

Jan. 25, 1966

P. R. BRITNELL ET AL

3,231,776

DISPLAY DEVICE

Filed Sept. 28, 1962

3 Sheets-Sheet 1

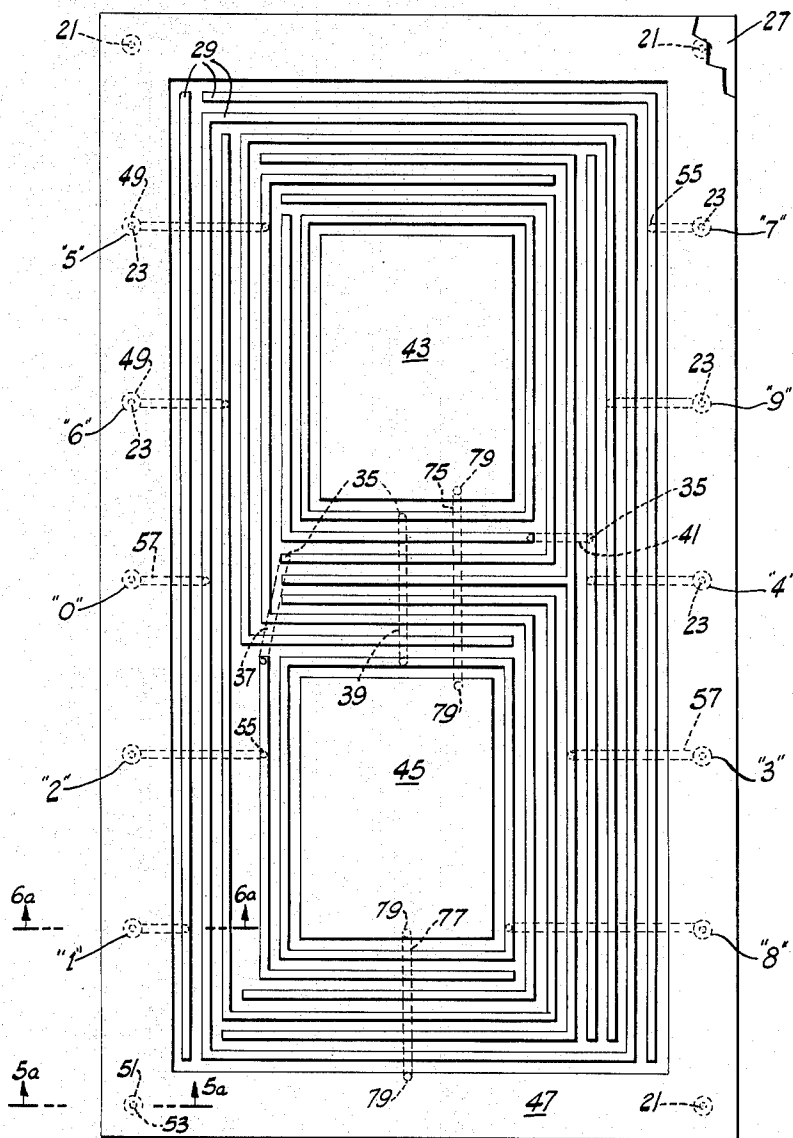


Fig. 1

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Jan. 25, 1966

