# United States Patent [19]

**Scovronek**

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[54] **GAS-FILLED DISPLAY DEVICE HAVING MERCURY INLET SHIELD**


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



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[52] **U.S. Cl.** ..... **313/174,** 313/220

[51] **Int. Cl.** ..... **H01j 61/28**

[58] **Field of Search** ..... 313/174, 220, 188



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[57] **ABSTRACT**

The display panel comprises a gas-filled envelope which includes a base plate on which a plurality of groups of cathodes and their conductors are formed, each group of cathodes being operable to display a character. The envelope also includes a face plate, spaced from the base plate, and carrying transparent conductive anodes, each associated with one group of cathodes. The base plate of the panel is provided with a hole and a short, small-diameter tube axially aligned with the hole and extending away from the outer surface of the base plate. The usual tubulation is secured to the outer surface of the base plate enclosing the hole and the short tube, and the desired gas and mercury vapor are introduced into the panel envelope through the tubulation and through the short tube and hole in the base plate. The short tube prevents large mercury globules, which might be present in the sealed-off tubulation, from accidentally getting into the panel envelope.


**8 Claims, 5 Drawing Figures**

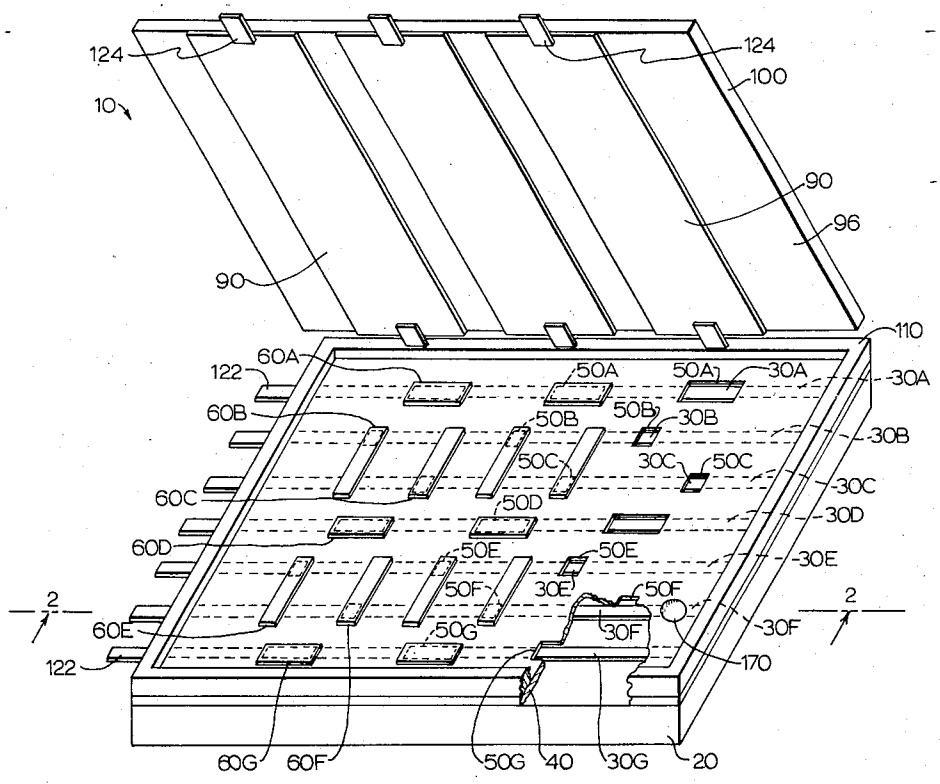
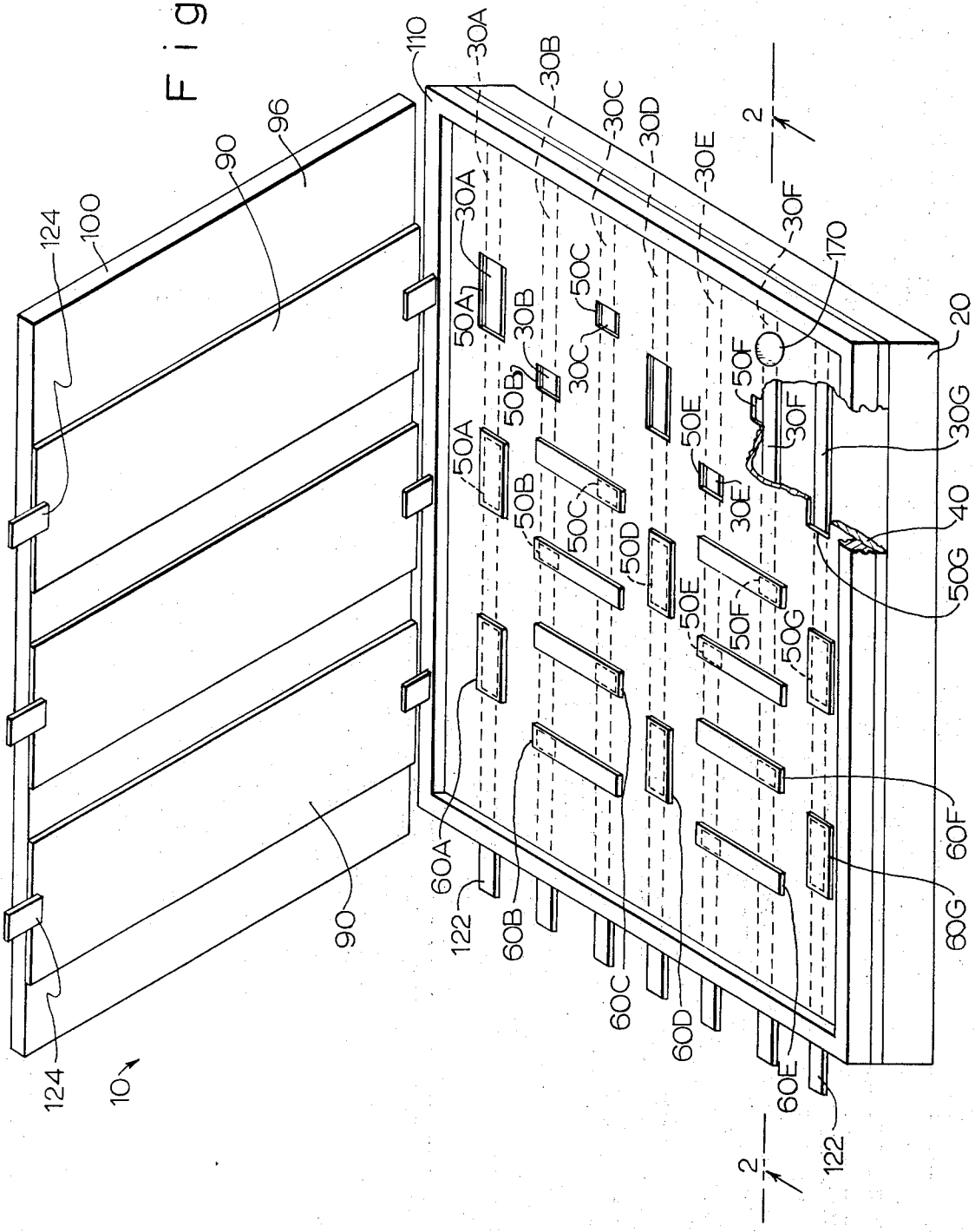


Fig. 1


110
30A
30B
30C
30D
30E
30F
2
170
20
30G
40
50G
60F
60G
124
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50G
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60E
122
10

