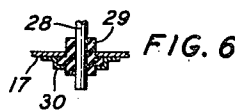
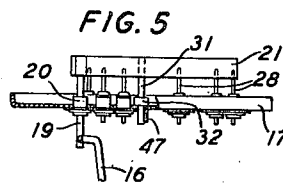
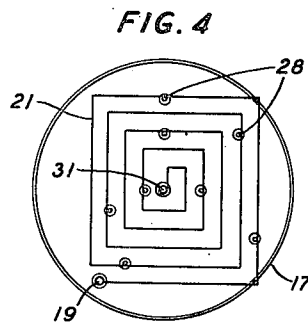
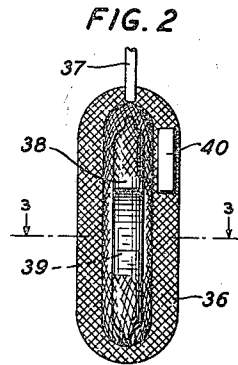
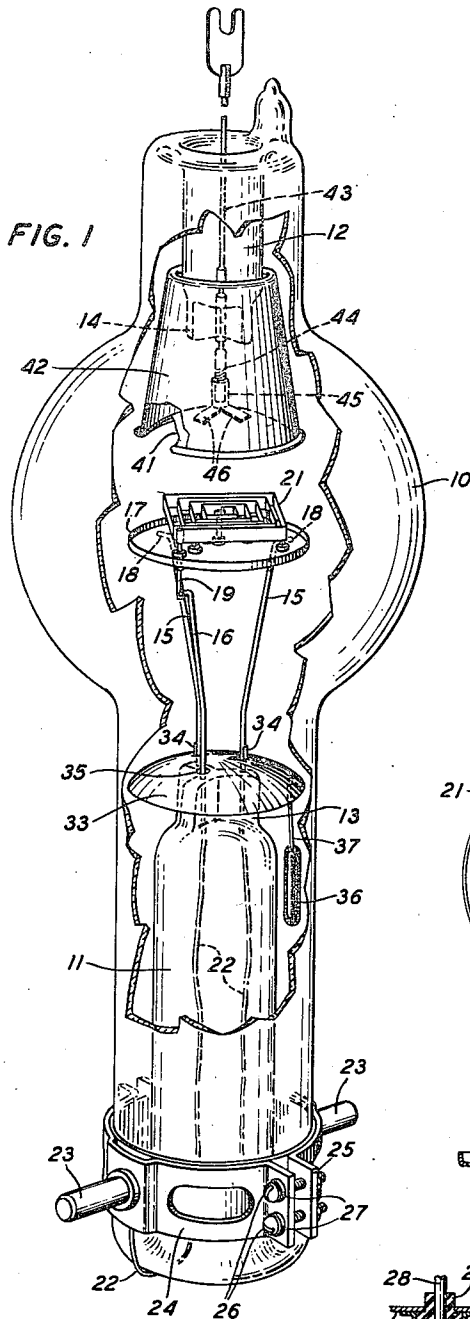


Nov. 7, 1933.

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ELECTRIC DISCHARGE DEVICE

1,934,369

Filed Jan. 27, 1931



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1,934,369

ELECTRIC DISCHARGE DEVICE

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Application January 27, 1931. Serial No. 511,506

15 Claims. (Cl. 250—27.5)

This invention relates to electric discharge devices and more particularly to high power mercury vapor rectifiers of the incandescent cathode type.

An object of this invention is to improve the efficiency of high power electric discharge devices.

Another object of this invention is to prevent disruptive discharges in such devices.

A further object of this invention is to simplify and to facilitate the preparation of electric discharge devices.

The features of this invention are exemplified, in one embodiment, in a mercury vapor rectifier having a double-ended enclosing vessel with a reentrant stem at each end. A metallic disc is supported from one of the stems by a plurality of rigid wires, certain of which serve as leading-in wires for a filamentary cathode. The cathode consists of an oxide coated ribbon folded to form a rectangular spiral and supported by the metallic disc. This arrangement provides a compact cathode occupying a relatively small space and having a large electron emitting surface. Furthermore, since the turns of the cathode are closely spaced and immediately adjacent the metallic disc, which serves as a shield, heat radiation from the cathode is substantially reduced and the thermal efficiency of the cathode is thereby increased.

