May 1, 1934. H. M. FREEMAN 1,957,423

VACUUM TUBE FOR HEAVY CURRENTS

Original Filed March 29, 1924

Fig. 1.

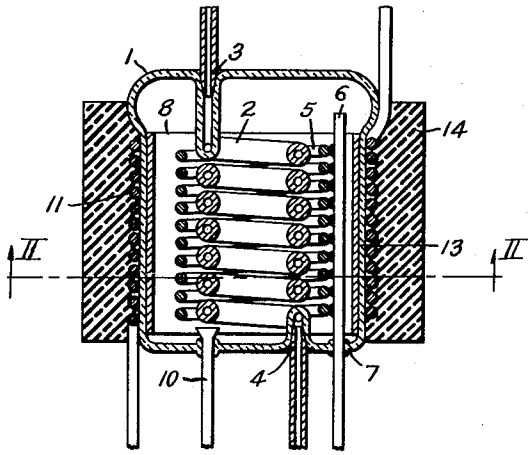
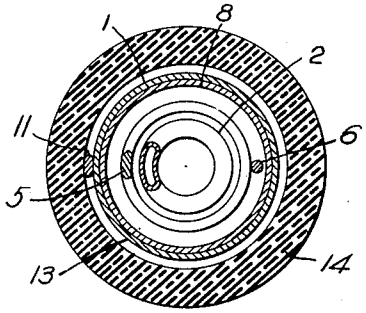


Fig. 2



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VACUUM TUBE FOR HEAVY CURRENTS

Hubert M. Freeman, deceased, late of East Pittsburgh, Pa., by Max F. Reges, administrator, Bloomfield, N. J.; said Freeman assignor to Westinghouse Electric & Manufacturing Company, a corporation of Pennsylvania

Original application March 29, 1924, Serial No. 702,716. Divided and this application May 28, 1930, Serial No. 456,345

12 Claims. (Cl. 250—27.5)

This application is a division of application Serial No. 702,716, filed March 29, 1924, and assigned to Westinghouse Electric & Manufacturing Company.

This invention relates to vacuum tube devices of the type used for controlling space currents.

It is an object of the invention to produce a device of the class described which can convey a greater space current for a given size of device than has been possible with devices of this class heretofore.

It is a further object of the invention to provide a device in which the heat developed at the anode may be removed by means of a stream of cooling fluid.

It is a further object of the invention to provide a device of the class described in which the cathode may be heated by a coil out of electrical contact therewith, the heating being accomplished by thermal conduction.

It is a further object of the invention to provide a heating device for the cathode which can be readily renewed when necessary.

It is a further object of the invention to provide means for minimizing the escape of heat, from the heating coil, into the surrounding atmosphere.

It is a further object of the invention to so arrange the several parts of the device that a compact apparatus is produced without reducing the size of the electrode surfaces.

Other objects of the invention and details of the construction will be better understood from the following description and the accompanying drawing in which;

Figure 1 is a central vertical sectional view of one form of the device.

Fig. 2 is a cross-sectional view on lines II—II of Fig. 1.

The device includes a glass envelope or container 1, which, preferably, is highly evacuated, but the device may still be operated with improved results when there is gas remaining within the envelope.

The anode consists of a coil 2 of metal. Copper, silver, or other good thermal conductor, may be used. Each end of this coil passes through the glass envelope, as indicated at 3 and 4. A suitable seal between the metal tubing and the glass is made at each of these ends, in order that the vacuum within the envelope may be preserved.

The anode is surrounded by any convenient form of grid. Preferably, the grid is a helix 5, which is supported by a standard 6, welded to each turn of the helix. The standard extends through the envelope at 7 and serves as a conductor by means of which potentials may be applied to the grid.

The cathode consists of a cylindrical plate 8, of a metal that is adapted to withstand high temperatures, such as tungsten or platinum. The inner surface of the plate 8 is preferably coated with a material that will emit electrons abundantly when the plate is hot. A mixture of the oxides of barium and strontium serves this purpose well, but other coatings of a high emission power may be used. The cylindrical plate may be supported by a standard 10, which also serves as a lead or conductor, or it may be supported in other ways as described below, and the lead 10 will then serve only as a conductor.

Concentric with the cylindrical cathode, is a heating coil 11. In the form shown in Figure 1, this coil is outside of the container 1.

Escape of heat from the coil 11 into the outer atmosphere is prevented or minimized by a covering 14 of heat-insulating material. Preferably, this covering and the coil 11 are made to constitute a single unit which can be slipped onto the tube from the small end and will be stopped in the proper position by the enlargement at the upper end of the tube.

When current is passed through the coil 11 to heat it, heat will flow through the glass wall 13 and raise the temperature of the metallic cylinder 8. The emission of electrons from the coated inner surface of this cylinder will thus be increased. The heat is constrained to pass through the glass wall instead of into the surrounding atmosphere by the heat insulation 14.

