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ELECTROLUMINESCENT LIGHT

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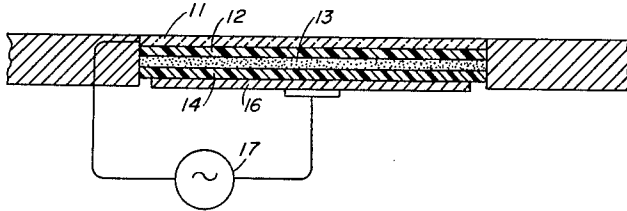


Fig. 1

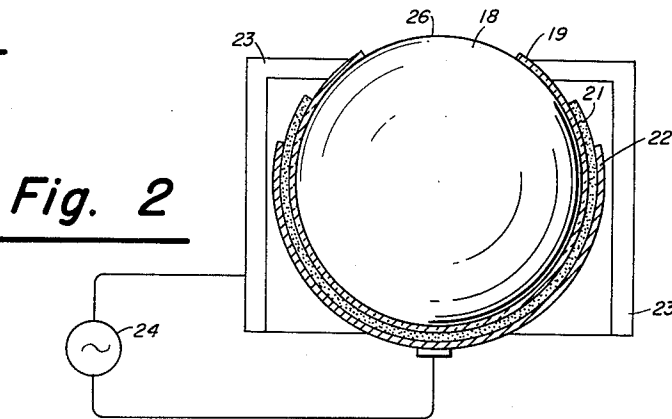


Fig. 2

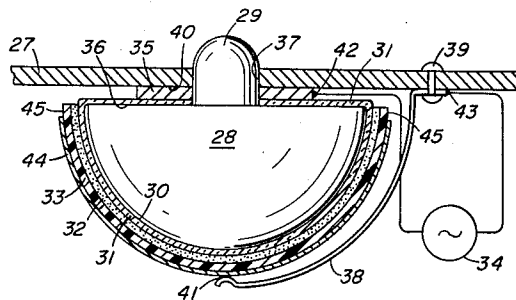


Fig. 3

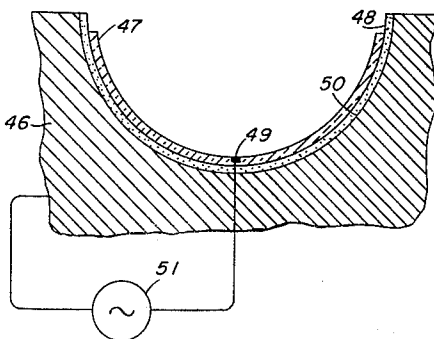


Fig. 4

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ELECTROLUMINESCENT LIGHT

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(Granted under Title 35, U.S. Code (1952), sec. 266)

The invention described herein may be manufactured and used by or for the Government of the United States of America for governmental purposes without the payment of any royalties thereon or therefor.

This invention covers an improvement in electroluminescent devices. More specifically it provides a method for concentrating or focusing a large area of electroluminescent rays into a smaller area whereby greater light intensity is provided.

In the past, improvement of light intensity was the result of improving the basic concepts or compositions of the dielectric phosphor and conductors. In the present invention the electroluminescent surface has been applied to a geometric figure or reflecting surface, and the rays concentrated or focused at a window or opening of smaller area than the reflector area. The preferred form of the proposed invention consists of a glass or transparent body in the shape of a focusing lens or reflector covered with an electroluminescent coating and adapted to concentrate the light at a smaller window area. Said glass body with a protruding window portion, is adapted to precisely fit an opening in an instrument panel and be maintained there by means of a spring clip which also serves as a connector of the electroluminescent conductor to the power source.

The general object of this invention is to improve the light intensity from an electroluminescent source by incorporating a combination of optical features and structural features in the device.

Another object is to provide means for concentrating or focusing the light from an electroluminescent coating by pin-pointing the light rays for pilot light use.

Still another object is to provide a transparent lens with the subject side of the lens being covered with an electroluminescent coating whereby a concentration of said electroluminescent lighting will be focused at a point on the objective side of said lens to increase the intensity.

Another object is to provide a geometric lens cavity or reflector covered with an electroluminescent lamp, consisting of dielectric, phosphor, and conductors, whereby the light from said lens cavity or reflector will be focused at a point to provide pilot light intensity.

