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2,399,003

ELECTRIC DISCHARGE DEVICE

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Fig. 1.

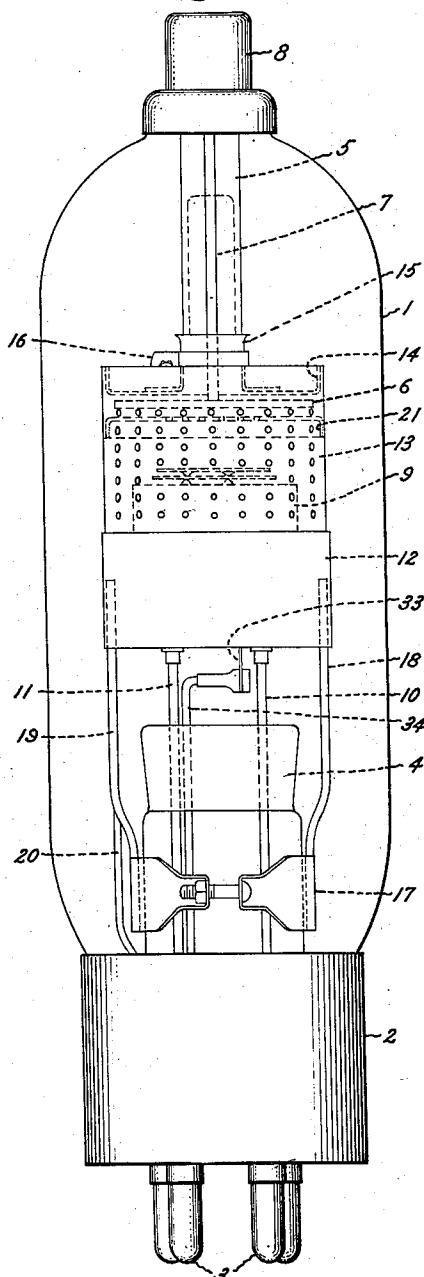


Fig. 2.

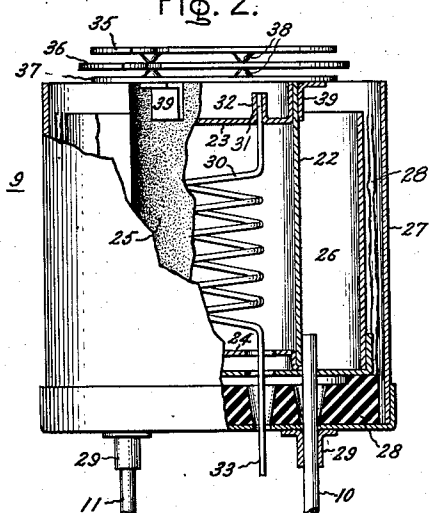
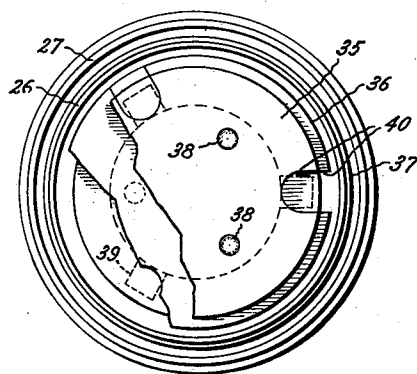


Fig. 3.



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UNITED STATES PATENT OFFICE

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ELECTRIC DISCHARGE DEVICE

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6 Claims. (Cl. 250—27.5)

My invention relates to electric discharge devices and more particularly to improvements in the electrode structure and associated shields for electric discharge devices of the type employing an ionizable medium.

The operation of electric discharge devices at high voltages, and particularly intermittently at high voltages, imposes a number of requirements on the devices not encountered to an appreciable extent in lower voltage continuous operation. For example, in devices utilizing a thermionic cathode having emitting portions at varying distances from the anode, it has been found, particularly in pulse operation, that most of the emission tends to take place from a limited area of the cathode with the result that the emitting surface of the cathode in this area is damaged and the emission shifts to another localized area. In this way the surface of the cathode is progressively destroyed and the cathode structure as a whole has a short life. This defect also requires a large cathode structure for a given rating tube to provide an adequate emitting surface. In accordance with my invention I provide a cathode and shielding structure in which the emission is evenly distributed over the cathode surface.

It is an object of my invention to provide a new and improved electric discharge device.

It is another object of my invention to provide a new and improved cathode and shielding structure for an electric discharge device.

It is still another object of my invention to provide a new and improved cathode construction which readily emits an adequate supply of electrons and in which the emission takes place uniformly over the surface of the cathode.

