Jan. 23, 1945. W. C. WHITE 2,367,987

MULTIANODE DISCHARGE DEVICE

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Fig. 1.

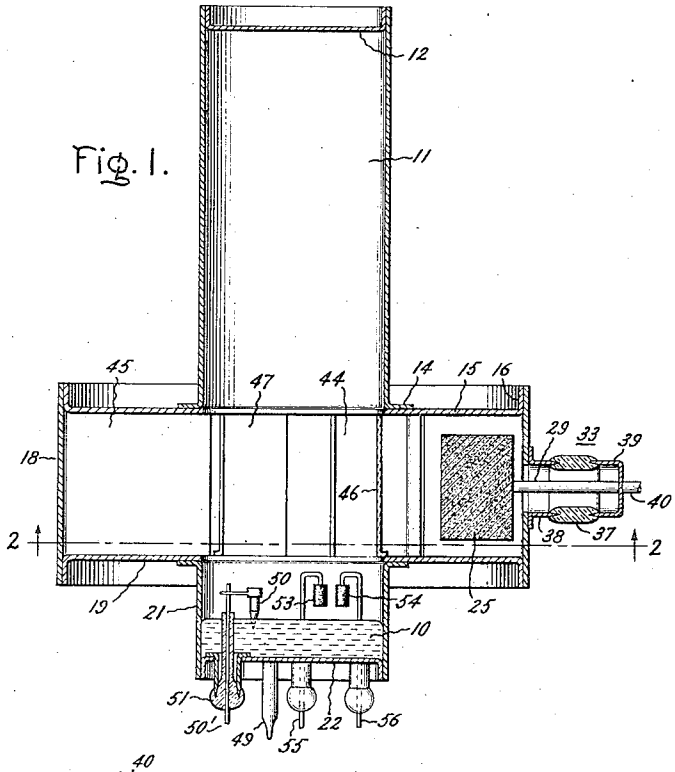
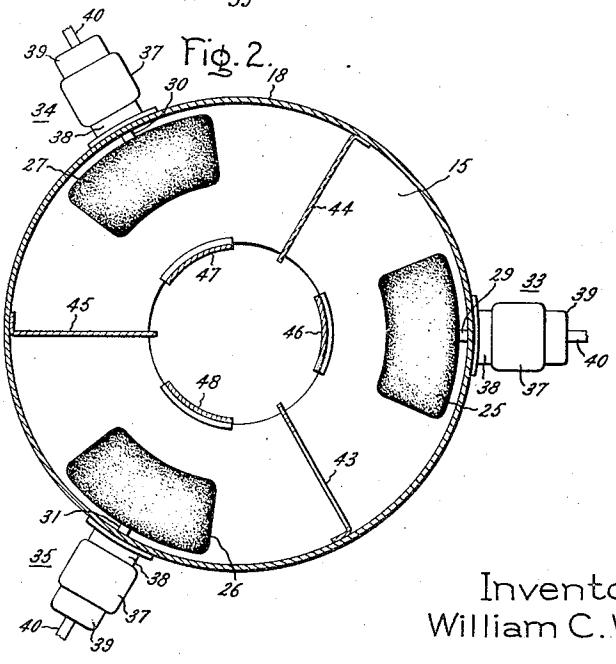


Fig. 2.



Inventor:
William C. White,
by Harry E. Dunham
His Attorney.

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Fig. 3.

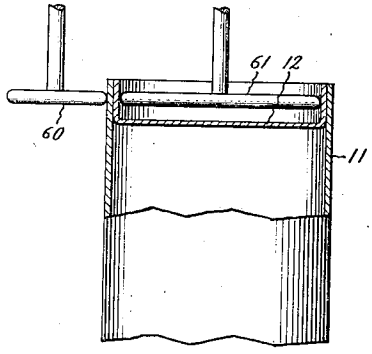


Fig. 4.

