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CATHODE CONSTRUCTION FOR THERMIONIC DEVICES

Filed July 19, 1921

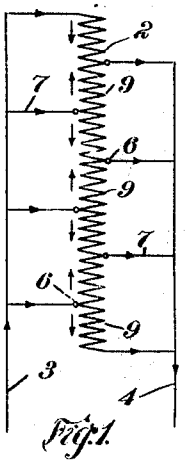



Fig. 1.

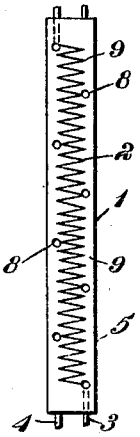



Fig. 4.

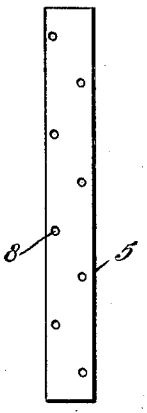



Fig. 2.

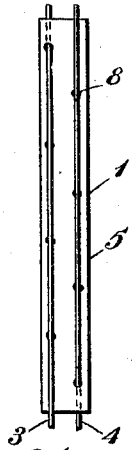



Fig. 3.

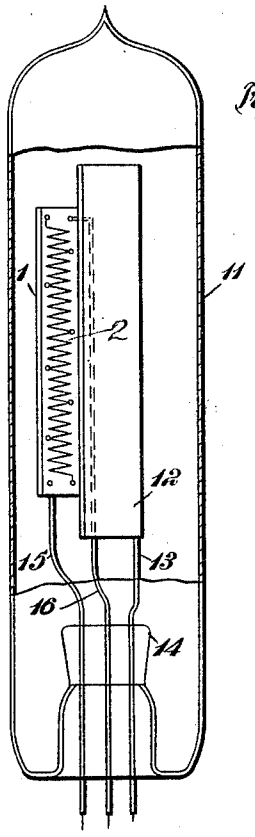



Fig. 5.

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# UNITED STATES PATENT OFFICE.

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## CATHODE CONSTRUCTION FOR THERMIONIC DEVICES.

Application filed July 19, 1921. Serial No. 485,949.

My invention relates to evacuated electric devices and particularly to a novel cathode structure which may be employed in such devices.

One object of my invention is to provide a cathode structure which is of unusual rigidity and strength of construction and which admits of the elimination of the adjusting springs heretofore employed to compensate for the expansion and contraction of the filament.

Another object of my invention is to provide a low-voltage, high-current filament wherein the effects of the magnetic fields set up by the filament currents upon the electron emission therefrom may be neutralized to a large extent.

Still another object of my invention is to provide such a filament-supply system that the effects of the potential drop along the filament upon the electron emission therefrom may be reduced to a low value, thereby providing a filament having the characteristics of an equipotential cathode.

A further object of my invention is to provide a filament structure especially adapted to externally controlled tubes which tends to protect the walls of the tube immediately adjacent the filament from such electron bombardment and heat radiation as emanates from the filament.

Other objects of my invention will appear from the following description when taken in connection with the accompanying drawings and claims.

Heretofore, the normal operation of electron tubes has been adversely affected by the potential drop along the filament and by the magnetic field surrounding the filament, resulting from the passage of the exciting currents therethrough. Furthermore, in the manufacture of vacuum tubes, considerable difficulty has been experienced in so adjusting the filament as to maintain the tension thereof constant during the periods of operation and nonoperation.

Additional difficulties have been experienced in the operation of vacuum tubes, especially externally controlled tubes, in that the surface of the tube opposite the hot cathode tends to be destroyed by reason of the electron bombardment and heat radiation emanating from the filament, as just mentioned.

According to my invention, I provide a filament structure wherein expansion of the heated element may take place without serious distortion thereof; wherein the effects of the potential drop and of the magnetic fields, resulting from the passage of the filament currents, are reduced to a minimum value; and wherein the surface of the walls of the tube opposite the filament is protected.

Briefly speaking, the filament structure embodying my invention comprises a filament, which is supported upon one face of an insulating supporting member having opposite parallel faces, and supply conductors for said filament, which are supported upon the opposite parallel face. The insulating supporting member also serves as a screen to protect the walls of the tube from the filament-effects heretofore mentioned.

One of the supply conductors is connected to the filament at spaced points and the other supply conductor is connected to the filament at spaced points intermediate the first-named points to divide the filament into a number of parallel sections, wherein the current flow in each section is opposite to the current-flow in the sections immediately adjacent.

A better understanding of my invention may be had by referring to the accompanying drawings, wherein;

Fig. 1 is a diagrammatic view of the filament and supply circuits therefor embodying my invention;

Fig. 2 is a front elevational view of the insulating supporting member upon which the filaments and conductors of Fig. 1 are mounted;

Figs. 3 and 4 are rear elevational views and front elevational views, respectively, of the completed filament structure;

Fig. 5 is a diagrammatic view of one type of evacuated tube having a portion of the containing walls broken away, wherein my arrangement may be employed.

Referring to Figs. 1, 2, 3 and 4, I have shown a cathode structure 1 which comprises a filament 2, preferably of irregular outline, supply conductors 3 and 4 therefor and an insulating strip 5 having opposite parallel faces for supporting the filament 2 and the supply conductors 3 and 4. The supply conductors 3 and 4, which are disposed adja-

cent one face of the insulating strip 5, are alternately connected to the filament 2, which is disposed adjacent the opposite face of the insulating strip, at spaced points 6 by conductors 7 which extend through staggered holes 8 in the supporting member 5.

