United States Patent [19]

Holz

[11] **3,863,087**

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[54] **DISPLAY PANEL HAVING AN ARRAY OF INSULATED STRIP ELECTRODES**

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[52] **U.S. Cl.** ..... **313/188,** 313/210, 313/217, 313/220, 315/169 TV

[51] **Int. Cl.** **H01j 61/04**

[58] **Field of Search** ..... 313/109.5, 220, 108 R, 313/217, 210, 188; 315/169 R, 169 TV

[56] **References Cited**

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[57] **ABSTRACT**

A gas-filled display panel includes a slotted base plate and a similar slotted face plate, each carrying an array of electrodes seated in the slots. One array comprises scanning anodes, and the other comprises display anodes. An array of apertured strip electrodes is provided between the base plate and face plate and thus between the arrays of electrodes. The strip electrodes are separated from each other by glass strips which are secured to the edges of the strip electrodes. The strip electrodes and the scanning anodes form a layer of scanning cells, and the strip electrodes and display anodes form a layer of display cells.

15 Claims, 8 Drawing Figures

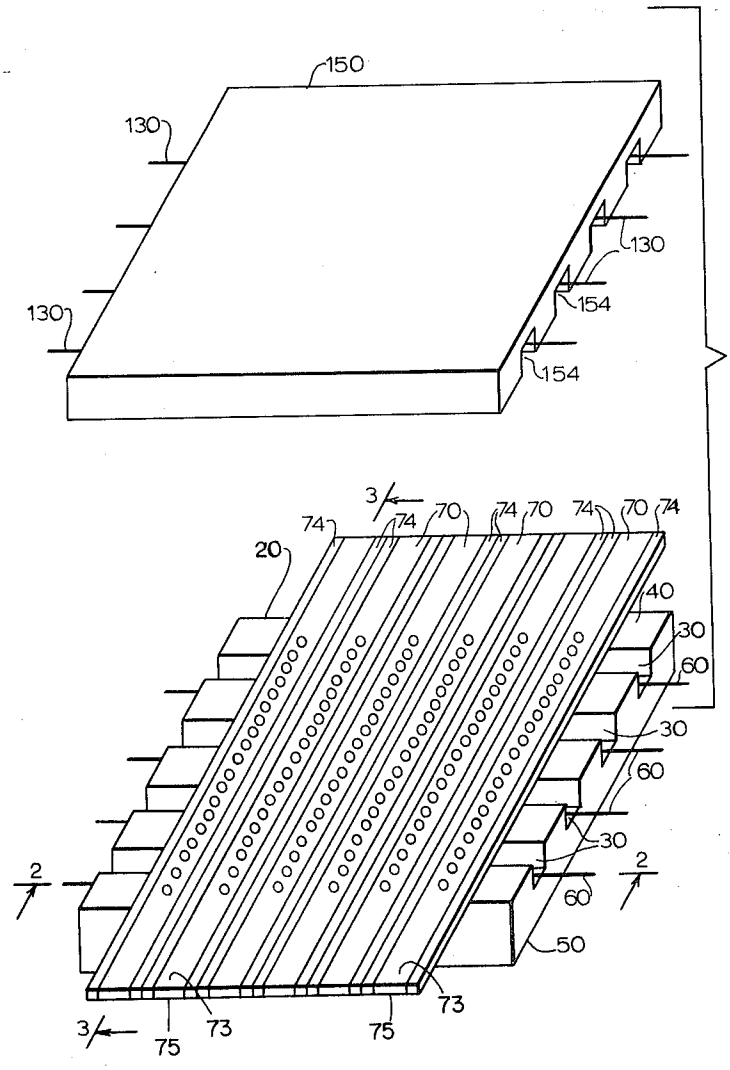

Fig. 1

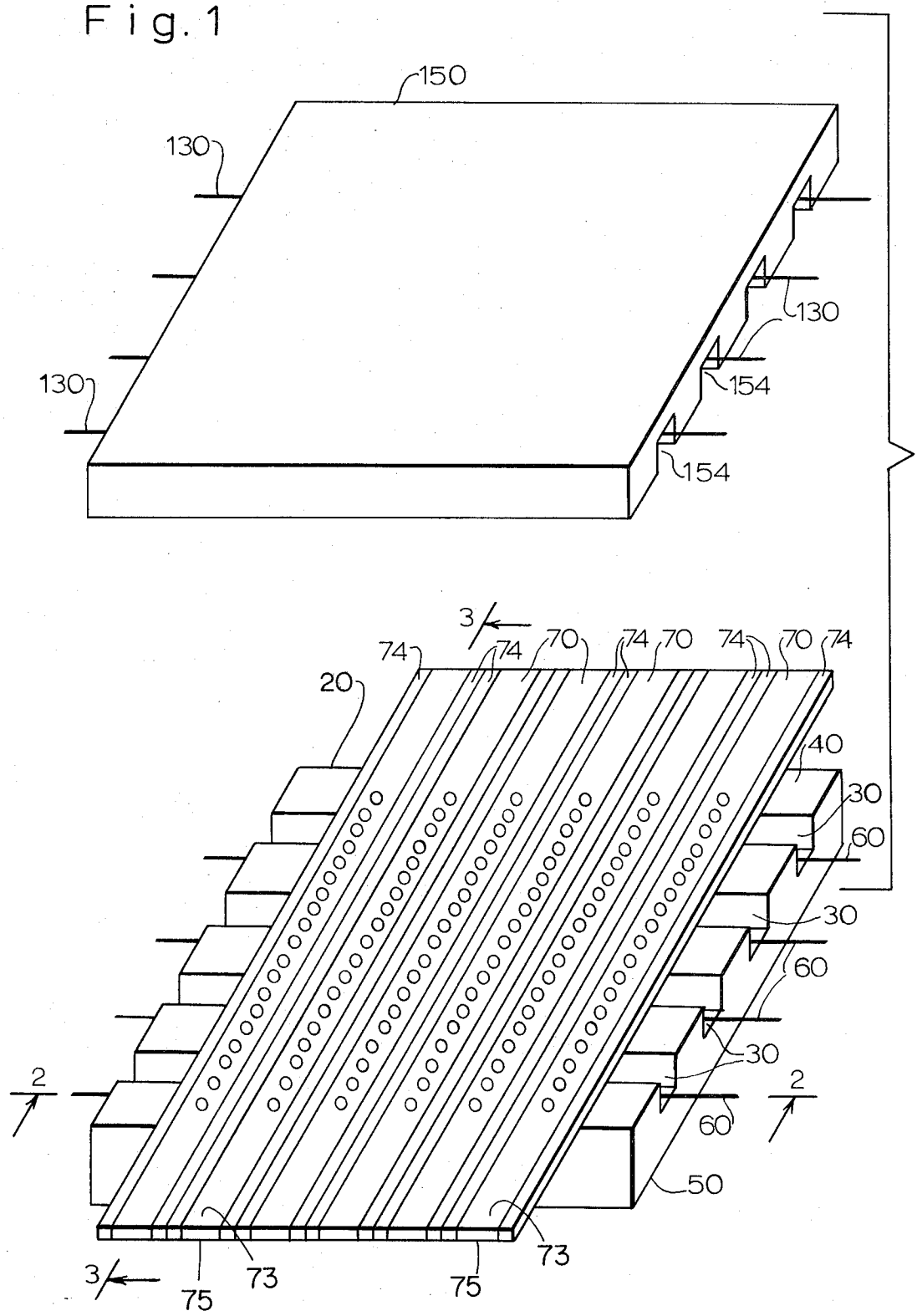
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Fig. 2

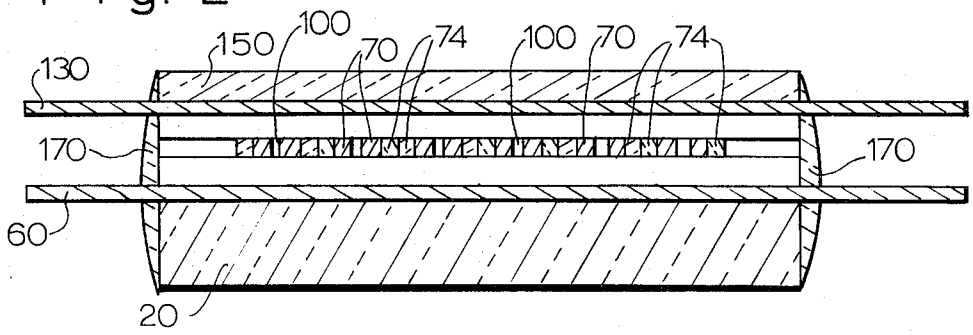
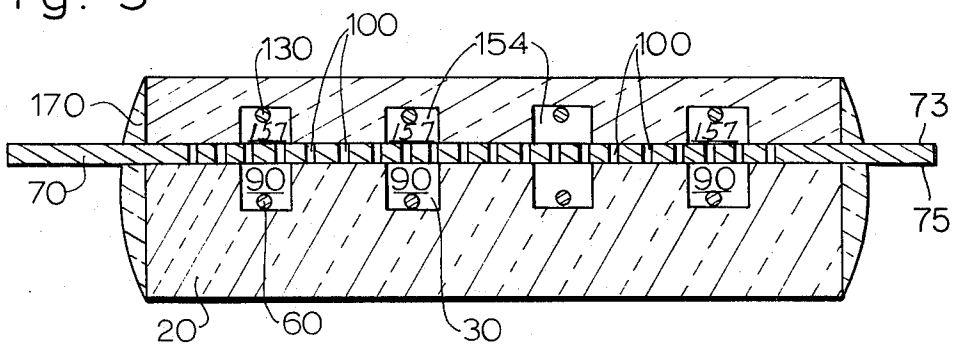


