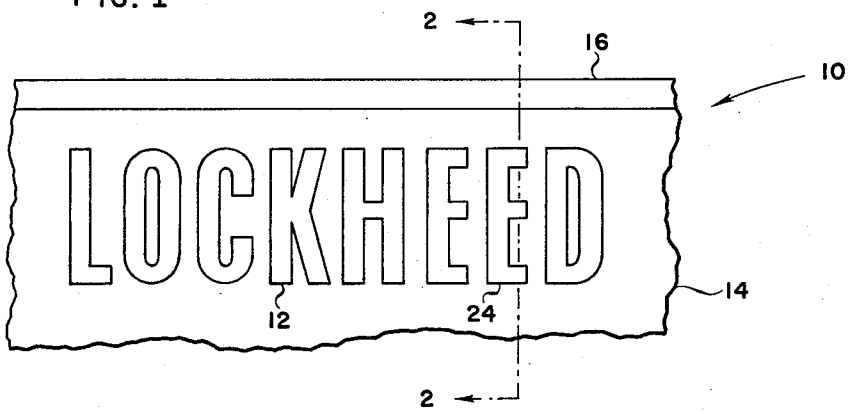
May 11, 1965 W. BROOKS 3,182,415

ELECTROLUMINESCENT DISPLAY PANELS

Filed Nov. 9, 1962

FIG. 1



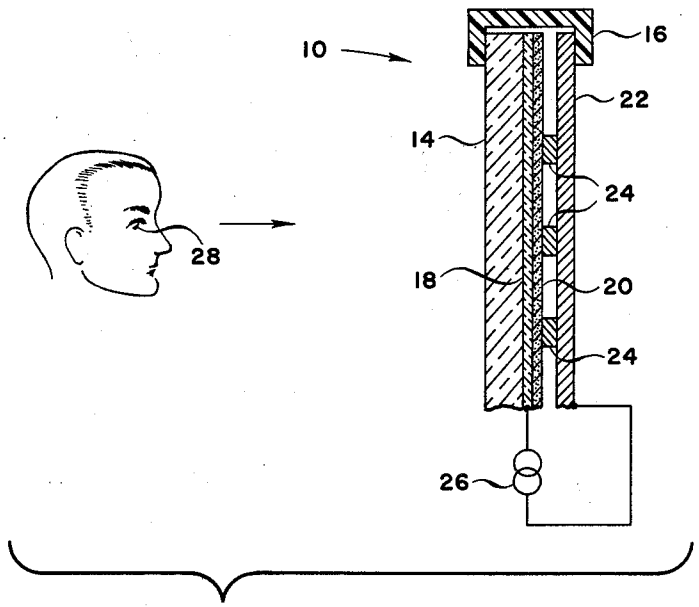




FIG. 2

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# ELECTROLUMINESCENT DISPLAY PANELS

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1 Claim. (Cl. 40—130)

This invention relates to electroluminescent display panels, and more particularly to electroluminescent display panels having associated therewith replaceable alpha-numeric symbols which are responsive to an applied alternating current voltage.

In the prior art, numerous arrangements have been proposed to provide an illuminated panel having alpha-numeric and other symbols therein for purposes of display. In general, such illuminated display panels have included a glass face plate or transparent insulative support member having a first semi-transparent conductive coating on one side thereof, a layer of electroluminescent phosphor covering the first semi-transparent conductive coating, and a second conductive coating covering the phosphor layer. The phosphor glows when an alternating current voltage is applied between the first and second conductive coatings to provide light issuing through the glass face plate. In addition, such devices are usually provided with associated engraved displays which are illuminated by the light issuing through the glass face plate when the engraved display is disposed in the path of the light. In the alternative, the markings or alpha-numeric symbols which are to be illuminated may be formed directly on the exposed surface of the glass in a variety of colors different from that of the phosphor to be illuminated. The phosphor may also act as a background to thereby provide a contrast for ready observation of the display.

Another well known form of display panel in the prior art has a front surface defined by a layer of opaque material, a layer of white translucent material covered by the opaque layer, with the exception of those areas where the white translucent area is exposed through openings in the opaque area, defining the desired markings, or symbols, a relatively thick sheet or layer of clear acrylic material which may be dyed a specific color and carry fluorescent dyes to control color of the emitted light and which is disposed in back of the white translucent layer, a black plate of relatively rigid insulating material which may be also of an acrylic plastic and has recesses in its front face corresponding to the areas of the opaque front layer having alpha-numeric markings defining openings therein, and relatively small electroluminescent plates loosely received in the recesses of the black plate so that when the various plastic sheets and layers are bonded together and voltages applied to the several electroluminescent plates, the latter uniformly illuminate all the alpha-numeric symbols defining openings.

