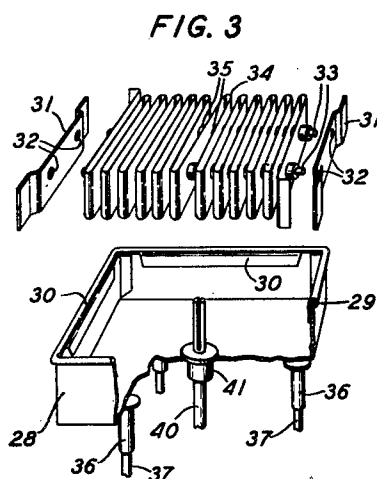
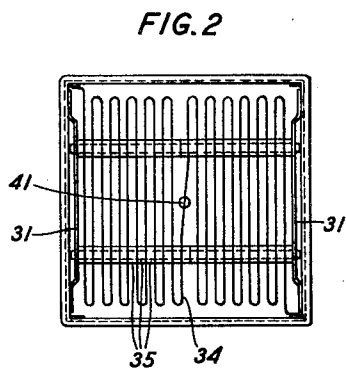
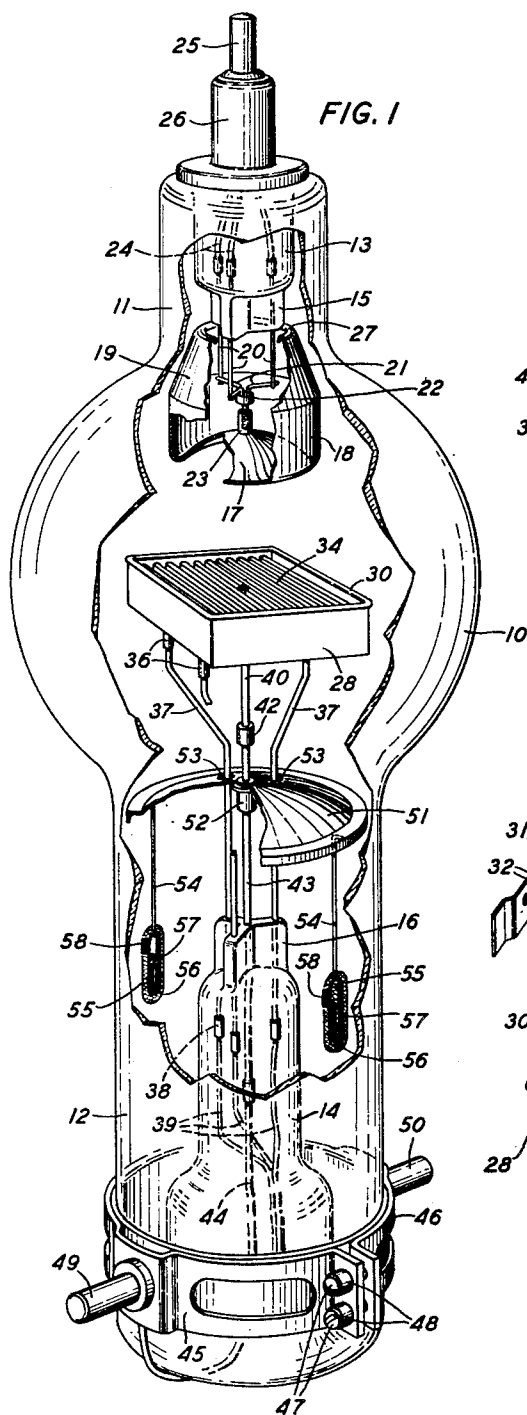


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ELECTRIC DISCHARGE DEVICE

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ELECTRIC DISCHARGE DEVICE

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This invention relates to electric discharge devices and more particularly to high voltage mercury vapor rectifiers employing an incandescent cathode.

An object of this invention is to enable and facilitate the efficient handling of large electrical power in electric discharge devices.

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

In one embodiment of this invention a high voltage mercury vapor rectifier comprises a double-ended enclosing vessel having a reentrant stem at each end, a cathode structure supported from one of said stems, and a cooperating anode supported from the other of said stems. In a preferred form the cathode structure comprises a flat ribbon adapted to emit electrons when heated. This ribbon consists of a number of closely spaced folds forming an accordion-like filament which is mounted within a rectangular metallic receptacle on a pair of parallel rods of insulating material passing through apertures in the folds of the ribbon. Each end of the cathode is attached to the receptacle which is connected to supporting rods which serve as current conductors. Another rod extends through an insulating bushing in the receptacle and is attached approximately to the midpoint of the cathode, thereby forming two cathode sections electrically connected in parallel.

