

[54] SEGMENT DISPLAY PANEL WITH CATHODE GROUPS

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Related U.S. Application Data

[60] Division of Ser. No. 97,886, Dec. 14, 1970, and a continuation-in-part of Ser. No. 61,642, Aug. 6, 1970, abandoned.

[52] U.S. Cl. 29/25.16, 313/109.5, 316/17

[51] Int. Cl. H01j 9/18

[58] Field of Search 29/25.13, 25.16; 316/17, 24; 313/109.5, 190, 220, 210, 313

[56] References Cited

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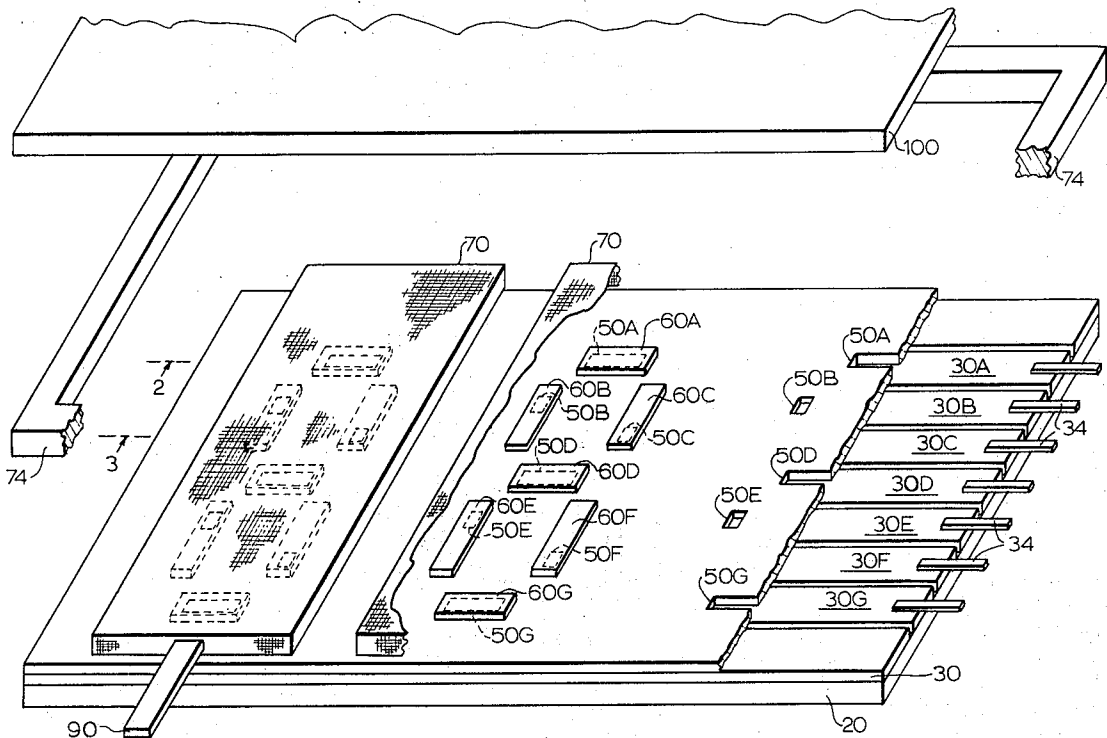
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[57]

ABSTRACT

A gas-filled display panel includes a plurality of groups of cathode electrode segments, each group having an anode electrode, the cathodes in each group being selectively energizable, with the associated anode, to glow and display a character. The cathode electrode segments are made up of strips of conductive material covered by an insulating layer which has at least one aperture exposing each conductive strip and with a conductive member in each aperture in direct contact with the associated conductive strip. Each conductive member comprises a cathode which can glow, with the glow filling the aperture in which the conductive member is seated. The cathodes are selectively energized so that the combined glow represents a character.

