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DISPLAY DEVICE

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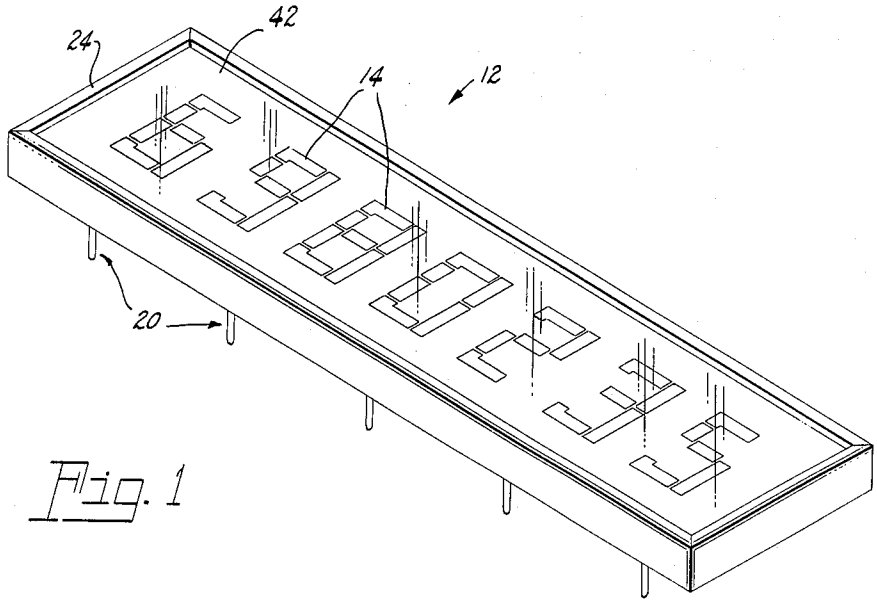


Fig. 1

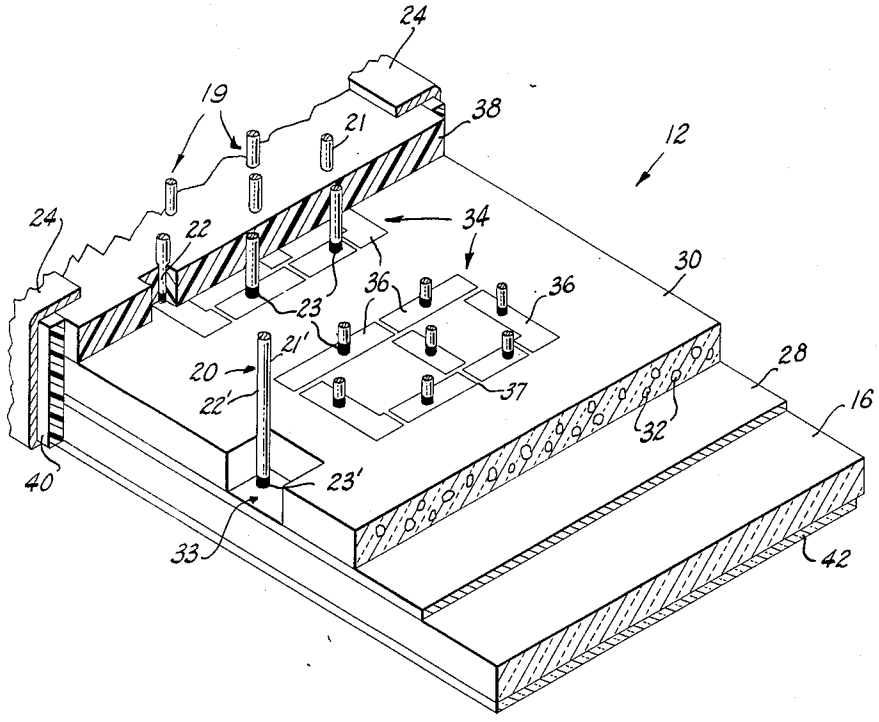


Fig. 2

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DISPLAY DEVICE

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This invention relates to electroluminescent display devices and more particularly to devices wherein a plurality of similar configurations may be simultaneously viewed for association thereof.

A variety of individual illuminated display devices are commonly employed in the visual portrayal of information. Gaseous ionization, incandescence, and electroluminescence have been used to selectively accentuate configurations such as letters (alphas), numerals (numerics), and multiple manifestations of either (alphanumerics). Individual characterizations such as numerics have limited utility; therefore, it is usually advantageous to provide for the simultaneous activation of two or more associated numerics to portray the desired data. In the past the combining of two or more of these individual units resulted in bulky and unwieldly arrangements usually requiring additional supporting or retaining structures. Thus there were structural limitations restricting minimum spacing of units. Such segmentation between individual configurations detracted from the desired association therebetween. In addition, the segmentation or breakup of the display surface formed edge barriers which often restricted the viewing angle.

