Jan. 26, 1960 J. D. MILLER 2,922,912

INDICIA BEARING ELECTROLUMINESCENT PANEL AND METHOD OF MANUFACTURE

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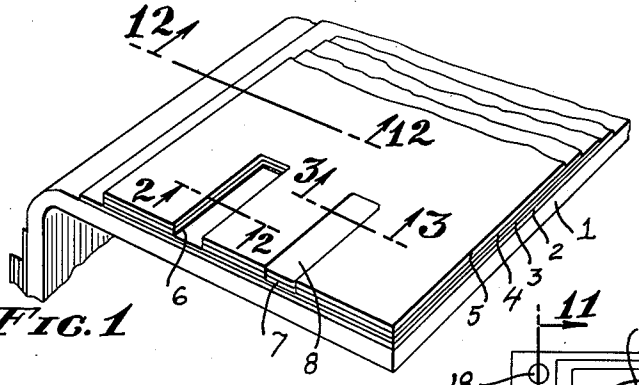


FIG. 1

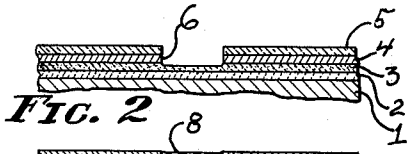


FIG. 2

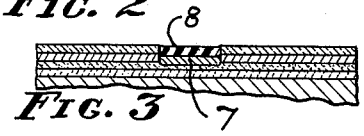


FIG. 3

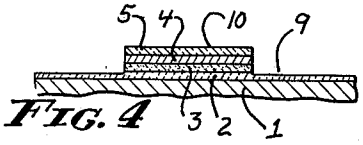


FIG. 4

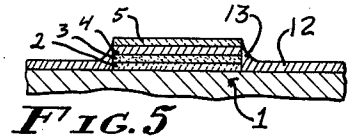


FIG. 5

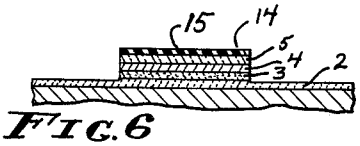


FIG. 6

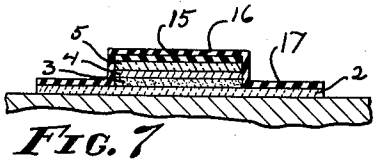


FIG. 7

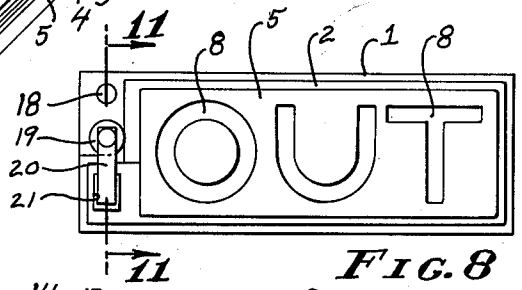


FIG. 8

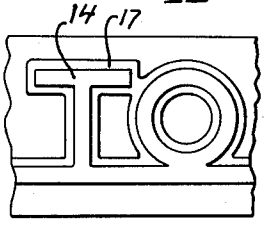


FIG. 10

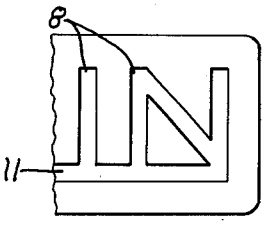


FIG. 9

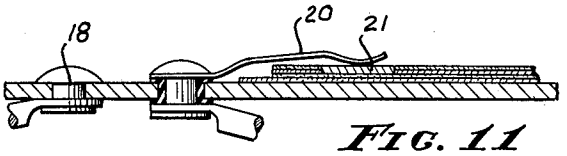


FIG. 11

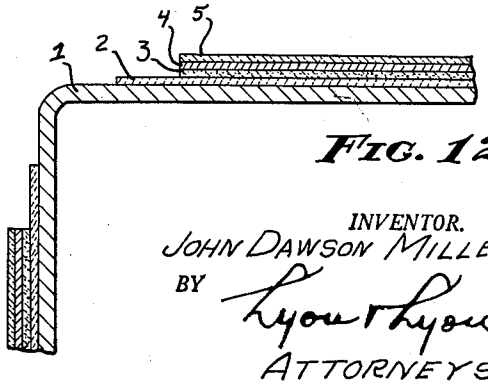


FIG. 12

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INDICIA BEARING ELECTROLUMINESCENT PANEL AND METHOD OF MANUFACTURE

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Application January 5, 1959, Serial No. 785,058

8 Claims. (Cl. 313—108)

This invention relates to indicia bearing electroluminescent panels and to a method of manufacture, and included in the objects of this invention are:

First, to provide an electroluminescent panel and method of manufacture wherein an electroluminescent panel of standard dimension may be treated to remove selected coatings therefrom in predetermined regions, whereby the panel may be punched, bent, or otherwise shaped as desired without damage to the remaining coatings, and wherein removal of the coatings may be so predetermined as to provide luminescent and non-luminescent areas, either of which may constitute indicia and the other background.