This arrangement provides a rigid and compact cathode having a large electron-emitting surface, which is easily fabricated and assembled in the device. Furthermore, the close spacing of the cathode folds increases heat transfer therebetween and the metallic receptacle decreases heat radiation from the cathode as a whole, whereby the thermal efficiency of the cathode is materially increased and the efficient handling of high electrical powers is facilitated.

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

Fig. 1 is a perspective view of an electric discharge device with portions of the enclosing vessel and the electrode assemblies therein broken away to show various details of construction;

Fig. 2 is a top view of a cathode structure for electric discharge devices capable of handling large electrical power, made in accordance with one feature of this invention; and

Fig. 3 is an exploded perspective view of the cathode structure showing the constituent ele-

ments and the arrangement and assembly thereof.

Referring now to the drawing, the electric discharge device in accordance with one embodiment of this invention comprises an evacuated enclosing vessel having an enlarged bulbous central portion 10 and two cylindrical end portions 11 and 12 enclosing reentrant stems 13 and 14 respectively, which terminate in tri-armed presses 15 and 16 respectively.

A hollow anode, preferably of carbonized nickel, consisting of a dome-shaped portion 17, a cylindrical portion 18 and a truncated conical portion 19 is supported from the stem 13 by three metallic rods 20. The rods 20 are embedded in the arms of the press 15 and are joined to angular metallic links 21 attached to a stud 22 which is threaded into a nipple 23 projecting from the center of the dome-shaped portion 17 of the anode. The other end of each of the rods 20 is welded to one of leading-in wires 24 electrically connected to a metallic terminal pin 25. The pin 25 is mounted on a thimble-type insulating plug 25 of "isolantite", or the like, which is attached to the end of glass portion 11. The truncated conical portion 19 is provided with an edge 27 which is spun over as shown to provide an anode having no sharp edges and hence less conducive to the formation of corona discharges. This anode construction, furthermore, shields the rods 20 and the press 15 against disruptive corona discharges and also increases the heat radiating capacity of the anode, thereby facilitating the handling of high powers and protecting the press 15 against softening by the high temperatures developed during the operation of the device.

An electron-emitting cathode is mounted from the stem 14 and comprises an open top rectangular metallic receptacle or box 28, preferably of nickel, including a frame member consisting of a metallic rod 29 having a plurality of metallic sheets 30 spun thereover, the sheets being welded to the interior walls of the box 28. The frame member provides a smooth rounded edge and thereby minimizes the tendency of the formation of a disruptive arc or corona discharge between the cathode structure and the anode.

A pair of metallic bridge strips 31 are affixed to opposite sides of the box 28 and are provided with apertures 32 for accommodating the ends of parallel rods 33 of insulating material, such as "isolantite" or magnesium oxide. The rods 33 extend through apertures in the sections of an accordion-like or folded cathode 34, the sections being separated by spacers 35, of in-

insulating material, such as "lavite". The cathode 34 in a preferred embodiment consists of a relatively wide oxide coated metallic ribbon capable of emitting electrons when heated, such as a nickel ribbon coated with barium and strontium oxides. The ends of the cathode 34 are welded to opposite walls of the box 28.

A plurality of metallic sleeves 36 having flat heads are welded to the base of the box 28 and accommodate rigid metallic rods 37 having an end held therein. The rods 37 are embedded in the arms of the press 16 and terminate in integral sleeve portions 38 which surround the leading-in wires 39. A central rod 40 of nickel extends through a bushing 41 of insulating material, such as "lavite", in the base of the box 28 and has a split end which is joined approximately to the midpoint of the folded cathode 34. The other end of the rod 40 terminates in an integral sleeve 42 in which an end of a tungsten rod 43 is held. The rod 43 is embedded in the center of the press 16 and is electrically connected to a leading-in wire 44.

A split metallic collar comprising two flanged semi-cylindrical portions 45 and 46 is clamped about the end of glass portion 12 of the enclosing vessel by bolts 47 (only one pair of which is shown) extending through insulating bushings 48. The semi-circular portions 45 and 46 carry pins 49 and 50 respectively which serve as external terminals for the cathode 34. The leading-in wires 39 are electrically connected to each other and to the pin 50 and the leading-in wire 44 is electrically connected to the pin 49.

This assembly provides a rigid and compact cathode having a large, concentrated, effectively plane electron-emitting surface. The folds of the cathode are closely spaced and heat transfer therebetween is increased and the cathode heat thereby concentrated and conserved. Furthermore, the box 28 substantially encloses the cathode 34 and decreases heat radiation therefrom to the walls of the enclosing vessel, thereby further increasing the thermal efficiency of the cathode and the overall efficiency of the discharge device. There is also thus provided a cathode having two sections electrically connected in parallel, which enables the use of lower voltages for heating the cathode.

