March 25, 1930. C. A. SABBAH 1,752,204

VAPOR ELECTRIC DEVICE

Filed June 30, 1925 2 Sheets-Sheet 1

Fig. 1.

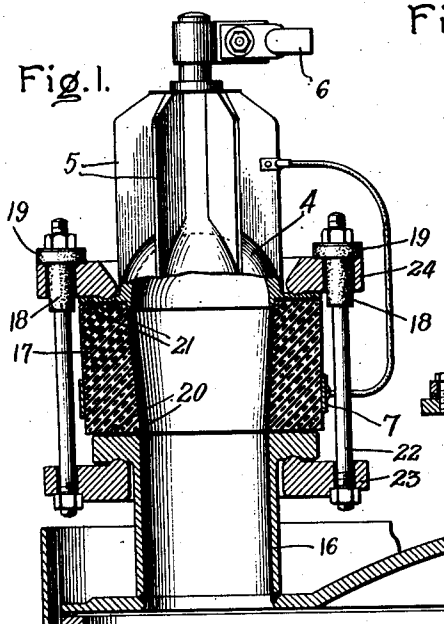


Fig. 2.

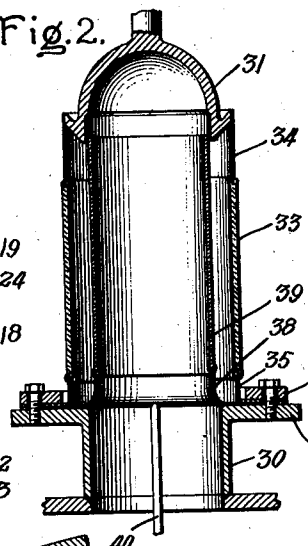
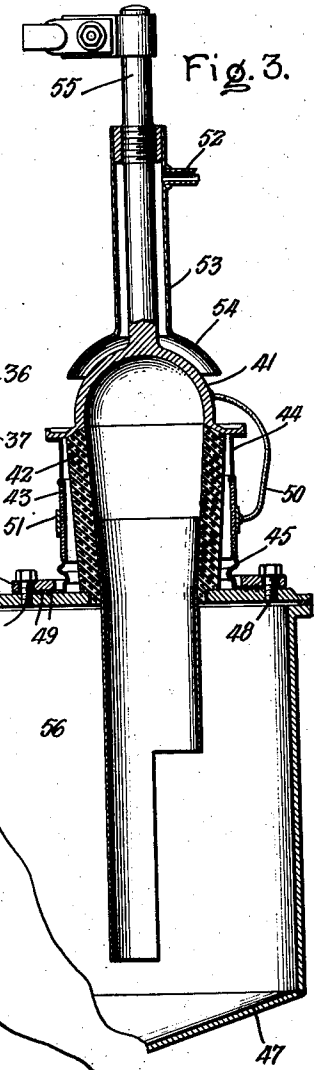


Fig. 3.



