

[54] **SEGMENTED ELECTRODE DISPLAY PANEL HAVING CLOSED STRUCTURE**

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[51] Int. Cl. **H01j 7/42**

[58] Field of Search **313/109.5; 315/169 R, 169 TV; 340/336**

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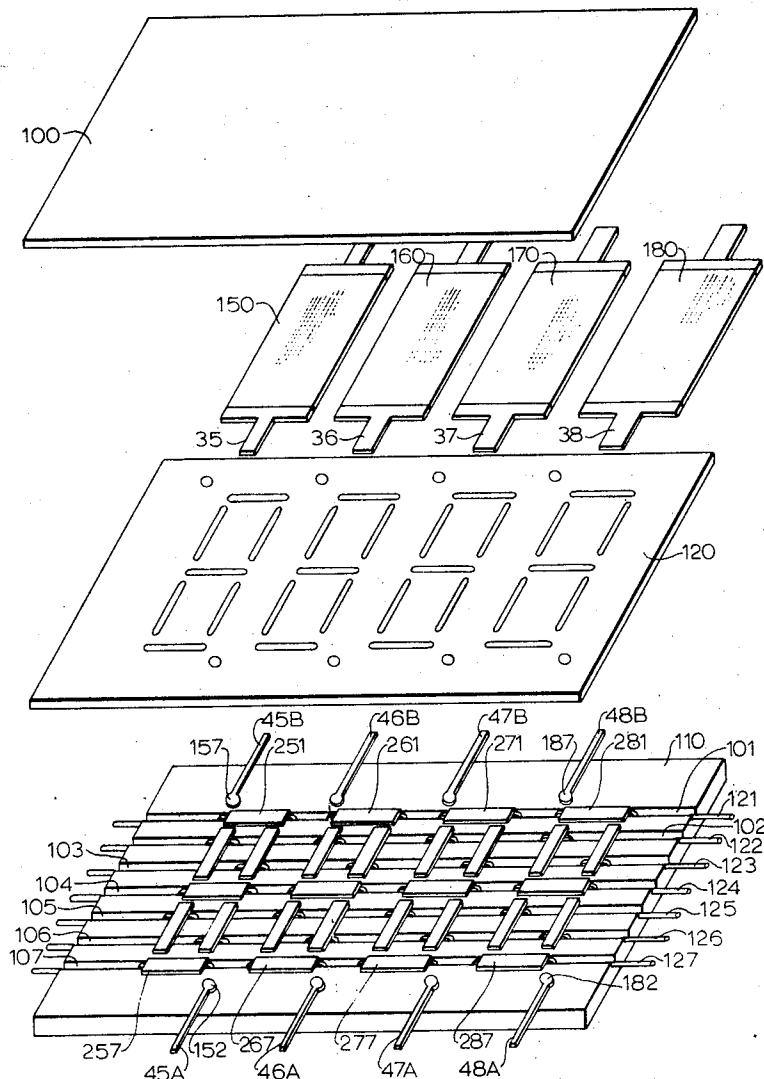
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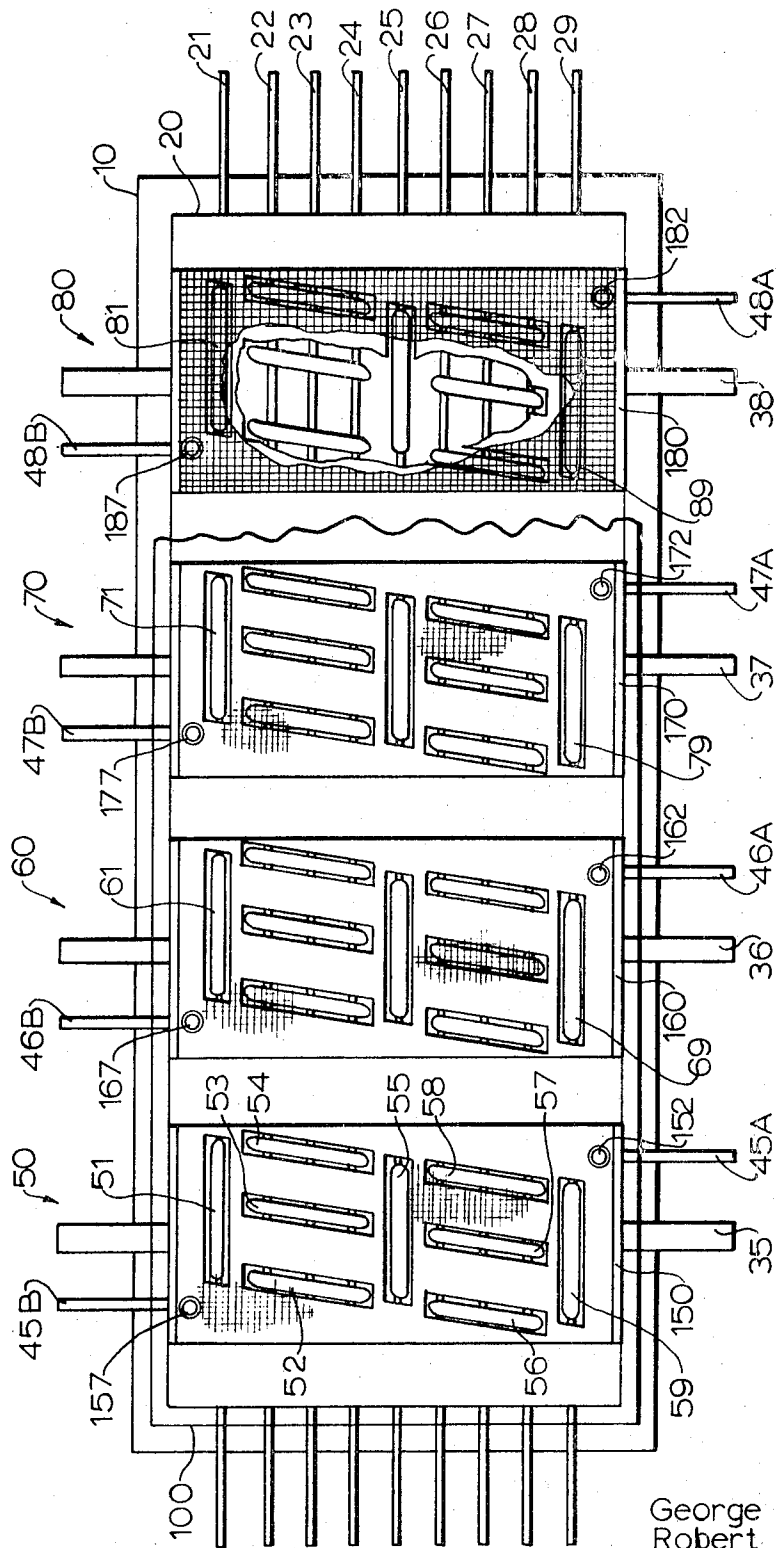
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[57] ABSTRACT