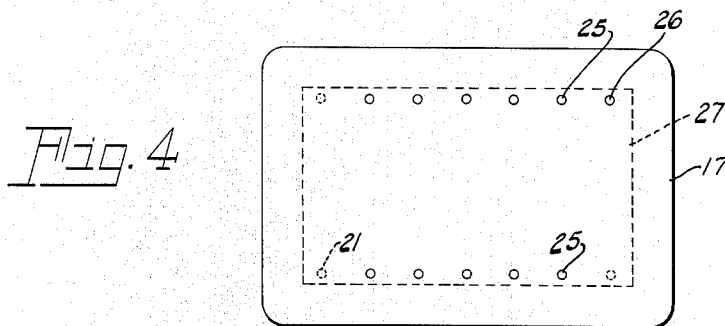
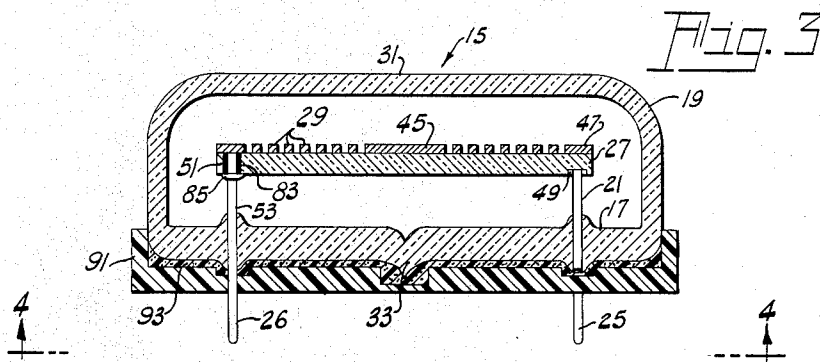
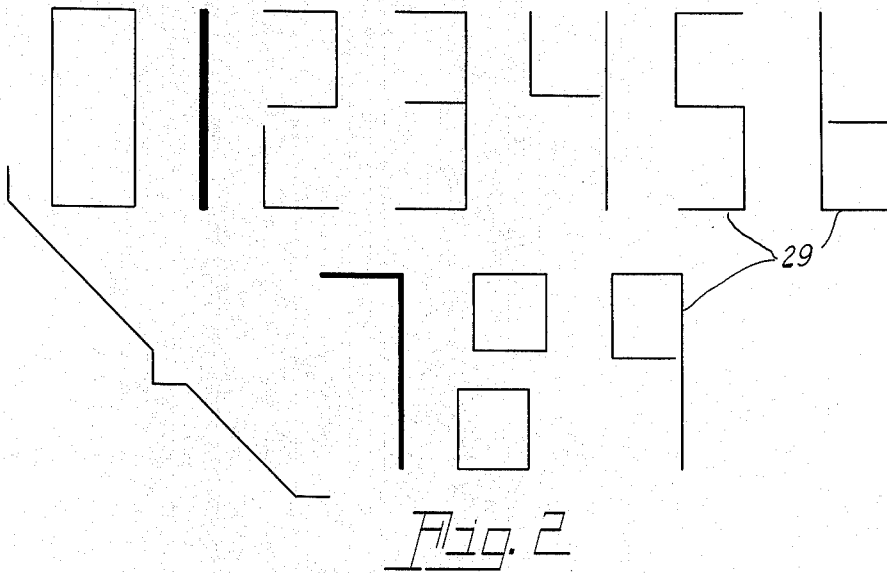
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3 Sheets-Sheet 2



