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3,297,898

MERCURY SUPPORT CUP FOR COLD CATHODE MERCURY VAPOUR TUBE

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2 Sheets-Sheet 1

FIG. 1.

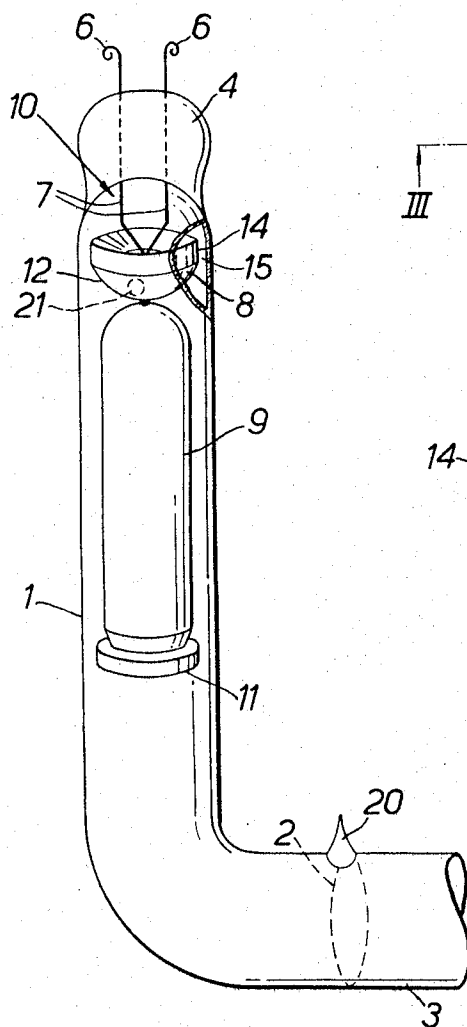


FIG. 2.

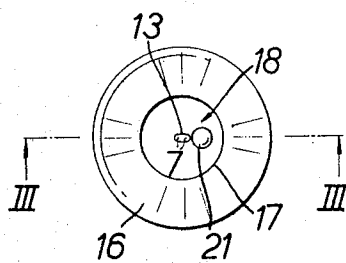
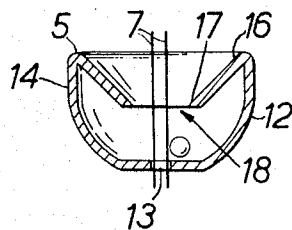


FIG. 3.



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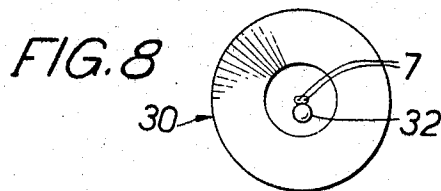
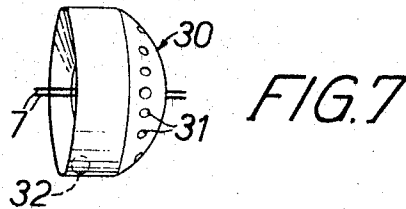
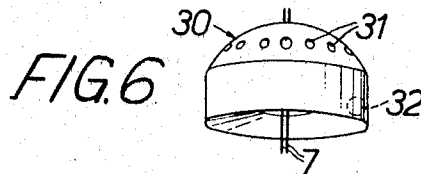
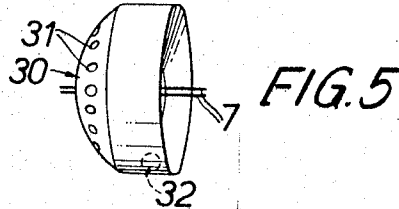
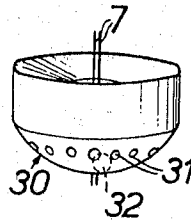
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MERCURY SUPPORT CUP FOR COLD CATHODE MERCURY VAPOUR TUBE

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FIG. 4.



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MERCURY SUPPORT CUP FOR COLD CATHODE MERCURY VAPOUR TUBE

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2,460/63

5 Claims. (Cl. 313-174)

A disadvantage experienced by cold cathode tubes, particularly if of some length, is that they do not always light up immediately in cold weather on being switched on, or only light up in parts. This failure to light is because the mercury globule has come to rest in a relatively cold portion of the display tube and therefore takes some time to become sufficiently warm after switching on the tube to generate the vapour necessary to produce the ultra-violet light by the electrical discharge occurring between the electrodes. It will also be appreciated that before the display tube can become completely and evenly illuminated the ionized mercury vapour must be distributed evenly throughout its length and thus also takes time if the tube is cold.

