Feb. 12, 1935. A. GAUDENZI ET AL 1,990,989

ELECTRIC CURRENT RECTIFYING DEVICE

Filed July 2, 1929

Fig. 1.

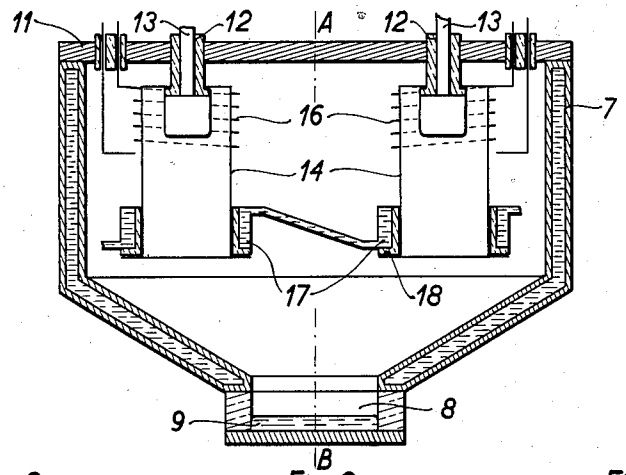


Fig. 2.

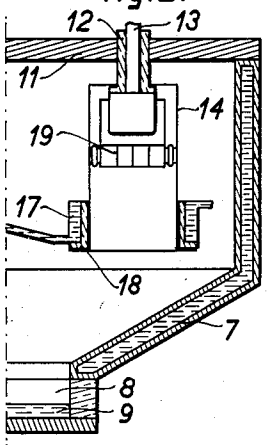


Fig. 3.

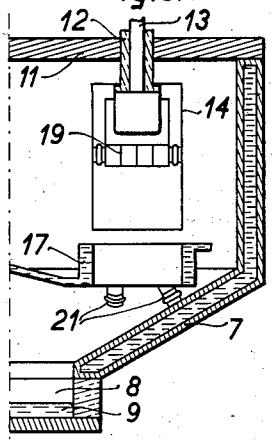


Fig. 4.

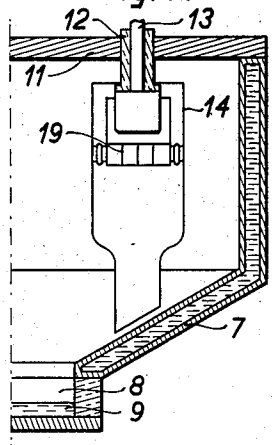


Fig. 5.

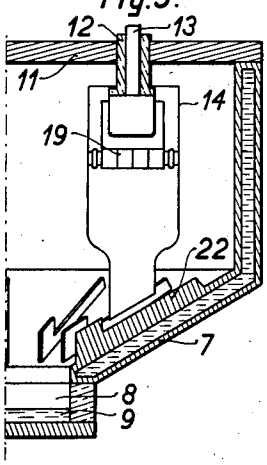
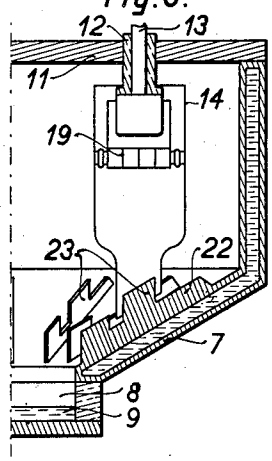


Fig. 6.



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ELECTRIC CURRENT RECTIFYING DEVICE

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6 Claims. (Cl. 250—27.5)

This invention relates to improvements in electric current rectifying devices of the metallic vapor type in which an electric arc flows from an anode to a cathode.

Electric power rectifiers require a large arc at a high temperature which vaporizes excessive amounts of the material from the cathode of the structure, which is usually a liquid metal such as mercury, which excessive amounts of vapor create a high vapor density in the operating space. Such vapor density is likely to cause condensation of some of the metallic vapor on the anodes thereby forming a so-called cathode spot which, at such time, when it is negative with respect to the cathode, permits a reverse flow of current or so-called backfiring. Such backfiring causes disturbances in the circuit to which the electric rectifying device is connected and may even lead to destruction of the rectifying structure itself.

