Feb. 21, 1939. O. KRINES 2,148,300

MERCURY ARC DISCHARGE DEVICE

Filed July 8, 1936

Fig. 1.

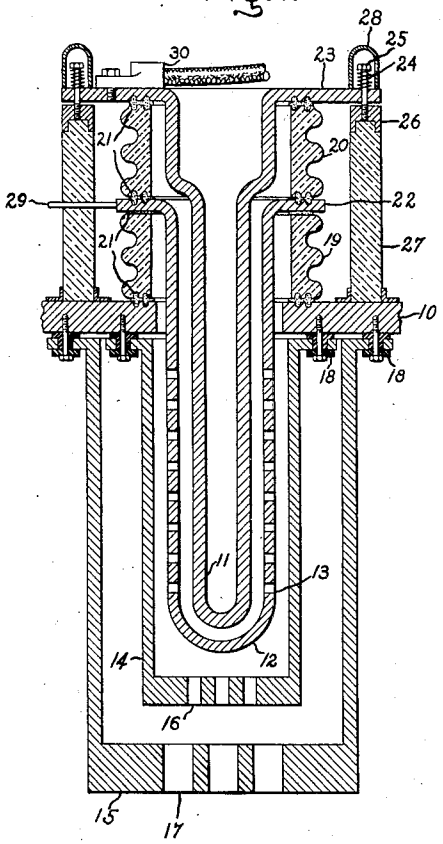
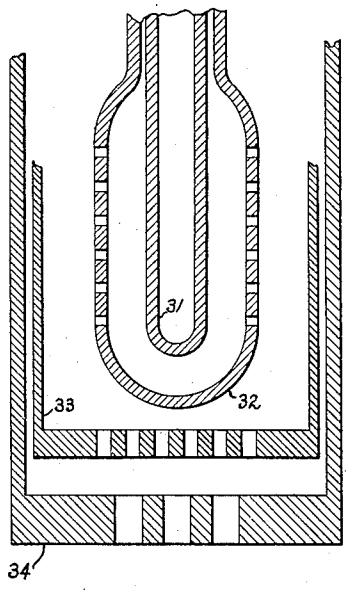


Fig. 2.



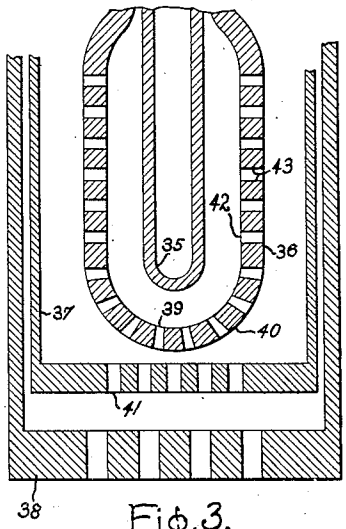


Fig. 3.

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MERCURY ARC DISCHARGE DEVICE

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5 Claims. (Cl. 250—27.5)

My invention relates to mercury arc discharge devices such as mercury arc rectifiers, and particularly to an improved anode arrangement for such devices.

Gas-filled rectifiers of the high voltage type are subject to the danger in operation that during the interruption or blocking period a discharge may start which becomes an arc, so that an arcback occurs. In order to avoid this disturbance in operation it has already been suggested to arrange in the arc path, between the anodes and the cathode, metallic or other conducting interior structures which have more or less wide openings for the passage of the arc. These arrangements have the disadvantage that the anodes begin to pass current only with difficulty during the current conducting period. Very often it happens that the anode ignition voltage assumes values of several hundreds of volts, or even over a thousand volts.

It is the object of the present invention, therefore, to provide an anode arrangement for rectifiers of the high voltage type, especially mercury arc rectifiers, whereby the above mentioned disadvantage is avoided. In accordance with my invention this object is accomplished by mounting the principal or main anode in the interior of a hollow auxiliary anode which is provided with openings and which is adapted to be so connected to a relatively low voltage alternating current source that during the conducting period of the main anode an arc discharge occurs at the auxiliary anode.

My invention will be better understood from the following description when considered in connection with the accompanying drawing and its scope will be set forth in the appended claims.

Referring to the drawing, Fig. 1 is a sectional view of an anode structure for a mercury arc discharge device embodying my invention, and Figs. 2 and 3 are sectional views of anode structures illustrating modifications of the invention.