To overcome these disadvantages, attempts have been made to prevent the liquid mercury from contacting the inside surface of the fluorescent part of the tube by incorporating a mercury trap in the rear end of the terminal tube containing the electrode. This rear end, located between the electrode and closed end of the tube, is known as the "cold zone" and, like the remainder of the terminal tube, is not coated with a fluorescent coating so that holding the liquid mercury in this zone does not result in such rapid aging of the tube due to the creation of shadows along its length. One proposal for a mercury trap was to mount a disc on the back of the electrode and in the cold zone, the disc nearly filling the bore of the terminal tube. It was hoped that this disc would hold a mercury globule within the cold zone whilst allowing the mercury vapour produced by it to travel unimpeded through the remainder of the tube when switched on. However, such an arrangement was found to be unsatisfactory in practice because during fixing of the tube in its operating position by workmen, it was invariably moved about so much that the mercury globule was shaken from behind the disc into the body of the tube between the electrodes where it remained during the remainder of the tube's life. A second proposal—rather more successful in practice—was to incorporate in the cold zone a mica disc spanning completely across the terminal tube at the electrode end of the cold zone and penetrated in its central portion by two small pipes extending from both sides of the disc. During manufacture of the tube, the mercury globule is introduced by a tubulation into the cold zone in which it is trapped by the mica disc. During use, mercury vapour is able to flow through the two small pipes in the centre of the disc, but the mercury globule itself is prevented from passing through them because they project into the cold zone above the level of the globule when resting on the wall of the cold zone. Such an arrangement, however, suffers from the disadvantages that it is expensive to construct and it also can only be used when the mercury globule is introduced into the cold zone by a tubulation which is not always desirable.

This invention provides a terminal tube suitable for fixing to the end of a mercury vapour discharge tube and containing an electrode and a liquid mercury holding chamber having an entry surrounded by a re-entrant flange shaped to deflect a mercury globule into the chamber when the tube is tilted in one direction and thenceforth to retain the globule in the chamber during subsequent tilting of the tube in any direction.

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With the terminal tube of the invention incorporated into a complete tube, the mercury can be introduced into the manufactured tube at any desired point along its length, either at the junction between the terminal tube and the display tube or at a tubulation extending through the closed end of a terminal tube. Because the liquid mercury globule is prevented by the re-entrant flange from flowing from the holding chamber the useful life of the display tube may be materially increased.

The invention will now be described in more detail, by way of example, with reference to accompanying drawings, in which:

FIGURE 1 shows in partial section a terminal tube fused to one end of a fluorescent display tube;

FIGURE 2 shows, in plan, the entry of a re-entrant cup;

FIGURE 3 is a section through the cup taken on the line indicated by the arrows III—III in FIGURE 2; and,

FIGURES 4 to 8 show a modified re-entrant cup in five different positions to illustrate its ability to retain a mercury globule within it.

Referring to FIGURE 1 the terminal tube comprises a glass tube 1 having an internal diameter of $\frac{1}{2}$ -inch and a wall thickness of about $\frac{1}{16}$ -inch. One end of the terminal tube is open and fused at 2 to one end of a display tube 3 and the other end of the terminal tube is closed by a pinch 4 through which pass two connecting wires having diminished diameters where they pass through the pinch. The wires terminate outside the pinch in two electrical terminals 6 and inside the pinch in two further pins 7 which pass axially through the centre of a thin, metal cup 8, defining a mercury holding chamber, and which are welded to the rear end of a tubular iron electrode 9 of hollow form and about $1\frac{1}{4}$ -inches long. The electrode 9 is supported axially in the terminal tube by the attached pins 7. The end of the electrode adjacent the pins and the cold zone 10, is closed, and the other end is open and terminates in an annular ceramic disc 11 which prevents sputter from the end of the electrode 9 whilst in use.