The above problem may be solved by either one of two methods or by a combination of these two methods, both of which have the common object of reducing the vapor density ahead of the anodes and thereby decreasing the danger of formation of a cathode spot thereon. The amount of vapor in the operating space ahead of the anodes may be reduced by enclosing the anodes in arc guides which are heated directly adjacent to the anode or are cooled at the aperture through which the metallic vapor flows. It will be understood, of course, that the two methods may be combined to further decrease the vapor density during operation of the device.

It is, therefore, among the objects of the present invention to provide an electric current rectifying structure which will reduce the amount of metallic vapor directly ahead of the anodes therein.

Another object of the invention is to utilize a cooling means and a heating means to reduce the vapor density within the operating space ahead of the anodes of a metallic vapor rectifier.

Another object of the invention is to provide a structure in which cooling means are arranged about or directly ahead of the entrance into the anode operating space and in which heating means are arranged within the operating space adjacent the anode.

Objects and advantages, other than those above set forth, will be apparent from the following description and the drawing in which

Figure 1 is a vertical cross-sectional view of an electric current rectifier of the metallic vapor type showing one embodiment of the present invention, and

Figs. 2, 3, 4, 5, and 6 are fragmentary views of vertical cross-sections similar to that shown in Fig. 1, but showing modified embodiments of the present invention.

Referring more particularly to the drawing by characters of reference, reference numeral 7 indicates a double walled tank portion having a cathode well 8 in the bottom portion thereof, which well is arranged in insulated relation to the other portions of the tank. Tank 7 is formed with double walls to provide a path for the circulation of cooling medium therethrough. Cathode well 8 is arranged to receive a quantity of a liquid metal, such as mercury, which forms a cathode 9. The tank is closed by a tank cover or top plate 11 having apertures therethrough to receive insulating members 12 through which anodes 13 extend into the interior of tank 7. Arc guides 14, which are generally formed of metal, are arranged in insulated relation about the anodes 13 to form an operating space directly ahead of each anode and to serve as means for confining and directing the arc flowing from the anodes to the cathode. The amount of metallic vapor, which forms the conductor for the arc, flowing into arc guides 14 is reduced by heating the space directly adjacent the anode by a heating element 16 and by cooling the aperture into the arc guides 14 by the use of cooling chambers 17 which may be secured to the arc guides 14 by means of insulators 18 or may be secured thereto in uninsulated relation, as may be desired. The heating element may be arranged either within or without the arc guides as may be desired.

Providing the use of a separate heating element is undesirable, a grid-like member 19 may be arranged within arc guides 14 ahead of anodes 13. The arc flowing through the arc guides from the anodes to the cathode is of such high temperature that sufficient heat is extracted therefrom by screen 19 to maintain the space ahead of the anodes in substantially heated condition both during the time in which the anode is in operation and during the time in which no current is flowing therethrough. Anodes 13 may themselves be heated by a special separate heating means or they may be heated by overloading in which case it is necessary that they be capable of resisting disintegration at high temperatures.

The cooling members 17 may also be supported in spaced relation on the bottom of tank 7, by means of insulating supports 21, immediately ahead of the aperture into arc guides 14, if a greater cooling and increased condensation of the metallic vapor is desired before the vapor flows into the arc guides. For multi-anode rectifiers, the arc guides may be conductively connected with the cooling medium supply conductor while the cooling members are connected in insulated relation thereto for the purpose of maintaining the proper potential relations in the several portions of the structure.

The arc guides 14 may also be extended into close proximity with the bottom of tank 7 which is formed with double walls through which a

cooling medium may flow. When the arc guides extend into proximity with the bottom of the tank, the ends of the guides are preferably cut off parallel to the bottom of the tank. Such arrangement of the several portions forces the metallic vapor into contact with the cooled bottom portion of the tank and causes condensation of a substantial portion of the vapor which returns to the cathode and is prevented from entering the operating space within the arc guides. The metallic vapor flowing into the arc guide is again superheated by contact with the heating element or the grid and is forced, by expansion, into contact with the cooling members where a further quantity thereof is condensed and returned to the cathode.

