Feb. 9, 1937. V. L. HOLDAWAY 2,069,832

ELECTRIC DISCHARGE DEVICE

Filed Dec. 29, 1934

FIG. 1

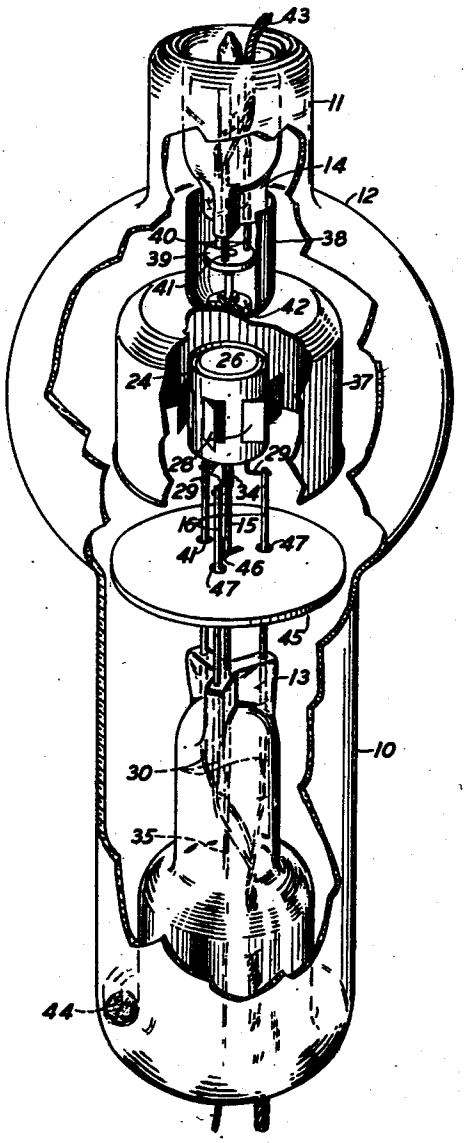


FIG. 2

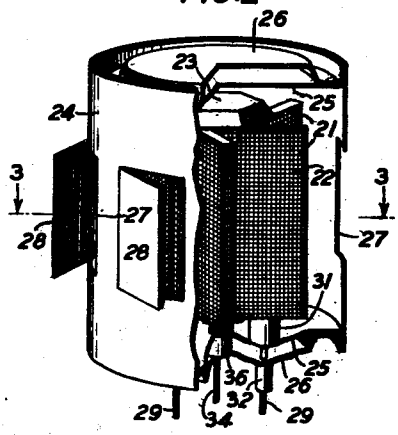


FIG. 3

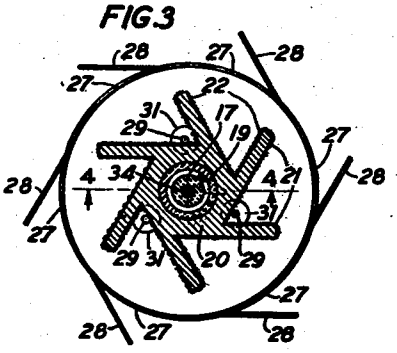


FIG. 4

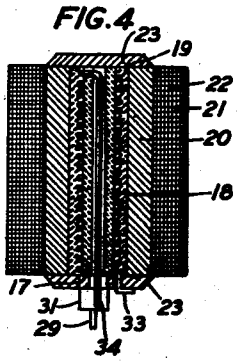
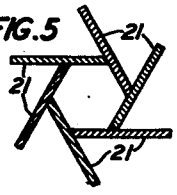


FIG. 5



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ELECTRIC DISCHARGE DEVICE

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3 Claims. (Cl. 250—27.5)

This invention relates to electric discharge devices and more particularly to an equipotential cathode assembly for such devices.

One object of this invention is to increase the thermal efficiency and operating life of cathodes for electric discharge devices.

Another object of this invention is to obtain good adhesion of thermionic material to the carrier therefor in cathodes.

Still another object of this invention is to obtain a substantially uniform dispersion of electrons from a cathode to an anode.

In one embodiment of this invention a cathode assembly comprises a cylindrical core of insulating material, a heater filament disposed about the core and coated with an insulating material, and a cathode element including a plurality of vanes arranged at like angles to radii of the cathode, the vanes being coated with a thermionic material such as alkaline earth oxides. In order to obtain good adhesion of the thermionic material, the vanes may be provided with flutes or corrugations, or otherwise mechanically roughened, they may have mesh screens secured to the surfaces thereof, or they may have a coarse grained layer of metal applied to their surfaces.

The cathode is substantially enclosed in a heat conserving shield including a cylindrical portion having lateral openings for allowing egress of electrons, and double walled end portions. In order to obtain a reflection of heat to the cathode and at the same time allow the electric field to penetrate to the cathode, and also to insure a uniform dispersion of space current, the cylindrical portion of the shield is provided with a plurality of deflectors or fins partially overlying the openings and arranged in the same relation, for example, parallel to the corresponding cathode vanes.

The cathode and shield assembly may be disposed within a cup-shaped anode disposed coaxially with the shield.

The invention and the 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 a perspective view of an electric discharge device illustrative of one embodiment of this invention, portions of the enclosing vessel and of the anode being broken away to show the internal structure more clearly;

Fig. 2 is a detail view in perspective of the cathode and shield assembly in the device shown in Fig. 1, portions of the shield being broken away to show details of construction more clearly;

Fig. 3 is a cross-sectional view along line 3—3 of Fig. 2;

Fig. 4 is a cross-sectional view along line 4—4 of Fig. 3; and

Fig. 5 is a cross-sectional view showing another manner of forming the cathode.

