April 20, 1943. V. L. RONCI 2,317,222

ELECTRON DISCHARGE DEVICE

Filed March 20, 1941 2 Sheets-Sheet 1

FIG. 1

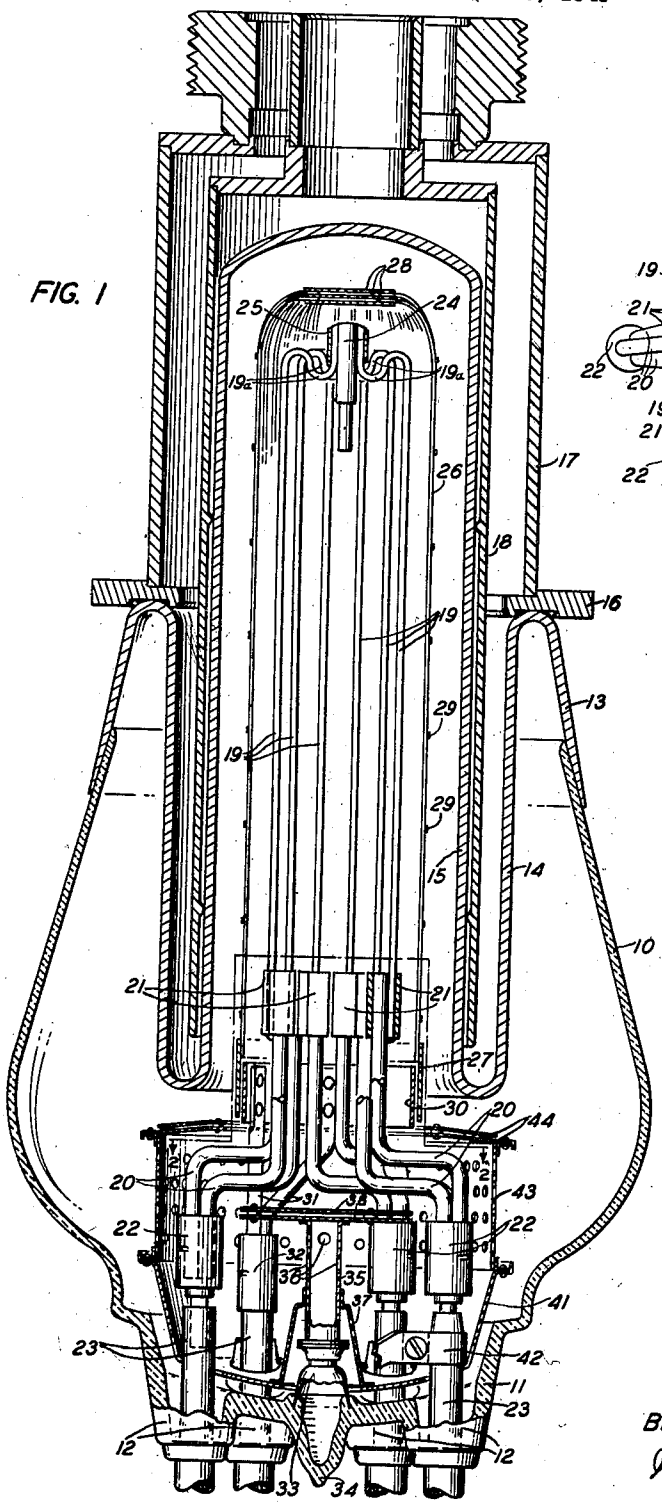


FIG. 2

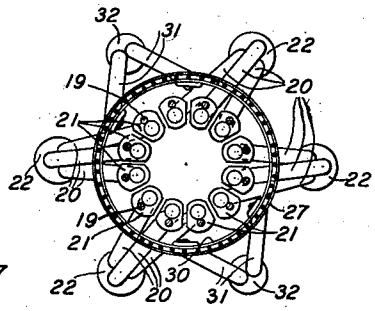
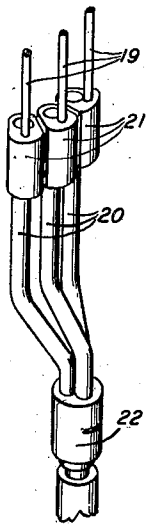