Fig. 3



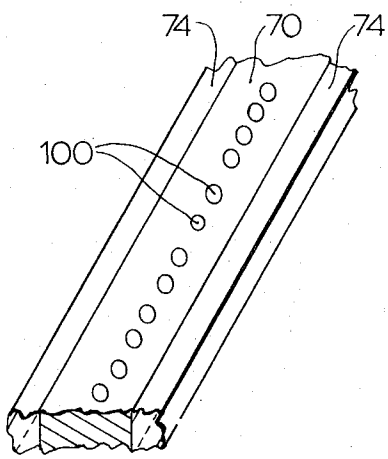


Fig. 4

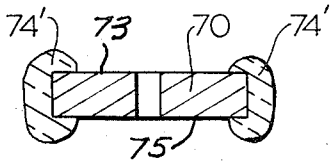


Fig. 5

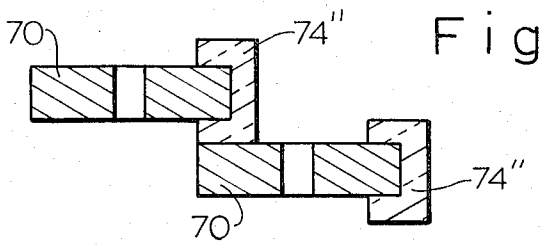


Fig. 6

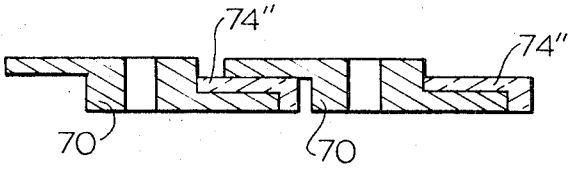


Fig. 7

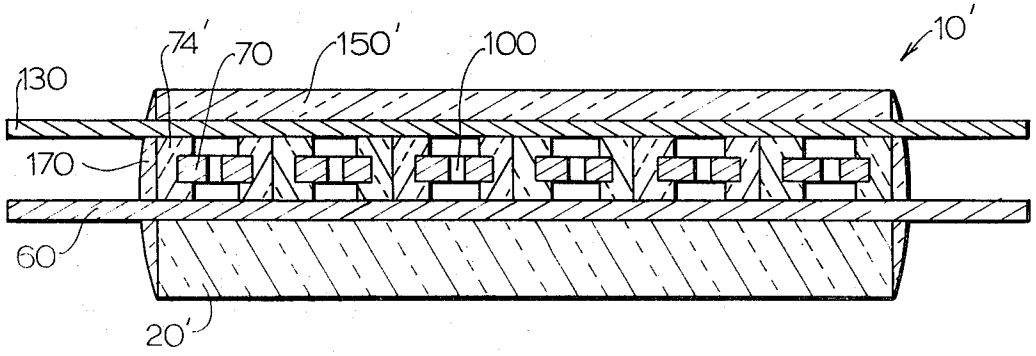


Fig. 8

DISPLAY PANEL HAVING AN ARRAY OF INSULATED STRIP ELECTRODES

BACKGROUND OF THE INVENTION

One type of panel display presently available commercially is known as a SELF-SCAN panel and includes a base plate, an apertured center plate, a face plate, and three arrays of electrodes. The various plates and electrodes are coupled together to provide first and second layers of gas cells which operate together to provide the desired display.