Referring to FIGURE 3 the re-entrant cup 8 has a rounded conical base 12 in contact with the rear of the electrode 9 and is crimped at its centre 13 to the support pins 7. The periphery of the base 12 merges into a cylindrical side wall 14 coaxially disposed in the terminal tube 1 and one-sixth of an inch in length. An annular gap 15 of about $\frac{1}{32}$ of an inch is left between the cylindrical side wall 14 of the cup 8 and the inner surface of the terminal tube 1. The cylindrical side wall 14 terminates in the cold zone 10 in a rounded rim 5 which merges into a frusto-conical re-entrant flange 16 which is peened-in and is approximately parallel to the bulging conical base 12 of the cup. As is clearly seen in FIGURE 2 the inner edge 17 of the flange 16 defines a circular central entry 18 to the cup of about one-fifth of an inch diameter and through the centre of which the support pins 7 pass.

During manufacture of the discharge tube the open end of the terminal tube 1 is fused at 2 to the edge of a hole in one end of the display tube 3 which is internally coated with a layer of fluorescent material adapted to fluoresce under ultra-violet light generated by ionization of mercury vapour in the tube. The mercury is admitted to the discharge tube after cleaning through a fine bore pipe 20 fused into the junction between the terminal tube 1 and the display tube. After a mercury globule has been admitted through the pipe 20 it is sealed and cut short. The discharge tube is then tilted so that the mercury globule runs down the terminal tube 1, past the electrode 9, and through the annular gap 15 between the cylindrical side wall 14 of the cup 8 and the inner wall of the terminal tube 1 to the pinch 4 at the end of the cold zone 10. The discharge tube is then turned upside-down so that the mercury globule flows back from the closed end of the cold zone 10 towards the electrode 9 and is deflected by

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the inwardly directed frusto-conical flange 11 of the cup to the entry 18 in the centre thereof. The mercury lodges in the holding chamber as shown at 21 in FIGURE 1 and is held therein by the re-entrant flange 16 irrespective of the angle of tilt at which the tube is subsequently held.

This will be more clearly understood by referring to FIGURES 4 to 8 which show a modified mercury holding chamber 30 in five different positions. The holding chamber 30 is similar to the re-entrant cup 8 except that it is provided with a ring of perforations 31. The perforations 31 comprise a number of small circular holes of $\frac{1}{32}$ -inch diameter which are sufficiently large to allow mercury vapour to pass easily through them but are too small to allow a mercury globule 32 to pass through. Thus the mercury vapour is able to flow easily into the display tube while the mercury globule is safely held within the chamber 30. From the five views shown in FIGURE 4 it will be seen that the mercury globule 32 is safely held irrespective of the angle to which the chamber 30 is tilted.

It will thus be appreciated that the invention provides a mercury trap which is simple to manufacture, is applicable to all known ways of introducing mercury into the tube and is capable of holding the liquid mercury globule in the cold zone of the tube during fixing of the tube in position and throughout the useful life of the tube.

What I claim is:

1. A cold cathode discharge tube, comprising: a display tube, a terminal tube fused to said display tube, wires extending through a pinch at the closed end of the terminal tube, an electrode mounted inside said terminal tube and supported by said wires, a re-entrant cup defining a mercury holding chamber and mounted on said wires between the electrode and the closed end of the tube, and a flange defining an entry to the cup and extending inwardly thereof from its outer wall which is spaced from the inner wall of the terminal tube by a narrow gap of sufficient

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width to allow a globule of mercury to pass therethrough towards the closed end of the tube when the terminal tube is tilted in one direction but sufficiently narrow to result in the mercury globule being deflected by the flange into the entry to the cup when the terminal tube is tilted in the reverse direction.

2. The cold cathode discharge tube as claimed in claim 1, in which the cup and flange are integrally formed from a thin metal shell crimped to the wires adjacent the electrode.

3. A cold cathode discharge tube as claimed in claim 1, wherein said holding chamber has its base adjacent the electrode, a globule of mercury in said holding chamber, said entry to the holding chamber facing in a direction away from the electrode; the cup being provided with perforations of sufficiently small size to prevent passage of the liquid mercury globule therethrough.

4. A cold cathode discharge tube as claimed in claim 1, wherein said electrode is cylindrical and mounted coaxially in said terminal tube, the centre of the cup lying on the axis of the electrode and the terminal tube.

5. A cold cathode discharge tube as claimed in claim 3, in which the perforations comprise a band of small holes in the base of the cup.

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