Multiple position display panels for displaying one or more characters side-by-side in one or more rows and including a plurality of parallel elongated conductors bearing a plurality of flat cathode segments along their length and an anode associated with each group of the display segments. Portions of the cathode-connecting conductors are offset and are disposed within grooves or depressions in an insulating sheet or are embedded in an insulating layer where the cathode elements cross them. A slotted insulating sheet is disposed between the cathode elements and the anodes, the slots being aligned with the cathodes, and the assembly is sealed in a gaseous atmosphere at a suitable pressure.

6 Claims, 7 Drawing Figures





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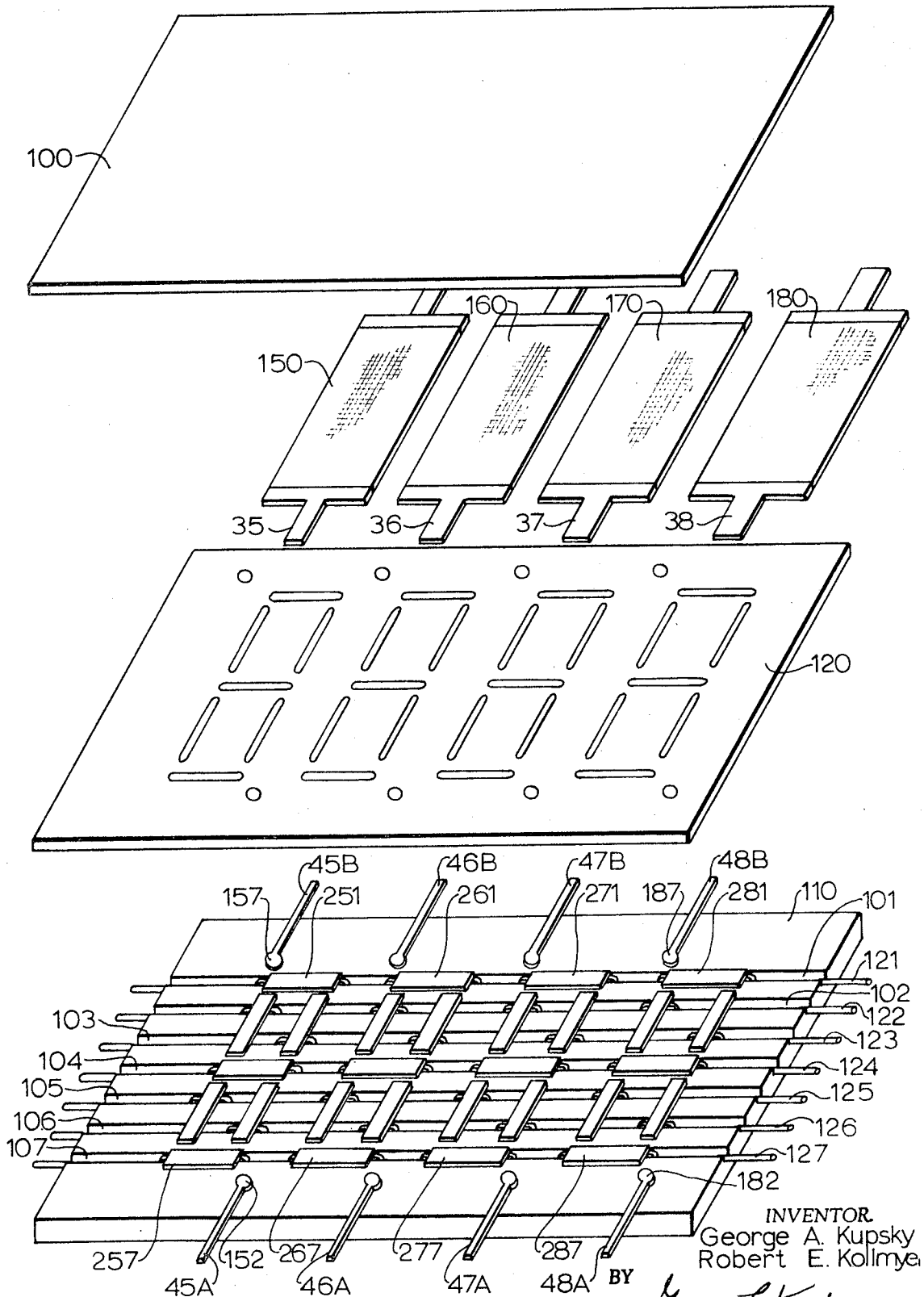
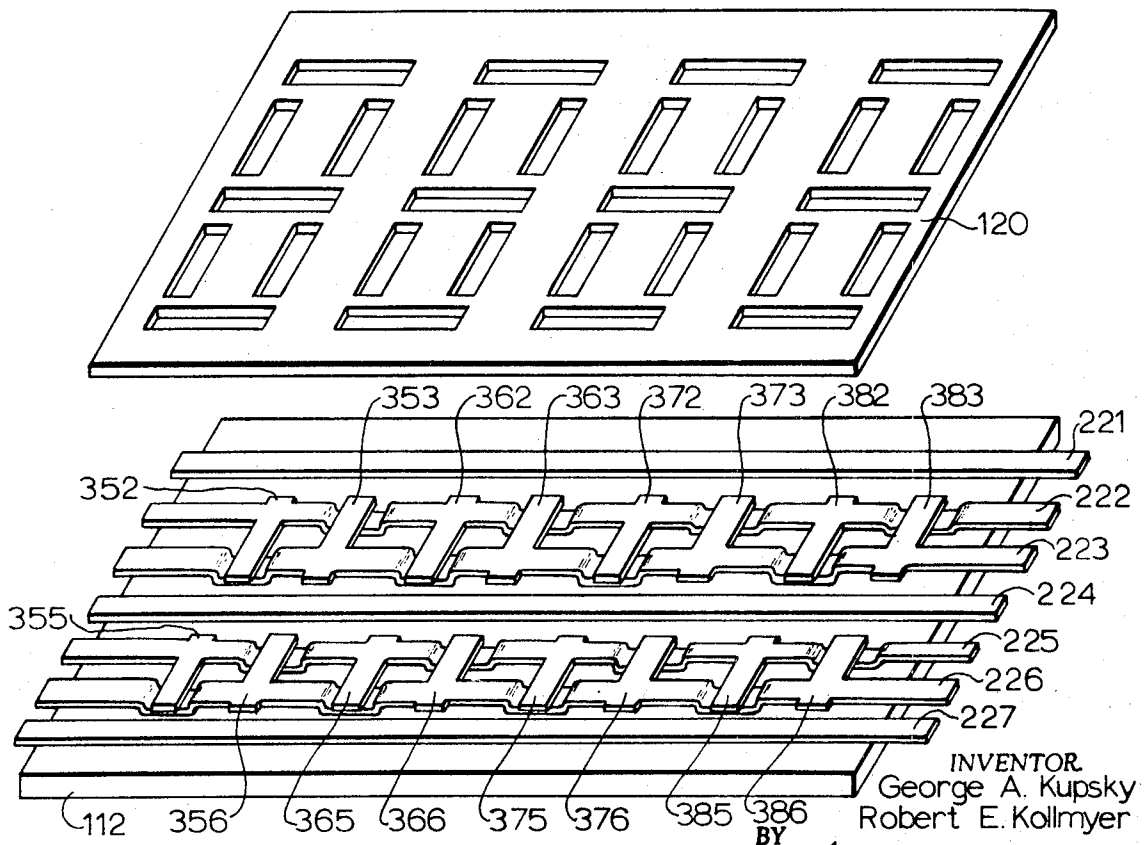
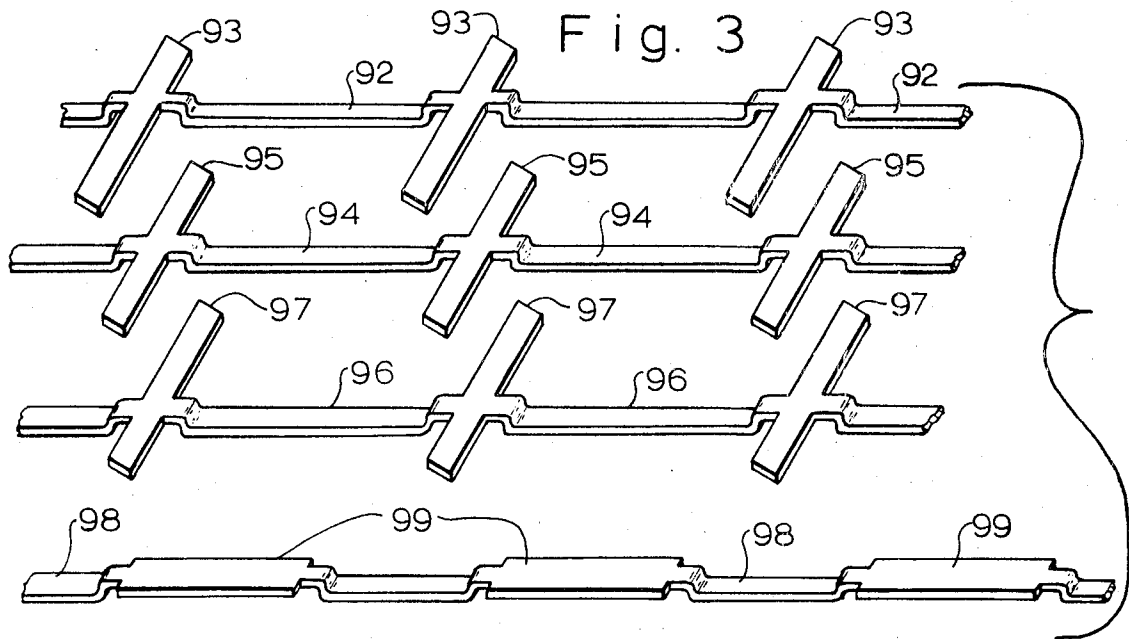