An anode which comprises a dished portion and a truncated conical portion having its larger base attached about the periphery of the dished portion is supported from the other stem by a leading-in wire embedded in the stem. The anode is so positioned that the base of the dished portion is substantially parallel to the plane of the cathode and the truncated conical portion encircles a section of the anode leading-in wire and a portion of the stem. The truncated portion of the anode prevents disruptive discharges between the cathode and the anode leading-in wire and also provides a large heat radiating surface whereby the handling of high power is accomplished without excessive heating of the anode and the adjacent stem.

The conduction of current between the electrodes is aided through the medium of a vapor, such as mercury which is supported in a unitary assembly consisting of a perforated metallic container enclosing a vitreous capsule in which a quantity of mercury is sealed. A gas absorbing or getter material is mounted on the container which is supported within one end of the enclosing vessel and is adapted to be inductively heated by high frequency current whereby the getter

material is vaporized and the mercury liberated at separate intervals during the manufacture of the device.

The several 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 of an electric discharge device made in accordance with this invention with a portion of the enclosing vessel broken away to show the electrode assembly;

Fig. 2 is an enlarged detail view of the unitary mercury capsule and getter assembly with portions of the container and capsule broken away to show the elements more clearly;

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

Fig. 4 is a plan view of the cathode for electric discharge devices formed in accordance with one feature of this invention;

Fig. 5 is a side view of the cathode structure with a portion of the supporting disc broken away to show the method of mounting the cathode on the disc; and

Fig. 6 is an enlarged detail view in cross-section showing the method of mounting the cathode supporting studs on the supporting disc.

Referring now to the drawing, the electric discharge device of this invention comprises a double-ended enclosing vessel 10 having reentrant stems 11 and 12, one at each end, which terminate in presses 13 and 14 respectively. Metallic rods 15 and 16 are embedded in the press 13 and support a flanged metallic disc 17 preferably of nickel. The free end 18 of each of the rods 15 is bent at an angle and welded to the disc 17. The rod 16 is welded to a metallic stud 19 extending through an insulating bushing 20 in the disc 17, as shown more clearly in Fig. 5. The leading-in wires 22 extending through the stem 11 are connected to each of the rods 15 and 16 and are attached to terminal pins 23 on a split metallic collar clamped about one end of the vessel 10. The collar consists of two flanged semi-circular portions 24 and 25 clamped together by pairs of bolts 26, only one pair being shown, which are insulated from the semi-circular portion 24 by insulating bushings 27.

The cathode 21 consists of a flat metallic ribbon adapted to emit electrons when heated, such for example as a nickel ribbon coated with barium and strontium oxides. The cathode is folded to form a rectangulated spiral, the turns of which are closely spaced, as shown more clearly in Fig. 4. The cathode is supported above and closely

spaced to the metallic disc 17 by a plurality of metallic studs 28 set in flanged insulating bushings 29 passing through the disc 17 and secured thereto by annular flanged hangers 30, as shown more clearly in Fig. 6. A central stud 31 extends through the disc 17 and is electrically connected thereto by a metallic collar 32 and a bracket 47. The stud 31 is welded to the inner end of the rectangular spiral cathode 21 and serves as one of the current conductors for the cathode through the electrical connection with the disc 17 and rod 15 which is attached to one of the leading-in wires 22. The outer end of the cathode is welded to the insulated stud 19 which is attached to the rod 16 connected to the other leading-in wire 22. This supporting construction provides a rigid cathode not sensitive to shocks and excessive distortion by heat. Furthermore, a large concentrated electron emitting surface is provided in a relatively small space and since the turns of the cathode are closely spaced and are adjacent the disc 17, heat radiation from the cathode is materially decreased and the thermal efficiency thereof is increased.