It has been found that the aforesaid prior art devices are not readily adaptable to a wide variety of uses. More particularly, in such applications where it is desirable to have a large electroluminescent display panel of a permanent nature, such as an airline schedule board or an office building directory, for examples, with removable alpha-numeric symbols, the foregoing prior art devices are incapable of providing such features, inasmuch as the alpha-numeric markings which are associated with the display panel are usually made a permanent part thereof or require the replacement of the entire message to be displayed by the panel. In addition, the symbols are not of conductive material so as to be compatible with an electroluminescent device. Thus, it can readily be seen that prior art devices are incapable of providing an arrangement whereby the alpha-numeric symbols or markings



may be changed at will to thereby provide greater versatility where such versatility is required.

The present invention obviates the disadvantages and shortcomings of such prior art display panels by providing a unique and different approach to the display of conventional alpha-numeric symbols. More specifically, the present invention provides an electroluminescent display panel having a transparent support member or face plate with a transparent conductive coating on one side thereof, a layer of electroluminescent phosphor over the transparent conductive coating, a counter electrode, and a plurality of flexible, replaceable alpha-numeric symbols sandwiched between the exposed surface of the electroluminescent phosphor layer and the counter conductive electrode. The surface of the alpha-numeric symbols, which is in contact with the electroluminescent phosphor, causes the electroluminescent phosphor in the area in contact with the symbols to be illuminated when an alternating current voltage is applied between the transparent conductive coating and the counter electrode in such a manner that light issues through the transparent insulative support member.

Accordingly, it is the broad objective of this invention to provide an improved electroluminescent display panel which is adapted for readily changing the individual symbols of a display.

Another object of the invention is to provide an electroluminescent display panel in which a plurality of interchangeable alpha-numeric symbols are utilized to provide greater versatility and for ready reading in the use of the display panel.

Still another object of the invention is to provide an electroluminescent display panel having a plurality of flexible conductive alpha-numeric symbols which make uniform contact with the electroluminescent phosphor to thereby illuminate only the area in contact with the conductive symbol.

Yet another object of the invention is to provide an electroluminescent display panel having a plurality of replaceable alpha-numeric symbols which is economical, simple, and capable of providing a wide variety of displays.

The novel features which are believed to be characteristic of the invention, both as to its organization and method of construction and operation, together with further objects and advantages thereof, will be better understood with the following description considered in connection with the accompanying drawing in which illustrative embodiment of the invention is displayed by way of example. It is expressly understood, however, that the drawing is for purposes of illustration and description only and does not define limitations within the invention.

In the drawing:

FIGURE 1 is a diagrammatic view of an electroluminescent display panel illustrating the use of alphabetical letters in a display device according to the invention.

FIGURE 2 is a fragmentary cross-sectional view of the display panel shown in FIGURE 1 taken along lines 2—2 illustrating the cross-sectional details of the construction of the device and arrangement of the panel in accordance with the invention.

With reference to the drawing, FIGURE 1 shows a section of a display panel 10 which has a plurality of conductive, flexible alphabetical letters 12 which extend along the length thereof to form a display message and to provide an illuminated presentation of the alphabets which is transmitted to a viewer through an insulative front panel 14. In addition, there is shown a clamping member 16 which is provided to hold the conductive alphabets in electrical contact between the associated

electroluminescent phosphor and conductive backing electrode.

The construction details of the panel may be understood more readily by a reference to FIGURE 2, in which the insulative support member 14, which may be of any suitable material such as glass or plastic, has a transparent conductive coating 18 deposited thereon to form a first conductive electrode of the device. The device also includes a layer of electroluminescent phosphor 20 being disposed over the exposed surface of the transparent conductive coating 18, a plurality of alphabetical letters 12 sandwiched between the phosphor 20 and a counter electrode 22 which forms the second conductive element for the device for the application of an applied voltage. In FIGURE 2 there is shown three sections designated 24, of the letter "E," illustrating the manner in which an alphabetical symbol makes intimate contact between the phosphor layer 20 and the counter electrode 22, thereby defining the area which is illuminated when an alternating current voltage is applied between electrodes 18 and 22. The voltage supply for the device is symbolically shown and designated by reference numeral 26. No special voltage supply is required and may be one of several types commercially available.