8 Claims, 7 Drawing Figures



SHEET 1 OF 2

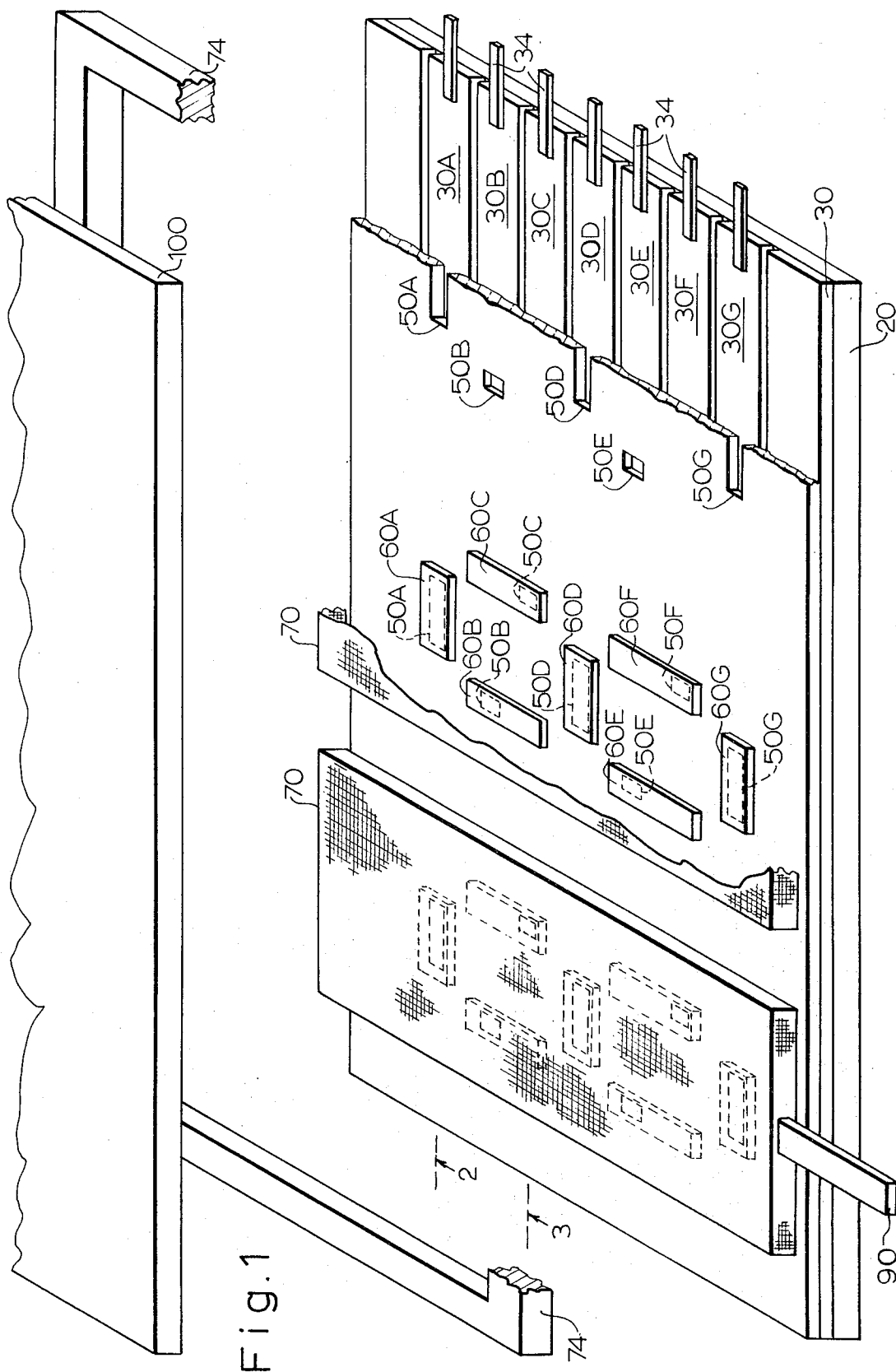


Fig. 2

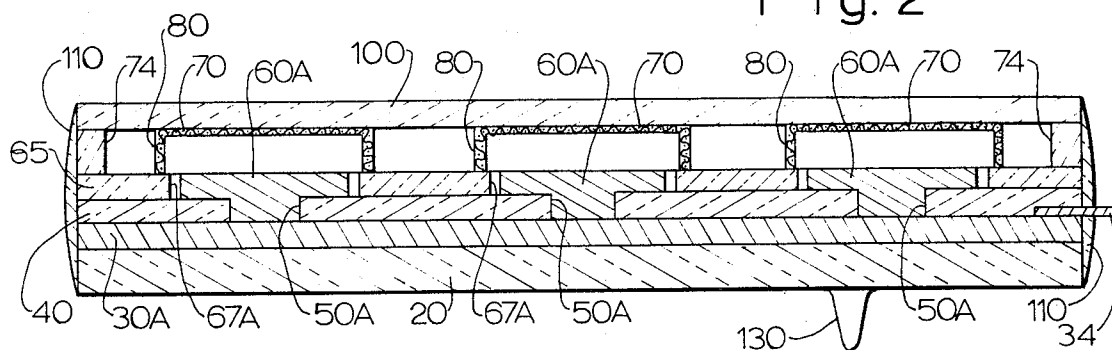


Fig. 3

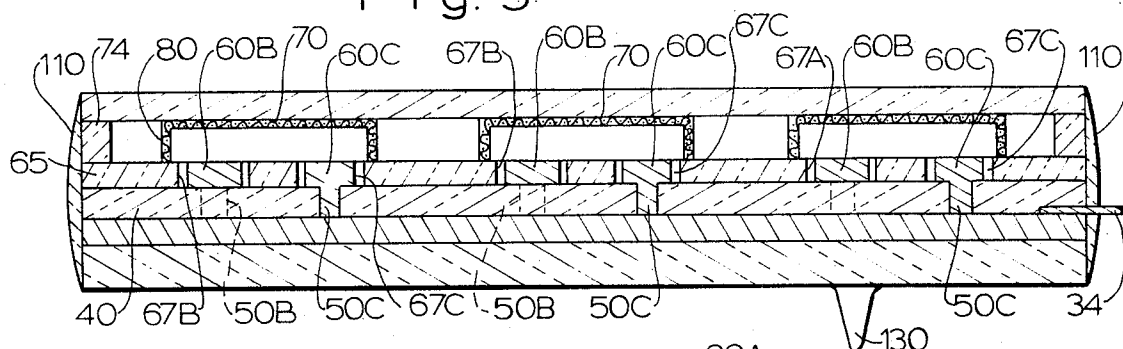
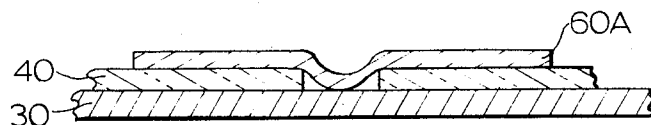


Fig. 5

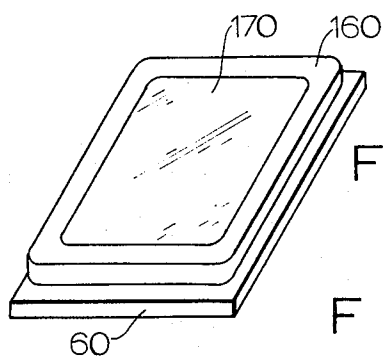


Fig. 7