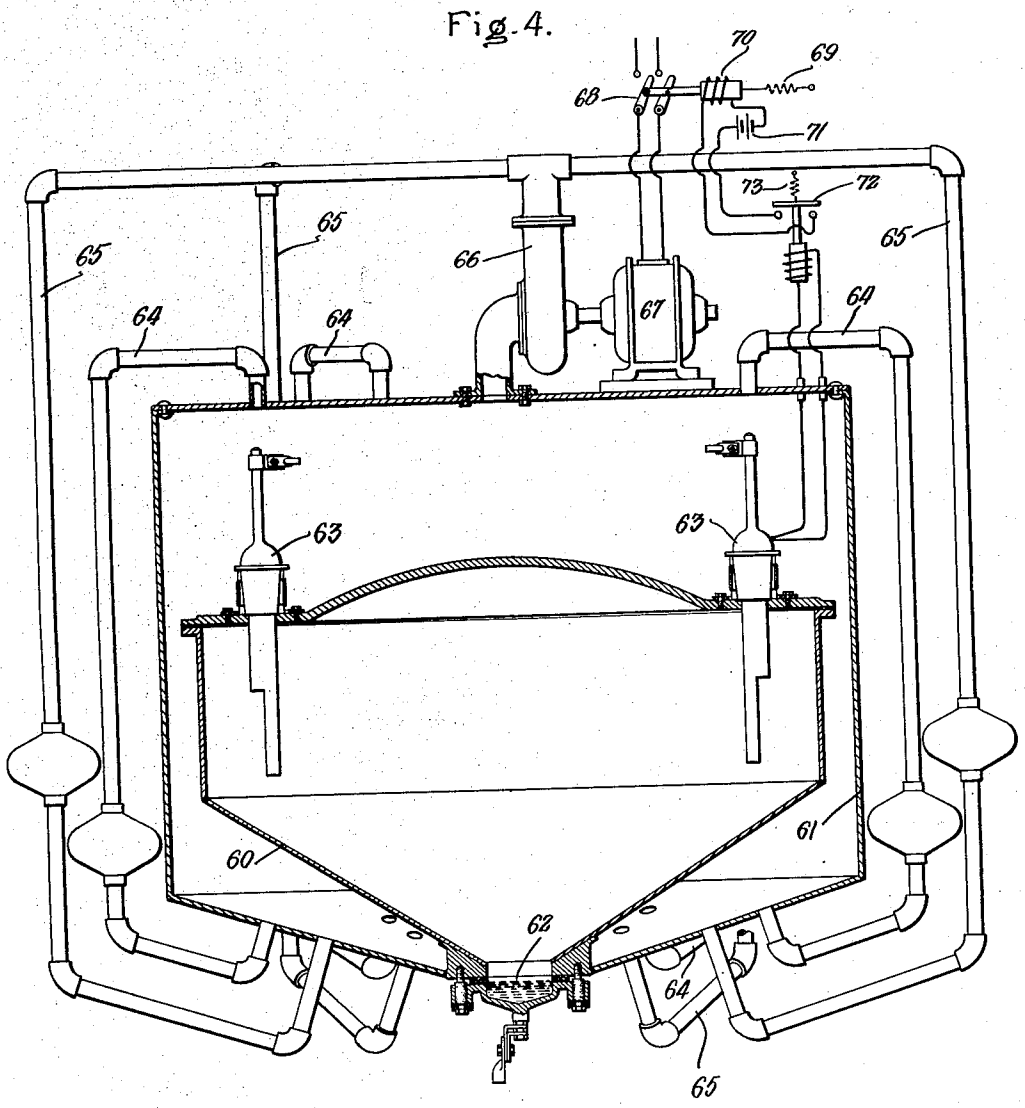
Inventor:
Camille A. Sabbah,
by Alexander S. Lamb
His Attorney.

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Filed June 30, 1925 2 Sheets-Sheet 2

Fig. 4.



Inventor:
Camille A. Sabbah,

by Alexander S. Lent.
His Attorney.

Patented Mar. 25, 1930 1,752,204

UNITED STATES PATENT OFFICE

CAMILLE A. SABBAH, OF SCHENECTADY, NEW YORK, ASSIGNOR TO GENERAL ELECTRIC COMPANY, A CORPORATION OF NEW YORK

VAPOR ELECTRIC DEVICE

Application filed June 30, 1925. Serial No. 40,654.

My invention relates to vapor electric devices comprising a plurality of anodes adapted to transmit current successively in the same direction through a circuit including a mercury cathode, and has for its principal object the provision of an improved construction whereby temperature control of the anodes and other parts of the device is facilitated and the formation of destructive arcs either between the anodes or between a negatively charged anode and the cathode is prevented.

It is well known that a mercury rectifier will operate satisfactorily only when the temperature of its anodes is maintained within predetermined limits. If the anode temperature is too high, surface particles of the anode metal are vaporized and the resulting metal vapor both decreases the effectiveness of the insulation between the anode and its support by being deposited on it and increases the vapor pressure in the vicinity of the anode to such an extent that destructive arcs, commonly designated by the expression "arc back", are likely to be produced. This difficulty is also likely to be encountered when the anode is cooled to too low a temperature for the reason that mercury condensed on the cool areas of the anode surface flows down to or drops on the hot areas of this surface and is vaporized, thereby producing local areas of high vapor pressure at the anode surface.