Fig. 2

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Fig. 5

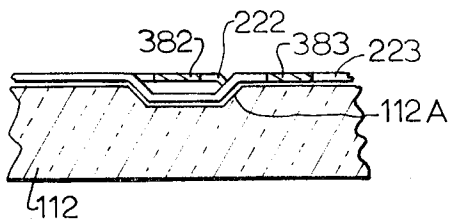


Fig. 6

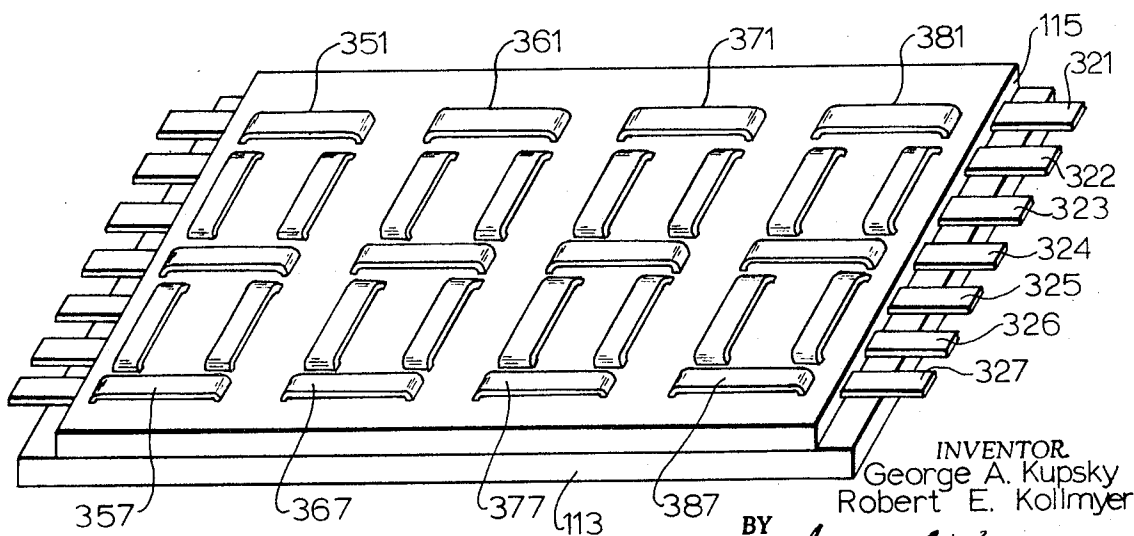
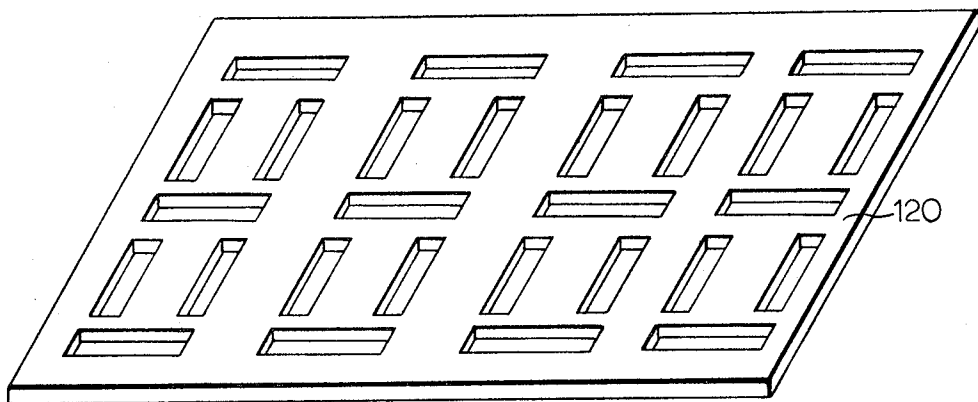
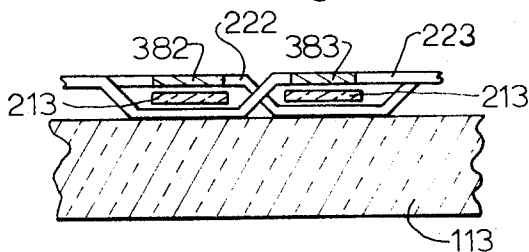


Fig. 7

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SEGMENTED ELECTRODE DISPLAY PANEL HAVING CLOSED STRUCTURE

BACKGROUND OF THE INVENTION

This invention relates to multiple position display panels having a plurality of interconnected cathode electrode segments positioned in a row for displaying characters side-by-side.

