

[54] **DISPLAY PANEL HAVING
ELECTRODE REGISTRATION
SUPPORT AND CONNECTION MEANS**

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[22] Filed: **Aug. 24, 1970**
[21] Appl. No.: **66,383**

[52] U.S. Cl. **313/51, 313/220**
[51] Int. Cl. **H01j 5/48**
[58] Field of Search **313/49, 51, 109.5, 220;**
315/169 R, 169 TV; 339/17 LM, 17 CF

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[57] **ABSTRACT**

The illustrated display panel includes a matrix of communicating gas-filled display cells. A first layer includes an enlarged first plate having grooves in it, with first electrodes seated in the grooves, and second electrodes supported across them. A second layer includes an apertured plate seated on the second electrodes, with third electrodes positioned on the top surface of the second plate. The first electrodes residing in the grooves in one extension of the first plate are exposed and are accessed there by connector contacts. The third electrodes are fitted at one end into grooves in another extension of the first plate. The electrodes and plates forming the device may also be aligned with reference to the grooves in the base plate.

14 Claims, 5 Drawing Figures

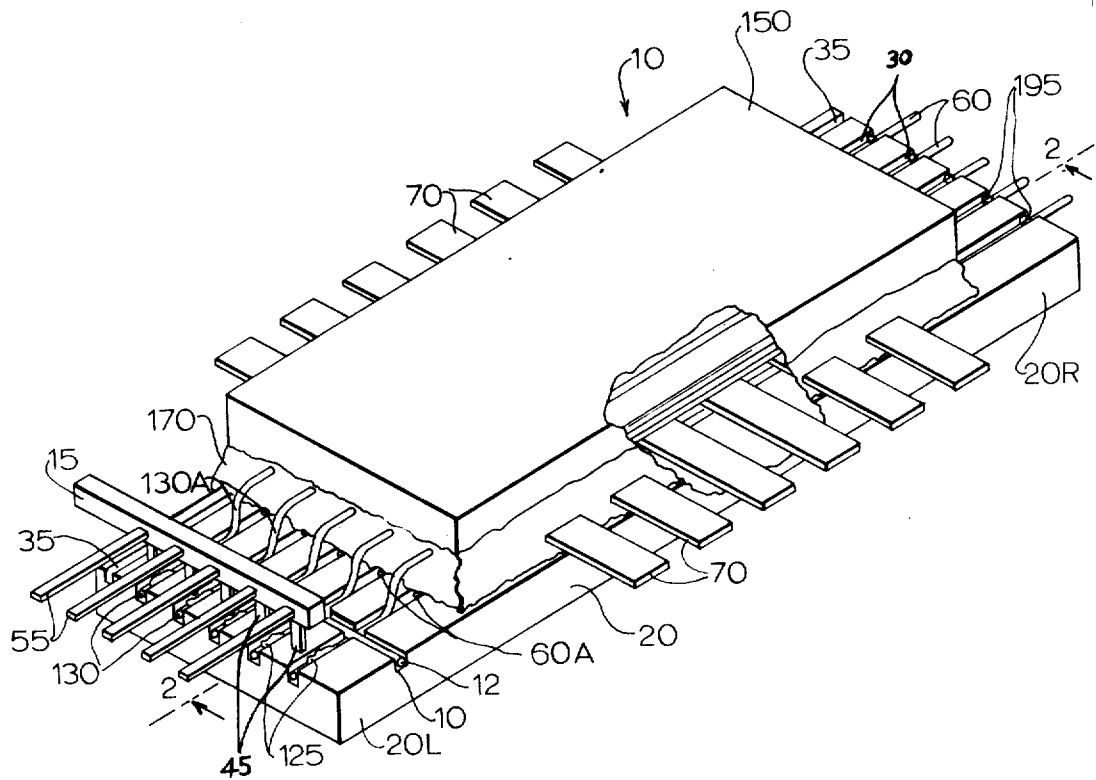


Fig. 1

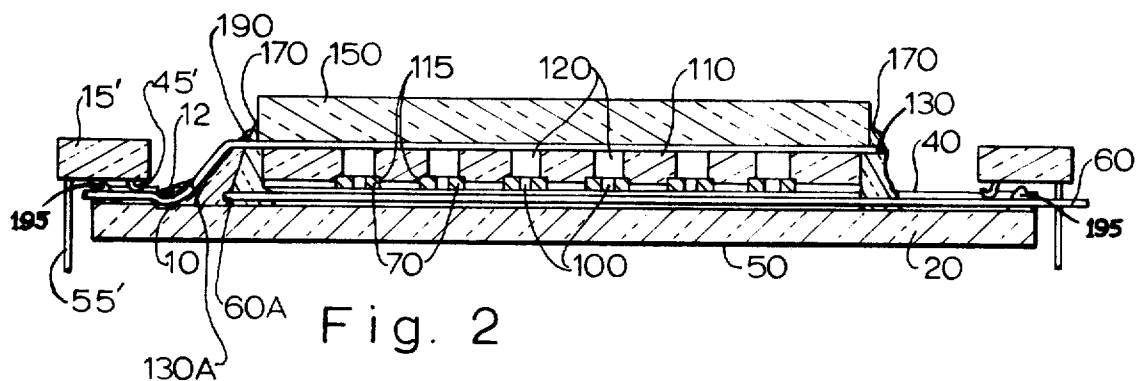
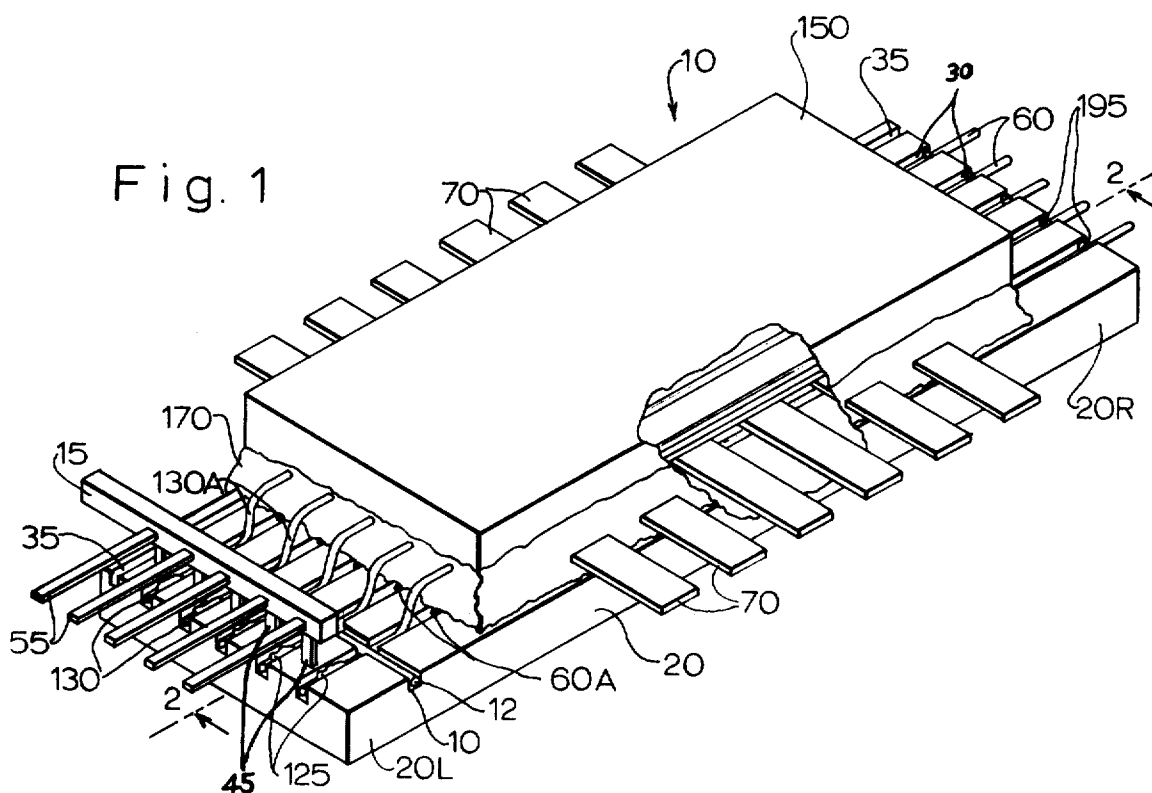
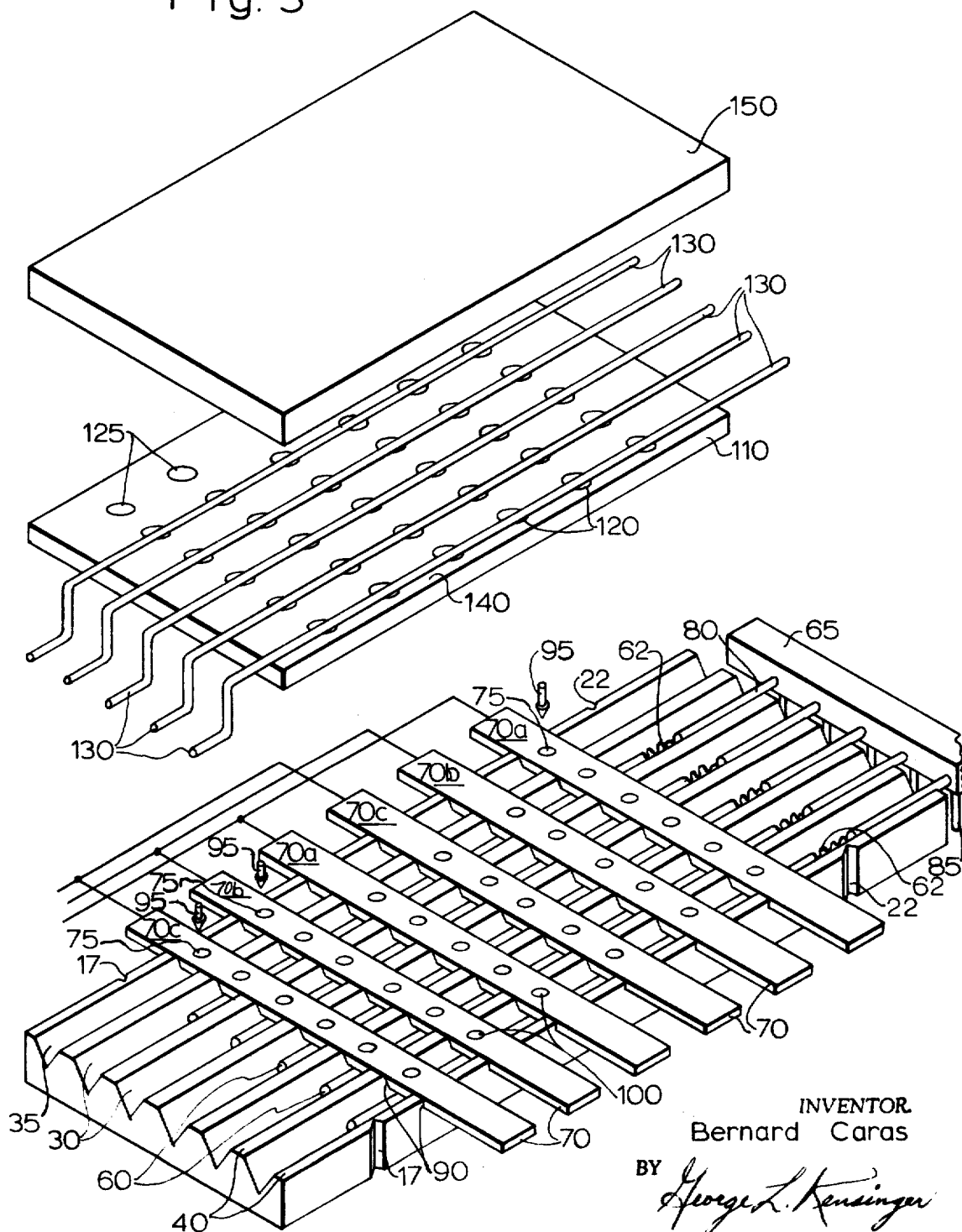