In general the object of this device is to increase the light intensity within a limited area by focusing or concentrating the rays from a larger area of electroluminescence.

Other objects and many of the attendant advantages of this invention will be readily appreciated as the same becomes better understood by reference to the following detailed description when considered in connection with the accompanying drawings in which like reference numerals designate like parts throughout the figures thereof and wherein:

FIG. 1 is a basic electroluminescent lighting device;

FIG. 2 is an electroluminescent lighting device employing an optical lens for carrying the electroluminescent coating;

FIG. 3 illustrates an improved version of the electroluminescent device shown in FIG. 2;

FIG. 4 illustrates a lens cavity or reflector for carrying the electroluminescent coating.

In detail FIG. 1 illustrates an electroluminescent lighting device in which a phosphor layer 13 is sandwiched in between two dielectric layers 12 and 14. Layer 14 is a reflector layer and 12 is a transparent layer. The

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electrodes or conductors 11 and 16 complete the capacitor construction to form the electroluminescent light. The conductor 16 is the reflector conductor and conductor 11, like the dielectric layer 12, is transparent whereby the light is generated in the phosphor layer 13 and passes through the transparent layers 11 and 12 to the exterior of the device. An alternating power source 17 is connected to the conductors 11 and 16 for energizing the electroluminescent cell.

An improvement over the basic concept described above and illustrated in FIG. 1 has been disclosed in FIGS. 2 to 4. In FIG. 2 the reflector area of the lens 18 as defined by the conductor 22, is larger than the window area 26. Specifically the electroluminescent cell is built upon a transparent lens 18, a sphere in this case. The cell comprises the reflective conductive layer 22, the phosphor-dielectric layer 21 and the transparent conductor 19. The lens body is mounted in a base 23 and the conductive layers 19 and 22 connected to a power source 24. By virtue of the larger area illuminated as limited by the conductive area 22, compared with the smaller window area 26, a greater concentration of light is provided at the window not only as a result of the relative areas but also from the focusing ability of the lens 18.

FIG. 3 is a preferred form of the lens shown basically in FIG. 2 especially as applied to pilot lights for electronic panels. The panel 27 is provided with an aperture 37 through which the illumination is externally viewed as a pilot light. A transparent lens body 28 is provided with a protruding window area 29 designed to fit snugly into the aperture 37. The panel 27 is provided with a flat area 40 to coincide with the flat shoulder 36 of the lens body for locating the pilot light lens body 28 in the correct position in the aperture 37 of the panel 27. A conductor surface or washer 35, fixed to the panel 27 is located between the adjacent flat surfaces 36 and 40.

The lens body 28 may be made of glass, plastic, or any suitable transparent material and an electroluminescent cell is applied to reflector area 30 which is comparatively larger than the window area 29 or opening 37. Said cell comprises the transparent conductive coating 31 which covers the reflector area 30 as well as the flat area 36 encircling the protruding window portion 29. A phosphor-dielectric coating 32 is then placed over the transparent conductor 31 adjacent the reflector area 30. A special reflector dielectric coating 33 covers the phosphor-dielectric layer 32 and a reflector conductor electrode 44 is spread over the reflector dielectric coating 33 except for the small area 45 at the end the coating which is masked out to prevent a short between conductors 44 and 31.

A connector or contact washer 35 is fixed to panel 27 between the flat surfaced 40 of panel 27 and the transparent conductor surface 31 adjacent the area 36. One leg of the power source 34 is connected to connector washer 35 at point 42, which in turn makes electrical contact with the transparent conductor 31.

A spring clip 38 made of a conductive material is fastened to panel 27 by rivet 39 or other suitable means. The outboard end of clip 38 bears against the opaque coating 44 at point 41 primarily to provide resilient means for physically maintaining the lens 28 and window 29 correctly positioned in the aperture 37. The power source 34 is connected to the electroluminescent cell through contact 43 and point 41 of the reflector conductor 44.

Another species of the invention is shown in FIG. 4 wherein a lens cavity 50 in the conductor base 46 is coated with a dielectric-phosphor layer 48 and a transparent conductor 47 on said phosphor layer. A power source 51 is connected to the conductor base 46 and the conductor layer 47 at point 49.

