

Dec. 31, 1940.

C. M. WHEELER ET AL
VACUUM TUBE CATHODE SUPPORT

2,226,680

Filed May 9, 1939

2 Sheets-Sheet 1

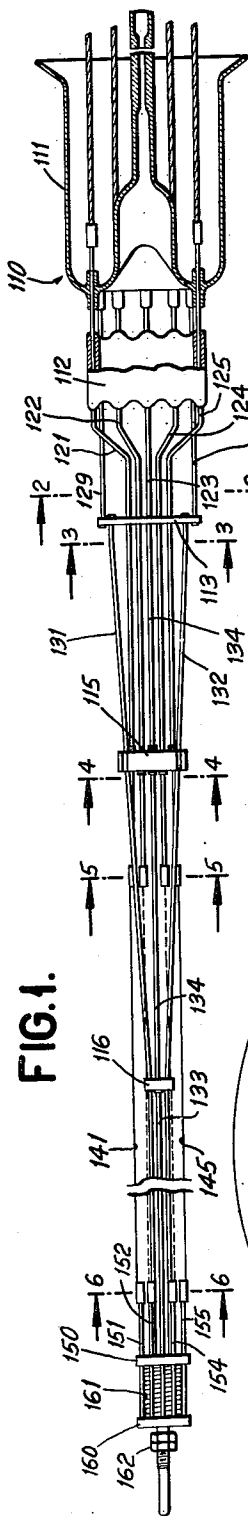


FIG. 1.

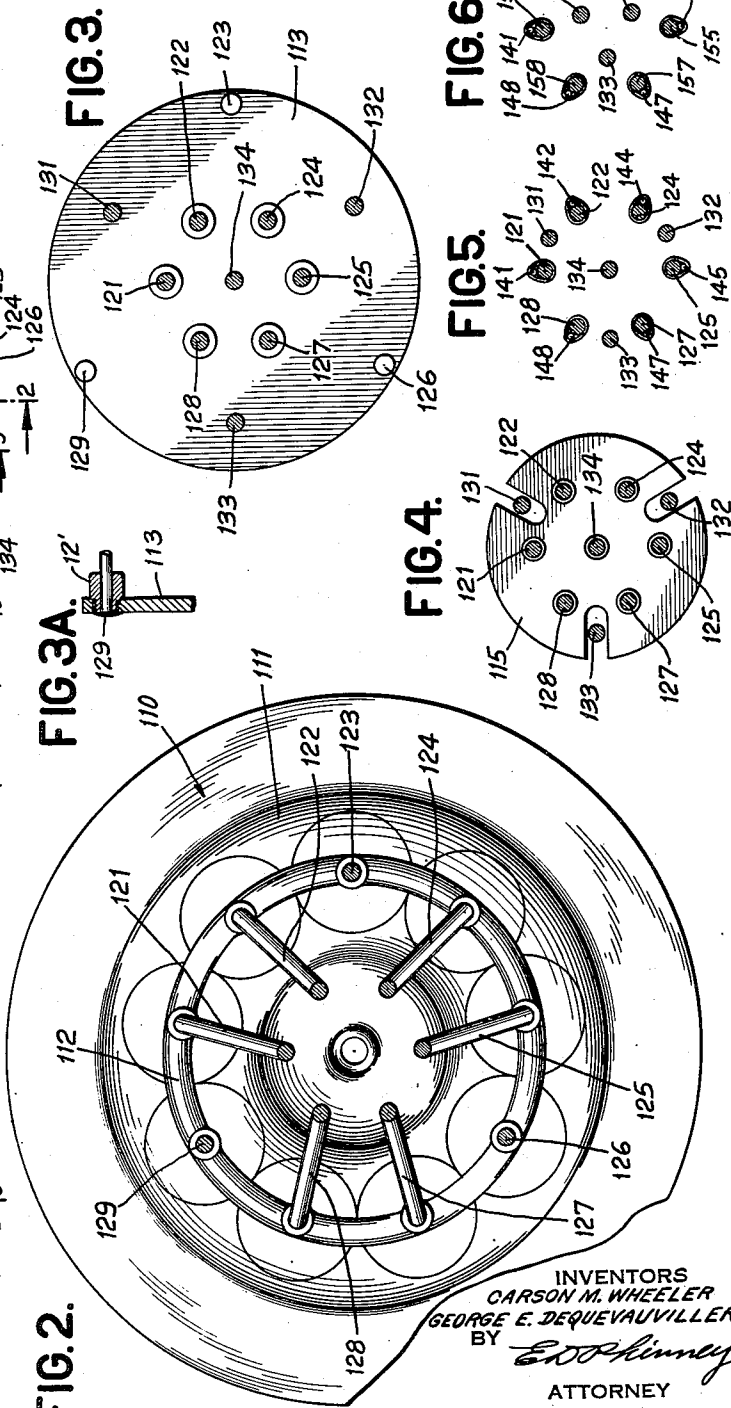


FIG. 2.