Fig. 2

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Fig. 3



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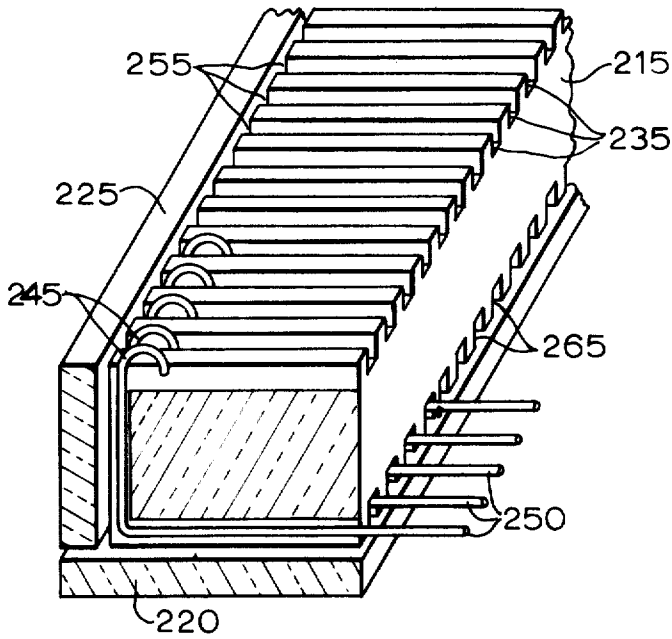


Fig. 4

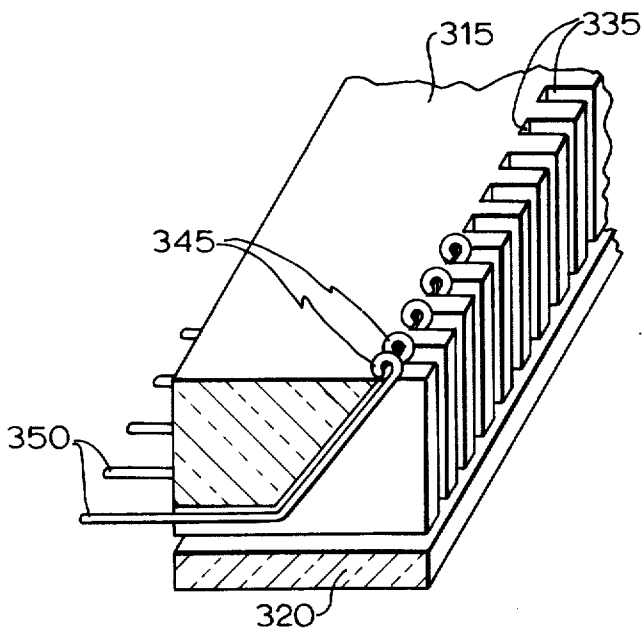


Fig. 5

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DISPLAY PANEL HAVING ELECTRODE REGISTRATION SUPPORT AND CONNECTION MEANS

BACKGROUND OF THE INVENTION

Display panels comprising a plurality of gas-filled cells which can be ionized selectively to display a message are known in the art. A display panel has been developed recently which has two layers of cells, a first layer being used as a scanning or addressing layer for sequentially addressing the cells, one by one or column by column, and a second layer into which information is inserted to be displayed, and perhaps stored, as the first level is scanned. These multi-layer devices have been constructed of several layers of glass or other insulating material with groups of thin wire and strips electrodes suitably positioned between them in alignment with a matrix of closely spaced apertures in the device which serve as the gas cells.

Although these devices have been built and operated successfully, there is a need to provide improved means for insuring the proper insulation, registration, and support for the electrodes and their terminations, especially when fine wires are used. Registration of the plates of the panel with each other and with the associated electrodes has also proved to be difficult to achieve reliably and simply. There is also a need for a reliable and practical system for connecting other devices and auxiliary equipment to the electrodes of such devices.

These problems are compounded in multiple-register display panels such as that described in the commonly assigned B. Caras patent application filed Mar. 19, 1970, Ser. No. 21,125. The subject invention is also applicable to providing electrode support and connections in display devices such as those described in the commonly assigned S. Kuchinsky, et al. patent application filed July 16, 1970, Ser. No. 55,388 and in the Ogle, et al., patent application filed Aug. 18, 1969, Ser. No. 850,984.