While this panel operates well and is commercially successful, improvements are always needed to simplify construction and reduce costs. The present invention is concerned with eliminating the apertured center plate and its attendant costs of manufacture and assembly.

SUMMARY OF THE INVENTION

Briefly, a display panel embodying the invention includes a base plate which carries a first array of electrodes and a face plate which carries a third array of electrodes, with an array of second electrodes disposed therebetween and forming a first layer of scanning cells with the first electrodes, and a second layer of display cells with the third electrodes. The second electrodes also provide isolation between the scanning cells and display cells.

DESCRIPTION OF THE DRAWINGS

FIG. 1 is an exploded, perspective view of a display panel embodying the invention;

FIG. 2 is a sectional view, along the lines 2—2 in FIG. 1, showing the panel assembled;

FIG. 3 is a sectional view, along the lines 3—3 in FIG. 1, showing the panel assembled;

FIG. 4 is a perspective view of a portion of an electrode used in the panel of FIG. 1;

FIG. 5 is a sectional view of a modification of the electrode of FIG. 4;

FIG. 6 is a sectional view of a modification of the arrangement of one of the electrodes in the panel of FIG. 1;

FIG. 7 is a sectional view of a modification of the arrangement of FIG. 6; and

FIG. 8 is a sectional view of another display panel embodying the invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring to FIGS. 1 to 3, a display panel 10 embodying the invention includes a first insulating plate 20 of glass, ceramic, or the like, having a top surface 40 and bottom surface 50 and a plurality of parallel slots or channels 30 formed in the top surface 40 thereof. The number of slots is determined by the number and size of the characters to be displayed in the panel, as is clear to those skilled in the art.

First electrodes 60, generally operated as scanning anodes, are seated at the bases of the slots 30. Electrodes 60 may be wires, flat strips of metal, or they may be plated or evaporated or otherwise formed in the slots.

The panel also includes second electrodes 70, generally operated as scanning cathodes, seated on the top surface 40 of first plate 20 parallel to each other and at an angle, preferably 90°, to the first electrodes 60.

The electrodes 70 are flat metal strips having top and bottom surfaces 73 and 75, respectively. The region at which each second electrode 70 crosses a first electrode 60 defines a scanning gas cell 90, and these cells are arrayed in rows and columns. Each cathode strip electrode is provided with a series of apertures 100 which extends along its length so that communication can take place from a scanning cell 90 through electrode 70 to other elements disposed above the electrodes 70 (to be described). If desired, a single aperture may be provided overlaying each scanning cell, or a series of apertures 100 may be provided, with one or more apertures overlaying each scanning cell. It is noted that each cathode 70 is aligned with a column of scanning cells 90.

According to the invention, each cathode strip 70 carries along its edges, a film or layer 74 of glass or comparable insulating material, and the strips are set in place with their insulated edges abutting each other. This provides effective spacing between adjacent cathodes, and it also prevents light, which may be present on the lower surface of a cathode, from passing upwardly between cathodes. Thus, the glass layers are preferably opaque.

As noted in FIG. 2, the glass layer 74 may have the same thickness as the cathode 70 and any suitable width. Other configurations may also be used as desired. For example, as shown in FIG. 5, the glass layer 74′ may extend above and below the top and bottom surfaces of the cathodes 70.

Under some circumstances, to insure that glow is not seen between cathode strips, adjacent edges of cathodes 70 may overlap each other, as illustrated in FIGS. 6 and 7. In this case, the overlapping surfaces may be thinned down, as shown in FIG. 7, to permit the cathode strips to lie flat. However, since these strips are quite thin, such shaping may not be needed. In any case, all touching parts would be properly insulated from each other, for example, by having the insulating layers 74″ extending onto the top and bottom surfaces of the cathodes near their edges. If desired, only one edge of each cathode need be insulated as shown.

The panel 10 is completed by a face plate 150 which is similar to the base plate 20 and includes in its lower surface, a plurality of slots 154 in which display anodes 130 are secured. The slots 154 and anodes 130 are parallel to and overlay slots 30 and electrodes 60, respectively, in base plate 20. The display anodes 130 and cathodes 70 cross each other, and each crossing defines a display cell 157.

In panel 10, the plates 20 and 150 are sealed together at their edges by means of a glass frit or the like to form a seal 170, shown in FIGS. 2 and 3. For convenience in making this seal, top plate 150 and bottom plate 20 are usually made somewhat larger than center plate 110.

