United States Patent

Caras et al.

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[54] DISPLAY PANEL WITH KEEP ALIVE CELLS

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[52] **U.S. Cl.** .....**313/198**, 313/220, 315/84.6, 315/169 TV

[51] **Int. Cl.** **H01j 61/54**

[58] **Field of Search** .....313/220, 109.5, 198; 315/169 R, 84.6

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[57] **ABSTRACT**

A display panel includes a plurality of rows and columns of display cells and anode and cathode electrodes associated therewith for causing glow discharge. The panel includes auxiliary starter or reset cells for facilitating the turn-on of the display cells and several keep-alive cells, including at least one uniquely located and constructed keep-alive cell, for facilitating the operation of the reset cells.

11 Claims, 9 Drawing Figures

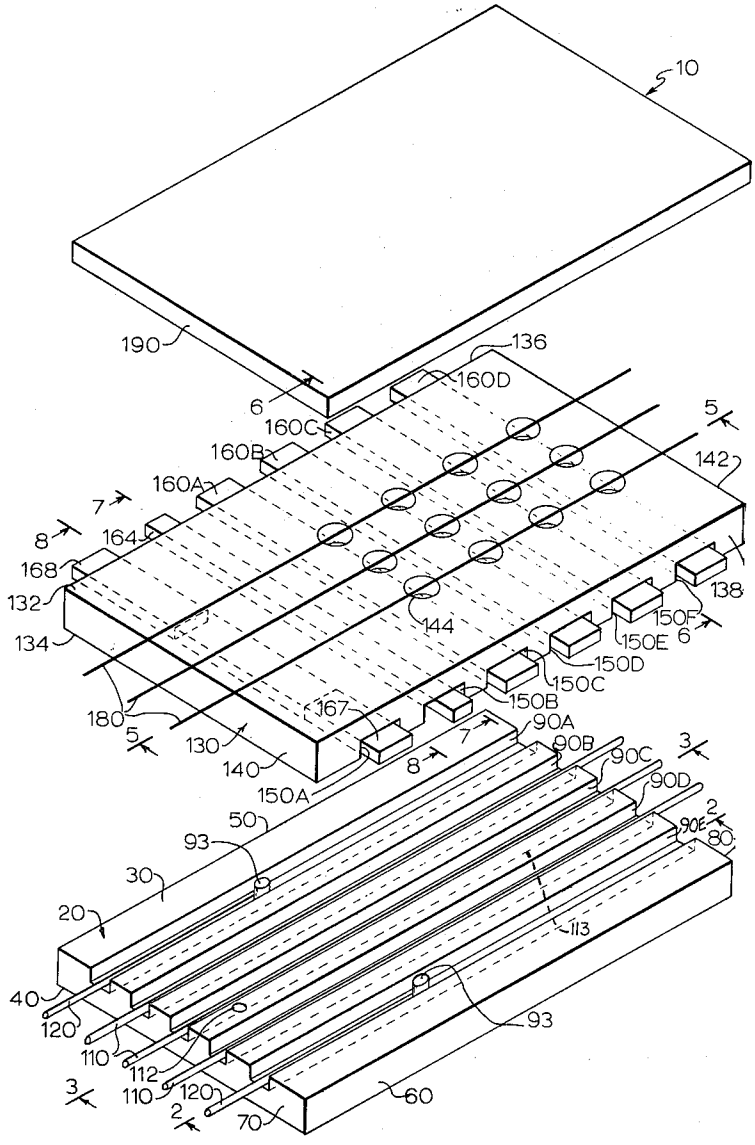
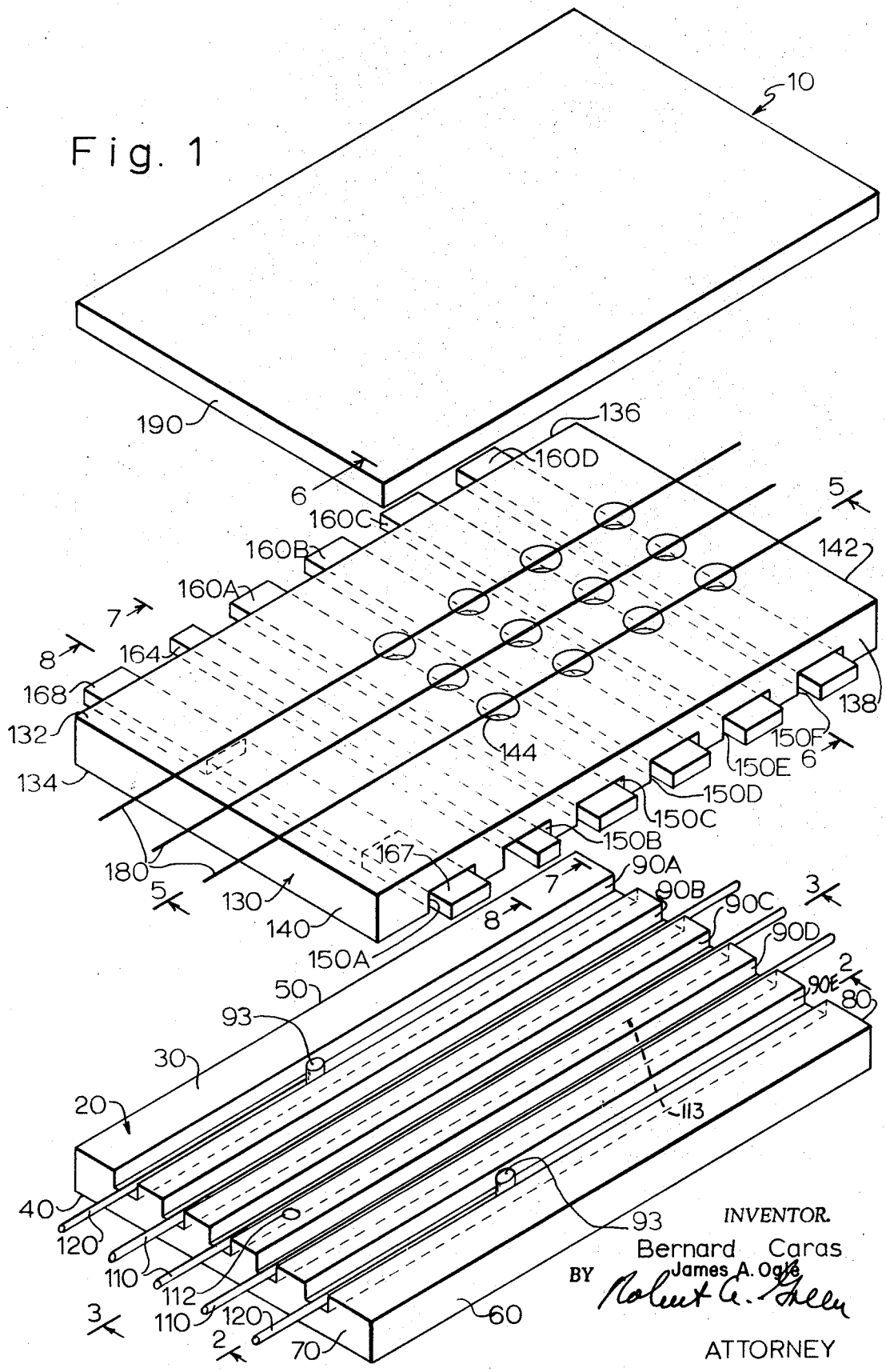