One multiple position display device which is available commercially is known as a PANAPLEX numeric panel display. This type of display panel includes a plurality of groups of display elements which are in the form of elongated bars or segments. Each group of segments is arrayed generally in a figure 8 pattern or the like, and the various segments can be energized in different groups to represent different characters. This type of panel includes, as one of its advantageous features, identical cathode structures which comprise elongated support members, each of which carries a plurality of plate-like cathode segments spaced along its length. Generally, in the manufacture of this type of panel, the desired number of cathode structures are assembled in grooves in a support plate with the cathodes oriented on edge, and selected cathodes are bent or twisted to provide the desired figure 8 pattern. Although these devices are manufactured with relative ease and they operate well, it can be seen that the procedures involved in providing precise grooves in a base plate and in bending the individual cathode segments is undesirably time-consuming and expensive.

In addition, since the cathodes are edge-mounted and it is the glowing edges that are viewed, certain disadvantages arise. For one thing, power consumption is relatively high for a sufficiently bright display. Also, positive column discharge or other electrical interference or cross-talk often arises between adjacent groups of cathode segments and their anodes, giving rise to spurious glow or discharge in the device.

One approach to solving this problem is to provide an auxiliary electrode partially surrounding and electrically isolating the groups of cathode segments and their anodes from each other. Anode electrodes of special shapes for insertion beneath the cathode segments are also used sometimes. This is a complicated and costly arrangement, however.

SUMMARY OF THE INVENTION

Accordingly, an object of this invention is to reduce electrical interference and cross-talk between adjacent character positions in multiple position segmented-electrode display devices.

Another object of the invention is to simplify and reduce the cost of multiple position character display panels having segmented display electrodes.

In accordance with these objects, there is provided multiple position display devices having a plurality of parallel elongated conductors bearing substantially flat cathode display segments or elements along their length and an anode associated with each group of display segments. Portions of the conductors interconnecting the cathode elements are disposed within groups or depressions in an insulating sheet or layer where the cathode elements cross them. A slotted insulating sheet is disposed between the cathode elements and their anodes, with the slots in alignment with the elements in a sealed gaseous atmosphere.

Briefly, a display panel embodying the invention and of the general type described above includes cathode structures in which the cathode segments are generally flat plates, and they are preformed to the desired orientation so that, in manufacture, no bending or twisting of the cathodes is required.

According to a feature of the invention, the slots in the insulating sheet can be made larger than the cathode elements beneath them to expose them completely or they may be made smaller than the corresponding segments to restrict and define the glow observable by the viewer, thus providing a sharper character outline, as desired.

The invention also eliminates the need for an auxiliary suppressor electrode and reduces cross-talk in such multiple position segmented electrode devices as a result of its closed structure. Furthermore, the use of flat cathode elements eliminates the need for bending or twisting cathode segments. They also reduce the power required to provide a sufficiently bright display by a significant amount since the glow discharge is confined to the top surface of the flat cathode segments in the device.

DESCRIPTION OF THE DRAWINGS

FIG. 1 is a plan view, partly broken away, of a multiple position nine-segment display panel incorporating the invention;

FIG. 2 is an exploded view of a multi-position seven-segment display panel showing the structure of another embodiment;

FIG. 3 is an illustration of four representative cathode connectors bearing flat cathode segments for use in such embodiments;

FIG. 4 is an exploded view of the base assembly of another embodiment;

FIGS. 5 and 6 are sectional views showing variations of the electrode and base plate arrangement; and

FIG. 7 is an exploded view of the base assembly of a further embodiment.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

According to FIGS. 1 and 3 a display panel incorporating the present invention includes a base plate 10 of glass, ceramic or the like on which is disposed a plurality of cathode conductors or connectors 21-29. Each of these connectors bears a plurality of substantially flat cathode segments. That is, conductor 21 bears and thus interconnects cathode segments 51, 61, 71 and 81; connector 22 bears and connects cathode segments 52, 62, 72, and 82; conductor 23 connects cathode segments 53, 63, 73, and 83; . . . and conductor 29 connects cathode segments 59, 69, 79, and 89. Each of the cathode segments is fixed to the corresponding cathode connector by welds or the like or is formed integral therewith. The cathode conductors and their associated segments are oriented so that they are not in electrical contact with each other.

The character display positions 50 - 80 also each includes a pair of decimal point cathode elements or the like 152 and 157, 162 and 167, 172 and 177, 182 and 187. These decimal point elements are of comparable thickness to the other cathode electrodes and are also supported by base plate 10. Decimal point elements 152 - 182 are connected to terminal leads 45A - 48A and decimal electrodes 157 - 187 are connected to ter-

minal leads 45B - 48B, respectively. The decimal points might also be commas or the like.