Second, to provide an electroluminescent panel and method of manufacture which eliminate preforming or punching of the metal blank before application of the various coatings which produce electroluminescence so that the manufacture of the panel may produce standard panels for later conversion into indicia bearing panels.

Third, to provide an electroluminescent indicia bearing panel in which the capability of producing luminescence in the non-luminescent areas is destroyed rather than being merely covered so that any scratching of the surface will not expose an underlying luminescent layer.

With the above and other objects in view, as may appear hereinafter, reference is directed to the accompanying drawings in which:

Figure 1 is a substantially diagrammatical, fragmentary, perspective view of a panel incorporating one form of the invention;

Figure 2 is a further enlarged, sectional view through 2—2 of Figure 1;

Figure 3 is a similar fragmentary, sectional view through 3—3 of Figure 1;

Figure 4 is a substantially diagrammatical, fragmentary, sectional view showing a modified form of the invention;

Figure 5 is a similar fragmentary, sectional view showing a further modified form of the invention;

Figure 6 is another similar fragmentary, sectional view showing a step involved in the manufacture of another form of the invention;

Figure 7 is a similar fragmentary, sectional view showing a further step in the manufacture of the construction shown in Figure 6;

Figure 8 is a plan view of a panel incorporating the construction shown in Figures 1, 2, and 3;

Figure 9 is a fragmentary plan view of a panel incorporating the construction shown in Figure 4;

Figure 10 is a fragmentary plan view of a panel showing the construction corresponding to Figures 6 and 7;

Figure 11 is an enlarged fragmentary, sectional view through 11—11 of Figure 8 showing one manner in which the panel may be connected to a source of electrical energy;

Figure 12 is a fragmentary, substantially diagrammatical, sectional view taken through 12—12 of Figure 1.

The present invention utilizes as a blank a prepared luminescent panel or lamp which comprises a base member 1, of vitreous enameling steel, which serves as one conductor of the lamp or panel and provides mechanical strength and physical rigidity to the completed structure. The steel base member 1 receives a base coating 2 of ceramic material, such as white porcelain, which constitutes an insulation layer.

Over the base coating or insulation layer 2 there is applied a coating 3 of an electroluminescent phosphor impregnated in a ceramic material. Over the electroluminescent coating 3 there is applied a transparent electrically conducting coating or layer 4. Over this layer is applied a fourth coating or layer of transparent insulation 5. This may be glass-like.

The steel base member 1 and the transparent electrically conducting layer 4 serve as the plates of a condenser, whereas the base ceramic layer 2 and electroluminescent phosphor layer 3 constitutes the dielectric of the condenser. When the steel base member 1 and transparent electrically conducting layer 4 are connected to a source of alternating current, light is emitted from the dielectric-phosphor layer. The transparent insulating layer 5 of glass protects the other layers, particularly the dielectric-phosphor layer 3, from the effects of humidity and mechanical damage, and also provides an insulating outer surface. The coatings are quite thin, the sum of the thicknesses of all of the coatings being less than one-fiftieth of an inch. In the drawings, these layers are necessarily greatly exaggerated in thickness.

Reference is directed particularly to Figures 1, 2, 3, and 8. In the construction here illustrated, the luminescent portion of the panel is utilized as a background, and indicia as represented by the word "OUT" in Figure 8 is without electroluminescence. This is accomplished by sandblasting, chemical etching, or otherwise cutting through the transparent layer 5 and electrically conducting layer 4 to form relieved areas or channels 6. The relieved areas or channels 6 are partially filled with a conductive coating 7. This may be a conductive paint.

The conductive coating 7 is sufficiently deep to provide electrical connection with the conducting layer 4 so that, for example, the central part of the "O" in Figure 8 is electrically connected to the surrounding conducting layer. The coating 7 need not be continuous throughout the relieved areas 6, although as a matter of convenience the coating may be continuous. The conductive coating 7 is opaque so that there is no transmission of luminescence from the underlying phosphor impregnated coating or layer 3. The conductive coating 7 is covered by an insulating filler 8 which may completely fill the relieved areas 6. The insulating filler 8 may have a color contrasting with the surrounding panel so that under daylight conditions, without ultilization of electroluminescent phosphor, the indicia is clearly visible. Under conditions of operation in darkness, the luminescent panels surrounding the relieved areas 6 glow, whereas the relieved areas 6 are dark.

