United States Patent [19]

Tanji

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[54] **ELECTRIC DISPLAY TUBE AND ENVELOPE STRUCTURE THEREFOR**

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[21] Appl. No.: **379,709**

Related U.S. Application Data

[63] Continuation of Ser. No. 198,463, Nov. 12, 1971, abandoned, which is a continuation of Ser. No. 864,666, Oct. 8, 1969, abandoned.

[52] **U.S. Cl.** **313/483,** 313/220, 313/282, 313/318

[51] **Int. Cl.** **H01j 61/36**

[58] **Field of Search** ..... 313/109.5, 108 A, 108 R, 313/220, 266, 282, 318; 315/169 R

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Primary Examiner—Palmer C. Demeo
Attorney, Agent, or Firm—Dike, Bronstein, Roberts, Cushman & Pfund

[57] **ABSTRACT**

In an electric display tube comprising an evacuated envelope containing a display electrode and terminals connected to the display electrode and extending through the envelope, the envelope is comprised by a metal cap provided with a transparent window and a flange and metal base welded to the flange.

4 Claims, 5 Drawing Figures

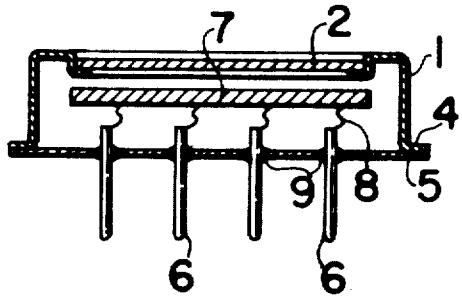


FIG. 1

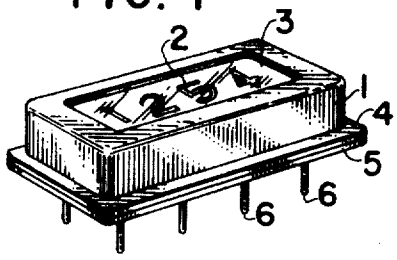


FIG. 2

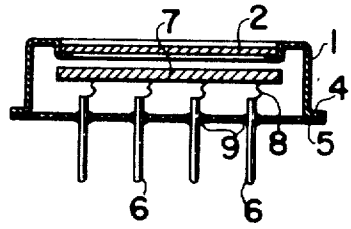


FIG. 3

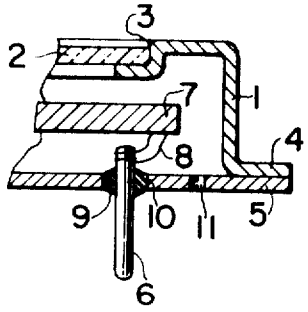


FIG. 4

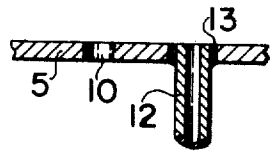
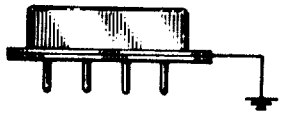


FIG. 5



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ELECTRIC DISPLAY TUBE AND ENVELOPE STRUCTURE THEREFOR

This is a continuation, of application Ser. No. 198,463 filed Nov. 12, 1971, and now abandoned which was a continuation of Ser. No. 864,666, filed Oct. 8/69, and now abandoned.

BACKGROUND OF THE INVENTION

This invention relates to a novel electric display tube and a method of manufacturing the same.

Prior display tubes are comprised by cylindrical or elliptical glass envelopes. These configurations are mainly due to the fact that the envelopes are made of glass. However, sealing of glass envelopes involves such various problems as the oxidation of electrodes by heat conduction, long time required for sealing operation, etc. Further, use of glass also makes it difficult to provide display tubes of any configuration or size.

SUMMARY OF THE INVENTION

It is an object of this invention to provide an improved display tube which can be made to have any desired configuration and can be fabricated without oxidizing the internal electrode.

According to this invention an evacuated envelope adapted to contain an internal display electrode is comprised by a metal case and a metal base. The metal case is provided with a transparent window and a metal flange at its base, which is sealed to the base by means of electric welding or brazing. The external terminals connected to the display electrode extend through terminal perforations in the metal base and sealed thereto by electric insulators. The interior of the envelope can be exhausted through an exhaust perforation provided for the metal base or cap, and after evacuation a suitable inert gas may be introduced into the envelope.

BRIEF DESCRIPTION OF THE DRAWING

Further objects and advantages of the present invention will be better understood from the following description, reference being made to the accompanying drawing, in which:

FIG. 1 is a perspective view of an electric display tube embodying this invention;

FIG. 2 shows a longitudinal section of the display tube shown in FIG. 1;

FIG. 3 is an enlarged view of a portion of FIG. 2;

FIG. 4 is an enlarged sectional view of exhausting means for the display tube and

FIG. 5 is a diagrammatic representation of the display tube when it is used as a fluorescent display tube.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

The display tube embodying this invention comprises an envelope adapted to contain an internal electrode for displaying desired informations, said envelope consisting of a metal cap with a display window through which displayed characters or numerals can be viewed and a display glass, and a metal base sealed to the flange of the cap by electric welding or brazing.

The display tube illustrated in FIG. 1 comprises a metal cap 1 provided with a window 3 in which a sheet 2 of transparent glass or plastic is sealed to view characters or numerals displayed on the electrode contained in the display tube. The cap 1 is provided with a flange 4 at its bottom edge which is sealed to a metal base 4 by means of electric welding or soldering. A plurality of terminals 6 for the internal display electrode extends through base 5 as will be described in more detail hereinafter.