Fig. 1



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Fig. 2

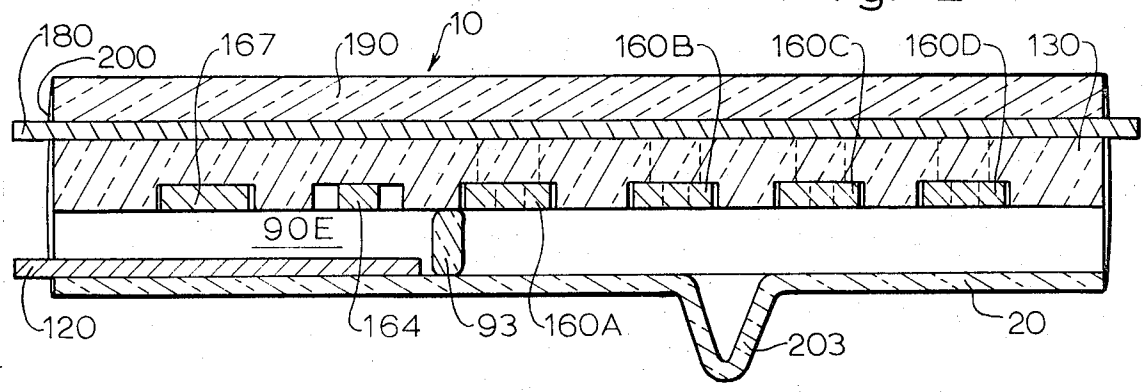


Fig. 3

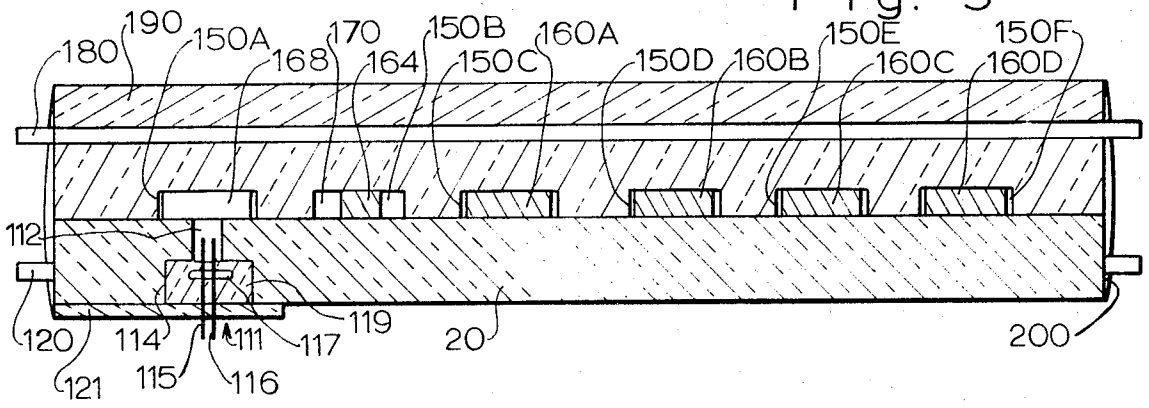
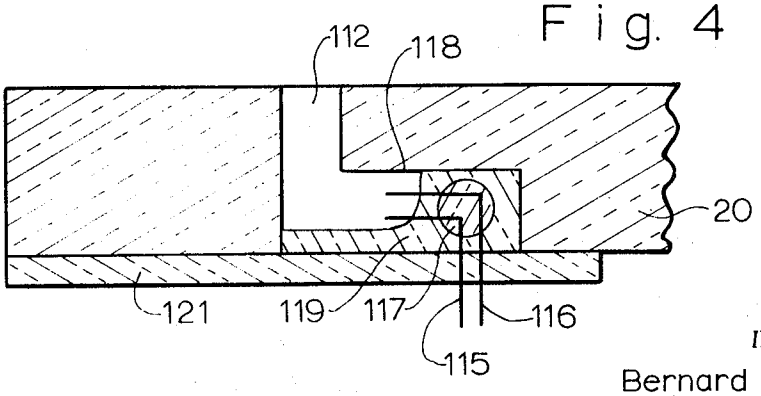


