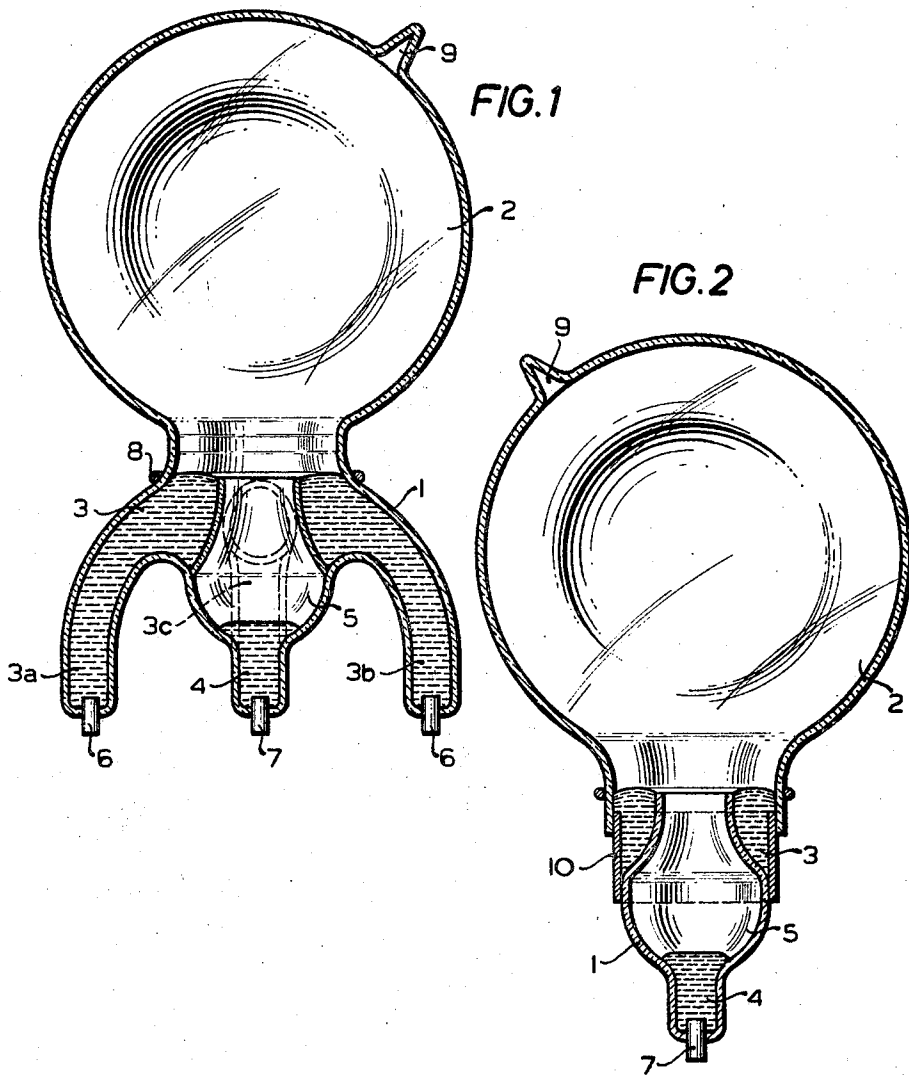


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MEANS SEPARATING MERCURY ELECTRODES
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1

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MERCURY VAPOR TUBE WITH SPECIAL DISCHARGE CHAMBER MEANS SEPARATING MERCURY ELECTRODES

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1 Claim. (Cl. 313—165)

ABSTRACT OF THE DISCLOSURE

A mercury vapor tube for switching high currents and comprising tube means having a vertical axis and including a pair of mercury electrode means arranged at different elevations and discharge chamber means between said electrode means, said electrode means and said discharge chamber means being arranged symmetrically with respect to said axis and said discharge chamber means being constructed to permit overflow of mercury from the higher to the lower electrode with the overflowing mercury at least during part of its pass out of contact with the wall of the discharge chamber means.