Accordingly, an object of this invention is to reduce the aforementioned disadvantages by providing a compact electroluminescent display device wherein a plurality of separate and independent configurations are contained on a common substrate base.

An additional object is to provide a common first electrode for all of the configurations disposed on the common substrate so that fewer external electrical connections are required.

Another object is to provide for uniformity of brightness by disposing a continuous layer of electric field responsive phosphors on the common substrate.

A further object is to facilitate close spacing of the separate and independent configurations so that close association of the plurality may be evidenced with ease.

Still further objects are to provide a multiple display in a unitized assembly that can be advantageously manufactured and commercially utilized, and one wherein an unbroken display of sequential information may be viewed with adequate association from wide angle perspective.

The foregoing objects are achieved in one aspect of the invention by the provision of an electroluminescent multiple display device having a plurality of electrodes functioning as independent configurations contained on a continuous layer of electroluminescent phosphors which is disposed on a conductively coated transparent substrate. Electrically conductive pins in an insulative baseboard make contact with the plurality of display configurations, and the device is sealed and packaged as a unitized assembly.

For a better understanding of the present invention, together with other and further objects, advantages, and capabilities thereof, reference is made to the following disclosure and appended claims in connection with the accompanying drawings in which:

FIGURE 1 is a perspective view showing the viewing area of the device; and

FIGURE 2 is an inverted cut-away perspective portraying structural details.

Referring to FIG. 1, there is shown an electroluminescent display device 12 wherein a plurality of configurations 14, such as numerals, letters, or other data conveying signs or symbols may be evidenced through the light transmissive substrate 16 when the electroluminescent phosphor areas therebeneath are activated. Two groups of electrical pin connections 19 and 20 facilitate plug-in adaptability of the device 12. Peripheral protection and ruggedness are unhanced by the circumscribing frame 24 which may be of metal or plastic formed to provide fitted edge engagement.

Referring in greater detail to FIG. 2, there is shown an inverted cut-away view detailing the structural aspects of the device 12. The light transmissive insulative substrate 16 may be of a material exhibiting a high degree of transparency as exemplified by glass or plastic. Since the substrate forms the front or face of the device 12, the light transmission characteristic thereof is such as to heighten visual contrast of the luminescent display information viewed therethrough.

Upon the inner surface of substrate 16 there is disposed an unbroken layer of transparent electrical conductive material providing a continuous first electrode 28. This may be a material such as tin oxide applied in a conventional manner, for example vapor deposition in the presence of heat; or thin films of gold or antimony suitably disposed by evaporative techniques.

Contiguous to the first electrode 28 and overlaying the same is an unbroken dielectric layer 30 of ceramic or plastic containing embedded particles of an electric field responsive phosphor 32 such as zinc sulfide or other materials of similar responsive nature. Several specific holes or voids 33 are formed initially in the dielectric 30 to facilitate subsequent electrical connections to be made therethrough with first electrode layer 28.

A plurality of electrically conductive display configurations or second electrodes 34, being of a metallic material such as aluminum, gold, or silver are suitably disposed on dielectric layer 30 as by any of a number of acceptable means as for example vacuum vapor deposition, spray masking or photoetching techniques. To achieve versatility, each of the configurations 34 may be composed of a multiple number of separated independently operative second electrode segments 36 which are electrically insulated from one another by the separation spacings 37 therebetween.

Over this layer of second electrode configurations 34 there is alignigly placed a compatibly shaped insulative baseboard 38 having discretely positioned and positively staked therein a plurality of electrical connections comprising two groups 19 and 20. These are in the form of metal pins providing external connective projections 21 and 21', staked portions 22 and 22' and internal electrically conductive rubber terminals 23 and 23'. Second electrode electrical connections 19 comprising external connective projections 21, staked portions 22 and conductive rubber terminals 23 are oriented to contact the individual second electrode segments 36. In similar fashion, first electrode electrical connections 20 comprising external projections 21', staked portions 22' and conductive rubber terminals 23' are positioned to contact several discrete areas on the first electrode layer 28 through the several special voids 33 in the dielectric layer 30.

The electrically conductive rubber terminals 23 and 23' are similarly formed to facilitate pressured electrical contact engagement with each of the several individual electrode segments 36 and discrete areas on the first electrode layer 28. Thus the plurality of individual internal electrical contacts are adequately and collectively accomplished by the application of suitable pressure, such

as by temporary clamping, to the aligned baseboard-substrate assembly.

Electrical connections with the first electrode layer **28** are usually made on discrete areas at spaced intervals to insure voltage uniformity across the lighted display area. A voltage drop in the first electrode layer **28** sufficient to deleteriously affect electroluminescent brightness would be highly objectional. Therefore, to insure the availability of desired voltages across the lighted display area for optimum operation, it is preferable that an electrical contact area be discretely provided for approximately each two square inches of display area. At less than optimum operating requirements, at least one contact area for approximately each ten square inches of lighted display area is used.