FIG. 3A.

FIG. 3.

FIG. 4.

FIG. 5.

FIG. 6.

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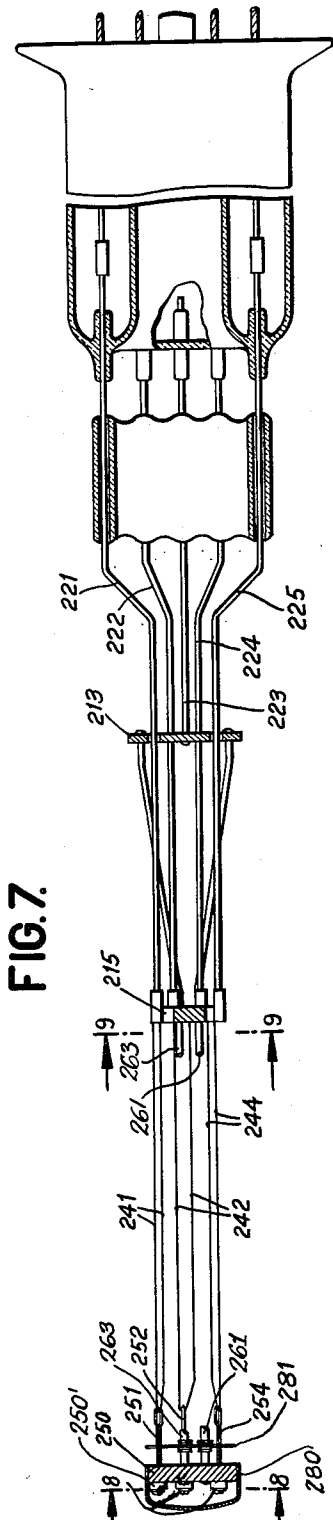
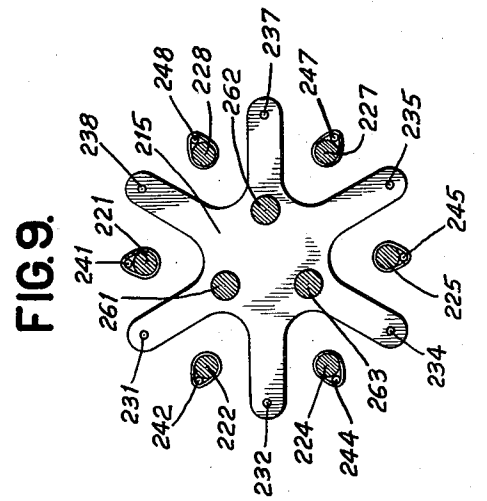
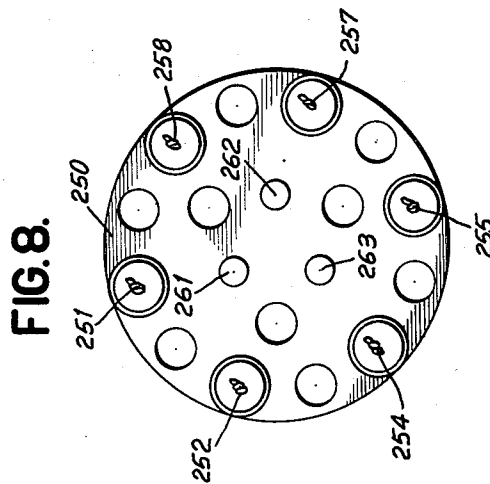
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2,226,680

VACUUM TUBE CATHODE SUPPORT

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Application May 9, 1939, Serial No. 272,564

8 Claims. (Cl. 250—27.5)

Our invention relates to vacuum tube structures and pertains more particularly to a filamentary cathode supporting arrangement.

