

[54] **FLAT FLUORESCENT LETTER DISPLAY TUBES**

[75] Inventor: **Kazuhiko Kasano**, Ise, Japan

[73] Assignee: **ISE Electronics Corporation**, Ise City, Mie Prefecture, Japan

[22] Filed: **May 23, 1973**

[21] Appl. No.: **362,919**

[30] **Foreign Application Priority Data**

May 23, 1972 Japan..... 47-50396

[52] U.S. Cl. **313/514, 313/519, 315/169 TV**

[51] Int. Cl. **H01j 7/42**

[58] Field of Search..... **313/109.5, 220, 210; 315/169 TV, 169 R**

[56] **References Cited**

UNITED STATES PATENTS

3,260,880	7/1966	Kupsky	313/210
3,327,153	6/1967	Bickmire	315/169 TV
3,327,154	6/1967	Bowerman	313/210

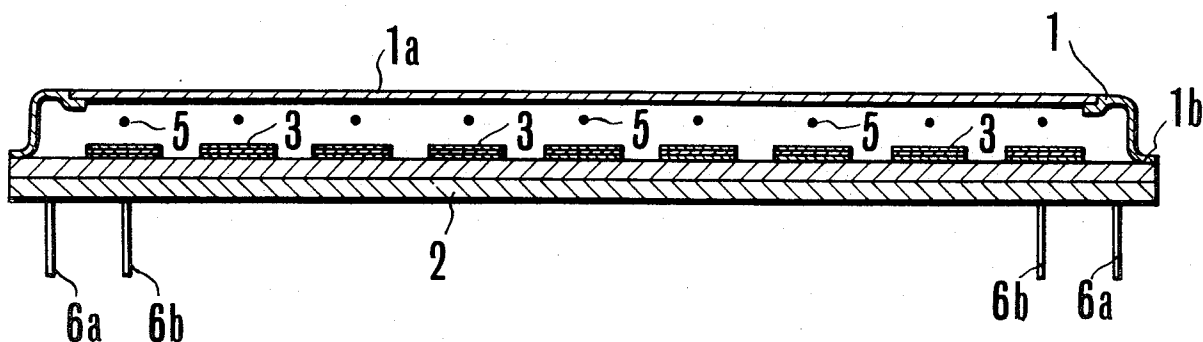
3,456,152	7/1969	Anderson.....	313/109.5
3,641,383	2/1972	Tagawa.....	315/169 R
3,646,384	2/1972	Lay.....	313/220
3,675,065	7/1972	Warne.....	313/109.5
3,723,789	3/1973	Tanui.....	313/109.5
3,735,180	5/1973	Coulon.....	313/193

Primary Examiner—James W. Lawrence
Assistant Examiner—D. C. Nelms
Attorney, Agent, or Firm—Dike, Bronstein, Roberts, Cushman & Pfund

[57] **ABSTRACT**

In a flat fluorescent letter display tube of the type wherein a plurality of letter display units are disposed in an sealed envelope including a transparent upper half and a lower half which are joined together in an air tight fashion, there are provided an insulative substrate and a plurality of segment electrodes printed on the substrate and constituting the plurality of letter display units. The upper half is joined hermetically to the substrate to complete the sealed envelope.

2 Claims, 5 Drawing Figures



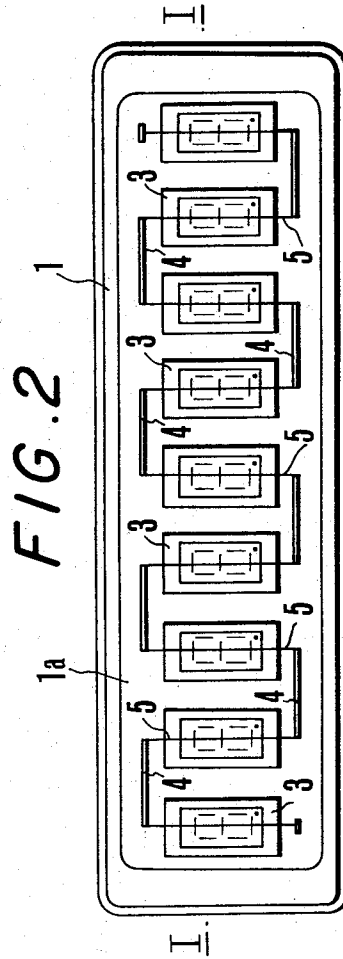
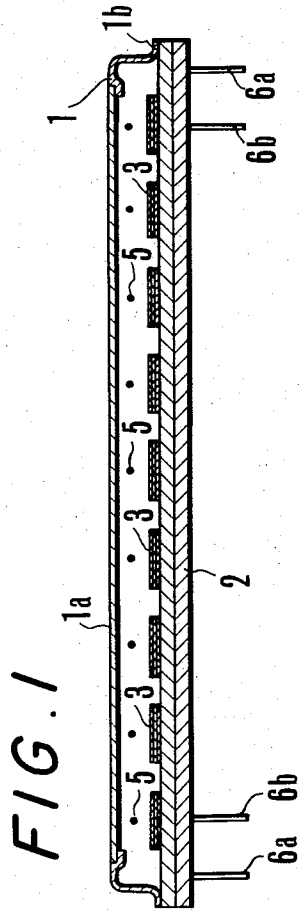


