Sept. 22, 1953 R. C. SCOTT 2,653,259

ELECTRON DISCHARGE DEVICE ANODE

Filed March 29, 1946

FIG. 1

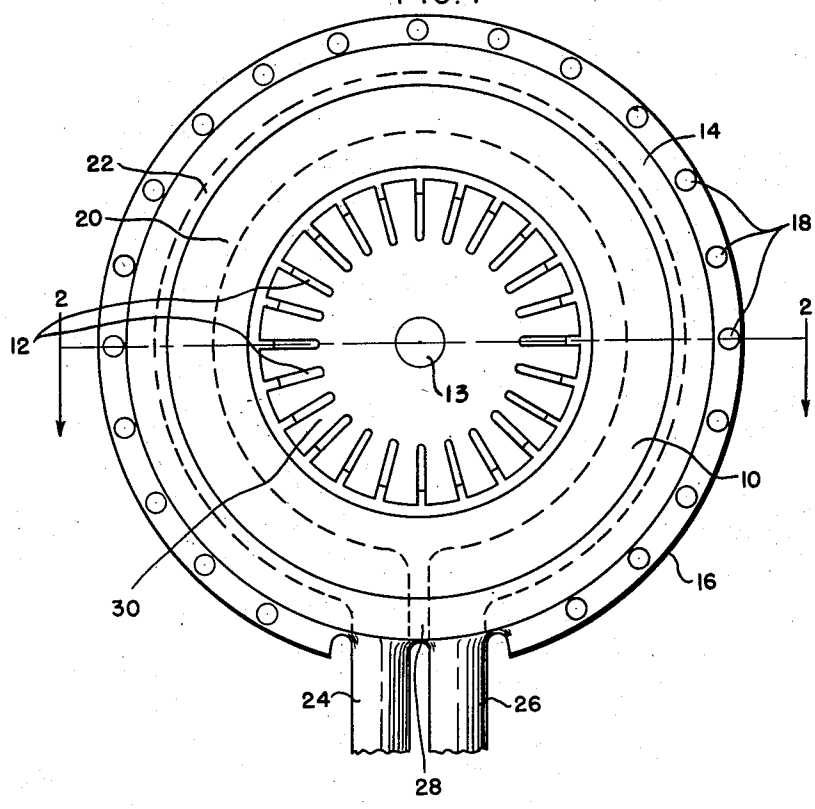
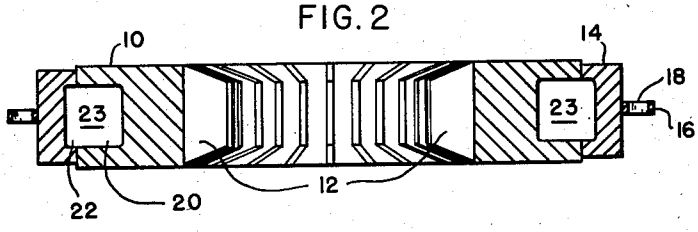


FIG. 2



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ELECTRON DISCHARGE DEVICE ANODE

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3 Claims. (Cl. 313—31)

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This invention relates generally to electrical apparatus, and, more particularly to an anode for a high frequency thermionic vacuum tube, for example, of the resnatron type.

There have been devised various types of high frequency, high power vacuum tubes. The power dissipated at the anode of such a tube is often considerable, and, hence some means of cooling, usually by air or water, is necessary. A factor which limits the efficiency of many of such tubes is secondary emission of electrons from the anode, especially when the anode potential is near or below that of the screen grid. By reducing the effect of secondary emission, the efficiency of operation is improved, and, hence, a smaller plate power dissipation is possible for a given power output, and the problem of anode cooling may be rendered somewhat less complex.

It is, therefore, an object of the present invention to provide a high frequency vacuum tube anode which will reduce the effect of secondary emission and thus improve the efficiency of operation of the vacuum tube.

It is another object to provide a means for cooling this anode.

The invention, in general, may be embodied in an annular metallic anode having on its inner surface a series of radial planar flanges, fins or plate-like members, and having an inner cavity through which water may be circulated for cooling.

Other objects, features and advantages of this invention will become apparent from the following description taken in connection with the accompanying drawing in which:

Fig. 1 is a plan view of one embodiment of the invention; and

Fig. 2 is a cross-sectional view of the embodiment shown in Fig. 1, taken along line 2—2 thereof except that the cathode is not shown.

