Oct. 31, 1950

H. D. DOOLITTLE

2,527,799

FILAMENT STRUCTURE

Filed April 2, 1949

2 Sheets-Sheet 1

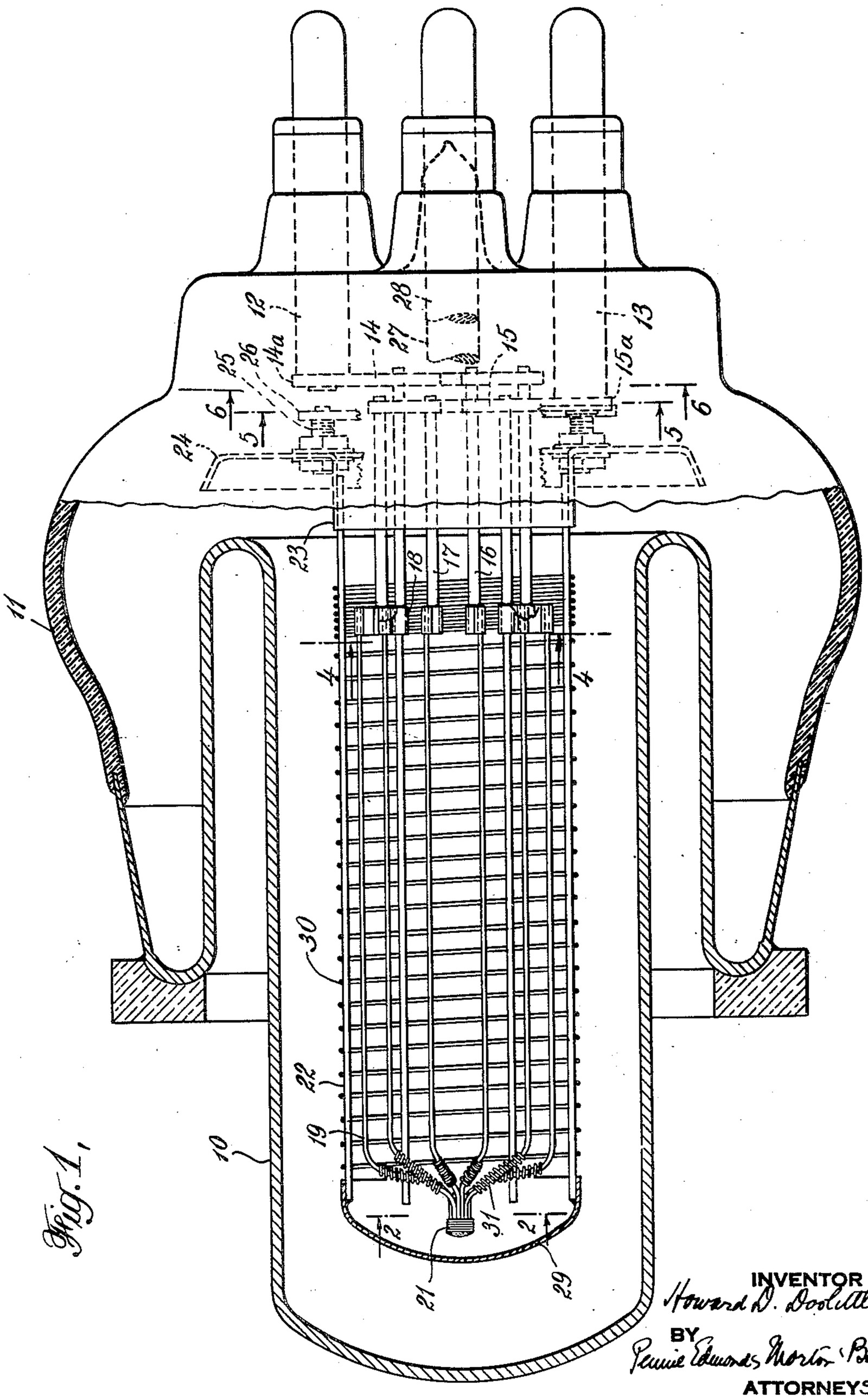

Fig. 1.