Panel 10 also includes an ionizable gas such as argon, neon, xenon, or the like, preferably a Penning mixture of such gases, and a small quantity of mercury vapor, to minimize cathode sputtering. The gas is provided at a suitable pressure for the intended purpose. The gas may be introduced by means of a tubulation (not shown) suitably secured to the panel, or it may be introduced in any other suitable manner.

One convenient method of making panel 10 is described in copending application Ser. No. 383,827, filed July 30, 1973. According to this method, the cath-

ode strips **70** are formed from a continuous ribbon which is wound around the base plate **20** of the panel from a suitable reel. In one arrangement, a rotatable four-sided mandrel is provided which can support at least four plates **20** (carrying wires **60**) and positioned to have the cathode strips wound thereon from a reel.

After the cathodes have been wound, and, with the plates **20** still on the mandrel, the face plates **150** carrying their electrodes **130** are coupled to each plate **20**, and the assemblies are sealed together and removed from the mandrel. The cathode ribbon can then be cut to form the individual strips and to separate the panels which can then be processed to completion in normal fashion. At some time during the processing of the panels, a laser is used to drill the holes **100** in the cathode strips **70**.

With the modification of the invention shown in FIG. **5**, a panel **10'** may be constructed (FIG. **8**) in which the slots in the base plate and face plate (shown in FIG. **1**) are not required, and the desired spacing between the scan anodes **60** and display anodes **130**, and between each of these and the cathodes, is achieved by the insulating coating **74'** on the cathodes **70**. Panel **10'** thus includes base plate **20'** having a flat top surface on which the scan anodes **60** are seated and secured in any suitable manner. The cathodes **70** have their bottom surfaces **75** positioned adjacent to the scan anodes with the scan anodes in contact with insulating layers **74'** thereof, and the assembly of face plate **100'** and display anodes **130** is positioned adjacent to the top surfaces **73** of the cathodes with anodes **130** seated on the insulating layers **74'** thereof.

The desired spacings of the scan anodes from the cathodes and of the display anodes from the cathodes are achieved by the thickness of the insulating layers **74'**. It can be seen that the base plate **20'** and anodes **60**, and the face plate **100'** and anodes **130**, may be formed as separate assemblies, with the electrodes cemented to their respective plates, and then coupled together, with the cathodes **70** suitably positioned between them.

The principles of the invention are particularly applicable to SELF-SCAN display panels, and the structure and operation of such panels are described in detail in copending application Ser. No. 255,133, filed May 19, 1972. However, it is clear that the principles of electrode construction taught herein may be used in other types of devices.

Briefly, panel **10** (and **10'**) operates as follows. As already noted, the cathodes **70** and scan anodes **60** form scanning cells **90**, with the cathodes defining and aligned with columns of scanning cells. In addition, the cathodes **70** and the display anodes **130** form display cells **157**. In operation of the panel, the scanning cells are energized column-by-column by the application of operating potential to all of the anodes **60** at the same time, and by the application of operating potentials to each of the cathodes **70** in turn. Simultaneously, information signals are applied to the display anodes **130** in accordance with applied information, and, where appropriate signals are present as each column of scanning cells is energized, glow is transferred from a scanning cell through a cathode aperture **100** to the associated display cell which glows. This operation is repeated for each column of cells sequentially at such a rate that an apparently stationary but changeable message is presented between energized display cells.

What is claimed is:

1. A display panel comprising

a gas-filled envelope made up of a base plate and a face plate hermetically sealed together, said face plate having a viewing window,

an array of first electrodes adjacent to said base plate,

an array of second electrodes adjacent to said face plate,

an array of third electrodes disposed between said array of first electrodes and said array of second electrodes and having upper and lower surfaces,

said third electrodes forming, with their lower surfaces, an array of first cells with said first electrodes and forming, with their upper surfaces, an array of second cells with said second electrodes,

said third electrodes comprising metal strips disposed side-by-side adjacent to each other and carrying insulating layers only on their adjacent edges, their upper and lower surfaces being substantially free of said insulating material and able to exhibit cathode glow.

2. The panel defined in claim **1** wherein said first electrodes are seated on said insulating layers adjacent to the bottom surfaces of said third electrodes, and said second electrodes are seated on said insulating layers adjacent to said top surface of said third electrodes.

3. The panel defined in claim **1** wherein adjacent edges of said third electrodes overlap each other.

4. The panel defined in claim **3** wherein said adjacent edges of said third electrodes which overlap each other are thinner than other portions of said third electrodes.