In accordance with my invention these difficulties are minimized or obviated by the provision of an anode constructed as a protuberance in the vapor chamber casing of the rectifier. With this construction, arc back due to condensation and revaporization of the mercury is prevented because the hottest part of the anode surface is located above the cooler part of this surface, cooling of the anodes both by radiation and convection is greatly increased for the reason that the electrodes extend outwardly from the vapor chamber casing of the rectifier, the electrostatic field strength at the active anode surface is maintained at a low value due to the concave form of this surface, and the use of a grid or control electrode to prevent arc back from a negatively charged anode is greatly facilitated so that much higher currents and potentials can be safely utilized. Other advantages of this construction will appear as my invention is considered in detail.

My invention will be better understood from the following description when considered in connection with the accompanying drawings and its scope will be pointed out in the appended claims.

Referring to the drawings, Figs. 1, 2 and 3 are fragmentary views showing anodes constructed in accordance with my invention; and Fig. 4 shows my invention as embodied in a rectifier, arranged for automatic temperature control.

Fig. 1 is a fragmentary view of a rectifier comprising a vapor chamber casing 1, cooling chamber casings 2 and 3, an anode 4 provided with cooling fins 5 and connected both to a terminal 6 and an electrostatic control member 7, and a mercury cathode 8 contained in a receptacle 9 and connected to a terminal 10. The receptacle 9 and casing 3 are insulated from the casings 1 and 2 by insulation washers 11 and 12 and insulation sleeves 13, insulation cylinders 14 and 15, being provided for controlling the position of the arc at the cathode surface. Since the particular cathode supporting structure shown forms no essential part of my invention, it will not be described in further detail.

It will be observed that the anode 4 is insulated from the casing 1 and anode support 16 by insulation member 17, made of pyrex glass or other suitable material capable of standing sudden and excessive change in temperature and by insulation collars 18 and insulation washers 19; that the joint between the insulator 17 and the support 16 comprises wire hoop gaskets 20 positioned in semi-circular grooves at the upper surface of support 16; that the joint between insulation member 17 and the flanged part of the anode 4 comprises wire hoop gaskets 21 likewise positioned in semi-circular grooves at the lower surface of the anode flange; and that bolts 22 and split collars 23 and 24 are provided for compressing the gaskets 20 and 21 to form tight joints at the upper and lower

ends of the insulator 17. It will of course be understood that the number of anodes utilized in each particular case will depend upon the number of phases to be rectified.

The provision of an electrostatic grid or control member conductively associated with the anode is advantageous in that it permits operation of the anodes at a higher voltage between anodes than is otherwise possible without danger of arc back. The problem of supporting and insulating such a grid is a source of trouble in internal anodes but is greatly simplified in the case of the external anode because the electrostatic field inside of the anode is directed along the axis of the insulation neck leading to the anode and the control grid can be placed around this neck instead of being supported within the vapor chamber. It should be noted that the location of the hottest part of the anode at the top is further advantageous in that the convectional current of cooling medium brought into contact with the insulation neck move at a rate dependent on the anode temperature, thus tending to maintain within the insulation neck, a low temperature and vapor pressure which, materially increases the effectiveness of the grids.

Fig. 2 shows a support 30, an anode 31 and a seal comprising an insulation cylinder 33 secured at its upper end to a metal cylinder 34 which is welded to the edge of the anode 31 and at its lower end to a flanged cylinder 35 arranged to have its flanged portion clamped between a split ring 36 and a flange 37 at the top of the member 30. A shield comprising a flanged cylinder 38 and an insulation cylinder 39 is provided to protect the seals between the insulation cylinder 33 and the metal members 34 and 35 against excessive changes in temperature. Any mercury condensed outside the shield is returned to the main vapor chamber through a small pipe 40.

