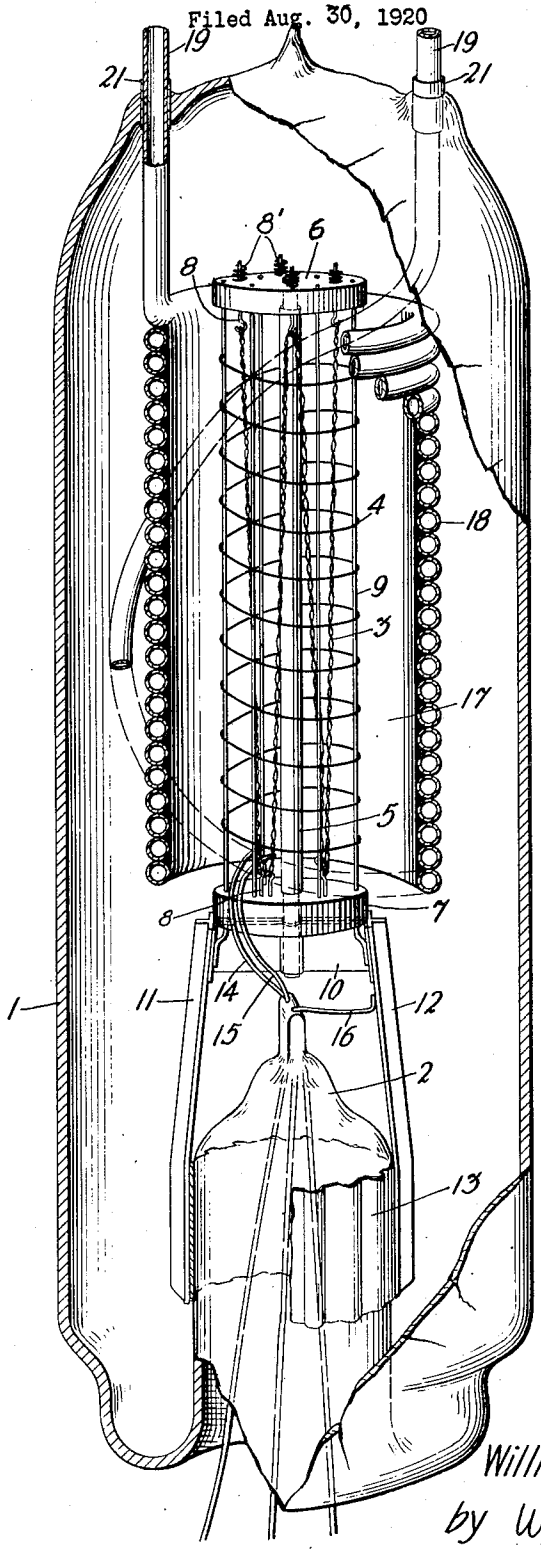
Nov. 17, 1925. 1,562,172

W. G. HOUSKEEPER

ELECTRON DISCHARGE DEVICE

Filed Aug. 30, 1920



Inventor:
William G. Houskeeper.
by W. C. Beatty. Att'y.

Patented Nov. 17, 1925. 1,562,172

UNITED STATES PATENT OFFICE.

WILLIAM G. HOUSKEEPER, OF NEW YORK, N. Y., ASSIGNOR TO WESTERN ELECTRIC COMPANY, INCORPORATED, OF NEW YORK, N. Y., A CORPORATION OF NEW YORK.

ELECTRON-DISCHARGE DEVICE.

Application filed August 30, 1920. Serial No. 406,921.

To all whom it may concern:

Be it known that I, WILLIAM G. HOUSKEEPER, a citizen of the United States, residing at New York, in the county of New York and State of New York, have invented certain new and useful Improvements in Electron-Discharge Devices, of which the following is a full, clear, concise, and exact description.

This invention relates to electron discharge devices and has particular reference to the electrode structure thereof.

An object of the invention is the provision of an electrode structure which will permit of a much greater dissipation of heat therefrom than is usually the case.

Another object is the provision of an electrode structure which is capable of being cooled by a circulating medium such as water.

Another object is the provision of a fluid cooled electrode structure which is provided with a smooth symmetrical inner surface for the reception of the electron stream.

Another object is the provision of an electrode unit which is rigid and compact and which can be easily assembled in its complete form prior to its insertion in the tube.

In accordance with the above mentioned objects, the invention comprises a closely wound coil of hollow tubing in the form of a hollow cylinder in which the inner surfaces between the tubing are filled in with a material in such a manner that the inner surface of the cylinder is presented to the electron stream as a smooth symmetrical surface. In this respect any irregularity in the functioning of the electron stream because of its encountering an irregular surface is eliminated.

The invention further comprises a new and improved mounting for the electrodes, such as the grid and filament, which is adapted for general use in vacuum tubes but is particularly advantageous in the herein described tube. The construction of this mounting will readily be apparent from a consideration of the following detailed description.