In operation, the voltage supply 26 is raised to or set at a predetermined voltage level whereby an electric field produced by the circuit current will cause the electroluminescent phosphor to be excited. Illumination of the phosphor is restricted to the region adjacent the alpha-numeric symbols such as 24 shown in FIGURE 2 of the present embodiment, thereby defining the areas from which light issues through the panel face plate 14. The light issuing from the panel 10 is communicated to a viewer, symbolically illustrated by a human eye 28 shown in FIGURE 2.

It should be noted at this point that the sharpness of the displayed image issuing from the phosphor adjacent the alpha-numeric symbol is a function of the phosphor utilized and the cross-section configuration of the alpha-numeric symbols employed. More particularly, it has been found that the use of a phosphor having a relatively high light versus voltage characteristic will provide an unusually clear display. Such a phosphor as that disclosed in the commonly assigned copending patent application Serial Number 191,882, filed May 2, 1962, entitled "Improved Electroluminescent Phosphor and Method for Making Same," by William Brooks, has been found to provide such results. In a similar manner, satisfactory results have been obtained by moulding the alpha-numeric symbols from a resin loaded with graphite or metal particles to make the symbols conductive. A preferred material suitable for this purpose is Conductive Resin No. 1200, produced and available from Chomerics, Inc., at 341 Vassar Street, Cambridge 39, Massachusetts. The alpha-numeric symbols may be formed by spreading the conductive resin material in a preselected mold form to produce a thickness of about 1/16", which has been found satisfactory. It should be noted that the thickness has not been found to be critical and will depend upon the particular phosphor and the magnitude of the voltage applied thereto. It is desirable to have the surfaces of the phosphor and symbols in total contact with one another to insure efficient current flow therebetween. Thus, it has been found advantageous to employ a compressible material for the symbols.

In closing, it is useful to summarize some of the advantages of the present invention. One such advantage involves the use of a unique light output electroluminescent phosphor having a rapid light decay versus voltage characteristic which enhances the resolution or sharpness of the display, since there is little or no light dispersion associated with the illumination of the phosphor in the region adjacent the alpha-numeric symbols.



Another advantage of the present invention arises from the use of the unique removable and replaceable alpha-numeric symbols which may be fabricated economically and easily to provide means for rapidly changing the message to be displayed on a particular panel and thereby increases the versatility of the display panel. In contrast, the prior art devices are rather expensive in that they cannot be readily and economically modified to accommodate the messages displayed thereon without a major modification of the display panel itself.

It is to be understood that the above-described embodiment is only illustrative of the principle applicable in the invention. Numerous other arrangements and modification may be defined by those skilled in the art without departing from the spirit and scope of the invention. Thus, by way of example, and not limitation, the cross-sectional configuration of the alphabet illustrated by sections 24 of the letter "E" may be made in a configuration other than a rectangle; that is, the portion adjacent the phosphor may be smaller than the portion adjacent the counter conductor 22 which would provide sufficient area at the back of the letter for good electrical connection and would provide a small area adjacent the phosphor in order to make the size of the alpha-numeric letter smaller while still providing good electric contact with the phosphor. It should be noted at this point, however, that such an arrangement may not have all the advantages of the arrangement disclosed in the illustrated embodiment of the present invention. Accordingly, it is to be understood that the present invention is limited only by the spirit and scope of the appended claim.

What is claimed is:

An electroluminescent display panel comprising: five layers including an insulative transparent support member, a transparent conductive layer superimposed on one side of said support member, a layer of electroluminescent phosphor material superimposed over said conductive layer, and a second conductive layer having a removable symbolic message of conductive material sandwiched between said phosphor layer and said second conductive layer; clamping means for keeping said symbolic message sandwiched between said phosphor layer and said second conductive layer; and electrical connection means to said first conductive layer and said second conductive layer for applying an alternating current voltage thereto for exciting said electroluminescent phosphor layer in regions defined by a conductive symbolic message adjacent thereto which may be viewed by one facing the unobstructed surface of the transparent support layer.


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