SUMMARY OF THE INVENTION

Briefly, a display panel embodying the invention includes a plurality of insulating plates and electrode arrays interrelated to provide rows and columns of display cells and electrodes for operating them. A portion of the panel includes a grooved structure for receiving and supporting one or more of the arrays of electrodes in proper alignment and separated from each other. The grooved structure also permits relatively easy connection from the electrodes to external elements and facilitates registration of the plates and electrodes forming the device. The grooved structure also protects the electrodes it supports from being broken even though they are exposed and may be clamped against by external connector contacts. Other features and advantages of the subject invention will be clear from the following description of the preferred embodiments, relating to the accompanying drawings, wherein:

FIG. 1 is a perspective view of a display panel system, with the panel partly cut away,

FIG. 2 is a section of a panel such as that of FIG. 1, shown in combination with another connector configuration, also in section,

FIG. 3 is an exploded view of a panel such as those of FIGS. 1 and 2, shown in combination with yet another connector, and

FIGS. 4 and 5 illustrate additional connectors for use in combination with the display panels of FIGS. 1 to 3.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring to FIGS. 1 to 3, one form of display panel 10 which utilizes the invention includes a first insulating plate 20 of glass, ceramic, or the like having a plurality of parallel electrode-receiving slots, grooves or channels 30 formed therein and extending from the top surface 40 toward the bottom surface 50 thereof. An additional groove or slot 35 for a purpose to be described, is provided in top surface 40 near one edge of base plate 20, and parallel to the other grooves. Relatively few slots have been shown to simplify the drawing, but it should be understood that in most applications, plate 20 would be considerably wider and would have many more slots in it. The grooves 30 and 35 may have any suitable cross-section. Optional pairs of notches 17 and 22 may also be formed in the sides of base plate 20 near the opposite ends to provide reference points for horizontal registration of the component parts of the panel in a manner to be described.

First electrodes 60, used as scanning anodes in one mode of operation, are seated in the slots 30 and extend along the length thereof. Electrodes 60 are normally fine wires and they may be secured in place by means of a cement frit or the like disposed at the ends of slots 30 or at any other suitable location. No electrode is placed in groove 35, which is provided for registration of electrodes and plates in the device as will be described.

The panel 10 also includes second electrodes 70, used as scanning cathodes in one mode of operation, seated on the top surface 40 of the first plate 20. The second electrodes 70 are parallel to each other also, and they are oriented generally perpendicular to the first electrodes 60, although they can be oriented at other angles with respect to them. The electrodes 70 are preferably flat strips, having apertures 100 disposed along their lengths and they may be seated in slots (not shown) formed in the top surface 40 of the plate 20, or in similar slots 115 in the bottom surface of the second insulating plate 110 which is positioned above them, or partially in slots in both of these plates. The region at which each second electrode 70 crosses a first electrode 60 defines a gas cell known as a scanning cell and a cathode aperture 100 is located at each such electrode crossing or scanning cell.

Thus, it can be seen that there are a plurality of rows of scanning cells disposed along slots 30 and columns of scanning cells aligned with the cathodes 70.

Electrodes 70 also have additional apertures 75 vertically aligned with groove 35 in base plate 20, as shown in FIG. 3, and rod-like pins or pegs 95 of suitable shape are fitted into groove 35 and into apertures or holes 75 in these electrodes. This establishes horizontal registration of electrodes 70 with base plate 20. The electrodes 70 may also have notches or grooves 90 formed across the bottom surface of them as illustrated in FIG. 3 for receiving the ridges or plateaus 42 in the top surface 40 of base plate 20 along the grooves 30 and 35. This also aids in registering electrodes 70 with base plate 20. These auxiliary electrode alignment features are optional and may not be required.

A second insulating plate 110 having a plurality of apertures or cells 120 arrayed in rows and columns is seated on the electrodes 70 and on plate 20. Insulating plate 110 is of approximately the same width as plate 20, but is shorter and is positioned so that plate 20 extends beyond both ends of it. Each aperture or cell 120 of plate 110 is aligned with a cathode electrode aperture 100 and the scanning cell beneath it defined by a crossing of a scanning cathode electrode 70 and a scanning anode electrode 60. The plate 110 may be of glass, ceramic, or the like and it has a plurality of additional holes or apertures 125 formed in it for receiving the upper ends of pins or pegs 95. This establishes registration of plate 110 with electrodes 70 and transversely with base plate 20 and assures alignment of the holes or apertures in plate 110 and electrodes 70 with each other. The plate 110 and electrodes 70 may also be aligned horizontally with base plate 20 by aligning the ends of plate 110 with notches 17 and 22 near the ends of the base plate or in any other suitable manner.

