

[54] MULTI-POSITION CHARACTER DISPLAY
PANEL

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Related U.S. Application Data

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abandoned, which is a continuation-in-part of Ser.
No. 124,373, March 15, 1971, abandoned, which is a
continuation-in-part of Ser. No. 61,642, Aug. 6,
1970, abandoned.

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[51] Int. Cl. H01j 61/66
[58] Field of Search 313/188, 217, 220, 217,
313/519, 190

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ABSTRACT

The display panel includes a plurality of character po-
sitions and is of a sandwich construction and includes
a base plate on which a plurality of groups of cathodes
and their conductors are formed. Each group of cath-
odes can display a character. The panel also includes
a face plate, spaced from the base plate, and carrying
transparent conductive anodes, each associated with
one group of cathodes and shaped and positioned to
provide proper operation with its group of cathodes
but to minimize cross-talk between groups of cathodes
and between adjacent character positions.

31 Claims, 11 Drawing Figures

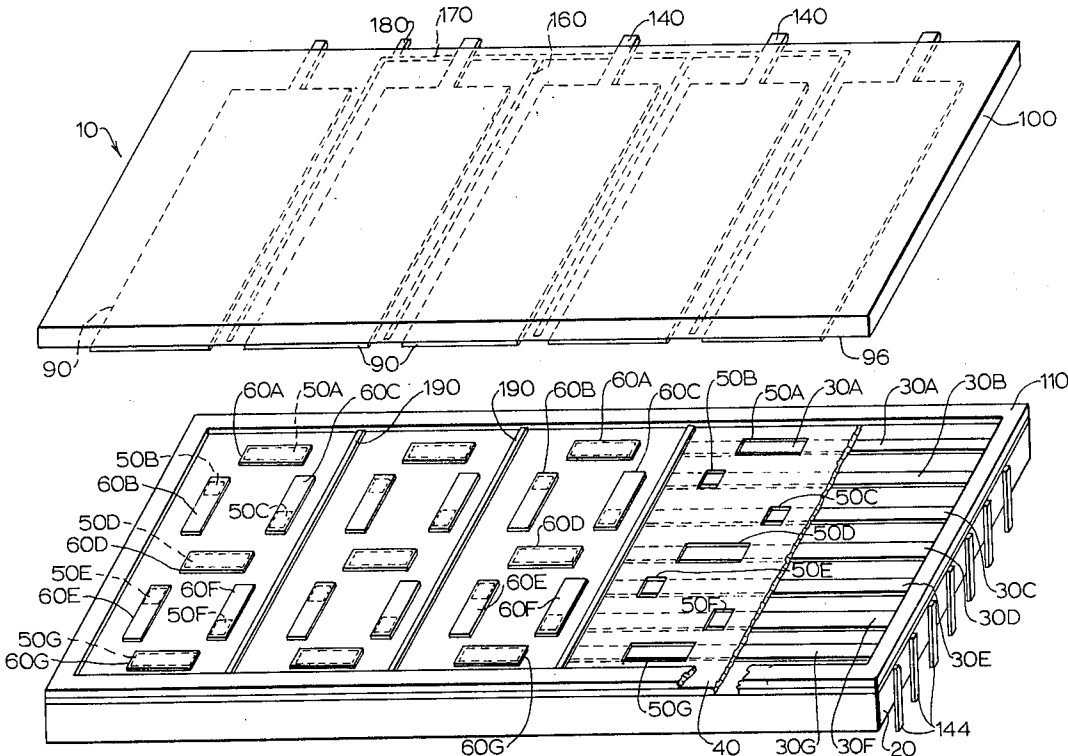
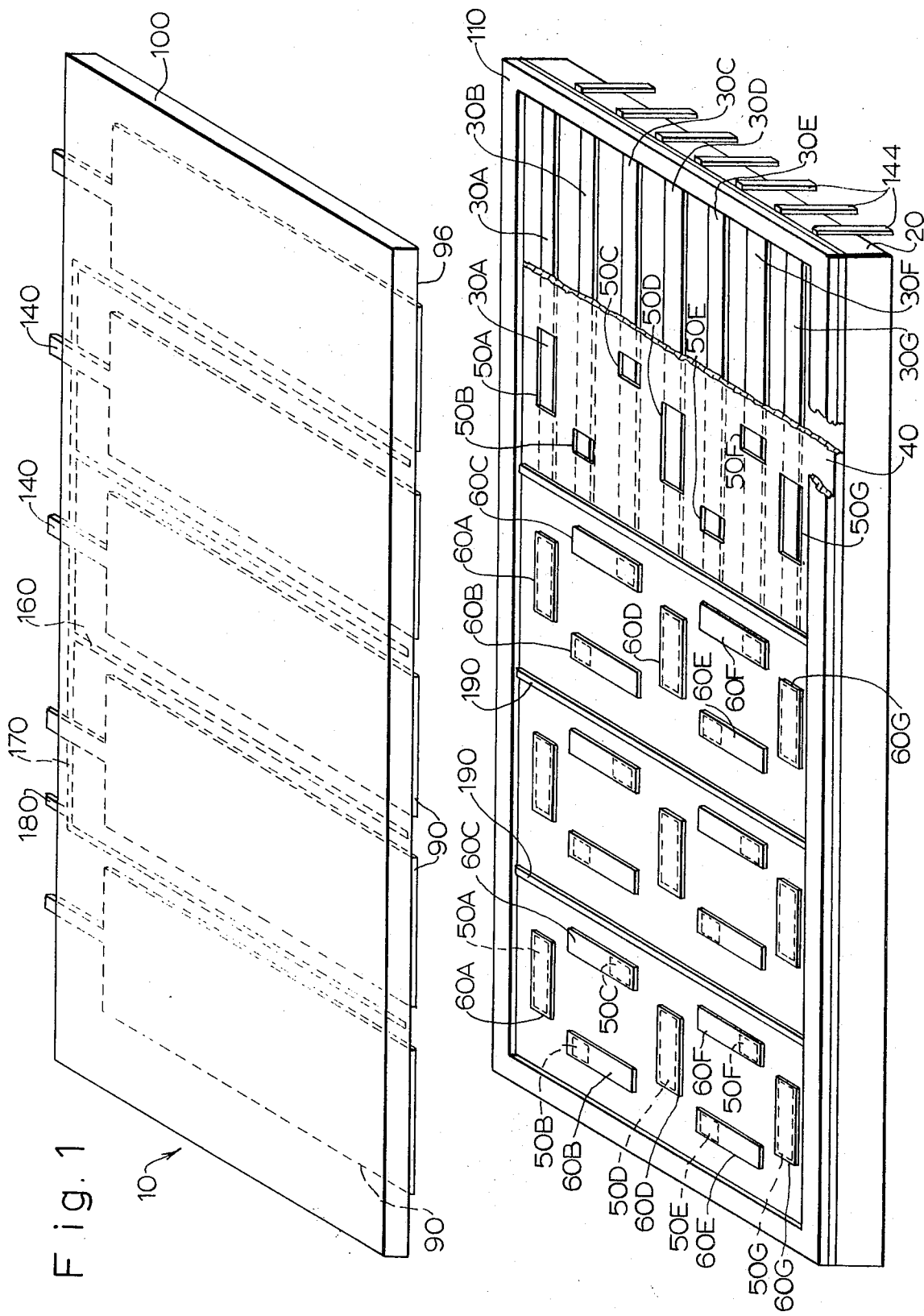
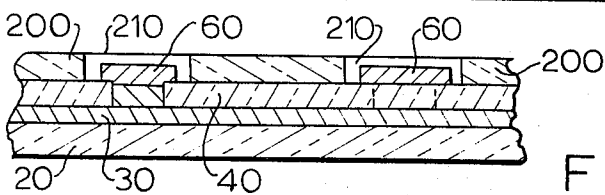
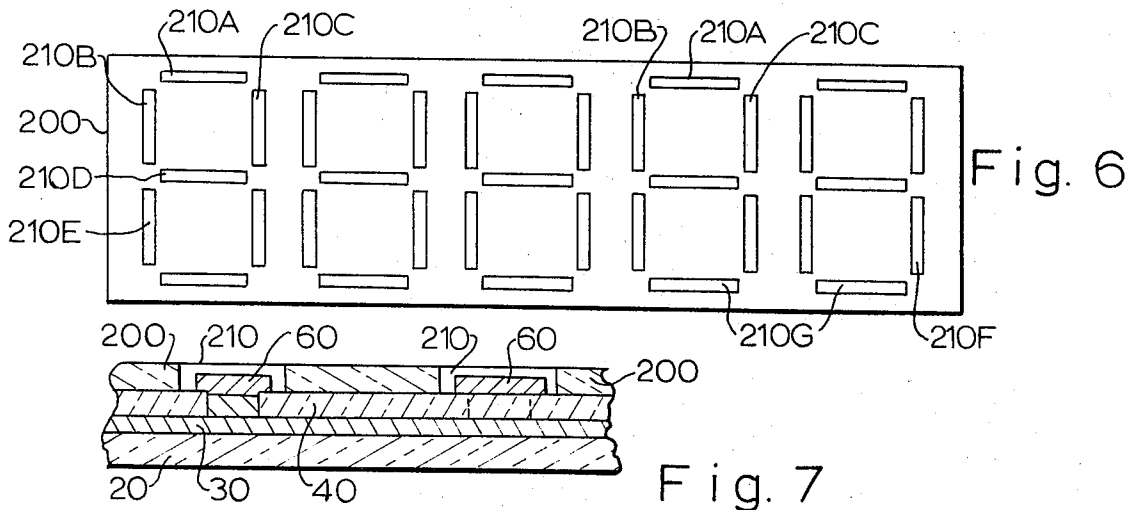
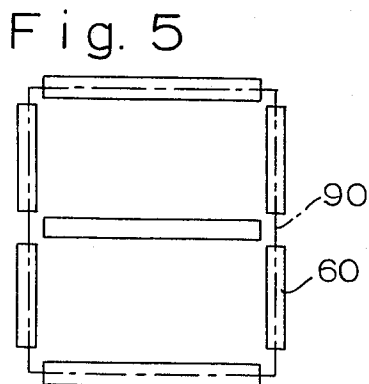
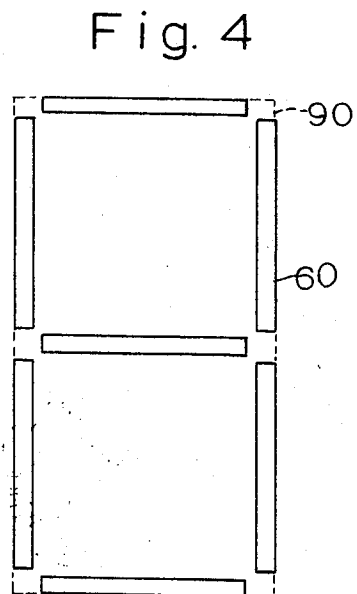
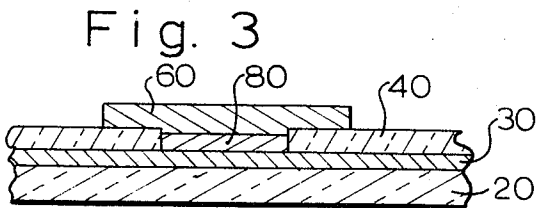
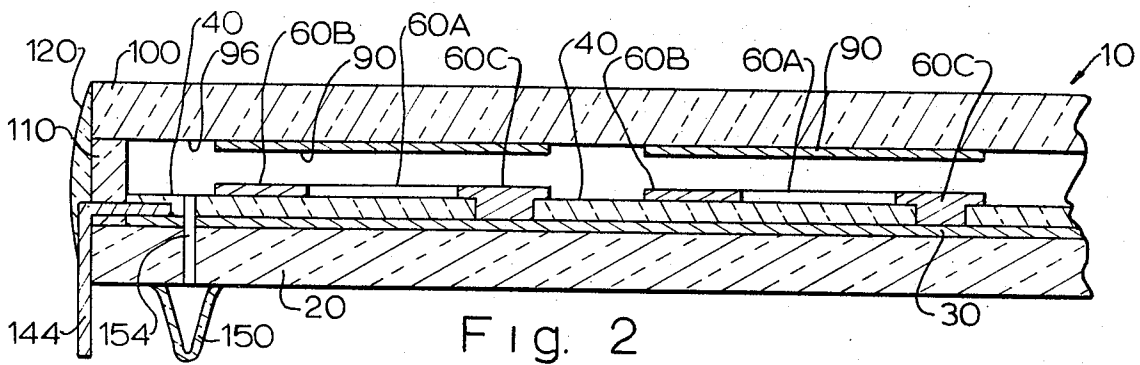
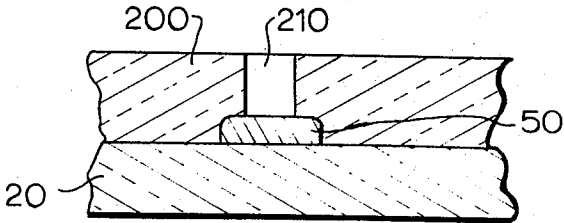
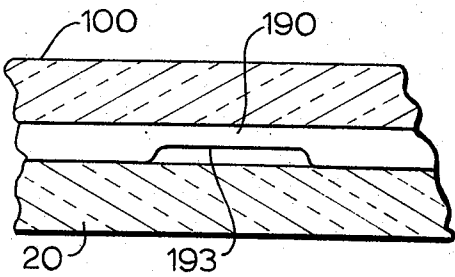
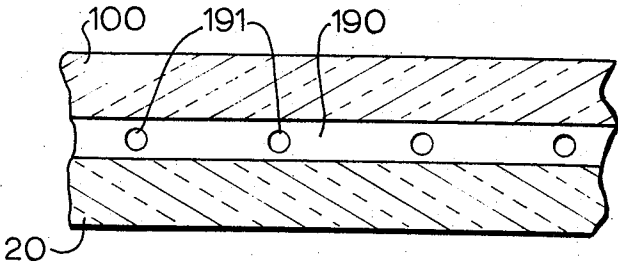
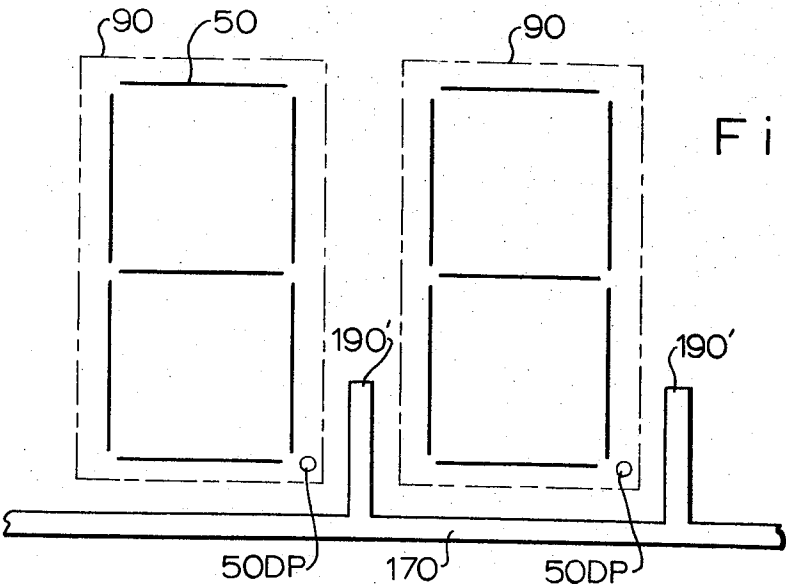


