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D. E. PROTZMANN

2,745,946

DIAL ILLUMINATOR

Filed Jan. 27, 1954

2 Sheets-Sheet 1

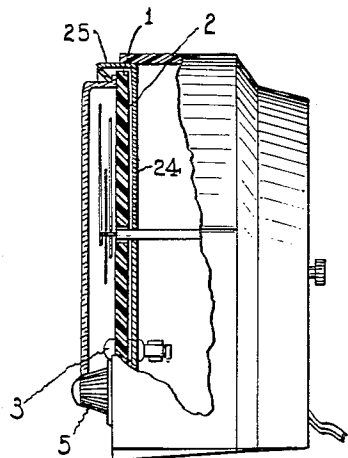
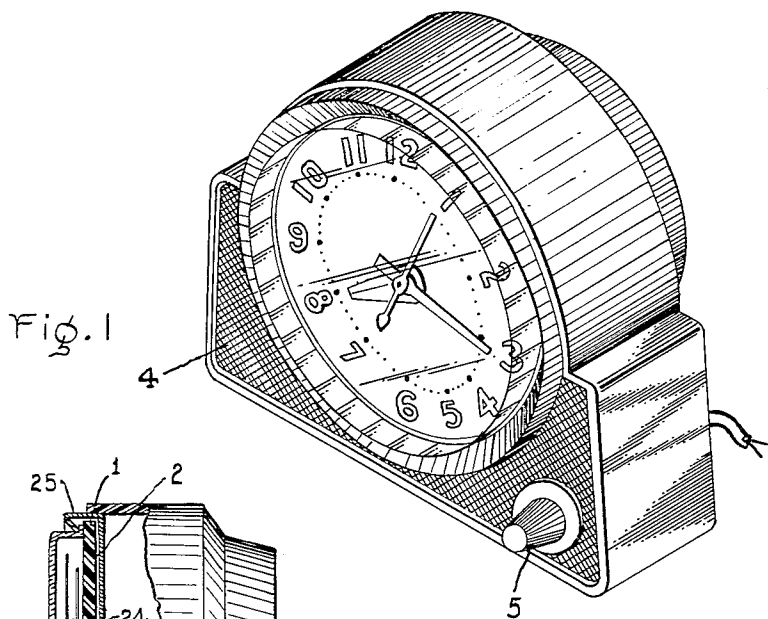