5. The panel defined in claim **1** wherein said third electrodes have generally flat top and bottom surfaces and generally parallel side edges, and each said insulating layer covers one of said side edges and portions of said top and bottom surfaces adjacent thereto.

6. The panel defined in claim **5** wherein said insulating layers on each third electrode extend above and below the top and bottom surfaces thereof.

7. The panel defined in claim **2** wherein

said third electrodes have generally flat top and bottom surfaces and generally parallel side edges, and each said insulating layer covers one of said side edges and portions of said top and bottom surfaces adjacent thereto, and

said insulating layers extend above and below the top and bottom surfaces of said third electrodes a distance suitable to provide a predetermined spacing between said first electrodes and said third electrodes, and between said second electrodes and said third electrodes.

8. A display panel comprising

a gas-filled envelope including a base plate and a face plate sealed together to provide a gas-tight enclosure,

said base plate including a plurality of parallel slots,

a first electrode seated in each of said slots,

a plurality of second electrodes disposed between said base plate and said face plate,

a plurality of third electrodes disposed between said second electrodes and said face plate and spaced from said second electrodes,

said third electrodes comprising flat strips having upper and lower surfaces, and

insulating layers secured to the edges of said strip electrodes, with the insulating layers of adjacent

electrodes being in contact with each other to separate said strip electrodes from each other, said upper and lower surfaces being substantially free of said insulating layers so that they can exhibit cathode glow.

9. The panel defined in claim 8 wherein said second electrodes comprise metal strips having layers of insulating material secured to their adjacent edges and disposed parallel to each other and with adjacent electrodes in contact with each other at their edges.

10. The panel defined in claim 9 wherein said insulating coating is of the same thickness as said second electrode.

11. The panel defined in claim 9 wherein said insulating coating covers the edge of its second electrode and extends onto the top and bottom surfaces thereof closely adjacent to said edges.

12. The panel defined in claim 8 wherein said face plate includes a plurality of slots in which said second electrodes are seated.

13. A display panel comprising

a gas-filled envelope made up of a base plate and a face plate hermetically sealed together, said face plate having a viewing window,

said base plate having a flat top surface inside said envelope,

said face plate having a flat bottom surface inside said envelope,

an array of first electrodes adjacent to said base plate,

an array of second electrodes adjacent to said face plate,

an array of third electrodes disposed between said array of first electrodes and said array of second electrodes,

said third electrodes forming an array of first cells with said first electrodes and an array of second cells with said second electrodes,

said third electrodes comprising metal strips having top and bottom surfaces and disposed side-by-side adjacent to each other and carrying insulating layers on their adjacent edges, said insulating layers extending above and below said top and bottom surfaces, respectively, of said third electrodes, said array of first electrodes being in contact with said insulating layers beneath said third electrodes, and said array of second electrodes being in contact with said insulating layers above said third electrodes, said top and bottom surfaces of said third electrodes being substantially free of said insulating layers whereby they can exhibit cathode glow.

14. A display panel comprising

a gas-filled envelope made up of a base plate and a face plate hermetically sealed together, said face plate having a viewing window,

an array of flat strip first electrodes disposed close together side-by-side and having upper and lower operating surfaces,

at least one set of second electrodes in operative relation with said first electrodes to form a plurality of gas cells therewith,

a portion of the upper surface of each of said first electrodes being visible to a viewer through said face plate,

said strip electrodes, each having opposed edges and a layer of insulating material secured to the edges of said strip electrodes without covering the upper and lower surfaces thereof, said layers being approximately as thick as said strip electrodes.

15. A display panel comprising

a gas-filled envelope made up of a base plate and a face plate hermetically sealed together, said face plate having a viewing window,

an array of flat strip first electrodes disposed close together side-by-side and having upper and lower operating surfaces,

at least one set of second electrodes in operative relation with said first electrodes to form a plurality of gas cells therewith,

a portion of the upper surface of each of said first electrodes being visible to a viewer through said face plate,

said flat strip electrodes each having left and right edges and positioned with the right edge of one strip electrode being adjacent to the left edge of the adjacent strip electrode, and

a thin layer of insulating material on the left and right edge of each strip electrode, with such layers of adjacent strip electrodes being in contact with each other to serve to space said strip electrodes from each other,

said layers of insulating material covering only the side edges of said strip electrodes whereby said upper and lower surfaces thereof can exhibit cathode glow.

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