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ELECTROLUMINESCENT LAMP WITH ALTERNATIVELY
DEFINED AND UNDEFINED INDICIA
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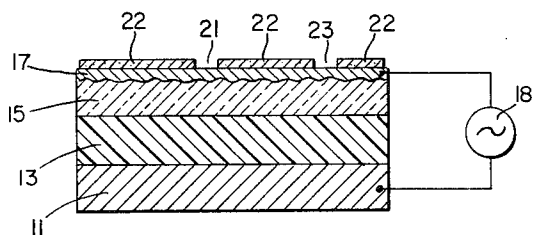


Fig. 1

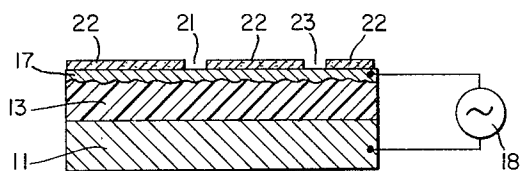


Fig. 2

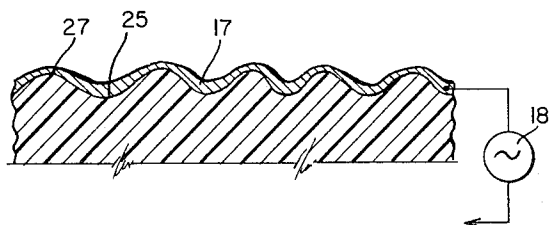


Fig. 3

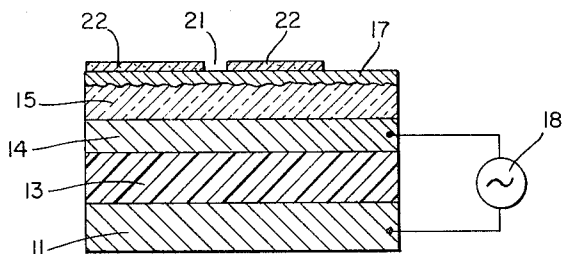


Fig. 4

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ELECTROLUMINESCENT LAMP WITH ALTERNATIVELY DEFINED AND UNDEFINED INDICIA

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4 Claims. (Cl. 313-108)

ABSTRACT OF THE DISCLOSURE

The present invention provides a "transparent" electrode means which enables indicia to be defined when the lamp is lighted, or energized, and undefined when the lamp is de-energized.

This invention relates to electroluminescent lamps and more particularly to an electroluminescent lamp which has indicia selectively defined on its face.

Electroluminescent lamps find great utility with instruments and signs which can be illuminated such as the dashboard instruments of automobiles, the control panel of an airplane or nautical ship, the "no-smoking" or "fasten your safety belts" signs in an aircraft fuselage, etc. Heretofore, the electroluminescent lamps have been masked to define the indicia when the lamp is lighted, but masked in such a manner that a person observing the instrument or sign could read the indicia without having the lamp energized. For many applications, this arrangement has been satisfactory. However, for other applications, this arrangement has not been satisfactory.

In certain of the aircraft panels it has become desirable to provide instruments whose indicia cannot be read until the lamp is energized. The requirement has come into being because under some conditions of high ambient light, it is difficult to determine whether or not the lamp or panel is lighted. Such an arrangement is very disconcerting to a pilot who must continually scan his instrument panel. Accordingly, it is necessary that the pilot know without question whether or not the panel is lighted.

The present invention provides a "transparent" electrode which is not fully transparent since it defines the required indicia, but which has its transparent portion so designed and fabricated that to ordinary daytime light, such as room light, the indicia cannot be distinguished from the non-transparent background.

Summary

The present invention provides a "transparent" electrode of a thin film of anti-static metal such as Inconel, tin, cadmium and the like, which is deposited by evaporation deposition on a rough surface of either glass or epoxy resin. In the preferred embodiment, the metal Inconel is employed as the thin film metal. In addition, indicia are placed on the outer surface of the Inconel electrodes by means of a photographic process or a silk screening process. Inconel is an alloy which is made up of approximately 80% nickel, 14% chromium and 6% iron.

The indicia are formed by keeping the areas of the Inconel electrode, which define the indicia, clear or free of the background ink or colored material. The background material, when Inconel is used as the transparent electrode, is black so that the hue or color resulting from the Inconel being placed on a rough surface (which hue is black), blends with the black color of the background material. Accordingly, the viewer sees a black instrument face when the lamp is de-energized, and alternatively lighted and defined indicia on said instrument face, when the lamp is energized.