A dielectric plate or sheet 20 having slots aligned with each of the cathode segments to be viewed is disposed above and in substantial contact with the cathode segments. The slots in the dielectric sheet 20 define the viewing apertures for the corresponding cathode elements and isolates them from each other both optically and electrically. The insulating sheet 20 includes openings for each of the decimal point cathodes as well as slots for each of the cathode elements, as shown.

A planar anode 150, 160, 170 or 180 is disposed on the apertured insulating sheet 20 in alignment with the corresponding display positions 50 - 80. The anodes are formed of mesh screen members, etched screen material or any other transparent or semi-transparent material. Terminal leads 35 - 38 are connected at one or at both ends (as shown) of the corresponding anode electrodes 150 - 180.

The display device is completed by a glass cover plate or the like which is sealed around the edges to the base plate by a glass or ceramic frit or the like and the device is evacuated and filled with a suitable gas mixture such as neon, argon, xenon, etc., singly or in combination, between about 20 - 250 Torr at ambient temperature through a tubulation (also not shown).

The cathode segments oriented at an angle to the cathode connectors cross over the adjacent connectors, as may be seen in the broken-away portion of FIG. 1. As previously indicated, the cathode display segments may be either fixed to cathode conductors 21-29 by welding or may be formed integral with the conductors. In either case, the segments must be insulated from the adjacent cathode connectors and, preferably, are offset from the cathode conductors or the conductors are offset downwardly from the associated cathode segments to avoid electrical contact with them.

Four exemplary integrally formed cathode electrodes suitable for use in the display panel of FIG. 1, for example, are illustrated in FIG. 3. Electrode 92 bears a plurality of cathode segments 93 which are upwardly offset at their remote ends in the figure; cathode electrode 94 bears a plurality of cathode electrode segments 95 upwardly offset from it at their mid-points; and electrode 96 bears a plurality of electrode segments 97 upwardly offset from it at the near ends of them; and electrode 98 bears a plurality of cathode elements 99 which may be offset from it as shown or not, since no clearance need be provided for crossing cathode segments or their connectors. Electrode 98 or any suitable variation thereof may be utilized as cathode conductor 21, 25 or 29 in FIG. 1.

The display device of FIG. 1 is operated by the application of relatively negative potentials to selected ones of cathode conductors 21 - 29 and decimal terminal leads 45A - 48A and 45B - 48B, and the selective application of relatively positive potentials to anode electrodes 150, 160, 170 and 180, either sequentially or otherwise. For each character to be displayed, selected ones of cathode conductors 21 - 29 are energized concurrent with activation of one of anodes 150 - 180. If this is rapidly repeated with activation of anodes 150, 160, 170 and 180 successively, then a constant yet changeable display of numerals, together with certain alphabetic characters or symbols, may be provided by the device.

In the embodiment of FIG. 2 an insulating base plate 110 is provided having a plurality of parallel grooves or depressions 101 - 107 therein, in which are disposed cathode conductors 121 - 127, each bearing a plurality of cathode segments. Cathode conductor 121 bears cathode segments 251, 261, 271, and 281 and cathode conductor 127 bears cathode segments 257, 267, 277, and 287, for example. Decimal point electrodes 152 - 182, connected to terminal leads 45A - 48A are supported by base plate 110, as are decimal electrodes 157 - 187 having terminal leads 45B - 48B.

The cathode display segments in this embodiment are attached to the corresponding cathode conductors 121 - 127 suitably offset therefrom, as illustrated, and are electrically isolated from each other and the adjacent connectors within grooves 101 - 107 in base plate 110 as shown.

The display panel of FIG. 2 also includes an apertured insulating plate or sheet 120 having openings and slots for the corresponding cathode elements or segments. In this embodiment, the slots are narrower than the corresponding cathode segments and, therefore, define the glow seen by the viewer for providing a sharp character outline. The device illustrated in FIG. 2 also includes a plurality of anode screen electrodes 150 - 180 having terminal leads 35, 36, 37, 38, respectively, and a glass cover plate. It is operated similar to the device of FIG. 1 except that only 7 different character segments are provided at each display position for indicating the desired numbers or symbols.

In a modification of the invention shown in FIG. 4, the connectors are depressed beneath the cathode segments rather than the cathode segments being elevated above their connectors as described above. Referring more specifically to FIG. 4, a base plate 112 of glass, ceramic or the like is provided as a support for substantially flat cathode segments, as shown. Cathode conductors 221, 224 and 227 may be thin flat strips disposed on base plate 112 as shown, or may have wider or narrower cathode segment portions defined along their lengths, if desired. Cathode conductors 222, 223, 225 and 226 are each formed with integral cathode segments oriented at an angle to them.