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2 Sheets-Sheet 2

Fig. 2,

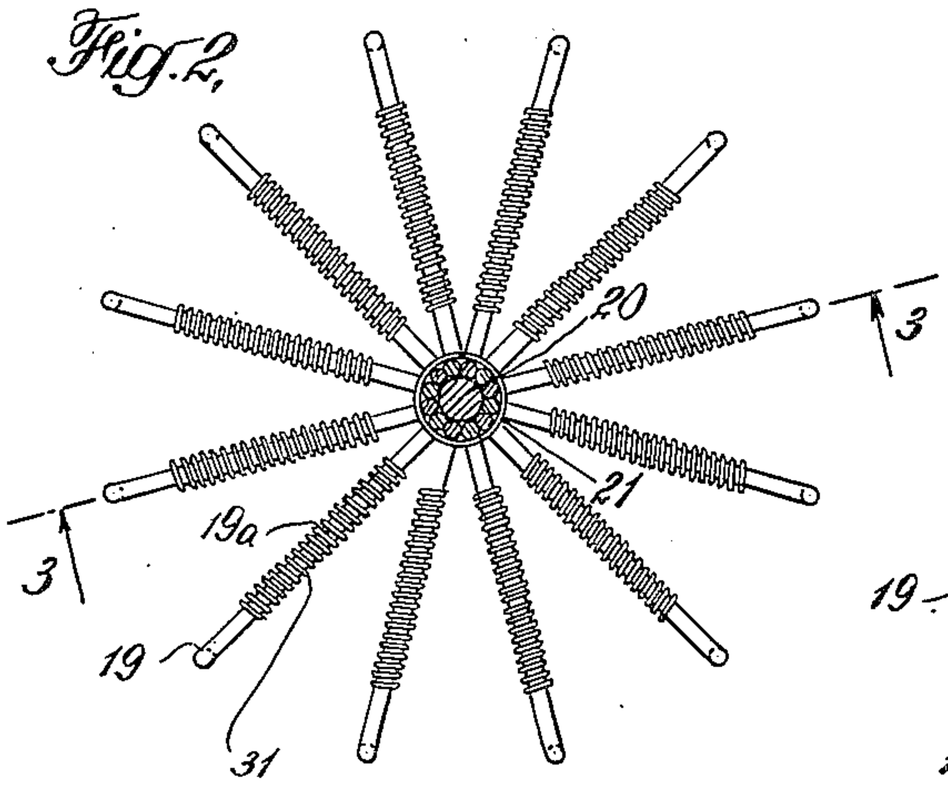


Fig. 3,

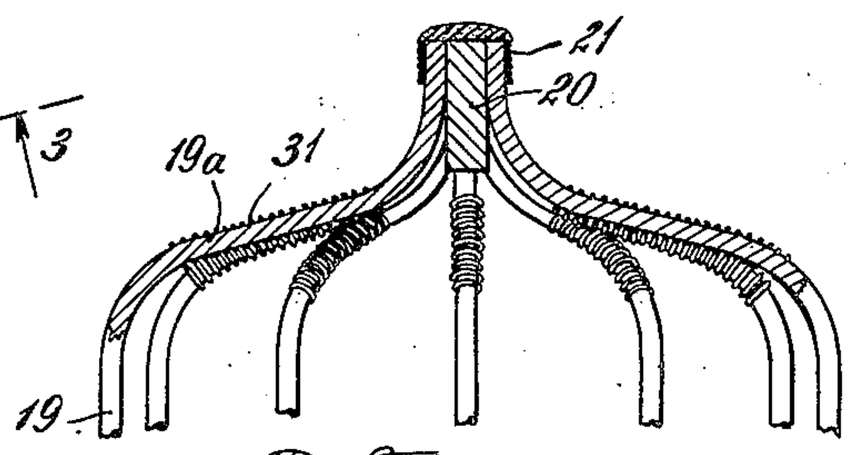


Fig. 4,

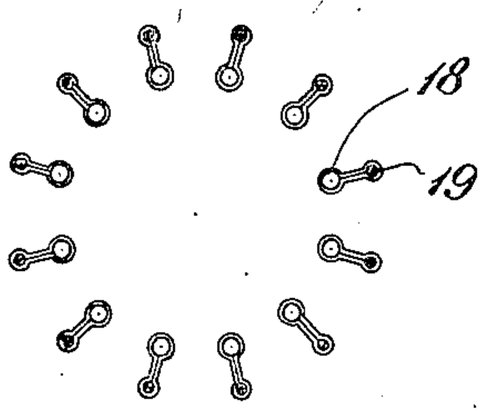


