

Nov. 12, 1935.

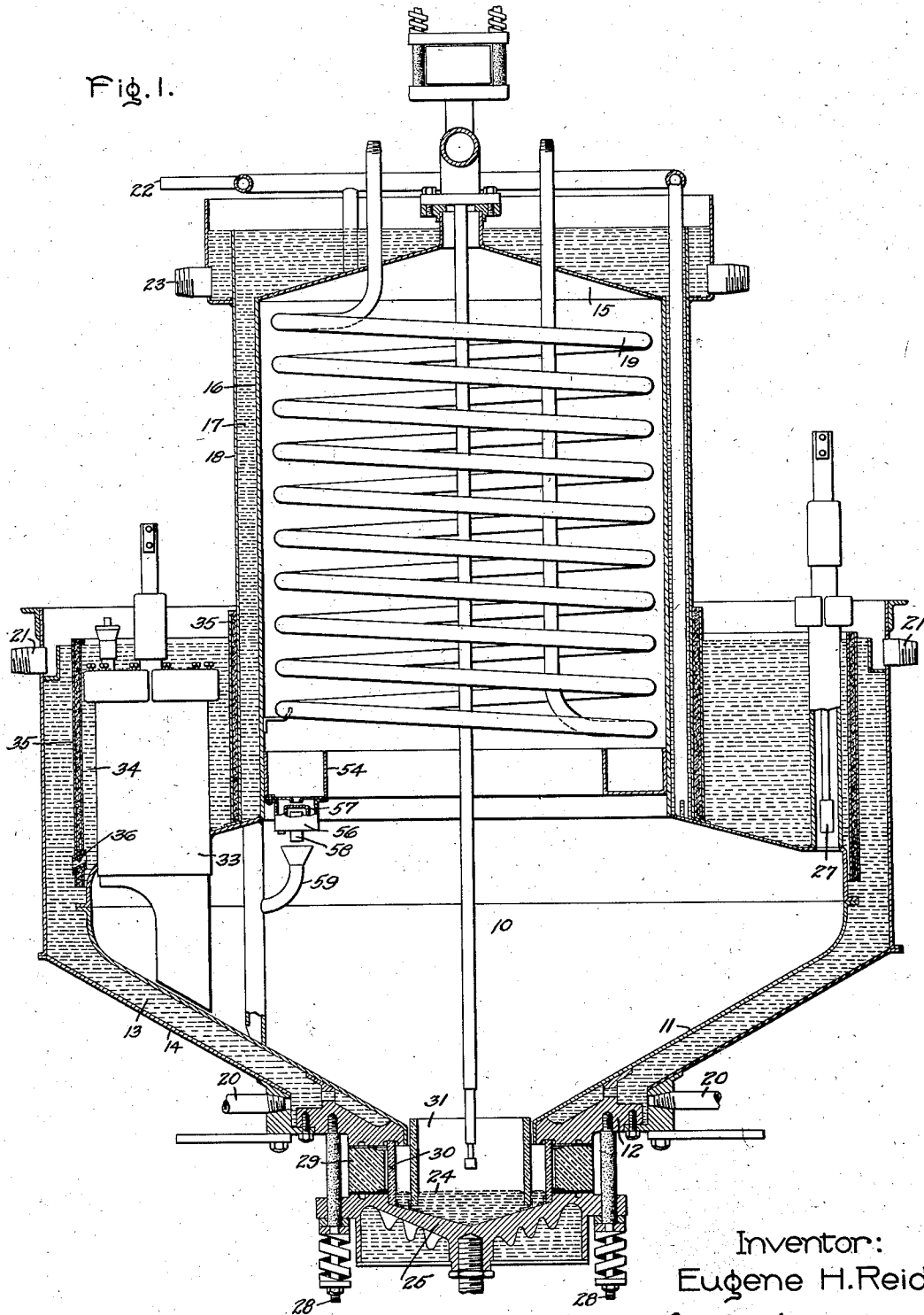
E. H. REID

2,020,962

VAPOR ELECTRIC DEVICE

Original Filed May 20, 1930 2 Sheets-Sheet 1

Fig. 1.



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Fig. 2.