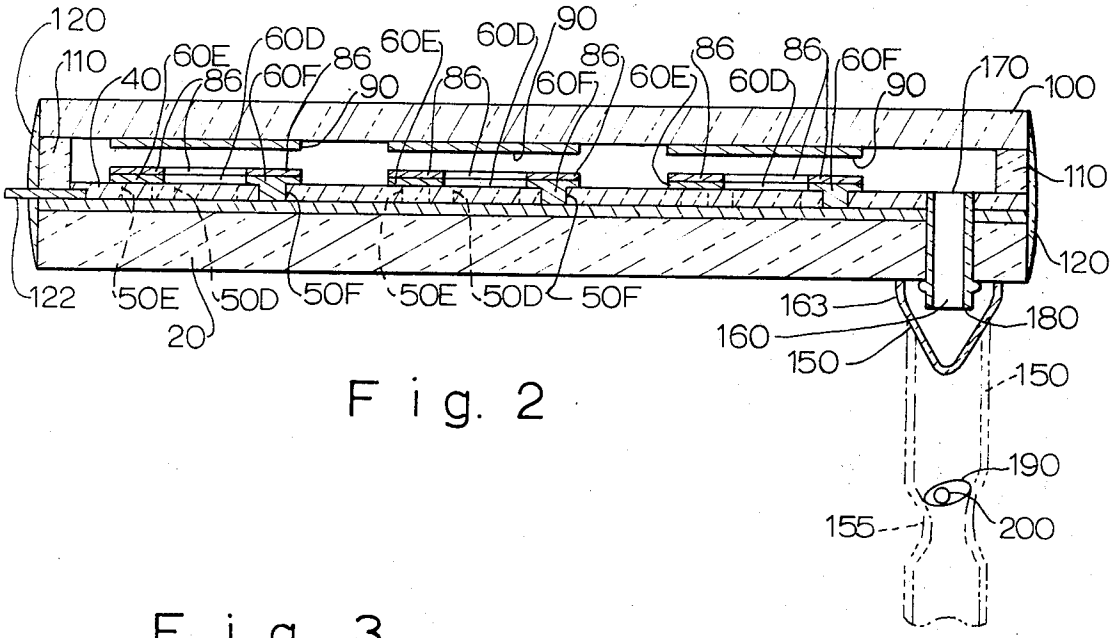



Fig. 2

Fig. 3

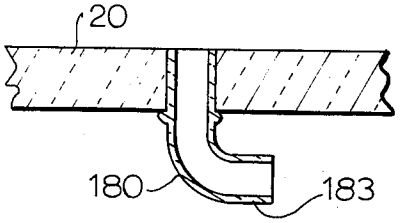



Fig. 4

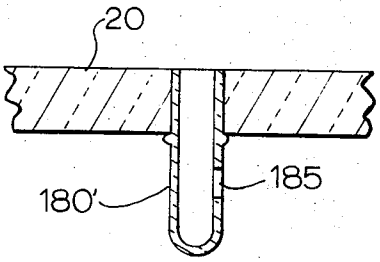
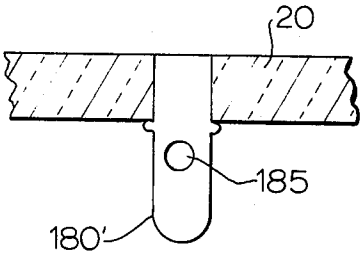



Fig. 5



# GAS-FILLED DISPLAY DEVICE HAVING MERCURY INLET SHIELD

## BACKGROUND OF THE INVENTION

It is customary in cathode glow discharge devices, such as the display panel described above, to include mercury vapor in the gas atmosphere to minimize cathode sputtering. Generally, the mercury is introduced from a small glass capsule held in the tubulation which is secured to the panel base plate and communicates with the interior of the panel by way of a small hole in the base plate. The glass capsule containing the mercury is broken at a suitable time in the manufacture of the panel to release the mercury and to permit its vapor to enter the panel through the hole in the base plate.

The mercury provided in the glass capsule is a relatively small ball, and, when the capsule is broken, the mercury ball enters the tubulation and some of its vapor flows into the panel through the hole in the base plate. However, a quantity of the mercury ball remains in the tubulation after the tubulation is sealed and the capsule is removed, and, under some circumstances, when the panel or its assembly is physically manipulated, some or all of the mercury ball may enter the panel through the hole in the base plate and may cause shorts between electrodes or may cause other problems.

## 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 base plate is provided with a hole through which mercury vapor and the gas filling for the panel are introduced from a tubulation secured to the base plate. Means are provided in operative relation with this hole in the base plate and within the tubulation to prevent excess mercury from entering the panel.

## DESCRIPTION OF THE DRAWINGS

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

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

FIG. **3** is a side elevational view, partly in section, of a modification of a portion of the invention;

FIG. **4** is a side elevational view, partly in section, of another modification of a portion of the invention; and

FIG. **5** is a front elevational view of the apparatus shown in FIG. **4.**

## 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 panel may also include any suitable ionizable gas such as neon, argon, xenon, etc., singly or in combination. A wide range of gas pressure may be used, for example, from about 20 to about 350 Torr or higher at ambient temperature, with about 75 to 120 Torr being a pressure range which is commonly and conveniently used. Those skilled in the art understand the interplay of parameters which affect the selection of a suitable gas pressure.



