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ELECTRIC DISCHARGE TUBE

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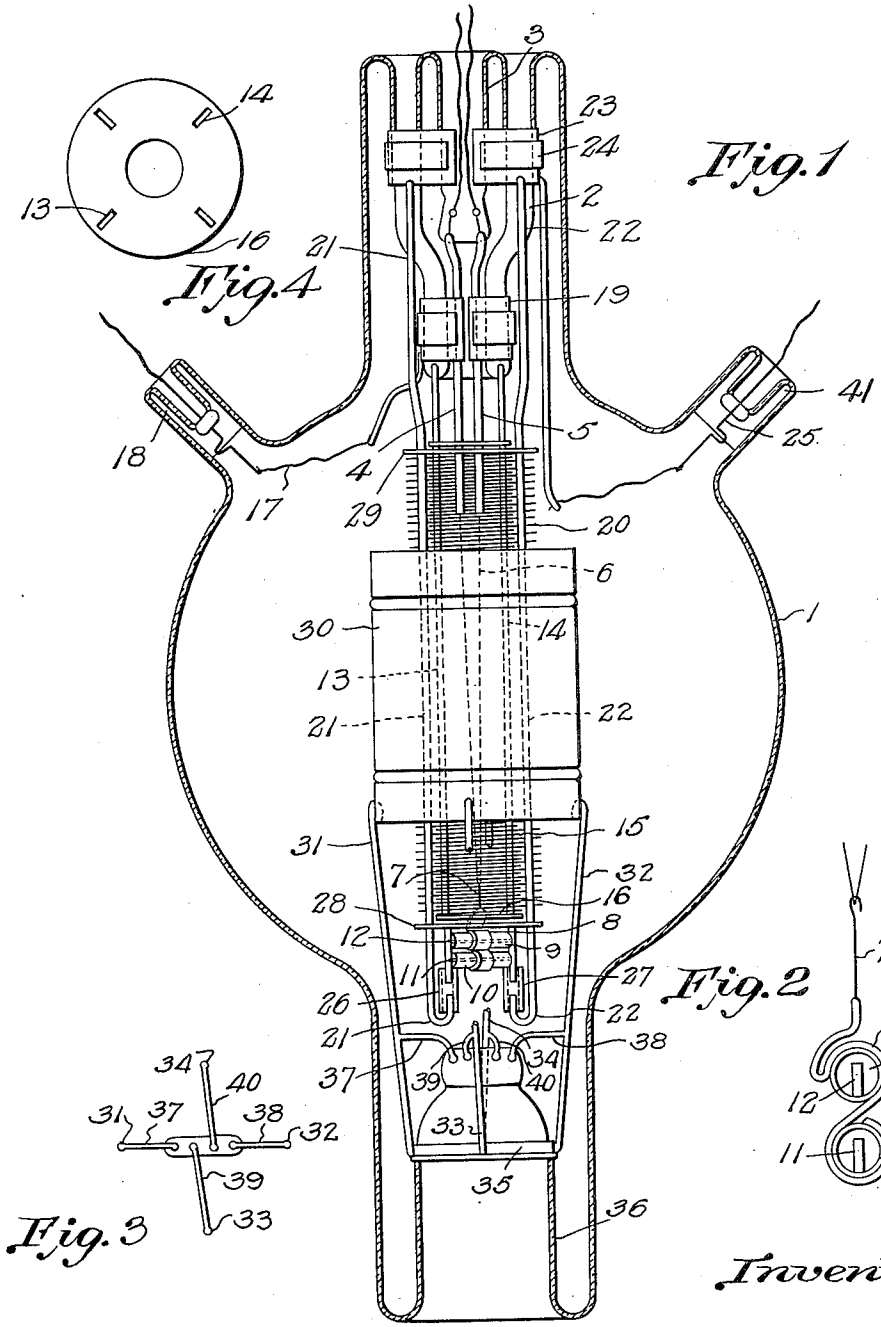

Fig. 1

Fig. 4

Fig. 2

Fig. 3

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ELECTRIC DISCHARGE TUBE

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The present invention relates to the attachment of electrodes in electric discharge tubes, more particularly to the attachment of the incandescent cathode, the anode and one or more grid shaped electrodes in discharge tubes.

Usually, the cathode is made in the shape of an elongated V, the two sides of the V being connected to the leading-in wires, and the apex of the V being connected to a metallic hook which is secured to and insulated from another electrode.