Fig. 1







MULTI-POSITION CHARACTER DISPLAY PANEL

CROSS-REFERENCE TO RELATED APPLICATIONS

This application is a continuation of Ser. No. 173,854, filed Aug. 23, 1971, now abandoned, which in turn is a continuation-in-part of Ser. No. 124,373, filed Mar. 15, 1971, now abandoned, which is a continuation-in-part of Ser. No. 61,642, filed Aug. 6, 1970, now abandoned.

BACKGROUND OF THE INVENTION

The present invention relates to panel-type segment display devices which include a plurality of groups of cathode electrodes, the cathode electrodes comprising elongated bars or segments arrayed in a pattern so that the cathodes of each group can be selectively energized to display a character. For reasons of economy, the same corresponding electrodes, usually cathodes, in each group have a common conductor, but the anodes are separately energizable and the panel is operated by a multiple mode of operation. In this mode of operation, at time *t*1 operating potential is applied to selected cathode conductors and thus to selected cathode segments, and the first anode is energized and a first character is displayed by the energized cathode segments in the first group. At time *t*2, operating potential is applied to the same or other cathode conductors and to the second anode and a second character is displayed by the second group of cathodes. This same operation is carried out for each character position, and it is repeated continually along the entire display panel at a suitable frequency so that stationary but changeable characters can be displayed.

Devices of this type often suffer from cross-talk, that is, when one group of cathodes displays a character, cathode segments in an adjacent group may also glow, spuriously. This problem can be avoided by including various arrangements for shielding the groups of electrodes from each other; however, this complicates the device structure and, in some cases, reduces the viewing angle. Auxiliary shielding electrodes also represent an undesirable added expense, both in the display device and the associated circuitry.

SUMMARY OF THE INVENTION

Briefly, a display device embodying the invention includes a base plate carrying a plurality of groups of cathode electrodes, and a face plate carrying a transparent conductive anode electrode for each group of cathode electrodes, the anode electrodes being shaped and positioned to minimize cross-talk between groups of cathodes.

DESCRIPTION OF THE DRAWINGS

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

FIG. 2 is a sectional view of a portion of the panel of FIG. 1 shown assembled;

FIG. 3 is a sectional view of a modification of a portion of the invention;

FIG. 4 is a plan view showing the relationship between an anode and its associated cathode strips;

FIG. 5 is a plan view showing another relationship between an anode and its cathode strips;

FIG. 6 is a plan view of a shield plate usable in practicing the invention;

FIG. 7 is a sectional view of a portion of a panel showing the shield plate of FIG. 6 in place;

FIG. 8 is a plan view of a portion of a display panel illustrating a modification of a portion of the invention;

FIG. 9 is a sectional elevational view of a modification of another portion of the invention;

FIG. 10 is a sectional elevational view of a modification of the apparatus shown in FIG. 9; and

FIG. 11 is a sectional elevational view of a modification of another portion of the invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

The display panels described herein are thin, flat, sheet-like members which may have substantially any desired size and shape, and may include substantially any number of character display positions. The panels 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 wide range of gas pressures may be used, for example, from about 20 to about 250 Torr at ambient temperature, with about 75 Torr being a pressure which is commonly used.

A display device 10 embodying the invention includes an insulating base plate 20 of glass, ceramic, or the like, with an inexpensive glass being suitable and preferred. A plurality of conductive leads or runs 30 (A to G) are formed on the top surface of the insulating plate 20. The runs 30 are parallel to each other and aligned with the horizontal axis of the base plate. Seven runs 30A to 30G are shown; however, more or fewer may be provided, the number being determined by the total number and type of characters to be displayed. The runs 30 may be formed by an evaporation process, a silk-screen process, an electroless plating process or the like, or they may be discrete strips of metal, heat sealed, arc plasma sprayed, or otherwise secured to the insulating plate 20. A silk-screen printing process is particularly suitable because it is fast, efficient, and reproducible.

A second thin layer 40 of insulating material such as glass or ceramic is formed on the conductive runs 30, preferably by a silk-screen process, and the second layer 40 includes a plurality of groups of apertures 50A to 50G, each aperture exposing one of the runs 30A to 30G. Thus, each group of apertures includes aperture 50A which exposes run 30A, aperture 50B which exposes run 30B, aperture 50C which exposes run 30C, etc.

Panel 10 includes a group of cathode electrodes 60 (A to G) for each group of apertures 50; the cathodes are generally elongated bars or segments, and they are generally arrayed in a figure "8" pattern, as is well known in the art. The cathodes 60 may be formed by means of a silk-screen process with a conductive paste such as palladium-gold, platinum-gold, palladium-silver, or the like. Each cathode element is in direct contact with one of the runs 30 exposed in an aperture 50, and it fills the aperture 50 and covers a portion of layer 40 to achieve the desired shape and size.

The cathodes 60 may also be formed of discrete strips of metal (FIG. 3), each of which is preferably brazed to a conductive run 30 by means of a mass of brazing material 80 deposited in each of the apertures 50 in the insulating layer 40. The brazing material may

also be deposited by a silk-screen process. One suitable brazing material is a gold-germanium substance known as FORMON and sold by DuPont.

Thus, cathodes 60 are preferably thin, flat members which do not project to any significant extent above the top surface of insulating layer 40.

The cathodes may also be formed in any other suitable manner such as by electroless plating or the like.

In addition, runs 30, layer 40, and cathodes 60 may be formed by a process known as arc plasma spraying and performed with a gun of the type sold commercially by Plasmadyne Company.