Fig. 4



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Fig. 5

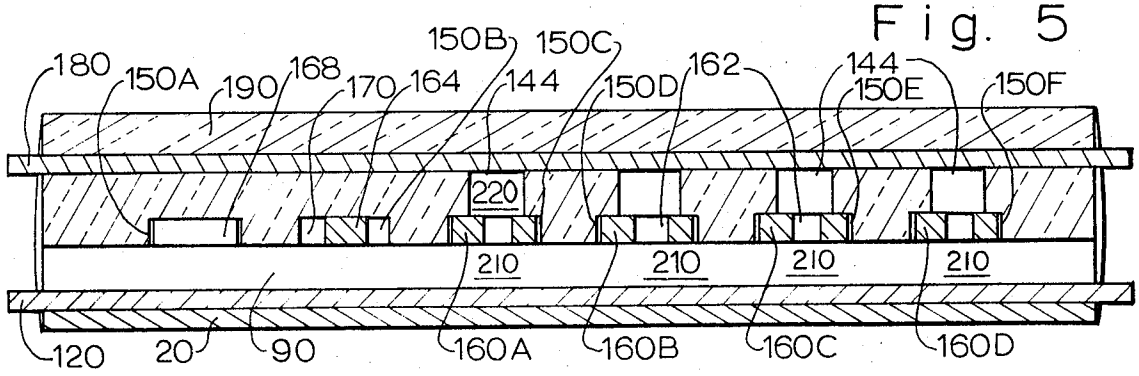


Fig. 6

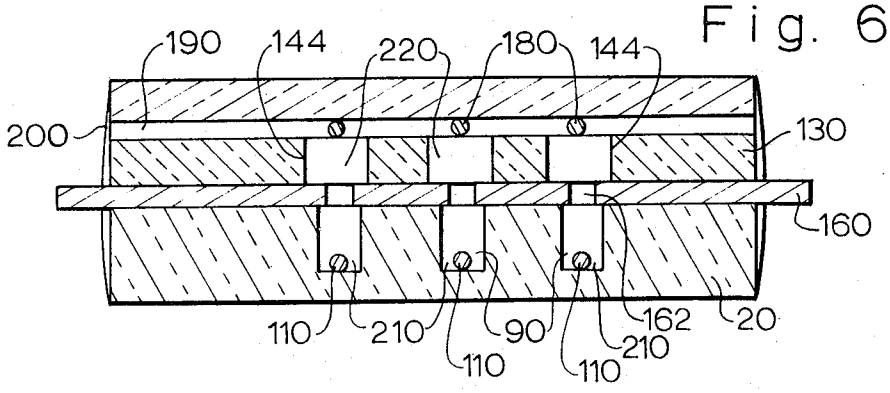
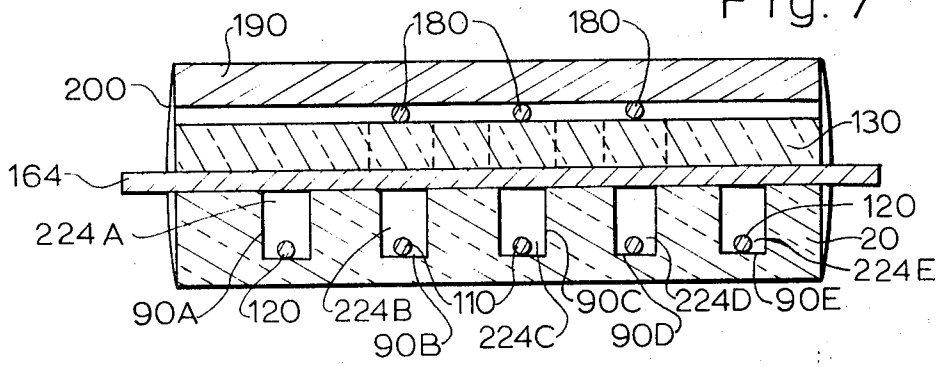
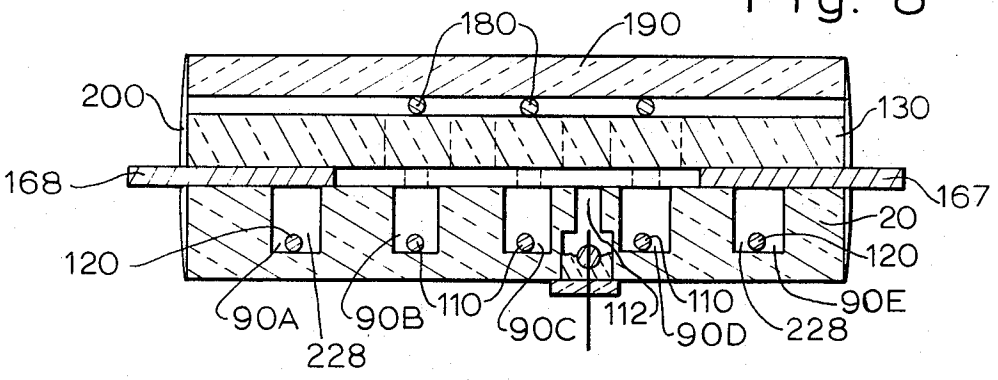