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Filed Sept. 28, 1962

3 Sheets-Sheet 3

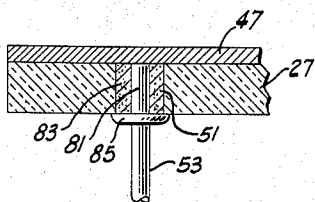


Fig. 5A

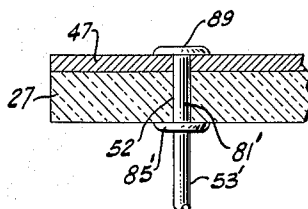


Fig. 5B

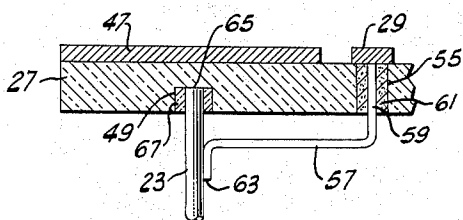


Fig. 6A

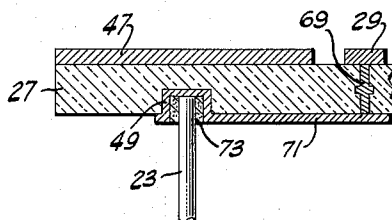


Fig. 6B

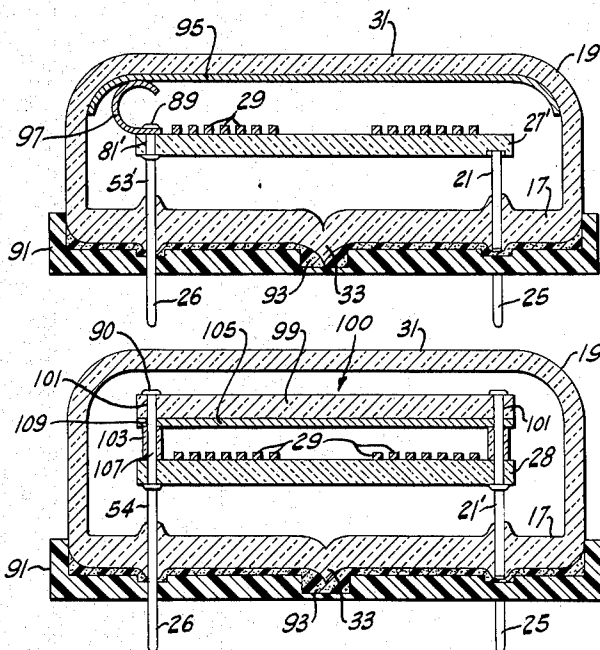


Fig. 7

Fig. 8

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3,231,776

DISPLAY DEVICE

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Filed Sept. 28, 1962, Ser. No. 227,007

3 Claims. (Cl. 313-109.5)

This invention relates to character display devices and more particularly to multi-electrode gaseous discharge devices wherein individual characters may be selectively displayed.

Various types of electrical character display devices including incandescent lamps, gaseous glow discharge devices and electroluminescent panels are well known in the art and have been adapted to numerous applications. Diverse constructions ranging from a plurality of characters in stacked array to an interconnected multi-segment planar character combination have been utilized to achieve the desired application results. Unfortunately the different constructions and principles of operation have inherent disadvantages such as restricted angle of vision, annoying parallax, high power requirements, slow transfer speeds, complicated selective circuitry, complex assembly and high package cost.

Accordingly, an object of this invention is to reduce the aforementioned disadvantages by simplifying the construction of a character display device.

A further object is to facilitate wide angle viewing from a substantially planar character display.

A still further object is to achieve a planar display wherein the several characters are contiguously contained within the same approximate area.

An additional object is to facilitate a planar display that will not require complicated circuitry for selective character energization.

The foregoing objects, as well as other objects which will become apparent after reading the following description, are achieved in one aspect of the invention by the provision of a hermetically sealed multi-electrode gaseous discharge display device having a transparent viewing area. Within this device there are bonded to the surface of a planar support member a number of adjacently spaced electrical conductors defining a plurality of individual character configurations. These function as individual negative potential cathodes in conjunction with an adjacent positive potential anode electrode surface to produce an ionization glow display of the individual character selected.

For a better understanding of the present invention, together with other and further objects, advantages and capabilities thereof, reference is made to the following specification and appended claims in connection with the accompanying drawings in which:

FIG. 1 is an enlarged plan view of the planar support showing the plurality of cathode conductors and anode areas bonded to the surface thereof;

FIG. 2 illustrates the individual digit configurations formed on the surface of the planar support by the cathode conductors;

FIG. 3 is a sectional view of the display device showing the orientation of parts;

FIG. 4 illustrates a bottom view of the display device illustrating the external arrangement of base connections for the device shown in FIG. 3;

FIG. 5a is an enlarged section showing means for establishing electrical contact between the conductive support pin and the anode electrode taken along line 5a-5a of FIG. 1;

FIG. 5b illustrates an alternate means for establishing electrical contact taken along line 5a-5a of FIG. 1;

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FIG. 6a is an enlarged section showing means for establishing electrical contact between a conductive support pin and an individual cathode conductor taken along line 6a-6a of FIG. 1;

FIG. 6b illustrates an alternate means for establishing electrical contact taken along line 6b-6b of FIG. 1;

FIG. 7 is a sectional view of an alternate construction of the device having the anode electrode bonded to the dome of the envelope; and

FIG. 8 is a sectional view of an alternate construction of the device having the anode electrode bonded to a separate transparent plate.