Reference is now directed to Figures 4 and 9. In this construction, the luminescent area constitutes the indicia and the non-luminescent area, constitutes the background. As in the construction of the panel shown in Figure 8, relieved areas 9 are formed by sandblasting, chemical etching, or mechanically cutting away the various layers. In this case, the transparent insulating layer 5, transparent electrically conducting layer 4, and phosphor impregnated layer 3 are removed, leaving the major portion of the base ceramic coating 2 intact. The relieved areas thus form luminescent raised areas 10. Again, it should be noted that the thickness of the layers is greatly exaggerated so that the raised areas 10 are only a few thousandths of an inch above the relieved areas 9. In order that all of the raised

areas 10 be luminescent, it is of course necessary that they be electrically connected. This may be done in several ways, as, for example, in Figure 9 where the letters "IN" are joined by a common base bar 11.

Reference is now directed to Figure 5. In this case, the relieved areas correspond to the relieved areas 9, but, instead of retaining the ceramic base coating 2, all four coatings are removed in the relieved areas exposing the steel base member 1. The relieved areas are then covered by an insulating coating 12, such as an enamel. The coating 12 is preferably applied in such a manner that a meniscus 13 is formed around the margins of the raised areas so as to insulate the transparent electrically conducting layer 4 from the base member 1. In the arrangement shown in Figure 4, the ceramic base coating 2 performs this function.

Reference is now directed to Figures 6, 7, and 10. In the construction of the panel here illustrated, those areas which are to become the luminescent raised areas 14 are covered with an initial protective coating 15 so as to mask these portions of the panel. The transparent insulating layer 5, transparent electrically conducting layer 4, and phosphor impregnated layer 3 are then sandblasted, etched, or otherwise removed in the manner similar to Figure 4 leaving the ceramic base coating 2.

A second protective coating 16 is applied over the raised areas and for a predetermined distance over the ceramic base coating 2 around the raised areas to form marginal areas 17. The unprotected portions of the ceramic base coating 2 are then removed. After the protective coatings 15 and 16 are cleaned from the panel, each of the luminescent areas is surrounded by a marginal area of the base coating 2 which serves to insulate the transparent electrically conducting layer 4 from the base member 1. It should be noted that the thickness of the ceramic base coating 2 and the phosphor impregnated coating 3 are of insufficient thickness to prevent arcing if the transparent electrically conducting layer 4 is exposed at its edges directly above the base member. The marginal areas 17 ensure an adequate minimum spacing between the exposed edges of the conducting layer and the base. As a practical example, the marginal portion 17 may be approximately one-sixteenth of an inch wide.

The manner of providing electrical connections with the base member 1 and conducting layer 4 may be conventional. By way of example, the base member 1 may be provided with a ground terminal 18 and an insulated terminal 19, the insulated terminal 19 being connected by a contact spring 20 to a conductive strip 21 in electrical contact with the conducting layer 4. The conductive strip 21 may be applied within a relieved area similar to the relieved area 6 from which the transparent insulating layer 5 has been removed. The conductive strip 21 may be in electrical contact with the underlying transparent conducting layer 4, or its margins may contact the edges of the layer if the etching has penetrated this layer.

It is not only desirable to sandblast or etch, or otherwise remove, the coatings from those areas which are to form indicia in a luminescent background or luminescent letters on a dark background, but also to provide for various forming and punching operations on the panel. If, for example, it is desired to provide mounting holes, the coatings or layers are etched away in the area of the hole and for a limited marginal distance clear of the hole in the manner shown in Figure 5 or in Figures 6 and 7. After this is done the hole may be punched in the base member 1. The portion of the panel needed for the mounting of the terminals 18 and 19 may be similarly prepared. Still further, if it is desired to fold the panel, the region along the intended fold line is sandblasted or etched so as to remove the various layers, as shown in Figures 1 and 12, so that the panel may be bent or otherwise formed in the area from which the coatings or layers have been removed.

It will be observed that the method of manufacture of the panel is essentially the same in each of the constructions shown; that is, in each instance a panel blank is provided having the various coatings or layers uniformly distributed thereover. The areas to remain luminescent, whether they be background areas or indicia-forming areas, are suitably protected, for example, by a protective coating. The remaining areas which are to be non-luminescent are treated to remove at least the transparent insulating layer 5 and the transparent electrically conducting layer 4.

