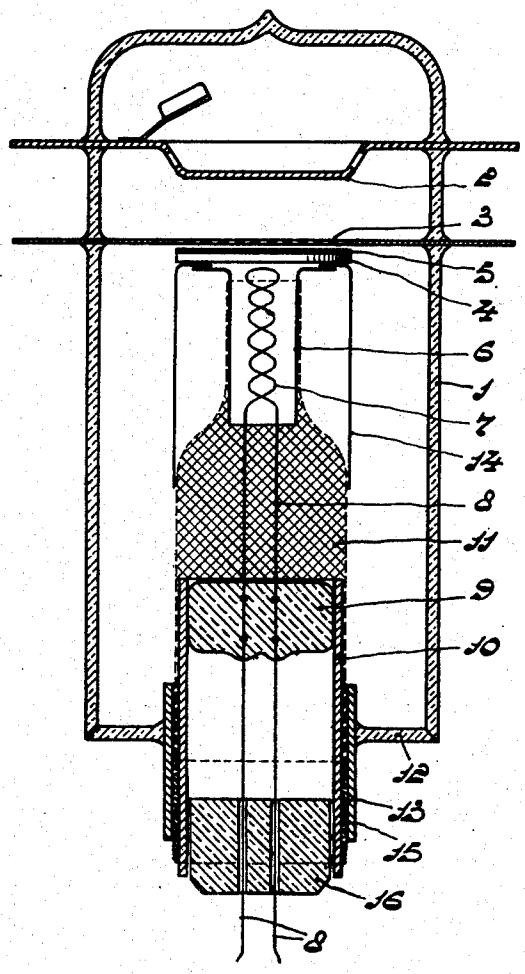
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METHOD OF MANUFACTURING ELECTRIC DISCHARGE TUBES

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METHOD OF MANUFACTURING ELECTRIC DISCHARGE TUBES

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The invention relates to electric discharge tubes, particularly to electric discharge tubes comprising flat electrodes and a cathode having a disc-shaped emissive part.

With such tubes, for example cathode-ray tubes, beam tubes, particular tubes for ultra-short waves and the like, the cathode frequently comprises a disc-shaped part coated with emissive material and secured at right angles to the longitudinal axis of a tubular member. In general, this tubular member serves for the attachment of the cathode to the tube and lodges the heater. According to their shape such cathodes are sometimes separated into pot cathodes and mushroom cathodes. The disc-shaped emissive part need not be flat, but may be convex, concave, conical or profiled. The invention relates in addition to a method of manufacturing such a tube.

The manufacture of tubes comprising flat electrodes, in which a cathode of the said kind having a disc-shaped emissive part is required to be arranged at a very short distance from a flat grid, entails difficulties in mounting these electrodes. On correct positioning of such a cathode it used to be secured by welding, preferably by means of the cylindrical part, to one or more stay rods but this may result in bending the stay rods out of shape and hence in disadjustment of the cathode distance, so that the correct cathode-grid spacing cannot be predetermined for certain.

This disadvantage is obviated in that in electric discharge tubes according to the invention, which have an electrode system comprising one or more flat electrodes and a cathode having a disc-shaped emissive part, the cathode is mounted on a cylindrical body which has a wall made, at least in part, of perforated material and which is secured in a metal tube sealed in the tube wall.

Such a construction enables accurate mounting in a very simple manner. For example, after a strip of perforated metal sheet has been bent into the form of a cylinder, this cylindrical body has secured to it at one of its ends a cathode having a flat emissive surface, whereas at the opposite end the perforation of the wall is filled with solder or enamel, for example by rolling this substance in the form of a powder into the apertures of the perforation and, if necessary, by securing it by melting. When the heater, the supply leads of which may be sealed in an airtight manner in a metal cylinder with the use of a glass bead, is placed in position, the cylinder thus finding its way into the cylindrical body having a perforated wall, the cylindrical body is introduced into a tube made, for example, of copper and sealed in the tube bottom, in which it is allowed to move endwise with a small amount of friction. Owing to the perforation of the wall of the cylindrical body, this wall is slightly resilient, so that correct friction with the sealed-in tube may be ensured in a simple manner by slightly lengthening the cylindrical body by stretching or by slightly shortening it by compression, since this results in a decrease or in an increase respectively in the diameter of the cylindrical body. A microscope, for example, permits of accurately positioning the emissive surface of the cathode at the correct distance from the first grid by moving the cylindrical body endwise in the sealed-in tube, whereupon the end extending beyond the tube is heated, so that the solder or enamel flows out of the apertures of the perforation and the perforated wall with the sealed-in tube and the tube within this wall are assembled in an airtight manner. The material of the perforated wall is preferably constituted by so-called expanded metal i. e. metal sheet provided with very small cuts, which by

stretching the metal sheet are widened to form apertures. The use of such perforated metal for the wall of the cylindrical body is also of great utility with a view to obtaining a reduction of the thermal dissipation of the cathode. In addition, a cylinder of thin foil may be arranged to surround the outer edge of the disc-shaped emissive part of the cathode, in order to reduce the thermal radiation of the heater. If the foil is very thin, the thermal losses by dissipation are thus only slightly affected.