A dished metallic disc 33, preferably of nickel, is mounted on the supporting rods 15 by integral projections or lugs 34 and is provided with an aperture 35 through which the rod 16 passes. A container 36, shown more clearly in Fig. 2, consists of two similar shell wire gauze sections attached together to form a central elongated hollow portion and a peripheral flange portion. The container is supported from the disc 33 by a wire 37 and encloses a thin walled sealed capsule 38, of vitreous material, containing a predetermined quantity of mercury 39. A strip of gas absorbing or getter material 40, such as magnesium is mounted on the container 36 as shown in Fig. 2.

The anode, which is preferably of carbonized molybdenum, consists of a dished portion 41 having its base substantially parallel to the plane of the edge wound cathode 21 and a truncated conical portion 42 which encircles the press 14 and a portion of the stem 12. The anode is supported by the stem 12 through a leading-in wire 43 sealed in the press 14. The leading-in wire 43 is provided with a threaded stem 44 which engages a socket 45 provided with arms 46 welded to the dished portion of the anode. In high power electric discharge devices, the discharge tends to occur through a path of high gradient, which in the case of an unshielded anode leading-in wire lies between the cathode and the exposed portion of the anode leading-in wire. In the device shown in Fig. 1, however, the exposed portion of the leading-in wire 43 is shielded by the truncated conical portion 42 of the anode and disruptive discharges between the cathode and the anode leading-in wire are thereby prevented. Furthermore, the truncated conical portion 42 increases the anode surface and thereby increases the heat radiating capacity thereof. This enables the handling of high power and also prevents excessive heating of the press 14 through which the anode leading-in wire 43 is sealed.

In the manufacture of the electric discharge device the internal metallic parts are heated in any desired manner, such as by high frequency induction, to drive occluded gases therefrom and the vessel 10 is evacuated and then sealed from the vacuum pump. A high frequency magnetic field is caused to act upon the container 36 which becomes heated sufficiently to vaporize the getter material 40. Further application of the high frequency field causes the glass capsule 38 to

burst and liberate the mercury 39 therein. This procedure enables and facilitates the introduction of mercury into the discharge device after gases which might deleteriously affect the mercury have been fixed by the getter material and thereby insures the presence of pure mercury vapor in the device. Furthermore, it expedites the manufacture of discharge devices since no auxiliary apparatus is necessary for the introduction of mercury into the vessel.

During the operation of the device the mercury becomes heated and partially vaporizes to form a conducting medium between the anode and cathode. Excessive heating of the mercury by radiated heat from the cathode 21, which would result in the development of too great a mercury vapor pressure within the device and a consequent change in the characteristics of the device is prevented by the discs 17 and 33 which shield the mercury from the heat radiated by the cathode. The discs also shield the press 13 to prevent cracking thereof by heat.

Although a specific embodiment of the invention has been shown and described hereinbefore it is to be understood that modifications may be made in the structural arrangement of the electrodes 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 metallic disc supported from said stem, a plurality of insulating bushings mounted on said disc, an edgewise wound ribbon cathode mounted on said bushings, and an anode positioned opposite said cathode.

2. An electric discharge device comprising an enclosing vessel having a stem, a metallic disc supported from said stem, a plurality of insulating bushings extending through said disc, an incandescent cathode comprising a flat ribbon wire forming a rectangulated spiral, an anode in opposed relation to said cathode, and a plurality of metallic members attached to successive sections of said cathode and supported from said bushings.

3. An electric discharge cathode comprising a metallic disc, a plurality of insulating bushings mounted on said disc, metallic studs extending through said bushings, and a spiral electrode on one side of said disc and spaced therefrom by said studs.

4. An electric discharge cathode comprising a metallic disc, a plurality of insulating bushings mounted in said disc, metallic studs extending through said bushings, an electrode adapted to emit electrons when heated consisting of a flat ribbon wire in the form of a rectangulated spiral mounted on said studs, and an anode cooperatively disposed with respect to said electrode.