Referring to the drawings, in FIG. 3 a gaseous discharge character display device 15 is shown as comprising a stem portion 17 to which is hermetically sealed a glass envelope 19. The stem portion 17 has suitably disposed and sealed therein several pins serving solely as internal dummy corner supports 21. In addition, stem portion 17 also contains a plurality of conductive connector pins 23, shown in FIGURES 1 and 6a, positionally sealed therein and contiguously extended therethrough to provide conductive external connections as basing pins 25. A planar insulating support 27, having a number of character electrode elements 29 bonded to the upper surface thereof, is spacedly positioned in a plane superpositionally adjacent to and substantially parallel with the plane of stem portion 17 being terminally mounted on the plurality of internal corner support pins 21 and the interspaced conductive pins 23. The envelope 19, enclosing the foregoing support structure, has a substantially transparent viewing area 31 through which the character elements 29 may be observed. The volume of envelope 19 is exhausted of air and refilled with a gaseous atmosphere such as neon or a neon-argon mixture. The envelope is then sealed by exhaust tubulation closure 33.

More specifically, the planar support 27 as shown in FIG. 1 is suitably composed of an insulative material such as glass, ceramic, or the like. It has bonded to the upper surface thereof by photo etching, overlay, stamping, or painting, a plurality of narrow electrical conductors 29 as of, for example, copper, nickel, gold, or similar conductive material. These conductors which operate as cathodes are insulatively spaced from one another to form a number of individual characters, such as the numerals "0" to "9." The configurations of these numerals are individually shown in FIG. 2 and are defined within a substantially parallelogrammatic area as shown in FIG. 1. As is clearly evident, other characters such as letters or symbols can in like manner be insulatively arrayed as cathode configurations on a common surface for planar display.

In the planar layout of a plurality of numeric characters it is natural that one or more of the configurations will have overlapping portions. In referring to FIG. 1 in this particular layout, it will be noted that of the plurality of adjacent cathode configurations shown, the numerals "2," "4" and "8" require the insulative interconnection of two different cathode electrode elements 29 to form the respective individual configuration requirements. To avoid electrical shorts, the interconnections are completed on the underside of planar insulating support 27. Perforations 35 are disposed in the planar support as by molding or drilling to facilitate the desired connections for "2," "4" and "8." The internal diameters of the perforations 35 are slightly smaller than the overlapping cathode electrode conductors 29. The connectors 37, 39 and 41 for numerals "2," "4" and "8" respectively may be strip-like electrically conductive bondings on the lower surface of planar support 27, or they may be spaced therefrom as separate conductive leads or ribbons. In either instance both ends of connectors 37, 39 and 41

are conductively cemented into the proper planar support perforations 35 so that conductive interconnections are completed between the respective cathode electrode conductors to provide the individual numeric outlines desired.

Also bonded to the upper surface of planar support 27 are anode electrode areas 43 and 45 disposed within the parallelogrammatic configuration area and the perimetrical surrounding border area 47; all of which are in coplanar relationship with and insulatively spaced from cathode conductors 29. These anode electrode areas are of conductive materials similar to those used for the cathode conductors 29 such as copper, nickel, gold or the like and may be applied to planar support 27 by a separate process or simultaneously with the application of the cathode conductors 29.

The lower surface of planar support 27 has therein a plurality of circular indentations or cup-shaped recesses 49 substantially arranged in two parallel rows spacedly disposed adjacent the longitudinal edges of the planar support. Three of the plurality of these recesses 49 occupy similar end-of-row positions substantially oriented in corner locations for support relationship with the internal dummy support pins 21. The remaining or fourth corner position is occupied by a corner support perforation 51, the internal diameter of which is similar to that of recesses 49.