This basic method is modified as in Figures 1, 2, 3, and 8 by completely or partially covering the non-luminescent areas with a conductive coating 7 and then filling the non-luminescent areas with a suitable insulating and preferably opaque filler 8. This method is primarily suited for the production of non-luminescent indicia on a luminescent background.

If the reverse condition is desired, merely luminescent indicia on a non-luminescent background, the methods shown in Figures 4, 5, 6, 7, 9, and 10 are employed. In these methods the non-luminescent areas are formed by removing the layers to the base coating 2, as in Figure 4, or to the steel base member 1, as in Figure 5, then coating the non-luminescent layer with suitable insulating material 12. In this case, the margins of the raised portions are protected by the meniscus 13 coating the vertical edges of the raised portions.

A further modified method of forming raised luminescent portions involves first masking the luminescent portions to be retained, partially removing the coatings to expose the base ceramic coating 2, then masking the base ceramic portion to the marginal areas around the luminescent portions, and completing the etching or removing process in the luminescent areas until the steel base member 1 is exposed. It of course follows that if the steel base member 1 is exposed, a protective coating thereover will be required, and such coating is preferably transparent so that it may be sprayed over the entire panel.

The method of manufacture also includes the steps of removing the layers to the base metal for the purpose of punching, bending, or otherwise treating or shaping the base member 1.

While particular embodiments of this invention have been shown and described, it is not intended to limit the same to the exact details of the constructions set forth, and it embraces such changes, modifications, and equivalents of the parts and their formation and arrangement as come within the purview of the appended claims.

What is claimed is:

1. An electroluminescent structure comprising a continuous metal base having successive coatings of; an insulating layer, a phosphor bearing layer, a transparent conductive layer, and a transparent insulating layer, and a source of electrical energy connected to said base and conductive layer, at least said phosphor-bearing layer being removed from predetermined areas whereby said areas are non-luminescent.

2. An electroluminescent structure comprising a continuous metal base having successive coatings of; an insulating layer, a phosphor bearing layer, a transparent conductive layer, and a transparent insulating layer, and a source of electrical energy connected to said base and conductive layer, at least said transparent layers being removed from predetermined areas whereby said areas are non-luminescent; and a filler for said non-luminescent areas including conductors bridging between edges of said transparent conductive layer.

3. A method of producing an indicia bearing electroluminescent structure from an electroluminescent blank panel wherein a metal base is coated successively with

an insulating base layer, a phosphor bearing layer, a transparent conductor layer, and a transparent insulating layer, the steps comprising: removing portions of at least said transparent layers to form non-luminescent areas on said panel.

4. A method of producing an indicia bearing electroluminescent structure from an electroluminescent blank panel wherein a metal base is coated successively with an insulating base layer, a phosphor bearing layer, a transparent conductor layer, and a transparent insulating layer, the steps comprising: removing portions of at least said transparent layers to form non-luminescent areas on said panel; bridging said non-luminescent areas with a conductor means; and applying a coating of insulating material over said conductor means.

5. A method of producing an indicia bearing electroluminescent structure from an electroluminescent blank panel wherein a metal base is coated successively with an insulating base layer, a phosphor bearing layer, a transparent conductor layer, and a transparent insulating layer, the steps comprising: removing portions of said layers to expose said insulating base layer thereby to divide said panel into luminescent and non-luminescent areas.

6. A method of producing an indicia bearing electroluminescent structure from an electroluminescent blank panel wherein a metal base is coated successively with an insulating base layer, a phosphor bearing layer, a transparent conductor layer, and a transparent insulating layer, the steps comprising: removing portions of said layers to expose said metal base thereby to divide said

panel into luminescent and non-luminescent areas; and coating said metal base.

7. A method of producing an indicia bearing electroluminescent structure from an electroluminescent blank panel wherein a metal base is coated successively with an insulating base layer, a phosphor bearing layer, a transparent conductor layer, and a transparent insulating layer, the steps comprising: removing portions of said layers to expose said insulating base layer and divide said panel into luminescent and non-luminescent areas; and removing portions of said exposed insulating base layer to form borders around said luminescent areas.

8. A method of producing an indicia bearing electroluminescent structure from an electroluminescent blank panel wherein a metal base is coated successively with an insulating base layer, a phosphor bearing layer, a transparent conductor layer, and a transparent insulating layer, the steps comprising: removing portions of said layers to expose said metal base thereby to divide said panel into luminescent and non-luminescent areas; and performing work operations on said exposed metal base.

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