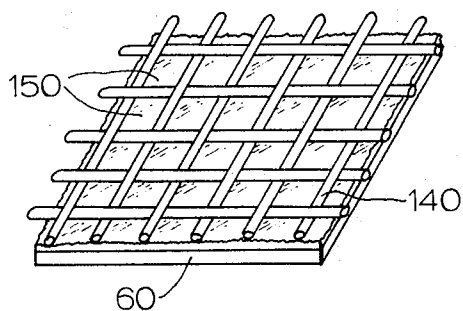


Fig. 6

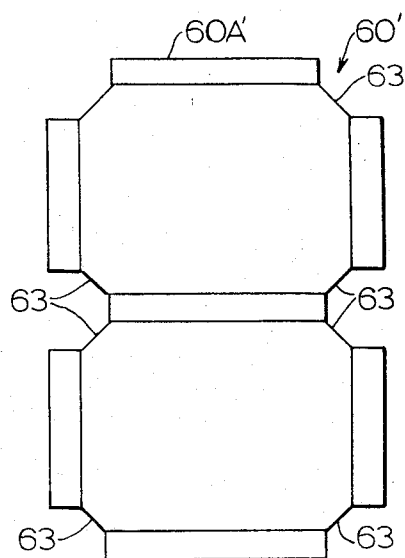


Fig. 4

SEGMENT DISPLAY PANEL WITH CATHODE GROUPS

This application is a Division of Ser. No. 97,886, filed Dec. 14, 1970, as a continuation-in-part of application Ser. No. 61,642, filed Aug. 6, 1970, and now abandoned.