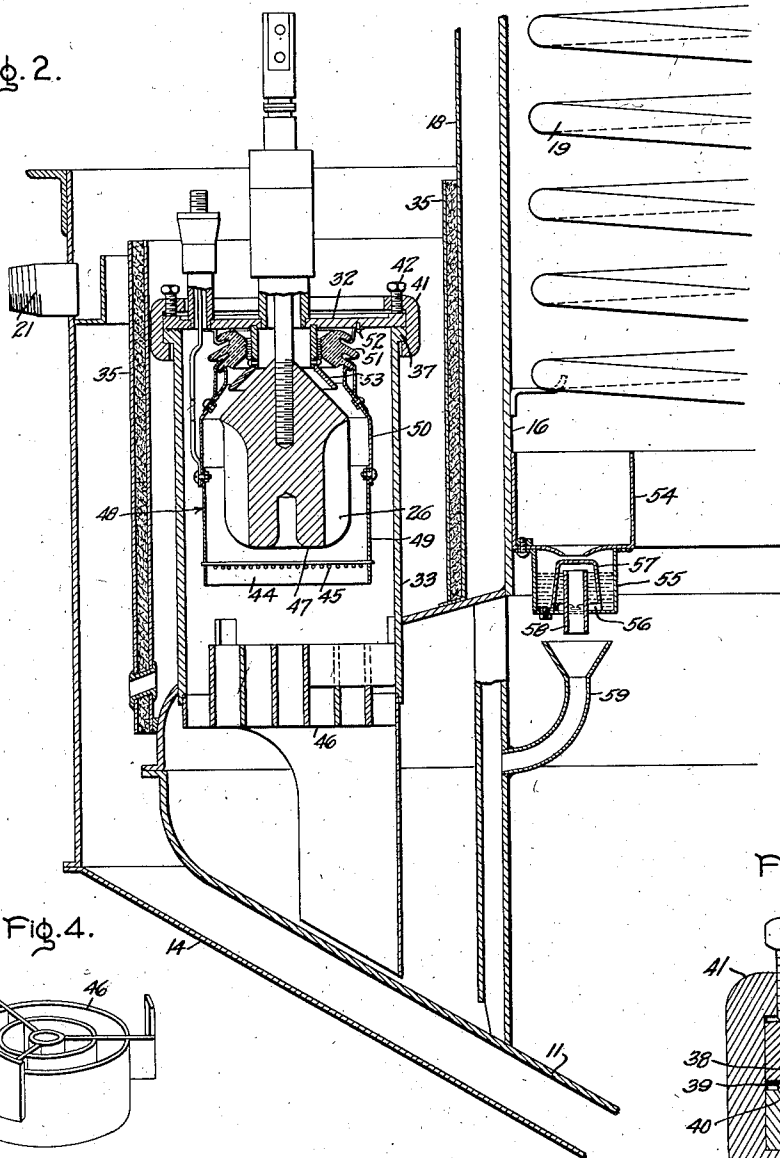


Fig. 4.

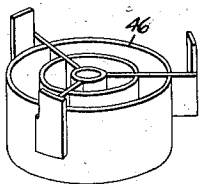


Fig. 3.

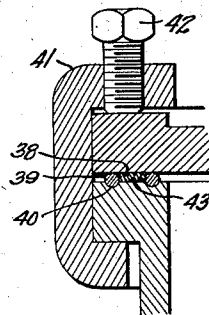


Fig. 5.

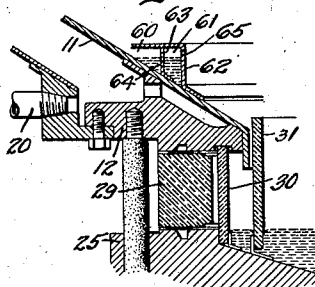
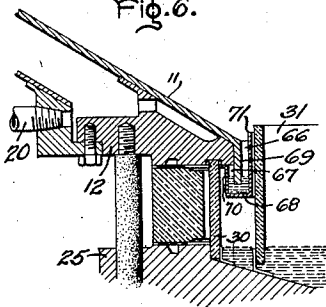


Fig. 6.



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## UNITED STATES PATENT OFFICE

2,020,962

## VAPOR ELECTRIC DEVICE

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Original application May 20, 1930, Serial No.  
454,142. Divided and this application June 30,  
1932, Serial No. 620,219

## 2 Claims. (Cl. 250—27.5)

This application is a division of my application Serial No. 454,142 filed May 20, 1930 and assigned to the same assignee as the present application.

