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CATHODE STRUCTURE FOR ELECTRON DISCHARGE DEVICES

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FIG. 1

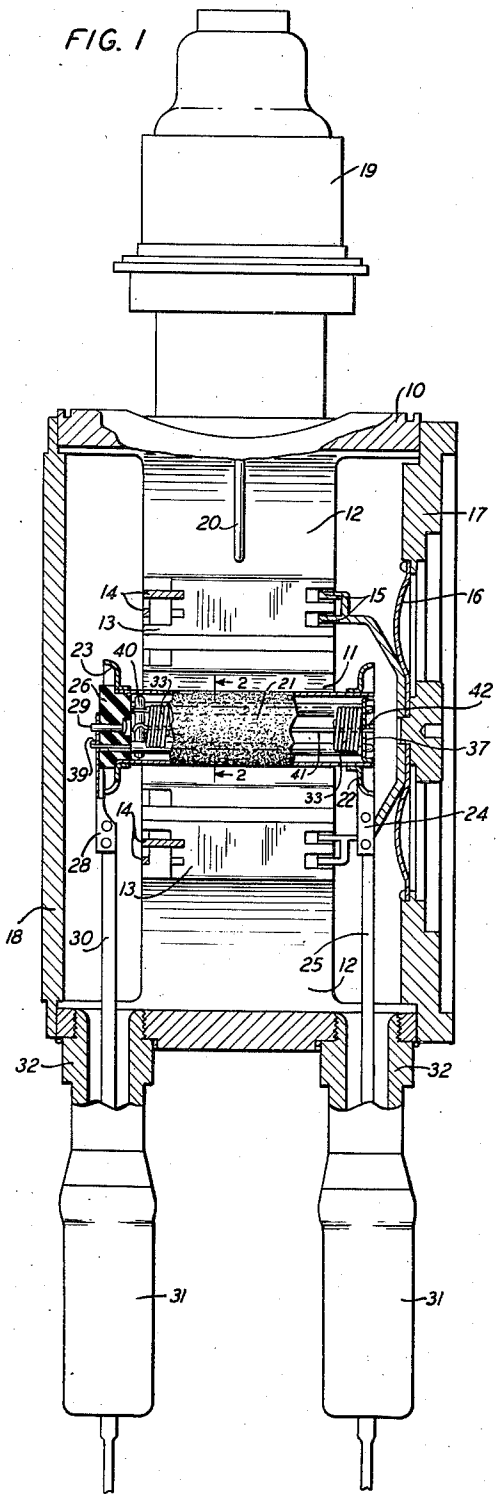


FIG. 2

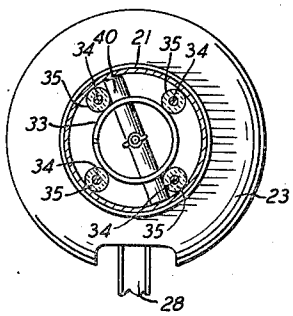


FIG. 3

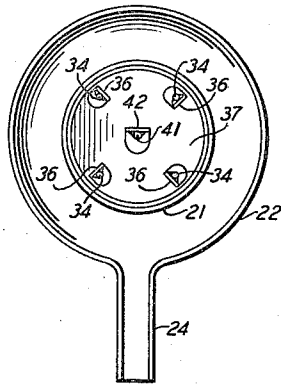


FIG. 4

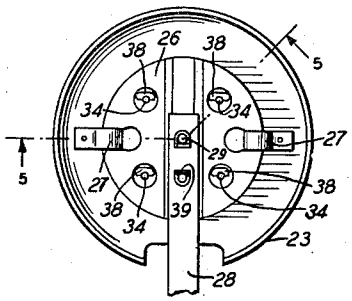
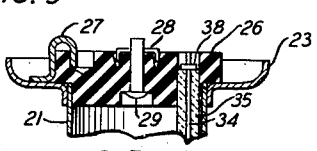


FIG. 5



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CATHODE STRUCTURE FOR ELECTRON DISCHARGE DEVICES

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10 Claims. (Cl. 250—27.5)

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This invention relates to cathode structure for electron discharge devices and more particularly to heater type cathode assemblies for such devices intended for use in mobile equipment.

Indirectly heated cathodes of one construction comprise, generally, a metallic cylinder having an electron emissive coating upon the outer surface thereof and a heater element, such as a filament coated with a refractory oxide, within the cylinder. Efficient operation and adequate heating dictate that the heater element be in proximity to the cylinder and that the filament be of relatively great length. Such length may be realized practically by forming the coated filament as a helix of small pitch, for example, with adjacent turns in contact. Such a helix may be mounted upon one or more supports in turn mounted from the cylinder.

In electron discharge devices including such a cathode and utilized in mobile equipment, the cathode may be subjected to vibration and shock. As a result, relative motion between the heater filament and the support therefor and between the filament and cathode may occur, whereby the insulating coating upon portions of the filament may be worn away or otherwise destroyed. Consequently, short-circuits in the filament or between the filament and the cathode cylinder may result so that the discharge device is rendered inoperative.

