon via reflective portions.

It should be noted that the present invention may be embodied in any acceptable manner
15 without departure from characterizing features of the invention. Therefore, the foregoing embodiments are merely illustrative in all respects but should not be construed limitative. The scope of the invention is as defined by the appended
20 claims without any obligation of restriction attributable to a part or the whole of description in the specification which has prepared in that way. Further, it should be noted that all changes or modifications made without any departure from
25 the scope of the invention should be construed to be included within the scope of the invention.



CLAIMS:

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1. A dial illuminator comprising:

a plate-shaped light permeable member including an upper face, a lower face opposite to said upper face and a side face, said light permeable member having

5 information to be illuminated formed on a portion of said upper face, and a recess formed in said lower face at a location which avoids a location corresponding to said portion of the upper face;

a light source disposed in said recess, for emitting
10 light toward said upper face of the light permeable member with the optical axis thereof being perpendicular to said upper face;

first reflective means including a horn-shaped recess having a circumferential face, and formed in said
15 upper face opposite to said light source such that a center axis of said horn-shaped recess is co-axial with said optical axis, said circumferential face having a substantially inverted triangular shape with oblique sides being curved inwardly when sectioned by a plane
20 including said center axis, said first reflecting means being adapted to reflect light incident into said light permeable member from said light source in a direction radial to the direction of the incident light by means of said circumferential face; and

25 second reflecting means formed on said side face of



the light permeable member and having a wall portion of an arched configuration provided around said horn-shaped recess with a center axis thereof being co-axial with the center axis of said horn-shaped recess, said second
5 reflective means being adapted to receive light which is reflected at the first reflective means in a direction away from said information and re-reflect said reflected light toward said information, so that the information is illuminated by light from the light source which is
10 reflected at both the first and second reflective means.

2. A dial illuminator as defined in claim 1, wherein said light source comprises a light emitting diode.

3. A dial illuminator as defined in claim 1, wherein each of said information is formed by a printing
15 operation.

4. A dial illuminator as defined in claim 1, wherein said information is formed by grooves which define the periphery of the configuration thereof, said grooves being filled with coloring means.

20 5. A dial illuminator as defined in claim 1, wherein said information is formed by a combination of grooves which define the periphery of the configuration thereof and a printed area surrounded by said grooves.



6. A dial illuminator as defined in claim 1, wherein said information is formed by a recessed area having the configuration equal to that of an information means, said recessed area being filled with coloring means.
- 5 7. A dial illuminator substantially as hereinbefore described with reference to Figures 3 to 10 of the accompanying drawings.
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