My invention relates to vapor electric devices for transmitting current between direct and alternating current systems, and has for its object the provision of an improved device of this character which is of high load capacity and of increased efficiency and reliability in operation.

A feature of my invention is the provision of an improved temperature regulating means for the anode region of a mercury arc device. In the operation of power mercury arc devices it is well known that the anodes and parts adjacent thereto must be maintained at a temperature above the condensing temperature of the mercury vapor in the device, thus preventing the occurrence, in the region adjacent the anodes, of high vapor pressure which would otherwise be present by reason of the revaporizing of mercury which is condensed during the idle periods of the device. Electric heater means employed heretofore for the above described purpose have the disadvantage that they require appreciable power and provide adequate temperature control over only a small part of the anode region. In accordance with my invention these disadvantages are avoided by the provision of improved means to maintain the housings in which the anodes are mounted immersed in a body of stagnant temperature controlling medium.

Another feature of the present invention is the provision of an improved sealing means between cooperating sealing surfaces in the mercury arc device. Difficulties have been encountered heretofore in forming tight seals at various points therein, particularly between the anode housings and cover members therefor. Heretofore gaskets of soft metal such as aluminum have been used, two of such gaskets or rings being mounted between the cooperating sealing surfaces and the rings being retained in position by grooves formed in one of the surfaces. In operation relative motion of the surfaces due to alternate heating and cooling has resulted in leakage at the seal. In accordance with my invention the above disadvantage is avoided by the provision of a gasket of soft elastic material such as rubber mounted between the metal gaskets.

A further feature of my invention is the provision of improved means for control of the arc discharge in mercury arc devices and for prevention of arc-back therein. Difficulties have

been encountered in the control of the arc discharge between cathode and anode, the control electrode provided therefor proving inadequate in certain cases. These difficulties are avoided by providing that the control electrode is mounted between the anode and a member which functions as an auxiliary control means and which is constituted by an anode baffle member through which the arc discharge passes before reaching the control electrode.

A further feature of my invention is the provision of an improved insulating means for the control electrode. Difficulties in the insulating of the control electrode have been encountered heretofore especially in high power mercury arc devices, by reason of the exposure of the control electrode insulating member to extremely high temperature, with consequent coating of the insulating surface by decomposition products. In accordance with my invention these difficulties are avoided by mounting the control electrode insulator at a point within the anode housing remote from the tip of the anode; by connecting the insulator to the cover of the housing, this cover or end portion being immersed in temperature controlling medium; and by providing a shield member mounted between the insulator and the anode to protect the insulator from the blast of the arc stream.

A further feature of the invention is the provision of improved means for removing impurities from the mercury which is returned to the cathode after being condensed from the mercury vapor rising from the cathode. In the operation of mercury arc devices difficulties have been encountered in the use of mercury straining devices, for example, short circuits have occurred due to the accumulation of trash or residue in spaces closely adjacent the active surface of the mercury cathode. In accordance with the present invention these difficulties are overcome by the provision of a mercury strainer or impurity removing means so mounted with relation to the cathode that the trash or residue recovered from the condensed mercury vapor is retained at a distance sufficiently remote from the cathode active surface to prevent arcing.

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, Fig. 1 is a sectional view of a mercury arc device embodying my invention;

Fig. 2 is a cross sectional view of a portion of Fig. 1;

Fig. 3 is a sectional detailed view of a vacuum seal;

Fig. 4 is a perspective view of an anode baffle member;

Figs. 5 and 6 are fragmentary sectional views showing modifications of a mercury strainer.

In Figs. 1 and 2 is shown a mercury arc device 10 which comprises casing members 11, 12 and which is surrounded by a temperature controlling medium 13 contained in a chamber 14. A vapor cooling dome 15 may be provided having a casing member 16 extending upwardly from casing member 11 and surrounded by cooling medium 17 contained in chamber 18. In order to provide further vapor cooling means a coil of pipe 19 through which cooling medium is circulated may be mounted within the dome. Temperature controlling medium 13 is admitted to chamber 14 through openings 20 and discharged therefrom through openings 21. Similarly, openings 22 and 23 are the admission and discharge openings respectively for cooling fluid in chamber 18. The mercury arc device further comprises a mercury cathode 24 contained in a cathode receptacle 25, and a plurality of main anodes 26 and holding anodes 27. Only one of each of the main anodes and holding anodes is shown in order to simplify the drawings. The cathode receptacle 25 is connected to the casing member 12 by insulated bolts 28, and in order to insulate the cathode receptacle completely from the casing member an insulating member or ring 29 is interposed between the receptacle and the casing member. Mercury in the receptacle 25 is separated from insulating ring 29 by a cylindrical member 30 of vitreous or other suitable insulating material. To maintain the cathode spot within the required area upon the surface of the mercury a quartz cylinder 31 is provided, the lower edge of this cylinder being immersed in the mercury.