Fig. 7



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Fig. 8



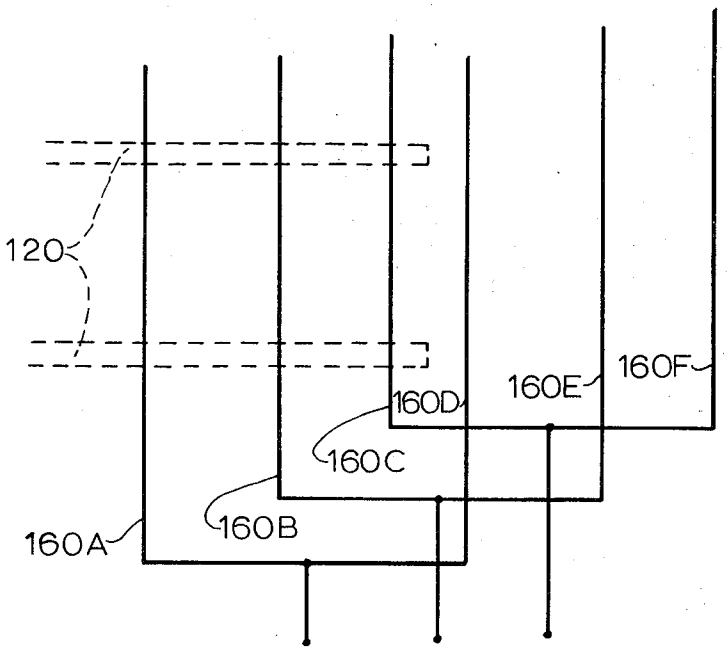


Fig. 9

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DISPLAY PANEL WITH KEEP ALIVE CELLS

BACKGROUND OF THE INVENTION

Display panels comprising a plurality of gas-filled cells which can be turned on selectively to display a message are known in the art, but have thus far not become widely used commercial devices. In a recent development, a display panel has been developed which has two layers of cells, a first layer of counting or scanning cells used as a scanning or addressing layer for sequentially addressing the cells, one by one or column by column, and a second layer of display cells in which information is inserted to be displayed, and perhaps stored, as the first level is scanned. These multi-layer panels are usually constructed of several glass plates having various arrays of slots and holes, and a plurality of arrays of electrodes which perform various functions.

For optimum operation, display panels of the type described include a group of starter or reset cells to facilitate the firing and operation of the counting cells at the beginning of a scanning cycle. In addition, keep-alive cells are provided to facilitate the operation of the starter or reset cells. However, in some panels, known arrangements for providing the keep-alive cells are not satisfactory, and optimum keep-alive action cannot be achieved.

SUMMARY OF THE INVENTION

Briefly, a display panel embodying the invention includes an array of cells held between top and bottom cover plates. The array of cells includes display cells, reset cells, and keep-alive cells. An auxiliary keep-alive cell is provided in operation with the reset cells but physically located remote therefrom to facilitate construction and operation of the panel.

DESCRIPTION OF THE DRAWINGS

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

FIG. 2 is a sectional view along the lines 2—2 in FIG. 1;

FIG. 3 is a sectional view along the lines 3—3 in FIG. 1;

FIG. 4 is a sectional view of a modification of a portion of the device shown in FIG. 3;

FIG. 5 is a sectional view along the lines 5—5 in FIG. 1;

FIG. 6 is a sectional view along the lines 6—6 in FIG. 1;

FIG. 7 is a sectional view along the lines 7—7 in FIG. 1;

FIG. 8 is a sectional view along the lines 8—8 in FIG. 1; and

FIG. 9 is a schematic representation of some of the electrodes in the display panel of FIG. 1.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

The display panel described herein is a thin, flat, sheet-like member which may have substantially and desired size and shape from, for example, postage stamp size to wall size, and it may include substantially any number of display cells. The panel may also include any suitable ionizable gas such as neon, argon, xenon, etc., singly or in combination, with a vapor of a metal such as mercury usually included in the gas to minimize cathode sputtering.

A display panel **10** embodying the invention includes a bottom plate **20** of an hermetic, dielectric material, such as glass or ceramic, which has a top surface **30**, a bottom surface **40**, an upper edge **50**, a lower edge **60**, a left edge **70**, and a right edge **80**. The plate **20** has a plurality of parallel slots or channels **90** extending a convenient distance into the body of the plate from the top surface **30**. For purposes of illustrating and describing the invention, the panel is oriented so that the slots **90** extend horizontally across plate **20** from the left edge **70** to the right edge **80**.

The array of slots **90** is suitably positioned between the upper and lower edges of plate **20**, with the first slot **90A** being closest to the upper edge **50** of the plate, and the last slot **90E** being closest to the lower edge **60** of the plate.

The slots **90** are all identical in size, shape, width, depth, etc., and can be made by any suitable mass production process; however, first and last slots **90A** and **90E** are blocked and, in effect, terminated at a selected area along their lengths by an obstruction **93** (FIGS. **1** and **2**) such as a mass of a glass frit, for example, of the type known as Pyroceram. The slots **90A** and **90E** thus terminate nearer to left edge **70** of the plate **20** and of the panel, this being the end at which the scanning operation originates in one mode of operation of the panel.

Electrodes **110**, which are used as counting or scanning anodes in one mode of operation of the panel, are seated in the slots **90B**, C, and D, and these electrodes are long enough to extend beyond the left and right edges of plate **20** so that they are accessible outside the panel. Electrodes **110** are preferably individual wires; however, they may also be plated, evaporated or otherwise formed in the slots. The electrodes **110**, if separate wires, might also be secured in the slots **90** by means of a cement such as a fused glass frit or the like. An auxiliary wire electrode **120**, also an anode, is seated in each of the shortened slots **90A** and **90E**, and these originate at the obstruction **93** and extend only beyond the left end **70** of the plate **20**.

