Dec. 24, 1968 S. M. FROUWS ET AL 3,418,509

ELECTRICAL DISCHARGE CHARACTER INDICATOR TUBE

Filed June 8, 1966

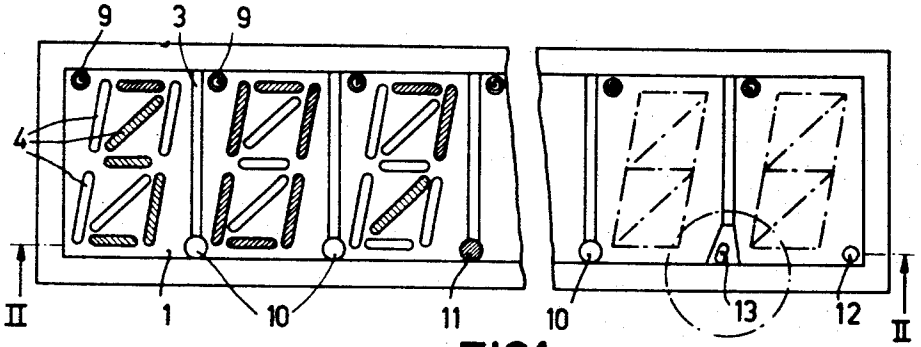

FIG.1

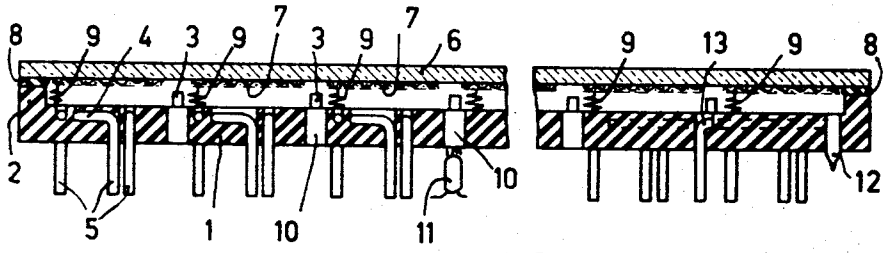

FIG.2

SIMON M. FROUWS
GEORGE KERR
ADRIANUS A.M. HENDRIKS
INVENTORS

BY

Frank R Trifari

AGENT

United States Patent Office 3,418,509 Patented Dec. 24, 1968

3,418,509

ELECTRICAL DISCHARGE CHARACTER INDICATOR TUBE

Simon Mari Frouws, George Kerr, and Adrianus Anthonius Maria Hendriks, Emmasingel, Eindhoven, Netherlands, assignors to North American Philips Company, Inc., New York, N.Y., a corporation of Delaware

Filed June 8, 1966, Ser. No. 556,128
Claims priority, application Netherlands, July 3, 1965, 6508596
10 Claims. (Cl. 313—109.5)

ABSTRACT OF THE DISCLOSURE

A gas-filled character-indicator tube employing a plurality of electrodes forming at least two matrix groups in which combinations of electrodes, when energized, produce luminous effects which form legible signs. The electrodes are arranged on the bottom of a box-shaped envelope in matrix groups which are arranged side-by-side and are separated by partitions. A separation sign formed by a cylinder of transparent material extends hermetically through the bottom wall of the envelope beneath which a light source can be disposed.

The invention relates to a discharge tube with a gas filling, in which given combinations of electrodes forming matrix groups are capable of producing luminous signals in the form of digits and/or characters. In particular the invention relates to an electric discharge tube comprising a plurality of electrodes, a number of which forms a matrix group, while given combinations of electrodes are capable of producing light effects forming legible signs. The electrodes are accommodated in an envelope consisting of a bottom plate with upright rims, on which a transparent, or translucent cover plate is fastened in a vacuum-tight manner.

Digital tubes in which a number of electrodes are arranged in the form of a matrix and in which legible signs can be formed by causing given combinations of the parts of the matrix to luminesce are known. It is also known to arrange these electrodes in a flat box-shaped envelope comprising a bottom plate with upright rims and a transparent cover plate.

These tubes have, however, the disadvantage that a number of them have to be arranged side by side in order to form a number or a word, which requires a large space. Furthermore, the device is fairly costly. Moreover, the characters or digits may be spaced apart by a fairly large distance, so that they seem to form separate signs and the relationship required to form a number or a word may be insufficient. In addition, the construction of such tubes is complicated and costly.