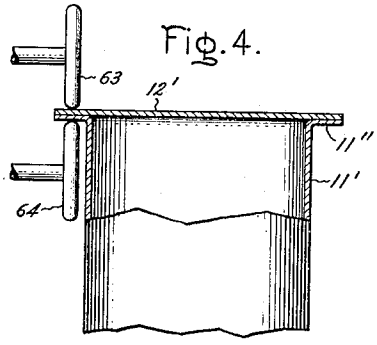
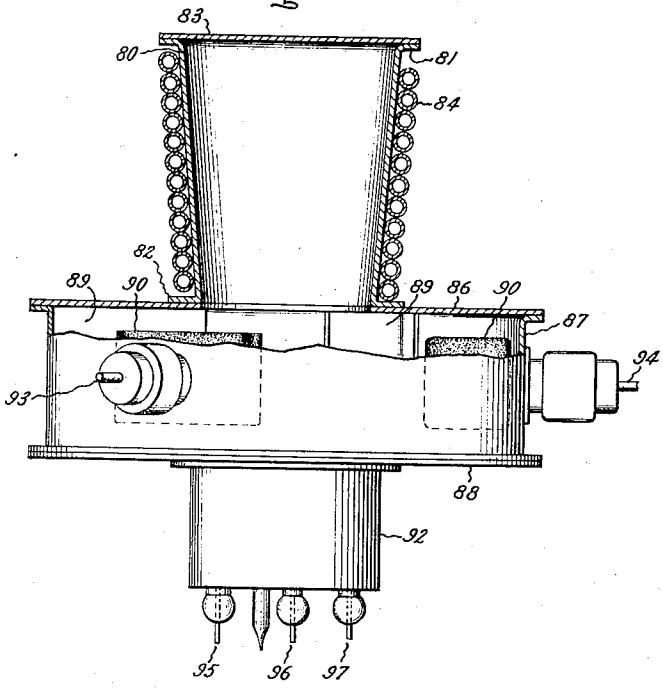


Fig. 5.



Inventor:
William C. White,
by Harry E. Dunham
His Attorney.

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MULTIANODE DISCHARGE DEVICE

William C. White, Schenectady, N. Y., assignor to General Electric Company, a corporation of New York

Application May 22, 1942, Serial No. 444,007

6 Claims. (Cl. 250—27.5)

The present invention relates to an improved form of multi-anode discharge device and is primarily concerned with devices which employ a pool-type cathode, such as a cathode constituted of mercury.

A form of mercury pool rectifier which has found extensive application in European practice is that which comprises a glass bulb or dome surrounded by a plurality of anode-containing arms. This type of tube, in which the glass bulb provides a condensing space for mercury vaporized from the cathode, has numerous advantages which are due in part to the fact that the anodes are effectively separated from one another and from the condensing chamber. This latter factor in particular is advantageous in that it permits the anodes to run at a very high temperature and thus effectively to dissipate heat generated by the passage of high currents without thereby objectionably raising the mercury vapor pressure in the discharge space, such pressure being controlled mainly by the lower temperature maintained in the condensing chamber. In spite of these advantages, however, the glass side-arm construction has not found favor in American practice because of the preference in this country for metal-enclosed devices.

While metal-enclosed devices currently available have numerous advantages, they do not for all uses provide all the favorable properties attributable to the multiple side-arm construction. However, it has not heretofore been considered practical to fabricate the side-arm type of tube in an all-metal construction because of the relatively high cost of producing metallic structures of the indicated configuration.

It is a primary object of the present invention to provide a metal-enclosed multi-anode rectifier which possesses the advantageous characteristics of the side-arm construction but which is capable of being produced at low cost and by simple fabricating methods. In this connection, use is made of an arrangement in which all the major structural parts are of rotationally symmetrical character and so formed that they may be readily joined by easily practiced factory methods. For example, in a specific embodiment of the invention, this is accomplished by forming the condensation chamber as a cylindrical metallic structure and by joining this peripherally at its lower extremity to a second cylindrical metallic structure which is of sufficiently large diameter to project outside the contour of the condensation chamber. The second structure thus provides an annular chamber within which a number of anodes may be placed in an arrangement which causes them to be offset from any straight-line path between the cathode (disposed below the anode chamber) and the condensation space. This arrangement, combined with baffling means for separating the various anodes from one another, has the useful properties of the side-arm construction and possesses the further advantage of being capable of being fabricated in metal by easily practiced welding techniques.

