

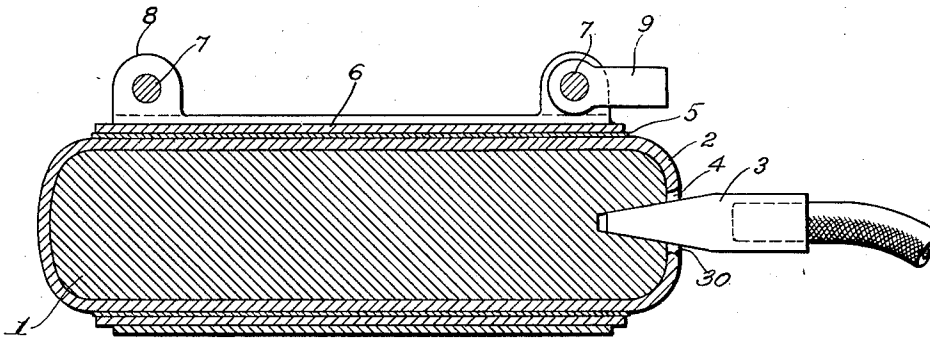
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RECTIFIER

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RECTIFIER

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My invention relates to rectifiers and particularly to rectifiers of the junction type which depend for operativeness on the unilateral electrical conductivity by the layers of solid materials.

One of the objects of my invention is to provide a junction rectifier in which the reverse current is reduced to a minimum.

Another object of my invention is to provide rectifiers of the junction type, of such form that the size and cost for a given output capacity are minimized by reducing the heat dissipated in the flow of reverse current.

Other objects of my invention will be apparent on reading the following specification, taken in connection with the drawing, in which:

The figure is a sectional view of a rectifier embodying the principles of my invention.

It is now well known that if a block of copper has a portion of the surface oxidized and contacts are made to the mother copper and to the surface of the oxide respectively, a circuit element is obtained which possesses a uni-lateral conductivity; that is to say, it conducts electricity much more readily in the direction in which electrons flow from the mother copper into the oxide than in the direction in which electrons flow from the oxide into the mother copper. By properly combining elementary units of the above described character, an arrangement which will convert alternating current into direct current may be produced. Such arrangements are too well known to the art to need detailed description here.

It is found, however, that, while the current flow in the so-called "non-conductive" direction may be made very small, it is not absolutely zero. For most practical purposes, however, it is desirable that this reverse current shall be made as small as possible. Investigation shows that the magnitude of the reverse current is largely determined by the perimeter of the opening which must be made in the oxide layer covering the surface of the copper in order to make electrical contact between the mother copper and conductors of the circuit in which the unit is included. It is further found that with a given per-

imeter for the boundary of this opening, the reverse current may be minimized if a margin is left between the terminal plates which are used to make contact with the outer surface of the oxide and the boundary edge between the oxide and the mother copper. It is also found that reverse current is minimized if the oxidized surface is of such form as to have no sharp edges or points.

In accordance with one feature of my invention, I make the copper block in a form having no sharp edges or points; for instance, in the form of a circular rod or cylinder with rounded ends. I then make contact between a line terminal and the mother metal underlying the oxide by piercing the oxide surface at one point with a hole only slightly larger than the line terminal to be engaged. By this means, the perimeter of the boundary edge of the layer between the mother metal and the oxide is minimized, and reverse current is reduced by reason of the shortness of this boundary and of the absence of sharp edges and points on the oxidized surface. In general, it is desirable that the length of the perimeter of the junction of the layer of compound with the mother metal shall be less than the square root of

$$\frac{2}{\pi}$$

times the area of the junction,

$$\sqrt{\frac{2A}{\pi}},$$

where the perimeter and the area are expressed in corresponding units.

With the foregoing principles and objects in mind, my invention may be embodied in a structure such as that shown in the figure, in which a copper cylinder 1 with rounded ends has its entire surface oxidized by heating in contact with oxygen to approximately 1000° C. The unit is maintained at this temperature for about three minutes and is then cooled in the course of about five minutes to a temperature of 700° C. It may then be rapidly quenched by plunging it into water or another suitable cooling medium. Such

treatment covers the entire surface of the cylinder 1 with layer or layers 2 of oxidized copper.