Plate 10 includes an anode electrode 90 for each group of cathode electrodes 60. The anode electrodes 90 comprise thin, transparent conductive films of gold, NESA, or the like formed on the lower surface 96 of the panel face plate or viewing plate 100 which is made of glass. The anode films 90 are of the order of a few Angstroms thick and, in effect, they are coplanar with the surface 96 of the face plate. Thus, the anodes, for all practical purposes, do not project into the gas discharge space in the panel. The anode films 90 are generally rectangular in shape, or they are otherwise shaped, depending on the orientation of the cathodes, and they are dimensioned and positioned so that they overlay the total area defined by each group of cathode electrodes, as illustrated in FIGS. 2 and 4. If desired, each anode may be somewhat narrower and shorter than the area defined by its cathodes, as shown in FIG. 5, but, in any case, the anode must overlay and be in operative relation with a favorable portion of each of its cathodes. Preferably, the spacing between each anode and its group of cathodes should be of the order of 20 to 25 mils, and the spacing between each anode and the adjacent group of cathodes should be of the order of 30 to 40 mils. With this relationship, each anode is in a favorable operating position with respect to its own cathodes, but it is sufficiently remote from adjacent groups of cathodes so that the panel may be operated over a suitably wide range of potentials without developing cross-talk between adjacent groups of electrodes. Another factor tending to prevent cross-talk is the location of the anodes in substantially coplanar relation with the surface of the glass cover plate and not projecting into the gas space in which cathode glow takes place.

Another advantage of the close spacing of each anode to its group of cathodes, thus providing a thin volume of gas, is that metastable-state atoms produced in the gas during discharge diffuse to, and are readily neutralized at, these closely spaced surfaces. In addition, excited or charged particles are readily swept out through the anode-cathode circuit path. The tendency for crosstalk to develop is minimized by these two factors.

The top glass cover plate 100 is of substantially the same length as the insulating layer 40 and the bottom plate 20, and it is spaced from the base plate 20 by a rectangular glass frame 110 which is disposed between the top glass plate 100 and the insulating layer 40. Frame 110 may be an integral part of the top and/or bottom plates. The rectangular frame serves thus to provide the desired spacing between each anode and its associated group of cathode electrodes. The top glass plate 100 is also preferably slightly wider than the insulating layer 40 and base plate 20 so that one edge, say the upper edge, extends beyond the remainder of the

panel and is accessible to permit the connection of leads 140 to each of the anode films 90. The three glass members 20, 100, and 110 are sealed together in any suitable manner, for example, by means of a seal 120 formed of a glass frit or the like.

Connection to the runs 30 may be made, as an example, by means of L-shaped pins or contacts 144 which are embedded in the seal 120 at one or both ends of the panel.

The panel 10 can be filled with the desired gas atmosphere through a tubulation 150 secured to the base plate 20 and communicating with the interior of the panel through a hole 154 in plate 20 and layer 40, and, generally, mercury is introduced from a glass capsule (not shown) held in the tubulation and suitably processed at the desired stage in the assembly process.

Although the panel 10 can be operated satisfactorily without cross-talk between groups of electrodes, under some circumstances, it may be desirable to provide auxiliary means for electrically shielding each group of electrodes and each character position from adjacent positions. This means, according to the invention, comprises conductive strips 160 of gold, NESA, or the like, formed on the bottom surface 96 of the cover plate 100 between each anode 90, with the strips all connected to a common bus 170 formed along one edge of the face plate 100. A single external contact 180 can be made to the bus. If the bus 170 and anode leads 140 lie along the same edge of the face plate, they are suitably insulated from each other. They may also be positioned along opposite edges of the face plate. Alternatively or in addition, an electrode strip 190, which may be screened or plated or which may be a metal strip, is provided on the insulating layer 40 between each character position. If desired, the strips 190 need not extend completely across the panel between the groups of electrodes. Under some circumstances, it may be only necessary to provide a short strip 190', secured to a suitable frame, and disposed between a decimal point electrode 50DP, where such is provided, and the adjacent character positions. This is illustrated in FIG. 8, wherein two character positions are shown schematically.

If frame member 110 is made of metal, then the frame and electrode strips 190 might comprise a single integral member. Under some circumstances, for example, if the strips 190 have any considerable thickness so that they fill the space between the base plate and the cover plate of the panel, then it may be desirable to either provide holes 191 therein (FIG. 9) or to provide a depression 193, either in the top or bottom surface thereof, to permit the ready flow of gas and mercury vapor throughout the panel. As above, these electrodes may also be connected to a common terminal (not shown) for applying operating potential. The electrodes 160 and/or 190 may be operated with a suitable potential to provide the desired shielding action. This type of operation is described generally in copending applications Ser. No. 87,058, filed Nov. 5, 1970, now U.S. Pat. No. 3,694,693.