The features of the invention desired to be protected herein are pointed out in the appended claims. The invention itself, together with further objects and advantages thereof, may best be understood by reference to the following description taken in connection with the accompanying drawings, in which Fig. 1 is a sectional view of a discharge device suitably embodying the invention; Fig. 2 is a cross section taken on line 2—2 of Fig. 1; Figs. 3 and 4 illustrate alternative methods of fabricating certain of the sealed joints employed in a construction such as that of Fig. 1; and Fig. 5 represents a modification of the invention.

Referring particularly to Fig. 1, there is shown a multi-anode rectifier having a mercury pool cathode which is indicated at 10. Above the cathode and in line with it, there is provided a condensing chamber in the form of a cylindrical wall structure 11 which is closed at its upper extremity by means of a flanged metal disk 12, the disk being preferably welded to the cylinder 11. It will be understood that the condensing chamber is adapted to receive mercury vapor evolved from the cathode 10 during the operation of the device and to condense this vapor, causing it to return to the mercury pool.

At its lower end the cylinder 11 is provided with an outwardly extending flange 14 by means of which it is joined to a further chamber-forming structure which consists, in the first instance, of an annular wall part 15 having a circumferential flange 16 at its outer periphery. This flange abuts the inner surface of a metal cylinder 18 to which it is hermetically joined. A further flanged annular member 19 secured to the lower extremity of the cylinder 18 forms with the other parts referred to an annular chamber which lies wholly outside the contour of the condensation chamber provided within the cylinder 11.

The enclosure of the rectifier as a whole is completed by means of a cup-shaped structure which depends centrally from the part 19 and which is made up of a flanged cylinder 21 having its lower end closed by a flanged metal disk 22

upon which the cathode material 10 rests. The parts 19, 21 and 22 are peripherally joined by seam-welding at their abutting surfaces.

Within the annular space defined by the wall members 15, 18 and 19 there are arranged a series of anodes 25, 26 and 27 which are disposed symmetrically about the rectifier axis. The anodes 25—27 are of arcuate configuration having arcuate cooperating surfaces or faces. Each of these anodes is supported from the metal cylinder 18 by means of a heavy conductor (i. e. the conductors 29, 30 and 31) which serves additionally as a current supply means for the anode. Each of the conductors referred to is in its turn insulatingly supported from the cylinder 18 by means of a glass-to-metal seal arrangement, as indicated at 33, 34 and 35. The details of the seal 33 are illustrated in Fig. 1 and show this seal to consist of a glass ring 37 which is sealed at one end to a metal eyelet 38 and at the other end to a metal cap 39. The eyelet 38 is affixed directly to the outer surface of the cylinder 18, while the cap 39 is joined to the end of the anode supporting conductor 29. Connection to a potential source may be made by means of a further conductor 40 which is affixed to the outer surface of the cap 39.

As a result of the arrangement specified, the various anodes 25, 26 and 27 are all in communication with the space which contains the cathode 10, but are offset from any straight-line path between the cathode and the condensing chamber 11. Furthermore, the space within which they are located is effectively isolated from the condensing space. Accordingly, the anodes may operate at high loading and consequently at high temperature without raising the temperature of the condensing surfaces above the level required to maintain a safe vapor pressure within the discharge space. Independent high temperature operation of the anodes has the further advantage of minimizing condensation of mercury on the anodes and anode seals.

If air cooling of the device is to be employed, it may suitably take the form of means, such as a fan and directive baffles (not shown), for propelling a stream of air downwardly around the cylinder 11. With this arrangement the air which reaches the surface of the anode-containing compartment will already have been raised to an elevated temperature by heat exchange with the condensation chamber so that no excessive cooling of the anode compartment can occur. If liquid-cooling is to be used, a water jacket should be provided in connection with the outer surface of the cylinder 11.