A hole is then drilled in one end of this unit and may be reamed to a slightly conical form suitable for engaging a line terminal plug 3. The hole may be countersunk slightly in the margin of the oxide layer to provide a proper gap 4 between the terminal 3 and the edge of the oxide layer 2. Contact may be made to the oxidized surface 2 by any suitable method, such as surrounding it by a sheath 5 of impressionable metal such as lead. Finely pounded graphite may, if desired, be rubbed on the portion of the oxide surface which underlies the sheath 5. A split sleeve 6 of copper or other suitable conducting material may be placed around the layer 5 and bolted tightly into contact therewith by bolts 7 extending through lugs 8. A terminal 9 may be held tightly in contact with the sleeve 6 by the bolts 7.

A unit made up in the manner described will be found to have a substantially uni-directional conductivity and it will be found that the leakage current in the "non-conductive" direction will be very small. A margin of separation is preferably left between the edge of the opening 4 and the edge of the impressionable metal contact 6.

While I have described my invention as applied to junction rectifiers employing oxidized copper, it will be obvious that it is not limited in use to that material, but may be applied to other junction rectifier elements employing compounds of other metals; for instance, iron oxide. It will also be recognized that small perimeters of the edge of the layer, margin of separation between the contact sheath and that edge, and absence of sharp corners are adjunctive features in the invention. Thus, in the embodiment of my invention shown in the drawing, it will be noted that the corners of the oxide layer or layers are rounded, as indicated at 30.

It will be seen that in accordance with my invention, I have provided junction rectifiers of forms in which the reverse current is minimized; thereby reducing losses and increasing the current and voltage capacity of the resulting elements, since such capacity is largely determined by ability to dissipate the heat generated by leakage current.

In accordance with the patent statutes, I have described several embodiments of my invention; however, the principles thereof are capable of different embodiments which will be evident to those skilled in the art. I accordingly desire that the following claims shall be limited only in accordance with the express terms and with the limitations imposed by the prior art.

I claim as my invention:

1. A solid rectifier of the junction type which depends for operativeness upon the

unilateral electrical conductivity across layers of solid materials, characterized by having a base of mother metal, a layer of a compound of said metal covering substantially the entire surface thereof, and an electrical connection to said mother metal through an opening in said compound relatively small compared to the surface thereof.

2. A rectifier comprising a base of mother copper, an oxidized layer covering substantially the entire surface of said copper and a connection to the mother copper through an opening in said layer relatively small compared to the entire surface thereof.

3. A solid rectifier of the junction type which depends for operativeness upon the unilateral electrical conductivity across layers of solid materials, characterized by having a base of mother metal, a layer of a compound of said metal formed thereon and covering substantially the entire surface thereof and a single opening in said layer relatively small compared to the entire surface thereof.

4. A rectifier comprising a base of mother metal, a layer of a compound of said metal covering substantially the entire surface thereof, a single opening in said layer having an area small compared to the entire surface thereof, and line terminal means adapted to make contact with said mother metal through said opening and filling nearly the entire cross section thereof.

5. A rectifier comprising a base of mother metal and having a layer of a compound thereof partially covering its surface, of such shape that the length of the perimeter of the junction of the layer of compound with the mother metal is less than the square root of $\frac{2}{\pi}$ times the area of the junction, where the perimeter and area are expressed in corresponding units.

6. A solid rectifier of the junction type which depends for operativeness upon the unilateral electrical conductivity across layers of solid materials, characterized by having such a unilaterally conducting surface between two layers of dissimilar solids in contact with each other, one of said solids being a compound having less conductivity than the other of said solids, said compound covering substantially the entire surface of said other solid, said compound having a single opening therein relatively small compared to the entire extent thereof, and a terminal connector which is of a cross-section smaller than said opening and which makes electrical contact with said other solid.

7. A solid rectifier of the junction type which depends for operativeness upon the unilateral electrical conductivity across layers of solid materials, characterized by having a rod of mother metal having a rounded cross-sectional shape, a layer of a compound

of said metal formed thereon and covering substantially the entire surface thereof, said compound having a single opening therein which is disposed at one end of said rod, and which is relatively small compared to the entire extent thereof, and a terminal connector which is of a cross-section smaller than said opening and which makes electrical contact with said mother metal.

In testimony whereof, I have hereunto subscribed my name this 6th day of September, 1928.

JOSEPH SLEPIAN.