With the insulative baseboard **38** temporarily clamped in pressured alignment with the substrate **16** and layers **28**, **30**, and **34** therebetween, a high temperature type substantially edge-disposed seal **40** of suitable materials such as waxes or epoxies is applied to the contiguous peripheries thereof effecting an internal hermetically edgewise bonded unitized assembly wherein the internal conductive rubber terminals **23** and **23'** are pressurally maintained in electrical contact relationship with the first electrode **28** and the individual second electrode segments **36**.

A frame **24** of a suitable metal such as aluminum or steel being substantially U-shaped in cross section, circumscribes the periphery of the unitized assembly and completes the packaging of the device thereby imparting added protection and ruggedness. If so desired, a plastic frame molded to have a substantially U-shaped cross section for fitted peripheral engagement may be utilized. Plastic materials such as the polyethylenes, polypropylenes or vinyls are adaptable for molding into frames having a degree of flexure suitable to facilitate manipulation for circumscribing engagement.

To achieve a reduction in ambient light reflection a layer of suitable coating material **42** such as colloidal silicate and lacquer is applied by spray technique or film deposition to the external surface of substrate **16**. This layer **42** may be applied before or subsequent to the application of the framing **24**. Other means for reducing ambient light reflection would include chemically etching or mechanically abrading the external surface of the substrate.

Selective application of a suitable electrical potential through a signal translator, not shown, to the first electrode **28** and the selected segments **36** of selected configurations **34** activates to a state of electroluminescence specific areas of the electric field responsive phosphors **32** contained in dielectric layer **30** therebetween.

A typical operating potential for this type of device would be 250 v. A.C. at 400 c.p.s. Although dependent upon the degree of brightness desired, the operating potentials may be suitably varied within a voltage range of 50 to 800 v. and a frequency range of 60 to 15 kc. c.p.s.

Thus a luminescent display of a plurality of closely spaced configurations **14** may be evidenced as shown in FIG. 1 While numerics are shown, alphas, alphanumerics and numerous other signs and symbols may be suitably displayed in like manner.

There has been described an electroluminescent multiple display device wherein a plurality of separate and independent configurations are contained on an unbroken viewing area in closely spaced relationship to easily facilitate association therebetween. In addition to the common viewing area or substrate, the use of a common first electrode reduces the number of electrical connections required. The continuous layer of electric field responsive phosphors in connection with the common substrate eliminates distracting segmentation between configurations, promotes uniformity of brightness and permits wide angle viewing perspective. Thus this compact unitized multiple display device advantageously meets a need for closely associated independent configurations that has been heretofore unfulfilled.

While there has been shown and described what is at present considered the preferred embodiment of the invention, it will be obvious to those skilled in the art that various changes and modifications may be made therein without departing from the scope of the invention as defined by the appended claims.

What is claimed is:

1. In an electroluminescent display device having a viewing portion formed of a transparent substrate with a substantially transparent first electrode layer applied to the inner surface thereof, over which a dielectric-phosphor-containing layer is disposed with a plurality of electrically conductive configurations discretely formed thereon to function as separately excitable second electrodes, a structural combination comprising:

a preformed insulative baseboard, having a plurality of electrical pin connections oriented therein to extend therethrough, positioned contiguous to said second electrodes, said electrical connections being discretely located and formed to make pressured electrical contact with said respective first electrode and said plurality of second electrodes; and

a continuous hermetic seal substantially edge-disposed in a peripheral manner to provide integral edgewise bonding of said substrate having said integral layers and electrodes thereon with said preformed baseboard to form a unitized assembly.

2. In an electroluminescent display device having a viewing portion formed of a transparent substrate with a substantially transparent first electrode layer applied to the inner surface thereof, over which a dielectric-phosphor-containing layer is disposed with a plurality of electrically conductive configurations discretely formed thereon to function as separately excitable second electrodes, a structural combination comprising:

a preformed insulative baseboard, having a plurality of electrical pin connections oriented therein to extend therethrough, positioned contiguous to said second electrodes, said electrical connections being discretely located and formed to make pressured electrical contact with said respective first electrode and said plurality of second electrodes;

a continuous hermetic seal substantially edge-disposed in a peripheral manner to provide integral edgewise bonding of said substrate having said integral layers and electrodes thereon with said preformed baseboard to form a unitized assembly; and

means for reducing ambient light reflection formed relative to the external surface of said substrate.