Anode 26 is mounted on the cover member 32 of an anode housing 33 which is welded to the rectifier casing member 11. The anode housings are within a compartment 34 separated in accordance with the invention from cooling chamber 14 and from cooling chamber 18 by thermally insulated walls 35 which are provided with only a small opening or openings 36 for communication with chamber 14. Those portions of the anode housings which project above the casing 11 are immersed in the substantially stagnant temperature controlling medium 13 contained within compartment 34. The medium in this separate compartment absorbs the heat loss of the anodes during operation periods and stores the heat for the periods when the mercury arc device is not running or is under light load. During operating periods the body of water or other temperature controlling medium in compartment 34 rises to and remains at a temperature sufficiently high to insure that the surfaces, within the anode region, on which mercury vapor tends to condense, are maintained at a temperature above the condensing temperature of the vapor.

Anode housing 33 is provided with a flange 37; the upper surface of this flange and the surface 38 at the lower edge of housing cover 32 form cooperating sealing surfaces between which are mounted deformable metal rings or hoop rings 39. These rings lie in grooves 40 formed in the lower sealing surface. Clamping members 41 and locking screws 42 are provided to draw the seal-

ing members together and thereby to press and flatten the metal rings to form a seal. In order to prevent loosening of the seal and subsequent leakage due to sliding of the smooth upper sealing surface 38 over the flattened rings 39 mounted in the grooves 40, I provide in accordance with my invention, an additional sealing means constituted by a member of soft elastic material such as a rubber ring 43 mounted between the metal rings 39. It will be seen that the two metal gaskets or hoop rings 39 form a pocket, and as the sealing surfaces 37, 38 are brought closer together by screws 42 the space between the metal casings decreases, so that the rubber ring 43 is pressed laterally as well as vertically. The rubber is thereby forced to spread under the edges of the metal gaskets 39 and is sealed to the sealing surfaces 37 and 38, thus preventing seepage over these surfaces. Further, during the process of bake-out of the mercury arc device by heavy current the rubber ring is partially vulcanized to the sealing surfaces and to the metal rings, thus forming a still more effective seal. During this bake-out process and subsequently during operation of the mercury arc device the rubber is protected from damage due to high temperature by reason of the fact that the seal is covered by the temperature controlling medium contained in compartment 34.

Control means for the arc discharge in the rectifier include a control electrode 44 and an anode baffle member 46 comprising three concentric rings of steel or other suitable material. The control electrode includes the grid member 45. It will be observed that in accordance with my invention the arrangement of anode, control electrode and baffle is such that the control electrode is mounted between the tip 47 of the anode and the baffle 46. This arrangement of the baffle in the arc discharge path is essential to adequate control of the arc by the control electrode and to operation of the mercury arc device at vapor pressures varying to such a degree as would otherwise cause interruption of operation of the device. The baffle 46 is secured by welding or otherwise to the anode housing 33 in the lower end thereof.

The grid member 45 is formed of molybdenum or other suitable wire and is mounted within a cylinder 48 which may comprise a lower cylinder 49 of molybdenum 49 surrounding the tip 47 of the anode and an upper cylinder 50 of steel. In order to avoid difficulties heretofore encountered due to exposure of the control electrode insulating means to extreme heat, the insulator 51 for the control electrode is mounted, in accordance with the invention, in the upper portion of the anode housing and therefore remote from the hottest portion of the anode. The insulator is mounted on the housing cover 32 as by screws 52 and cylinder 50 is secured to the insulator. The control electrode 44 comprising grid member 45 mounted within cylinder 49 is therefore suspended from the insulator 51. For the further protection of this insulator from excessive heat and from the blast of the arc discharge I provide a shield 53 mounted on cover member 32 and between the insulator and the anode.

