June 19, 1923. 1,459,417

P. SCHWERIN

ELECTRON DISCHARGE DEVICE

Filed Nov. 1, 1916

Fig. 1.

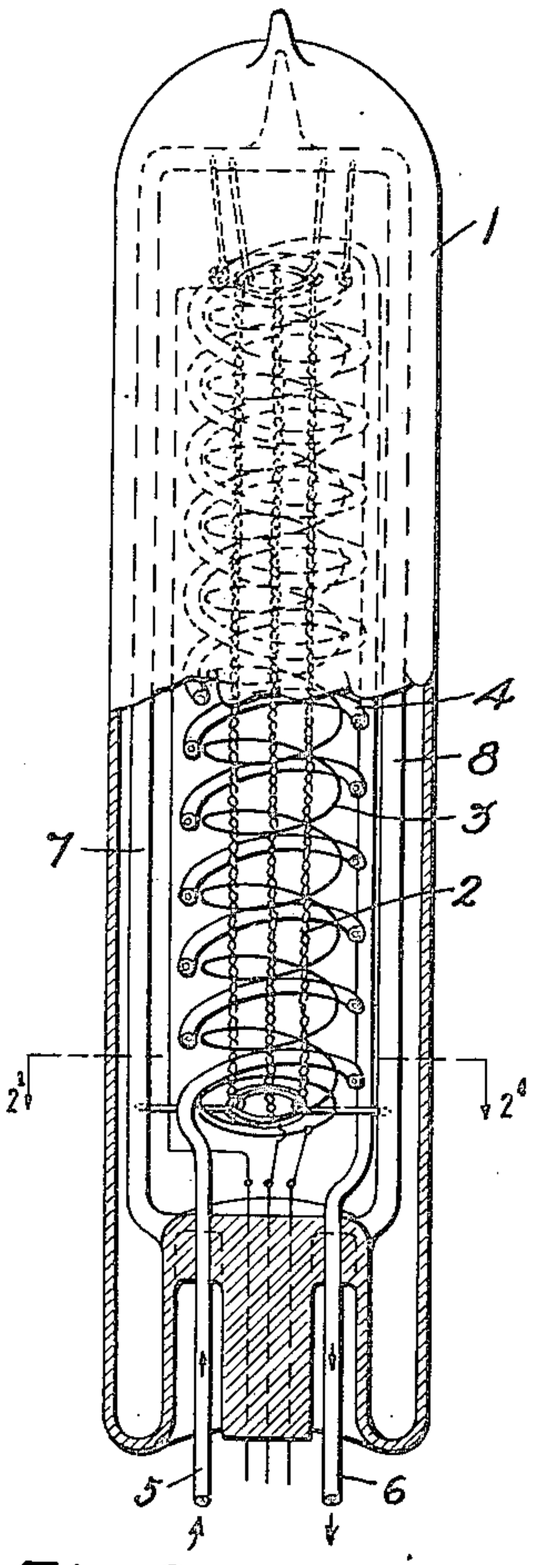


Fig. 2.