FIG. 3



INVENTOR
V. L. RONCI
BY
Walter C. Kiesel
ATTORNEY

April 20, 1943. V. L. RONCI 2,317,222

ELECTRON DISCHARGE DEVICE

Filed March 20, 1941 2 Sheets-Sheet 2

FIG. 4

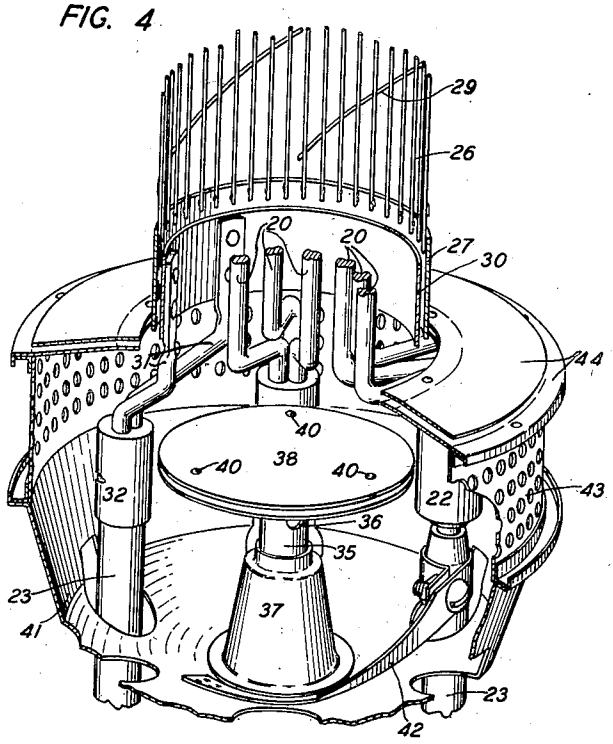


FIG. 8

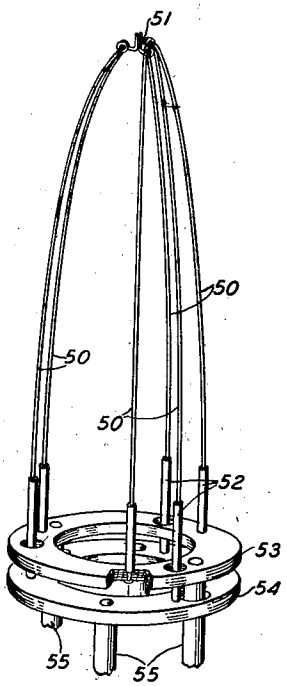


FIG. 5

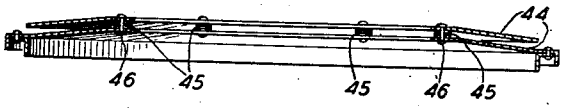


FIG. 6

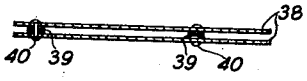
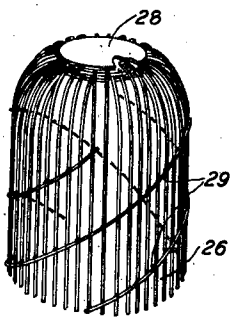


FIG. 7



INVENTOR
V. L. RONCI

BY Walter C. Kiesel

ATTORNEY

Patented Apr. 20, 1943 2,317,222

UNITED STATES PATENT OFFICE

2,317,222

ELECTRON DISCHARGE DEVICE

Victor L. Ronci, Brooklyn, N. Y., assignor to Bell Telephone Laboratories, Incorporated, New York, N. Y., a corporation of New York

Application March 20, 1941, Serial No. 384,255

4 Claims. (Cl. 250—27.5)

This invention relates to electron discharge devices and more particularly to such devices of high power capacity.