Under some circumstances, it may be desirable to provide shield means for shielding the individual cathode segments from each other to prevent the formation of conductive paths due to sputtered cathode metal. This shield means may comprise a thin plate 200 of insulating material such as glass or ceramic having a plurality of apertures 210, each corresponding to and en-

closing one of the cathode electrodes. The plate 200 is shown by itself in plan view in FIG. 6, and it is shown positioned within a panel in sectional view in FIG. 7. The insulating sheet may be only of sufficient thickness so that the cathodes are positioned beneath the top surface thereof. Thus, this sheet need not fill the space between the bottom surface of the cover plate 100 and the electrodes beneath it supported on plate 20. The apertures 210 in the insulating sheet 200 may also be used to dimension or define the desired shape of the cathode segments, as illustrated in FIG. 11. Thus, if the aperture 210 in the insulating plate 200 is made somewhat narrower than the cathode segment and of the desired dimensions and it is formed with sharply defined apertures, then each cathode character is defined by the aperture. With this arrangement plate 200 is preferably formed by a screening process.

What is claimed is:

1. A gas-filled display device comprising an envelope consisting of a base plate and a top cover plate having a viewing window, said base plate and top plate being hermetically sealed together to form said envelope, said envelope containing a filling of an ionizable gas capable of supporting cathode glow, said plates being spaced apart a distance of about 20 to 25 mils, a plurality of groups of cathode electrodes spaced apart along and supported on the surface of said base plate, said cathode electrodes being generally flat and coplanar, and an anode electrode associated with each of said groups of cathode electrodes, each anode being spaced from and positioned generally parallel to its group of cathode electrodes, each anode electrode comprising a thin, transparent film on the lower surface of said top plate, each anode being a few Angstroms thick and thus so thin that it is substantially coplanar with said lower surface, each anode electrode being closer to its associated group of cathode electrodes than to an adjacent group of cathode electrodes, each anode electrode and its group of cathode electrodes comprising a character position, the gas-filled space between said anodes and said groups of cathodes being free of any obstructions extending into said space from either said base plate or cover plate along the length of the panel between character positions, each anode being spaced from its group of cathodes a distance of about 10 to 25 mils and from the adjacent group of cathodes by about 30 to 40 mils.
2. The device defined in claim 1 and including an insulating layer covering said cathodes and formed with apertures overlaying said cathodes and defining the shape of said cathodes.
3. The device defined in claim 2 wherein each cathode has a larger area than its associated aperture in said insulating layer.
4. A gas-filled display device comprising an envelope consisting of a base plate and a top cover plate having a viewing window, and sealed together containing a gas filling capable of sustaining cathode glow, a plurality of conductive runs on the top surface of said base plate,

- an insulating layer on said runs and having a plurality of groups of apertures, each aperture exposing one of said runs,
- a plurality of groups of cathode electrodes spaced apart along the surface of said base plate, said cathode electrodes being generally flat and coplanar, each cathode being in contact with one of said runs through the associated aperture in said insulating layer, corresponding cathodes in each group being in contact with the same conductive run,
 - an anode electrode associated with each of said groups of cathode electrodes, each anode being spaced from and positioned generally parallel to its group of cathode electrodes,
 - each anode electrode comprising a thin, transparent film on the lower surface of said top plate, each anode being so thin that it is substantially coplanar with said lower surface,
 - each anode electrode being closer to its associated group of cathode electrodes than to an adjacent group of cathode electrodes, each anode being spaced from its group of cathodes a distance of about 20 to 25 mils and from the adjacent group of cathodes by about 30 to 40 mils.
 5. A gas-filled display device comprising an envelope consisting of a base plate and a top cover plate having a viewing window, and sealed together containing a gas filling capable of sustaining cathode glow, a plurality of conductive runs on the top surface of said base plate, a first insulating layer on said runs and having a plurality of groups of apertures, each aperture exposing one of said runs, a plurality of groups of cathode electrodes spaced apart along the surface of said base plate and supported on said first insulating layer, said cathode electrodes being generally flat and coplanar, each cathode being in contact with one of said runs through the associated aperture in said insulating layer, corresponding cathodes in each group being in contact with the same conductive run, a second insulating layer disposed on said first insulating layer and including apertures in each of which one of said cathode electrodes is positioned, an anode electrode associated with each of said groups of cathode electrodes, each anode being spaced from and positioned generally parallel to its group of cathode electrodes, each anode electrode comprising a thin, transparent film on the lower surface of said top plate, each anode being a few Angstroms thick and thus so thin that it is substantially coplanar with said lower surface, each anode electrode being closer to its associated group of cathode electrodes than to an adjacent group of cathode electrodes.
 6. The device defined in claim 5 wherein said second insulating layer is a separate sheet set in place on said first-named insulating layer.
 7. The device defined in claim 5 wherein said second insulating layer is a layer screened on said first-named insulating layer.
 8. The device defined in claim 5 wherein the apertures in said second insulating layer are larger in area than said cathode electrodes.

9. The device defined in claim 5 wherein said second insulating layer embeds, completely covers, and intimately engages the edges of said cathode electrodes.

10. The device defined in claim 5 wherein said second insulating layer is thicker than said cathode electrodes, and its top surface is closer to said face plate than said cathodes.

11. The device defined in claim 5 wherein said anode electrodes are seated on said second insulating layer.

12. The device defined in claim 5 wherein each anode covers an area comparable to the area defined by each group of conductive members.

13. The device defined in claim 5 and including a conductive shield member disposed between each group of cathode electrodes.

14. The device defined in claim 5 wherein each conductive shield member includes apertures to permit equalization of gas pressure along said groups of cathode electrodes.