Fig. 2

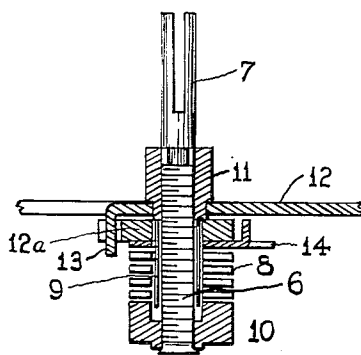


Fig. 3

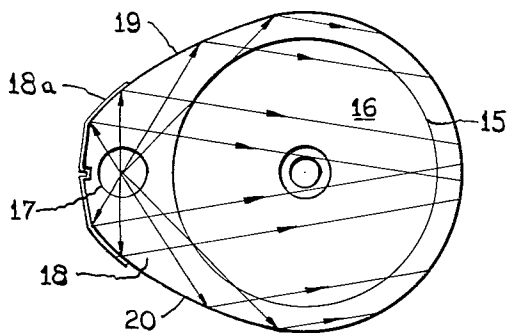


Fig. 4

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2 Sheets-Sheet 2

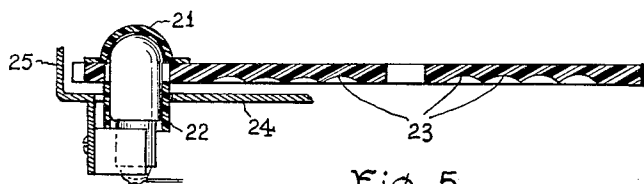


Fig. 5

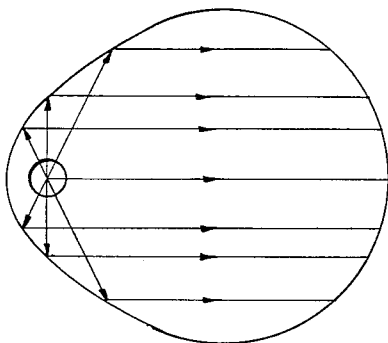


Fig. 6

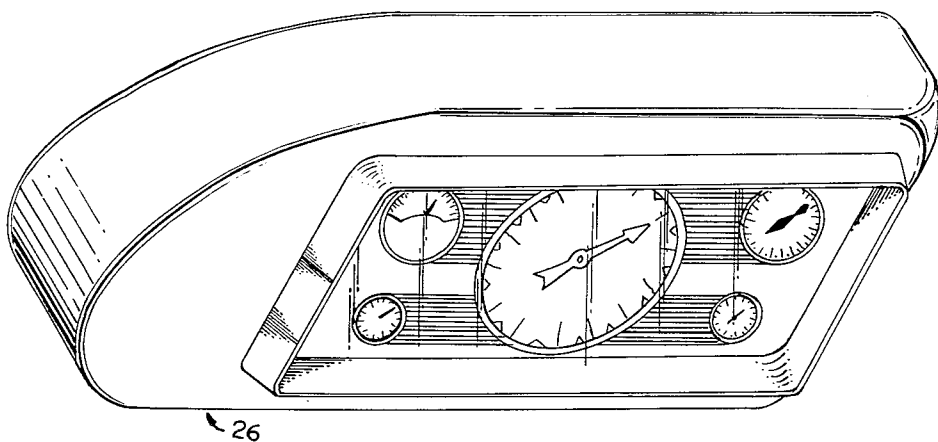


Fig. 7

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2,745,946

DIAL ILLUMINATOR

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4 Claims. (Cl. 240—2.1)

This invention relates to the illumination of clock faces, dials, instrument panels and similar devices in which light is transmitted across the area to be illuminated through a transparent, translucent or similar light-conducting material. In illuminated devices of this type, it has been a fairly common practice to introduce the light along the edge of the light-conducting material in an area shielded from view so that the relatively high intensity of the light source will not be directed at the viewer. The light is then transmitted through the light-conducting material and reflected outwardly toward the viewer in various ways such as by numerals or patterns painted on the back surface of the light-conducting material or by patterns indented directly into the light-conducting material. This type of illumination has been referred to as "edge lighting" and this invention relates in particular to improvements in illumination systems of this type.

Accordingly, it is an object of this invention to provide an improved edge lighting system in which novel means are provided for uniformly and evenly directing and dispersing light across the area to be illuminated.

It is another object of this invention to provide an improved edge lighting system for devices having obstructions extending through the area to be illuminated in which novel means are provided for directing the light so as to avoid the occurrence of shadows around these obstructions.

It is still a further object of this invention to provide an improved edge lighting system in which novel means are provided for internally reflecting the light emitted from the source so as to more efficiently utilize the available illumination and to provide novel means for controlling the intensity of the illumination in an illumination system of this type.

In accordance with one aspect of this invention as applied to electric clocks, a plate-like member of suitable light-conducting material is provided which extends across the bezel aperture of the clock and which has a portion thereon extending beyond the bezel aperture. This extending portion has parabolically shaped edges thereon with each of these parabolic edges being slightly tilted with respect to the other but each having the same focal point. A light source is located at the combined focus of these edges in a position to transmit light through the light-conducting member. Light emitted from the source within the critical angle of reflection for the material used will be internally reflected from the parabolic edges and across the bezel aperture, thereby evenly distributing the light over the bezel aperture. The parabolic edges are tilted slightly with respect to each other so that these edges will reflect the light at slight angles with respect to each other and avoid the occurrence of a shadow behind the center stack of the clock. In other types of dials or instrument faces wherein a center stack or equivalent obstruction is not present, the parabolic edges need not be tilted with respect to each other and in such a case the light will be directed in parallel relationship across the face of the aperture. Over that portion of the

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edge where the light impinges at an angle greater than the critical angle, so that the light would normally pass through the edge instead of being reflected, a reflecting surface may be provided to reflect the light passing through that portion of the edge back across the aperture. In one embodiment of this invention as applied to an electric clock, it was found that this reflecting surface was unnecessary since the internally reflected light was sufficient to provide a uniform illumination of the bezel aperture.

The electrical energy for the lamp is obtained from several turns of wire coupled to the clock motor transformer. A manually adjustable carbon pressure type resistor is provided in series with the lamp to provide novel means for varying the intensity of illumination in an arrangement of this type over the range from "off" to full bright.