In order to avoid cross-firing between the anodes and to approximate as closely as possible the functioning of the side-arm construction previously referred to, the anode-containing chamber is subdivided into a number of separate compartments by the use of radially extending baffles, as indicated at 43, 44 and 45. The openings of the various compartments are partially blocked by further baffles 46, 47 and 48 which have flanges welded to the parts 15 and 19 and by which the anodes within the compartments are prevented from "seeing" one another. By this arrangement, the various discharge paths between the cathode and the respective anodes are effectively segregated.

The tube described may be used as a sealed-off construction, and to this end there is shown an exhaust tubulation 49 projecting from the bottom of the closure member 22. This member also supports an immersion starting electrode or ignitor 50 by which the rectifier may be rendered initially operative, potential being conveniently applied to the ignitor by means of a conductor 50' which is sealed into a body of glass 51 by which it is insulated from the mercury cathode 10. Auxiliary anodes 53 and 54 having external connections 55 and 56 are also provided, although their use will not ordinarily be required since the discharge can be sustained by the main anodes.

It is an important advantage of the rectifier construction described in the foregoing that all the principal joints of the rectifier may be fabricated by relatively simple factory methods. That is to say, the connections between such parts as the cylinder 11 and the disk 12, the flange 14 and the annular wall 15 and between the flange 16 and the cylinder 18 may all be produced by well established seam-welding technique, which represents a low cost fabricating procedure. Its mode of use is illustrated, for example, in Fig. 3 in which parts 11 and 12 correspond to the similarly numbered parts of Fig. 1. In this figure, welding electrode wheels 60 and 61 are shown as being respectively in contact with the outer surface of the cylinder 11 and the inner surface of the flange of the part 12 at the region where the welded joint is to be produced. By rotating the electrodes 60 and 61 concurrently so that they travel around the periphery of the structure while welding current passes between them with properly applied pressure they may be made to produce a continuous vacuum-tight seam weld extending around the entire circumference of the parts being welded.

An alternative fabricating method which may be used in this connection is illustrated in Fig. 4, which shows a cylinder 11' having a flange 11'' by which it is desired to be joined to a closure member 12' these parts corresponding functionally to the corresponding parts 11 and 12 of Fig. 3. The welding electrodes in this case are indicated at 63 and 64 as being applied with proper pressure respectively to the upper surface of the closure member 12' into the lower surface of the flange 11'. By rotating the cylinder 11' with the parts in the relationship indicated, a complete seam weld may be readily produced. This alternative technique may be employed in connection with most of the principal joints of a rectifier of the general character of that illustrated in Fig. 1 by the use of an appropriate configuration of the rectifier parts. This is further illustrated in Fig. 5 of the drawings.

It is not necessary that all the constituent parts of a rectifier constructed in accordance with my invention be of cylindrical configuration, and in Fig. 5 I have illustrated an alternative embodiment. In this case, the condensation chamber comprises a metal structure 80 which has the form of an inverted truncated cone having flanges 81 and 82 at its upper and lower ends respectively. A flat metal disk 83 is secured, by welding, to the flange 81 so as to close the upper end of the chamber. A cooling coil 84 is provided in contact with the outer surface of the member 80 so as to maintain its inner wall surface at an appropriate condensing temperature.

The lower flange 82 of the part 80 is welded to an annular metal member 86 and this in turn is joined to one end of a flanged metal cylinder 87, a second annular member 88 being provided for tthe purpose of closing the lower end of the cylinder. This provides an annular chamber

which is sub-divided by radial baffles 89 so as to form a number of separate compartments within which anodes 90 are arranged. A cathode-containing cup 92 depends centrally from the lower surface of the part 88. Current-supply terminals for certain of the enclosed anodes are indicated at 93 and 94 and lead-in connections for discharge-starting and discharge-maintaining elements associated with the cathode are indicated at 95, 96 and 97.

It will be noted that most of the principal joints of the structure of Fig. 5 are of such nature that they may appropriately be produced by a technique such as that indicated in Fig. 4. The inclined wall surface provided by the tapering of the part 80 presents the advantage that it directs mercury condensed on the surface toward the center of the cathode pool and thus prevents it from dropping on the heated walls of the anode chamber.