According to the invention, a cell **111** (FIG. **3**) used as an auxiliary keep-alive cell is provided in bottom plate **20** in communication with slot **150A** in center plate **130** which is described below. This auxiliary keep-alive cell includes a small hole **112** (FIGS. **1** and **3**) which extends downwardly from the top surface of bottom plate **20** at about midway between the upper and lower edges of the plate **20** and in the rib **113** which lies between two slots **90**, say between slots **90C** and **90D**. The point on bottom plate **20** at which the hole **112** originates lies beneath a portion of slot **150A** in center plate **130** disposed above it. The hole **112** extends vertically downwardly to near the bottom surface where it joins a relatively large opening or chamber **114** formed in the bottom surface of plate **20**. The chamber extends into the body of plate **20** and is of sufficient volume to receive a keep-alive electrode structure.

The keep-alive electrode structure, in one arrangement, comprises two wires **116**, one used as an anode and one used as a cathode, held together by a glass bead **117** and seated in the chamber **114** with the electrodes more or less aligned with hole **112**. Thus positioned, the electrodes **115** and **116** can fire the gas in the cell and can provide excited particles which can diffuse through hole **112** and thus into communication with slot **150A** for a purpose to be described.

If desired, the chamber may also include a lateral arm **118** (FIG. **4**) in which the keep-alive electrode structure can be seated still in communication with hole **112** but more remote therefrom, if this is considered necessary.

The chamber can be filled with Pyroceram, a glass frit, which is fused to form a hermetic seal **119**. If desired, a small glass plate **121** may be placed over the filled chamber **114** (and **118**) and sealed to the bottom surface of plate **20** to insure a good hermetic seal.

Panel **10** also includes a center sheet or plate **130** of a dielectric material, like plate **20** if desired, which is seated on bottom plate **20** and has a top surface **132**, a bottom surface **134**, an upper edge **136**, a lower edge **138**, a left edge **140**, and a right edge **142**. The sheet **130** is provided with a plurality of rows and columns of apertures or holes **144**, and the bottom surface **134** thereof is provided with a plurality of generally rectangular, parallel slots **150**. Slots **150** have the same width and depth and extend along sheet **130** from the lower edge **138** to the upper edge **136**. The slots **150** are oriented at 90° to each of the slots **90**, and thus, in effect, across each of the slots **90** in the bottom plate **20**. The array of slots **150** is suitably positioned between the left and right edges **140** and **142**, respectively, of center sheet **130**, with slot **150A** (FIGS. **1** and **5**) considered to be the first slot positioned close to the left edge **140** of sheet **130**, and the last **150F** being positioned close to the right edge **142** of sheet **130**. The columns in which apertures or holes **144** in center sheet **130** are arrayed are generally aligned with the slots **150C** to **150F**, as shown in FIG. **1**, and the rows in which they are arrayed are generally aligned with slots **90B**, C, and D in bottom plate **20**. The holes

144 are identical, and the slots 150 are identical, and each may be made by any suitable mass production process.

A plurality of electrodes, operated as cathodes, are associated with center sheet 130, and these include scanning cathode seated in the slots 150C, D, 160A, B, C, and D D, E, and F in sheet 130. The scanning cathode electrodes 160 are metal strips which substantially fill the slots 150 and extend along the entire length thereof and beyond the upper and lower edges of sheet 130. The cathodes 160 are oriented at 90° to the anodes 110, and each cathode crosses each anode. Each electrode 160 is provided with a plurality of tiny apertures 162 disposed along its length, with each aperture 162 being generally centrally positioned over a slot 90 (FIG. 6) in bottom plate 20 and beneath a hole 144 in center sheet 130. The cathodes 160 are identical in size and shape and can be made by any suitable mass production process.

A cathode electrode 164, used as a reset cathode, is seated in slot 150B. Cathode 164 has the same thickness and length as electrodes 160; however, it is narrower so that there are spaces 170 on either side of it which extend all along the slot 150B. Cathode 164 crosses all anodes 110 and 120.

The panel also includes a pair of cathode strip electrodes 167 and 168 (FIGS. 1 and 8) used as keep-alive cathodes, and seated in slot 150A, with electrode 167 having its inner end originating at a location between slot 90D and slot 90E and extending out of the panel beyond the lower edge of the panel. Similarly, the inner end of electrode 168 originates at a location between slot 90A and slot 90B, and the electrode extends out of the panel beyond the upper edge. Electrodes 167 and 168 are identical in size and shape to electrodes 160 so that they, too, fill the slot 150A. Thus, cathodes 167 and 168 can be formed by removing a center portion from a cathode 160.

A second group of wire electrodes 180, used as display anodes, are seated on the top surface 132 of sheet 130, or in slots (not shown) in top surface 132, each being aligned with or overlaying a row of holes 144 in center sheet 130. The electrodes 180 need not be centered over the holes; they need only communicate with the gas in the holes, with no particular alignment required.

A transparent cover or viewing plate 190 of a dielectric material such as glass completes the panel and is seated on center sheet 130. The wire electrodes 180 might be seated in slots in the bottom surface of top plate 190 (not shown), if desired. In the completed panel 10, the three plates 20, 130, and 190 are hermetically secured together by a seal 200 formed along their adjacent edges by any suitable means such as a fused glass frit (Pyroceram) or the like.

