

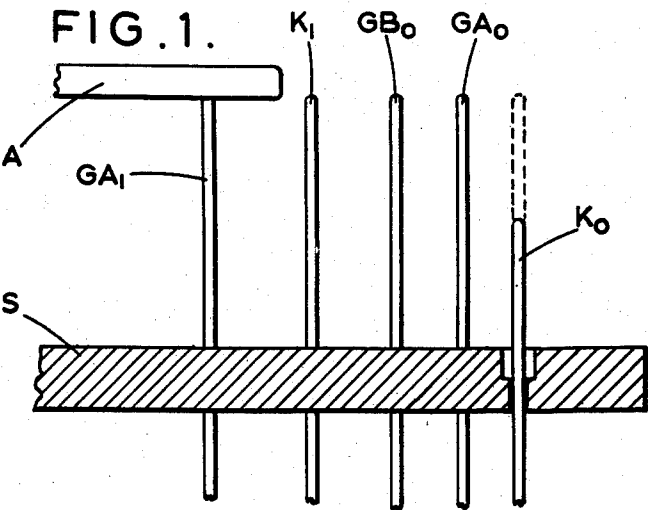
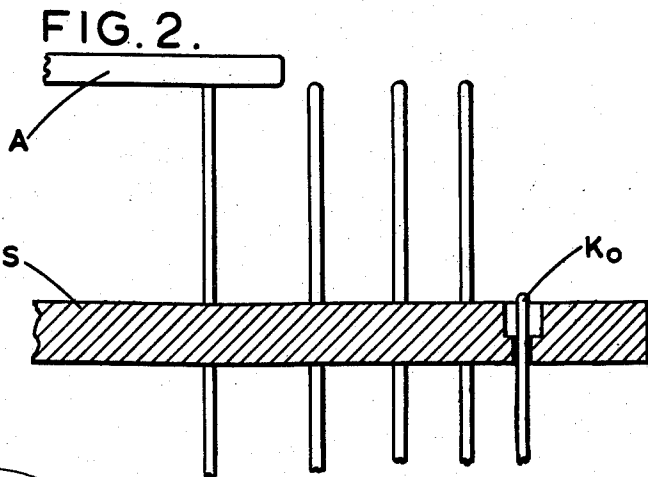
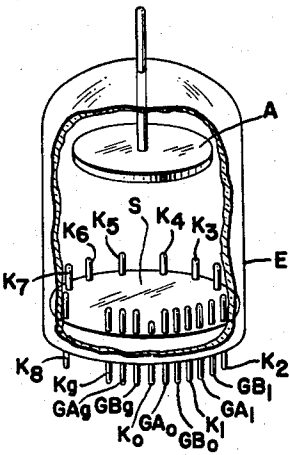
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M. J. HART

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COLD-CATHODE STEPPING TUBES

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INVENTOR.
MICHAEL JAMES HART

BY
Frank R. J. J. J.
AGENT

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COLD-CATHODE STEPPING TUBES

Michael James Hart, Worcester Park, England, assignor
to North American Philips Company Inc., New York,
N.Y.

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This invention relates to cold-cathode stepping-tubes of the type comprising a central electrode surrounded by a row of other electrodes. In such tubes the central electrode may be circular and further may be arranged to function as an anode; the other electrodes, which hereinafter will be termed "second electrodes," may function as cathodes and may be arranged in a circular row.

In known stepping-tubes certain of the cathodes function as main cathodes on which a discharge rests between stepping operations, the transfer of the discharge from its rest position on one main cathode to its rest position on the next main cathode being effected by means of a plurality of guide cathodes; where there are two guide cathodes between adjacent main cathodes the guide cathode next to the main cathode in the direction of rotation of the discharge is usually termed the "first guide"; the next guide cathode, again in the direction of rotation of the discharge, is termed the "second guide." In these known tubes all the main cathodes are usually connected together inside the envelope: in operation, the discharge is transferred in its entirety from its rest position on one main cathode to a first guide, then from the said first guide to a second guide and finally from the second guide to the next main cathode. In a decade counter tube it is normal to refer to the last main cathode of the series as the ninth main cathode and to refer to the first main cathode of the series as the "zero" main cathode; this notation will be followed herein. Further, the term "breakdown potential" is used to denote that potential difference between the anode and a main cathode or a guide cathode at which a discharge will be initiated between the two electrodes.

It is an object of this invention to provide an improved stepping-tube in which at least one of positions of the discharge may be distinguished from other positions.

It is a further object of the invention to provide a stepping-tube which distinguishes one position of the discharge from the other without the necessity of expensive circuit elements.

Other objects of the invention will become apparent from the following description and from the claims.

According to one aspect of the invention a cold-cathode stepping-tube comprises a central electrode and a row of parallel rod-shaped electrodes surrounding said central electrode, said row of electrodes including at least one electrode shorter than the remaining rod-shaped electrodes, whereby the breakdown voltage between the central electrode and the said shorter electrode is greater than the breakdown voltage between the central electrode and any of the remaining rod-shaped electrodes.

