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ELECTROLUMINESCENT INSTRUMENT LIGHTING

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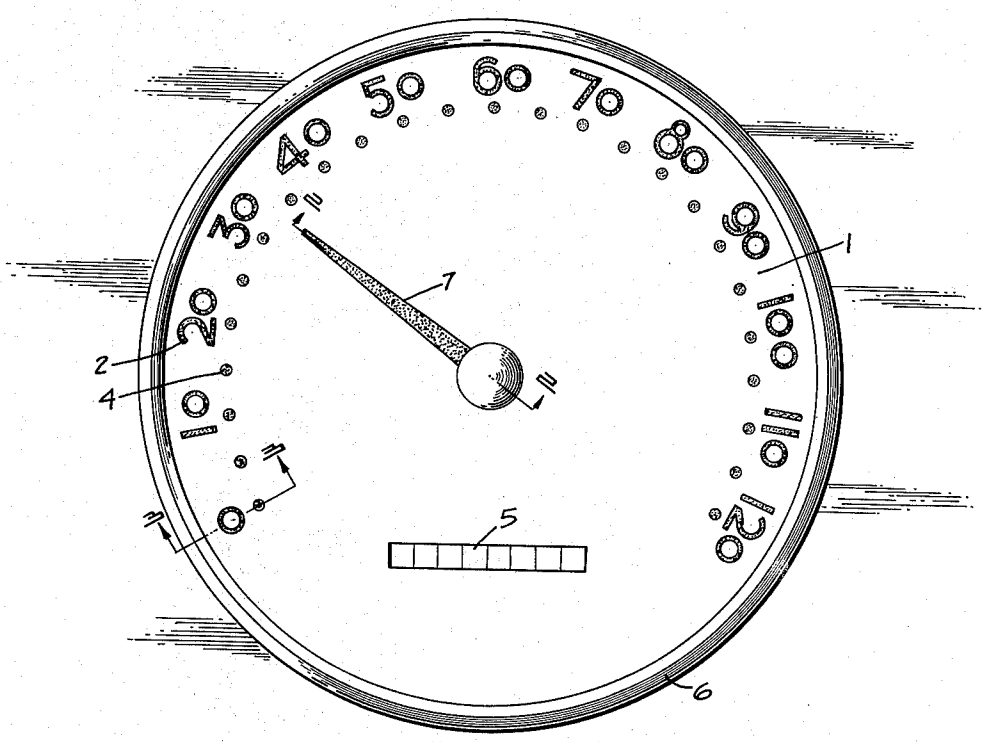

FIG_1

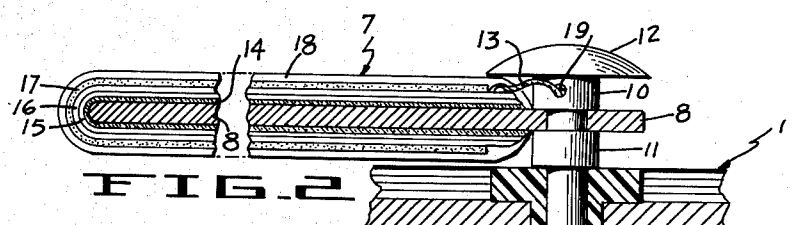

FIG_2

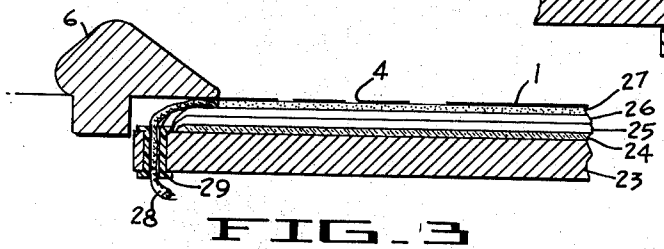

FIG_3

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ELECTROLUMINESCENT INSTRUMENT LIGHTING

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This invention relates to electroluminescent devices, that is to devices including a phosphor which emits light when subjected to an electric field.

The invention is particularly directed to the illumination of instruments by such devices, and particularly to the incorporation of electroluminescent devices in the dials and pointers of indicating instruments, including clocks, and especially for use in automobile panel instruments.

Previously such instruments have been illuminated by incandescent lamps, the light from which is reflected by the sidewalls of the instrument in a kind of "floodlighting." However, that type of lighting, while illuminating the pointers and dials, also illuminates all the back dial decoration to cause annoying reflections, and this additional reflected light adversely affects the night adaptation, that is, the dark adaptation of the eye. Moreover, with such lighting, sharpness and clear definition is difficult to obtain, and extraneous light is bothersome.