Third electrodes 130, viewed as display anodes in the aforementioned scanning mode of operation, are seated on the upper surface 140 of the apertured plate 110, and, if desired, they may be embedded either in slots (not shown) in plate 110 or in slots (not shown) in a transparent cover plate or viewing plate 150 which is seated on plate 110. The electrodes 130 are also thin, fine wires like electrodes 60. Viewing plate 150 is preferably the same approximate size and shape as center plate 110 and is aligned therewith.

Thus, in panel 10, plate 20 extends beyond plates 110 and 150 at both ends by means of a slotted left-hand extension 20L and a slotted right-hand extension 20R.

In panel 10, plates 20, 110, and 150 are sealed together and the electrodes 60, 70 and 130 secured in place by means of beads of glass frit or the like 170 shown in FIGS. 1 and 2. If desired, and if necessary, second beads of sealing frit 190 (FIG. 2) insulate electrodes 130 from the ends 60A of electrodes 60 where they are bent down into grooves 30 in base plate 20 and holds them in place. Mounds of frit 195 retain the ends of electrodes 60 and 130 in place as shown.

First electrodes 60 in grooves 30 of base plate 20 terminate at one end 60A, the left-hand end as seen in FIG. 1, preferably close to the ends of plates 110 and 150 and in the seal area. The opposite ends of electrodes 60 lie in grooves 30 in the right-hand extension 20R of plate 20 and extend through the seal and beyond the edges of plates 110 and 150 and in the seal area. The opposite ends of electrodes 60 may be secured in place by means of insulating cement masses 195 in slots 30.

The right-hand ends of electrodes 130 terminate within the panel or in the seal area and the left-hand ends are seated in slots 30 in the left-hand extension of plate 20. If necessary, the left-hand ends of electrodes 130 are deformed into open slots 30 by rod 12 fitted into a transverse groove 10 which crosses grooves 30. Rod 12 is formed of glass, ceramic or the like, and may be a solid rod such as cane glass or may be a hollow glass or ceramic tube if desired. Rod 12 is preferably secured in place by itself being fused or by means of a glass frit. The protruding ends 130A of third electrodes 130 may, alternatively, be preformed for fitting down

into grooves 30 in base plate 20, or suitable end pieces may be affixed to them, shaped to fit down into grooves 30.

The gas used in panel 10 and the mercury additive, if any, may be introduced by means of a tubulation (not shown) suitably secured to the panel, or it may be introduced in any other convenient manner.

External connections to first electrodes 60 and third electrodes 130 are effected in grooves 30 in the portions of base plate 20 which extend beyond plates 110 and 150. For this purpose a connector 15 shown at the left-hand end of panel 10 in FIG. 1 is used in operative relation with ends 130A of electrodes 130 seated in grooves 30 in plate 20. Connector 15 comprises rod or bar of insulating material having a plurality of projecting metal contacts 45 shaped to fit into grooves 30. Terminal tabs 55 secured to contacts 45 within the body of connector 15, exit from the rear thereof for circuit connection to be made to them. To facilitate electrical contact, beads of conductive frit or epoxy 125 may be placed in grooves 30 on top of electrodes 130 near their left ends as shown to provide relatively large-area flat conductive areas in grooves 30 which are larger than the top edge of electrodes 130.

Such electrical connection could, alternatively, be effected in transverse slot 10 by means of connector 15 and its contacts 45 or by contacts carried by insulating rod 12 or other piece, for example. Similar connection is made to electrode 60 at the right-hand end of panel 10.

In a modification of the invention, electrical connections to first electrodes 60 and third electrodes 130 are made in the embodiment of FIG. 2 by modified connectors 15' having curved contacts 45' and terminal conductors 55' extending downwardly from the connector. Curved contacts 45' extend forward from connector 15', but may, alternatively, curve back toward the connector. Contacts 45' are also shaped to fit down into grooves 30 of plate 20 against electrodes 60 or 130 or electrode terminals disposed in them.

