Sept. 22, 1931. S. J. M. ALLEN 1,824,004

ALTERNATING CURRENT RECTIFIER

Filed March 24, 1927

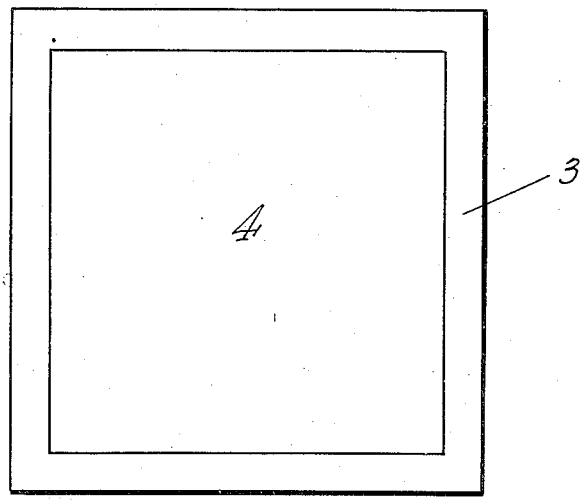


FIG 1

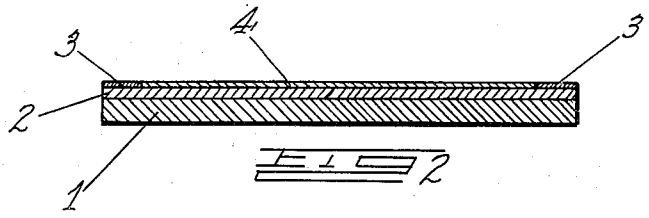
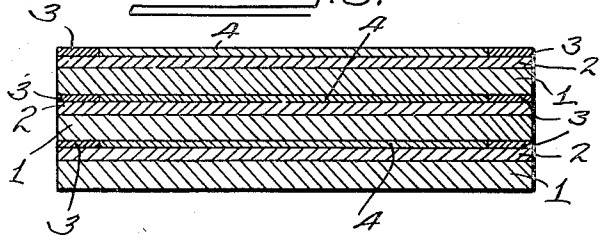


FIG 2

FIG 3.



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ALTERNATING CURRENT RECTIFIER

Application filed March 24, 1927. Serial No. 178,136.

This invention relates to electrical rectifiers or valves adapted to change an alternating current into a substantially unidirectional current, and to the method of manufacturing them. The invention particularly relates to rectifiers of the dry type wherein the rectification is obtained by the asymmetric association of a demi-conductor between conductors.

A rectifying element or unit of this type is described and claimed in copending application, Serial No. 164,375. According to the disclosure of that application, a layer of copper oxide is associated on one side with copper from which it has been oxidized, and on the other side with copper which preferably has been reduced from the outer layer of black oxide.

Said application, Serial No. 164,375, points out the necessity of avoiding the reduction of the black copper oxide to an extent sufficient to form a short circuit at the edges of the rectifying element. Despite this precaution the rectifying results, while useful, have been variable as to inverse current which has in instances been undesirably high.

The object of this invention is to provide a rectifying element of the class described, said element characterized in operation by a low inverse current flow.

This invention is predicated on the ascertainment that the inverse current flow through a rectifying element comprising a layer of demi-conductor asymmetrically associated between conductors, is due to an appreciable extent to leakage around the edge of the layer of demi-conductor. This leakage though far less than a short circuit, is often great enough to merit obviation.

Therefore, another object of this invention is to provide a rectifying element of the class described in which the current leakage about the edge of the demi-conductor is small.

In the drawings forming part of these specifications I have illustrated an embodiment of one aspect of my invention, in the form of a rectifying element.

Figure 1 is a view of the top of a rectangular element.

Figure 2 is a section therethrough.

Figure 3 shows in section an assembly of rectifying elements.

The drawings are diagrammatic and exaggerated to show the various layers. 1 is a body of copper, bearing a layer 2 of red copper oxide.. A layer of black copper oxide 3 has been reduced to metallic copper centrally as at 4, so as to give the element an upper surface comprising a central contacting portion of metallic copper and a marginal portion of black copper oxide.

This invention comprises constituting a rectifier having one or more layers of demi-conductors, each symmetrically associated between conductors and each with the marginal zone of one face uncontacted by a conductor. The extent of this marginal zone may be varied but one-eighth of an inch has been found to yield results on discs about two inches in diameter carrying three or four volts per disc.

