Sept. 20, 1938. A. L. SAMUEL 2,130,510

ELECTRON DISCHARGE DEVICE

Filed June 30, 1937

FIG. 1

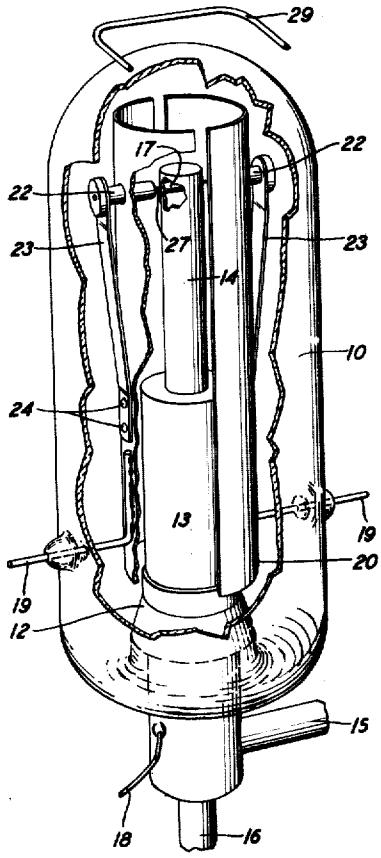


FIG. 2

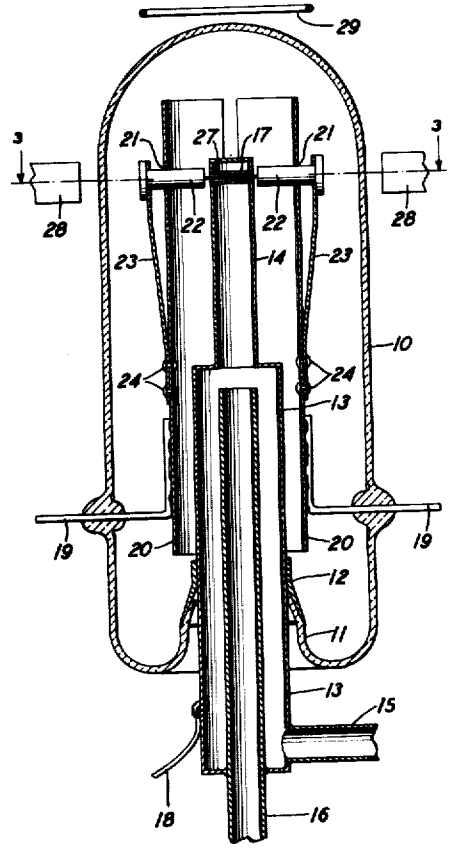


FIG. 3

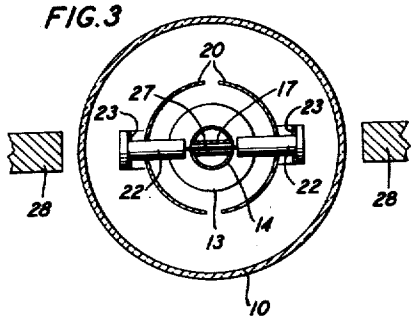
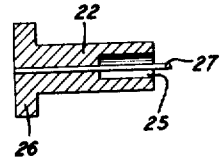


FIG. 4



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2,130,510

ELECTRON DISCHARGE DEVICE

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Application June 30, 1937, Serial No. 151,093

13 Claims. (Cl. 250—27.5)

This invention relates to electron discharge devices and more particularly to such devices, for example of the magnetron type, suitable for the generation and amplification of ultra-high frequency impulses.

One object of this invention is to increase the power capacity of high frequency electron discharge devices.

Another object of this invention is to facilitate the production of a strong concentrated magnetic field adjacent the cathode in devices of the magnetron type.

A further object of this invention is to reduce end cooling effects in thermionic cathodes in electron discharge devices.

In one illustrative embodiment of this invention, a magnetron comprises a linear incandescible filamentary cathode and a cylindrical anode encompassing the cathode and mounted coaxially therewith.

In accordance with one feature of this invention the anode is in the form of a tubular eyelet extending transversely through an elongated hollow member and adjacent one end thereof, and means are provided for circulating a cooling medium in the hollow member and about the tubular eyelet, whereby the anode may be maintained at a safe operating potential and the power capacity of the magnetron increased.

In accordance with another feature of this invention the cathode is supported by and between magnetic members secured to the ends thereof. The magnetic members or blocks may be supported in turn by resilient strips mounted upon substantially semi-cylindrical metallic supports opposed to each other and encompassing and coaxial with the elongated hollow member.

In accordance with still another feature of this invention, the magnetic blocks are provided with recessed portions into which the ends of the cathode extend so that cooling of the ends of the cathode is reduced and substantially uniform electron emission from all portions of the cathode in juxtaposition to the anode is obtained.