One object of this invention is to increase the operating life of electron discharge devices particularly suitable for use in equipment subject to shocks and vibration, and including heater type cathodes.

More specifically, one object of this invention is to prevent short-circuits in the heater element of such cathodes and between this element and the electron emissive element.

In one illustrative embodiment of this invention, a cathode comprises a metallic cylinder having an electron emissive coating upon its outer surface, closure discs at opposite ends of the cylinder, parallel supports or posts within the cylinder and extending between the discs, and a helical, insulated heater filament mounted by the supports or posts. Rigid supports are affixed to the cathode assembly, for example to the closure discs, for mounting the cathode in cooperative relation with another electrode, for example coaxially with the anode in a magnetron.

In accordance with one feature of this invention, means are provided for anchoring the heater filament in position to prevent relative longitudinal motion therebetween and the support posts therefor and the metallic cylinder.

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In accordance with a more specific feature of this invention, the closure discs are fixed to opposite ends of the cathode cylinder, the helical heater filament has one end seated against one of the closure discs and its other end engaged by a draw bar, and means are provided for drawing the bar toward the one closure disc and fixing it in position, whereby the filament is compressed and motion thereof relative to the cathode cylinder and the heater supports is prevented.

The invention and the above-noted 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, mainly in section, of an electron discharge device including a cathode assembly illustrative of one embodiment of the invention;

Fig. 2 is a sectional view of the cathode assembly, taken along plane 2—2 of Fig. 1;

Figs. 3 and 4 are enlarged views of opposite ends of the cathode assembly; and

Fig. 5 is a fragmentary sectional view of one end of the cathode assembly, taken along line 5—5 of Fig. 4.

Referring now to the drawing, the electron discharge device illustrated in Fig. 1 is a magnetron of the multiresonant cavity type, such as disclosed in the application Serial Number 593,627, filed May 14, 1945 of Renato D. Fracassi, and comprises an anode body 10 having therein a central bore 11 and having therein also a plurality of cavity resonators 12 which communicate with the bore 10 by radial slots 13. The body 10 has mounted in recesses in one face thereof a pair of coaxial annular conductors 14 defining mode locking straps as disclosed in the application Serial Number 529,619, filed April 5, 1944 of James B. Fisk. The other face of the block 10 has therein a pair of coaxial annular recesses into which coaxial cylindrical members 15 extend. The members 15 are mounted from a diaphragm 16 carried by an end plate 17 affixed to one end of the body 10, the diaphragm being flexible to move the members 15 into or out of the recesses therefor, thereby to adjust the resonant frequency of the oscillating system of the magnetron. The other end of the body 10 is closed by an end plate 18.

Power may be taken from the oscillating system by way of an output coupling 19 including

a coupling loop 20 extending into one of the cavity resonators 12.

Disposed within the bore 11 and coxial therewith is a cathode comprising a metallic cylinder 21 the outer surface of which is coated with thermionic electron emissive material. A pair of flanged metallic members 22 and 23 are secured to the cathode cylinder 21 at the ends thereof, the flanged member 22 having a stem portion 24 which is secured to a rigid leading-in conductor 25. The other flanged member 23 encompasses an insulating disc 26 which, as shown clearly in Fig. 5, has a portion of reduced diameter fitted in the cathode cylinder 21 and is locked firmly in position by bent locking tabs 27 secured to the flanged member 23. The disc 26 is provided with parallel slots for receiving the side portions of a channel member 28 which is locked in place by a pin or rivet 29 extending through the disc and is secured to a rigid leading-in conductor 30.

The leading-in conductors 25 and 30 are of sufficient diameter to be rigid and extend through and are sealed to vitreous stems 31 which are sealed in turn to metallic tubes 32 extending into apertures in the anode body 10, and sealed to the body.

Disposed within the cathode cylinder 21 is a heater element 33 in the form of a helical filament coated with a refractory insulating material. The heater element is mounted coaxially with the cylinder 21 and in proximity to the inner wall thereof by a plurality of equally spaced, parallel support members each of which comprises a metallic wire or rod 34 encased in a ceramic insulating sleeve 35. As shown in Figs. 1 and 3, the wires or rods 34 are secured at one end to integral tabs 36 on a metallic cap 37 fitted within the cylinder 21 and joined thereto; at the other end, as shown in Figs. 1 and 4, the rods or wires 34 extend through the insulating disc 26 and are anchored by tabs or wires 38 affixed to the rods 34 and seated in recesses in the disc 26. As illustrated clearly in Fig. 2, the heater element 33 is positioned between the support members and bears against the insulating sleeves 35 so that it is positively positioned relative to the cylinder 21 throughout the length of the heater element.

One end of the heater filament, as shown in Figs. 1 and 4, extends through the insulating disc 26 and is connected electrically to the support 28 by a tab or wire 39 affixed to the filament and the support 28. The other end of the heater filament is connected electrically to the disc 37.