Fig. 5

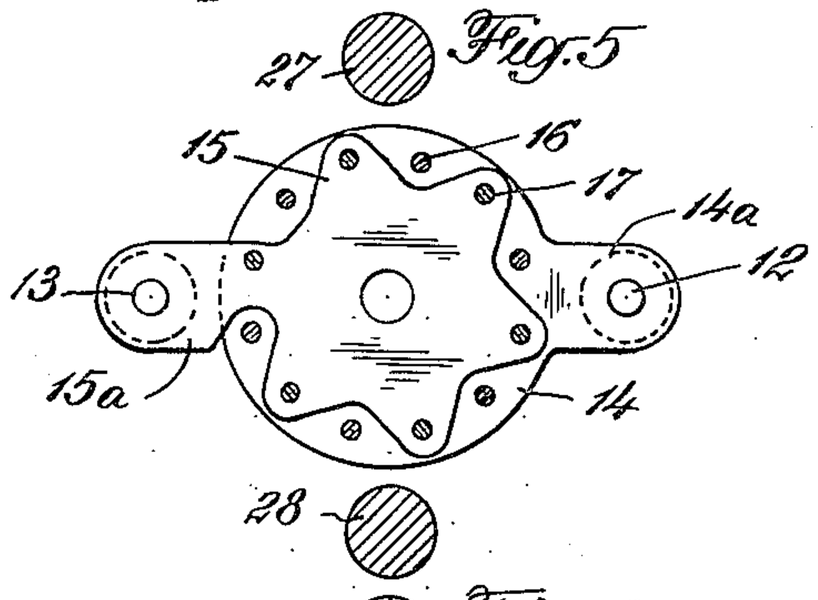


Fig. 6,

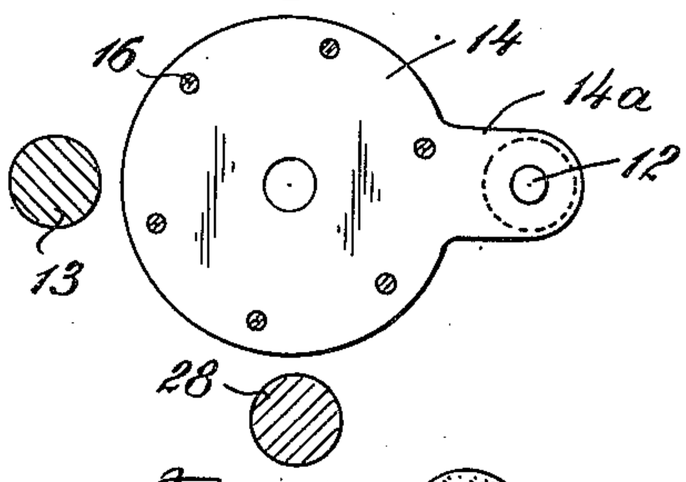


Fig. 7,

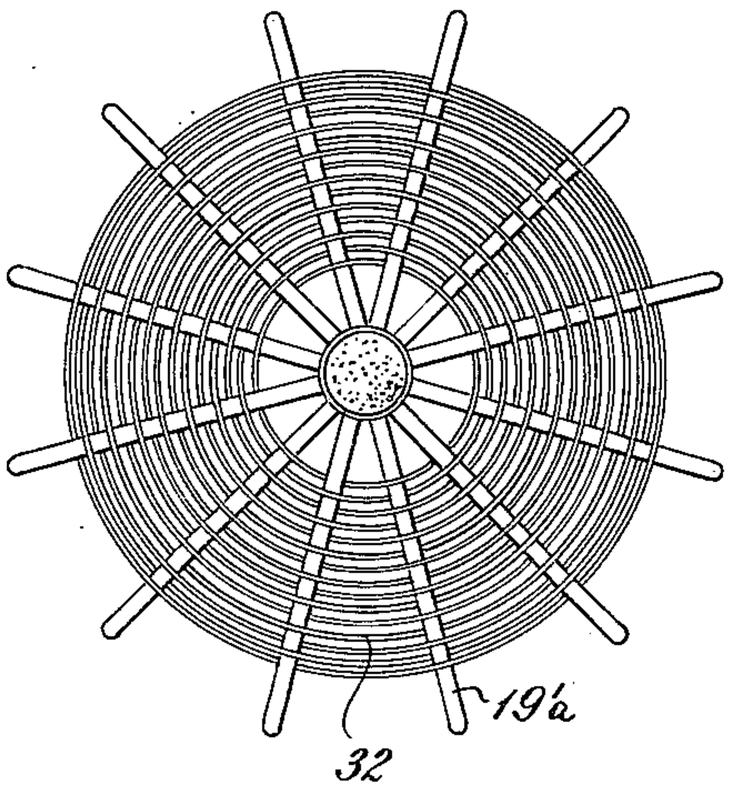
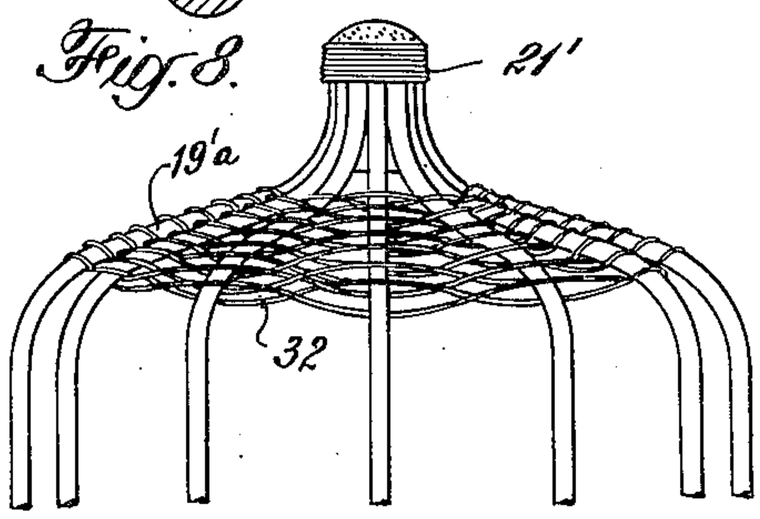