By combining the features of FIG. 3 and FIG. 4, a cavity or enclosure may be provided with a small window as compared with the large internal area of the enclosure. If the enclosure is formed in any irregular shape as compared with a symmetrical geometric figure, the light intensity as a result of the large internal area covered with an electroluminescent cell viewed through the small window, will increase the pilot light intensity in spite of the fact that no focusing effect prevails. In other words, it appears that the light intensity viewed through the smaller window area may be increased, first, as a result of the greater area of the electroluminescent cell as compared with the window area, and secondly, by virtue of the focusing feature of the geometric cavity or electroluminescent coating. Therefore it is preferred that the cell be deposited on a geometric reflecting surface to gain both advantages.

The operation and process for making the device can best be understood by referring to FIG. 1 which illustrates a basic electroluminescent light, namely a plate capacitor with the phosphor 13 suspended between the dielectric layers 12 and 14, sandwiched between the two electrodes or conductors 11 and 16. With the application of an alternating current, an alternating field is produced and results in excitation of the phosphor 13 with the emission of visible light. Since the light is generated in the phosphor layer 13, the electrode 11 and the dielectric layer 12 of the capacitor must be transparent or translucent to produce a useful lamp. The brightness of this light is dependent upon the voltage and frequency applied.

The transparent electrode 11 is either glass or plastic that has been treated to make one side electrically conductive. This is accomplished in the case of glass substrate, by spraying with a metal salt at an elevated temperature. In a typical operation the glass is supported on a suitable base, either baked ceramic or asbestos, and placed in a furnace. The glass is heated until it is red hot, just below the softening point, from 800° F. to 1300° F., depending upon the type of glass used. If a soda lime (soft) glass is used it is effectively heated to 1100° F., and withdrawn from the oven at this temperature. A coating solution is immediately sprayed on before substantial cooling takes place. The coating solution is prepared by dissolving stannic tetrachloride in methanol. A halogen salt is preferably added to this base solution to increase the effectiveness of the stannic salt and improve the clarity of the conductive coating. A quantity of this solution is placed in an atomizing spray gun and sprayed on the heated glass for a period of 10 to 25 seconds. The length of spraying time will depend upon the thickness of the film to be produced. For example, a preferred procedure is to start by using approximately one quarter ounce of coating solution for each 12 square inches of surface to be covered. The conductive coat so formed will have a resistance of 100 ohms, or less per unit square. The glass should be allowed to cool gradually after spraying to prevent surface cracking.

In the case of the lens body 28 FIG. 3, after a suitable transparent conductive coating 31 is produced as described above, and the glass has cooled to room temperature, the subsequent layers of the electroluminescent lamp are applied. An area 36 is masked off to assure an electrical connection to the power supply through washer 35 when a dielectric material is sprayed on the conductive coating 31. This dielectric can be ceramic or organic, should have a high breakdown voltage, and should be transparent. The organic resins have been found to be most effective, with the catalyzed materials most nearly approaching the properties of the ideal dielectric. A liquid polyurethane resin, catalyzed according to manufacturer's directions, and thinned in equal proportions with butyl acetate, is preferred as a mixture. The dielectric film is dried in a forced-air oven, at 130° F. to accelerate curing and its thickness maintained at 0.0003-0.0005 inch. After this dielectric coating is

cured, forming a smooth uniform film, the electroluminescent phosphor emulsion in the resin solution is sprayed on, again using an organic resin as the binder for the phosphor.

Recent work in this area indicates that optimum results are obtained when we combine the dielectric and phosphor layers and apply the combination as a single coating 32 FIG. 3. By using the same liquid polyurethane resin thinned one to one with butyl acetate as the phosphor binder, a combination dielectric-phosphor coat 32 can be made by using 4 grams phosphor per 10 milliliters of resin solution. This film is sprayed on to a thickness of .001-.0015 inch, and dried in a forced-air oven at 130° F. to accelerate cure of the resin. When the phosphor coat is cured, forming a smooth uniform film, a combination dielectric-reflector coat 33 is usually applied to increase the dielectric strength of the cell and improve the direction of the light toward the transparent substrate. For this reflective coat 33, a white polyurethane resin is preferred. This polyurethane, catalyzed according to the manufacturer's directions, is preferably thinned one to three with butyl acetate, to form a good sprayable mixture. This white polyurethane is sprayed on to a thickness of about .0005 inch and cured in a forced air oven at 130° F. to accelerate the cure and form a smooth uniform coat. The second or reflector electrode 44 is then sprayed over the white coating 33 after an additional border 45 has been masked off to prevent accidental contact with the transparent conductive coating 31 on the glass. This reflector electrode 44 can be a metallic conductive paint and preferably silver because it is convenient to use and easy to obtain. The cell is now complete, and all that remains is a suitable protective coat over the complete unit to act as a dust and moisture barrier.