A dome-shaped flanged metallic shield 51, preferably of nickel, is supported on the rod 43 by a nickel bushing 52 and is provided with apertures 53 through which the rods 37 extend. A pair of rigid wires 54, supported from the shield 51, extend within the end portion 12 of the enclosing vessel, and carry wire gauze containers 55. The containers 55 enclose a vitreous capsule 56 containing a predetermined quantity of mercury 57 and also carry a strip of getter material, such as magnesium, for fixing residual gases in the enclosing vessel.

In the preparation of the device the enclosing vessel is evacuated by any suitable method and means and the unitary elements each consisting of a gauze container 55, capsule 56, mercury 57 and getter 58 are heated, for example by a high frequency magnetic field, to flash the getter 58. Upon continued heating the capsules 56 burst and metallic mercury is liberated into the end portion 12 of the enclosing vessel. During the operation of the device the mercury partially vaporizes and forms a conducting medium between the anode and cathode. The metallic shield 51, together with the box 28, shields the mercury supply in the end portion 12 of the

enclosing vessel and thereby prevents excessive heating and vaporization thereof, and the development of too great a vapor pressure in the device which might deleteriously affect the characteristics of the device.

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

What is claimed is:

1. An electric discharge device comprising an enclosing vessel having a stem, a hollow member of low heat conductivity supported from said stem, a plurality of supporting members mounted within said hollow member, and an electrode including a folded ribbon adapted to emit electrons when heated mounted on said supporting members.

2. In an electric discharge device, an electrode structure comprising a rectangular open-topped metallic receptacle, a pair of parallel rods extending between opposite sides of said receptacle, and a filamentary cathode adapted to emit electrons when heated, insulatingly mounted on said rods.

3. In an electric discharge device, an electrode structure comprising a metallic open-topped receptacle, a pair of rods of insulating material mounted within said receptacle, a folded ribbon cathode adapted to emit electrons when heated mounted on said rods, and spacer members mounted on said rods intermediate adjacent folds of said ribbon cathode.

4. In an electric discharge device, a unitary cathode structure comprising a rectangular receptacle, a frame member forming a smoothly rounded rim for said receptacle, a pair of bridge members attached to opposite walls of said receptacle, a pair of parallel insulating rods extending between said bridge members, a cathode comprising a folded ribbon capable of emitting electrons when heated mounted on said rods, each of the folds of said ribbon being provided with apertures for allowing passage of said rods, and insulating spacers mounted on said rods intermediate adjacent folds of said ribbon.

5. In an electric discharge device, an electrode structure comprising a substantially rectangular open-topped metallic receptacle, a cathode consisting of a folded ribbon adapted to emit electrons when heated positioned within said receptacle, each of the folds of said ribbon having a plurality of apertures therein, a plurality of rods for supporting said cathode extending between opposite sides of said receptacle and passing through said apertures in said folds, and spacer means mounted on said rods intermediate adjacent folds of said cathode.

6. An electric discharge device comprising an enclosing vessel having a stem, a pair of terminals mounted on said vessel and insulated from each other, a metallic member mounted on said stem, a cathode comprising a folded ribbon capable of emitting electrons when heated mounted on said metallic member, said ribbon having its end electrically connected to said member, means including said member for establishing an electrical connection between the ends of said ribbon and one of said terminals, and conductive means insulated from said member connecting the midpoint of said ribbon and the other of said terminals.

7. An electric discharge device comprising an

enclosing vessel having an end portion including a reentrant stem, a pair of terminals mounted on said end portion and insulated from each other, a plurality of metallic rods embedded in said stem and electrically connected to one of said terminals, a metallic receptacle mounted on said rods, a filamentary cathode mounted within said receptacle having its end in electrical connection with said receptacle, and another rod embedded in said stem and electrically connected to the other of said terminals, said rod insulatingly extending through said receptacle and connected to the midpoint of said cathode.

8. An electric discharge device comprising a double-ended enclosing vessel having a reentrant stem at each end, a split metallic collar about one end of said vessel, a pair of terminal pins carried by said collar, said terminal pins being insulated from each other, a plurality of metallic

rods embedded in one of said stems and extending lengthwise of said enclosing vessel, means connecting said rods with one of said terminals, a rectangular metallic receptacle mounted on said rods substantially at right angles thereto, a pair of parallel insulating rods extending between opposite sides of said receptacle, a folded ribbon adapted to emit electrons when heated mounted on said insulating rods, said ribbon defining a substantially plane cathode having its ends in electrical connection with said receptacle, means insulated from said receptacle connecting the midpoint of said ribbon to the other of said terminal pins, and an anode supported from the other of said stems having a concave portion the base of which is substantially parallel to the plane of said cathode.

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