Fig. 8.



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FILAMENT STRUCTURE

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6 Claims. (Cl. 250—27.5)

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This invention relates to filament structures for use in electron tubes and is concerned more particularly with a novel filament structure of the self-supporting type, which may be advantageously employed in tubes for power purposes. In the new filament structure, difficulties arising from cross-radiation between closely adjacent portions of the filaments are overcome, so that the life of the structure is substantially increased.

Self-supporting filament structures for use in electron tubes include a plurality of filaments of tungsten wire, which are held at one end and extend parallel from their supports in a close series. The end portions of the filaments remote from the supports converge and are connected together at the axis of the series. The convergent portions of the filaments lie closer together and thus run hotter because of cross-radiation, than the remainder of the filaments with the result that there is excessive evaporation from the convergent lengths of the filaments and the life of the structure is thereby decreased.

The present invention is directed to the provision of a self-supporting structure, in which the radiating capacity of the convergent portions of the filaments is increased, so that the operating temperatures of such parts is kept within acceptable limits. The increase in radiating capacity of the convergent lengths of the filaments is obtained by increasing the radiating surface thereof and, for this purpose, the convergent parts of the filaments may be provided with individual windings of smaller wire or such wire may be interlaced with the filaments adjacent their junction point. With either arrangement, the parts of the filaments lying relatively close together are kept from becoming overheated.

For a better understanding of the invention, reference may be made to the accompanying drawings, in which:

Fig. 1 is a view partly in elevation and partly in section of a typical electron tube containing one form of the new filament structure;

Fig. 2 is an end view of the filament structure of Fig. 1;

Fig. 3 is a sectional view on the line 3—3 of Fig. 2;

Figs. 4, 5 and 6 are sectional views on the lines 4—4, 5—5, and 6—6, respectively, of Fig. 1; and

Figs. 7 and 8 are an end view and a fragmentary elevational view of a modified form of the new filament structure.

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The tube shown in Fig. 1 comprises an envelope made up of a metallic anode section 10 having one end embedded in the end of a glass section 11, through the wall of which are sealed four posts spaced apart 90°. Post 12 carries a circular plate 14 having a radial extension 14*a* attached to the end of the post and post 13 carries a plate 15, which is formed with a scalloped edge and has a radial extension 15*a* attached to the end of the post. A plurality of rods 16, shown as 6 in number, are mounted on plate 14 at equal spacings along its periphery and plate 15 carries another group of rods 17, which lie in alternate relation to rods 16. The rods extend parallel at right angles to the plates and lengthwise of the tube. At its end, each rod carries a clip 18, which extends outwardly from the rod and supports one end of a filament 19. The twelve filaments extend parallel in a closed series and, with the arrangement described, the filaments in the series are connected alternately to plates 14 and 15 and to posts 12, 13. At their ends remote from the supporting clips 18, the filaments are bent inwardly to converge and then reversely bent so that their extreme end portions lie parallel and are secured to the surface of a metal plug 20 by welding and by a wrapping of fine wire 21.

