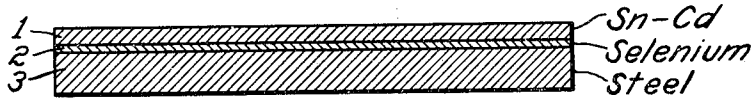
Oct. 11, 1949. W. E. BLACKBURN 2,484,204

SELENIUM RECTIFIER

Original Filed July 25, 1942




WITNESSES:

Wm. B. Sellers.

John P. Shipman

INVENTOR

Wayne E. Blackburn.

BY F. W. Lyle

ATTORNEY

Patented Oct. 11, 1949

2,484,204

# UNITED STATES PATENT OFFICE

2,484,204

## SELENIUM RECTIFIER

Wayne E. Blackburn, Wilkinsburg, Pa., assignor to Westinghouse Electric Corporation, East Pittsburgh, Pa., a corporation of Pennsylvania

Original application July 25, 1942, Serial No. 452,263. Divided and this application June 2, 1945, Serial No. 597,191

5 Claims. (Cl. 175—366)

1

My invention relates to selenium rectifiers and, in particular, to methods of insuring consistent rectifying performance throughout the area of a relatively large selenium surface.

This application is a division of my application Serial No. 452,263, filed July 25, 1942, now Patent No. 2,390,771, issued December 11, 1945, and assigned to the Westinghouse Electric Corporation, East Pittsburgh, Pennsylvania.

One object of my invention is to provide a rectifier of the selenium type which shall exhibit rectifying properties of great uniformity as between different specimens manufactured.

Another object of my invention is to provide a selenium rectifier which shall have a rectifying contact layer exhibiting great uniformity in rectifying action throughout its expanse.

Still another object of my invention is to produce selenium rectifiers by a wholesale manufacturing process yielding a product of great uniformity and reliability.

A further object of my invention is to produce selenium rectifiers of high electrical efficiency.

Other objects of my invention will become apparent upon reading the following description, taken in connection with the drawing in which the single figure illustrates a rectifier produced in accordance with the principles of my invention.

It is customary in manufacturing selenium rectifiers to coat a backing-plate of metal with a layer of molten selenium and to subject this layer to an annealing process at a temperature somewhat below its melting point. When this is done, it is found that a layer appears on the outer surface of the selenium which may be an oxide of selenium, but which at any rate has undesirable qualities in the rectifier. For example, such a layer is liable to be found of non-uniform character throughout the extent of the surface, and also to show considerable variations between rectifiers made at different times.

In order to avoid the difficulties resulting from this lack of uniformity and to produce rectifiers of reliable rectifying characteristics, I have found that a superior product is produced if the selenium surface, after annealing, is submerged in boiling water for thirty seconds. Thereupon the selenium element is removed from the water and permitted to dry by evaporation of the remaining moisture due to the heat stored in the element. The element is then dipped for thirty seconds into a boiling solution of sodium hydroxide of approximately 1.3 grams per liter of solution. Thereafter it is removed and permitted

2

to dry by its own heat. The selenium unit to which the above-mentioned treatment is applied is preferably formed by taking a piece of sheet metal of the iron group such as cold-rolled steel, indicated at 1 in the drawings. One surface of this sheet is roughened to a matt surface by any convenient process, such as sand blasting or acid etching. On this surface 1 place a coating of amorphous selenium by heating it to a temperature between 220° C. and 250° C., the molten selenium being applied to a thickness of several mils and thereafter the plate is allowed to cool quickly. Thereafter the coated plate is heated to approximately 130° C. and is pressed against a smooth flat surface with sufficient force to reduce the plastic selenium to a smooth uniform layer preferably about 2 mils thick. The smooth flat surface may conveniently comprise a plate of the phenol condensation produce sold under the tradename of "Micarta." The plate is then introduced into an oven at room temperature and heated gradually to approximately 180° to 190° C., within a period of two hours, remaining at this temperature for several hours, preferably at least six. The plate is then preferably gradually cooled to room temperature before the plate is removed from the oven, the time taken for cooling being preferably of about three hours.