BACKGROUND OF THE INVENTION

Display devices of many types are known in the art including those which can display numerals or letters and those known as segment devices. Segment display devices include a plurality of segment structures, each of which can glow and each of which can be combined with one or more of the others to represent different characters. The present invention relates to cold cathode gas-filled segment devices which combine cathode segments to form the desired display, and, while devices of this type are known in the art, none is as simple and inexpensive to construct as the device described herein. In addition, the display device of the invention readily lends itself to a type of construction in which a plurality of characters can be displayed simultaneously, side-by-side, in a single envelope.

SUMMARY OF THE INVENTION

Briefly, a display device embodying the invention includes one or more large-area anode electrodes, each of which is associated through an apertured mask with a group of cathode glow segments of unique construction, the electrodes being related to each other in a novel and simplified fashion to permit selection and glow of one or more segments in each group.

DESCRIPTION OF THE DRAWINGS

FIG. 1 is a perspective 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 plan view of a cathode assembly which may be used in practicing the invention;

FIG. 5 is a sectional view of a portion of a display device utilizing the cathode assembly of FIG. 4;

FIG. 6 is a perspective view of a modified cathode construction; and

FIG. 7 is a perspective view of another modified cathode construction.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

A multi-segment display panel 10, according to the invention, includes a base plate 20 of glass, ceramic, or the like, carrying on its top surface a plurality of conductive strips 30 (A to G) of gold, tin oxide, or the like. The strips 30 may also be thin sheets of a metal such as stainless steel or the like suitably secured to plate 20. The conductive strips 30 are oriented generally horizontally and are suitably spaced apart and insulated from each other. A conductive tab or lead 34 is connected to each strip 30. A thin insulating layer 40 of glass, ceramic, or the like is disposed on the conductive strips 30. The layer 40 is preferably as thin as possible, for example one-half mil, and may be prepared by means of a glass sheet decal which consists of a glass frit in a suitable binder. The assembly is prepared by

placing the sheet decal on plate 20 and then heating to remove the binder and to fuse the glass frit and form a thin layer.

A plurality of groups of segment apertures 50 (A to G) are formed in the insulating layer 40, each exposing one conductive strip 30. In a panel which is adapted to display numerals 0 to 9, seven strips 30 and seven such apertures 50 are provided in each group. However, any number of each may be provided as required, as those skilled in the art will understand. To display numerals 0 to 9, the apertures 50 are arrayed generally in the form of a figure eight, as is well known in the art, and they include three horizontal segments and four vertical segments arrayed as shown. Horizontal segment aperture 50A is aligned with and exposes conductive strip 30A, vertical aperture 50B is aligned with and exposes strip 30B, vertical aperture 50C is aligned with and exposes strip 30C, horizontal aperture 50D is aligned with and exposes strip 30D, vertical aperture 50E is aligned with and exposes strip 30E, vertical aperture 50F is aligned with and exposes strip 30F, and horizontal aperture 50G is aligned with and exposes strip 30G. The number of groups of segments 50 provided is determined by the desired total number of characters which may be displayed by the panel at the same time. Panel 10, as shown, can display three characters at one time. If layer 40 is made of a decal, the apertures 50 can be cut out of the decal sheet before the sheet is fused to plate 20.

According to the invention, conductive material 60, for use as a cathode electrode and generally rectangular in shape, is deposited in each of the segment apertures 50 and is in direct contact with the associated conductive strip 30. Thus, cathode material 60A deposited in aperture 50A is in direct contact with conductive strip 30A. Conductive cathode material 60B is deposited in aperture 50B and is in contact with conductive strip 30B. Conductive cathode material 60C is in aperture 50C and is in contact with conductive strip 30C. Cathode 60D is in aperture 50D and is in contact with strip 30D. Cathode 60E is in aperture 50E and contacts strip 30E, and cathode 60F is in aperture 50F and contacts strip 30F. Finally, cathode 60G is in aperture 50G and contacts strip 30G.