FIG. 3

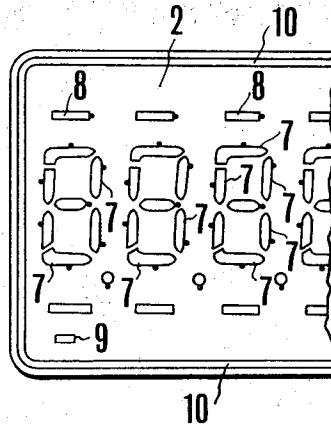


FIG. 4

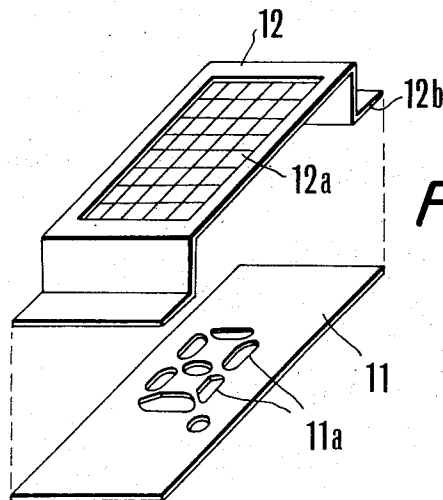
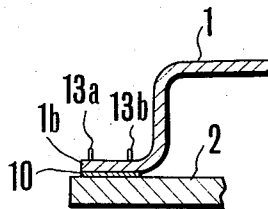


FIG. 5



FLAT FLUORESCENT LETTER DISPLAY TUBES

BACKGROUND OF THE INVENTION

This invention relates to an improvement of a flat fluorescent display tube for selectively displaying a plurality of letters, digits or symbols which are arranged side by side relationship.

The display tube of the type described above is usually sealed in an envelope comprising a transparent upper half and a lower half which are hermetically joined together. To facilitate the assembly of the upper and lower halves they are usually provided with mating flanges which are fused together to form an air tight bond. Provision of such flanges, however, not only increases the cost of manufacturing but also renders it difficult to reduce the thickness of the completed envelope.

SUMMARY OF THE INVENTION

Accordingly, it is an object of this invention to provide an improved flat fluorescent letter display tube which can be fabricated readily and has a reduced thickness.

According to this invention, there is provided a flat fluorescent letter display tube of the type wherein a plurality of letter display units are disposed in a sealed envelope including a transparent upper half and a lower half which are joined together in an air tight fashion, characterized in that there are provided an insulative substrate and a plurality of segment electrodes printed on the substrate and constituting the plurality of letter display units and that the upper half is joined to the substrate in an air tight fashion thus completing the sealed envelope.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention can be more fully understood from the following detailed description taken in conjunction with the accompanying drawings in which:

FIG. 1 shows a longitudinal section of a fluorescent display tube embodying the invention taken along a line I-I in FIG. 2;

FIG. 2 is a top plan view of the fluorescent display tube shown in FIG. 1

FIG. 3 shows a plan view of a portion of the multi-layer printed substrate utilized in the fluorescent tube shown in FIGS. 1 and 2;

FIG. 4 shows an exploded perspective view of one digit display unit and

FIG. 5 is a partial view showing a manner of welding the upper half or cover to the substrate of the display tube.