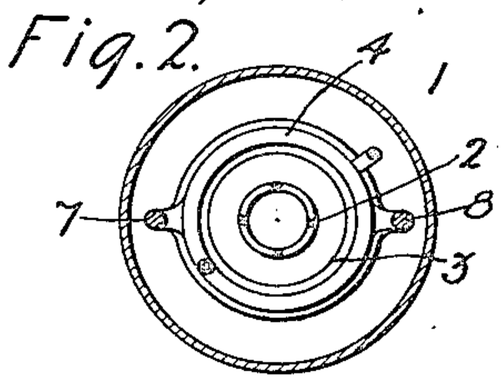
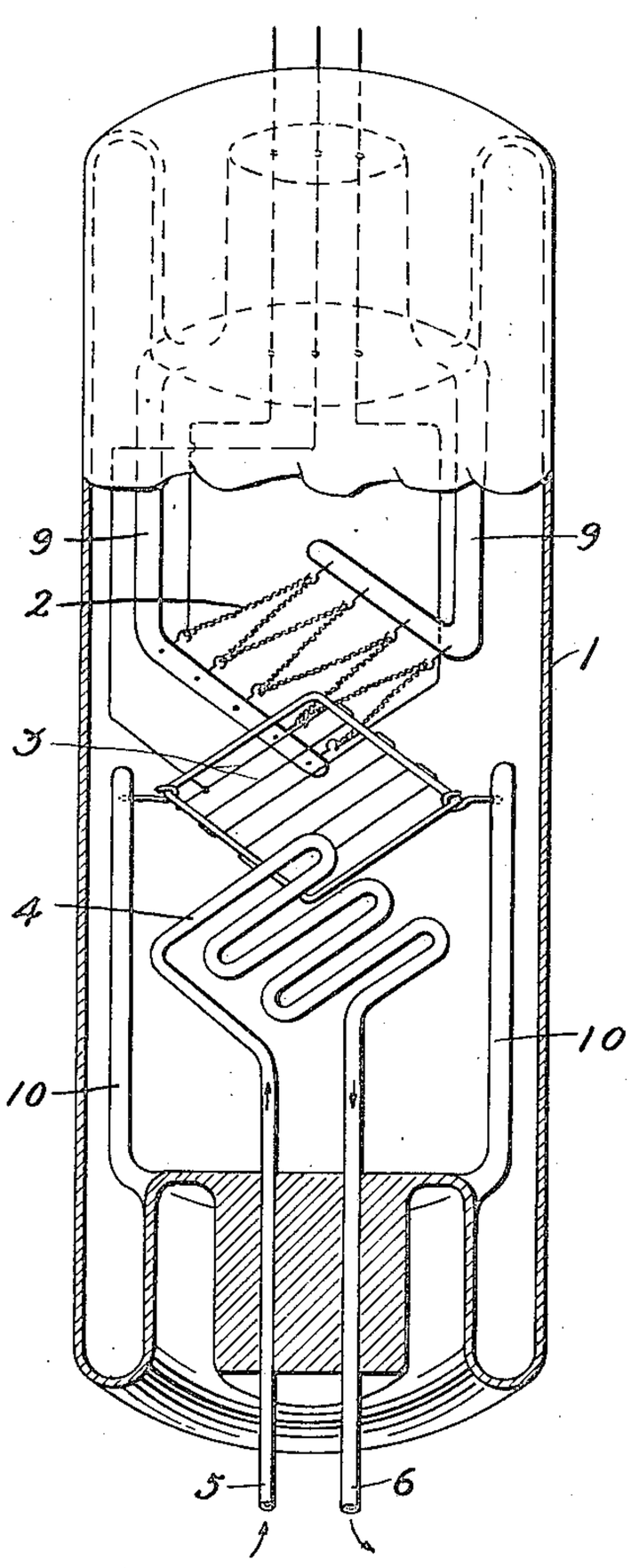


Fig. 3.



Inventor
Paul Schwerin.
by A. C. Hamel. Att'y.

Patented June 19, 1923. 1,459,417

UNITED STATES PATENT OFFICE.

PAUL SCHWERIN, 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 November 1, 1916. Serial No. 128,876.

To all whom it may concern:

Be it known that I, PAUL SCHWERIN, a citizen of the United States, residing at New York, in the county of Bronx 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 especially to vacuum tubes of the audion type, and has as an object a device of the above character which has a very large power capacity.

In electron discharge devices of the audion type, two or more elements are used, one of the elements being a cathode or a source of electrons. Another element is the anode or collector of electrons. Under the action of a strong electrical field, the electrons from the cathode travel towards the anode, and acquire a high velocity. As a result of the electronic bombardment to which it is thus subjected, the anode becomes heated. This fact limits the power input, since excessive heating of the anode drives off the occluded gas, or may even melt the anode, destroying the device.

In this invention then, the purpose is to so construct and arrange the anode that it will be able to dissipate a very large quantity of heat. Such an arrangement will make vacuum tubes of this type largely independent of the heating factor, which heretofore has been a serious limitation to their efficiency. This result has been obtained by having a circulating medium in contact with one surface of the anode element to act as a cooling agent, and of the various agents which may be used, it has been found that water or oil is particularly suitable. This cooling of the anode, as herein described, has made possible a manifold increase in the amount of power which the audion tube can handle.

Other objects and features of the invention will be apparent by reference to the following specification and accompanying drawings, in which Figs. 1 and 3 are views in perspective, with certain parts in section, of two forms that this invention may take; Fig. 2 is a cross-sectional view of Fig. 1 at the line marked 2′, 2′. The same reference characters are used to designate like parts in the several figures.