As illustrated, the various cathodes 60 are disposed within their respective apertures 50, and they also cover portions of the surface of the insulating layer surrounding each aperture. The cathode segments 60 are arrayed generally in the form of a figure eight with their adjacent ends being positioned as close together as possible so that, in operation of the panel, when adjacent cathodes glow, the two separate glow areas appear to join and form a single continuous length of glow.

The cathode material may be any well known, conductive paste including palladium, platinum, silver, or mixtures of these. The cathodes 60 may also be thin strips of metal such as stainless steel or the like welded to the conductive strips 30. In the latter arrangement, a unitary cathode structure 60' (FIG. 4) may be used which includes the bar segments 60 connected by metal filaments 63, for example, at their adjacent ends. The assembly 60' is used by being seated on the apertured insulating layer or film 40, having the segments welded to their strips 30 and then having the filaments 63 removed by means of a pulse of current passed through the assembly 60. The filaments 63 can also be mechanically cut out or removed in any suitable manner. FIG.

5 illustrates the connection of such metal cathodes to their underlying strips 30. Since sheet 40 is very thin, the cathode segments 60 are only slightly deformed.

Although it is not essential, an apertured insulating plate 65 is provided to isolate the individual cathodes from each other and the groups of cathodes from each other. The plate 65 is seated on layer 40 and includes apertures 65 (A to G), each of which encloses one of the cathodes 60 (A to G) so that the cathodes are positioned below the top surface of plate 65 and they are thus shielded from each other.

An anode electrode 70 in the form of a screen or a ring or the like is positioned over, or otherwise disposed in operative relation with, each group of segments 50 and their cathodes 60. Screens are preferred for the anodes, and they are insulated from the cathodes in any suitable manner. In one arrangement, an insulating glass or other rectangular frame 74 is seated on the insulating plate 65, and the anode screens 70 are supported thereon. Frame 74 lies along the outer edges of insulating plate 65 and serves to elevate the main screen area above the groups of cathodes. Such side walls may also serve to isolate adjacent groups of cathode electrodes from each other. Each anode has a suitable tab or lead 90 extending therefrom. Frame 74 may also be used with the box-shaped screens having side walls 80, and, in this case, tabs 90 may rest on the frame.

The panel 10 is completed by a glass cover plate 100 which is sealed to the base plate 20, the insulating layer 40, plate 65, and frame 74, if provided, by means of a seal 110 made up of a glass frit, a ceramic cement, or the like sealed to the adjacent edges of the plates.

The cover plate 100 may rest on the screens 70, or it may be raised above the screens by insulating rectangular frame 74.

The panel 10, during manufacture, is filled with a suitable gas through a tubulation 130 secured to the bottom plate 20. The gas may be any of the well known gases which can support cathode glow, such as neon, argon, xenon, etc., or mixtures of two or more of these. Usually, a small quantity of mercury is added to the gas to minimize cathode sputtering. A wide range of gas pressures may be used from about 20 to about 200 Torr at room temperature, with a pressure of about 70 Torr being typical.

In a modification of the invention, the cathode electrodes are constructed to carry phosphor material in order to obtain a color of glow different from that characteristic of the gas filling of the panel. In one arrangement (FIG. 6), the modification is achieved by placing a fine mesh screen 140 on each cathode 60 and filling the openings in the screen with a suitable phosphor material 150, either dry or in paste form.

In still another modification (FIG. 7), the cathodes are modified by the provision of a ring-like member 170 of substantially the same shape as the cathode plate and seated on the cathode plate. The interior of the ring is filled with the desired phosphor material 70.

Typical phosphors which may be used include the well known zinc sulfides, zinc orthosilicates, lead sulfides, and the like.

In operation of the panel 10, if operating potential is applied to an anode 70 and one or more of its associated cathode segments 60 through the proper strips 30, then the gas adjacent to the selected segments glows and represents a character. For example, if seg-

ments 50B and 50E are energized, then the numeral "1" is represented. As noted, since the adjacent ends of these two cathode segments are positioned close to each other, the respective cathode glow regions blend to form a continuous character.