In accordance with the illustrated embodiment of my invention an electric discharge device of the gas filled type is provided with a cathode and shielding construction including a substantially cylindrical cathode which is surrounded and supported by an open-ended cylindrical shield. At the end of the cathode adjacent the open end of the shield member is mounted additional structure in the form of a plurality of disks supported concentrically with the cathode and having a diameter substantially greater than the cathode cylinder and substantially less than the diameter of the cylindrical shield. This construction has been found to distribute the emission over the cathode surface, to conserve the heat supplied to the cathode and to prevent any contaminating material from the cathode from becoming deposited on the control member or grid.

For a better understanding of my invention, reference may be had to the following description taken in connection with the accompanying drawing, and its scope will be pointed out in the appended claims. In the drawing, Fig. 1 is an elevational view of an electric discharge device embodying my invention; Fig. 2 is an enlarged elevational view, partially broken away, of the cathode and shielding structure employed in the device of Fig. 1, and Fig. 3 is a plan view of the construction shown in Fig. 2.

Referring now to the drawing, I have shown in Fig. 1 an electric discharge device comprising a generally cylindrical envelope 1 having an insulating base member 2 secured to one end thereof and provided with the usual contact prongs 3. The electrode structure of the device is supported from a stem press 4 in the lower end of the envelope and a rod-like portion 5 depending from the upper end of the envelope. The anode 6, which is preferably in the form of a disk formed of nickel or similar material, is supported by a lead-in conductor 7 which passes centrally through the glass portion 5 and terminates in a terminal cap 8 which is cemented or otherwise secured to the top of the envelope 1. The cathode and shielding structure, designated generally by the numeral 9, is supported from the press 4 by a pair of rigid conductors 10 and 11. These conductors are secured to separate ones of the contact prongs 3. The discharge space between the anode 6 and the cathode and shielding structure 9 is totally enclosed by a grid and shield structure of generally cylindrical form. As illustrated in the drawing, this structure includes a lower portion 12 in the form of a sheet metal band and an upper portion 13 in the form of a perforated sheet metal cylinder. The portions 12 and 13 are joined together and closed at the upper end by a header 14 having a central flange 15 which is clamped to the lower end of the rod-like glass member 5 by a suitable clamp 16. The lower end of the grid cylinder is supported from the stem press 4 by a clamp 17 and a pair of rigid conductors 18 and 19 which are secured at one end to the clamp and at the other end to the band 12 of the grid cylinder. A rigid conductor 20 is connected between the grid structure and one of the contact prongs to provide an external grid connection. The control grid of the device is provided by a transverse disk 21 which is welded to the upper portion 13 of the grid cylinder. The member 21 is located close to the anode 6 and has the central portion thereof provided with a large number of small openings (not shown)

through which the discharge takes place. The envelope is evacuated in accordance with usual practice and is charged with an ionizable medium which may to advantage be a gas such as hydrogen under a pressure of one to several hundred microns. Preferably, the operating pressure is in the neighborhood of 500 or 600 microns.

Referring now to Figs. 2 and 3, which show in detail the cathode shield construction of Fig. 1, the cathode proper is formed of a cylinder 22 which is closed at opposite ends by headers 23 and 24. The exterior of the cathode cylinder 22 is provided with a coating 25 of material which provides a good source of electrons when heated to a predetermined temperature. The coating may comprise a composition including alkaline earths or alkaline earth oxides and may to advantage be applied to a fine metal mesh which is secured to the exterior of the grid cylinder 22 by sintering. The cathode cylinder is supported centrally in a cylindrical heat shield structure open at one end and including an inner member 26 and an outer member 27 of larger diameter. As indicated on the drawing, the wall of member 26 terminates short of the upper end of the cathode cylinder while the wall of the outer cylinder terminates substantially flush with the end of the cathode cylinder. The members 26 and 27 of the heat shield structure are spaced at their lower ends by a disk 28 of insulating material, and the space between the side walls of these members may be filled with heat insulating material such as sheet metal foil 28'. The cathode cylinder 22 and the cylinders 26 and 27 of the heat shield construction are secured together by the rigid conductors 10 and 11 which are welded to the cathode cylinder and the inner cylinder 26 of the heat shield and to the eyelets 29 which are secured to the base of the cylinder 27. A helical heating element 30 is supported within the grid cylinder 22 to provide the means for maintaining the cathode at operating temperature. As illustrated in the drawing, the upper end 31 of the heater is welded to an eyelet 32 formed integrally with the upper header 23 of the cathode. The lower end 33 of the filament passes through the lower header of the cathode and through the lower ends of cylinders 26 and 27 and through the insulating disk 28. The conductor 33 is welded to a rigid conductor 34 which is supported from the stem press 4 and connected with one of the contact prongs 3. In order to minimize the energy required to maintain the cathode at operating temperature, as well as to control the distribution of emission over the cathode surface and prevent foreign substances from the cathode from depositing on control member 21, I provide a novel shield arrangement which cooperates with the cathode cylinder and the shields 26 and 27. As illustrated, this shield arrangement includes a plurality of metal disks 35, 36 and 37 which are maintained in spaced relation by indentations 38 formed on plates 35 and 37. The three plates are welded together at the indentations so that they form a unitary assembly which is secured to the upper end of the cathode cylinder by angular brackets 39. These brackets are welded to the cathode cylinder and to the lower plate 37 of the shield assembly. Suitable notches 40 are provided in disks 35 and 36 to permit the welding electrode to engage the upper surface of plate 37 at the location of the brackets 39. The perforations in the grid member 21 are preferably confined