It should be understood, of course, that the foregoing disclosure relates to only preferred embodiments of the invention and that it is intended to cover all changes and modifications of the examples of the invention herein chosen for the purposes of the disclosure, which do not constitute departures from the spirit and scope of the invention.

What is claimed is:

1. An electroluminescent indicator light comprising a transparent lens, the surface of said lens being divided into a window area and a reflector area much larger than said window area, an electroluminescent coating applied to the outside surface of said reflector area, the exterior surface of said coating being opaque and the interior surface adjacent said reflector area transparent, said reflector area being concave inward so that its focal center is opposite said window area, and electrical means for exciting said coating and illuminating the reflector surface of said lens.
2. The device as described in claim 1 wherein said transparent lens reflector area is a spherical surface adapted to focus the electroluminescent light at a point interiorly of said lens opposite said window area.
3. An electroluminescent indicator light comprising a transparent spherical lens, an electroluminescent cell applied to the larger portion of the surface of said spherical lens, said cell containing a transparent conductor interiorly adjacent said lens and an opaque conductor exteriorly of said cell, a smaller clear window area through which light may pass from said cell and electrical means for exciting said cell.
4. An electroluminescent indicator light comprising a transparent geometric light focusing lens, a transparent conductor applied to the larger portion of the external surface of said lens, a dielectric phosphor layer applied to the external surface of said transparent conductor, an opaque conducting layer applied to the external surface of said dielectric phosphor layer, a source of electrical energy applied across said conductive layers of opposite polarity for exciting said dielectric phosphor on said lens surface so that a concentration of the light rays from the electroluminescent element will occur at the focal point

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of said lens and at a relatively small clear window area on the lens surface opposite the focal point of said lens so that a high intensity of illumination will appear in the window area.

5. An electroluminescent indicator light comprising a transparent geometric light focusing lens divided into a raised window section area encircled by a flat shoulder and a reflecting surface area greater than said window area, a panel for mounting said lens, an aperture in said panel for receiving said raised window section, said aperture being encircled by a flat area adapted to coincide with said flat shoulder on the lens section to facilitate assembling said lens on said panel, an electroluminescent coating applied to said reflecting surface area, and a power source for exciting said coating and illuminating said lens.

6. An electroluminescent indicator light comprising a transparent lens body including in combination a reflector area and a window area smaller than said reflector area, a panel for mounting said lens and provided with an aperture to coincide with said window area, an electroluminescent coating applied to the reflector area, and a power source connected to said electroluminescent coating for luminating said coating.

7. The device as set forth in claim 6 wherein said lens body window area is raised and adapted to fit said panel aperture.

8. The device as set forth in claim 7 wherein said raised window area of said lens is encircled by a flat shoulder, and said aperture in said panel being surrounded by a flat area coinciding with said flat shoulder.

9. An electroluminescent indicator light comprising a transparent lens body including in combination a reflector

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area and a raised window area smaller than said reflector area, said lens having its focal point internal of said lens and opposite said window area a panel provided with an aperture for holding said raised window area and mounting said lens, an electroluminescent cell including a transparent inner conductor adjacent the external surface of the reflector area of said lens, an opaque outer conductor, a spring clip anchored to said panel and adapted to resiliently hold the lens window in the panel aperture, said spring clip being electrically insulated from said panel and in contact with said outer conductor, and a source of power connected to said spring clip and said inner conductor for energizing said electroluminescent cell so that the light from said reflector area will be concentrated opposite said smaller window area.

10. An electroluminescent indicator light comprising an electroluminescent cell coating applied to the major portion of the external surface of a lens having an internal focal point, a small clear window area on said lens surface opposite said focal point, the external conductor of said cell being an opaque reflector so that the electroluminescence light rays will be reflected inward and concentrated at a point opposite said window.

11. An electroluminescent indicator light as described in claim 10 wherein the coated portion of said lens is a spherical surface.

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