The present invention relates to mercury vapor tubes, and especially to a mercury vapor tube for switching of high currents in which a pair of mercury electrodes are arranged at different elevations and in which an overflow device is provided for maintaining substantially constant amounts of mercury at each of the mercury electrodes.

Mercury vapor tubes of this kind are known in which the tube is substantially U-shaped. The two legs of the U-shaped tube, which each contain one of the mercury electrodes extend downwardly at different lengths so that the meniscus shaped upper surfaces of the two mercury electrodes are arranged at different elevations. An overflow tube leading from the upper to the lower electrode serves in this case to maintain the level of the upper surfaces of the two electrodes during operation of the tube.

Mercury vapor tubes of the aforementioned kind have a relatively large inductivity so as to be unsuitable for the control of large currents and the glass erosion of these tubes, when used for control of large currents, is considerable, resulting in a short working life of the tube and even after a very short operation time to misfirings, since glass particles ejected from the walls of the tube are deposited on the mercury electrodes and change thereby the ignition characteristics of the tube.

It is an object of the present invention to provide for a mercury vapor tube which avoids the above-mentioned disadvantages of mercury vapor tubes known in the art.

It is an additional object of the present invention to provide for a mercury vapor tube of small inductivity, and which will stand up perfectly during extended use.

With these objects in view, the mercury vapor tube according to the present invention mainly includes tube means having a vertical axis and comprising mercury cathode means, mercury anode means spaced from the mercury cathode means and discharge chamber means between said cathode and anode means, wherein said cathode means, said anode means and said discharge chamber means are arranged symmetrically with respect to the aforementioned axis.

According to a further feature of the present invention, the mercury vapor tube includes further an ignition electrode arranged about the tube means and coaxially with the aforementioned axis.

The novel features which are considered as charac-

2

teristic for the invention are set forth in particular in the appended claim. The invention itself, however, both as to its construction and its method of operation, together with additional objects and advantages thereof, will be best understood from the following description of specific embodiments when read in connection with the accompanying drawings, in which:

FIG. 1 is an axial cross section through a first embodiment of a mercury vapor tube according to the present invention; and

FIG. 2 is an axial cross section through a second preferred embodiment.

Referring now to the drawing, and more specifically to FIG. 1 of the same, it will be seen that the mercury vapor tube illustrated in FIG. 1 includes a lower tube portion 1 and an upper tube portion 2 in form of a condensation dome. The lower portion 1 comprises wall portions defining mercury electrodes 3 and 4 and a discharge chamber 5. The mercury cathode 3 encloses the upper part of the discharge chamber 5 and branches outwardly into four cathode arms arranged symmetrically with respect to a vertical axis of the tube. Only the cathode arms 3a, 3b and 3c are shown in FIG. 1, whereas the fourth cathode arm opposite the arm 3c is not shown in the cross sectional view of FIG. 1. A central mercury anode 4 is arranged along the axis of the tube beneath the wall portions thereof defining the discharge chamber 5. Metal pins 6 and 7 fused in lower portions of the aforementioned cathode arms and in the central tube portion defining the mercury anode 4, respectively, serve to supply current to the cathode and anode respectively. The pins 6 and 7 are preferably made from molybdenum. An ignition electrode 8 arranged substantially at the elevation of the mercury level of the mercury cathode 3 surrounds the tube coaxially with the axis thereof. FIG. 1 shows also the fused tube portion 9 through which the tube has been evacuated.

The preferred embodiment illustrated in FIG. 2 differs from the above described embodiment illustrated in FIG. 1 in that the various cathode arms are omitted in this arrangement and the mercury cathode 3 is in annular form surrounding the upper portion of the discharge chamber 5. Furthermore, the metal pins 6 by means of which current is supplied to the mercury cathode 3 are likewise omitted in the embodiment illustrated in FIG. 2 and current is supplied to the mercury cathode 3 by means of an annular metal member 10 which surrounds the mercury cathode 3 and which forms part of the outer wall of the tube. The annular member 10 is arranged coaxially with the axis of the tube and the metal pin 7 is arranged along this axis. It will be noted that in both embodiments the discharge chamber 5 has an upper portion of smaller diameter than the lower portion thereof.

