United States Patent

Kupsky

[15] **3,644,925**

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[54] GASEOUS DISCHARGE DISPLAY PANEL WITH AUXILIARY EXCITATION CELLS

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[73] Assignee: **Burroughs Corporation**, Detroit, Mich.

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[21] Appl. No.: **791,208**

[52] **U.S. Cl.** .....**340/378 R**, 313/197, 313/208, 315/169 TV

[51] **Int. Cl.**.....**H01j 17/30**

[58] **Field of Search**.....340/373, 378 R, 324.1, 343, 340/344; 313/208, 109, 108, 210, 197; 315/249, 169, 169 TV, 169 T; 178/7.3 D, 7.5 D

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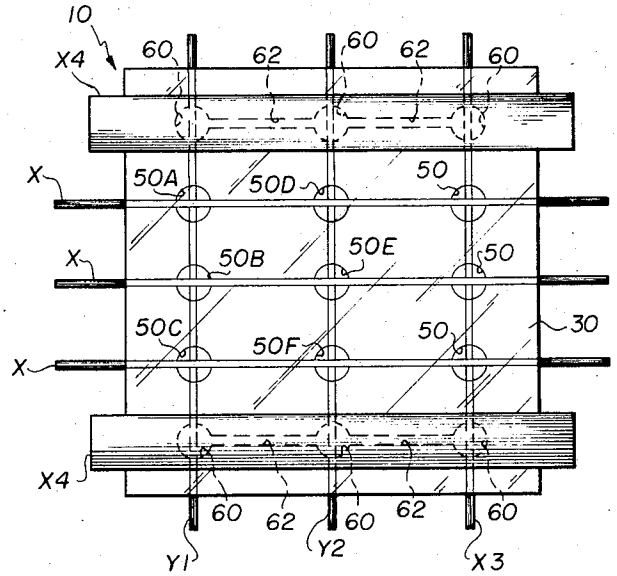
[57] **ABSTRACT**

A display panel comprising a plurality of gas-filled cells, each having a pair of energizing electrodes and adapted to be energized in groups to display characters. The panel also includes a plurality of cells which are adapted to be energized so that they glow continuously and facilitate the turning on of the groups of cells which are used to display a character. These auxiliary energizing cells are hidden from view so that they perform their function without being seen and without interfering with viewing of the primary characters.