In Fig. 1 the numeral 10 designates a cover member or anode plate forming a part of the evacuated tank or receptacle of a mercury arc discharge device or rectifier having a main anode 11 arranged in the interior of a hollow auxiliary anode 12 provided with numerous holes 13. The auxiliary anode 12 is mounted in the interior of one or more anode shields 14, 15 which are arranged one within the other and which also are provided respectively with openings 16, 17 for the passage of the arc. The anode shields 14, 15 are so constructed in the embodiment illustrated in Fig. 1 that the openings 13 of auxiliary anode 12 do not stand opposite to the openings 16 of the shield 14. The openings 16, 17 and the anode shields 14, 15, mounted one within the other, may be offset with relation to each other if it is desired that the passage of stray ions is to be restricted to an especially high degree, but generally such offset arrangement of the shield openings will not be necessary.

The two anode shields 14, 15 are secured by insulating means 18 to the cover member 10. Main anode 11 and auxiliary anode 12 are insulated from one another and from the cover member 10 by two insulators 19 and 20. Rubber gaskets 21 are provided at the joints between the insulators 19, 20 and the cover member 10, flange 22 of auxiliary anode 12, and flange 23 of main anode 11. The gaskets 21 are so compressed as to be vacuum-tight by means of springs 24 and screw bolts 25 securing the flange 23 of anode 11 to a metal ring 26 insulated from the cover member 10 by an insulator 27. Instead of an insulator such as 27 of ring form as illustrated, pin insulators or the like may be employed.

To avoid undesirable discharges from one anode to another it is advisable to cover, in a well known manner, the edges of those parts which lie particularly close to neighboring anodes. For example, it is advisable to cover the springs and bolts 24, 25 by caps 28, these caps being either formed of insulating material, or, if of metal, having rounded surfaces and therefore contributing to only a slight degree, by reason of their rounded form, to the formation of corona discharges.

The conducting of current to anode 12 from a suitable current source (not shown) may be effected by means of a lead 29 which passes through the insulator 27, while the main current connection for the rectifier from a current source (not shown) is provided on the main anode 11, for example by a cable connection 30.

The height of the two insulators 19, 20 should be chosen in accordance with the requirements of the voltages between the parts insulated by these insulators, assuming that no thermal or mechanical considerations require a departure from this rule of construction. It is usually advisable to make the insulator 19 higher than required by the above rule, since, thereby it is possible to avoid an inadmissible cooling of the auxiliary anode 12 through the cover member or anode plate 10.

In operation of the embodiment of my invention illustrated in Fig. 1, the arc discharge which, during the conducting period, flows to auxiliary anode 12 ignites much more easily than the arc discharge flowing to main anode 11 would ignite if an intense ionization in the neighborhood of the openings 13 of auxiliary anode 12 were not already produced by the arc discharge to the auxiliary anode. During the interruption or blocking period the ions are drawn from the discharge space in the neighborhood of main anode 11 in the shortest possible time by means of the extended surfaces of auxiliary anode 12, and also

by means of the side walls of the auxiliary anode openings 13. Thus no danger exists that, at the end of the conducting period, ions will remain in the discharge space and that, because of the presence of such remaining ions, a discharge turning into an arc will occur. Further, with the above described anode arrangement, a glow discharge cannot occur if the dimensions of the openings and the spacing of main anode 11 from auxiliary anode 12 and the surrounding anode shield 14 are properly chosen. The arrangement thus provides a high degree of protection against arcback and for this reason is suitable for rectifiers of the high voltage type operating in the highest range of voltages.

The energy which is required for the excitation of the auxiliary anode 12 is comparatively slight although the current is usually equal to or even greater than that of the main anode because the voltage required for operating the auxiliary anode amounts to only a small part, 30 to 200 volts, of the main anode voltage.