While the filament 2 has been shown as supported by the conductors 7, which extend through the holes 8 to connect the supply conductors 3 and 4 to the filament 2, it is apparent that the filament 2 may be also supported at spaced points by projections (not shown) which extend from the supporting member 5 or by being cemented to the supporting member 5.

It will be noted that, in such an arrangement, the filament 2 is divided into a plurality of parallel-connected sections 9, the current-flow in each section being opposite to the current-flow in the sections immediately adjacent thereto, as indicated by the arrows in Fig. 1.

In Fig. 5 is shown an evacuated electric device 11, of the Fleming type, employing a cathode construction, as just described, though I do not wish to be limited to such arrangement of electrodes. The evacuated electric device, just mentioned, comprises the cathode structure 1 and an anode 12. The anode 12 is supported by a conducting member 13 which is mounted in a press 14. The cathode structure 1 is supported by means of the conductors 15 and 16 which are also mounted in the press 14. The cathode structure 1 and the anode 12 are preferably disposed in parallel planes, the hot cathode 2 facing the anode 12, as shown.

One advantage of my invention is the provision of a cathode structure which is simple in design and rugged in construction.

Another advantage of my invention is the provision of a cathode structure which is especially well adapted to alternating-current filament excitation by reason of the relatively large currents which are permitted to traverse the filament sections, all as will be understood by those skilled in the art.

Still another advantage of my invention is the provision of a filament of irregular outline which is supported at a plurality of spaced points, thereby providing a filament structure which admits of expansion and contraction of the filament without undue distortion thereof. Other advantages of my invention will be apparent from the foregoing description.

While I have shown a particular type of construction for the filament structure embodying my invention, it is capable of various changes and modifications without departing from the spirit of my invention. I desire, therefore, that only such limitations shall be imposed thereon as are indicated in the appended claims.

I claim as my invention:

1. A cathode structure comprising a heated filament, a plurality of supply conductors connected to lead currents into said filament at spaced points and a plurality of supply conductors connected to lead currents from said filament at points intermediate said first-named points.

2. A cathode structure comprising a heated filament of irregular outline, means for supporting said filament, a plurality of supply conductors connected to lead currents into said filament at spaced points and a plurality of supply conductors connected to lead currents from said filament at points intermediate said first-named points.

3. A filament structure comprising a heated element, means for supporting said heated element, a supply lead connected to said element at spaced points, and a second supply lead connected to said element at points intermediate said first-named points.

4. A filament structure comprising a plurality of filament sections connected in parallel, each section being oppositely connected in an electrical sense with respect to the filament sections immediately adjacent and means for energizing said filament sections.

5. A filament structure comprising a plurality of filament sections, forming one filament, a supporting member, and conductor supports extending from said supporting member to the junction of said sections for supporting said filament sections and for connecting said filament sections in parallel relation with currents flowing in opposite directions in adjacent sections.

6. A filament structure comprising a plurality of filament sections of zig-zag outline, a supporting member, and conductors supported by said supporting member for supporting said filament sections and for connecting said filament sections in parallel, each filament section being oppositely connected with respect to the filament sections immediately adjacent thereto.

7. A filament structure comprising a plurality of filament sections, united into a filament, an insulating supporting member, and conductor supports extending from said supporting member to the junctions of said sections for supporting said filament sections and for connecting said filament sections in parallel relation.

8. A filament structure comprising a plurality of filament sections arranged in series relation, an insulating support therefor having opposite faces and incoming and outgoing connections, whereby each filament section may be traversed by currents opposite to those in the filament sections immediately adjacent thereto said connections being mounted on and supported by said insulating support and securing the filament sections thereto.

9. A filament structure comprising a heated element, an insulating support therefor having opposite faces, a supply lead connected to said filament at spaced points and a second supply lead connected to said filament at spaced points intermediate said first-named points.

10. A filament structure comprising a heated element, an insulating support therefor having opposite faces, said opposite faces being substantially parallel, a supply lead connected to said filament at spaced points and a second supply lead connected to said filament at points intermediate said first named points, said heated element being supported upon one of said parallel faces and said supply leads being disposed immediately adjacent said opposite parallel face.

11. A filament structure comprising a heated element, a supply lead connected to said filament at spaced points, a second supply lead connected to said filament at points intermediate said first-named spaced points, and an insulating member for supporting said heated filament and said supply leads and for insulating said heated element and said circuit conductors.

12. In a vacuum tube device, a combined cathode structure, including a filament support of insulating material having two opposite faces, a pair of conductors extending along one of said faces, a filament extending along the other face of said insulating support and means for securing said filament, insulating support and pair of conductors together, and supporting conductors attached to said pair of conductors, whereby said supporting conductors hold the combined cathode structure.

13. In a cathode structure, a filament support of insulating material, a pair of parallel conductors extending along one face of said support, said support having two rows of holes, one row along each of said conductors, the holes in said rows being staggered, a filament upon the opposite side of said support and filament connections extending through said holes and uniting said filament and said conductors.

14. In a cathode structure, a filament support of insulating material, a pair of parallel conductors extending along one face of said support, said support having two rows of holes, one row along each of said conductors, the holes in said rows being staggered, a filament extending in zig zag form along one side of said support between said rows of holes, the filament extending from one row to the other, and conducting attaching means extending through said holes and connecting said filament with said parallel conductors.

15. In a vacuum tube device, a filament, a supporting body of insulating material to which said filament is attached and a pair of supporting conductors extending through the wall of the vacuum tube and holding said supporting body spaced away from said wall.

In testimony whereof, I have hereunto subscribed my name this first day of July, 1921.

VLADIMIR K. ZWORYKIN.