The invention and the foregoing and other features thereof will be understood more clearly and fully from the following detailed description with reference to the accompanying drawing, in which:

Fig. 1 is an elevational view in perspective of a magnetron constructed in accordance with this invention, a portion of the enclosing vessel and the electrode structures being broken away to show details of construction more clearly;

Fig. 2 is an elevational view in section of the magnetron shown in Fig. 1, illustrating in addition the poles of an external magnet;

Fig. 3 is a view in cross-section along line 3—3 of Fig. 2; and

Fig. 4 is an enlarged detail view mainly in section of one of the magnetic members and a portion of the cathode.

Referring now to the drawing, the electron discharge device there shown comprises an evacuated enclosing vessel 10 having an inwardly extending portion 11 at one end to which a metallic collar 12 is hermetically sealed. An elongated, hollow metallic member 13 having a reduced portion 14 is sealed to the collar 12 and provided with an outlet port or tubulation 15. Disposed within the hollow member 13 and secured thereto is an elongated inlet tubulation or pipe 16, which preferably extends to immediately adjacent or into the reduced portion 14. A tubular eyelet 17, forming the anode element of the electron discharge device, extends laterally through the reduced portion 14 adjacent the inner end thereof. A suitable positive potential may be applied to the anode through a leading-in conductor 18 affixed to the hollow metallic member 13.

During operation of the device a cooling medium such, for example, as water may be circulated in the hollow member 13 and about the eyelet 17 so that the anode is maintained at a relatively low and safe temperature and, hence, is capable of handling large currents.

Mounted within the vessel 10, as by rigid leading-in conductors 19, are a pair of elongated, substantially semi-cylindrical, metallic members 20, disposed on opposite sides of the hollow member 13, 14 and coaxial and forming a blocking condenser therewith. Preferably, the semi-cylindrical members 20 are of non-magnetic material. Each of these members is provided with an aperture 21, in alignment with the anode eyelet 17, into which suitable strongly and oppositely magnetized end members or blocks 22 extend, the apertures 21 preferably being sufficiently large to prevent contact between the magnetic blocks 22 and the semi-cylinders 20. The metallic blocks 22 are supported by resilient metallic strips or cantilever springs 23 affixed to the semi-cylindrical members 20 as by rivets 24 and biased so that they tend to move the blocks apart. As shown clearly in Fig. 4, each of the magnetic blocks 22 has a recess 25 in the inner end thereof and an enlarged head portion 26 against which the springs 23 bear. Preferably, the magnetic blocks 22 are so mounted that the inner ends thereof are in proximity to the ends of the anode eyelet 17.

A thermionic cathode 27, which may be for example a linear thoriated tungsten filament, extends in the axis of the anode 17, each end of the filament, as indicated in Fig. 4, being secured in a central bore in one of the magnetic blocks 22. As will be apparent, the filament 27 is held under tension by the springs 23 so that the linearity thereof and the desired coaxial relation of the cathode and anode are maintained. The cathode may be energized from a suitable battery, not shown, connected to the conductors 19.

Because of the recesses 25, end cooling of the filamentary cathode 27 is reduced as a result of which all portions of the cathode between the ends of the anode 17 operate at substantially the same temperature. Consequently, uniform emission from these portions is obtained. Also, inasmuch as the metallic blocks 22 extend into proximity to the anode 17, emission from the cathode is confined substantially to the region between the ends of the anode.

The magnetic blocks 22 may be highly magnetized so that an intense highly concentrated magnetic field parallel to the cathode and between the cathode and the anode is achieved. This field may be augmented, if desired, through the agency of an external magnet having poles 28 adjacent the vessel 10 and in alignment with the cathode 27. The field produced by the external magnet may be varied in accordance with a signal to modulate the current flowing between the anode 17 and cathode 27.

In another form of the device, the blocks or members 22 may be normally unmagnetized but of a material having a relatively high permeability. In this case the magnetic field is provided entirely by the external magnet.

The high frequency oscillating field produced by the magnetron will be confined substantially between the semi-cylinders 20 and the cylindrical member 13, 14, and an output current corresponding thereto may be obtained in a suitable conductor 29 disposed adjacent the upper end of the vessel 10. If desired, the magnetron may be mounted within a dielectric guide or the outer conductor of a coaxial conductor transmission line, and the high frequency fields propagated along the guide or transmission line. In such case, it will be appreciated that a close and efficient coupling between the oscillation generator, i. e., the magnetron, and the transmission system may be obtained.

Although a specific embodiment of the invention has been shown and described, it will be understood, of course, that various modifications may be made therein without departing from the scope and spirit of the invention as defined in the appended claims.