In Fig. 2 the arrangement is similar in structure and operation to that of Fig. 1, a main anode 31 being enclosed within an auxiliary anode 32 surrounded by one or more anode shields 33, 34, the anodes and shields being preferably mounted on and insulated from an anode plate in the manner shown for example in Fig. 1. Since the energy which is dissipated as heat on the auxiliary anode is usually greater by a not inconsiderable amount than the energy which is dissipated on the main anode, it is advantageous under certain circumstances to make the distance between the two anodes greater than as shown in Fig. 1. This constructional feature is illustrated in Fig. 2, wherein the side and end walls of the main and auxiliary anodes 31, 32 are spaced at a considerably greater distance apart than are the corresponding walls of the main and auxiliary anodes 11, 12 of Fig. 1. Thus in Fig. 2 the surface of auxiliary anode 32, which carries the heavier current, is considerably larger than that of the main anode 31. If the rectifier is not intended for the highest range of voltages it is generally desirable to make the distance between the auxiliary anode and the surrounding anode shield such that the access of the auxiliary arc to the auxiliary anode side surfaces provided with holes does not become too difficult.

In Fig. 3 the anode arrangement is similar to that of Fig. 2 in that a main anode 35 is connected within and spaced a considerable distance from an auxiliary anode 36 surrounded by one or more anode shields 37, 38. The arrangement according to Fig. 3, however, is used to better advantage for still lower voltages than those to which the arrangement of Fig. 2 is adapted. For this purpose, in Fig. 3 the auxiliary anode 36 is provided with openings 39 in that part, extremity 40 in the present case, which lies nearest to the openings 41 in the anode shield 37. As a result the ignition voltage for the main anode 35 is lowered to a considerable extent because the openings 39 in this portion 40 of the auxiliary anode 36 opposite the anode shield openings 41 carries a relatively large proportion of the total current of the auxiliary anode. The ionization density at the holes 39 of auxiliary anode 36 is, therefore, considerably greater than that at the holes 42 located farther away.

The anode arrangement as above described in connection with Fig. 3 provides during the interruption or blocking period a less effective protection against the occurrence of arcback because the presence of ions remaining from the conducting or forward period, and of stray ions, during the interruption or blocking period is prevented to a lesser extent than in the embodiments of my invention shown in Figs. 1 and 2. For this reason, the arrangement illustrated in Fig. 3 is above all adapted for rectifiers of the high voltage type herein described operating in the lowest range of voltages for such rectifiers. To improve the deionizing effect, in the arrangement illustrated in Fig. 3, the wall thickness of the auxiliary anode 36 is made greater than that of the auxiliary anodes 12 and 32 of Figs. 1 and 2, so that the side surfaces 43 of the openings 39, 42 have a considerable influence on the deionization.

My invention has been described herein in particular embodiments for purposes of illustration. It will be understood, however, that the invention is susceptible of various changes and modifications and that by the appended claims I intend to cover all such modifications as fall 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. In an arc discharge device, a cathode, an anode structure comprising a main anode and a hollow auxiliary anode provided with openings, said main anode being mounted in the interior of said auxiliary anode, and means to produce between said auxiliary anode and said cathode during the current conducting period only of said main anode a discharge current of a substantial order of intensity.

2. In an arc discharge device, an anode structure comprising a main anode, a hollow auxiliary anode provided with openings, said main anode being mounted in the interior of said auxiliary anode, and at least one anode shield surrounding said auxiliary anode and having openings opposite a portion of said auxiliary anode not provided with openings.

3. In an arc discharge device, a cathode, an anode structure comprising a main anode, a hollow auxiliary anode provided with openings, said main anode being mounted in the interior of said auxiliary anode, a plurality of anode shields mounted one within the other and surrounding said auxiliary anodes, and means to produce between said auxiliary anode and said cathode during the current conducting period only of said main anode a discharge current of a substantial order of intensity.

4. In an arc discharge apparatus, a main anode, a cathode, a hollow auxiliary anode provided with openings, said main anode being mounted in the interior of said auxiliary anode, and means to produce an arc discharge between said auxiliary anode and said cathode during the current conducting period only of said main anode, said arc discharge having a substantial order of current intensity.

5. In an arc discharge apparatus, a main anode, a cathode, a hollow auxiliary anode provided with openings, said main anode being mounted in the interior of said auxiliary anode, means to produce an arc discharge between said auxiliary anode and said cathode during the current conducting period only of said main anode, and a plurality of anode shields mounted one within the other and surrounding said auxiliary anode, said arc discharge having a substantial order of current intensity.

OSKAR KRINES.