Electrical connections for the plurality of the cathode conductors 29 are made with conductive connector pins 23. Planar support 27 contains a plurality of predeterminedly spaced cathode perforations 55, one for each character cathode conductor 29 formed therethrough either by molding or drilling, so that a cathode perforation 55 is positioned directly beneath each cathode conductor segment 29 as shown in FIG. 6a. These perforations have internal diameters slightly smaller than the width of the covering cathode conductor electrodes 29. A conductive lead or wire 57 for each cathode conductor configuration has one end 59 positioned substantially within the perforation 55 and is affixed therein by electrically conductive cement 61 such as silver solder to insure electrical conductive contact with an individual cathode segment 29. The opposite end of lead 57 is attached to conductive pin 23 as by welding or the like at junction 63. The terminal end 65 of internal conductive pin 23 is butted within recess 49 in planar support 27 and anchored therein with ceramic cement 67. Electrical connections in like manner are made for each of the cathode numerals "0" to "9" as indicated in FIG. 1.

Alternate means for making the individual cathode connections is shown in FIG. 6b. Instead of the individual perforations 55, conductive connectors 69 are molded into the planar support 27 at the time of fabrication and are spaced to facilitate subsequent contact with the separate cathode electrodes 29 placed thereon. The lower surface of planar support 27 has a conductive strip 71 disposed thereon as by photo etching, overlay, stamping, painting or the like extending from conductive connector 69 to a recess 49 the inner surface of which is conductively coated with a contiguous extension of strip 71. Internal conductive pin 23 is butted within recess 49 and conductively affixed therein by conductive cement 73. This in like manner is substantially repeated for each of the cathode numerals "0" to "9." This alternate method of making cathode connections eliminates a plurality of welds and facilitates closer spacing between planar support 27 and stem 17 and provides for more compaction of structure height. Because of complexity of illustration, the aforementioned connections are not shown in FIGURES 3, 7 and 8.

Anode electrode areas 43, 45 and 47 are bonded to and spacedly positioned on the upper surface of planar support 27. Anode area connectors 75 and 77 are disposed adjacent to the opposite or lower surface of planar support 27. Although not specifically shown in detail these connectors may be strip-like electrically conductive

bondings on the lower surface of planar support 27 or they may be spaced therefrom as conductive leads or ribbons. In either instance both ends of connections 75 and 77 are conductively cemented into anode area connector perforations 79 so that the anode electrode areas 43, 45 and 47 are electrically interconnected forming a multiple segment anode area.

Electrical conductive contact for the anode area 47 is made as shown in FIG. 5a wherein the terminal end 81 of the internal conductive support pin 53 is positioned within corner support perforation 51 and affixed therein with conductive cement 83 making electrical contact with anode area 47. An upset or cold heading provides a support platform 85 on the terminal end 81 of anode conductive support pin 53 which is of a diameter larger than the internal diameter of corner support perforation 51. Anode conductive support pin 53 extends exteriorly through the stem portion 17 as an external anode connector or base pin 26.

Alternate means for making electrical contact with anode area 47 is illustrated in FIG. 5b. The lengthened terminal end 81' of internal conductive support pin 53' with integral cold-headed platform 85' is inserted through perforation 52, which is of restricted internal diameter slightly larger than that of pin 53' to allow a slidable fit therethrough. A terminal cold heading or swaging 89 pressurally secures pin 53' in conductive contact with anode area 47.

The assembled structure comprising planar support 27 affixed to a plurality of pins 23 and pin 53 on stem portion 17 is enclosed by a glass envelope 19 and hermetically joined to stem portion 17 as by glass sealing, cementing or the like. After processing evacuation, a gaseous atmosphere such as neon, a neon argon mixture, helium or the like is introduced under pressure into the cavity of the device which is then sealed by effecting a hermetic tubulation closure 33.