DESCRIPTION OF THE PREFERRED EMBODIMENT

The fluorescent display tube illustrated in the accompanying drawings comprises a sealed envelope having an upper half or cover 1 including a transparent display window 1a and a printed substrate 2 of an insulator, uramic for example. According to this invention the substrate 2 is constructed so as to act as the lower half of the envelope. It is advantageous to construct the substrate as a multilayer construction for the reason to be described later. A plurality of, for example 9, digit display units 3 are formed on the upper surface of the substrate to display numerals of nine orders. Electroconductive filament supports 4 are mounted on the sub-

strate on both sides of the array of digit display units 3 to support filaments 5 therebetween. As shown in FIG. 2, in the example shown therein, filaments 5 are connected in series. Terminals 6a and 6b are secured to the bottom surface of the substrate 2.

As shown in FIG. 3, a plurality of segment electrodes 7 coated with a phosphor and arranged in the form of a digit eight, electrodes 8, two for each digit display unit 3, electrodes 9 connected to the filament supports, and a rectangular metal film 10 about the periphery of the substrate and adapted to form an air tight joint between the cover 1 and the substrate are printed on the upper surface of the substrate 2. Corresponding segment electrodes 7 of nine digit display units are connected to a common conductor, not shown, printed on the rear surface of the substrate via connecting conductors extending through the substrate. The common conductor is connected to lead terminals 6a. In the same manner, electrodes 8 are also connected to terminals 6b through a common conductor, not shown, printed between the layers of the multi-layer substrate 2.

As shown in FIG. 4, each digit display unit 3 comprises a digit shaping electrode 11 and a mesh or grid shaped control electrode 12. The digit shaping electrode 11 is provided with a plurality of perforations corresponding to the segment electrodes 7 for defining the contour of a digit to be displayed. The electrode 11 also functions to shield the digit display unit 3 from external electric field and to absorb the substance evaporated from the filament thereby prolonging the operating life of the digit display unit. The control grid 12 is provided with a metal mesh grid which may be formed by intersecting at right angles fine metal wires or photo-etching a thin metal sheet. The control grid 12 is connected integrally to electrode 11 by welding flanges 12b on the opposite ends to the electrode 11. After mounting the assembly on the substrate 2 with perforations 11a correctly aligned with respective segment electrodes 7 the electrode 11 is electrically connected to the electrodes 8.

The display tube is assembled in the following manner.

After forming electrodes 7, 8 and 9 and metal film 10 on the substrate 2, each digit display unit 11 is secured to electrodes 8 in a manner just described. Filament supports 4 are secured to the upper surface of the substrate 2 on both sides of the array of digit display units 3 and then filaments 5 are mounted between opposing filament supports as shown in FIG. 2 so that at least one filament overlies each digit display unit.

Then cover 1 is mounted on the substrate with the peripheral flange 1b disposed on the metal film 10 as shown in FIG. 5. The flange 1b is then heated, for example by electric current supplied thereto through terminals 13a and 13b to weld the cover 1 to the substrate 2 thereby forming an air tight joint therebetween to complete a flat fluorescent display tube.

Although, in the foregoing description, the letters to be displayed were digits any alphabetical letter or symbol can also be displayed.

Thus, it will be clear that the invention provides a flat fluorescent display tube for displaying letters of simplified construction, and also can reduce the number of fabrication steps.

What is claimed is:

3

1. In a flat fluorescent letter display tube of the type wherein a plurality of letter display units are arranged on a straight line on an insulative substrate, each of said letter display units having a plurality of segment electrodes arranged in a predetermined configuration, an electrode provided with perforations adapted to contain said segment electrodes and a control grid mounted on said perforated electrode to cover said perforations and said segment electrodes and disposed in a sealed envelope including a transparent upper half and a lower half which are joined together in an air tight fashion, said display tube further comprises a plurality of filament supports mounted on said substrate on both sides of the array of said letter display units, a plurality of filaments mounted on the opposing filament supports, such that at least one filament extends above each letter display unit, the improvement in

4

which said plurality of segment electrodes, terminals for said electrodes with perforations, terminals for said filaments and a metal film are printed on said substrate; and means for heating said metal film and air tightly joining said upper half to said substrate thereby completing said sealed envelope.

2. The display tube according to claim 1 wherein said insulator substrate is of the multi-layer construction, corresponding segment electrodes of respective letter display units are connected to a common conductor provided on the rear surface of said substrate and said perforated electrodes and said control electrodes of respective letter display units are connected to a common conductor provided between the layers of said multi-layer substrate.

* * * * *

20

25

30

35

40

45

50

55

60

65