to a circular area slightly smaller than the area of the disk 35.

I have found that the construction described above, in which the annular space between the cathode cylinder and heat shield is partially closed at the upper end by a shield of substantially larger diameter than the cathode cylinder, provides improved operation and a longer life, and that emission is distributed uniformly over the surface of the cathode.

While I have shown and described a particular embodiment of my invention, it will be obvious to those skilled in the art that changes and modifications may be made without departing from my invention in its broader aspects, and I, therefore, aim in the appended claims to cover all such changes and modifications as fall within the true spirit and scope of my invention.

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

1. In an electric discharge device, a thermionic cathode comprising a cylindrical member having an electron emitting surface, a shield structure surrounding said cathode including a cylinder substantially coaxial with said cathode and open at one end, and a shield for partially closing the annular space between said cathode and the wall of said cylinder including a disk-like member supported adjacent the end of said cathode at the open end of said cylinder, said disk-like member being substantially larger than said cathode to prevent emission from said cathode from localizing at the region adjacent the open end of said cylinder.

2. In an electric discharge device, a thermionic cathode comprising a cylindrical member having an electron emitting surface, a shield structure surrounding and supporting said cathode including a cylinder substantially coaxial with said cathode and open at one end, and a shield for partially closing the annular space between said cathode and the wall of said open-ended cylinder including a disk-like member supported from the end of said cathode, said disk-like member being substantially larger than said cathode to prevent emission from said cathode from localizing at the region adjacent the open end of said cylinder.

3. In an electric discharge device, a thermionic cathode comprising a cylindrical member having an electron emitting surface, a shield structure surrounding and supporting said cathode including a pair of open-ended concentric cylindrical members substantially coaxial with said cathode, and a shield for partially closing the annular space between said cathode and the wall of the outer one of said open-ended cylinders including a disk-like member supported adjacent the end of said cathode and substantially in the plane of the open end of the outer member of said shield structure, the inner member of said shield structure terminating a substantial distance short of the plane of said disk-like member, said disk-like member being substantially larger than the cross section of said cathode to prevent emission from said cathode from localizing at the region adjacent the open end of said cylinder and substantially smaller than the outer member of said shield structure to provide a discharge passage.

4. In an electric discharge device, a plate-like anode, a cathode comprising a cylindrical member in spaced relation to said anode and having the axis thereof extending substantially perpendicular to said anode, a shield structure in-

cluding a cylindrical member open at the end nearer the anode and surrounding said cathode in spaced relation thereto, a grid structure including a metal cylinder surrounding said anode, said cathode and said shield structure and a transverse member supported within said metal cylinder between said anode and said cathode, and a second transverse member within said cylinder and adjacent the end of said cathode nearer the anode, said second member being substantially larger in diameter than said cathode and substantially smaller in diameter than the metal cylinder of said shield structure.

5. In an electric discharge device, an anode having a planar discharge receiving surface, a thermionic cathode comprising a cylindrical member in spaced relation to said anode surface and having the axis thereof extending substantially perpendicular to said anode, a shield structure including an open ended cylindrical member surrounding said cathode in spaced relation thereto, a grid structure including a metal cylin-

der surrounding said anode, said cathode and said shield structure, a first transverse member supported within said grid structure between said anode and said cathode, and a second transverse member within said cylinder and supported from the end of said cathode nearer the anode, said second member being substantially larger in diameter than said cathode and substantially smaller in diameter than the metal cylinder of said shield structure to shield said first transverse member from said cathode and to effect a distribution of emission over said cathode surface.

6. A cathode construction including a cylindrical sleeve-like cathode, a plurality of disks of larger diameter than said cathode, certain of said disks being provided with indentations and said disks being welded together at said indentations to provide a unitary assembly of spaced disks, and means for securing one of said disks to one end of said cathode.

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