In order that the invention may be more clearly understood and readily carried into effect, it will now be described more fully with reference to the accompanying drawing, in which the single figure shows by way of example, one form of tube according to the invention.

Referring to this figure, **1** designates the bulb of the tube, in which disc-shaped electrodes, viz. an anode **2** and a grid **3**, are sealed, for example with the use of metal flanges. The cathode which at its top end comprises a disc-shaped part **4** coated with emissive material **5**, is mounted on a tubular body **6**, having secured in it a filamentary heater **7**, from which it is insulated. With the use of a glass bead **9** the supply leads **8** to this heater are sealed in an airtight manner in a metal cylinder **10** having a solid wall; this cylinder is arranged within the bottom end of a cylindrical body **11** according to the invention. The cylindrical body **11** has a perforated wall and with the use of soldering material **15** is secured in a tube **13** made, for example, of copper and sealed in the tube bottom **12**. The soldering material **15** also ensures an airtight union of the body **11** with the cylinder **10**. Instead of using soldering material, use may be made of enamel. The cylinder **10** primarily serves to arrange the glass bead **9** in an airtight manner, since otherwise the solder or the enamel would tend to melt on the conductors **8** being sealed in this bead. The top end of the body **11** may have wound about it a foil **14** in order to reduce the thermal radiation of the body **6** and the resistance for high-frequency currents. The cylinder **10** may have its end extending beyond the tube obturated by a ceramic plug **16**.

The following procedure is followed for introducing the cathode into the tube. After the cathode with its tubular part **6** has been arranged in the body **11** and secured in position, for example by tightening, welding or soldering, the tubular body **10**, in which the heater **7** has already been secured with the use of the conductors **8** and the bead **9**, is introduced into the cylinder **11** until the heater **7** is correctly positioned. The aggregate is then introduced into the tube **13**, correct friction between the perforated wall of the cylindrical body **11** and the tube **13** being ensured by slightly stretching the perforated cylinder or by shortening it by compression. The emissive surface **4** is then correctly positioned relatively to the grid **3**, for example, with the use of a microscope and the soldering material or enamel previously inserted by rolling in part of the apertures of the perforation of the perforated material **11**, is heated so as to melt. The solder or enamel thus flows out of the perforation and unites the cylinder **11** in an airtight manner with the cylinders **10** and **13**. The ceramic plug **16** may then be placed in position to prevent that part of the cylinders **10** and **11** which extends beyond the tube from getting out of shape during transport of the tube and arrangement of the cathode connection and the glass bead **9** from being damaged. If desired, one of the conductors **8** may be united with the cylinder **10**.

Although only one embodiment of the invention has been described, it is obvious that otherwise shaped cathodes may be used. The provision of a separate cylinder for taking through the supply leads to the heater is not essential for the invention.

What I claim is:

1. A method of manufacturing an electric discharge tube of the type having an electrode system including a plurality of flat electrodes and a cathode having a disc-shaped emissive part, which comprises the steps of sealing a first metal tube into the wall of the discharge tube, securing said cathode to an end of a second metal tube, the walls of which are made, at least in part, of gauze-like perforated metal, applying forces to opposite ends of said second tube to vary the width thereof so that it

will fit tightly within said first tube and sliding said second metal tube into said first metal tube, and securing the second to the first tube in an airtight manner.

2. A method of manufacturing an electric discharge tube of the type having an electrode system including a plurality of flat electrodes and a cathode having a disc-shaped emissive part, which comprises the steps of sealing a first metal tube into the wall of the discharge tube, securing said cathode to an end of a second metal tube, the walls of which are made, at least in part, of gauze-like perforated metal, applying forces to opposite ends of said second tube to slightly compress the same in an axial direction and thereby increase the width of said second tube so that the tube will fit tightly within said first metal tube and sliding said second metal tube into said first metal tube, and securing said tubes to each other in an airtight manner.

3. A method of manufacturing an electric discharge tube of the type having an electrode system including a plurality of flat electrodes and a cathode having a disc-shaped emissive part, which comprises the steps of sealing a first metal tube into the wall of the discharge tube, securing said cathode to an end of a second metal tube, the walls of which are made, at least in part, of gauze-like perforated metal, and having an external diameter exceeding the internal diameter of the first tube, placing

said second metal tube ready for sliding into said first metal tube, applying forces to opposite ends of said second metal tube to elongate the same and thereby decrease the diameter of said second tube in an axial direction until it will tightly fit into said first metal tube, sliding the second into the first metal tube, and securing said tubes to each other in an airtight manner.

4. A method of manufacturing an electric discharge tube as claimed in claim 2 in which the first and second metal tubes are secured to each other in an airtight manner by soldering.

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