11 Claims, 7 Drawing Figures



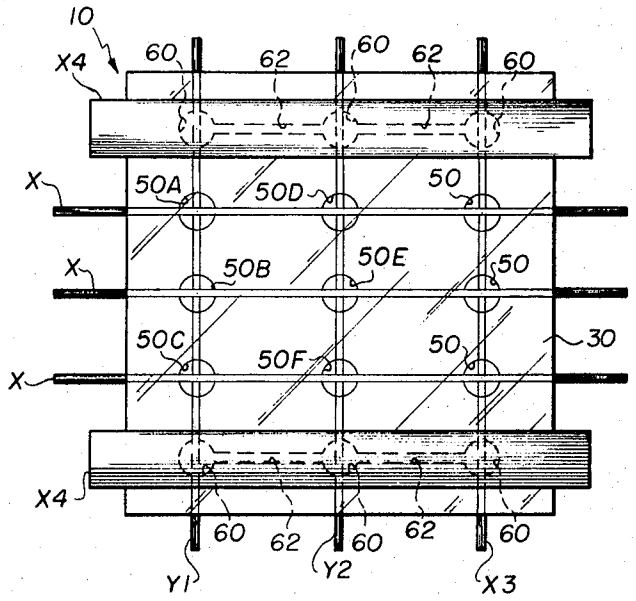


FIG. 1

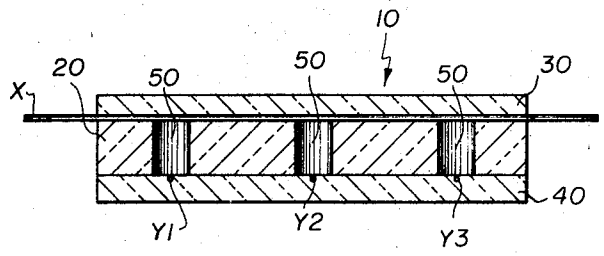


FIG. 2

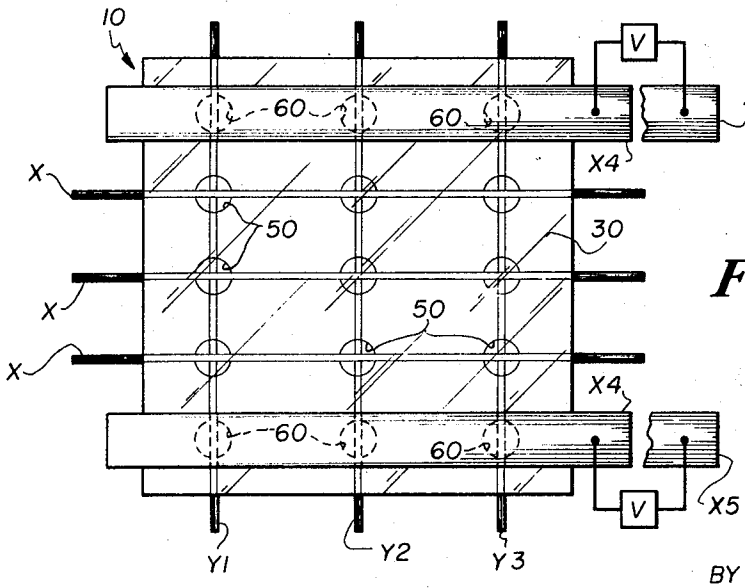


FIG. 3

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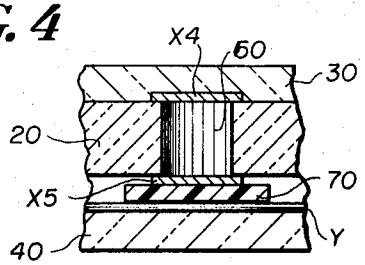
FIG. 4



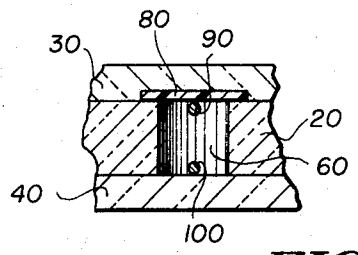
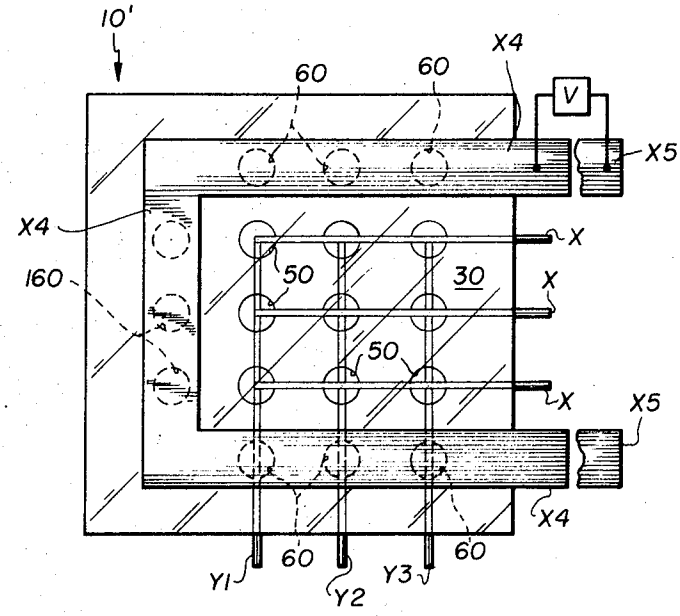