Fig. 3 shows an anode 41 supported upon an insulation member 42 which is surrounded by a seal comprising a cylinder 43 of glass or other suitable material, a flanged metal cylinder 44 secured to the edge of the anode 41 and to the upper end of the cylinder 43, and a flanged metal member 45 which has its edge clamped between the split ring 46 and the top of the tank 47 by means of bolts 48, wire hoop gaskets 49 being positioned on both sides of the flange to ensure a tight joint. The insulation member 42 thus serves both to support the anode and to protect the insulation seal against excessive changes in temperature. The anode 41 is connected through a lead 50 to a grid 51 surrounding the insulation cylinder 43 and is cooled by a suitable fluid brought into contact with its surface through pipes 52 and 53 and bell shaped member 54 which are shown as supported by the anode lead 55. A baffle 56 may be provided to protect the anode against the blast of mercury vapor projected from the cathode during operation of the rectifier.

Fig. 4 is a sectional view of a rectifier comprising a vapor chamber casing 60, a cooling chamber casing 61, a cathode 62 and anodes 63 similar to that illustrated by Fig. 3. It will of course be understood that other types of anode, such as those shown by Figs. 1 and 2 for example, may be substituted for those shown in the figure.

Cooling of the vapor chamber casing 60 and anodes 63 is effected by means comprising a group of pipes 64 connected directly between the top and bottom of the cooling chamber casing 61 and by a group of pipes 65 connected between the top and bottom of this casing through a pump 66 coupled to a motor 67. Current for operating the motor 67 is supplied from a suitable source through a switch 68 which is biased to its open position by a spring 69 and is moved to closed position by a solenoid 70 arranged to be energized by current supplied from a battery 71 through a relay switch 72, actuation of the relay switch 72 being controlled by a thermocouple or other suitable means operating in accordance with the anode temperature.

With these connections, cooling of the rectifier is effected substantially altogether by convectional currents transmitted through pipes 64 until the temperature of the anodes 63 has attained a predetermined value. When this temperature is exceeded, however, operation of the motor 67 and pump 66 is initiated and circulation of cooling medium through the pipe 65 is maintained until the anode temperature has been reduced to a value at which the relay switch is opened by its biasing spring 73.

The embodiments of the invention illustrated and described herein have been selected for the purpose of clearly setting forth the principles involved. It will be apparent, however, that the invention is susceptible of being further modified to meet the different conditions encountered in its use and I therefore aim to cover by the appended claims all modifications within the true spirit and scope of my invention.

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

1. The combination of means forming a vapor chamber, an anode external to and insulated from said means, and means controlled by the temperature of said anode for regulating the temperature of said chamber.

2. The combination of means forming a vapor chamber having an opening, means including an anode arranged to cover said opening and form a closed passageway extending outwardly from said chamber, an electrostatic control member surrounding said passageway, and means for regulating the tem-

perature of said chamber in accordance with the temperature of said anode.

3. The combination of means forming a vapor chamber having an opening, means including an anode having a hemispherical surface arranged to cover said opening and form a closed passageway extending outwardly from said chamber, and a thermocouple arranged to regulate the temperature of said chamber in accordance with the temperature of said anode.

4. The combination of means forming a vapor chamber provided with an opening, an anode, means including an insulation member forming a passageway extending between said opening and said anode, and a sealing member surrounding said passageway and extending between said anode and the wall of said chamber.

5. The combination of means forming a vapor chamber provided with an opening, an anode, means including an insulation member forming a passageway extending between said opening and said anode, and a sealing member surrounding said insulation member and extending between said anode and the wall of said chamber.

6. The combination of means forming a vapor chamber having an opening, means including an anode arranged to cover said opening and form a closed passageway extending outwardly therefrom, a casing adapted to contain a cooling medium circulated in contact with said anode and the wall of said chamber, and means operable in accordance with the temperature of said anode for controlling the circulation of said medium.

7. The combination of means forming a vapor chamber having an opening, means including an anode arranged to cover said opening and form a closed passageway extending outwardly therefrom, a casing adapted to contain a cooling medium circulated in contact with said anode and the wall of said chamber, a plurality of pipes arranged to interconnect the top and bottom of said casing and means operable to regulate the circulation of said cooling medium through said pipes in accordance with the temperature of said anode.

In witness whereof, I have hereunto set my hand this 29th day of June, 1925.

CAMILLE A. SABBAH.