The mercury vapor tube according to the present invention will operate as follows:

Voltage is applied to the mercury electrodes 3 and 4 and a low energy high tension impulse is applied to the ignition electrode 8 which starts the ignition. The discharge proceeds in the electric field established between the mercury electrodes 3 and 4. The lines of force of the electric field extend in such a manner that the charge carriers movable along these lines do not substantially impinge on any portion of the glass walls of the tube. The plasma being heated up continuously in the discharge chamber 5 causes an evaporation of the mercury of the mercury electrodes 3 and 4. The evaporated mercury condenses in the condensation dome 2 which is cooled by the surrounding air. If necessary, the cooling can be increased by forceably blowing air onto the outer surface of the upper tube portion. The mercury condensed in the condensation dome 2 flows into the annular mer-

3

cury cathode 3. From there mercury will overflow over the upper edge portion of the tube wall defining the discharge chamber 5 so that the mercury level of the mercury cathode 3 and that of the mercury anode 4 will be maintained. Due to the specific construction of the discharge chamber 5, the greatest part of the inner surface thereof will not be contacted by the overflowing mercury so that an insulating strip between the mercury cathode 3 and the mercury anode 4 will be maintained even when the mercury after long operation of the tube leaves a residue on the contacted wall portions.

The mercury vapor tube according to the present invention differs from those of the prior art above described in that the various portions of the tube according to the present invention are symmetrically arranged with regard to the axis of the tube and that in the arrangement according to the present invention separate overflow means between the mercury electrodes are not necessary. In addition, the above-described construction of the tube according to the present invention results also in a greatly reduced glass erosion and any erosion is in any plane normal to the axis of the tube substantially uniform, that is localized erosions are avoided. This produces at the same time a considerable improvement of the ignition characteristics, since the mercury surfaces are in the arrangement of the present invention not spattered with eroded glass particles as in tubes known in the art. The coaxial current flow results also in especially low inductance of the tube of the present invention. The inductance of the tube shown in FIG. 1 is 55×10^{-9} henries, and for the embodiment shown in FIG. 2, 35×10^{-9} henries. The tubes according to the present invention will withstand an average of 450,000 current impulses.

It will be understood that each of the elements described above, or two or more together, may also find a useful application in other types of mercury vapor tubes differing from the types described above.

While the invention has been illustrated and described as embodied in a mercury vapor tube having mercury cathode means, mercury anode means and discharge chamber means coaxially arranged with each other, it is not intended to be limited to the details shown, since various modifications and structural changes may be made without departing in any way from the spirit of the present invention.

4

Without further analysis, the foregoing will so fully reveal the gist of the present invention that others can be applying current knowledge readily adapt it for various applications without omitting features that, from the standpoint of prior art, fairly constitute essential characteristics of the generic or specific aspects of this invention, and, therefore, such adaptations should and are intended to be comprehended within the meaning and range of equivalence of the following claim.

What is claimed as new and desired to be secured by Letters Patent is:

1. A mercury vapor tube, especially for switching high currents, comprising, in combination, tube means having a vertical axis and including annular mercury cathode means, central mercury anode means spaced downwardly from said annular mercury cathode means, and discharge chamber means between said anode and cathode means, said cathode means, said anode means, and discharge chamber means being arranged symmetrically with respect to said axis, and said discharge chamber means having an upper open end defined by an annular edge forming an overflow, said annular edge being arranged above the liquid level of said anode means and having a diameter smaller than a lower portion of said discharge chamber means, so that mercury flowing from said cathode to said anode means will only contact a small portion of the inner surface of said discharge chamber means; and an ignition electrode arranged about said tube means substantially at the level of said annular edge.

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