In power tube structures more especially in tubes designed to carry relatively high power it is generally desirable to utilize filamentary cathodes and to provide a plurality of separate filaments which may be supplied from a multiple phase source. In such an arrangement it is necessary to provide a number of filaments equal to the number of phases of the supply source for energizing these tubes. To properly support such filaments a relatively rigid structure is required, in order to prevent the filaments from relative movement with respect to the other electrodes of the tube and consequent poor operation of the tube.

It is an object of our invention to provide a simple and rigid filamentary cathode assembly suitable for use in vacuum tube structures.

It is a further object of our invention to provide a filament supporting assembly utilizing supporting rods arranged in the form of a closed pattern whereby a rigid assembly of parts is assured.

The filament assembly may comprise three rods arranged in a tripod form with the base of the tripod having a larger diameter than the other end thereof. Arranged outside the tripod and supported at least in part thereby are provided a plurality of filaments forming the cathode. This tripod assembly is mounted on a platform supported on rods sealed through the glass envelope.

The above mentioned and further objects of our invention, and the manner of obtaining them, will be apparent from the more complete description of some embodiments of our invention made in connection with the accompanying drawings, in which

Fig. 1 illustrates the filament assembly of the vacuum tube structure in accordance with our invention;

Fig. 2 is a plan view of a portion of the cathode structure looking toward plane 2—2;

Figs. 3, 3A, 4, 5 and 6, are sectional views taken along the lines 3—3, 4—4, 5—5 and 6—6, of Fig. 1;

Fig. 7 is a modified filament assembly structure in section for use in a vacuum tube in accordance with our invention;

Figs. 8 and 9 are cross-sections taken along the lines 8—8 and 9—9 of Fig. 7.

Since other parts of the vacuum tube structure form no part of our invention only the cathode assembly is illustrated. It is understood that the other necessary parts of the tube structure such as anode, grids, etc., may be made in any known manner.

A more detailed description of the cathode assembly is made referring particularly to Figs. 1 to 6, inclusive. The cathode assembly is supported on a glass stem shown generally at 110. This assembly comprises a reentrant stem portion 111 through which are sealed nine metallic rods 121 to 129. These rods are preferably of tungsten when the envelope is of glass, known in the trade under the name of "Nonex." About these rods and sealed thereto is provided a glass supporting ring 112 for holding them in rigid assembly. Other types of insulating supports may be provided if desired. Six of these rods 121, 122, 124, 125, 127, 128, which serve as filament supply leads are offset inwardly to pass through holes provided in a metallic disc 113. The other three of these rods 123, 126, 129, are firmly attached to metallic disc 113 and serve as a tripod platform support. The six rods passing through the platform disc may be insulated therefrom by insulating bushings placed around these rods at the point they pass through the disc, if desired. These six filament leads extending through the disc pass upwardly through a second supporting plate 115.

Fastened onto the discs 113 at equally spaced points are three other supporting rods 131, 132 and 133, forming the filament supporting structure or tripod. These rods pass through slots provided in disc 115 as shown in Fig. 4. A fourth rod 134 is fastened centrally of disc 113 and passes through the center of plate 115.

Preferably filament lead rods 121, 124 and 127 are fastened on the bottom side of disc 115, rods 122, 125 and 128 are fastened on the top side of disc 115 and center rod 134 is fastened both top and bottom. This fastening may be made in any desired manner but one preferred mode of fastening comprises winding of two or three turns of wires about the rods close to the plate 115 and spot welding each of these wires to the corresponding rod.

Rods 131, 132 and 133, converge upwardly as they pass through disc 115 until at the point 5—5 they are substantially the same distance from center rod 134 as are the filament supporting rods. At this point the filament supporting rods or leads terminate but rods 131, 132, 133, 134 continue onward. To each of filament leads 121, 122, 124, 125, 127 and 128, at their terminating ends are fastened separate filaments 141, 142, 144, 145, 147 and 148, respectively. The rods 131, 132 and 133, extend outwardly and are fastened to a metallic disc or plate 150. Also passing through plate 150 are six short metallic rods 151, 152, 154, 155, 157, 158, to which are fastened the other ends of filaments

141 to 148, respectively. These filaments may be fastened to the rods at either end by means of sleeves and then may be firmly held in place by welding. Rod 134 terminates at the disc 116 and does not extend therebeyond at which points rods 131-133 cease to converge. Discs 115 and 116 may be of metal or insulating material.