15. The device defined in claim 14 wherein said shield members are electrically connected to each other.

16. The device defined in claim 5 wherein said cathode electrodes comprise generally elongated, rectangular-shaped members having generally parallel end and side edges, and said second insulating layer covers said cathodes and intimately follows and engages the surface thereof including the edges thereof, said second insulating layer having apertures exposing the central generally flat portion of each cathode lying between the edges and ends thereof whereby only a flat cathode surface and no sharp edges thereof are exposed to the associated anode.

17. The device defined in claim 5 wherein said cathode electrodes comprise masses of screen-printed material including particles of conductive material which are in intimate engagement with said conductive runs.

18. The device defined in claim 5 wherein said cathode electrodes comprise metal strips secured through conductive cement to said conductive runs.

19. The device defined in claim 5 wherein said cathode electrodes comprise strips of metal deposited by a plating process in said apertures in said first insulating layer.

20. The device defined in claim 5 wherein said conductive strips, said first and second insulating layers, and said cathode electrodes comprise bodies of material formed by a screen-printing process.

21. A display device comprising a gas-filled envelope including an insulating base plate having a top surface, a plurality of conductive strips on said top surface of said base plate,

an insulating layer on said strips, a plurality of spaced-apart groups of apertures in said insulating layer, each aperture in each group exposing one conductive strip, corresponding apertures in each group exposing the same conductive strip,

a conductive member in each of said apertures in direct contact with the associated conductive strip and operable as a glow cathode, there thus being a group of conductive members associated with each group of apertures,

a second apertured insulating layer seated on said first insulating layer and having a plurality of apertures, each enclosing one of said conductive mem-

bers and shielding said conductive members from each other,

an anode electrode associated with each group of conductive members, and

an insulating cover plate having a viewing window through which glowing cathodes can be viewed, said base plate and said cover plate being hermetically sealed together and forming said envelope.

22. A display device comprising a sealed envelope having a viewing window and containing an ionizable gas at a pressure capable of sustaining cathode glow including

a first insulating sheet-like member,

a plurality of groups of cathode segments, said groups being disposed side-by-side along the front surface of said first sheet-like member,

conductive means for selectively energizing different combinations of cathode segments of each of said cathode segment groups to display different characters side-by-side in a substantially common plane along the length of said sheet-like member,

said conductive means comprising a plurality of conductive strips extending along the back surface of said sheet-like member at least over the area covered by said cathode segment groups,

a plurality of groups of apertures in said sheet-like member, the apertures of each group being aligned with one of said conductive strips and each aperture of the group being substantially aligned with a corresponding cathode segment of each cathode segment group, with the corresponding cathode segment being in electrical contact with the conductive strip,

a second insulating sheet-like member adjacent to said first sheet-like member and having a plurality of apertures in each of which one of said cathode segments is positioned, and

a plurality of anode electrodes each associated with one of said cathode segment groups.

23. A display device comprising a gas-filled envelope including an insulating base plate having a top surface, a plurality of conductive strips on said top surface of said base plate,

an insulating layer on said strips,

a plurality of groups of apertures in said layer, the apertures in each group being aligned in a pattern, there being correspondingly positioned and shaped apertures in each group, the same corresponding aperture in each group being aligned with and exposing the same conductive strip,

a conductive member in each of said apertures in direct contact with the associated conductive strip and operable as a glow cathode in the gas in said envelope, there thus being a group of conductive members,

a second insulating layer having a plurality of apertures, each enclosing one of said conductive members and shielding each in its group from conductive members of another group,

an anode electrode associated with the conductive members in said apertures, and

a glass cover plate through which glowing cathodes can be viewed, said base plate and said cover plate being hermetically sealed together to form said envelope.

24. A flat display panel for displaying any one of a predetermined number of characters in each of a plurality of side-by-side character positions, comprising

- a gas-tight envelope formed of front and base plates closely spaced to one another and sealed together along a predetermined perimeter surrounding the character positions, the front and base plates forming the outside walls of the envelope,
- an ionizable gas within said envelope at a pressure capable of sustaining glow discharge,
- at least the portions of the front plate which are aligned with the character positions being transparent to glow within the envelope to provide a viewing window for the characters to be displayed,
- an assembly supported within the envelope on the base plate portion thereof including a plurality of conductive runs on said base plate, a layer of insulating material on said conductive runs, and a plurality of groups of cathode electrodes aligned side-by-side on said insulating layer, with each such group forming one of said character positions,
- each such conductive run being electrically connected through said insulating layer to a cathode electrode in each of said cathode groups, so that selective combinations of said cathode electrodes in each such group can be energized to provide a multi-character display,
- said conductive runs extending substantially parallel to one another along the length of said cathode electrode groups, and continuing along the surface of said base plate beyond said groups to the sealed perimeter, and through said sealed perimeter to the exterior of said envelope to provide external electrical connections to said cathode electrodes, and
- a plurality of anode electrodes, each positioned in operative relation with one of said cathode electrode groups and having a conductive lead extending through said envelope,
- said anode electrodes comprising thin transparent conductive films formed on the inner surface of said front plate, and each anode overlaying its group of cathode electrodes and spaced therefrom by a distance of the order of 20 to 25 mils, each anode electrode also being spaced a distance of the order of 30 to 40 mils from each adjacent group of cathode electrodes.