A spring made of tungsten or similar material, is frequently used to keep the filament rigidly stretched. It has however been found that such a spring loses its tension in course of time and therefore in the construction according to the invention a spring is preferably omitted.

It has, moreover, been found that the insulating material to which the hook is secured, becomes more or less conductive owing to the high temperatures to which it is exposed, and it also occurs frequently that the material which is disintegrated or which volatilizes from the filament, precipitates on the insulating material in such a degree that conduction may occur along the surface of the said material.

An object of the invention is to protect the insulating material from excessive heat, because at high temperatures the insulating material may become conductive. Another object of the invention is to shield the insulating material from the hot filament in order to prevent any volatilized matter from the filament from being precipitated on the insulating material.

According to the invention a screen is arranged for this purpose between the cathode and the material by means of which the supporting or suspending device of the cathode is attached so as to be insulated from the members which carry the current.

Between the points of attachment the incandescent cathode is preferably suspended to or supported by one or more metal hooks which are secured to one or more supporting devices with the aid of insulating material.

According to the invention the metal hook or hooks may be secured to one or more supporting pieces made of quartz or similar material; these pieces are supported by metal members which are connected to another electrode and the hook or hooks are led through one or more apertures provided in a plate which likewise is secured to the other electrode.

According to the invention, in a discharge tube like the one abovementioned, comprising an anode and a grid and in which the electrodes are arranged concentrically, the grid supports or their extensions may be provided with transverse rods carrying little tubes made of quartz or similar material whilst the hook or hooks for supporting the cathode is or are attached to the said tubes by means of a clamp or a resilient connection. The resilient connection serving for the attachment of a hook is preferably an S-shaped plate.

In discharge tubes according to the invention it is of great importance that means are provided for keeping the other electrodes so rigid in their places that a displacement of the electrodes relative to each other during the operation of the discharge tube cannot occur. According to the invention the anode or another electrode which does not act as a cathode, is attached for this purpose to a re-entrant glass tube, by means of a number of supports, the ends of which are secured to a closed or open ring which is arranged around the glass tube at some distance from the end; the supports are provided in this case with lateral arms the ends of which are sealed into the end of the glass tube.

If two grid-shaped electrodes have to be arranged in the discharge tube, they may be attached according to the invention on one side to a re-entrant glass tube, whereas their other ends are kept spaced at the required distance from each other by means of an insulating connection.

According to the invention the supports of each of the grid-shaped electrodes may further be so shaped or arranged that the ends of said supports are located pair-wise opposite each other, the ends of each pair being kept together by a small tube of quartz or the like. According to the invention the ends

of each pair of supports may be located in one line and may be connected to each other by means of a straight piece of a tube made of quartz or similar material.

The accompanying drawing illustrates by way of example a construction of a discharge tube comprising an incandescent cathode according to the invention. In the said drawing:

Figure 1 is an elevation of a discharge tube comprising an incandescent cathode, and anode and two grid-shaped electrodes.

Figure 2 is a detail view showing the attachment of the hook of the filament to the tubes made of quartz.

Figure 3 is a detail view showing the attachment of the anode to a re-entrant glass tube.

Figure 4 is a plan of the plate located between the filament and the securing device of the hook which supports the filament.

The discharge tube shown in the drawing, is formed by a glass bulb 1 to which a twice bent glass tube 2 is hermetically sealed.

Leading-in wires 4 and 5 for a cathode 6 are hermetically sealed into the clamped portion of the innermost glass tube 3. The cathode 6 has the shape of an elongated **V** and is suspended at its apex to a metal hook 7 which is attached to an **S**-shaped plate 8 (see Figure 2) which clamps itself elastically on to tubes 9 and 10 which are made of quartz and through which pass little rods 11 and 12.

The hook 7 passes through an aperture provided in a metal plate 16 which is carried by a grid-shaped electrode 15. This plate protects the quartz tubes 9 and 10 from being heated too high by the filament whilst at the same time it intercepts the material volatilized from the filament.

The rods 11 and 12 are secured to lengthening pieces or extension rods of supports 13 and 14 of the grid-shaped electrode 15 which consists of a metal wire helically wound on four supports, only two being shown in the drawing. The other ends of these supports are connected to a resilient clamp 19 which may be of any known construction and which is slid on the end of the glass tube 2. A leading-in wire 17 for the electrode 15 is secured to the metal clamp 19 and is hermetically sealed into a little tube 18.