The end turn of the heater element 33 toward the disc 23 has bearing thereagainst an insulating draw-bar 40 which is slidable within the cylinder 21 and positioned diametrically thereof by two of the ceramic sleeves 35 as shown in Fig. 2. Affixed to the central part of the draw-bar 40 is a wire 41 which is anchored to a tab 42 on the cap 37. During the assembly of the cathode tension is placed upon the wire 41 to draw the bar 40 toward the cap 37, thereby to compress the heater element 33 to place adjacent turns thereof in firm engagement with one another. The wire is then anchored to the tab 42 to hold the heater turns in such engagement.

It will be noted that in the completed cathode assembly the heater element 33 is positioned firmly both laterally and longitudinally and relative longitudinal motion between the heater element and cathode cylinder 21 and sleeves 35 is prevented. Hence, frictional wearing away of the refractory insulating coating on the heater filament or of the insulating sleeves 35 also is prevented so that short-circuiting of adjacent heater turns and short-circuits between the filament and the cathode cylinder 21 by way of the wires or rods 34 or by contact of the bared filament and the cylinder 21 cannot occur. Thus, the device may be subjected to shocks and vibration without impairment of operation of the cathode.

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

What is claimed is:

1. A cathode assembly comprising a hollow cylindrical cathode member, a fixed member adjacent one end of said cathode member, a helical heater element within said cathode member and having one end seated against said fixed member, support means for said heater element in lateral engagement therewith, and means compressing said element against said fixed member to lock said element against longitudinal movement relative to said support means.

2. A cathode assembly comprising a hollow cylindrical cathode member, a support post extending within said cathode member, a fixed member adjacent one end of said cathode member, a helical heater filament having an insulating coating thereon, said filament having one end abutting said fixed member and being seated laterally against said support post, and anchoring means coupled to said fixed member and engaging the other end of said filament for preventing relative longitudinal motion between said filament and said post.

3. A cathode assembly comprising a hollow cylindrical cathode member, support members within and extending between the ends of said cathode member, means including a closure member at one end of said cathode member fixing said support members relative to said cathode member, a helical heater filament within said cathode member, in lateral engagement with said support members and having one end abutting said closure member, said filament having an insulating coating thereon, and means compressing said filament against said closure member and locking said filament against longitudinal motion relative to said cathode and support members.

4. A cathode assembly comprising a hollow cylindrical cathode member, a plurality of parallel support posts extending between opposite ends of said cathode member and immediately adjacent the inner wall thereof, means at opposite ends of said posts fixedly mounting said posts from said cathode member, a helical heater filament having an insulating coating thereon, extending between said posts and in lateral engagement therewith, and means anchoring said filament against longitudinal motion relative to said posts.

5. A cathode assembly comprising a hollow cylindrical cathode member, closure members at opposite ends of said cathode member and fixed thereto, support posts extending between said closure members and fixed thereto, a helical heater filament having an insulating coating thereon and mounted upon said posts, and means clamping said filament longitudinally against one of said closure members.

6. A cathode assembly comprising a hollow cylindrical cathode member, closure members at opposite ends of said cathode member and fixed thereto, support posts extending between

said closure members and fixed thereto, a helical heater filament having an insulating coating thereon and mounted upon said posts, an anchoring means extending from one of said closure members and engaging the end of said filament remote therefrom for compressing said filament against said one closure member.

7. A cathode assembly comprising a hollow cylindrical cathode member, closure members at opposite ends of said cathode member and fixed thereto, a support extending between said closure members and anchored thereto, a helical heater filament having an insulating coating thereon and seated at one end against one of said closure members, said filament being engaged laterally by said support, and locking means fixed to said one closure member and engaging the other end of said filament for compressing said filament against said one closure member.

8. A cathode assembly comprising a hollow cylindrical cathode member, a closure member secured to one end of said cathode member, a plurality of posts extending within said cathode member and fixed to said closure member, a helical heater filament within said cathode member and having one end seated against said closure member, said filament having an insulating coating thereon and being in lateral engagement with said posts, and means for compressing said filament against said closure member and locking said filament against longitudinal motion relative to said posts.

9. A cathode assembly comprising a hollow cylindrical cathode member, closure members at

opposite ends of said cathode member and fixed relative thereto, supports extending between said closure members and supported therefrom, a helical heater filament having an insulating coating thereon, mounted by said supports and seated at one end against one of said closure members, a draw member seated against the other end of said filament, and means for drawing said draw member toward said one closure member and anchoring it with respect thereto.

10. A cathode assembly comprising a hollow cylindrical cathode member, closure discs at opposite ends of said cathode member, a helical heater filament disposed coaxially within said cathode member, having an insulating coating thereon and having one end engaging one of said closure discs, a plurality of insulating supports extending between said discs and supported thereby, said supports being disposed between and in engagement with said filament and the inner wall of said cathode member, a draw piece engaging the other end of said filament, and a draw wire affixed to said draw piece and anchored to said one disc.

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