5. An electric discharge device comprising an enclosing vessel having a stem, a plurality of wires embedded in said stem, a metallic disc supported by said wires, certain of said wires being electrically connected to said disc and one of said wires being insulated from said disc, an edge wound spiral cathode supported on said disc having one end electrically connected thereto and the other end electrically connected to said insulated wire, and an anode cooperatively disposed with respect to said cathode.

6. An electric discharge device comprising an enclosing vessel having a plurality of reentrant stems, a cathode supported from one of said stems, a leading-in wire embedded in another of said stems, and an anode supported by said lead-

ing-in wire, said anode having a dished portion opposite said cathode and a hollow portion encircling said leading-in wire and a portion of said stem adjacent said anode.

7. An electric discharge device comprising an enclosing vessel, a plurality of electrodes within said vessel, a supporting member within said vessel, a wire gauze container mounted on said member, a vitreous capsule in said container, a quantity of mercury in said capsule, and a getter material carried by said container.

8. An electric discharge device comprising an enclosing vessel having a stem, an anode mounted in said vessel, a plurality of rods extending from said stem, a cathode supported by said rods, a heat shield mounted on said rods and disposed intermediate said stem and said cathode, a metallic container supported from said heat shield on the side thereof remote from said cathode, a vitreous capsule in said container, a vaporizable material in said capsule, and another vaporizable material mounted on said container.

9. An electric discharge device comprising a double-ended enclosing vessel having a reentrant stem at each end, a cathode consisting of a flat ribbon wire forming a flat rectangular spiral supported from one of said stems, and an anode supported from the other of said stems having a frusto-conical portion encircling a part of said other stem and a dished portion, the base of said dished portion being substantially parallel to the plane of said cathode.

10. An electric discharge device comprising a double-ended enclosing vessel having a reentrant stem at each end, a plurality of wires embedded in one of said stems and extending lengthwise of said vessel, a metallic disc mounted on said wires substantially at right angles to the longitudinal axis of said vessel, one of said wires being insulated from said disc, a plurality of insulating bushings mounted on said disc, metallic studs carried by said bushings, a cathode consisting of a folded ribbon wire mounted on said studs, said cathode having one end electrically connected to said disc and the other end electrically connected to said insulated wire, a leading-in wire embedded in the other of said stems having a portion extending within said vessel, and an anode carried by said leading-in wire, said anode having a dished portion, the base of which is substantially parallel to the plane of said cathode and a hollow portion encircling the extending portion of said leading-in wire and a portion of said stem through which the leading-in wire is embedded.

11. In the manufacture of an electric discharge device including a container supporting an electrically conductive material and a getter material, the method which comprises first vaporizing said getter material and finally diffusing said conductive material from said container.

12. In the manufacture of an electric discharge device having an enclosed metallic container, a vitreous capsule within said container, a vaporizable material within said capsule, and another vaporizable material carried by said container, the method which comprises heating said container to vaporize said last mentioned material, and further heating said container to burst said capsule and to liberate the vaporizable material therein.

13. In the manufacture of an electric discharge device containing electrodes, a perforated container attached to one of said electrodes, a vitreous capsule within said container, a vaporizable material within said capsule, and another vaporizable material carried by said container, the method which comprises heating said electrodes to drive occluded gases therefrom, inductively heating said container to vaporize said last mentioned vaporizable material, and further inductively heating said container to burst said capsule and to liberate the vaporizable material therein.

14. In the manufacture of a mercury vapor discharge device including an enclosing vessel, a plurality of cooperating electrodes within said vessel, a perforated metallic container, a vitreous capsule in said container, a quantity of mercury in said capsule, and a getter material mounted on said container, the method which comprises heating said electrodes to remove occluded gases therefrom, inductively heating said container to vaporize said getter material, and further inductively heating said container to burst said capsule to liberate said mercury.

15. An electric discharge device comprising an enclosing vessel, a plurality of cooperating electrodes within said vessel, a metallic container mounted within said vessel, a vitreous capsule having a vaporizable material therein carried within said container, and a getter mounted on said container, said getter and vaporizable material being adapted to be successively vaporized, said vaporizable material providing a conductive vapor between said electrodes.

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