In the embodiments of this invention shown, the numerals and the dial pattern are indented directly into the light-conducting member to cause a reflection of the light passing through this member outwardly toward the viewer, thereby distinctly illuminating the indented portion. In order to provide a uniform intensity illumination, the numerals and dial pattern are indented at increasing depths progressing across the dial face from a minimum at the vicinity of the lamp to a maximum opposite the lamp. A similar effect may be obtained by tapering the dial thickness. It will be apparent that other methods of causing reflection from the numerals in dial pattern may be used such as by painting or screening the numerals and pattern either on the front or back surface of the light-conducting member.

This invention will be better understood and other objects and advantages will be apparent from the following description taken in connection with the accompanying drawings, and its scope will be pointed out in the appended claims.

Referring to the drawings, Fig. 1 is a perspective view of an electric clock embodying this invention; Fig. 2 is a side view partly in cross section of the clock shown in Fig. 1; Fig. 3 is a cross sectional view of the carbon pressure type resistor provided for varying the illumination of the dial face; Fig. 4 is a front view of the light-conducting dial of the clock showing the tilted parabolically shaped edge portions and illustrating the paths of travel of the reflected light; Fig. 5 is a cross sectional view of the light-conducting dial shown in Fig. 4 together with a view of the lamp and the indented pattern increasing progressively in depth across the back side of the dial; Fig. 6 is a front view of a light-conducting member similar to that shown in Fig. 4 with the exception that the parabolically shaped edge portions are not tilted with respect to each other so that the light in this case is reflected in parallel relationship across the area to be illuminated; while Fig. 7 is a perspective view of an instrument panel illustrating another embodiment of this invention.

Referring in particular to Figs. 1 and 2 of the drawings an electric clock is provided with a dial 1 of light-conducting material, such as glass or a suitable plastic material, in which the numerals and the various dial markings are indented on the back surface 2 thereof in a manner illustrated in Fig. 5 and hereinafter described in more detail. A lamp 3 is located in that portion of the clock shown generally at 4 and receives its electrical energy from a few turns of wire coupled to the clock motor transformer. A carbon pressure type resistor, illustrated in cross section in Fig. 3, is included in series with the lamp circuit and is provided with an adjusting knob 5 to permit a manual adjustment of the intensity of illumination.

Referring to Fig. 3, the carbon pressure type resistor

is provided with a shaft having a threaded portion 6 and an extension 7 adapted to receive the adjusting knob 5. The threaded portion 6 extends through and is insulated from the carbon disks 8 by means of the sleeve 9 and is attached to an aluminum header plate 10 which in turn engages the stack of carbon disks 8. The threaded portion 6 engages the bushing 11 which is mounted in the front plate 12 so that the pressure exerted on the carbon disks by the aluminum header 10 may be increased or decreased by rotation of the shaft extension 7. An insulating washer 12a is locked in place by means of a tab 13 extending from the front plate 12 and a terminal member 14 is positioned immediately adjacent the insulating washer 12a in electrical contacting relationship to the stack of carbon disks 8. The end of the carbon stack opposite the terminal member 14 is connected to the front plate of the clock, which serves as a common ground, through the aluminum header 10, the threaded portion 6 and the bushing 11.

A front view of the dial member 1 is shown in Fig. 4, the bezel aperture being defined generally by the circle 15 and the center stack being indicated at 16. A circular opening 17 is provided in the extending portion 18 of the dial member to receive the lamp 3 which provides the illumination for the dial. Parabolically shaped surfaces 19 and 20 are provided on the extending portion 18 to internally reflect the light within the dial member 1 across the bezel aperture.

The maximum angle of incidence at which the light will be internally reflected is referred to as the "critical angle," and varies with the material used. Light traveling through the dial member and impinging upon the edge at an angle greater than critical will pass through the edge without being internally reflected. Those portions of the edge of extending portion 18 on which the light from the lamp 3 impinges at an angle greater than critical may be provided with a reflecting edge coating 18a to reflect the light which would otherwise pass through the edge. In certain embodiments of this invention as applied to electric clocks, it has been found unnecessary to provide the reflecting edge coating, sufficient illumination being obtained from the direct and internally reflected light.

The parabolically shaped surfaces 19 and 20 are slightly tilted with respect to each other so that the light is reflected at a slight angle as shown in order to avoid the occurrence of a shadow behind the center post 16. As shown in Fig. 5, the lamp 3 is shielded by means of a cup 21 positioned on the front side of the dial member 1 and is further shielded by the shield member 22 so that the light may pass from the lamp only by being transmitted through the light-conducting dial member 1.