In still another modification of the invention, external connections with first electrodes 60 in FIG. 3, for example, are effected by a connector 65 having horizontal contact pins 80 and vertical terminal leads 85 which extend downwardly therefrom. In using connector 65, the ends of wires 60 to be contacted are deformed to provide resilient ball-like masses 62 which are inherently elastic. The contact pins 80 of the connector 65 are positioned in the grooves 30 and are inserted into or against the conductive jumbles 62 to make intimate electrical contact therewith. Connector 65, and the other connectors illustrated, may have retaining clips or bails (not shown) attached to them for engaging notches 17 and 22 of plate 20 and attaching the connectors to the ends of the panel, if desired.

In most uses of display panels embodying the subject invention, it is not essential that very low impedance electrical connections be effected with the anode electrodes in the grooves in base plate 20. The anode circuit tolerances preferably do not require connections of resistance less than a few hundred ohms. Also, relatively low currents and relatively high voltages are usually involved, which are not greatly affected by voltage drops at the connectors.

The drawing of FIG. 4 illustrates a modified connector for making electrical connection with first electrodes 60 and third electrodes 130 in grooves 30 of display panel base plate 20 having contacts 245 connected to terminal leads 250. The connectors of FIGS. 4 and 5 are shown upside-down for clarity of presentation only. An insulating core piece 215 has grooves or slots 235, 255 and 265 formed in its bottom surface, front surface and top surface, respectively. El-shaped terminal conductors or leads 250 reside in grooves 265 and 255 and curved contacts 245 curl back toward core piece 215 in grooves 235, as shown. Conductors 250 are covered by insulating face plate 225 and insulating top plate 220. Contacts 245 are shaped to fit into the corresponding grooves 30 in the base plate of an associated display panel. The insulating members may be glass, ceramic, phenolic or the like.

The drawing of FIG. 5 illustrates another connector for making connection with electrodes in a panel display base plate 20 having curled contacts 345 connected to terminal conductors or leads 350 and supported by insulating housing 315. The conductors 350 reside in corresponding slots 335 in insulating plate or sheet 320 as shown. The contacts 345 curl back toward connector housing 315 and are shaped to fit into the corresponding grooves of an associated display panel. The insulating members of the connector are formed of glass, ceramic, phenolic or the like.

The operation of multi-cell display panels such as panel 10, is described in detail in a co-pending application of Ogle and Holz, Ser. No. 850,894, filed Aug. 18, 1969, and reference is made to that application for a complete discussion of the operation of them.

Briefly, in the operation of panel 10, electrodes 60 are used as scanning anodes and electrodes 70 are operated as scanning cathodes and the cells formed between them are operated as scanning cells. The scanning cells are fired column by column by the application of operating potentials to all of the anodes 60 simultaneously and by the application of operating potentials to each of the cathodes 70, in turn, beginning at one end of the panel and continuing to the other end. The scanning operation is facilitated by the slots 30 which permit priming of each column of cells by the column which precedes it in the scanning cycle.

Simultaneously with the scanning, and synchronously with the scanning rate, information signals are applied to the anode electrodes 130. Where such information signals are present, glow is transferred upwardly into cells 120 from the associated scanning cells, at an intensity determined by the amplitude of the information signals, to display a visible message. As each column of cells is scanned in turn, and information signals are applied, a stationary but changeable display is distributed to the columns of cells 120 and is visible through the top plate. The glow present in the lower scanning cells, however, is not deleteriously visible through the top plate, so that the internal scanning operation of the panel does not interfere with or obscure the display of information on it.

As described in application Ser. No. 850,984 circuit economies can be achieved by connecting the scanning cathodes in groups as illustrated in FIG. 3 so that a single cathode potential source can be connected to each group of scanning cathodes to carry out the desired

scanning operation. Other arrangements can be used to fire the scanning cells and the display cells of course.

It will be apparent to one skilled in the art that various modifications may be made in the specific features shown, within the scope of the invention. The present disclosure has been made by way of example only, and the invention may be practiced otherwise than as specifically disclosed, in light of the above teachings.

For example, the principles of electrode contact are not limited to panels having a plurality of layers of cells but may be used with panels having a single layer of cells, examples of which are shown in application Ser. No. 850,984.