FIG. 5

FIG. 6



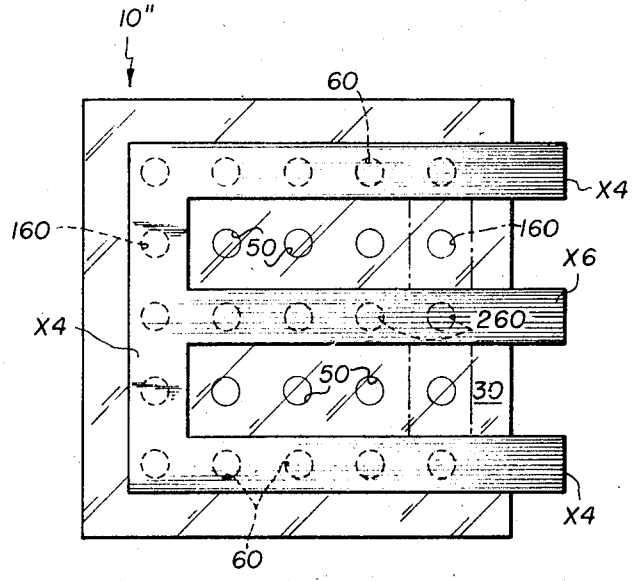


FIG. 7

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GASEOUS DISCHARGE DISPLAY PANEL WITH AUXILIARY EXCITATION CELLS

BACKGROUND OF THE INVENTION

Display panels comprising large numbers of light-producing cells, particularly gas-filled cells, have been known in the art for some time. However, up to the present time, the necessary inventions have not been made to convert these devices from the theoretical or laboratory state to the practical commercial state. In gas-filled devices which are intended to be caused to glow to display characters, a voltage is applied across selected cells to provide the desired breakdown and glow. The breakdown and glow-producing process is generally considered to require the presence in the gas of at least one electron to initiate the required collisions and energy interchanges which produce glow.

The initiating electron(s) are not, relatively speaking, easy to obtain, but they can be obtained, for example, by field emission or photoemission. However, these methods are not sufficiently fast or easy to carry out when it is desired to enter and change information in a display panel at relatively high speed.

SUMMARY OF THE INVENTION

Briefly, the invention comprises providing, in an operating display panel, auxiliary cells which glow without being seen and provide electrons or ions which facilitate the turning on of cells which are intended to display information.

DESCRIPTION OF THE DRAWINGS

FIG. **1** is a plan view of a display panel embodying the invention;

FIG. **2** is a sectional view of the device of FIG. **1** showing display cells and their electrodes;

FIG. **3** is a plan view of a modification of the invention;

FIG. **4** is a sectional view of a portion of the device of FIG. **3**;

FIG. **5** is a sectional view showing a modification of the invention;

FIG. **6** is a plan view of another modification of the invention; and

FIG. **7** is a plan view of still another modification of the invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

The principles of the invention are applicable to display devices of many types, some of which are described and claimed in a copending application of G. A. Kupsky, Ser. No. 764,984, now abandoned. Devices of this type are shown and described herein in only enough detail to illustrate the invention. Details of manufacturing and assembly operations are omitted.

Referring to the drawings and to FIGS. **1** and **2**, a display device or panel **10** comprises a sandwich of plates including an insulating central plate **20** of glass or ceramic, a top glass plate **30** which is a viewing window, and a bottom glass plate **40**. The center plate has apertures or cells **50** arrayed in rows and columns, and a row electrode X is provided in contact with the top surface of the central plate in operative relation with each row of cells, and a column electrode Y is provided in contact with the bottom surface of the central plate and in operative relation with each column of cells. The cells **50** are intended to display information, and they define an information display or viewing area.

The top electrodes, that is, the row electrodes X in FIG. **1**, are designed so that the glow in cells **50** is not obstructed by them. For this purpose, these electrodes are flat strips having apertures aligned with the cells, or they are thin wires which do not entirely cover the cells, or they may be strips offset so that they only partially cover the cells, or they may be transparent electrode films which may be formed on the top glass plate. Any other suitable expedient may also be employed.

The cells **50** are filled with a suitable gas such as neon, argon, or a mixture of these at any suitable pressure, for example, 20 to 100 Torr at room temperature.