A preferred rectifying element is described in application, Serial No. 164,375. According to this application a copper plate is placed in an electric furnace and heated to about 1900° F. The element is then cooled until it no longer appears to emit light (in daylight) and is dipped in or contacted with oil such as transformer oil, or other reducing agents to provide a thin copper layer on the outside of the oxide layer. The depth of reduction can be varied to provide copper directly on the red oxide or directly on a film of black oxide which covers the red oxide.

This invention involves the same procedure and process except that the margin of the plate is protected against being reduced either by non-exposure to the contact of the reducing agent or by lowering the temperature at the margin to a non-reducing range. The former can be accomplished in many ways, for instance, by a member or substance disposed over the margin to protect it from the reducing agent or by application of the reducing agent to a limited area only. The lowering the temperature at the margin can be and is accomplished by conducting the heat away from the margin, for instance, by contacting the margin with a colder element

adapted to absorb heat therefrom. For instance, if the rectifying element is a copper disc, when it is withdrawn from the furnace a relatively cold copper or nickel ring is placed concentrically thereon to withdraw the heat from the margin. When the center of the disc is at proper surface reducing temperature the disc is contacted with a reducing agent, such as oil. The resistance of the disc varies inversely with the depth of reduction. For battery charging rectifiers it is preferable to reduce down to the red oxide. The result is an element having a marginal zone of black copper oxide unreduced and therefore relatively non-conducting.

These elements are stacked to constitute a rectifier of the desired capacity, one surface of each element, (the back) being unoxidized or deoxidized to afford proper contact with the adjacent reduced copper. The contact between the black copper oxide and the back of the adjacent disc is not sufficiently intimate for current flow and there is very little leakage of inverse current about the edges of the rectifying elements.

By this uncontacted marginal zone these dry rectifiers are rendered more efficient. By providing a rectifying element having a margin of black copper oxide and enclosing a copper surfaced area, a durable, readily assembleable, efficient rectifier is made possible. And by this method of pre-cooling the margin of a hot oxidized copper element to non-reducing temperatures before reducing the surface of the center, the process of manufacturing rectifying elements is made to yield more uniform and controllable results.

Having described my invention, I claim:

1. An alternating current rectifier, comprising a plurality of layers of a demi-conductor each asymmetrically associated between conductors, all serially disposed in relation to one another, each layer of demi-conductor provided with a marginal zone one surface of which extends beyond the corresponding conductor surface in contact therewith and is protected by a layer of relatively non-conducting substance.

2. An alternating current rectifying unit of the class described, comprising, a copper element having a coating of copper oxide thereon, a layer of black copper oxide exteriorly exposed about the margin of the unit, and a layer of reduced copper on the central portion of the copper oxide surface.

3. An alternating current rectifier, comprising, a plurality of serially disposed units each comprising a copper element, a coating of red copper oxide on one surface thereof, a layer of black copper oxide on said red copper oxide about the margin of each unit, and electrical connections between the central portions only of the copper oxide surfaces and the copper of the adjacent units.

4. An alternating current rectifier of the class described, comprising, a plurality of copper members serially disposed, each having a copper oxide coating on one surface thereof and elemental copper disposed between the centers of all the copper oxide surfaces and the copper of the adjacent member, said elemental copper contacting less than the whole of said surface of said copper-oxide coating.

5. An alternating current rectifier, comprising, a plate of copper having a coating of red copper oxide thereon, a layer of reduced copper on the central portion of the red copper oxide coating to provide electrical contact, and a layer of black copper oxide on the coating of red copper oxide about the margin of the plate.

6. An alternating current rectifier, comprising, a copper member, a film of red copper oxide on the surface thereof, and a layer of reduced copper on the central portion of the copper oxide film, the marginal portion being unreduced.

7. An alternating current rectifier unit comprising a copper conductor, a layer of copper-oxide rectifying substance thereon, and a conductive layer in contact with the central portion of the surface of said rectifying substance, the marginal portion of said surface covered by a layer of relatively non-conductive substance.

8. An electric current valve comprising a copper member, a copper oxide film formed thereon at an elevated temperature and a reduced copper surface upon the copper oxide film, the said reduced copper surface stopping short of the edges of said oxide film.

In witness whereof, I hereunto subscribe my name.

SAMUEL J. M. ALLEN.