These disadvantages may be drastically reduced in such a tube, by arranging, in accordance with the invention, a number of matrix groups separated by partitions, side by side on the bottom plate.

The electrodes of each matrix group may each be sunk in a groove in the bottom plate and have a portion bent over at right angles extending in a vacuum-tight manner through the bottom plate. These latter portions form the contact pins on the outer side of the bottom plate. The space in the envelope is filled with a rare gas or a mixture of gases, the pressure of which must exceed the normal pressure, i.e., 10 cms. Hg. The higher the pressure the smaller the tube. The counter-electrode for the electrodes of the matrix groups may be formed by a transparent, for example, conductive tin oxide layer applied to the inner side of the cover plate. Alternatively, this counter-electrode may also be formed by a fine

metal gauze, which is secured to the inner face of the cover plate, for example, of glass, for example, by means of cement or glaze. The counter electrode is preferably formed, however, by a perforated metal layer, applied to the inner side of the cover plate, the apertures of which may form a pattern corresponding with that of the matrix. Between the matrix groups there may be arranged a member operating as a separation sign, for example in the form of an electrode or, preferably in the form of a glass rod or a rod of a synthetic resin, sealed in the bottom plate beaneath which a small source of light can be disposed outside the tube.

The invention will be described more fully with reference to the drawing, in which

FIG. 1 is a plan view of a given embodiment of a tube according to the invention without cover plate, and

FIG. 2 is a longitudinal sectional view of such a tube.

As shown in the drawing, the ceramic bottom plate **1** with the upright rims **2** is subdivided into a number of compartments by means of partitions **3**. Grooves at the bottom of the part **1** accommodate rod-shaped electrodes **4**, which are each provided with a portion **5**, bent over at right angles and which extends through the bottom **1** in a vacuum-tight manner, for example by means of a soldering metal, a readily melting type of glass or a suitable synthetic resin. The ends of the portions **5** projecting from the bottom **1** serve as contact pins.

The electrodes **4** are arranged in matrix groups, which comprise here each nine electrodes, particularly suitable for the formation of luminous signals in the form of digits 0 to 9. By a different but known disposition of the electrodes in the matrix the tube may also be used for the reproduction of characters. In FIG. 1 the first three matrix groups reproduce the digits 3, 0 and 7.

The bottom part **1** is closed by a cover plate **6** consisting of glass, mica, transparent ceramic or a suitable synthetic resin, which is secured to the rims **2** in a vacuum-tight manner, for example by means of a readily melting type of glass, or a solder layer **8**. The inner surface of the cover plate **6** is provided here with counter-electrodes **7** consisting of fine metal gauze. Although one common counter-electrode may be employed for all matrix groups, it is advantageous from a technical point of view, to provide a separate counter-electrode **7** for each matrix group.

The corresponding electrodes of all matrix groups may in this case be connected in parallel, so that only that group luminesces, the counter-electrode of which receives a voltage. For the reproduction of a number the counter-electrodes in the matrix groups may be caused to luminesce alternately at such a rate by repeated pulses and electrode combinations that a stationary number is visible to the eye.

In the embodiment shown a number of eight digits can be reproduced. In order to fully utilize this sequence of digits, it is desirable for the decimal sign to be placed after given matrix groups as desired. For this purpose the partitions **3** are provided with rods **10** of glass or of a synthetic resin, which extend through the bottom plate and are sealed therein in a vacuum-tight manner, beneath which small light sources, for example neon tubes can be arranged outside the tube. In the drawing the rod **11** is illuminated, and it therefore serves as a decimal sign.

In FIG. 1 there is locally indicated a further possibility in which the decimal sign is formed by an electrode **13**, accommodated in a recess of the partition.

Although such a matrix tube requires a complicated circuitry, the latter can be disposed on a plate using the semi-conductor technique, there being provided apertures for receiving the contact pins **5** and separate apertures for the decimal light sources, so that this plate can be arranged closely beneath the matrix tube.