The use of ultraviolet floodlighting, with phosphors painted onto the numerals and the like, is somewhat better, but many of the deficiencies in the floodlighting approach are still present.

So-called "edge lighting" has also been used. In this, the light is directed through a plastic by total reflection. However, the pointers still have to be "floodlighted" as before, with the consequent disadvantages.

We have found that making the dials and pointers electroluminescent removes the disadvantages of other forms of lighting, and transforms the dials and pointers into their own light source. The light then does not have to be directed onto the indicia, but is generated in the indicia themselves, exactly where it will be needed.

We have discovered that can be accomplished by using an electroluminescent panel, with an opaque overlay covering and "blacking out" or shielding all parts of the electroluminescent panel except the indicia themselves, which appear as openings in the opaque overlay.

We have also discovered that the pointers can be made of a metal piece of the desired shape, with the necessary coatings to make it electroluminescent. The piece can be flat or of rod or tubing. We have discovered that the coatings will not make the needle too heavy for use. The necessary electrical connections from the movable needle to the stationary parts of the instrument can be made with flexible wires or can be made by means of movable contacts bearing on and moving over fixed contacts, as with slip rings. The latter are especially useful in clocks where complete rotation is necessary.

In one embodiment, the necessary electrical connections can be made directly from the metal piece to a contact, and the other by attaching a flexible wire to a transparent conductive coating over an electroluminescent coating on the metal piece and attaching a hollow shaft to the pointer and running the wire through the hollow of the shaft. The wire is insulated from the shaft and after emerging from another part of the shaft, the wire can be connected to one side of an electric powering circuit, a contact to the shaft itself being connected to the other side of said circuit.

The pointer can be of plastic or glass instead of metal if the plastic is conductive or has a conducting coating to replace the conductivity of the metal.

The indicia on the dial can be made to electroluminesce

green, blue or white, and the pointer red, if desired, for contrast.

The dial can be made in a full circle or a part thereof and can be flat, if desired, although for many purposes, it can be made as only a part of a circle, say one quadrant, and bent so that the luminescent surface of the dial is convex. In some cases, it may be desirable to move the pointer along a straight or non-circular line, rather than radially.

FIGURE 1 is a front view of one embodiment of a speedometer dial and indicating needle according to the invention.

FIGURE 2 is an enlarged side sectional view through the needle on line 2—2 in FIGURE 1; and

FIGURE 3 is an enlarged sectional view through the dial on line 3—3 in FIGURE 1.

In FIGURE 1, a circular electroluminescent lamp base plate **23**, described later in connection with FIGURE 2, carries the overlay **1**, which is an opaque layer having openings in the shape of the various numerals 0, 10, 20, etc., referred to for convenience as numerals **2**, and the openings **4**, in the form of dots to indicate the divisions around the dial. Thus when the lamp is operating, only the numbers and dots appear luminous. The opening **5** is for the numerals showing the total mileage to date. A plastic ring **6** encircles the outer rim of the lamp disc.

The pointer or needle **7** is also electroluminescent, and its construction is shown in more detail in the sectional view of FIGURE 2. In that view, the pointer **7** comprises the steel needle **8** of metal such as a chromium-steel alloy, for example that known as "No. 4 alloy." The needle is held in the hollow shaft **9** by the collars **10**, **11**, the outer end of the shaft **9** carrying a button **12** which shields the connecting wire **13** from view. A ground coat **14** of ceramic capable of sealing to the metal used and having a very high dielectric constant, for example several thousand, is applied as a frit and fused into place. The ceramic is that shown in U.S. Patent 2,906,631, application for which was filed on June 28, 1956, by Guy E. Rindone and is applied in the manner shown.

A coating **15** of phosphor embedded in ceramic is then applied over the ceramic coating as a powdered mixture of phosphor and ceramic as shown in, and using the materials of, U.S. patent application Serial No. 365,617, filed July 2, 1953 by R. M. Rulon, now abandoned. The phosphor can also be the phosphor shown in that application or any suitable electroluminescent phosphor, for example that shown in copending U.S. application serial No. 705,750, filed December 30, 1957 by Goldberg et al., now U.S. Patent No. 2,982,740.