As used in the claims, the expression "closed pattern" applied to the arrangement of supporting rods refers to a tripod or a ring shaped grouping of the rods, which assures resistance to lateral bending of the rod assembly.

For maintaining tension on the filaments, rods 151 to 158 are fastened to a disc arrangement 160 and are slidable in openings in the disc or plate 150. A spring 161 may be compressed between discs 160 and 150, and a bolt nut assembly 162 may be provided for adjusting the compression of spring 161 during the assembly of the tube. The bolt of the assembly is fastened to disc 150 and passes freely through a hole in disc 160. The bolt and nut hold the spring 161 initially compressed so that the filaments can be put in position after which the nut is unscrewed slightly to permit free action of the spring with respect to the filaments.

With the filament assembly as described above, a six phase supply may be utilized, each filament being heated from a different phase of the supply system. Since the currents in the separate filaments are preferably balanced, no return path is necessary, it being sufficient to connect together the separate filaments. However, should any unbalance occur, the rod assemblies 131 to 133 may serve as return conductors for the filament supply. These rods are connected to rods 123, 126 and 129 which extend outwardly through the envelope and may be connected to ground if desired.

The modified filament assembly illustrated in Fig. 7 is similar to that shown in the other figures, but is designed for use with filaments of a hairpin type. The particular illustration is designed for use in a tube of smaller dimensions and generally lower power than that of Figs. 1 and 2. The same number of filaments, lead-in rods and supporting rods are shown in the structure of Fig. 7, as in Fig. 2. However, the supporting rods, only one of which 223, appears in the drawings, extend inwardly and are attached to platform disc 213. The point of fastening is determined by the disc size used and preferably is made near the outer end of the disc in order to provide a wide supporting base. The supporting rods and tripod rods are preferably fastened to the plate 213 in the same manner as those shown in Fig. 1, as illustrated in Fig. 3A. A small sleeve 12' is fastened into plate 113 or 213 for example by screw threading. Rods such as 129 are tightly fitted into the sleeve and are held in place by arc-welding. The sleeve 12 serves to form a stronger fastening than would be provided by the relatively thin disc, and improves the structure particularly since tungsten tends to crystallize and become brittle upon welding and therefore becomes weaker. By use of the sleeve a support at a distance from the point of welding is provided.

The tripod rods 261, 262, 263, attached to platform disc 213, converge upwardly through the metal supporting member 215 and are fastened to the filament supporting plate 250. To this plate is attached hook assemblies 251 to 258 held in place by fastening means such as the insulating beads 250'. Preferably a heat shield 281 is provided to protect the bead assembly from the direct heat of the cathode. A drawn metal cap 280

fitted about plate 250 serves to further protect the assembly. The filaments 241, 242, 244, 245, 247, 248, are fastened at one end to rods 221, 222, 224, 225, 227, 228, respectively, at one end pass over hooks 251, 252, 254, 255, 257, 258, and on the return end are fastened to the metallic supporting member 215 preferably by being inserted in holes 231, 232, 234, 235, 237, 238, as shown in Fig. 9. Thus each filament forms a hairpin bend. The return ends of these filaments are connected together at metallic supporting member 215 and may be returned to ground through rods 223, 226 and 229, similarly to the return through rods 123, 126 and 129 of Figs. 1 and 2. This alternative filament assembly likewise shows an arrangement suitable for six phase energization, similar to that disclosed in Figs. 1 to 7. In Fig. 7 tripod rods 261 and 263 are partly cut away for clarity.

It should be understood that in each of the embodiments disclosed the filament supporting structure provides a closed pattern support, so that a very rigid assembly of parts is assured. Furthermore the preferred tripod or three leg supporting arrangement assures a stable support throughout the structure.

While we have illustrated our invention in the form of a filament structure suitable for six phase energization, it should be distinctly understood that any form of energization may be utilized. Furthermore, any desired multiple phase or other energization arrangement may be utilized instead of a six phase system.

Likewise, the supporting tripod elements may converge according to a curve instead of in straight line form as shown. Further, although in the preferred arrangement the support of the electrode structure is made to depend upon the tripod arrangement, it should be understood that other forms of closed pattern supporting arrangements may be utilized within the scope of our invention. What we consider to be our invention is defined in the accompanying claims.