The cathode 8, preferably fits closely against the inner face of this cylinder. Any of the usual methods for obtaining a close union between the metallic cylinder 8 and the glass cylinder 13 may be followed. For example, the inner surface of the glass may be silvered and a platinum film electro-chemically deposited on the silver. A tungsten cathode may be sealed directly to the inner surface of the glass in the same way that tungsten wire is sealed into the glass when making the usual connections for vacuum devices. The barium and strontium salts, or other coating material, may be applied to the cathode after it is in place.

In the operation of the device, current, which may be either direct or alternating, is supplied to the coil 11 to heat it. The coil heats the cathode and so produces electron emission. A difference of potential between the cathode and

the anode may be supplied by means of the lead 10 and an external part of the coiled tube, which causes a space current from the anode 2 to the cathode 8. The bombardment of the anode by the electrons constituting this space current heats the anode, but heat is rapidly removed therefrom by the stream of water or other cooling fluid flowing through the coiled anode.

If the container 1 is highly exhausted, the space current is made up wholly of the electron stream, but if gas be present, ions also will take part in the space current. A much larger current may be carried in the latter case and a much greater quantity of heat will be liberated at the anode, but, because of the provision for cooling the anode with a stream of fluid, the device will transmit large amounts of power without the necessity of building it in prohibitive sizes.

It will be evident to those skilled in the art that many variations of structure may be made without departing from the spirit of this invention. No limitations except those necessitated by the prior art or expressed by the claims is intended.

What is claimed is:

1. An electrical discharge device including an envelope having a cylindrical wall having closed ends, an anode, and a cathode, said cathode comprising a coating of electron emitting material on the interior of said wall, heat producing means and means for minimizing heat dissipation from the external surface of said cylindrical wall.

2. An electrical discharge device including an envelope in the form of a cylindrical wall having closed ends, an anode, a cathode, said cathode comprising a coating of the electron emitting material on the interior of said wall, a heater coil on the exterior of said wall, and means for minimizing heat dissipation from the external surface of said envelope.

3. An electrical discharge device including an envelope in the form of a cylindrical wall having closed ends, an anode, a cathode, said cathode comprising a coating of electron emitting material on the interior of said wall, a heater coil on the exterior of said wall, and means for minimizing heat dissipation from the external surface of said envelope, said means comprising heat insulating material surrounding said heater coil.

4. An electrical discharge device including an envelope having a curved outer wall, an anode positioned inside said wall, and a cathode, said cathode comprising an electron emitting material coated on the concave interior of said outer wall.

5. An electrical discharge device comprising an anode and a cathode consisting of a chamber coated on its interior walls with material which emits electrons freely when heated and means on the exterior wall of said chamber for maintaining it at an elevated temperature, at least a portion of said anode being surrounded by said cathode.

6. An electrical discharge device including an envelope in the form of a cylindrical wall having closed ends, an anode and a cathode within said cylindrical wall said cathode comprising electron emitting material adjacent an inner portion of said cylindrical wall and heat producing means on the exterior of said wall in thermal conducting relation with said cathode.

7. An electrical discharge device including an envelope in the form of a cylindrical wall having closed ends, an anode and a cathode within said cylindrical wall said cathode comprising electron emitting material adjacent an inner portion of said cylindrical wall, heat producing means on the exterior of said wall in thermal conducting relation with said cathode and means for minimizing heat dissipation from the external surface of said envelope.

8. An electrical discharge device including an envelope, an anode within said envelope, cooling means for said anode, a cathode within said envelope, heating means exterior to and surrounding said envelope in thermal conducting relationship with said cathode, and means covering a large portion of the exterior of said envelope and greatly minimizing the heat dissipation from the exterior of the device into the outer atmosphere.

9. An electrical discharge device having an anode and a cathode comprising an electrical discharge chamber coated on its concave interior walls with material which emits electrons freely when heated, means for heating said cathode and means for substantially minimizing heat dissipation from the external surface of said electrical discharge chamber.

10. An electrical discharge device having an anode and a cathode comprising a wall enclosing an electron-emissive surface, said wall having a convex external surface, electron emitting material on an inner wall of said convex external wall, means for heating said cathode, and means surrounding the convex external surface of said wall for substantially minimizing heat dissipation from said external convex surface.

11. An electrical discharge device having an anode and a cathode comprising an electrical discharge chamber coated on its concave interior walls with material which emits electrons freely when heated, means for heating said cathode and means for substantially minimizing heat dissipation from the external convex surface of said electrical discharge chamber.

12. An electrical discharge device having an anode and a cathode having a curved convex surface, means surrounding said cathode to heat said cathode and heat-flow impedance means interposed in the path of heat outflow from the convex surface of said cathode.

MAX F. REGES,
Administrator of the Estate of Hubert M. Freeman, Deceased.