A typical device of the type generally described and illustrated in FIGURES 1 and 3 is constructed by utilizing an insulative planar support dimensioned 1.000 inch by .780 inch by .0625 inch thickness. The upper surface of the planar support has bonded or clad thereto a layer of copper of .004 inch thickness from which a plurality of cathode conductors and adjacent anode areas are defined as by photo etching or a similar process. The anode areas are separated from the adjacent cathode conductors by spacings in the range of .012 to .018 inch. The cathode conductors forming the plurality of discrete numeric configurations are confined within a surface area of .766 inch by .438 inch. The cathode conductors are spaced .066 inch apart, and have varied widths to provide substantially equivalent areas for each character with resultant equalized levels of glow ionization, for example:

Cathode	
Numeric configuration:	
conductor width, inches	
1	.019
2	.007
3	.007
4	.009
5	.007
6	.007
7	.012
8	.005
9	.007
0	.006

After stem mounting of the cathode-anode electrode assembly and suitable hermetic envelopment of the assembled structure, a gaseous atmosphere comprising 98% neon and 2% argon is introduced into the envelope cavity and sealed therein. With the electrode spacings herein mentioned the gaseous mixture is confined at a pressure of 50 mm. Hg.

In operation a positive potential is applied to the anode electrode. When a negative potential of sufficient

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magnitude is applied to any one of the cathode character electrode elements, the gaseous mixture in the vicinity of the cathode becomes ionized and produces a glow outlining the respective character configuration. In a device of this nature, ionization brightness or character illumination can be varied by cathode conductor area, internal gas pressure or electrical potential.

If desired, a base 91 can be attached to stem portion 17 as by plastic cement 93, thus affording protection for exhaust tubulation closure 33. This base also imparts support to the plurality of external connectors or base pins 25 and 26.

An alternate construction is shown in FIG. 7 wherein the conductive anode area 95 is of a transparent nature such as for example tin oxide applied to the inner surface of envelope 19 by a spray or vapor technique prior to final device assembly. In this embodiment the planar support 27' does not contain an anode area except a resilient conductive contact member 97. This resilient member is conductively attached to the terminal end 81' of conductive support pin 53' as by a cold heading or swage 89 in the manner similar to that shown in FIG. 5b. When the mount structure is enclosed with glass envelope 19, the resilient conductive member 97 makes electrical contact with the anode area 95. In the type of structure shown in FIG. 7 all cathode character electrodes 29 are equidistant from anode electrode area 95 at a spacing approximately .125 inch dependent upon the internal gaseous pressure finally confined within envelope 19. The remainder of the structure is similar to that shown in FIG. 3.

FIG. 8 is a modification of the structure shown in FIG. 7. A transparent anode electrode support 99 as of glass having four substantially corner perforations 101 is positioned on a plane horizontal to and spaced from planar support 28 as by tubular glass or ceramic insulators 103. A transparent conductive anode area 105 as of tin oxide or the like is applied to the surface of the anode electrode support 99 facing the cathode character elements 29 on planar support 28, the spacing therebetween being approximately .125 inch dependent upon the internal gaseous pressure finally confined within envelope 19.

Conductive support pin 54 in FIG. 8 is similar to support pin 53' as illustrated in FIG. 5b except it embodies a longer terminal portion 107 for insertion through tubular insulator 103 and perforation 101 in electrode support 99. Cold heading 90 is similar to cold heading or swaging 89 on support pin 53'. Electrical conduction between anode area 105 and support pin 54 is achieved at contact area 109 and insured by the application thereon of a small quantity, such as a drop, of a conductive cement. In addition to the conductive support pin 54, three internal dummy support pins 21' provide adequate support for the corners of the cathode-anode structure 100.

As evident in FIG. 8 and the foregoing explanation, the cathode-anode structure 100 can be completely assembled before being hermetically enclosed in envelope 19.

While a rectangular construction has been shown and described, it is obvious that other shapes, such as round or oval, can be constructed with equal facility.

As is evident from the foregoing description, if desired, both the anode area and the cathode configurations may be of transparent electrical conductive materials, as for example tin oxide, suitably disposed on a transparent support or supports such as of glass to facilitate viewing therethrough.

Thus there has been provided a hermetically sealed multi-electrode gaseous discharge display device which is both compact and simplified in construction. Wide angle viewing is adequately provided by the substantially planar character display with no annoying parallax. Selective circuitry is not complicated, nor are the power re-

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quirements high. Character selection need not be sequential.