In operation of the panel **10**, selected cells **50** can be caused to glow by the application of suitable voltages between the row and column electrodes associated with the selected cells. Without the provision of some means for providing the first electron in the cells to cause the cells to turn on, such means being, for example, an external source of ultraviolet light, the turn-on time for each cell is often undesirably long. According to the invention, this problem is overcome by the provision of auxiliary rows of cells **60** positioned outside the area occupied by cells **50** which are intended for use in displaying characters. In FIG. **1**, two rows of auxiliary cells **60** are shown, one along the upper margin of panel **10** and one along the lower margin of the panel. The auxiliary cells **60** have row electrodes **X4** and **X5** and the same column electrodes as the column cells with which each is aligned.

The auxiliary cells **60** are arranged so that they glow, but without the glow being seen by a viewer. These cells **60** thus serve as a source of charged particles such as electrons or ions which find their way between the center plate and the other plates to the other cells to thereby facilitate their turning on. The auxiliary cells **60** may be hidden from view, for example, by having their top electrodes in the form of strips which are wide enough to cover the cells so that they cannot be seen by a viewer. To facilitate their operation, it might be desirable to interconnect cells **60** by channels **62** illustrated in FIG. **1**.

Other expedients might also be employed to hide cells **60** from view. For example, the portions of top glass plate **40** which cover cells **60** might be painted black, or a layer of some plastic might be cemented on the top or bottom surface of the top plate. In either case then, the top electrode associated with cells **60** need not also conceal the cells.

In one mode of operation of panel **10**, the column cells are scanned or energized from left to right, as illustrated in FIG. **1**, at a rate which makes information appear to be stationary. This is achieved by applying energizing potentials to electrodes **Y1**, **Y2**, **Y3** . . . **Yn** in turn, and, as each Y electrode is energized, appropriate information-representing potentials are applied to the X electrodes to turn on the proper cells in the column of cells associated with the energized Y electrode.

Thus, for example, when electrode **Y1** is energized, suitable information signals are supplied to the appropriate X electrodes to turn on cells **50A** and **50C**. Then when electrode **Y2** is energized, the information signals on the X lines are changed so that, say, cell **50E** is turned on, etc. This scanning operation is carried out at a rate which keeps the selected cells ON and displaying a character or message for a time until the input information is changed and the display is changed. However, operating turn-on potentials are applied continuously to lines **X4** as the Y lines are energized to turn on the auxiliary cells **60** in each column, and thus to provide a source of ionic stimulation for the display cells **50**.

The auxiliary cells **60** may be separated electrically from the cells **50** by not using the Y electrodes as common electrodes as described above, but by having a second electrode for operation with electrodes **X4** to turn on cells **60**. As shown in FIGS. **3** and **4**, the second electrode can be a row electrode **X5** positioned between the center plate and bottom plate and aligned with cells **60** paralleled to electrodes **X4**. The second electrodes **X5** are suitably insulated from the Y electrodes which pass through the area by means of insulating coatings or strips **70** where needed. Of course, the Y electrodes need extend across only one set of cells **60** and out of the panel **10** to provide external connection thereto.

Electrodes **X4** and **X5** and their cells **60** are energized by a separate signal source V connected between them. The source V may provide an AC signal synchronized with the scanning signal, or it may be a DC voltage which holds cells **60** on continuously.

In another concealing arrangement illustrated in FIG. **5**, an insulating strip **80** is placed on the top surface of plate **20** over

each row of cells **60**, and electrode wires **90** and **100** are seated in slots in the top and bottom surfaces of center plate **20** and extending along the rows of auxiliary cells **60**. As described above with respect to FIG. **3**, either an AC or DC signal may be applied to electrodes **90** and **100** to operate auxiliary cells **60**.

In another modification of the invention shown in FIG. **6**, a panel **10'** includes the upper and lower rows of auxiliary cells **60**, as described above, and, in addition, a column of auxiliary cells **160** positioned ahead of the first column of cells **50** viewed in a scanning operation. In FIG. **6**, the column of auxiliary cells **160** is positioned at the left-hand edge of the panel, and it is assumed that the scanning operation proceeds from left to right.