Cathode conductors 222, 223, 225 and 226 are each offset at specific points to provide clearance for the cathode strip segments from adjacent elements which overlay them, as shown. Cathode conductors 222 and 223 are positioned side-by-side with their associated cathode elements interleaving the adjacent portions of the other conductor. Cathode conductors 225 and 226 are positioned side-by-side with their associated cathode elements 355-385 and 356-386, respectively, interleaved with the adjacent conductor, as shown.

The offset portions of conductors 222, 223, 225 and 226 of the assembly of FIG. 4 at the point of cathode segment crossovers may be disposed within depressions or notches 112A of base plate 112, as shown in the sectional view of FIG. 5 or may rest upon the surface of a base plate 113, as shown in the sectional view of FIG. 6. Conductors 222, 223, 225 and 226 may be fixed in place or isolated from each other by a glass or ceramic frit or the like in the arrangement of FIG. 5 or FIG. 6.

In the structure of FIG. 5 insulating frit may be placed within notches or depressions 112A in base plate 112 or elsewhere, as desired. In the structure of FIG. 6, insulating pads 213, insulating globules of frit, or the like are placed between the cathode strip ele-

ments and the adjacent cathode connectors at the crossover points, and insulating frit may be placed between the connectors and base plate 113, as desired.

In the base plate assembly of FIG. 7 a layer 115 of insulating material such as a glass or ceramic frit or glaze is disposed on a base plate 113 or the like and cathode conductors 321-327 are at least partially embedded in the insulating layer, leaving their associated cathode elements exposed. That is, flat cathode elements 351, 361, 371 and 381 of cathode conductor 321 are exposed, although the connecting portions of the conductor are covered by insulating layer 115. Likewise, the flat cathode elements 357, 367, 377 and 387 of cathode conductor 327 are exposed and the connecting portions of conductor 327 are covered by insulating layer 115.

The exposed cathode segments 351-381, . . . 357-387 may reside at an elevation above the top surface of insulating layer 115 or may be at least partially disposed within depressions in the insulating layer 115, if desired. An apertured sheet or plate 120 having slots of desired length and width in its opaque surface or coating is disposed above the exposed cathode segments for outlining the portions of the cathode elements which are to be viewed. Suitable planar anode electrodes or the like are disposed above apertured insulating sheet 120 of the apparatus of both FIGS. 4 and 7 in the construction of an operating device.

Although the preferred embodiments of the invention have been described in detail, it should be understood that the present disclosure has been made by way of example only. Many modifications and variations of the invention are possible in light of the above teachings. It is, therefore, to be understood that within the scope of the appended claims, the invention may be practiced otherwise than as specifically disclosed.

We claim:

1. A segmented electrode display device comprising a gas-filled envelope including an insulating base plate having top and bottom surfaces,
a plurality of elongated conductors supported on said base plate and individually bearing a plurality of

substantially flat cathode electrode segments spaced apart and offset upwardly from the conductors,

the segments being arrayed in groups along said conductors, with a segment of different ones of said conductors included in each group and each group comprising a display position in the device, the electrode segments being spaced apart and insulated from the other conductors and their segments,

an anode electrode positioned in operative relation with each said group of electrode segments, and a light-transmitting window sealed in said envelope.

2. The segmented electrode display device of claim 1 wherein the elongated conductors are substantially flat strips of conductive material carrying the display cathode segments along their lengths.

3. The segmented electrode display device of claim 1 wherein the insulating base plate contains grooves or depressions in its top surface to receive the cathode conductors between the associated offset cathode segments.

4. The segmented electrode display device of claim 1 wherein some of the cathode segments cross an adjacent conductor at an angle and insulating material is disposed between the offset portions of the cathode conductors and the cathode segments which cross them.

5. The segmented electrode display device of claim 1 further comprising insulating means disposed between the groups of cathode segments and the associated anode electrodes and having apertures smaller in area than the corresponding cathode segments for exposing the cathode segments and defining the glow from them.

6. The segmented electrode display device of claim 1 further comprising insulating means situated over the elongated conductors and having apertures which are sufficiently large to receive the corresponding cathode segments and thereby confine the glow discharges about them.

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