The numerals and the dial pattern 23 are indented directly into the dial member 1 on the back surface 2 thereof so that the light is diffused and reflected upon striking these discontinuities. In order to provide for a uniform illumination, the dial numerals and pattern are sunk to an increasing depth progressing across the dial from a minimum at the lamp to a maximum opposite the lamp. If the pattern were indented to a uniform depth, the light would be blocked or shadowed from the indentations further from the source by those closer to the source so that the intensity of illumination would decrease progressively away from the light source. By providing progressively deeper indentations, however, a portion of the light is permitted to travel unimpeded to each succeeding indentation to provide an even illumination of the pattern. A similar effect may be obtained by tapering the dial thickness.

The pattern may be illuminated in other ways such as by painting the pattern onto the front surface of the light-conducting member and allowing it to be silhouetted against the dial or by painting or screening the pattern on the back surface of the dial to cause an outward reflection of the light.

The dial cup, shown in Figs. 2 and 5, assists in the illumination of the dial and comprises a flat portion 24 and an edge portion 25 which follows the contour of the dial member and aids in reflecting the light back into the dial. In the embodiments of this invention wherein sufficient internal reflection of light from the parabolic surfaces is obtained, the edge portion 25 of the dial cup is not required. The flat portion 24 of the dial is illuminated by the pattern and may be made of a suitable reflecting material to reflect the light back through the bezel aperture or may be used merely to provide background color.

Fig. 7 illustrates an instrument panel embodying this invention in which the parabolic reflecting surfaces may be located either in the area shown at 26 to illuminate the entire panel from a single source or may be located adjacent each of the apertures with separate sources to illuminate each aperture separately.

It should be apparent from the foregoing that this invention is equally applicable to various other types of illuminated devices and other variations, modifications and substitutions within the scope of this invention will occur to those skilled in the art.

What I claim as new and desire to secure by Letters Patent of the United States is:

1. An illuminated device comprising a casing having an opening therein defining an area to be illuminated, a plate of light-conducting material extending across said opening and having a portion thereon extending beyond said opening, a light source in said extending portion in a position to introduce light into said plate, a first substantially parabolically shaped edge portion disposed so as to reflect internally within said plate and across said opening light emitted from said source, and a second substantially parabolically shaped edge portion on said extending portion disposed so as to internally reflect light emitted from said source across said opening at an angle with respect to the light reflected from said first edge portion.

2. An electric clock comprising an outer casing having an opening therein defining a dial area, a dial member of light-conducting material extending across said opening and having a portion thereon extending beyond said opening, said extending portion having a substantially parabolically shaped edge portion thereon, an electric lamp extending into an aperture in said extending portion at the focal point of said substantially parabolically shaped edge portion, and shielding means for shielding the portions of said lamp extending beyond the thickness of said dial member.

3. An electric clock comprising an outer casing having an opening therein defining a dial area, a dial member of light-conducting material extending across said opening and having a portion thereon extending beyond said opening, said extending portion having a substantially parabolically shaped edge portion thereon, an electric lamp extending into an aperture in said extending portion at the focal point of said parabolically shaped edge portion, a power supply, a carbon pressure resistor, said lamp and said carbon pressure resistor being connected in series to said power supply, a shaft extending from said carbon pressure resistor through said casing and having a knob attached thereon to allow manual adjustment of said resistor for varying the intensity of illumination of said lamp, and a dial cup, said dial cup comprising a flat portion extending behind said dial member and an edge portion extending around the edge of said dial member to internally reflect light passing through the edges of said dial member back into said member through the edges thereof.

4. An illuminating device comprising a casing having an opening therein defining an area to be illuminated, a plate of light-conducting material extending across said opening and having a portion thereon extending beyond said opening, a light source in said extending portion in

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a position to introduce light into said plate, a first substantially parabolically shaped edge portion disposed so as to reflect internally within the plate and across said opening light emitted from said source, a second substantially parabolically shaped edge portion on said extending portion disposed so as to internally reflect light emitted from said source across said opening at an angle with respect to the light reflected from said first edge portion, and a dial cup, said dial cup comprising a flat portion extending behind said plate, and an edge portion extending adjacent the edge of said plate to reflect light passing

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through the edges of said plate back into said plate through the edges thereof.

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