The advantages of the present invention will be ap-

parent and will be suggested to those skilled in the art from a reading of the following specification and claim in which:

FIGURE 1 is a schematic side view of an electroluminescent lamp employing the present invention;

FIGURE 2 is a schematic side view of a second embodiment of an electroluminescent lamp employing the present invention, and

FIGURE 3 is a partial view of the rough surface of the lamp upon which the transparent electrode is deposited;

FIG. 4 is another embodiment of an electroluminescent lamp employing the present invention.

As was stated earlier the present invention provides means whereby an electroluminescent lamp can provide lighted indicia when turned on, but which does not enable the viewer to see the indicia when it is turned off.

Such an arrangement has been found to be advantageous in aircraft control panels because the mental pressures of flying modern aircraft do not leave room for any disconcerting factors to be present in the cockpit. It has been found that the pilot is less distracted as he views his instrument panel if he sees solid panel face unless he is supposed to see a lighted instrument panel.

The manner in which the present invention effects this phenomenon is by roughing that portion of the electroluminescent lamp to which the transparent electrode is bonded. It has been found that if the surface of the lamp is "roughed" and a thin film electrode is applied, the thin film (which when applied against a smooth surface is virtually colorless and transparent) appears to have significant color characteristic. In the preferred embodiment, I have used Inconel as the transparent electrode.

When Inconel is applied to a rough surface, it has the hue or color of black and hence if a black ink or paint or colored material is used as background material (i.e. to define the indicia which are to be lighted) the entire face of the lamp appears black. In ordinary room light the indicia cannot be detected. The lamp must be energized in order for the indicia to be recognized.

Inconel as the transparent electrode has a number of advantages. It gives the black hue as indicated above and in addition is a strong material with which to work. Inconel is not normally employed as an electrode because of its high impedance, but I have found its high impedance to be advantageous since high voltages are often employed with instrument panel lights. In addition, Inconel has a good affinity for glass and plastics (such as epoxy resin) which usually form that part of the lamp to which the transparent electrode is bonded.

Consider FIGURE 1 which shows a side view of an electroluminescent lamp employing the present invention. In FIGURE 1, there is depicted an electroluminescent lamp with a back electrode 11 to which there is secured a layer of electroluminescent phosphors held in place by a layer of epoxy resin. This last mentioned layer will be referred to as the electroluminescent layer 13.

The phosphors in layer 13, in the preferred embodiment, are arranged according to the process set forth in my Patent Number 3,037,138, which in effect is a one crystal thick layer of phosphors. Accordingly, this arrangement provides for maximum light output. It should be understood that other phosphor arrangements can be used.

In the embodiment of FIGURE 1, there is shown a layer of glass 15 bonded to the electroluminescent layer 13. The upper portion of the glass layer 15 is "roughed" as shown. On the upper surface of the glass layer 15 there is deposited a thin layer of Inconel 17. The Inconel 17 serves as the "transparent" electrode. While the layer of Inconel is shown having a smooth upper surface, it

act its upper surface is better depicted in FIGURE 3. Connected to the back electrode 11 and the Inconel 17; an A.C. source 18 of electrical power which provides the electrostatic field across the electroluminescent layer 3 to generate light. The generation of light from electroluminescent phosphors by applying an A.C. field is well known and will not be described herein.

To the upper surface of the Inconel layer 17, there is applied a pattern of ink 22 or paint. In the preferred embodiment, the pattern of indicia is silk screen printed on the Inconel surface using Naz-Dar enamel manufactured by Naz-Dar Company. Other forms of ink can be employed such as Grip-Flex and other indicia forming techniques can be employed such as a photoresist technique.

In the preferred embodiment, the Naz-Dar ink provides a black hue to the viewer in room light and does not allow any light to pass therethrough in response to the electroluminescent lamp being energized. At the same time, the Inconel provides a black hue (of virtually the same depth as the ink), to the viewer in room light (i.e., ordinary daylight but does permit 50% to 70% of the light to pass therethrough from the illuminated electroluminescent lamp.

Accordingly, when the face 19 of the lamp is viewed in daylight, the indicia 21 and 23 cannot be detected. The entire face looks black.

The reason for the foregoing phenomenon seems to occur because of the behavior of the Inconel when it is deposited in the valleys of the rough surface. As can be seen in FIGURE 3, the Inconel becomes thicker in the valleys 25 of the rough surface than at the crests 27 of the nodes. This pattern has been determined by virtue of a microscope.