A second grid-shaped electrode 20 is concentrically arranged around the cylindrical electrode 15. The electrode 20 also consists of a metal wire helically wound on four supports, only two such supports 21 and 22 being shown. Encircling said supports and secured thereto are metal rings 28 and 29. These supports are connected at one end to a flexible metal plate 23 which is clamped on to the tube 2 by means of a spring plate 24. A wire 25, the end of which is connected to a clamp 24 and which is hermetically sealed into a glass tube 41, serves for carrying the current to the electrode 20. The other ends of the electrode supports 21 and 22 are provided with lengthening-pieces or extension rods which are bent in the shape of a hook so that the ends are brought into alignment with the extension rods of the supports 13 and 14 of the auxiliary electrode 15. Quartz tubes 26 and 27 are slid on the ends of the supports so that the electrodes 15 and 20 are not or substantially not movable relatively to each other.

It is understood of course that the second pair of supports (not shown) for the grid-shaped electrode 15 may be anchored to the second pair of supports (not shown) for the grid-shaped electrode 20 in a manner similar to that shown and described for supports 13, 14 and 21, 22.

A cylindrical anode 30 is arranged around the electrode 20 and is carried by four supports 31, 32, 33 and 34, the lengthening-pieces or extension rods of which are secured to a metal ring 35 which is arranged loosely around the re-entrant glass tube 36. The four supports are further secured to lateral arms 37, 38, 39 and 40 which are sealed into a clamped portion or press, commonly so-called, at the end of the tube 36. Although it is not necessary to lead all these four arms through the glass and it would be satisfactory to lead only one wholly through the glass it is advisable to make use of the construction shown in the drawing because in this case a very rigid attachment of the electrode is obtained.

It must be observed, in addition, that the discharge tube according to the invention is preferably so arranged during its operation that the top of the filament hangs down as is shown in the drawing. If during the operation the incandescent cathode becomes hot and expands, the apex of the cathode in the hook 7 is free to move downwards so that the cathode wire is prevented from being distorted.

What I claim is:—

1. A discharge tube having a plurality of electrodes including a cathode and at least one grid with its supports, said grid supports having transverse rods of insulating material, and hooks to support the cathode, said hooks being attached to the transverse rods by means of a resilient **S** shaped plate.

2. A discharge tube having a plurality of electrodes including a cathode and at least one grid with its supports, said grid supports having transverse rods of quartz, and hooks to support the cathode, said hooks being attached to the transverse rods by means of a resilient **S** shaped plate.

3. A discharge tube having a cathode and at least one other electrode, said other electrode being fastened to supports, the ends of the supports being secured to a ring arranged around a reentrant glass tube, said ring being

positioned at a distance from the end of the tube, and lateral arms extending from said supports, the ends of these arms being sealed into the end of the reentrant tube.

4. In a discharge tube having a cathode, plate and double grid, a plurality of rod supports secured at one end upon which one grid is supported, and a plurality of rod supports secured at one end upon which the other grid is supported, the free ends of the two sets of grid supports being connected by means of insulators.

5. In a discharge tube having a cathode, plate and double grid, a plurality of rod supports secured at one end upon which one grid is supported, a plurality of rod supports secured at one end upon which the other grid is supported, the free end of each supporting rod of one set of supports being bent so that the end is in alignment with one of the supports of the other grid, and an insulator securing the two ends together.

6. In a discharge tube having a cathode, plate and double grid, a plurality of rod supports secured at one end upon which one grid is supported, a plurality of rod supports secured at one end upon which the other grid is supported, the free end of each supporting rod of one set of supports being bent so that the end is in alignment with one of the supports of the other grid, and quartz tubes securing the two ends together.

7. A discharge tube comprising an anode, cathode, and grid, a tensioning member for the cathode, an S-shaped plate, the tensioning means being attached to said plate, insulating tubes supporting the S-shaped plate, supports for the grid, and means connecting the insulating tubes with the grid supports.

8. A discharge tube comprising an anode, cathode, and two grids, each grid being wound helically around a plurality of supports, the supports for one grid being connected to the supports for the other grid by means of quartz tubes.

In testimony whereof I affix my signature, at the city of Eindhoven, this twenty-first day of November, A. D. 1924.

POPKO REINDER DIJKSTERHUIS.