The gas used in panel 10 is introduced in any suitable manner, for example, by means of a bell jar or by means of a tubulation 203 (shown only in FIG. 2), secured to bottom plate 20 and communicating with the portion of slot 90E or to the right of mass 93.

As described, panel 10 includes a lower layer of counting or scanning gas cells 210 (FIGS. 5 and 6) arrayed in rows and columns, with each cell comprising a portion of a lower anode electrode 110 in slot 90, a portion of the apertured strip cathode electrode 160 above it, and the gas volume between them in slot 90. Thus, each column of counting cells is defined by each cathode 160 and its crossing of a slot 90 and the associated portion of a counting anode 110. As seen in FIG. 1, there are four columns of counting cells 210, and, for purposes of description, the first column is associated with cathode 160A, the second column with cathode 160B, the third column with cathode 160C, and the fourth column with cathode 160D. Each column of scanning cells 210 communicates with the adjacent column, that is, each scanning cell in one column communicates with the corresponding cell in the adjacent column, through the associated slot 90.

The panel 10 also includes an upper layer of display cells 220 associated with and vertically aligned with, the counting cells 210. Each display cell 220 (FIGS. 3 and 6) is made up of a portion of a cathode 160, the associated gas-filled hole or cell 144 in center sheet 130, and the associated portion of upper anode electrode 180. As with the counting cells, there are also four columns of display cells 220, each associated with a cathode 160, with the first column associated with cathode 160A, etc.

The panel 10 also includes a column of auxiliary cells which are known variously as starter cells, reset cells, particle-supply cells, or glow-spreading cells 224 (FIG. 7), and these cells supply excited particles to facilitate the turn-on of the first column of counting cells 210 associated with cathode 160A at the beginning of a scanning cycle. For convenience, cells 224 will be called reset cells. These reset cells are arrayed in a column to the left of the first column of counting cells and communicating therewith trough slots 90B, C, and D. Cells 224 are constituted by the cathode strip 164 and the portion of each anode 110 and 120 which it crosses and the gas volume in the slots 90 therebetween.

Panel 10 also includes keep-alive cells 228 (FIG. 8) which are provided to insure firing of the reset cells 224. Keep-alive cells 228 are constituted by cathodes 167 and 168 and the anode electrodes 120 which they cross and the gas volume between them in slots 90A and 90E. The keep-alive cells 228 communicate with the reset cells through slots 90A and 90E and through the portion of slot 150A between keep-alive cathodes 167 and 168 and through the slots 90B, C, and D which slot 150A crosses. The panel also includes auxiliary keep-alive cell 111 which provides excited particles for the reset cells through slot 150A in plate 130 and slots 90 in plate 20. The keep-alive cells are ON continually.

At this point, it might be noted that the extent to which the inner ends of the keep-alive anodes 120 can extend to the right in the panel as determined by the obstructions 93 is controlled by whether these anodes will interfere with the operation of any of the cathodes 160 and the associated counting cells. Thus, the anodes 120 and mass 93 (FIG. 2) might terminate inside the panel between reset cathode 164 and the first counting cathode 160A. If the counting cathodes are connected in groups and driven by common drivers, as described in copending and commonly assigned application Ser. No. 850,984, filed Aug. 18, 1969, and as shown schematically in FIG. 9, with cathode 160A connected to cathode 160D, cathode 160B connected to cathode 160E, and cathode 160C connected to cathode 160F, then the anodes 120 could extend only to between cathodes 160C and 160D but not into operative relation with cathode 160D. This is because cathodes 160A and 160D are connected together and their normal operation in the scanning cycle would be disturbed.

In addition, as shown in FIG. 8, the keep-alive cathodes 167 and 168 may not extend into operative relation with the counting anodes 110.

In the description of the operation of the invention set forth below, reference is made to "scanning" or "glow transfer" from cell to cell or column to column. Several different types of actions occur including glow transfer from a keep-alive cell 228 to a reset cell 224, from a reset cell to a reset cell, from a reset cell 224 to a scanning or counting cell 210, from a scanning cell to a scanning cell, and from a scanning cell to a display cell 220. The exact mechanism by which each such operation occurs cannot be described with complete certainty; however, the operations may involve actual transfer of a mass of glowing ionized gas, or the diffusion of excited particles including metastable states which facilitate a new firing of on OFF cell, or both mechanisms may be involved.

In operation of the panel 10, the keep-alive cells 228 communicate with the reset cells 224 through slots 90A and 90E primarily, and through slot 150A and slots 90B, C, and D, secondarily, and excited particles thus can diffuse from keep-alive cells 228 through both paths to the reset cells 224. The most direct path for diffusion is through slots 90A and 90E to the two immediately adjacent reset cells 224A and 224E (FIG. 8) associated with slots 90A and 90E between keep-alive cathodes 167 and 168 and then through slots 90B, C, and D to reset cells 224B, C, and D. Keep-alive cell 111 provides excited particles which diffuse through the aforementioned

secondary path. As noted, the keep-alive cells are always on, and, when it is desired to turn on the reset cells **224**, operating potential is applied to the reset cathode **164** and to all of the anodes **110** and **120**. With the aid of the keep-alive cells, glow starts first in reset cells **224**A and E and spreads immediately along the entire length of the reset cathode **164** in the spaces **170**. This is the reason for having electrode **164** narrower than its slot **150**B. The auxiliary keep-alive cell **11** is an auxiliary source of excited particles which have a favorably short path to the reset cells.