According to another aspect of the invention a cold-cathode stepping-tube comprises a central electrode, a row of rod-shaped electrodes surrounding said central electrode and at least one rod-shaped electrode shorter than the electrodes of the row and positioned out of alignment with the row whereby the breakdown path between the central electrode and the said shorter rod-shaped electrode is longer than the breakdown path between

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the central electrode and any one of the electrodes in the row.

The invention in another aspect also includes a cold-cathode stepping-tube comprising a central electrode, a row of long electrodes surrounding said central electrode and at least one short electrode positioned on the side of the row remote from the central electrode whereby the breakdown path between the central electrode and a short electrode is greater than the breakdown path between the central electrode and any of the long electrodes. The long and short electrodes may consist of parallel rods.

The central electrode may be circular.

The central electrode may be arranged to function as an anode.

The invention will now be described with reference to the accompanying drawing wherein:

Figure 1 illustrates one embodiment of the invention;

Figure 2 illustrates a second embodiment of the invention; and

Figure 3 is a partial cut-away view of a tube according to the invention.

Figure 1 shows, partly in cross-section, a portion of the electrode assembly of a cold-cathode stepping tube comprising a central circular anode A surrounded by a circular row of other electrodes which are supported and held in spaced relationship by a ceramic spacing disc S. These other electrodes are arranged in groups of three and certain of the corresponding electrodes of each group are connected together inside the tube. Each group of electrodes, proceeding anti-clockwise around the assembly comprises in turn a cathode K, a first guide GA and a second guide GB. Such a tube may for instance have ten positions but in Figure 1 only cathode electrodes K₀ and K₁ first guides GA₀ and GA₁ and second guide GB₀ are shown.

The cathode K₀ at the zero position is shorter than the other cathode and guide electrodes and extends only a portion, in Figure 1 approximately half, of the distance between the upper surface of the disc S and the level of the anode A. If the K₀ cathode were of the same height as the other cathode and guide electrodes it would occupy the position indicated in broken lines on Figure 1 and it will be seen that by shortening the electrode the distance between the anode and the nearest point of the cathode, that is the tip of the electrode, has been increased: this increase in distance results in an increase in the breakdown voltage between the anode and this cathode.

Figure 2 shows a view similar to Figure 1 of a portion of a tube wherein the tip of the K₀ cathode is substantially flush with the upper surface of the ceramic disc S.

Fig. 3 shows a tube comprising an envelope E filled with an ionizable gas and in which anode A is surrounded by electrodes K₀, K₁, K₂, . . . K₈ and guide electrodes GA₀, GB₀, GA₁, GB₁, etc. supported by a ceramic disc S.

In a further embodiment, not shown, the K₀ cathode is comprised by a short electrode rod which lies outside the circular row of other cathodes and guides.

Although the above description has been confined to a tube provided with only one electrode, K₀, having a greater breakdown voltage to the central electrode than any of the others, it will be obvious that more than one such electrode may be provided in a single tube. For instance, in a tube having ten positions two such electrodes may be provided at diametrically opposite positions.

While there have been described and illustrated specific embodiments of the invention it will be obvious that various changes and modifications may be made therein without departing from the spirit and scope of the invention as defined in the appended claims.

What I claim is:

1. A cold-cathode stepping-tube comprising a central electrode and a row of parallel rod-shaped electrodes surrounding said central electrode, said row of electrodes including at least one electrode shorter than the remaining rod-shaped electrodes, whereby the breakdown voltage between the central electrode and the said shorter electrode is greater than the breakdown voltage between the central electrode and any of the remaining rod-shaped electrodes.
2. A cold-cathode stepping-tube as claimed in claim 1 wherein the central electrode is circular.
3. A cold-cathode stepping-tube as claimed in claim 2 wherein the central electrode is arranged to function as an anode.
4. A cold-cathode stepping-tube comprising a central electrode, a row of rod-shaped electrodes surrounding said central electrodes and at least one rod-shaped electrode shorter than the electrodes of the row and positioned out of alignment with the row whereby the breakdown path between the central electrode and the said shorter rod-shaped electrode is longer than the breakdown path between the central electrode and any one of the electrodes in the row.
5. A cold-cathode stepping-tube as claimed in claim 4 wherein the rod-shaped electrodes are parallel.
6. A cold-cathode stepping-tube as claimed in claim 5 wherein the central electrode is circular.

7. A cold-cathode stepping-tube as claimed in claim 6 wherein the central electrode is arranged to function as an anode.

8. A cold-cathode stepping-tube comprising a central electrode, a row of long electrodes surrounding said central electrode and at least one short electrode positioned on the side of the row remote from the central electrode whereby the breakdown path between the central electrode and a short electrode is greater than the breakdown path between the central electrode and any of the long electrodes.

9. A cold-cathode stepping-tube as claimed in claim 8 wherein the long and short electrodes comprise parallel rods.

10. A cold-cathode stepping-tube as claimed in claim 9 wherein the central electrode is circular.

11. A cold-cathode stepping-tube as claimed in claim 10 wherein the central electrode is arranged to function as an anode.

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