Referring now to the drawing, the electric discharge device shown therein comprises an enclosing vessel including cylindrical end portions 10 and 11 and an intermediate bulbous portion 12, the end portions 10 and 11 having inwardly extending stems terminating in tri-armed presses 13 and 14, respectively.

A cathode and shield assembly is supported from the press 13 by a wire or rod 15 embedded in the press at the center thereof and a plurality of rods or wires 16 each embedded in one arm of the press. The cathode, as shown clearly in Figs. 3 and 4, comprises a tubular core 17 of a suitable ceramic or insulating material, which is encompassed by a helical heater filament 18. The heater filament may be covered with an insulating coating 19. Disposed about the coating 19 is a metallic member, for example of nickel, having a central tubular portion 20 and a plurality of vanes 21, which are uniformly spaced and preferably are disposed at substantially the same angle to the corresponding radius, in simulation of a pin wheel or substantially tangential with respect to the central tubular portion 20. The metallic member may be milled from a single piece of material or the central tubular portion 20 and the vanes 21 may be formed separately and the vanes 21 then secured, as by welding, to the central portion and substantially tangent thereto. The body of the cathode may also be formed by a number of flat strips of metal suitably secured together as shown in Fig. 5. The heating element is placed within the regular closed polygon formed, and a continuous metallic path free from joints or welds is thus provided from the area receiving the heat radiation to the extremities of the fins or vanes. Metallic end members or discs 23 are suitably secured, as by welding, to the tubular portion 20 and hold the core 17 and heater filament 18 in position.

The metallic member 20, 21 serves as the cathode element of the device and the vanes 21 may be coated with a thermionic material such as alkaline earth metal oxides. In order to insure good adhesion of the thermionic material to the vanes, the latter may have secured thereto, prior to the application of the thermionic material, wire mesh members or screens 22. Alternatively, the screens 22 may be omitted and

the surfaces of the vanes 21 roughened or corrugated to assure good adhesion of the thermionic material thereto.

The cathode element 20, 21 is substantially enclosed by a shield comprising a cylindrical portion 24 coaxial with the cathode element, and double walled end portions each including a flat disc or plate 25 and a flanged dished plate 26. The shield may be of nickel or the like and serves to conserve the cathode heat whereby a high thermal efficiency is obtained. The cylindrical portion 24 is provided with a plurality of equally spaced apertures 27 through which electrons emanating from the cathode may pass. In order to obtain a uniform dispersion of the electrons, the cylindrical portion 24 of the shield is provided with fins or vanes 28 arranged in simulation of a pin wheel, each fin or vane 28 being disposed in the same relation, for example substantially parallel, to a corresponding one of the vanes 21.

The cathode and shield assembly may be supported as a unit by a plurality of L-shaped wires or rods 29 which are secured, as by welding, to the cathode member 20, 21 and to the rods or wires 16. Each of the rods or wires 16 has secured thereto a conductor 30, the several conductors being entwined as shown in Fig. 1 and forming a leading-in connection to the cathode.

Each of the L-shaped wires or rods 29 carries an insulating sleeve 31, the sleeves spacing the cathode element from the lower disc or plate 25, and a metallic sleeve 32 against which the lower dished plate 26 abuts.

One end 33 of the heater filament 18 is secured to the lower end member 23. The other end 34 of the heater filament extends through the central bore in the insulating core 17 and is secured to the wire or rod 15 which has a leading-in conductor 35 secured thereto. The end 34 of the heater filament is insulated from the shield by an insulating member 36 disposed between the lower disc 25 and plate 26. The electrical circuit for the heater filament, then, comprises the conductor 35, rods or wires 15 and 34, filament 18, lower end member 23, shield 24, 25, 26, wires 29, rods or wires 16 and conductors 30. The space current circuit connection to the cathode is made through conductors 30 and rods or wires 16 and 29, the wires 29 being connected to the cathode proper. This prohibits the space current from passing through the heater coil.

The cathode and shield may be disposed within and coaxial with an inverted cup-shaped anode 37 having secured thereto a cup-shaped shield 38 encompassing the press 14. A platform 39 is disposed within the cup-shaped shield 38 and supported by a plurality of rods or wires 40 embedded in the press 14, and carries a stud 41 which is threaded to a collar 42 secured to the shield 38 and anode 37. Entwined leading-in conductors 43 are connected to the rods or wires 40, as shown in Fig. 1.

The enclosing vessel may have therein a quantity of mercury 44 which vaporizes during the operation of the device and forms a conductive vapor between the cathode and anode. In order to prevent excessive heating of the mercury and also to protect the press 13 from the heat of the cathode, a heat shield 45, which may be a disc of nickel or the like, is provided. The shield 45 is provided with an integral lip 46 which is secured to the rod or wire 15 and is provided also with oversized apertures 47 through which the rods or wires 16 pass. It is to be understood, of course, that other vapors or gases at suitable pressures may be used in this device.

Although a specific embodiment of the invention has been shown and described, it will be understood, of course, that 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. An electric discharge device comprising a cathode having angularly disposed vanes, a shield including a cylindrical portion encompassing said cathode, and having lateral openings, one for each of said vanes and deflector fins adjacent said openings and disposed in the same relation to corresponding vanes.

2. An electrode assembly comprising a cathode having angularly disposed vanes, a shield including a cylindrical portion encompassing said cathode and having lateral openings, one for each of said vanes, and deflector fins mounted on said portion and partially overlying said apertures, each of said fins being substantially parallel to a corresponding one of said vanes.

3. An electric discharge device comprising a cathode having angularly disposed vanes, a shield including a cylindrical portion encompassing said cathode and having lateral openings therein, one for each of said vanes, deflector fins adjacent said openings and disposed in the same relation to the corresponding vanes, and a cup-shaped anode encompassing said cylindrical portion.

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