The principles of the invention are applicable to many types of cold cathode display devices, and the display panel **10** shown and described herein is a segment-type device which includes an insulating base plate **20** of glass, ceramic, or the like which carries, on its top surface, a plurality of narrow conductive leads or runs **30** (A to G). The runs **30** are parallel to each other and aligned with the horizontal axis of the base plate. Seven runs **30**A to **30**G 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, arc plasma spraying, flame spraying, or the like, or they may be discrete strips of metal, heat-sealed or otherwise secured to the insulating plate **20.** A silk-screen printing process is particularly suitable because it is fast, efficient, and reproducible.

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

Panel **10** also includes a group of cathode electrodes **60** (A to G) for each group of apertures **50**; the cathodes are generally flat 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 any of the processes mentioned above with a silk-screen process or the like performed with a conductive paste such as palladium-gold, platinum-gold, palladium-silver, or the like. Each cathode element fills its aperture **50,** is in direct contact with one of the runs **30** exposed thereby, and covers a portion of the top surface of layer **40** to achieve the desired shape and size for each cathode.

The cathodes **60** may also be formed of discrete strips of metal, each of which is brazed to a conductive run **30** by means of a mass of brazing material deposited in each of the apertures **50** in the insulating layer **40.** The brazing material may also be deposited by a silk-screen process or the like, with one suitable brazing material being a gold-germanium substance known as FORMON which is sold by DuPont.

Panel **10** also includes an anode electrode **90** for each group of cathode electrodes **60.** The anode electrodes **90** preferably comprise transparent conductive films of gold, NESA, or the like deposited on the lower surface **96** of the panel face plate or viewing plate **100** which is made of glass. 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 area defined by each group of cathode electrodes, as illustrated in FIG. **2.** The anodes thus face the flat surfaces of the cathodes, and these surfaces generate cathode glow areas of the same general shape in operation of the panel. Alternatively, the anode electrodes may comprise separate screens (not shown) suitably supported above the groups of cathode electrodes.

The top glass cover plate **100** is spaced from the base plate **20** by a rectangular frame member **110** which may be integral with cover plate **100,** or it may be a separate piece which is disposed between the top glass plate **100** and the insulating layer **40.** The rectangular frame **100** serves to provide the desired spacing between each anode and its associated group of cathode electrodes.

The three glass members **20, 100,** and **110** are sealed together by means of an hermetic seal **120** (FIG. **2**) formed along the adjacent edges of the members by means of a glass frit or the like.

Suitable contact pins **122** are secured to the cathode runs **30,** and contacts **124** are also made to anodes **90,** and all contacts are embedded in seal **120.**

The panel **10** is 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 **160** in base plate **20.**

The tubulation **150** has a flared end **163** which is secured to the surface of the base plate axially aligned with holes **160** and **170.** According to the invention, a short, small-diameter tube **180** is axially aligned with the hole **160** in the base plate and extends away from the bottom surface of the base plate into the tubulation **150.** The tube **180** may be secured directly to the lower surface of the base plate, but preferably, it is secured within the hole **160** by means of a cement such as Pyroceram or the like. The tube **180** is preferably of metal, has a bore diameter of about 20 mils, and extends about 65 mils above the lower surface of the base plate.

In a modification of the invention illustrated in FIG. **3,** the tube **180** has its open end **183** bent at substantially a right angle to the longitudinal axis of the tube so that the opening therein faces to the side, rather than downwardly. In still another modification illustrated in FIGS. **4** and **5,** a tube **180'** is used which has a closed lower end, with a small opening **185** provided in its side wall. The opening **185** would have a diameter of the order of 20 mils for proper operation.

A mercury capsule **190,** containing a small ball of mercury **200,** is disposed within the tubulation **150** and is held in place in any suitable manner, for example, by means of a constriction **155** in the tubulation.