The cooling action of the bottom of tank 7 and diminishing of the metallic vapor may be increased by securing a plurality of heat transfer surfaces thereto such as are indicated by the cooling ribs 22 shown in Fig. 5. Such structure provides for a more intimate contact of the metallic vapor with the cooled bottom wall surface and thereby increases the amount of vapor condensed by contact therewith especially when the cross-section area of the guides is somewhat diminished adjacent the lower end thereof. Extensions 23 may be formed on cooling ribs 22 to extend into the aperture in arc guides 14 to increase the cooling effect at the point at which the metallic vapor must pass before flowing into the operating space for the anodes directly adjacent the grids 19. The cooling ribs, when arranged directly beneath the arc guides, serve to assist in directing the flow of the arc. The ribs are preferably arranged radially over the entire bottom of the tank in uniformly spaced relation.

It will be apparent that the amount of metallic vapor flowing into the arc guides and the vapor density ahead of the anodes is substantially decreased by the present invention without increasing the potential drop in the arc. The danger of the formation of cathode spots on the anodes with the resultant backfiring is therefore materially decreased which greatly increases the reliability and stability of the device.

Although but one embodiment has been illustrated and described, it will be understood that various other embodiments are possible, and that various changes may be made without departing from the spirit of the invention or the scope of the claims.

The invention claimed is:

1. In an electric current rectifying device, a double walled tank providing a path for the circulation of a cooling medium between the spaced walls thereof, a cathode retained within said tank, anodes extending into said tank, arc guides partially enclosing said anodes, grids capable of extracting heat from the arc flowing between said cathode and said anode, said grids being arranged within said guides directly ahead of said anodes for heating the anode space, and a tubular cooling member arranged about the inlet of said guides and connected with the space between the walls of said tank to provide for the circulation of a cooling medium therethrough.

2. In an electric current rectifying device, a container, a cathode of vaporizable material retained within said container, anodes extending into said container, arc guides surrounding said anodes, means disposed within said guides and adjacent said anodes operative to elevate the temperature of the space about the anodes, and means supported within said container adjacent said guides operative to simultaneously effect condensation of vapor flowing from said cathode towards said anodes by way of said guides.

3. In an electric current rectifying device, a container, a cathode of vaporizable material retained within said container, anodes extending into said container, arc guides partially enclosing said anodes, means supported by said guides for elevating the temperature of the space about the anodes, and means supported within said container adjacent said guides operative to simultaneously effect condensation of vaporized cathode material tending to flow towards said anodes by way of said guides.

4. In an electric current rectifying device, a container comprising spaced walls providing a path for the circulation of cooling medium therebetween, a cathode comprising a vaporizable material retained within said container, anodes extending within the said container, guides partially enclosing and constituting a channel for the flow of arcs from the anodes to the said cathode, means individual to and supported by said guides operative to elevate the temperature of the space about the anodes therein, and means disposed within said container adjacent said guides operative to extract and transmit to the said container walls the heat from vaporized cathode material tending to flow towards said anodes by way of said guides.

5. In an electric current rectifying device, a container comprising means providing a path for the circulation of a cooling medium thereabout, a cathode comprising a vaporizable material retained within said container, anodes extending into said container, guides partially enclosing and supported by said anodes in insulated relation thereto having an open end constituting a passage for the flow of arcs from the anodes to the said cathode, means supported by said guides operative to elevate the temperature of the space therein about the anodes, and means affixed to wall portions of said container and extending therefrom to positions adjacent said guides operative to simultaneously extract and transmit to said wall portions heat from vaporized cathode material tending to flow towards said anodes by way of said open ends of said guides.

6. In an electric current rectifying device, a closed container, a plurality of anodes extending within said container, a cathode comprising a vaporizable material contained within said container, an arc guide surrounding each said anode having an opening therein constituting a channel for the flow therethrough of vapor from said cathode toward the associated anode, means disposed within said container adjacent the said opening of each of said guides operative to effect the condensation of said vapor flowing towards said anodes, and means disposed within each said guide operative to simultaneously elevate the temperature of the space about the anode surrounded thereby.

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