April 11, 1939. R. B. AYER 2,154,298

CATHODE FOR ELECTRON DISCHARGE DEVICES

Filed Oct. 16, 1936

Fig. 6.

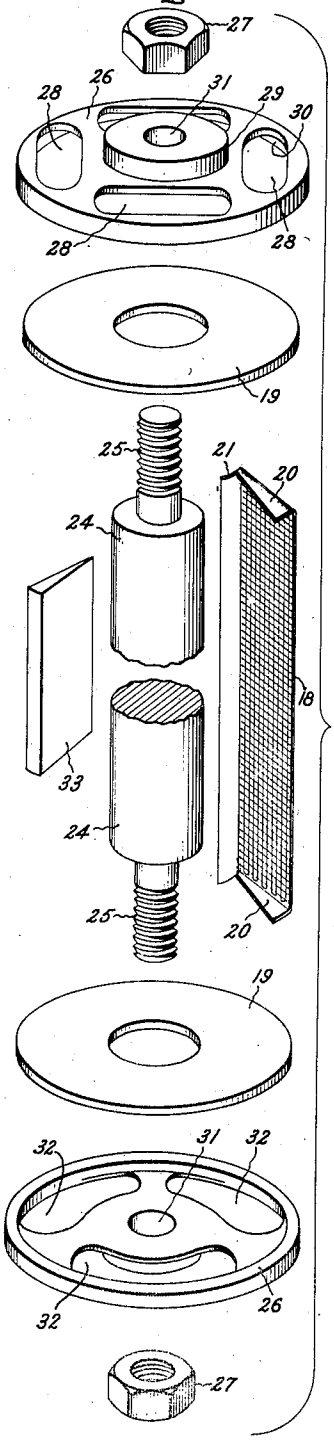


Fig. 1.

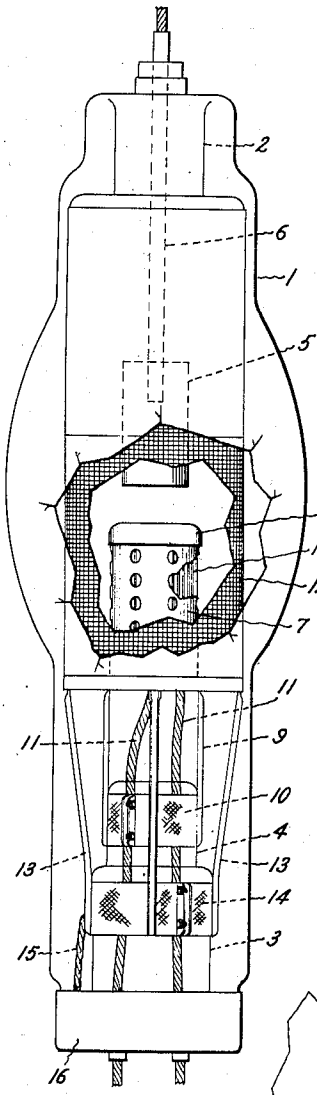


Fig. 3.

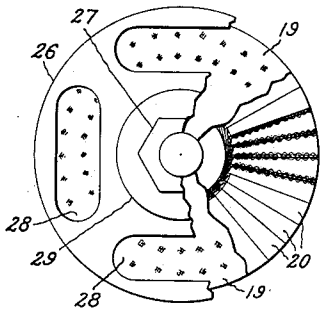


Fig. 2.

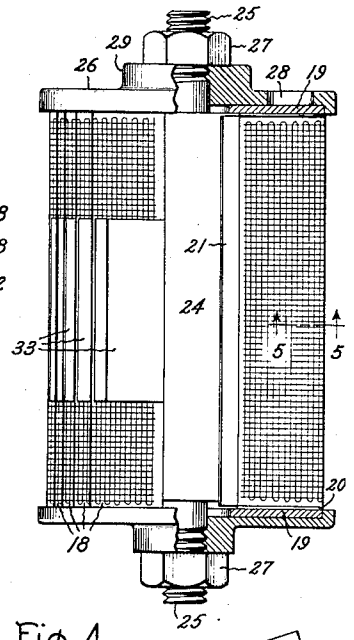


Fig. 4.

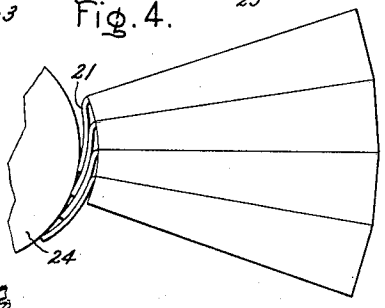


Fig. 5.