A tube in the embodiment shown may have dimensions of 15 x 80 x 5 mm. (exclusive of the contact pins) and it can be manufactured at considerably lower costs than eight corresponding digital tubes. With these dimensions a gas pressure of 30 cms. Hg is used. Such a comparatively high gas pressure is required to avoid interaction of the matrix groups in such a small tube.

The counter-electrodes **7** may be connected by means of resilient contact pins **9** to their own contact pins. The tube is exhausted and filled with the desired gas or gas mixture by means of an exhaust tube preferably of metal **12**, which may be closed by pinching without heating.

If a unidirectional voltage is used, the matrix electrodes are connected as cathodes and the counter-electrodes as anodes. If desired, the tube may be driven by an alternating voltage, if the counter-electrodes are formed in a suitable manner. The anodes or the counter-electrodes **7** may be formed by a metal layer applied, for example by vapor deposition on the cover plate **6**, which layer may be perforated by a chemical agent or by spark erosion, so that the light signals of the matrix groups are visible. These anodes may, as an alternative, be applied in the form of a transparent, conducting layer, for example of tin oxide, or they may consist of thin metal gauze, which may be secured to the cover plate, for example by glaze. If a cover plate of ceramic material of a thickness of less than 0.5 mm. is used, which is transparent, the advantage is that the separations between the illuminated matrix groups fade away due to the dispersion of the light.

Although a specific embodiment is described above, the discharge tube according to the invention may be constructed in other ways within the scope of the invention. The matrix electrodes may be coated with luminescent material, while the tube may have a high vacuum and the counter-electrodes are formed by electron-emitting cathodes. Therefore, the foregoing embodiment is to be considered as illustrative only, the invention being defined in the appended claims and covers other embodiments as well.

What is claimed is:

1. A gaseous electric discharge tube comprising at least one counter-electrode and a plurality of electrodes, a number of which form a matrix group in which given combinations of electrodes are capable of producing luminous effects which form legible signs, said electrodes being accommodated in a box-shaped envelope comprising a bottom plate with upright rims to which a light transparent cover plate is secured in a vacuum-tight manner, a number of matrix groups being arranged side by side on the bottom plate, said matrix groups being separated from one another by partitions, and a cylinder of transparent material extending perpendicularly through the bottom plate between at least two matrix groups in a vacuum tight manner beneath which a light source can be disposed thereby providing a luminous separation sign between the matrix groups.

2. An electric discharge tube as claimed in claim **1**, in which each electrode of each matrix group is sunk in a groove of the bottom plate and extends through the bottom plate in a vacuum-tight manner by a portion bent over at right angles.

3. An electric discharge tube as claimed in claim **1**, in which at least one light-transparent counter-electrode is applied to the inner side of the cover plate for the matrix groups.

4. An electric discharge tube as claimed in claim **1**, in which the tube has a gas filling at a pressure of more than 10 cms. Hg.

5. An electric discharge tube as claimed in claim **3**, in which the counter-electrode is formed by a transparent conducting layer.

6. An electric discharge tube as claimed in claim **3**, in which the counter-electrode is a fine metal gauze.

7. An electric discharge tube as claimed in claim **3**, in which the counter-electrode is a perforated metal layer.

8. An electric discharge tube as claimed in claim **1**, in which opposite each matrix group there is provided a corresponding counter-electrode.

9. An electric discharge tube as claimed in claim **1**, in which the tube is evacuated and the matrix electrodes are coated with a luminescent material, while the counter-electrodes are formed by electron-emitting cathodes.

10. An electric discharge tube as claimed in claim **5**, in which the transparent, conducting layer is tin oxide.

References Cited

UNITED STATES PATENTS

2,500,929	3/1950	Chilowsky	178—7.5
2,933,648	4/1960	Bentley	315—84.6 X
3,231,776	1/1966	Britnell et al.	313—109.5
3,260,880	7/1966	Kupsky	313—109.5
3,312,852	4/1967	Motson	313—108
3,327,153	6/1967	Bickmire et al.	313—109.5
3,327,154	6/1967	Bowerman	313—109.5
3,334,269	8/1967	L'Heureux	313—108 X

FOREIGN PATENTS

712,174	7/1954	Great Britain.

JAMES W. LAWRENCE, *Primary Examiner.*

P. C. DEMEO, *Assistant Examiner.*

U.S. Cl. X.R.

313—108, 185, 149