Electron discharge devices comprise in general a plurality of electrodes and leading-in conductors therefor which are sealed in one wall of the enclosing vessel of the device or a base secured to the vessel. The wall or base may be in whole or in part of vitreous material. In devices of high power capacity, considerable heat is developed in the electrode structure, principally in the cathode and the anode and in the leading-in conductors for the cathode, and when, as is frequently the case, the electrodes extend into proximity to the points at which the electrode leading-in conductors are sealed to the wall or base of the enclosing vessel, the heat thus developed may be of sufficient intensity to soften or even destroy the seals. In addition, in such devices, the anode may extend in proximity to the leading-in conductors for the cathode and the control electrode or grid so that the anode field deleteriously affects the operation of the device due to interaction of this field with the input elements of the device.

One object of the invention is to effectively screen, both electrically and thermally, the leading-in conductors for such electrodes as the cathode and grid of an electron discharge device. More specifically objects of this invention are to shield the leading-in conductor seals in an electron discharge device from heat generated in the device during operation thereof, to electrically screen the cathode and grid leading-in conductors from the anode, and to facilitate the construction of electron discharge devices including means for thermally and electrically shielding the leading-in conductors and the seals therefor.

In one illustrative embodiment of this invention, an electron discharge device comprises a cathode, grid and anode in coaxial relation, the anode forming a part of the enclosing vessel and the cathode and grid being supported by leading-in conductors sealed in a vitreous member which also forms a part of the enclosing vessel. These leading-in conductors are substantially enclosed in a metallic structure which is mounted on a single support sealed in the vitreous member and includes sets of baffles interposed between the electrodes and the leading-in conductor seals.

The invention and the various features thereof will be understood more clearly and fully from the following detailed description with reference to the accompanying drawings, in which:

Fig. 1 is an elevational view mainly in section of an electron discharge device illustrative of one embodiment of this invention;

Fig. 2 is a view along line 2—2 of Fig. 1 showing the arrangement and association of the elements of the cathode and the leading-in conductors therefor;

Fig. 3 is a detail perspective view illustrating the manner in which the cathode elements are connected to the leading-in conductors therefor;

Fig. 4 is another detail perspective view showing the construction of the baffle and shield assembly included in the device illustrated in Fig. 1, portions of the assembly being broken away to show more clearly the members enclosed by the assembly;

Figs. 5 and 6 are detail views in section of the baffle structures included in the assembly shown in Fig. 4;

Fig. 7 is a fragmentary view in perspective showing details of construction of the grid included in the device illustrated in Fig. 1; and

Fig. 8 is a perspective view illustrating another cathode construction which may be used in the device shown in Fig. 1.

Referring now to the drawings, the electron discharge device shown in Fig. 1 comprises an evacuated enclosing vessel having a generally pear-shaped vitreous portion 10, a dished base 11 of vitreous or ceramic material having a plurality of protuberances 12, and a metallic, e. g., copper, member including an outer wall 13 hermetically sealed to the vitreous portion 10, an inwardly extending cylindrical wall 14 and a central cup-shaped portion 15 which serves as the anode of the device. Secured to the metallic portion of the enclosing vessel adjacent the junction of the walls 13 and 14 is an annular metallic plate 16 which supports a pair of apertured, coaxial cup-shaped metallic members 17 and 18 defining with the anode 15 a chamber through which a cooling fluid may be circulated.

Mounted centrally within the anode 15 is a cathode which, in the form shown in Fig. 1, comprises a plurality, for example 12, of heavy wire, e. g., tungsten, elements 19 having reversely bent end portions 19a and mounted in parallel equally spaced relation in a cylindrical boundary. Each of the elements 19 is secured to a rigid metallic support 20 by a coupler member 21, the element and the corresponding support being fitted in apertures in the coupler member, as shown in

Figs. 1 and 3, and welded thereto. The supports 20 are grouped in threes, as shown in Figs. 2 and 3, and secured in other coupler members 22 affixed to leading-in conductors 23 sealed to the protuberances 12 on the base 11. At their other ends, the several elements 19 are connected together mechanically and electrically by a central stud or pin 24 to which they are clamped by a metallic band 25. The elements 19, then, may be connected electrically into two groups of six, each in parallel, the connection of the cathode leading-in conductors 23 preferably being such that the direction of current flow in each of the groups of three elements 19 is opposite to that in the two adjacent groups of three.