25. A flat display panel for displaying any one of a predetermined number of characters in each of a plurality of side-by-side character positions, comprising

- a gas-tight envelope formed of front and base plates closely spaced to one another and sealed together along a predetermined perimeter surrounding the character positions, the front and base plates forming outside walls of the envelope,
- an ionizable gas within said envelope at a pressure capable of sustaining glow discharge,
- at least the portions of the front plate which are aligned with the character positions being transparent to glow within the envelope to provide a viewing window for the characters to be displayed,
- a plurality of conductive runs extending along and supported on the interior surface of the base plate in the direction of the side-by-side character positions,
- a plurality of groups of cathode electrodes positioned side-by-side along said interior surface in said direction, each such group forming one of said char-

acter positions and each cathode electrode being in the general shape of a segment of a character to be displayed,

- each such conductive run being electrically connected to a cathode electrode in each of said cathode electrode groups, so that selective combinations of cathode electrodes in each such group can be energized by a selective energization of said conductive runs to display side-by-side characters,
- an insulating layer covering said conductive runs and said interior surface in the area of the character positions and having a group of apertures there-through for each cathode electrode group, each such aperture being aligned with one of said cathode electrodes,
- and insulating layer closely bordering the edges of each of said cathode electrodes to cover any projections from the borders of said electrodes and to define the shape of the character segments displayed, and
- a plurality of anode electrodes each positioned in operative relation with one of said cathode electrode groups and having a conductive lead extending through said envelope.

26. A display panel as in claim 25 wherein the apertures in said insulating layer are smaller than their associated cathode segments to cover the edges of such segments.

27. A display panel as in claim 25 wherein the surface of said insulating layer is closer to the front plate than are the cathode electrodes, so that said electrodes are recessed in the apertures of said insulating layer

28. A gas discharge display panel having a plurality of side-by-side character positions along a predetermined line, in each of which any one of a number of characters can be displayed, comprising

- an envelope formed of front and rear plates sealed together along a closed perimeter surrounding the line of character positions to establish a gas tight enclosure about said character positions;
- an ionizable gas within said envelope at a pressure capable of sustaining glow discharge,
- a plurality of conductive runs extending along and supported on the interior surface of said rear plate in the direction of the line of side-by-side character positions,
- a plurality of groups of cathode electrodes positioned side-by-side along said interior surface in said direction, each such group forming one of said character positions,
- the cathode electrodes in each such group being disposed in substantially the same pattern, such pattern having a predetermined height to display characters of that height, and each cathode electrode being in the general shape of a segment of a character to be displayed,
- each such conductive run being electrically connected to a correspondingly positioned cathode electrode in each of said cathode electrode groups, so that selective combinations of said cathode electrodes in each such group can be energized by a predetermined energization of said conductive runs to provide a multi-character display,
- an insulating layer covering said conductive runs and said interior surface in the area of the character positions, and having a group of apertures there-through for each group of cathode electrodes, each

such aperture being aligned with one of said cathode electrodes,
 said insulating layer closely bordering the edges of each of said cathode electrodes to cover any projections from the borders thereof and to define the shape of the character segments displayed, and
 at least the majority of said conductive runs extending along said interior surface within the height of said cathode electrode patterns throughout the length of said cathode electrode groups and then continuing along said surface beyond said character positions,
 a plurality of anode electrodes each positioned in operative relation with one of said cathode electrode groups.

29. A display panel as in claim 28 wherein said insulating layer covers substantially all of the edges of all of said cathode electrodes to define the character segments as the uncovered portions of said cathode electrodes.

30. A flat display panel for displaying any one of a predetermined number of characters in each of a plurality of side-by-side character positions, comprising
 a gas-tight envelope containing an ionizable gas at a pressure capable of sustaining glow discharge,
 said envelope having a front plate with at least the portions thereof which are aligned with the character positions being transparent to glow within the envelope, to provide a viewing window for the characters to be displayed,
 an insulating plate having an interior surface thereof facing said front plate and closely spaced thereto,
 a plurality of elongated conductive runs extending along said interior surface in a predetermined direction,

a first layer of insulating material on said conductive runs,
 a plurality of groups of cathode electrodes aligned side-by-side on said insulating layer along said predetermined direction, with at least the majority of said conductive runs passing directly behind all of said cathode electrode groups,
 the cathode electrodes in each of said cathode electrode groups being disposed in substantially the same pattern, and each such group forming one of said character positions,
 said first insulating layer having a plurality of apertures therethrough, each aligned with one of said cathode electrodes,
 each such conductive run being electrically connected through one of said apertures in said insulating layer to the correspondingly positioned cathode electrode in each of said cathode electrode groups, so that selective combinations of said cathode electrodes in each such group can be energized to provide a multi-character display,
 a second insulating layer covering said first layer and having a group of apertures therein for each group of cathode electrodes, the border of each said aperture contiguous the border of one of said cathode electrodes, and
 a plurality of anode electrodes each positioned in operative relation with one of said cathode electrode groups.

31. A display panel as in claim 30 wherein the surface of said second insulating layer is closer to the front plate than is the surface of said cathode electrodes, so that the cathode electrodes are recessed, one in each of the apertures in said second insulating layer.

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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

PATENT NO. : 3,868,535
DATED : February 25, 1975
INVENTOR(S) : George A. Kupsky

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Column 10, Line 16, change "and" to --said--

Signed and Sealed this
fourth Day of May 1976

[SEAL]

Attest:

RUTH C. MASON
Attesting Officer

C. MARSHALL DANN
Commissioner of Patents and Trademarks