What is claimed is:

1. A display panel comprising

a first insulating plate having top and bottom surfaces and a plurality of first parallel grooves therein,

a plurality of first elongated electrodes each disposed in one of said grooves,

a plurality of second parallel electrodes spaced from said first electrodes and oriented at an angle to said first electrodes and crossing a plurality of them,

a second plate having top and bottom surfaces and a plurality of apertures arrayed in a matrix proximate said electrodes, each aperture being aligned with a crossing of a second electrode and a first electrode and defining a gas cell,

a third plate positioned parallel to the first and second plates, and at least one of the first and third plates being capable of transmitting light,

a gaseous atmosphere in the region between the first and third plates and in the cells including an ionizable gas at a pressure capable of sustaining cathode glow discharge,

at least one end of said first plate extending beyond the corresponding ends of the other plates and supporting the ends of the first electrodes within the grooves in said plate for external connections to be made to them therein.

2. The display panel defined in Claim 1 wherein the second plate has registration means cooperating with a predetermined groove in the first plate for accurately positioning the second plate and the grooves in the first plate are v-shaped for aiding external connection of the first electrodes.

3. The display panel of claim 1 further comprising a plurality of third electrodes positioned on the top surface of the second plate, each being aligned with a group of said apertures whereby a portion of each third electrode is aligned with a portion of a second electrode and a portion of a first electrode at each said aperture.

4. The display panel of claim 3 wherein the third electrodes are elongated and are oriented in the same direction as the first electrodes, the second electrodes being elongated and crossing at least some of them.

5. The display panel defined in claim 3 wherein the first and third electrodes comprise conductive wires and the second electrodes comprise elongated flat strips which cross between them on the top surface of the first plate.

6. The display panel of claim 3 wherein the second electrodes comprise elongated flat strips having aper-

tures at the regions where the second electrodes cross the first electrodes and registration apertures aligned with a predetermined groove in the first plate.

7. The display panel of claim 3 wherein opposing ends of the first plate extend beyond the corresponding ends of the other plate, one end for supporting the ends of the first electrodes disposed within the grooves in the first plate and the opposite end for supporting the ends of the third electrodes.

8. The display panel defined in claim 7 wherein one end of each of the third electrodes is fitted into at least a portion of a groove in the top surface of said opposite end of the first plate and means is provided for retaining them in said grooves.

9. The display panel of claim 8 in which a cross groove intersects the grooves in the top surface of at least one end of the first plate and insulating means in the cross grooves retains the electrodes lying in that portion of the first plate.

10. The display panel of claim 8 in which the insulating means in the cross groove comprises a cylindrical glass member fixed in the cross groove.

11. A display system comprising

a light-transmitting panel having a plurality of discrete gas-filled display cells adapted to be energized singly or in groups to exhibit a character or message and including an insulating plate having an end which extends out from the body of the panel,

electrode means associated with each cell for applying potential thereto suitable for ionizing the gas in a cell and thereby causing a cell to glow,

said extending end of said plate having grooved means supporting at least one of said electrode means exposed for receiving external connection means, and

gas communication paths in said panel between selected cells for permitting the flow of excited

particles from one cell which is exhibiting glow to another cell, said particles assisting the other cell to ionize when operating potentials are applied to it.

12. The display system of claim 11 wherein said grooved means has v-shaped grooves in which connector means having a plurality of protruding conductive contacts removably engages said at least one electrode means.

13. A display panel comprising

light-transmitting housing means having a plurality of discrete gas-filled display cells adapted to be energized singly or in groups to display a character or message and including an insulating plate having at least one end that protrudes from the body of the housing,

first and second elongated electrodes associated with each cell for applying turn-on potential thereto and thereby causing the cell to glow,

one of said electrodes extending along the length of said plate and being at least partially recessed and laterally exposed within said one end of said plate for receiving external connection means,

a gaseous atmosphere in said cells including ionizable gas at a pressure capable of sustaining cathode glow discharge, and

gas communication paths serving, when operating potentials are applied to a selected one or more of the cells associated with said electrodes, to turn on preferentially the selected cells closest to a previously glowing cell due to the availability thereto of charged particles through the communication path between them.

14. The display panel of claim 13 wherein said one end of said plate includes raised insulating ribs between which are disposed said one of said electrodes in spaced-apart relationship for support and exposure to said external connection means in channels.

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