Any suitable arrangement may be used to conceal and to energize the column of auxiliary cells **160**. One convenient construction is similar to that shown in FIG. **3**, and, in effect, converts the individual row electrodes **X4** and **X5** to U-shaped electrodes which are aligned with cells **60** and **160**. The usual row and column electrodes X and Y are provided for the other cells **30**, with insulation being provided between the various electrodes where required. As above, signal source V is connected between the U-shaped electrodes **X4** and **X5** associated with the rows and columns of auxiliary cells.

The rows of cells **60** perform the function described above, and, in addition, the column of auxiliary cells **160** facilitate the starting of a new scanning cycle after all of the cells have been cycled from left to right. The cycle is begun again by having the column of auxiliary cells **160** turn on, and this provides the stimulus for the next adjacent column of cells **50** which are the first cells to carry visible information. As described above, the auxiliary cells **60** and **160** might be held on continuously or cycled.

In still another modification of the invention, illustrated in FIG. **7**, it might be desirable to have rows or columns of auxiliary cells interspersed among the display cells **50** throughout the panel. In panel **10''** shown in FIG. **7**, a row of auxiliary cells **260** is shown with an electrode **X6** connected to U-shaped electrode **X4**. The required associated electrode for cells **260** is provided even though it cannot be seen in FIG. **7**. This type of construction would normally be used in a large panel having many cells.

In another modification of the invention illustrated in FIG. **7**, a second column of auxiliary cells **160** and its electrodes are provided along the right-hand margin of the area occupied by the display cells **50**. Thus, a ring of auxiliary cells is provided completely surrounding the display cells **50**. With this arrangement, and particularly if intermediate auxiliary cells **260** are provided in a display panel, the turn-on of cells anywhere in the panel is facilitated. Thus, a scanning operation or entry of static information need not originate at a margin of a panel immediately adjacent to auxiliary cells, but can originate anywhere in the panel with ease.

What is claimed is:

1. A flat panel display device comprising

a gas-filled envelope including an insulating center plate and top and bottom insulating plates all sealed together vacuumtight along their adjacent peripheries,

said center plate comprising a solid sheet having a plurality of discrete apertures, each forming a gaseous display cell, said cells being arrayed in rows and columns,

the walls of said display cells being free of material which can generate excited particles and in the same physical state as other portions of the surface of said center plate,

a row electrode aligned with each row of display cells and a column electrode aligned with each column of display cells,

said display cells being adapted to be fired by the application of operating potentials to selected ones of said row and column electrodes,

a plurality of auxiliary discrete gas-filled cells adapted to glow at a low level, not for viewing, but to provide excited particles for firing said first cells,

the walls of said auxiliary cells being free of material which can generate excited particles and in the same physical state as other portions of the surface of said center plate,

each auxiliary cell being aligned with and in operative relation with a column of said first cells, each column electrode also being in operative relation with one of said auxiliary cells, and

an auxiliary row electrode in operative relation with each of said auxiliary cells,

said auxiliary electrode and said column electrodes being usable to fire each of said auxiliary cells to cause the gas therein to glow and to generate excited particles, said excited particles diffusing to adjacent display cells and energizing the gas therein to facilitate the firing of said display cells when operating potentials are applied thereto.

2. The panel defined in claim **1** wherein said auxiliary cells are arrayed in a series and each auxiliary cell is coupled to the adjacent auxiliary cell by a gas communication path whereby when one auxiliary cell is ON, it provides excited particles which diffuse to the adjacent auxiliary cell and facilitate its turning ON.

3. The panel defined in claim **1** wherein said auxiliary electrode is an opaque electrode which overlays said auxiliary cells and prevents light from said auxiliary cells from being seen by a viewer.