Inventor:
Raymond B. Ayer,
by Harry E. Dunham
His Attorney.

Patented Apr. 11, 1939

2,154,298

UNITED STATES PATENT OFFICE

2,154,298

CATHODE FOR ELECTRON DISCHARGE DEVICES

Raymond B. Ayer, Verona, N. J., assignor to General Electric Company, a corporation of New York

Application October 16, 1936, Serial No. 105,844

3 Claims. (Cl. 250—27.5)

The present invention relates to electron discharge apparatus and more particularly to the cathode structure thereof.

Radio transmitting tubes, power rectifiers and other tubes that handle considerable power usually employ an indirectly heated cathode of the built-up or assembled type. The electron-emitting surfaces of many of these cathodes constitute vanes or metal strips which are arranged around a cylinder and brought to an electron-emitting temperature by a heater contained within the cylinder. These vanes are usually coated with an electronically active material such as barium or strontium oxide. As the power handled by the tube becomes greater, necessitating greater electron emission and larger cathodes, the cathode structure becomes quite complicated and in many cases bulky. The power consumed in heating such a cathode is also considerable so that the matter of cathode efficiency is a very important item. While cathodes have been made which adequately fulfill this requirement, the prior art has not so far produced a high efficiency cathode which is well suited to the practice of mass production methods.

Accordingly, the objects of the present invention are to provide an indirectly heated cathode of the assembled type which is of rigid, simple and inexpensive construction, lending itself to quantity production methods of manufacture, and is efficient during operation. These objects are attained, in brief, by providing a vane type of cathode and forming arcuate extensions on each vane so that when the vanes are assembled on an improved type of mandrel, the arcuate extensions form an enclosure in which a heater may be mounted. The vanes are held in position between two disks by means of tabs formed integral with the vane. The vanes can be very quickly assembled, as will be described in detail hereinafter, and when properly secured between the disks, constitute a rigid structure. For a better understanding of the invention, reference should now be had to the following specification and the accompanying drawing in which Fig. 1 is an elevational view, partly broken away, of a tube containing a cathode of the improved type; Fig. 2 is an enlarged view of a partly assembled cathode; Fig. 3 is a plan view, partly broken away and in section, of the cathode, also showing a fragmentary portion of the assembly mandrel; Fig. 4 is another assembly view, showing the manner in which the vanes fit together; Fig. 5 is a greatly enlarged cross-sectional view taken along line 5—5 in Fig. 2; while Fig. 6 is an exploded view of the improved mandrel and various parts of the cathode, including the wedge spacers.

Referring more particularly to Fig. 1, numeral 1 designates an envelope, preferably of bulbous configuration, which terminates at one end in a reentrant stem 2 of uniform diameter and at the other end in the stem 3 having a reduced diameter portion 4. The envelope contains an anode 5 of carbon or metal which is secured to the stem 2 by a rod 6 which also serves as a leading-in conductor. There is an indirectly heated cathode, the details of which will be described presently, presented to the end of the anode 5 and in coaxial alignment therewith. The cathode is provided with one or more perforated heat shields 7 and a pair of terminating caps 8. The cathode structure is supported from the stem 4 by means of a plurality of equidistantly spaced rods 9 which terminate in a screw clamp 10. A pair of conductors 11 is taken from the cathode to the exterior of the tube. An electrostatic control element or grid 12, preferably made of mesh or perforated material, surrounds the electrodal space between the cathode and anode and is held in position by rods 13 which terminate at a screw clamp 14 embracing the stem 3. A conductor 15 is taken from the clamp 14 to the exterior. The tube may be provided with a metal cap 16, and the various leading-in conductors taken through the cap in any suitable manner.

The details of the cathode are shown in the remaining figures of the drawing. The cathode is constituted of a large number of radially extending vanes 18 which are equidistantly spaced and when assembled in the manner described hereinafter on a demountable mandrel, are welded at each end to a disk 19. To facilitate making this weld, the vanes are provided at each end with tabs 20 bent at right angles to the vanes so that when completely assembled, the two disks 19 can be spot-welded to the tabs, producing a rigid structure. As shown more particularly in Figs. 4 and 6, the inner longitudinal edge of the strips is provided with an arcuate portion 21 which, when assembled together in an overlapping position, as shown in Fig. 4, form a closed cylinder in which a resistance heater (not shown) may be mounted. As indicated in Fig. 2, both sides of each vane may have secured thereto, as by welding, a piece of mesh material to form interstices which receive the electronically active material. Fig. 5 is an enlarged view of one of the vanes covered with the mesh and coated with active material, and clearly shows the manner in

which the strands of the mesh serve to bind the active material to the surface.