What we claim is:

1. A vacuum tube structure comprising a glass stem, a plurality of supporting rods arranged in closed pattern and sealed at one end in said stem, a disc fixed to the other end of said rods and forming a platform therewith, a plurality of secondary rods attached at one end to said disc in a closed pattern arrangement, a plate attached to the other end of said secondary supporting rods, and an electrode supported between said disc and said plate.

2. A vacuum tube structure comprising a glass stem, a plurality of supporting rods arranged in closed pattern and sealed at one end in said stem, a disc fixed to the other end of said rods and forming a platform therewith, a plurality of secondary rods attached at one end to said disc in a closed pattern arrangement, a plate attached to the other end of said secondary supporting rods, a plurality of filament leads extending through said seal and through said disc, and a plurality of filaments supported between said plate and said filament leads.

3. A vacuum tube structure comprising a glass stem, a plurality of supporting rods arranged in closed pattern and sealed at one end in said stem, a disc fixed to the other end of said rods and forming a platform therewith, a plurality of secondary rods attached at one end to said disc in a closed pattern arrangement, a plate attached to the other end of said secondary supporting rods, a plurality of filament leads extending through said seal and through said disc, and a plurality of filaments sup-

ported between said plate and said filament leads, and filament tensioning means mounted on said plate for maintaining said filaments under tension.

4. A vacuum tube structure comprising an envelope, a plurality of filament leads extending into said envelope, a plurality of supporting rods extending into said envelope, a disc fastened to the upper end of said supporting rods, supporting means fastened to said disc and extending beyond the ends of said filament leads, a conductive plate supported on the extended end of said supporting means, and a plurality of filaments each connected at one end to one end of said filament leads and at the other end to said conductive plate.

5. A vacuum tube structure comprising a glass stem, a plurality of filament leads and supporting rods, arranged to form a closed pattern, extending through said stem and sealed thereto, a conductive supporting disc fastened to said rods at one end thereof, said filament leads being brought toward each other to form a smaller closed pattern and extending through said disc and insulated therefrom, a plurality of conductive supporting elements fastened to said disc and arranged about said filament leads to form a closed pattern at one end, the other end of said elements being brought together to form a closed pattern of smaller dimension than said smaller filament lead pattern and extending beyond the ends of said filament leads, a metallic plate member mounted on said extended end of said supporting structure, and a plurality of filaments supported by said filament leads and said plate.

6. A vacuum tube filament cathode arrangement, comprising a glass stem, a plurality of symmetrically arranged filament leads and supporting rods extending through said stem and sealed thereto, a metallic disc fastened to said rods, said filament leads extending through said disc and being insulated therefrom, a conductive supporting structure fastened to said disc and extending beyond the ends of said filament leads, a plate member carrying insulated supporting members mounted on the extended end of said supporting structure, a conductive filament supporting means

mounted on said supporting structure, and a plurality of filaments, corresponding in number to the number of filament leads, each of said filaments being fastened at one end to a respective one of said filament leads and passing through a corresponding one of said insulating supporting members and being conductively fastened at its other end to said filament supporting means.

7. A vacuum tube filament assembly comprising a plurality of filament leads, means for supporting said leads in a closed pattern about a circumference, a plurality of filaments supported at one end by said filament leads, at their other ends by a plate member to form the outline of a closed cylinder of said circumference, a plurality of supporting rods forming a supporting structure said structure being in the form of a closed pattern larger than said pattern of said filament leads at one end, said supporting rods being offset inwardly to form at the other end a closed pattern smaller than the pattern of said filament leads, and supporting connection between said supporting rods and said plate.

8. A vacuum tube structure comprising a glass stem, a plurality of filament leads and supporting rods, arranged to form a symmetrical closed pattern, extending through said stem and sealed thereto, a conductive supporting disc fastened to said rods at one end thereof, said filament leads being brought toward each other to form a smaller symmetrical closed pattern and extending through said disc and insulated therefrom, a plurality of conductive supporting elements fastened at one end to said disc and arranged about said filament leads to form a symmetrical closed pattern the other end of said elements being brought together to form a symmetrical closed pattern of smaller dimension than said smaller filament lead pattern, and extending beyond the ends of said filament leads, a metallic plate member mounted on said extended end of said supporting structure, and a plurality of filaments supported by said filament leads and said plate.

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