While the invention has been described mainly with reference to a mercury cathode device, it is also capable of use in connection with rectifiers employing other cathode materials of analogous quality, particular examples of such alternative materials being cadmium and bismuth. I aim in the appended claims to cover all such equivalent variations of structure or use as come within the true spirit and scope of the foregoing disclosure.

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

1. A metal-enclosed discharge device comprising a pool-type cathode, a rotationally symmetrical metallic wall structure providing a condensation chamber above the cathode, a second metallic wall structure secured to the lower extremity of said first-named structure, said second structure being of larger diameter than the first structure and defining an annular chamber which projects laterally beyond the contour of the first structure, means dividing the said annular chamber into a number of compartments each opening radially inwardly into the space which contains the said cathode, and a plurality of arcuate anodes respectively arranged within the said compartments and offset from any straight-line path between said cathode and said condensation chamber.

2. A discharge device comprising a pool-type cathode, a metallic cylinder positioned above said cathode and providing a condensation chamber for material vaporized from the cathode, a second metallic cylinder of greater diameter than the first and joined to the lower extremity of the first cylinder by means of a transversely extending annular wall part, a further transversely extending annular wall part joined to the lower extremity of said second cylinder and forming an annular chamber in conjunction with said cylinder and said first annular wall part, radially extending baffles dividing said annular chamber into a plurality of compartments each opening radially inwardly into communication with the space which contains said cathode, and a plurality of arcuate anodes respectively disposed in said compartments.

3. A metal-enclosed discharge device comprising a pool-type cathode, a rotationally symmetrical wall structure providing a condensation chamber above the cathode, a second rotationally symmetrical metallic wall structure secured to the lower extremity of the first structure by a circumferentially extending weld, said second structure being of larger diameter than the first structure and providing a generally annular chamber which projects beyond the contour of the first structure, means dividing said chamber into a plurality of separate compartments, a plurality of anodes respectively disposed in said compartments and having arcuate surfaces, a cup-like metallic structure depending centrally from said second metallic wall structure for providing a container for said cathode, and a circumferentially extending weld joining said cup-like structure to said wall structure.

4. A metal-enclosed discharge device comprising a pool-type cathode, a rotationally symmetrical wall structure providing a condensation chamber above the cathode, a second metallic wall structure secured to the lower extremity of said first-named structure, said second structure being of larger diameter than the first structure and defining an annular chamber which projects laterally beyond the contour of the first structure, a plurality of radially extending baffles dividing said annular chamber into a number of separate compartments each having an inwardly directed opening through which it communicates with the cathode-containing space, a plurality of anodes respectively disposed in the various compartments, and further baffling means opposite the anode faces partially obstructing the said compartment openings for shielding the said anodes from one another.

5. A metal-enclosed discharge device comprising a pool-type cathode, a rotationally symmetrical metallic wall structure providing a condensation chamber above the cathode, a second rotationally symmetrical wall structure secured to the lower end of said first structure and providing an annular chamber which projects laterally beyond the contour of said first structure, said second structure comprising a pair of annular metallic wall parts joined peripherally by seam welds to the opposite extremities of a metallic cylinder, radial baffles extending perpendicularly between said wall parts for dividing said annular chamber into a plurality of separate compartments each having radial access to the cathode-containing space, and a plurality of annularly spaced anodes respectively disposed in said compartments.

6. A metal-enclosed discharge device comprising a pool-type cathode, a rotationally symmetrical metallic wall structure providing a condensation chamber above the cathode, said condensation chamber being inwardly tapered in a downward direction, a second metallic wall structure secured to the lower extremity of said first-named structure, said second structure being of larger diameter than the first structure and defining an annular chamber which projects laterally beyond the contour of the first structure, means dividing the said annular chamber into a number of compartments each having access to the space which contains the said cathode, and a plurality of anodes respectively arranged within the said compartments and offset from any straight-line path between said cathode and said condensation chamber.

WILLIAM C. WHITE.