The filaments lie within a grid structure comprising a circular series of wires 22 extending into the tubular portion 23 of a shield and secured to the inner surface of that portion. The shield has a radial flange 24 secured by bolts 25 to a pair of arcuate plates 26 carried on the ends of posts 27, 28, respectively, the posts being sealed through the wall of the glass section of the envelope. The ends of the wires 22 extend into a metal cup 29 and are secured to the inner surface thereof, and a wire 30 is wound helically around wires 22.

In a self-supporting filament structure of the kind described, it is found that the convergent portions 19*a* of the filaments leading to plug 20 become overheated in operation because of cross-radiation and, in the structure of the invention, this difficulty is overcome by increasing the radiating capacity of the convergent lengths of the filaments. In the construction shown in Figs. 1 to 3, inclusive, the heat radiating capacity of the converging portions of the filaments is increased by wrapping each such portion of the filament with a fine wire 31. The additional radiating surface provided by the fine wire windings is sufficient to prevent localized overheating of the filaments and the life of the filament structure is, accordingly, increased.

In the modified construction shown in Figs. 7 and 8, the heat radiating capacity of the convergent lengths 19'*a* of the filaments is increased by spirally interlacing a fine wire 32 with the convergent portions of the filaments. The wire 32 serves the same purpose as wires 31 in that it serves to radiate heat and thus keep the convergent portions of the filaments from overheating. Wire 32 is interlaced with the filaments in as many turns as are necessary to obtain the desired effect.

The new filament structure is superior to prior self-supporting filament structures in that localized overheating of the filaments is avoided, as explained above. The new structure is also superior to filament structures of the type in which the inner ends of the filaments are connected to a plate acted on by a spring-pressed rod to maintain the filaments taut during operation. In a structure of the latter type, the plate radiates so much heat that lengths of the filaments of from one-half inch to one inch adjacent the plate operate at a low temperature and efficient emission is not obtained from these parts of the filaments. With the new structure, the filaments may be kept at a uniform temperature throughout their length without overheating, so that a tube in which the new structure is used may operate at a higher power than tubes provided with the former structures, or else it may operate at the same power level but at a lower filament temperature and thus with increased life.

I claim:

1. In an electron tube, a filament structure comprising a plurality of supports arranged in a closed series, a filament extending forward from each support, the filaments lying parallel having end portions remote from the supports which converge and terminate in parallel end sections, means for securing said end sections together, and metallic filamentary elements engaging the converging portions only of the filaments, said elements adding to the heat radiating capacity of said portions of the filaments.

2. In an electron tube, a filament structure comprising a plurality of supports arranged in a closed series, a filament extending forward from each support, the filaments lying parallel and having end portions remote from the supports which converge and are connected together, and a filamentary element wound around each filament only between its point of connection to the other filaments and its parallel portion, said filamentary element acting to increase the heat radiating capacity of that portion of the filament on which it is wound.

3. In an electron tube, a filament structure

comprising a plurality of supports arranged in a closed series, a filament extending forward from each support, the filaments lying parallel and having end portions remote from the supports which converge and are connected together, and a filamentary element wound around the convergent portion only of each filament and acting to increase the radiating capacity of said filament.

4. In an electron tube, a filament structure comprising a plurality of supports arranged in a closed series, a filament extending forward from each support, the filaments lying parallel and having end portions remote from the supports which converge and are connected together, and a filamentary element interlaced with the filaments adjacent their point of connection to one another and increasing the heat radiating capacity of the filaments.

5. In an electron tube, a filament structure comprising a plurality of supports arranged in a closed series, a filament extending forward from each support, the filaments lying parallel and having end portions remote from the supports which converge and are connected together, and a filamentary element interlaced with the convergent portions only of said filaments and acting to increase the heat radiating capacity of the filaments.

6. In an electronic tube, a filament structure comprising a pair of plates mounted in spaced relation face to face, a plurality of supports mounted on each plate, the supports all extending in the same direction and arranged in a closed series with alternate supports in the series mounted on one plate and intermediate supports mounted on the other, a filament attached to each support, the filaments extending parallel in a closed series at substantially right angles to the plates, the filaments having portions remote from the supports, which converge and terminate in parallel end sections, means for securing said end sections together, and metallic filamentary means engaging the convergent portions only of the filaments, said means acting to increase the heat radiating capacity of said portions of the filaments.

HOWARD D. DOOLITTLE.

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