As best shown in FIG. 2 which is a longitudinal section of the display tube shown in FIG. 1, within an envelope comprised by the cap 1 and the base 5 is disposed a display electrode 7 for displaying characters, numerals or patterns. The display electrode 7 is connected to external terminals 6 via flexible lead wires 8. As is well known in the art, terminals 6 extend through terminal perforations in the base 5 and gaps around terminals are filled with a suitable insulating material 9 such as glass or ceramic to electrically insulate and air tightly seal the terminals. Flange 4 of cap 1 and base 5 are fused together to form an air tight seal by means of an electric arc or spot welding or by soldering. The interior of the envelope in which is disposed the internal electrode 7 is evacuated or filled with an inert gas.

The above described display tube is fabricated in the following manner. Referring now to FIG. 3, a subassembly consisting of the internal electrode 7 and terminals 6 interconnected by lead wires 8 is first prepared. Then a plurality of terminal perforations 10 are formed through the metal base 5 of the number corresponding to that of the external terminals 6. Of course, the diameter of perforations 10 should be sufficiently larger than that of the outer diameter of terminals 6. Also an exhaust opening 11 is provided through the base 5. After mounting the subassembly on the base 5 with terminals 6 extended through perforations 10, gaps between terminals 6 and inner walls of the perforations 10 are filled with the insulating material 9 of glass or ceramic to position and electrically insulate the terminals 6 with respect to the metal base 5. Then the metal cap 2 with the transparent sheet 2 previously sealed to the window 3 is mounted upon the assembly and the flange 4 and base 5 are sealed together by electric spot or arc welding or brazing. Thereafter, air in the envelope is exhausted through the exhaust opening 11 and when desired a suitable inert gas may be admitted into the evacuated envelope. Then, the exhaust opening 11 is sealed off to complete a display tube. When exhausting the envelope an exhaust pipe 12 made of glass or metal is employed as shown in FIG. 4. The exhaust tube 12 is sealed to the base by means of a special glass or silver solder 13. After exhausting the envelope through the pipe 12, the pipe is pinched off.

Instead of preparing a preassembly consisting of internal electrode 7, terminals 6 and lead wires 8, terminals 6 may be secured in the perforations 10 of the base 5 to thereafter connect terminals 6 to the internal electrode 7. Further, it will be clear that the exhaust opening 11 may be provided for the cap 1 instead of the base 5.

Thus, in accordance with this invention, the envelope of the display tube is comprised by a metal cap and a metal base which are welded together. Accordingly, it is possible to made the envelope to have any desired configuration and size thus improving the space factor of the display tube when compared with that made of glass. Moreover, since the welding between the cap and base is provided by spot or arc welding at the flange of the cap, heat of welding is not transmitted to the internal electrode different from the previous seal provided by fusing glass. Consequently, the problem of oxidation

of the internal display electrode by the heat of sealing operation can be eliminated. Moreover, insulators fielded between terminals and the metal base effeciently interrupt heat conduction, thus further preventing oxidation of the internal electrode. Metal case also acts as an electrostatic shield for the internal electrode. This especially advantageous for fluorescent display tubes susceptible to external fields. A stable fluorescent display tube may be provided by grounding the case as shown in FIG. 5. Electric welding of the case and base greatly shortens the sealing time than glass seals. Display tubes of this invention are light weight, can well withstand against external shocks and can be fabricated readily.

What is claimed is:

1. An electric display tube comprising internal display electrode means, means forming a set of external terminals for extending within said tube with their internal ends respectively connected to support said internal electrode means in spaced relation to the interior surfaces of said tube, a metal base in the form of a flat plate provided with perforations through which said terminals extend, electric insulators rigidly sealing said terminals in said perforations, a metal cap enclosing and spaced from said internal display electrode means said cap having a top opening the inner periphery of which is formed with a reentrant flange, a transparent sheet sealed in said opening and supported on said reentrant flange, a peripheral outwardly extending flange formed on said cap, said outwardly extending flange spaced from said window a distance to assure spacing said internal display electrode means from the inner surface of said window, means forming a continuous peripheral bond between said outwardly extending flange and said base, and a partially evacuated atmosphere within the interior of said display tube, atmospheric pressure tending to urge said transparent sheet and said metal base in sealing relation against the respective flanges adjacent thereto.

2. A metal envelope electric display tube

comprising a metallic cap formed with a top wall with sidewalls extending therefrom and terminating in an external peripheral flange, and a metallic bottom plate conductively sealed against said flange;

said top wall having an opening formed with an internal peripheral flange depressed below the outer surface of said top wall, and a transparent plate in said opening supported on and sealed to said internal peripheral flange;

said bottom plate having a set of perforations therein, a set of terminals extending respectively through said perforations, and dielectric seals in each of said perforations rigidly supporting said terminals which pass through said dielectric seals;

display electrode means on the ends of said terminals within said envelope spaced from the internal surfaces of said metallic cap, said transparent plate and said metallic plate; and

a gaseous atmosphere within said tube below atmospheric pressure, atmospheric pressure tending to urge said transparent plate and said bottom plate in sealing relation against the respective flanges adjacent thereto.

3. The electric display tube according to claim 2 and including a ground connection for said metallic envelope.

4. The electric display tube according to claim 3 in which said display electrode means comprise fluorescent electrode means.

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