The embodiment of Fig. 1 is one which is adapted to be mounted between the upper and lower sections of a high-frequency vacuum tube of a type which may be disassembled when not in operation. Such a tube may be of the resnatron type, for example such as is disclosed in the copending application of John W. Livingood, Winfield W. Salisbury, and Edward S. Welch, issued as Patent No. 2,562,319 on July 31, 1951, Serial No. 648,542, filed February 18, 1946. The resnatron has also been described in the February 1946 issue of "Electronics" published by McGraw-Hill Publishing Company, New York, New York. The main anode structure comprises a metallic annulus 10 to the inner annular surface of which

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are affixed a series of radial metallic fins 12. These fins may be attached by brazing or any other suitable means. At the center of the circular aperture formed by the anode structure is a cathode 13. A second metallic annulus 14 having a circumferential flange 16 is arranged to fit closely around the outside of annulus 10, and may be joined thereto by brazing or similar means. Flange 16 has a series of holes 18 by means of which the entire structure may be fastened between the upper and lower portions of the vacuum tube with which it is to be used. Annulus 10 and annulus 14 have adjacent circumferential indentations 20 and 22 around their outer and inner peripheries, respectively. These indentations are of such dimensions that when the anode is assembled as shown in the drawing, an inner toroidal cavity 23 is formed through which water may be circulated by means of inlet conduit 24 and outlet conduit 26. These two conduits may be enclosed within the same envelope if desired. A partition 28 separates the inlet and outlet sections of the cavity so that the cooling medium may circulate freely therein.

A cross-sectional view of the anode along line 2—2 of Fig. 1 is shown in Fig. 2, which indicates more clearly the cavity formed by indentations 20 and 22 in annulus 10 and annulus 14 respectively. The cathode is not illustrated in Fig. 2.

The series of apertures or spaces 30 between radial fins 12 may be considered to be substantially equipotential cavities. The primary electrons from the cathode, which would ordinarily be located at or near the center of the circle formed by the anode as shown in Fig. 1, may be considered to give up their energy to the electric field at the time they pass into the cavities. These primary electrons thus impinge on the surface of the anode with rather low velocity. The problem of emission of secondary electrons is thereby reduced, and those that are emitted tend to be arrested by the fins due to their low velocity, which is a result of the low electrostatic field gradient within the cavity. The loss of efficiency which would ordinarily be caused by this secondary emission is thereby reduced. Other phases of the operation of the invention will be obvious from the figures taken in conjunction with the description given above.

Although the embodiment described is adapted for use in a vacuum tube which may be disassembled, it will be obvious that the same structure may be embodied in a vacuum tube of the ordinary permanently-sealed type.

While there has been here described what is at

present considered to be the preferred embodiment of the invention, it will be obvious to those skilled in the art that various changes and modifications may be made therein without departing from the scope of the invention.

The invention claimed is:

1. A vacuum tube anode comprising an inner metallic annular section, an outer annular section adjacent and joined thereto, a plurality of metallic fins affixed to the inner circumferential surface of said inner annular section and perpendicular thereto, said inner and outer annular sections bearing circumferential indentations on their adjacent surfaces, said indentations jointly forming a toroidal cavity, and an inlet conduit and an outlet conduit communicating with said cavity.

2. A vacuum tube anode comprising a metallic annular portion having an inner circumferential surface for collecting primary electrons, said surface defining a cylindrical space, means producing an equipotential region adjacent said surface for reducing secondary electron emission therefrom, said means including a pluurality of spaced metallic fins affixed to said surface, said fins extending radially inwardly less than one-half the distance to the center of said space with their ends spaced apart a substantially greater distance than their smallest physical dimension, and a hollow annular chamber within the body of said annular portion for circulating a cooling medium.

3. In an electron tube, an anode comprising a body portion having an inner wall portion defining a central aperture, a cathode within said aperture for emitting primary electrons toward said inner wall portion, and means for reducing secondary electron emission from said inner wall portion comprising a plurality of substantially planar metallic fin portions affixed to said inner wall portion and extending inwardly toward said cathode less than one-half the distance to the center of said aperture.

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