The stud or pin 24 and band 25, it will be noted, are supported by the cathode elements 19 so that substantially unrestrained expansion and contraction of these elements in accordance with temperature variations thereof is permitted. The reversely bent portions 19a of the elements 19 constitute flexible links between the linear portions of the elements and the stud or pin 24 whereby unequal expansion and contraction of the several elements is compensated for and the parallel relation of the elements and the cylindrical form of the cathode boundary are preserved.

The cathode is encompassed by a grid 26, which may be of the construction disclosed and claimed in the application Serial No. 376,564, filed January 30, 1941, of Victor L. Ronci, comprising a plurality of parallel wire verticals secured at one end to a foundation member or ring 27 and arranged in a cylindrical boundary coaxial with the anode and the cathode. As shown in Fig. 7, the grid verticals may be hairpin shaped and secured at their bights between parallel metallic plates 28, the verticals being bent inwardly adjacent the plates 28 to provide flexible sections to compensate for unequal expansion and contraction of the verticals with temperature variations therein. The verticals are maintained in parallel relation during expansion and contraction thereof by flexible wire helices 29 each having its turns secured to alternate verticals. The foundation member or ring 27 is fitted upon and secured to a metallic ring 30 which is supported by two pairs of rigid metallic rods 31 secured to two of the leading-in conductors 23 by a metallic coupler 32, as shown clearly in Figs. 2 and 4.

The device disclosed and described hereinabove, as is apparent, is operable at relatively high power levels. When the device is operated, intense heat is developed at the electrodes and particularly at the ends thereof toward the base 11 so that the various supports for the cathode and grid might be heated to such an extent as to shift from their intended positions and thereby cause displacement of the grid and cathode. Also the heat radiated might be sufficient to affect deleteriously or to destroy the hermetic seals between the leading-in conductors and the protuberances 12 on the base 11. To prevent these possible effects, means are provided in accordance with a feature of this invention to shield thermally the electrode supports and the seals from the heat radiated from the electrodes.

In the form shown in Figs. 1 and 4, this means is a unitary baffle and shield structure which encloses substantially portions of the cathode and grid supports and the leading-in conductors for these electrodes. Specifically, this structure comprises a hollow metallic hub 33 embedded in the base 11 and overlying the exhaust tubulature 34, a hollow metallic standard 35 secured to the hub 33 and provided with a plurality of apertures 36, and a metallic thimble-shaped member 37 affixed to the standard 35. Secured to the standard 35 at the inner end thereof are a pair of metallic baffles or plates 38 held in spaced relation by washer pile-ups 39 and rivets 40, as shown clearly in Fig. 6.

A cup-shaped metallic shield 41, provided with apertures through which the leading-in conductors 23 pass, is supported by the thimble-shaped member 37 and is connected electrically to one of the cathode leading-in conductors 23 by a metallic band 42, one end of which is clamped about the leading-in conductor and the other end of which is affixed, as by spot welding, to the shield 41. The shield 41 in turn supports a cylindrical, perforated metallic shell 43 on which there is mounted an annular baffle structure including metallic plates 44 secured to one another in parallel space relation by washer pile-ups 45 and rivets 46, as shown clearly in Fig. 5.