Referring to Fig. 1, 1 shows a gas tight, preferably evacuated, glass vessel containing three electrodes, a filament 2, a grid 3, and an anode 4 as is usual in the so-called audions. The anode 4 is in the form of a helical tube projecting through the exterior wall of the vessel. The interior of the anode tube is open to the atmosphere; and both ends 5 and 6 of the helix project through the glass vessel, thus affording an entrance and an exit for any medium circulating through said tube. As illustrated, both ends of the anode tube may project out of the same end of the evacuated vessel, but such an arrangement is not necessary as the tube can be arranged in any suitable manner. This arrangement affords a means whereby a cooling medium may be inserted in the hollow anode, and if desired, may be caused to flow through the tube, thereby preventing excessive heating of the anode from the electron bombardment of the cathode.

The tube designated as 4 with the ends 5 and 6 may have a uniform metallic wall from one end to the other, as is shown in the drawings. However, the lower portion of the tube 4, especially near its ends, plays little part in the electrode function of the tube, but merely serves as a passageway for the cooling liquid. Hence, it may be preferable to have this lower portion of the metallic tube of a different material such as glass, which serves to convey the cooling liquid to the heated portions of the metallic part.

The grid 3 is shown in the form of a metallic conductor, wound in the form of a helix within the helix of the anode tube. The filament is shown in the form of a plurality of wires connected in parallel and forming a cylindrical network inside the two helices. The filament and the grid, however, may be made in any of the other various forms known in the art. Fig. 2 is a cross-sectional view of Fig. 1 taken at the point marked 2′, 2′, and shows the arrangement of the three electrodes with reference to each other. The three electrodes may be supported by any suitable means. Herein the filament and grid are shown as being supported from glass columns 7 and 8 fastened to the base of the tube. The anode tube, however, may be made strong enough to be self-supporting on account of its own connections with the wall of the evacuated vessel, and herein is shown to be supported in such a manner.

Fig. 3 shows another form that this invention may take in which the hollow anode tube 4 is arranged in a somewhat sinusoidal form in a plane directly below the grid 3, both ends 5 and 6 of the anode tube 4 continuing to the base of the glass vessel and projecting through to the outside, so that a cooling agent may be readily inserted to keep at a desired temperature that part of the anode tube bombarded by electrons from the filament 2. The filament and grid may be of any suitable type and supported in any convenient manner. In this figure the anode is shown to be self-supporting, while the filament and grid are supported by the glass columns 9 and 10 respectively.

It is apparent that the arrangement of the electrodes herein described and claimed results in a highly efficient thermionic device in which the tubular helical anode surrounding the other electrodes provides a screen of cooling fluid between said electrodes and the walls of the vessel in which they are contained

It is obvious that the tube, together with its parts, may be arranged in various other forms than those described without departing from the spirit of the invention.

What is claimed is:

1. An electron discharge device comprising a gas-tight vessel containing a filament. an anode, and an auxiliary electrode, said anode being composed of a metallic conduit, said conduit being in the form of a helix in the interior of said vessel, and having its ends projecting outside the vessel so that a cooling liquid may be caused to flow therethrough.

2. An electron discharge device comprising a gas-tight vessel containing an anode, said anode consisting of a helical metallic tube having open ends projecting through the walls of the vessel and affording a passage for a cooling fluid for said anode.

3. An electron discharge device comprising a gas-tight vessel containing a filament, an anode, and a grid, said anode consisting of a helical metallic tube having open ends projecting through the walls of the vessel, thereby affording an entrance and an exit for a cooling liquid for said anode, said grid being located between the filament and the anode, and consisting of a metallic wire in the form of a helix.

4. An electron discharge device comprising a gas-tight vessel containing a tubular anode disposed longitudinally therein and having a greater effective length than the length of said vessel.

5. An electron discharge device comprising a gas-tight vessel containing an anode, a cathode and an auxiliary electrode, said anode being tubular in form and of a greater effective length than the length of said vessel.

6. An electron discharge device comprising a gas-tight vessel containing a tubular anode having a greater effective length than the length of said vessel, the interior of said anode being substantially at atmospheric pressure.

