June 13, 1933. A. H. DENZLER 1,913,432

ELECTRIC DISCHARGE DEVICE

Filed June 11, 1931

FIG. 1

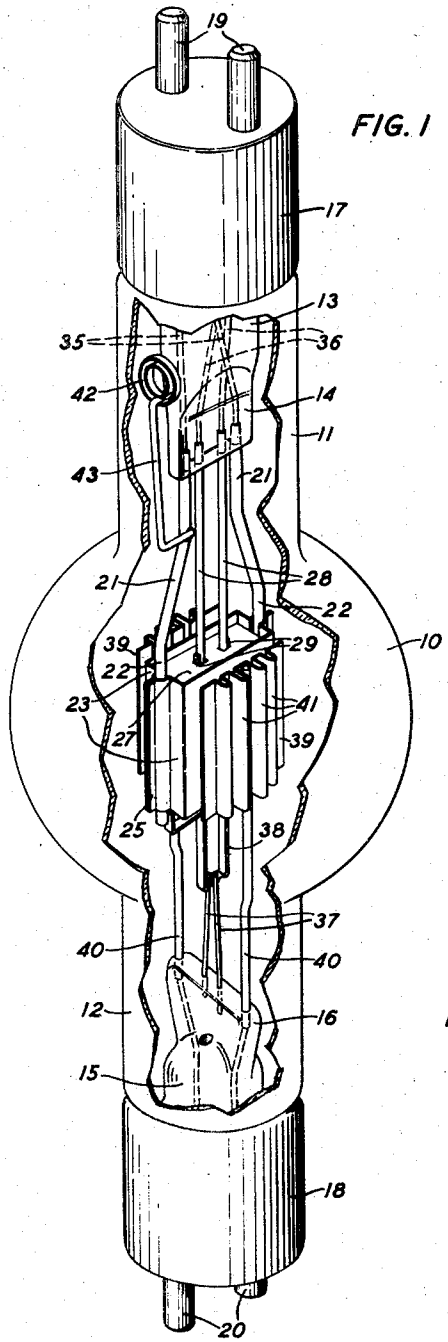


FIG. 2

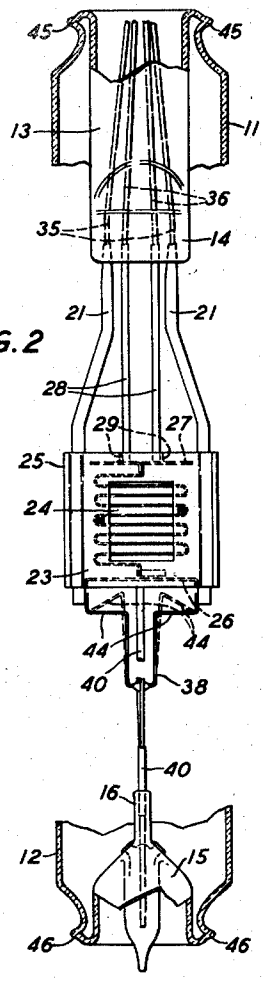
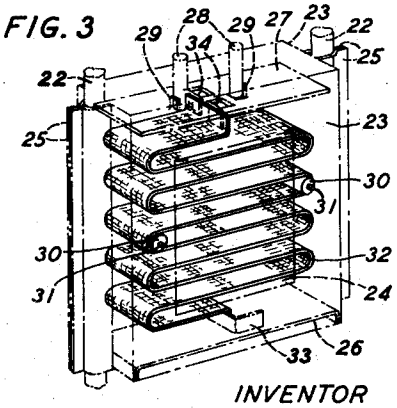


FIG. 3



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UNITED STATES PATENT OFFICE

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ELECTRIC DISCHARGE DEVICE

Application filed June 11, 1931. Serial No. 543,521.

This invention relates to electric discharge devices and more particularly to an electrode assembly and method of mounting the same.

One object of this invention is to mount a unitary electrode assembly in a double-ended enclosing vessel.

Another object of this invention is to increase the thermal efficiency of incandescent electron emitting cathodes in electric discharge devices.

The features of this invention are exemplified in one embodiment in a gaseous full-wave current rectifying device comprising an enclosing vessel having a stem at each end, one of the stems supporting a cathode assembly and the other stem supporting a pair of anodes.

The unitary electrode assembly includes a receptacle supported from one of the stems and connected to the other stem by a flexible forked member. The receptacle encloses a wire mesh cathode coated with thermionically active material. The wire mesh strip is folded to form an expanded book and is positioned within the receptacle and adjacent large openings in the walls of the receptacle. The receptacle in which the cathode is positioned serves as a heat reflecting shield to reduce the heat radiation from the cathode and together with a close spacing of the folds of the cathode increases the thermal efficiency of the cathode to reduce the input power necessary to heat the cathode to the desired degree. Each of the anodes comprises a corrugated sheet of metal and is positioned adjacent each of the large apertures in the receptacle and presents a large effective surface to the cathode.