I believe that the Inconel builds up in the fashion shown in FIGURE 3 because of the sputtering that takes place when it hits the sidewalls of the valleys. In other words, the valleys are located at a farther point from the vaporant than the crests and hence might well receive less evaporant (Inconel) in any given time. However, since the Inconel appears to be built up in the valleys, I have concluded that the sputtering, or splashing, from the sidewalls of the valleys creates a change in the crystalline structure arrangement of the Inconel and thus effects the build up.

Because the Inconel is built up in the valleys and faces the light incident thereto from an angular position, I have concluded that the colors (different light frequencies) of the light excepting black are absorbed thereby giving the overall layer a black hue. In other words, if the surface of Inconel is analyzed under a microscope, it does not appear as a solid black surface but more nearly a potty dark surface. However, when the surface is viewed with the human eye, the dark areas are predominant and give the whole area a black hue.

On the other hand, the light emanating from the reverse side of the Inconel layer is passed therethrough and hence the activation of the electroluminescent lamp results in providing a well illuminated lamp with well defined indicia.

FIGURE 2 is a second embodiment of the invention. The Inconel need not be deposited on glass as shown in FIGURE 1 although the embodiment of FIGURE 1 is sometimes preferable in the high voltage application. In FIGURE 2, the back electrode 11 has an electroluminescent layer 13 bonded thereto and the "away" surface is roughed. Thereafter, a layer of Inconel is deposited by evaporation on the "roughed" surface of the electroluminescent layer. As depicted in FIGURE 2, the Inconel electrode and the back electrode are connected to the A.C. source 18.

FIGURE 3 depicts a third embodiment wherein there is a back electrode 11, a layer of phosphors 13, a transparent electrode 14 (which can be gold, tin or Inconel), a glass layer 15 (the glass layer and transparent elec-

trode can be an integral layer commercially sold as Nesa-Glass), a layer of Inconel 17 deposited on the roughed surface of the glass and the non-transparent indicia 22. The package of FIGURE 3 has the advantage of securing the electrodes away from the outer surface of the package and lending a deep hue to the face of the panel.

It should be understood that the "roughed" surface can be so effected by applying hydrochloric acid on a glass surface, some other suitable etchant or by a physical abrasion process.

The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows:

1. An electroluminescent lamp having selectively defined indicia on its face comprising in combination: a back electrode means; a layer of electroluminescent phosphors on said back electrode means, said layer having a roughed surface; a selectively transparent and conductive means comprising a thin layer of an alloy made of approximately 80% nickel, 14% chromium and 6% iron on said roughed surface to provide an electrostatic field across said electroluminescent layer in conjunction with said back electrode; non-transparent means, having substantially the same hue to ambient light as said selectively transparent means, formed on said selectively transparent means, to define indicia thereon; and means connected to said selectively transparent means and said back electrode whereby said layer of electroluminescent phosphors may be energized.

2. An electroluminescent lamp according to claim 1 wherein said non-transparent means is a layer of black material such as black ink, black paint, black enamel or the like.

3. An electroluminescent lamp having selectively defined indicia on its face comprising in combination: a back electrode means; a layer of electroluminescent phosphors on said back electrode means; a thin, transparent layer of metal on said layer of electroluminescent phosphors, said thin, transparent layer and said back electrode means enabling an electrostatic field to be provided across said phosphors; a layer of glass material having one surface contacting said thin, transparent layer of metal and an opposite, roughed surface, a thin transparent layer of an alloy of approximately 80% nickel, 14% chromium and 6% iron on said roughed surface; non-transparent means, having substantially the same hue to ambient light as said thin, transparent layer of alloy, formed on said thin transparent layer of alloy to define indicia thereon; and means connected to said thin, transparent layer of metal and said back electrode whereby said layer of electroluminescent phosphors may be energized.

4. An electroluminescent lamp having selectively defined indicia on its face comprising in combination: a back electrode means; a layer of electroluminescent phosphors on said back electrode means; a layer of glass material having one surface on said layer of electroluminescent phosphors, 14% chromium and 6% iron on said roughed surface; a thin, transparent layer of alloy of approximately 80% nickel, 14% chromium and 6% iron on said roughed surface; non-transparent means, having substantially the same hue to ambient light as said thin, transparent layer thereon; and means connected to said thin, transparent layer of alloy and said back electrode whereby said layer of electroluminescent phosphors may be energized.

References Cited

UNITED STATES PATENTS

3,008,065	11/1961	Chamberlin	-----	313-108 X
3,316,435	4/1957	Kelso	-----	313-108

FOREIGN PATENTS

1,079,737	4/1960	Germany.
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ROBERT SEGAL, Primary Examiner.