A mercury strainer or impurity removing means in accordance with my invention is shown in Fig. 2 and comprises a trough member 54 which is mounted on casing member 16 of dome 15 adjacent the lower end thereof. Liquid mercury condensed from mercury vapor entering the dome flows from the trough 54 into a strainer re-

ceptacle 55 and thence through openings 56 into a second strainer receptacle 57 placed within receptacle 55. From receptacle 57 the mercury overflows into a discharge pipe 58. Pipes 59 conduct the mercury to the lower wall of the mercury arc device from which point the mercury returns to the cathode. Since the trash or residue in the mercury is always of lower specific gravity than the mercury, it is retained in receptacle 55 and thereby prevented from passing back to the cathode. In the modification of the mercury strainer shown in Fig. 5 the strainer comprises receptacles 60 and 61 formed by a trough shaped member 62 of inverted V section having a partition member 63, and mounted upon the lower portion of casing member 11. The liquid mercury condensed from mercury vapor within the mercury arc device flows down the casing member 11 into receptacle 60 which functions as a trough member to collect the mercury. From receptacle 60 the mercury passes through openings 64 in partition 63 into receptacle 61 from which it overflows through openings 65 in the trough member and thus returns to the cathode, the trash or residue being retained in receptacle 60. The modification of the mercury strainer shown in Fig. 6 is similar in construction and operation to that shown in Fig. 5. In the form shown in Fig. 6, however, strainer receptacles 66 and 67 are formed by a trough member 68 of U section and a partition member 69 extending downwardly from casing member 11 as shown in Fig. 6. The trough shaped member 68 extends downwardly into the annular space between quartz ring 31 and insulating ring 30 and is mounted upon casing member 12 by any suitable means. Since the strainer comprising trough member 68 is mounted close to the cathode ring 31, the condensed mercury which flows down the lower wall of casing member 11 and over the lower edge thereof passes into receptacle 66, thence under partition 69 into the receptacle 67 and overflows through openings 70 into the annular space between quartz ring 31 and insulating ring 30. The trash or residue from the mercury passing through the strainer is retained in receptacle 66. The inner wall 71 of trough member 68 extends upwardly sufficiently to prevent this residue accumulated in receptacle 66 from coming in contact with quartz ring 31.

It will be observed that in all the above described forms of the mercury strainer or trash gathering device the residue which is strained from the mercury is prevented from coming in contact with any portion of the mercury contained in the cathode receptacle 15 or with any portion of the insulation members 29, 30, and 31.

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

1. In a vapor electric device comprising a casing member, a mercury cathode receptacle, a cathode ring member of refractory material immersed in the mercury within said receptacle, a cylindrical insulating member mounted vacuum tight between said casing and said receptacle, and a sleeve of insulating material between said cathode ring member and said cylindrical insulating member to separate the mercury of said cathode from said cylindrical member, means to strain impurities from mercury condensed within said device and to prevent contact of said impurities with said cathode ring, said means including a circular trough member of U section mounted out of the arc path in said device below said casing member and independently of and surrounding said cathode ring, and a circular partition member extending downwardly from said casing member and within the trough member, the outer wall of said trough member having overflow openings above the level of the lower end of said partition member, said sleeve of insulating material extending above the level of said outer wall of said trough, the inner wall of said trough member extending adjacent the cathode ring to a point sufficiently above the upper end of said partition member to prevent condensate which carries said impurities from coming in contact with said ring member.

2. In a vapor electric device comprising a casing member, a mercury cathode receptacle, a cathode ring member immersed in the mercury within said receptacle, a cylindrical insulating member mounted vacuum tight between said casing member and said receptacle and surrounding said cathode, and a cylindrical member of vitreous material mounted adjacent the inner surface of said cylindrical insulating member, a circular trough member of U section mounted out of the arc path in said device below said casing member in the space between the cathode ring member and independently of said ring member and said insulating member, said casing member having a portion extending downwardly from the main portion thereof to form a partition extending within said trough member, the outer wall of said trough member having overflow openings above the level of the lower end of said partition, said member of vitreous material extending from a point below the level of the mercury in said cathode to a point above the top of said cylindrical insulating member and of said outer wall of said trough member, the inner wall of said trough member extending adjacent to the outside wall of said cathode ring member to a point sufficiently above the upper end of said partition member portion of the receptacle to prevent condensate which carries said impurities from coming in contact with said ring member and from flowing down the outside surface thereof into said annular space.

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