In the fabrication of the device the unitary cathode assembly is positioned within the enclosing vessel and the cathode supporting stem is sealed to the vessel. The other stem, to which the cathode assembly is connected by the flexible link member, is then sealed to the enclosing vessel and the seal is drawn to deform the flexible member so that it forms a rigid connecting link and rigidly positions the cathode assembly.

The features of this invention will be understood more clearly from the following detailed description with reference to the accompanying drawing.

Fig. 1 is a perspective view in elevation of an electric discharge device made in accordance with this invention with a portion of the enclosing vessel broken away to show the unitary electrode structure more clearly;

Fig. 2 is a detailed view in elevation illustrating the unitary electrode and stem assembly in accordance with this invention and showing both the original and final forms of the flexible link member; and

Fig. 3 is an enlarged detail view in perspective of the cathode assembly showing the folded book form, the enclosing receptacle being shown in outline.

Referring now to the drawing, an electric discharge device, in one embodiment of this invention, comprises an enclosing vessel having a filling of inert gas, such as argon, therein at a low pressure. The enclosing vessel is formed with a bulbous central portion 10 and two axially aligned tubular end portions 11, 12. An inwardly projecting glass stem 13 having a press portion 14 is sealed to the tubular portion 11 and another stem 15 having a press portion 16 is sealed to the tubular portion 12, the press 16 being disposed at substantially right angles to the press 14. Insulating bases 17, 18 are suitably attached, for example by cement, to the end portions 11, 12, respectively, and carry terminal pins 19, 20, respectively.

A pair of rigid metallic rods 21 having parallel portions 22 extending lengthwise of the enclosing vessel are embedded in the press 14 and carry a rectangular metallic receptacle. The receptacle comprises two similar oppositely faced metallic plates 23 each of which is provided with a rectangular aperture or window 24 and angular flange portions 25. Opposite flanges of the plates are longitudinally fluted to form a socket for the parallel portions 22 of the rods 21 and are welded to each other and to the rod portions 22. The end of the receptacle remote from the press 14 is closed by a flanged cap 26. The other end of the receptacle is substantially closed by a flat rectangular metal

plate 27 positioned within the receptacle and out of contact therewith. The plate 27 is rigidly supported from the press 14 by rods 28 embedded in the press and welded to outwardly extending tabs 29 integral with the plate 27.

A plurality of parallel insulating sleeves 30 is mounted on pins 31 held between the plates 23 and carry a folded cathode 32 in the form of an expanded book which is positioned adjacent the windows 24 of the metallic receptacle, the planes of the cathode folds being at right angles to the plates 23 of the receptacle. The cathode may consist of a wire mesh material, such as nickel, coated with thermionically active material, preferably barium and strontium oxides. One end of the cathode 32 is suitably secured, as by welding, to an angular strap or bridge member 33 centrally positioned with respect to the cap 26 and the other end of the cathode is similarly secured to inwardly projecting tabs 34 integral with the plate member 27. Leading-in wires 35 and 36 are connected respectively to the rods 21 and 28 and to the terminal pins 19, current being supplied to the cathode 32 through rods 28, plate 27, cathode 32, receptacle 23, and rods 21.

This construction provides a rigid electrode assembly and a cathode having a large concentrated emitting surface. The use of wire mesh as a core insures firm adhesion of the thermionically active material to the core and provides a large electron emitting area in a small space. The receptacle decreases heat radiation from the cathode 32 and, together with the close spacing of the folds of the cathode, enables the attainment of a high thermal cathode efficiency and a proportionately low power input for heating the cathode. Furthermore, due to the large concentrated electron emitting surface and the close spacing of adjacent folds of the cathode a concentrated electron field is formed immediately adjacent the cathode surfaces. This field serves as a wall or barrier through which the positive gas ions, for example, argon ions, cannot penetrate so that the cathode electrostatically shields the anodes from each other. This feature is described and claimed in a copending application of Donald S. Bond, Serial No. 482,425, filed September 17, 1930 and entitled "Electric discharge devices".

The metallic receptacle is connected to the press 16 by a linkage including rigid rods 37 embedded in the press 15 and a forked expansion member 38 centrally welded to the rods 37 and having outwardly extending arms 44 welded to the ends of the parallel portions 22 of the rods 21. A pair of anodes 39 are supported from the stem 15 by rigid rods 40 embedded in the press 15. Each of the anodes consists of a sheet metal plate, preferably of carbonized nickel, provided with outwardly directed ribs or corrugations 41, and is positioned adjacent one of the apertures or windows 24 in the metallic receptacle with its plane substantially parallel to the edges of the cathode 32. An annular recessed support 42 carrying a quantity of vaporizable material, such as magnesium, for fixing residual gases within the enclosing vessel, is supported from one of the rods 21 by a bent rod 43.

In the assembly of the device in accordance with a feature of this invention, the electrode structure shown in Fig. 2, including the stems 13 and 15, the cathode assembly, and anodes 39, is assembled as a unit prior to insertion in the enclosing vessel. In its original form the arms 44 of the forked expansion member 38 are bent toward the cap 26 as shown in dotted outline in Fig. 2; consequently the anodes 39 are displaced in longitudinal position with respect to the cathode assembly. The unitary assembly is positioned within the enclosing vessel and the stem 13 is sealed to the tubular end portion 11 of the vessel as at 45. The stem 15 is then sealed to the tubular end portion 12 of the enclosing vessel as at 46 and the seal is drawn outwardly so that the arms 44 of the member 38 are flexed to their normal form shown in full line in Fig. 2. In this form the flexible member 38 defines a substantially rigid link and the anodes are aligned in accurate relation to the cathode structure.