What is claimed is:

1. An electron discharge device comprising an enclosing vessel, an anode, an elongated cathode in cooperative relation with said anode, and magnetic members within said vessel and adjacent the ends of said cathode.

2. An electron discharge device comprising an enclosing vessel, a tubular anode within said vessel, a linear cathode within said anode and substantially coaxial therewith, and a pair of magnetized members adjacent opposite ends of said anode for producing a magnetic field adjacent and parallel to said cathode.

3. An electron discharge device comprising an anode, a filamentary cathode in cooperative relation therewith, and means supporting said cathode including magnetic members affixed to the ends of said cathode and resilient means mounting said magnetic members.

4. An electron discharge device comprising a linear filamentary cathode, an anode encompassing said cathode, magnetized members affixed to the ends of said cathode, and elongated resilient strips supporting said magnetic members and biased to tension said cathode.

5. An electron discharge device comprising an enclosing vessel, an elongated hollow member extending into said vessel, a tubular metallic eyelet constituting an electrode element extending laterally through said hollow member adjacent the inner end thereof, a cathode extending through said eyelet, and inlet and outlet ports for said hollow member whereby a cooling medium may be circulated through said member and about said eyelet.

6. An electron discharge device comprising an anode structure including an elongated metallic cylindrical member, a cathode in cooperative relation with said anode structure, a pair of semi-cylindrical metallic members on opposite sides of said cylindrical member and substantially coaxial therewith, and resilient means carried by said semi-cylindrical members for supporting said cathode.

7. An electron discharge device comprising an anode structure including a cylindrical member and a tubular eyelet extending transversely through said member adjacent one end thereof, a filamentary cathode extending through said eyelet, a pair of opposed, metallic semi-cylindrical supports on opposite sides of said cylindrical member and substantially coaxial therewith, and a pair of cantilever springs mounted on said supports and connected to the ends of said cathode.

8. In an electron discharge device, an incandescible cathode and supporting means for said cathode including members affixed to the ends of said cathode and surrounding and spaced from said ends.

9. An electron discharge device comprising a tubular anode, a cathode extending through and beyond the ends of said anode, and supporting means engaging said cathode, said means including members having a tubular portion surrounding the ends of said cathode and extending into proximity to the ends of said anode.

10. An electron discharge device comprising a tubular anode, a linear filamentary cathode extending through and beyond the ends of said anode, magnetic members affixed to the ends of said cathode and having a recessed portion surrounding and spaced from said cathode adjacent the ends thereof, and resilient means supporting said magnetic members and maintaining said cathode under tension.

11. An electron discharge device comprising an anode structure including a tubular member and a tubular eyelet extending transversely through said tubular member, a cathode extending through said eyelet, metallic supporting members on opposite sides of said tubular member and each having an aperture therein in alignment with said cathode, resilient strips carried by said supporting members, and means extending through said apertures, connecting said strips to said cathode.

12. A magnetron comprising an enclosing vessel, a cathode, an anode in cooperative relation with said cathode, a pair of magnetic members at the ends of said cathode and within said vessel, and magnetic means external to said vessel in-

cluding pole-pieces in juxtaposition to said magnetic members.

13. A magnetron comprising an enclosing vessel, a hollow, cylindrical metallic member extending into said vessel and sealed to one end thereof, a tubular eyelet extending laterally through said cylindrical member, a pair of opposed, metallic semi-cylindrical members on opposite sides of said cylindrical member and coaxial therewith, said semi-cylindical members having apertures in alignment with said eyelet, a cathode extending through said eyelet, magnetic members affixed to the ends of said cathode and extending through said apertures, and cantilever springs outside of said semi-cylindrical members and affixed thereto, said springs supporting said magnetic members.

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DISCLAIMER

2,130,510.—*Arthur L. Samuel*, Summit, N. J. ELECTRON DISCHARGE DEVICE. Patent dated September 20, 1938. Disclaimer filed May 31, 1940, by the assignee, *Bell Telephone Laboratories, Incorporated*.

Hereby enters this disclaimer to the subject-matter of claims 1, 2, and 12.

[*Official Gazette June 25, 1940.*]

cluding pole-pieces in juxtaposition to said magnetic members.

13. A magnetron comprising an enclosing vessel, a hollow, cylindrical metallic member extending into said vessel and sealed to one end thereof, a tubular eyelet extending laterally through said cylindrical member, a pair of opposed, metallic semi-cylindrical members on opposite sides of said cylindrical member and coaxial therewith, said semi-cylindical members having apertures in alignment with said eyelet, a cathode extending through said eyelet, magnetic members affixed to the ends of said cathode and extending through said apertures, and cantilever springs outside of said semi-cylindrical members and affixed thereto, said springs supporting said magnetic members.

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