7. An electron discharge device comprising a gas-tight vessel and a tubular anode having a greater effective length than the length of said vessel, said anode having open ends projecting through the walls of said vessel, thereby affording a passage for cooling fluid for said anode

8. An electron discharge device comprising a gas-tight vessel containing a helical conduit and a plurality of electrodes surrounded thereby.

9. In an electron discharge device, a gas-tight vessel containing an electrode comprising a conduit and another electrode surrounded by said conduit electrode.

10. An electron discharge device comprising a gas-tight vessel containing an anode, means for supplying a cooling fluid to one side of said anode, and a cathode and an auxiliary electrode within said anode.

11. An electron discharge device comprising a gas-tight vessel containing a helical grid, a filament disposed symmetrically about the axis of said grid and within said grid, and a hollow helical electrode disposed around the grid and the filament.

12. An electron discharge device comprising a gas-tight vessel containing a helical grid, a filament disposed symmetrically about the axis of said grid and within said grid, and a tubular helical electrode disposed around the grid and the filament.

13. An electron discharge device comprising a gas-tight vessel containing a helical grid, a filament disposed symmetrically about the axis of said grid and within said grid, and a helical tubular anode disposed around the grid and the filament, the ends of said anode projecting outside the vessel so that a cooling liquid may be caused to flow therethrough.

14. An electron discharge device comprising a gas-tight vessel, means for providing a screen of cooling liquid within said vessel, and electrodes within said screen.

15. An electron discharge device comprising a gas-tight vessel, electrodes within said vessel, and a screen of cooling fluid between said electrodes and the walls of said vessel.

16. An electron discharge device comprising a gas-tight vessel, electrodes within said vessel, and a helical screen of cooling fluid between said electrodes and the walls of said vessel.

17. An electron discharge device comprising a gas-tight vessel, a grid, a filament, and an anode within said vessel, said anode being in the form of a helix surrounding the filament and the grid, and being hollow to

provide passage for a flow of cooling fluid between the filament and the grid and the walls of the vessel.

18. An electron discharge device comprising a gas-tight vessel containing a hollow electrode the interior of which is adapted to receive a cooling fluid, an auxiliary electrode associated therewith and supporting connections between said electrodes and one end of said vessel.

19. An electron discharge device comprising a gas-tight vessel containing a grid, cathode and anode, said anode being hollow and adapted to receive a cooling fluid, and supporting connections between said electrodes and one end of said vessel.

20. An electron discharge device comprising a containing vessel having a stem integral therewith, a cathode, an anode supported solely from said stem, said anode being provided with a passage extending therethrough for the circulation of a cooling medium.

21. An electron discharge device comprising a plurality of electrodes, one of which is a conduit having an inlet and an outlet for the flow of cooling medium therethrough, one of said electrodes surrounding another of said electrodes.

22. An electron discharge device comprising a plurality of electrodes, one of which is a conduit having an inlet and an outlet for a flow of cooling fluid therethrough, said conduit electrode surrounding one of said other electrodes.

23. An electron discharge device comprising a cathode and an anode, the latter being a conduit having an inlet and an outlet for a flow of cooling fluid therethrough, said anode surrounding said cathode.

24. In an electron discharge device, a gas-tight vessel containing a filament, an anode and a grid, said anode surrounding said filament and grid and having an inlet and an outlet for a cooling fluid, said grid being located between the filament and the anode.

25. A thermionic device comprising a cathode and a hollow anode, said anode being in the form of a helix.

26. An electron discharge device comprising a cathode and a hollow anode, said anode being in the form of a helix and surrounding said cathode.

27. An electron discharge device comprising a cathode, a hollow anode and a grid, said anode being in the form of a helix surrounding said grid and cathode.

28. An electron discharge device comprising a cathode in the form of a plurality of sections connected in parallel, and a hollow helical electrode surrounding said cathode.

29. An electron discharge device comprising a cathode in the form of a plurality of sections connected in parallel, and a hollow helical anode surrounding said cathode.

30. An electron discharge device comprising a cathode in the form of a plurality of sections connected in parallel, a hollow helical anode surrounding said cathode, and a helical grid between said anode and said cathode.

In witness whereof, I hereunto subscribe my name this 30th day of October, A. D., 1916.

PAUL SCHWERIN.