When the reset cells **224** have fired, the first column of counting cells **210** can be fired with the aid of excited particles generated in the reset cells and able to diffuse to the first column of counting cells through slots **90**B, C, and D. An arrangement for using reset cells to fire counting cells is described and claimed in copending and commonly assigned application Ser. No. 791,208, filed Jan. 7, 1969. In addition, methods and apparatus including circuits for scanning columns of counting cells and energizing display cells therefrom are described and claimed in the above-mentioned application Ser. No. 850,984. These circuits are not shown here. In a typical scanning operation, the scanning or counting anodes **110** are connected to driver circuits for applying generally positive operating potential thereto, and each of the cathodes **160** is connected to a driver circuit for applying generally negative operating potential to each, sequentially, to cause each column of lower counting cells **120** to fire and glow. The firing of each column of counting cells, after the first has been fired, is facilitated by the diffusion of excited particles through the slots **90** from ON counting cells to the adjacent OFF counting cells to be fired. The columns of counting cells **210** are fired sequentially from left to right, as seen in FIGS. **1** and **2**. This sequential firing of the columns of lower counting cells **210** are carried out cyclically from left to right. Each time the last column of counting cells at the right-hand edge of the panel is reached, the column of reset cells **224** at the left-hand edge of the panel is turned on again, with the aid of the keep-alive cells, and the above-described cycle is repeated. If desired, circuit means may be provided to sense the turn-on of the last column of counting cells **210** and automatically turn on the reset cells to start the cycle again.

When it is desired to fire cells **220** in the upper layer to represent the display of information or the like, generally positive operating potentials are applied to the proper upper anodes **180** associated with the cells **220** to be fired and glow transfers from the associated lower cells **210** through the apertures **162** in cathode electrodes **160** to the upper cells where the glow can be viewed through top plate **190**. As described above, the glow transfer is facilitated by the presence of excited particles in each of the lower counting cells **210** when it is fired.

It is clear from the foregoing description of the invention that, since there is optimum uniformity in the parts used in the display panel, optimum ease of assembly and operation can be achieved. Of course, considerable savings in parts and assembly time are also achieved.

It is clear that modifications may be made in the panels described within the scope of the invention. For example, although the panel as described is canned from left to right, the scanning may be effected in other ways, and this might require a rearrangement of parts. In addition, although two keep-alive cells have been shown, one may be sufficient.

In general, the drawings are not intended to be dimensionally exact, and, in a typical display panel embodying the invention, the top plate **190** and bottom plate **20** are about one-quarter inch in thickness, and the center plate **130** is about 40 mils in thickness. In addition, in plate **20**, slots **90** are 10 mils wide and 35 mils deep, and electrodes **110** and **120** are 5 mils in diameter. In plate **130**, slots **150** are 36 mils wide and 1 to 3 mils deep, with cathodes **167**, **168**, and **160** having approximately the same dimensions. The holes **162** in the cathodes are 1 to 3 mils in diameter, the holes **144** in plate **130** are 18 to 24 mils in diameter and 40 mils deep, and electrodes **180** are about 3 mils in diameter.

What is claimed is:

1. A display panel comprising

a sandwich of dielectric plates including a bottom plate, a center plate, and a top plate,

a plurality of gas-filled glow cells disposed between said bottom plate and said center plate with an anode electrode and a cathode electrode associated with each cell, said cells being arrayed in rows and columns,

said bottom plate having slots formed therein extending along rows of cells and comprising gas communication paths interconnecting each glow cell in a column of cells to the adjacent cell in the adjacent column,

a source of excited particles disposed in operative relation with selected ones of said cells for facilitating the firing of said selected cells at the beginning of a period of operation of said panel,

said source being disposed within said bottom plate out of sight of a viewer but communicating through a hole in said bottom plate into a slot in said center plate and into a gas communication path coupled to at least one of said selected cells.

2. A display panel comprising

a sandwich of dielectric plates including a bottom plate, a center plate, and a top plate,

a plurality of gas-filled glow cells disposed between said bottom plate and said center plate with an anode electrode and a cathode electrode associated with each cell, said cells being arrayed in rows and columns, there being a first column and a last column,

a column of auxiliary cells adjacent to said first column of glow cells,

said bottom plate having slots formed therein extending along rows of cells and comprising gas communication paths interconnecting said column of auxiliary cells with said first column of glow cells and each column of glow cells with the adjacent column of glow cells, and

a source of excited particles disposed in operative relation with said column of auxiliary cells for facilitating the firing of said auxiliary cells,

said source being disposed within said bottom plate out of sight of a viewer but communicating through a hole in said bottom plate into a gas communication path coupled to said column of auxiliary cells.

3. A display panel comprising

a sandwich of dielectric plates including a bottom plate, a center plate, and a top plate,

a plurality of gas-filled glow cells disposed between said bottom plate and said center plate with an anode electrode and a cathode electrode associated with each cell, said cells being arrayed in rows and columns,

said bottom plate having first slots formed therein extending along rows of cells and comprising gas communication paths interconnecting each column of glow cells with the adjacent column of glow cells, and a second slot in the bottom surface of said center plate adjacent to said bottom plate, and

a source of excited particles disposed in operative relation with selected ones of said cells for facilitating the firing of said selected cells,

said source being disposed within said bottom plate out of sight of a viewer but communicating through a hole in said bottom plate and said slot in said center plate into a gas communication path coupled to at least one of said selected cells.