The invention as illustrated in the drawing comprises a containing vessel 1 provided with the usual press 2. A cathode 3 and a helical control electrode 4 are provided and suitably supported from the press 2. This support which is being broadly claimed in my copending application Serial No. 396,014, filed July 13, 1920, comprises a rod 5 preferably of steel to the upper and lower ends of which are fastened circular supports or plates 6 and 7 of insulating material such as lavite. To the lower surfaces of the plate 6, and to the upper surface of the plate 7 are attached hooks 8 through which the filament is threaded as shown. The hooks 8 in block 6 pass loosely through apertures in the block 6 and are suitably connected to and tensioned by means of springs 8′. Extending between the upper plate 6 and lower plate 7 are a plurality of vertical wires 9 which form a frame around which the control electrode wire 4 is wound and to which this wire is welded. The upper ends of the wires 9 pass through apertures in the plate 6, which are so dimensioned as to allow the wires 9 to expand under heat. The lower ends of the wires 9 are rigidly fastened to plate 7. The springs 8′ and the comparatively free ends of the wires 9 are placed at the top of the electrode mounting in this position. They are located at the relatively coolest position of the tube and their temper is not so affected by the heat. This position also permits of a more ready assembly than if they were located at the bottom. The lower end of the rod 5 extends through and below the lower plate 7 and is seated in an aperture in a cross-bar 10 which is made up of a pair of flat plates. The ends of the bar 10 are flanged and welded to T bars 11 and 12 which in turn at their lower ends are welded to a collar 13 which embraces the press 2. Suitable lead-in wires 14, 15 and 16 are connected to the cathode and control electrodes respectively.

Around the cathode and control electrode in a cylinder concentric with the axis of the rod 5 is an anode 17 formed of hollow tubing 18 in the form of helix. The successive convolutions of the tubing 18 are placed closely adjacent each other so as to form substantially a solid wall. The ends of the tubing 18 extend in the form of pipes 19 through the upper end of the evacuated vessel 11 to the exterior where they may be connected to a suitable source of circulating medium and also act as electrical conductors for the electron current. Sleeves 21, of metal such as platinum are sealed into the

glass and welded near one end to the pipes 19 and 20 and are provided to make an effective seal with the glass especially in the case where the material of which the anode 17 is formed will not seal with glass directly. By means of this invention it is possible to dissipate 400 watts of energy per square inch of plate surface as compared with 40 watts with the ordinary tube design where no cooling medium is employed. The metal tubing of the anode may for example be of iron, copper, nickel or steel.

In order to provide that the inner surface of the anode is presented to the electron stream in the form of a smooth symmetrical surface it is the purpose of my invention to fill in the spaces between the inner convolutions of the tubing 18 with some metal which can be flowed therein and which has a melting point essentially lower than the melting point of the material from which the tubes are made. For example, iron tubing may be used and the filler may be of copper, or copper tubing may be used and the filler may be silver, or wrought iron may be used and the filler may be of cast iron. The advantage of using this filler metal lies in the fact that it may be machined and adapted to exact dimensions and present a true plane or true cylindrical surface, besides being in good heat conducting contact with the cooling liquid circulating in tubing 18. It is within the scope of the invention, although it is not shown, to wind this hollow tubing in the form of a plan electrode. This hollow plane electrode may then be filled in on both sides with the soft filler metal.

What is claimed is:

1. An electron discharge device comprising a containing vessel, an electrode within said vessel in the form of a hollow cylinder, said electrode being formed of a plurality of closely spaced convolutions of circular tubing adapted for the flow of circulating medium therethrough, the interior faces of said convolutions being filled in with a material capable of being machined, and a second electrode within said first electrode.

2. An electron discharge device comprising a containing vessel, an electrode within said vessel comprising a plurality of closely spaced convolutions of circular tubing, a filler for the inner faces of the convolutions, and a second electrode within said first electrode.

3. An electron discharge device comprising a containing vessel, a cathode, a grid, an anode within said vessel, the cathode and grid being disposed symmetrically within the anode, said anode comprising a plurality of closely spaced convolutions of hollow tubing in the form of a hollow cylinder, the inner wall of which comprises a metallic filling.

4. An electron discharge device comprising a containing vessel, a press within the vessel, a cathode and grid supported from said press along the principal axis of said vessel, a tubular anode disposed around said cathode and grid, said anode being formed of abutting convolutions of hollow tubing, the inner faces of the convolutions being filled in to form a solid wall for the reception of electron current.

5. An electron discharge device comprising a containing vessel containing a tubular electrode, said electrode composed of closely situated continuous lengths of tubing, the irregular spaces between the lengths of tubing being filled in with metal to present a smooth surface.

6. In an electron discharge device, an anode comprising a closely wound helix of metallic tubing, a metallic filling between the inner faces of the adjacent turns of the helix forming a smooth lining, a cathode associated with said anode and means for circulating a cooling fluid through said tubing.

In witness whereof, I hereunto subscribe my name this 23rd day of August A. D., 1920.

WILLIAM G. HOUSKEEPER.