While there have been shown and described what are at present considered the preferred embodiments of the invention, it will be obvious to those skilled in the art that various changes and modifications may be made therein without departing from the scope of the invention as defined by the appended claims.

What is claimed is:

1. A hermetically sealed multi-electrode glow discharge character display device comprising:

a gas-filled glass envelope having a substantially transparent viewing area for observing said character display therein;

a stem portion hermetically sealed to said envelope and spaced from said viewing area, said stem portion having a plurality of conductive and support pins sealed therein and extended therethrough;

a substantially planar insulating support member positioned within said envelope being located by said pins intermediate said viewing area and said stem portion and having a surface thereof oriented toward said viewing area, said support member having a plurality of discretely oriented perforations formed therein;

a plurality of narrow electrical conductors insulatively spaced from one another and formed as display electrode elements disposed in contiguous relationship on said insulating support member and said perforations therein, said electrode elements having substantially uniform height and extending from said surface to a height thereabove, and connective portions extending through said perforations to the opposite side thereof, said elements being selectively operable as cathode elements oriented to form a planar display of configurations defined within a substantially parallelogrammatic border to provide wide angle viewing of said configurations; substantially planar anodes oriented adjacent said cathode elements;

one of said anodes forming said border and others of said anodes being areas wholly within said border, all of said cathode elements being arranged parallel to the border;

means for supporting said anode means and said cathode elements in relative spaced relationship; and a plurality of connectors for said individual cathode elements and said anode means attached respectively thereto and connected to said respective conductive stem pins to provide exterior electrical connections from said envelope to facilitate the application of proper electrical potentials to said selected cathode elements and said anode means to effect a glow discharge display.

2. The structure of claim 1 wherein the others of said anodes are constructed of two parallelogrammatic anodes offset from each other with relationship to the width of the device and said cathode elements being located between said offset anodes and between said offset anodes and the anode defining the border.

3. A hermetically sealed multi-electrode glow discharge character display device comprising:

a gas-filled glass envelope having a substantially transparent viewing area for observing said character display therein;

a stem portion hermetically sealed to said envelope being spacedly removed from said viewing area, said stem portion having a plurality of conductive support pins sealed therein and extended therethrough;

a substantially planar ceramic support member positioned within said envelope and having a surface for planar display oriented toward said viewing area, said support member having a plurality of discretely oriented perforations formed therein;

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a plurality of narrow electrical conductors, some of which are of different electrode lengths and widths, the ratio of width to length being such as to provide substantially equivalent areas for each character with resultant equalized levels of glow ionization, said conductors being insulatively spaced from one another and formed as character electrode display elements having substantially uniform height disposed on said surface of said ceramic support member each element being in overlying relationship with at least one of said perforations therein, said electrode elements having connective portions extending through said perforations to the opposite side thereof, said elements being selectively operable as individual cathode elements oriented to form a planar display of configurations defined within substantially parallelogrammatic area to provide wide angle viewing of said configurations;

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substantially planar anode means oriented adjacent said cathode elements; and

a plurality of connectors for said individual cathode elements and said anode means attached respectively thereto and connected to said respective conductive stem pins to provide exterior electrical connections from said envelope to facilitate the application of a proper electrical potential to said individually selected cathode configuration and said anode means to effect a glow discharge display.

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GEORGE N. WESTBY, *Primary Examiner.*

UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,231,776

January 25, 1966

Philip R. Britnell et al.

It is hereby certified that error appears in the above numbered patent requiring correction and that the said Letters Patent should read as corrected below.

Column 3, line 61, for "conductiviely" read
-- conductively --; column 4, line 3, for "connections" read
-- connectors --; line 45, for "ares" read -- areas --; column
6, line 68, after "conductive" insert -- and --.

Signed and sealed this 10th day of January 1967.

(SEAL)

Attest:

ERNEST W. SWIDER

Attesting Officer

EDWARD J. BRENNER

Commissioner of Patents