It will be appreciated that the shield and baffle construction shown and described effectively and efficiently screens the leading-in conductors, supports and seals in the base 11 from the heat of the electrodes. The baffles 38 are particularly effective to shield the seals from the heat radiated from the cathode and the leading-in conductors therefor while the baffles 44, being mounted opposite the junction of the metallic walls 14 and 15, are particularly effective to protect the seals and leading-in conductors from the heat radiated by the anode. The perforations in the shell 43 allow passage of heat from the interior thereof to the wall of vessel 10 from which it is radiated. Finally, the dished metallic member 41 because of the proximity of its base portion to the seals provides heat dissipation from the region adjacent the seals. In addition, the shield and baffle assembly constitutes an electrical screen shielding the leading-in conductors for the cathode and the grid from the anode so that undesired interaction between the input and output elements of the device is greatly reduced. Furthermore, it will be appreciated that this construction provides a unitary structure which can be assembled readily and facilely mounted on the base 11 by the single support 33.

The particular cathode construction shown and described has been found to be particularly advantageous. However, other constructons may be employed if desired. One such other construction which may be used to advantage is illustrated in Fig. 8 and comprises a plurality of hairpin-shaped heavy wire, e. g., tungsten, filaments 50 formed so that the arms thereof correspond to catenary curves. The several filaments 50 are connected mechanically and electrically at their bights by a triarmed connector 51 and have their ends secured in metallic sleeves 52, which are secured in turn to laminated metallic, e. g., copper rings 53 and 54. As shown clearly in Fig. 8, one end of each filament 50 is connected electrically to the ring 53 and the other end is connected to ring 54 so that the filaments 50 are electrically in parallel. The rings 53 and 54 are affixed to metallic supports 55 which may be secured to leading-in conductors, such as the conductors 23 in the device shown in Fig. 1.

It will be appreciated that because of the catenary form of the filaments 50, the cathode illustrated in Fig. 8 will retain its form during operation of the device in which it is utilized

whereby the requisite space relation of the cathode and the grid is preserved.

Although specific embodiments of the invention have been shown and described, it will be understood that they are 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. An electron discharge device comprising an enclosing vessel having a hollow insulating portion and a metallic wall extending within said insulating portion, an anode joined to the inner end of said wall, a cathode and a grid within said vessel, leading-in conductors for said cathode and grid sealed in a wall portion of said insulating portion at regions opposite the junction of said anode and said metallic wall, a support mounted on said insulating portion, and a unitary thermal and electrostatic shield mounted on said support and substantially enclosing said leading-in conductors, said shield comprising a portion encompassing said leading-in conductors, a metallic baffle adjacent said junction and extending transversely between it and said wall portion and a metallic member mounted between said wall portion and said metallic baffle.

2. An electron discharge device comprising an enclosing vessel including a dished vitreous portion, a metallic wall extending into said vitreous portion and a cylindrical anode member within said wall and connected at one end to the end of said wall within said vitreous portion, a cathode and a grid within said anode member, and each having one end opposite the base of said vitreous portion, leading-in conductors for said cathode and grid sealed in said base, and means for protecting the seals between said leading-in conductors and said base comprising a cup-shaped metallic member encompassing said leading-in conductors and having its base adjacent said base of said vitreous portion, a baffle member adjacent said one end of said anode, and a second baffle member within said cup-shaped metallic member and mounted opposite the end of said cathode nearest said base of said vitreous portion.

3. An electron discharge device in accordance with claim 2 wherein said first baffle member is mounted on said cup-shaped metallic member and comprising a support mounted on said vitreous portion and supporting said cup-shaped member, and a standard extending from said support and mounting said second baffle member.

4. An electron discharge device comprising an enclosing vessel having a vitreous portion, a cathode, control electrode and anode each having one end opposite said vitreous portion, leading-in conductors for said cathode and control electrode sealed in said vitreous portion, a standard extending from said portion, a shield member encompassing said leading-in conductors and having a portion overlying the points at which said leading-in conductors are sealed in said vitreous portion, means supporting said shield member from said standard, a baffle member mounted on said shield member and extending between said one end of said anode and said leading-in conductors, and a second baffle member mounted on said standard and extending between said one end of said cathode and said vitreous portion.

VICTOR L. RONCI.