4. The device defined in claim **1** and including an auxiliary cell aligned with each row of first cells.

5. A flat panel display device comprising

an insulating center plate having generally flat top and bottom surfaces and including a plurality of first gas-filled cells arrayed in rows and columns, said first cells comprising display cells for displaying information and occupying an information display area,

said cells being mechanically separate from each other,

the walls of said first cells being free of material which can generate excited particles and in the same physical state as other portions of the surface of said center plate,

an insulating base plate having a relatively flat top surface and secured along its periphery to a peripheral portion of said center plate,

the adjacent portions of the top of said base plate and the bottom surface of said center plate being in intimate contact with each other but not in gastight engagement,

a top plate being secured to said center plate along their adjacent margins with the bottom surface of said top plate in intimate engagement but not in gastight engagement with the top surface of said center plate,

there thus being minimal spacing between said center plate and the adjacent top and bottom plates, said spacing being too narrow to permit a mass flow of gas but permitting passage of charged particles of gas,

a plurality of auxiliary gas-filled cells spaced from said first cells and having electrode means for producing glow at a level suitable not for viewing but to provide charged particles for said first cells,

the walls of said auxiliary cells being free of material which can generate excited particles and in the same physical state as other portions of the surface of said center plate,

said electrode means associated with said auxiliary cells being usable to fire each of said auxiliary cells selectively to cause the gas therein to glow and to generate excited particles, said excited particles diffusing to adjacent display cells and energizing the gas therein to facilitate the firing of said display cells when operating potentials are applied thereto,

said excited particles diffusing from an auxiliary cell when it is ON to a first cell through the spacing between said center plate and said top and bottom plates,

said auxiliary cells each being aligned with a column of said first cells,

at least two electrodes associated with each of said first cells, and

at least two electrodes in said electrode means associated with each of said auxiliary cells,

at least one of said last two electrodes being positioned to conceal said auxiliary cells from view.

6. A flat panel display device comprising

a gas-filled envelope including an insulating center plate and top and bottom insulating plates all sealed together in vacuumtight engagement along their adjacent peripheries,

said center plate comprising a solid sheet of insulating material having a plurality of discrete appertures, each forming a gaseous display cell, said cells being arrayed in rows and columns,

the walls of said cells being free of material which can generate excited particles, said walls being in the same physical state as other portions of the surface of said center plate,

a row electrode aligned with each row of display cells and a column electrode aligned with each column of display cells, each row electrode crossing each column electrode, each crossing being at one of said display cells whereby each display cell can be fired by the application of electrical potential to the two electrodes associated with it, and

a plurality of auxiliary discrete gas-filled keep-alive cells positioned adjacent to said display cells and having operating electrodes and adapted to glow at a level, not necessarily suitable for viewing, but suitable to provide excited particles for firing said first cells,

the walls of said auxiliary cells being free of material which can generate excited particles, said walls being in the same physical state as other portions of the surface of said center plate,

said operating electrodes of said auxiliary cells usable to fire each of said auxiliary cells to cause the gas therein to glow and to generate excited particles, said excited particles diffusing to adjacent display cells and energizing the gas therein to facilitate the firing of said display cells when operating potentials are applied thereto.

7. The display device defined in claim **6** wherein said auxiliary cells are arrayed in a column adjacent to the first column of said display cells and in gas communication therewith whereby excited particles generated therein can reach said display cells in said first column.

8. The device defined in claim **7** wherein there is one auxiliary cell adjacent to each row of display cells.

9. The display device defined in claim **6** and including a strip of opaque material overlaying said auxiliary cells, the operating electrodes associated with said auxiliary cells being disposed beneath said opaque strip and in slots in the top and bottom surfaces of said center plate.

10. The display device defined in claim **6** and including circuit means connected to said electrodes for scanning and firing said display cells column by column, and circuit means coupled to said electrodes of said auxiliary cells for simultaneously scanning and successively energizing said auxiliary cells whereby each auxiliary cell as it is fired can generate excited particles for assisting the firing of the first column of display cells.

11. The display device defined in claim **10** wherein both said circuit means are operable for energizing each column of display cells in turn in a scanning cycle and energizing each auxiliary cell as each column of display cells is energized.

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