In assembling a cathode of the type described, a mandrel such as that shown in Fig. 6 may be conveniently used. This mandrel consists essentially of a round shaft 24 of a diameter comparable with the diameter of the inner cylinder of the cathode formed by the arcuate portions 21 referred to hereinbefore. The shaft is provided with screw threaded extensions 25 at each end. The remaining parts of the mandrel assembly include two heavy washers 26 and a pair of nuts 27 which are adapted to engage the threads on the screw extensions 25. The upper washer 26 is provided with four slotted openings indicated at 28, the purpose of which will be explained presently, and has a thin hub 29, and is provided with a depending lip 30 which has an internal diameter slightly larger than the external diameter of the disk 19. The washer 26 and hub 29 have a central opening 31 of a size sufficient to clear the threaded portion 25.

The lower washer 26 is similar to the upper washer 26 except that instead of four slotted openings, only three openings 32 of this character are provided.

After the vanes have been cut from strip material and the arcuate portions 21 and the tabs 20 formed thereon, the next step may be either to coat the vanes directly with an electronically active material in any suitable and well-known manner, or to provide the vanes with a mesh overlay and thereafter fill the interstices of the mesh with the active material. It will be understood that if desired, the coating process may be deferred until after the vanes have been assembled. The disks 19 are then assembled on a shaft 24 and held apart a distance comparable to the length of the vanes. The vanes are then spaced around the shaft with the arcuate portions 21 abutting the shaft in the manner shown more clearly in Fig. 4, the vanes being spaced apart by wooden wedges 33 of predetermined thickness and taper. When the vanes have been all assembled around the shaft and equidistantly spaced by the wedges, the upper and lower washers 26 are placed over the washers 19 so that the threaded rods 25 project through the openings 31. The nuts 27 are then tightened down, holding the vanes 18 securely in place. In order to prevent the wedges 33 from moving outwardly while the nuts are being tightened, a wire strap (not shown) may be applied around the assembled vanes and interposed wedges.

The assembly is then welded together by applying the welding electrodes to one of the disks 19 through the apertures 28 or 32, as is indicated more clearly in Fig. 3 wherein the small cross-hatched circles represent the spot-welds. When as many of the joints as possible have been welded through the openings 28 and 32, the nuts 27 are slightly loosened and the washers 26 rotated a few degrees so as to leave exposed fresh surfaces on the disks 19 to be welded. After all of the joints between the tabs 20 and both disks have been given at least two radial welds, the mandrel is disassembled by loosening the nuts and the wedges 33 removed after loosening the wire strap.

It will be found that a cathode made in this manner is extremely rigid and after a little experience can be very quickly assembled and welded. The arcuate portions 21 together form a completely closed cylinder in which may be mounted a heater of any suitable design. The heat generated by the heater is transferred to the vanes very efficiently on account of the fact that the arcuate portion 21 is integral with the vane and there is no joint at this place. Moreover, the tabs 20 provide a large flat surface to which the disk 19 can be securely welded. By making the vanes in the manner described, i. e., by forming the arcuate extensions 21 and the tabs 20 integral with the vanes, the latter may be cut from the raw strip material with little or no spoilage. Moreover, the arcuate portion 21 may be coated with the electronically active material at the same time that the remainder of the vane is coated so that all active parts of the cathode are coated with the active material.

What I claim as new and desire to secure by Letters Patent of the United States is:

1. A cathode of elongate configuration for an electron discharge device comprising a plurality of spaced vanes extending outwardly from an enclosure and lengthwise of the cathode, said enclosure being formed of integral extensions of the vanes, disks secured to the ends of said vanes, and a heater within said enclosure.

2. A cathode of elongate configuration for an electron discharge device comprising a plurality of spaced vanes extending radially from a cylinder and lengthwise of the cathode, said cylinder being formed of integral arcuate extensions of the vanes, circular disks secured to the ends of said vanes, and a heater within said cylinder.

3. A cathode of elongate configuration for an electron discharge device comprising a plurality of equidistantly spaced vanes extending outwardly from an enclosure and lengthwise of the cathode, said enclosure being formed of integral extensions of the vanes, said vanes being also provided at each end with tabs and disks welded to said tabs, and a heater within said enclosure.

RAYMOND B. AYER.