4. A display panel comprising

a sandwich of dielectric plates including a bottom plate, a center plate, and a top plate,

a plurality of gas-filled glow cells disposed between said bottom plate and said center plate with an anode electrode and a cathode electrode associated with each cell, said cells being arrayed in rows and columns, there being a first column and a last column,

a column of auxiliary cells adjacent to said first column of glow cells,

said bottom plate having first slots formed therein extending along rows of cells and comprising gas communication paths interconnecting said column of auxiliary cells with said first column of glow cells and each column of glow cells with the adjacent column of glow cells, a second slot in the bottom surface of said center plate adjacent to said bottom plate, and

a source of excited particles disposed in operative relation with said column of auxiliary cells for facilitating the firing of said auxiliary cells,

said source being disposed within said bottom plate out of sight of a viewer but communicating through a hole in said bottom plate into a gas communication path coupled to said column of auxiliary cells.

5. The panel defined in claim 4 wherein said hole associated with said source extends to the top surface of said bottom plate between selected ones of said slots therein and in alignment with said second slot.

6. A display panel comprising

a gas-filled envelope including a bottom plate, a center plate, and a top plate, all being of dielectric material and hermetically sealed together along their adjacent edges;

said bottom plate having a top surface, a bottom surface, a left edge, a right edge, an upper edge, and a lower edge,

said bottom plate also having a plurality of first parallel identical slots extending into said plate from said top surface and extending along the entire length of said plate,

at least one of said first slots being terminated close to one edge of said bottom plate and comprising a short slot,

a first electrode seated in all of said first slots except said short slot and extending along the entire length of said first slots and beyond the left and right edges of said bottom plate,

a second electrode seated in said short slot,

said center plate having a top surface, a bottom surface, a left edge, a right edge, an upper edge, and a lower edge,

a plurality of generally rectangular identical parallel slots formed in said bottom surface of said center plate and extending transversely to said first slots in said bottom plate, the first slot being considered to be adjacent to the left edge of said center plate and the last slot being considered to be adjacent to the right edge of said center plate,

a first flat strip electrode disposed in said first of said rectangular slots with the inner end thereof overlying said short slot in said bottom plate and extending therefrom out of said panel beyond said lower edge of said bottom plate, said first electrode being in operative relation with said second electrode seated in said short slot,

a second narrow flat strip electrode seated in the second of said rectangular slots and extending along the entire length of said second slot and beyond the upper and lower edges of said center plate, said narrow flat strip being narrower than said second slot, said second flat strip electrode being in operative relation with said first electrodes in said first slots and said second electrode in said short slot,

a plurality of third identical flat strip apertured electrodes seated in all of the others of said rectangular slots and filling said slots, said third flat strip electrodes being in operative relation with only said first electrodes,

a plurality of holes formed in said center plate and arrayed in rows and columns, each column of holes being aligned with one of said identical flat strip apertured electrodes with each aperture in said apertured electrodes being generally aligned with one of said holes, each row of holes being generally aligned along one of said slots in said bottom plate,

a plurality of fourth electrodes aligned with said rows of holes and disposed between said top plate and said center plate, and

an auxiliary gas cell formed within the body of said bottom plate and communicating with said first of said parallel slots formed in the bottom surface of said center plate.

7. The panel defined in claim 6 wherein said auxiliary gas cell includes an anode and a cathode electrode.

8. The panel defined in claim 6 wherein said auxiliary gas cell includes an anode and a cathode electrode which communicate from a chamber within the body of said bottom plate through a gas communication path extending to the top surface of said bottom plate between selected ones of said first slots.

9. A display panel comprising

a gas-filled envelope including a bottom plate, a center plate, and a top plate, all being of dielectric material and hermetically sealed together along their adjacent edges,

said bottom plate having a top surface, a bottom surface, a left edge, a right edge, an upper edge, and a lower edge,

said bottom plate also having a plurality of first parallel identical slots extending into said plate from said top surface and extending along the entire length of said plate,

two of said first slots being terminated close to one edge of said bottom plate and comprising short slots,

a first electrode seated in all of said first slots except said short slot and extending along the entire length of said first slots and beyond the left and right edges of said bottom plate,

a second electrode seated in one of said two short slots and a third electrode seated in the other of said two short slots,

said center plate of insulating material having a top surface, a bottom surface, a left edge, a right edge, an upper edge, and a lower edge,

a plurality of generally rectangular identical parallel slots formed in said bottom surface of said center plate and extending transversely to said first slots in said bottom plate, the first slot being considered to be adjacent to the left edge of said center plate and the last slot being considered to be adjacent to the right edge of said center plate,

first and second flat strip electrodes both disposed in said first rectangular slot but spaced apart from each other with one in operative relation with said second electrode and one in operative relation with said third electrode,

a second narrow flat strip electrode seated in the second of said rectangular slots and extending along the entire length of said second slot and beyond the upper and lower edges of said center plate, said narrow flat strip being narrower than said second slot, said second flat strip electrode being in operative relation with said first and second electrodes,

a plurality of third identical flat strip apertured electrodes seated in all of the others of said rectangular slots and filling said slots, said third flat strip electrodes being in operative relation with only said first electrodes,

a plurality of holes formed in said center plate and arrayed in rows and columns, each column of holes being aligned with one of said identical flat strip apertured electrodes, with each aperture in said apertured electrodes being generally aligned with one of said holes, each row of holes being generally aligned along one of said slots in said bottom plate,

a plurality of fourth electrodes aligned wit said rows of holes and disposed between said top plate and said center plate, and

an auxiliary gas cell formed within the body of said bottom plate and communicating with said first of said parallel slots formed in the bottom surface of said center plate.

10. The panel defined in claim 9 wherein said auxiliary gas cell includes an anode and a cathode electrode.

11. The panel defined in claim 9 wherein said auxiliary gas cell includes an anode and a cathode electrode which communicate from a chamber within the body of said bottom plate through a gas communication path extending to the top surface of said bottom plate between selected ones of said first slots.

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