After panel **10** has been assembled and processed as required, it is filled with the desired gas through tubulation **150,** and the tubulation is sealed off at a conveniently short length. Again, at a suitable time in the processing procedure, the glass capsule is broken, for example, by a suitable heating process, and the mercury ball is thus freed from the capsule and deposited in the tubulation. Either mercury vapor from the mercury ball diffuses through the holes **160** and **170** gradually, or the panel may be heated to forcefully drive mercury vapor into the panel. Other processing steps are carried out as required to complete the manufacture of the panel **10.** The panel is now ready for mounting in a suitable frame or carrier in association with printed circuit boards for ultimate inclusion in an instrument such as a desk top calculator. In these various operations, of course, the panel is handled and disposed in various orientations. It is noted that, during these manipulations, the tube **180** serves to prevent any solid mercury present in the tubulation from entering the panel through the holes **160** and **170.** If the tube were not present, mercury droplets might enter the panel and cause shorts between closely spaced electrodes.

Although the principles of the invention have been described with respect to one type of display panel, they are applicable to other types of gas-filled panels which include mercury. Thus, the panel illustrated is similar to a PANAPLEX panel made and sold by Burroughs Corporation; however, a SELF-SCAN dot matrix panel, also made and sold by Burroughs Corporation, could also utilize the invention.

What is claimed is:

**1.** A display device comprising

a generally flat panel-type envelope including

a base plate and a viewing face plate hermetically sealed together,

means in said envelope defining a plurality of gas-filled glow cells with an anode and cathode electrode associated with each of said glow cells,

a tubulation secured to the bottom surface of said base plate outside said envelope and communicating with the interior of said envelope through a hole in said base plate whereby gas can be introduced into said envelope,

a quantity of mercury globules disposed within said tubulation for introduction of the vapor of a portion thereof into said envelope, some of said mercury globules remaining in said tubulation, and

a short small-diameter tube secured to said base plate and having one end open and in communication with said hole therein, said tube extending from said base plate into said tubulation and having its opposite end, within said tubulation, closed, said tube having a side wall between said open end and said closed end and having a hole in said side wall between said open end and said closed end.

**2.** The device defined in claim **1** wherein said tube has a diameter of the order of 20 mils.

**3.** The device defined in claim **1** wherein said tube is of metal.

**4.** The device defined in claim **1** wherein said tube is secured within said hole in said base plate.

**5.** The device defined in claim **1** wherein said tube is secured within said hole in said base plate in axial alignment therewith.

**6.** The device defined in claim **1** wherein said small diameter tube has a diameter of about 20 mils and said hole in said side wall has a diameter of about 20 mils.

**7.** A display device comprising

a generally flat panel-type envelope including

a base plate and a viewing face plate hermetically sealed together,

means in said envelope defining a plurality of gas-filled glow cells with an anode and cathode electrode associated with each of said glow cells,

a tubulation secured to the bottom surface of said base plate outside said envelope and communicating with the interior of said envelope through a hole in said base plate whereby gas can be introduced into said envelope,

a quantity of mercury globules disposed within said tubulation for introduction of the vapor of a portion thereof into said envelope, some of said mercury globules remaining in said tubulation, and

a short small-diameter, open-ended tube secured to said base plate and having one end open and in communication with said hole therein, said tube

extending from said base plate into said tubulation, with the lower portion thereof remote from said base plate being bent at about a 90° angle to its axis and to the axis of said hole in said base plate.

**8.** A flat panel display device comprising

a generally thin, flat, gas-filled envelope including

a base plate and a viewing face plate hermetically sealed together,

a plurality of groups of light-generating cathode electrodes spaced apart along said base plate in said envelope, each group of electrodes including a plurality of cathode segments adapted to be energized in different groups to display different characters,

an anode electrode in operative relation with each said group of electrodes,

a tubulation secured to the bottom surface of said base plate outside said envelope and communicating with the interior of said envelope through a hole in said base plate whereby gas can be introduced into said envelope,

a quantity of mercury globules disposed within said tubulation for introduction of the vapor of a portion thereof into said envelope, some of said mercury globules remaining in said tubulation, and

a short small-diameter tube secured to said base plate and having one end open and in communication with said hole therein, said tube extending from said base plate into said tubulation and having its opposite end, within said tubulation, closed, said tube having a side wall between said open end and said closed end and having a hole in said side wall between said open end and said closed end.

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