If a multiplexing or time-sharing arrangement is used to operate panel 10, a plurality of characters can be displayed at the same time. This is done by energizing an arbitrarily selected first group of cathodes, say the leftmost group in FIG. 1, by applying the information signals to selected conductive strips 30 through their contacts 34 and to the associated anode 70. This causes the selected cathodes 60 to glow and display a character. By switching to the next adjacent anode while at the same time applying other information signals to the conductive strips, a character is displayed by the second group of segments. This operation is repeated for each group of segments, and, if the operation is carried out continuously through the panel at a sufficiently high rate, then a plurality of stationary but changeable characters can be displayed in the panel.

What is claimed is:

1. A method of fabricating 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 predetermined number of characters can be displayed, comprising the steps of

forming a plurality of elongated conductive runs along the inside surface of a back plate of insulating material in the direction intended for the line of character positions,

depositing a layer of insulating material on said conductive runs with a plurality of side-by-side groups of apertures therein, one such group at each character position,

placing into position on said insulating layer at each character position a unitary cathode structure formed of a plurality of cathode segments interconnected into a frame-like assembly by conductive bridging members, said unitary structure being placed into position at each character position such that each cathode segment thereof covers one of the apertures of the aperture group located at the character position,

connecting said cathode segments electrically through their respective underlying apertures to the exposed conductive runs and thereby mounting said cathode segments in place, while the cathode segments are still interconnected in said frame-like assembly,

thereafter severing the conductive bridging members between said cathode segments to render the cathode segments of each group electrically isolated from one another,

mounting an anode electrode adjacent each cathode segment group, and

placing a transparent front plate over said cathode segments and said anode electrodes and forming a gas-tight seal between said front and back plates.

2. The method of claim 1 wherein the step of severing the conductive bridging members between the cathode segments constitutes cutting such bridging members.

3. The method of claim 1 wherein the cross-section of the conductive bridging members is considerably smaller than the cross-section of the cathode segments, and wherein the step of severing the conductive brid-

ing members constitutes passing a current through such bridging members.

4. The method of claim 1 wherein the step of placing the front plate over the cathode segments and anodes is performed after the step of severing the conductive bridging members.

5. A method of fabricating a gas discharge display device having a plurality of side-by-side character positions along a predetermined line, in each of which any one of a predetermined number of characters can be displayed, comprising the steps of

forming a back plate of insulating material with a plurality of side-by-side groups of electrical contacts, one at each character position,

bringing into position at each character position a unitary cathode structure formed of a plurality of cathode segments interconnected into a frame-like assembly by conductive bridging members, said unitary structure being brought into position at each character position such that each cathode segment thereof is aligned with one of the electrical contacts of the electrical contact group located at the character position,

electrically connecting each said cathode segment to its aligned electrical contact and thereby mounting said cathode segments in place, while the cathode segments are still interconnected in said frame-like assembly,

thereafter severing the conductive bridging members between said cathode segments to render the cathode segments of each group electrically isolated from one another,

mounting an anode electrode adjacent each cathode segment group, and

placing a transparent front plate over said cathode segments and said anode electrodes and forming a gas-tight seal between said front and back plates.

6. A method of fabricating a gas discharge display device having an array of cathode segments, different combinations of which can be selectively energized to display different characters; comprising the steps of forming a back plate of insulating material with a group of electrical contacts exposed on at least one side thereof,

bringing into position over said contacts a unitary cathode structure formed of a plurality of cathode segments interconnected into a frame-like assembly by conductive bridging members, said unitary structure being brought into position such that each cathode segment thereof is aligned with one of said contacts,

connecting each said cathode segment to its aligned electrical contact to mount said cathode segments in place, while the cathode segments are still interconnected in said frame-like assembly,

thereafter severing the conductive bridging members between said cathode segments to render them electrically isolated from one another,

mounting an anode electrode adjacent said cathode segments, and

placing a transparent front cover over said cathode segments and said anode electrode and forming a gas-tight seal between said front cover and back plate.

7. The method of claim 6 wherein the step of severing the conductive bridging members is performed before the step of placing the front cover over the cathode segments and anode electrode.

8. The method of claim 7 wherein the step of severing the conductive bridging members comprises completely removing the conductive bridging members by passing a current therethrough.

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