As an alternative to insure a smooth and uniform coating of selenium, the disk with the molten layer applied may be rotated about an axis passing through its center so that centrifugal force will tend to carry a portion of the molten selenium to the periphery; surface tension maintaining a desirable uniform thickness in the layer remaining on the major area of the plate. The selenium layer appears at 2 in the drawings.

After the treatment with sodium hydroxide mentioned above, a contact layer 3 is formed on the selenium surface by any method well known in the art for this purpose. For example, an alloy comprising approximately 75% tin and 25% cadmium may be Schoop-sprayed in an approximately uniform layer over the selenium surface, as disclosed in E. D. Wilson Patent No. 2,193,610, for Selenium contact electrodes, assigned to the assignee of the present application and issued March 12, 1940. The remaining steps in the process of manufacture described in the aforesaid Wilson patent may likewise be applied to the unit chemically treated as above described, if so desired.

However, one step in the process of manufac-

ture which I have found to yield exceptionally good results consists in a certain treatment of the rectifier disc after the alloy coating described in the preceding paragraph has been applied. In order to insure a high resistance of the rectifier in the non-conductive direction, I impress a voltage tending to cause current flow in the high resistance direction; that is to say, high voltage tending to cause current flow in the opposite direction from that which the rectifier will allow to freely pass when alternating voltage is impressed upon it. Before impressing this voltage, however, I immerse the rectifier disc, held between appropriate electrodes, in thin transformer oil for a period preferably of minutes' duration. After such a treatment, the rectifier may be exposed to moisture without affecting the leakage current flowing in the high resistance direction and may even be stored for considerable times in a humid atmosphere. This process likewise tends to maintain a constant and uniform temperature on the rectifier element during the abovementioned voltage-forming period. While the greatest improvement from oil immersion is achieved if the voltage is impressed while the unit is still immersed in the oil, certain advantages, such as immunity from moisture absorption, are attained even when the unit is withdrawn from the oil before impression of the forming voltage.

While I have described the particular alkali solution employed as sodium hydroxide, it will be recognized by those skilled in the art that other chemically similar materials in normal solution, such as potassium hydroxide, may be substituted therefor.

I claim as my invention:

1. The method of treating rectifiers comprising a layer of selenium sandwiched between layers of metal, which comprises immersing said rectifier in oil and impressing between said layers a direct-current voltage tending to cause current flow in the higher resistance direction through said rectifier while still immersed in said oil.



2. The method of treating rectifiers comprising a layer of selenium sandwiched between layers of metal, which comprises immersing said rectifier in oil and impressing between said layers a direct-current high voltage tending to cause current flow in the higher resistance direction through said rectifier.

3. The method of treating rectifiers comprising a layer of selenium sandwiched between layers of metal, which comprises immersing said rectifier in oil for a period of the order of minutes' duration and impressing between said layers a direct-current voltage tending to cause current flow in the higher resistance direction through said rectifier while still immersed in said oil.

4. The method of treating an electric circuit element comprising selenium sandwiched between opposing metal layers, which comprises covering said element with oil and impressing between said layers a voltage tending to cause current flow between said layers in a higher resistance direction through said rectifier.

5. The method of treating an electric circuit element comprising selenium sandwiched between opposing metal layers, which comprises covering said element with oil for the period of the order of minutes' duration and impressing between said layers a voltage tending to cause current flow between said layers in a higher resistance direction through said rectifier.

WAYNE E. BLACKBURN.


REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

| Number | Name | Date |
|---|---|---|
| 2,229,807 | Hoppe | Jan. 28, 1941 |
| 2,237,802 | Wittke | Apr. 8, 1941 |
| 2,279,187 | Tompson et al. | Apr. 7, 1942 |
| 2,288,341 | Addink | June 30, 1942 |
| 2,352,640 | Kotterman | July 14, 1944 |