This construction insures a rigid support for the cathode assembly within the enclosing vessel and enables the accurate positioning of the cathode assembly with respect to the anodes and the maintenance of the proper space relation of the electrodes during the operating life of the device.

Although a specific embodiment of this invention has been described, it is to be understood, that many modifications may be made therein without departing from the scope of this invention as defined in the appended claims.

What is claimed is:

1. A unitary electrode assembly for mounting in the enclosing vessel of an electric discharge device, comprising two axially aligned stems, an electrode assembly, rigid means connecting said assembly and one of said stems, and flexible means adapted to be adjusted in the assembly of the device to define a substantially rigid connection between said assembly and the other of said stems.

2. A unitary assembly for mounting in the enclosing vessel of an electric discharge device, comprising two axially aligned stems, an electrode assembly including a receptacle, a cathode mounted within said receptacle and supported thereby, a support extending from one of said stems and secured to said receptacle, and a flexible linkage connecting said receptacle to said other stem.

3. An electric discharge device comprising an enclosing vessel having a reentrant stem at each end, an electrode assembly, rigid rods carried by one of said stems and secured to said electrode assembly, a linkage between said assembly and the other of said stems, said linkage including a flexible member adapted to be deformed in the assembly of the device to constitute a substantially rigid link, and a pair of anodes supported from said other stem and positioned on opposite sides of said assembly.

4. An electric discharge device comprising an enclosing vessel having a reentrant stem at each end, an electrode assembly, a rigid connection between said assembly and one of said stems, and a linkage including a flexible forked member connected between said assembly and the other of said stems.

5. An electric discharge device comprising an enclosing vessel having a stem at each end, an electrode assembly including a receptacle, a cathode mounted within said receptacle, rigid members embedded in one of said stems and secured to said receptacle, and a linkage including a forked flexible member connected between the other of said stems and said receptacle.

6. An electric discharge device comprising an enclosing vessel having a stem at each end, an electrode assembly including a receptacle having large oppositely disposed apertures in the walls thereof, a plurality of insulating members mounted within said receptacle, a folded cathode mounted on said insulators, a rigid connection between said receptacle and one of said stems, and an adjustable connection between said receptacle and the other of said stems.

7. An electric discharge device comprising an enclosing vessel having a stem at one end, an apertured receptacle closed at one end and extending lengthwise of said enclosing vessel, an anode adjacent an aperture in said receptacle, a plate member adjacent the open end of said receptacle and insulated therefrom, a cathode mounted within said receptacle, said cathode having one end secured to said receptacle and the other end secured to said plate member, means extending from said stem for supporting said receptacle, and means extending from said stem for supporting said plate member.

8. An electric discharge device comprising an enclosing vessel having a stem at one end thereof, rigid supporting means extending from said stem, a metallic receptacle having apertured walls mounted on said supporting means, an anode adjacent each of said apertured walls, a cap member closing the end of said receptacle remote from said stem, a metallic member within said receptacle substantially closing the open end of said receptacle, means extending from said stem for supporting said metallic member, and a folded cathode mounted within said receptacle, said cathode having one end secured to said cap member and the other end secured to said metallic member.

9. An electric discharge device comprising an enclosing vessel having a reentrant stem, a metallic box-shaped receptacle extending lengthwise of said enclosing vessel, said receptacle having large apertures in opposite walls thereof, an anode adjacent one of said apertures, supports embedded in said stem and attached to said receptacle, a metallic plate member substantially closing the open end of said receptacle, a support embedded in said stem and connected to said plate member, a folded cathode within said receptacle having its edges adjacent said apertures, one end of said cathode being secured to said receptacle and the other end being secured to said metallic plate member, and insulating members within said receptacle engaging the intermediate folds of said cathode.

10. In the manufacture of an electric discharge device including an enclosing vessel having a stem at each end, an electrode structure, rigid connections between said electrode structure and one of said stems, and a flexible connection between said electrode structure and the other of said stems, the method which comprises sealing said first stem to said enclosing vessel, sealing said second stem to said enclosing vessel, and drawing the seal of said second stem to deform said flexible member so that said member constitutes a substantially rigid link between said electrode structure and said second stem.

11. In the manufacture of an electric discharge device including an enclosing vessel having a stem at each end, a cathode structure supported from one of said stems, an anode supported from said other stem, and a connecting member attached to said anode stem and cathode structure, the method which comprises, deforming said connecting member to displace said anode with respect to said cathode, sealing said cathode stem to said vessel, sealing said anode stem to the opposite end of said vessel, and finally restoring said connecting member to its original form to relocate said anode with respect to said cathode structure.

In witness whereof, I hereunto subscribe my name this 4th day of June, 1931.

ARTHUR H. DENZLER.