A transparent conducting coating **16** is then applied over the phosphor-ceramic coating **15**, and can be of tin chloride applied as in the Rulon application Serial No. 365, 617, for example. A glaze **17** of plain ceramic, for example, one of the ceramics shown in said last-mentioned Rulon application is applied over the latter coating together with a coating **18** of red phosphor, which can be non-electroluminescent but excited by the radiation from the electroluminescent phosphor of layer **15**.

A portion of the transparent conducting coating **16** is kept free from the coatings **17** and **18**, and a flexible connecting wire **13** attached to it, for example, by painting the spot with an air-drying silver paint, baked on silver or gold, or other suitable materials, then placing an end of the connecting wire **13** over it, and then holding the two in firm electrical contact by coating it with epoxy resin. Other suitable methods of making contact can be used. The wire **13**, enamelled for insulation, passes through a hole **19** in collar **10** and into the hollow interior of the rotatable shaft **9**, which passes through the insulating backing **20**. Metal contact spring **21** makes contact

with the outside of metal shaft **9**, and the enamelled wire **13** is connected to another contact.

By placing a voltage between the contact **21** and wire **13** the needle will become luminous and glow red.

In FIGURE 3, the metal base plate **23**, which can be of the previously-mentioned No. 4 alloy steel, carries a ground coat **24**, a coating **25** of ceramic and electroluminescent phosphor, a transparent conductive coating **26** and a glass coating **27** over that. The metal base plate **23** acts as one contact to a source of power for energizing the device, and a wire **28**, connected to the transparent conductive coating **26** in the same manner as in the case of the pointer **7**. The wire is led through an insulating bushing in metal plate **23**.

The various coatings **24, 25, 26, 27**, can be applied in the same manner as in the corresponding coatings **14, 15, 16, 17** on pointer **7**.

If the metal plate **23** is of enamelling steel an additional ground coat of a glass having a coefficient of expansion nearer to that of enamelling steel is preferably used between the metal plate **23** and the regular ground coat **24**. This coating can contain some of the glass of high dielectric constant, such as the material of regular ground coat **24**, to avoid appreciable reduction of voltage across the electroluminescent layer **25**.

The pointer **7** or metal plate **23** can be made of aluminum if the ground coat **24** is adjusted to have a coefficient of expansion close to that of aluminum.

An overlay **1** is coated onto the glass coating **26** and is opaque except where the numbers or other indicia are to show through it. It may be stamped or printed onto the coating **30**, and may be of various materials, such as paints or inks. It can be black or colored, as desired.

A metal or plastic ring **6** is fitted around the outside rim of the dial **1** and enclosing said outer rim.

Although for convenience we have described a particular embodiment of the device, various modifications can be made by a person skilled in the art, without departing from the spirit and scope of the invention. For example, if desired, the pointer or dial can be made of a plastic sheet containing an electroluminescent phosphor embedded therein, with conductive coatings on each side of the plastic sheet, at least one of the coatings being of transparent conductive material. Ceramic materials are generally preferable, however, because they are more resistant to humidity.

What we claim is:

1. Instrument indicating means including a pointer comprising: a rotatable hollow metal shaft, a metal piece having substantially the shape of a pointer and electrically and mechanically connected to said hollow shaft, a coating including an electroluminescent phosphor on said piece, a transparent electrically conductive coating on said coating, and an electrical pigtail connection from said conductive coating extending into and through said hollow shaft but insulated therefrom.

2. Instrument indicating means including a pointer comprising: a piece having substantially the shape of a pointer and being of a solid dielectric material containing an electroluminescent phosphor, a transparent conductive layer on one side of said piece, and a conducting layer on the other side.

3. The instrument indicating means of claim **1** and an electroluminescent dial over which said metal piece having substantially the shape of a pointer is adapted to move.

4. Instrument indicating means comprising, in combination: a pointer having a metal piece of substantially the shape of a pointer; a coating disposed about said metal piece including an electroluminescent phosphor in a ceramic dielectric; a transparent electrically conductive coating disposed about said phosphor coating; a first electrical connector for said transparent conductive coating and a second electrical connector for said metal piece; said first and second electrical connectors being arranged for applying a voltage between said metal piece and said transparent conductive coating; an electroluminescent dial disposed behind said pointer, said pointer being movable over the face of said dial; means for supporting said pointer to provide said movement over the face of said dial; means to energize said dial so that light may be emitted therefrom, the light from said dial being directed from behind said pointer and being visible in addition to the light which is emitted from said pointer upon energization.

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