3. In an electroluminescent display device having a viewing portion formed of a transparent substrate with a substantially transparent first electrode layer applied to the inner surface thereof, over which a dielectric-phosphor-containing layer is disposed with a plurality of electrically conductive configurations discretely formed thereon to function as separately excitable second electrodes, a structural combination comprising:

a preformed insulative baseboard, having a plurality of electrical pin connections oriented therein to extend therethrough, positioned contiguous to said second electrodes, said electrical connections being discretely located and formed to make pressured electrical contact with said respective first electrode and said plurality of second electrodes;

a continuous hermetic seal substantially edge-disposed in a peripheral manner to provide integral edgewise bonding of said substrate having said integral layers and electrodes thereon with said preformed baseboard to form a unitized assembly; and

a protective frame of substantially U-shaped cross section formed to provide circumscribing peripheral engagement with said unitized assembly.

4. In an electroluminescent display device having a viewing portion formed of a transparent substrate with a substantially transparent first electrode layer applied to the inner surface thereof, over which a dielectric-phosphor-containing layer is disposed with a plurality of electrically conductive configurations discretely formed thereon to function as separately excitable second electrodes, a structural combination comprising:

a preformed insulative baseboard, having a plurality of electrical pin connections oriented therein to extend therethrough, positioned contiguous to said second electrodes, said electrical connections being discretely located in said baseboard and formed to provide externally extending pin connectors with internally extending portions making internal pressured electrical contact with said respective first electrode and said plurality of second electrodes, said internal electrical contact being provided by a conductive pressure adaptive terminal on each of said pin connections formed for contact engagement with each of said respective electrodes; and

a continuous hermetic seal substantially edge-disposed in a peripheral manner to provide integral edgewise bonding of said substrate having said integral layers and electrodes thereon with said preformed baseboard to form a unitized assembly wherein said internal conductive terminals of said pin connections are collectively pressured for individual electrical contact engagement with each of said respective electrodes, said edge-disposed seal being of a material differing from the insulative material of said baseboard.

5. In an electroluminescent display device having a viewing portion formed of a transparent substrate with a substantially transparent first electrode layer applied to the inner surface thereof, over which a dielectric-phosphor-containing layer is disposed with a plurality of electrically conductive configurations discretely formed thereon to function as separately excitable second electrodes, a structural combination comprising:

a preformed insulative baseboard, having a plurality of electrical pin connections oriented therein to extend therethrough, positioned contiguous to said second electrodes, said electrical connections being discretely located in said baseboard and formed to provide externally extending pin connectors with internally extending portions making internal pressured electrical contact with said respective first electrode and said plurality of second electrodes, said internal electrical contact being provided by a conductive pressure adaptive terminal on each of said pin connections formed for contact engagement with each of said respective electrodes;

a continuous hermetic seal substantially edge-disposed in a peripheral manner to provide integral edgewise bonding of said substrate having said integral layers and electrodes thereon with said preformed baseboard to form a unitized assembly wherein said internal conductive terminals of said pin connections are collectively pressured for individual electrical contact engagement with each of said respective electrodes, said edge-disposed seal being of a material differing from the insulative material of said baseboard; and

a protective frame of substantially U-shaped cross section formed to provide circumscribing peripheral engagement with said unitized assembly.

6. An electroluminescent display device comprising in combination:

a substantially light transmissive insulative substrate having external and inner surfaces affording an unbroken viewing area;

means for reducing ambient light reflection formed relative to said external surface of said substrate;

a transparent electrically conductive layer contiguously disposed on the inner surface of said substrate to provide a common first electrode, said first electrode having at least one discrete electrical contact area per ten square inches of display area;

a dielectric layer, having electric field responsive phosphors embedded therein, disposed over said first electrode, said dielectric layer having at least one void therein in alignment with each of said first electrode contact areas;

a preformed insulative baseboard having a plurality of electrical pin connections oriented therein to extend therethrough positioned contiguous to said second electrodes, said electrical connections being discretely located and formed to make pressured electrical contact with said plurality of second electrodes and with said first electrode through said dielectric voids;

a continuous hermetic seal substantially edge-disposed in a peripheral manner to provide integral edgewise bonding of said substrate having said integral layers and electrodes thereon with said preformed baseboard to form a unitized assembly wherein said internal conductive terminals of said pin connections are collectively pressured for individual electrical contact engagement with each of said respective electrodes, said edge-disposed seal being of a material differing from the insulative material of said baseboard; and

a protective frame of substantially U-shaped cross section formed to provide circumscribing peripheral engagement with said unitized assembly.

7. An electroluminescent display device according to claim 6 wherein the number of first electrode contact areas is preferably one per approximately each two square inches of display area.

8. An electroluminescent display device according to claim 5 wherein said protective frame is preformed of a plastic material having a degree of flexure suitable to facilitate manipulation for circumscribing peripheral engagement of said unitized assembly.

9. An electroluminescent display device according to claim 6 wherein said means for reducing ambient light reflection is in the form of a coating of colloidal silicate and lacquer applied to the external surface of said substrate.

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