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METHOD OF ROUGHENING THE SURFACE OF FERROUS ELEMENTS

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Fig. 1

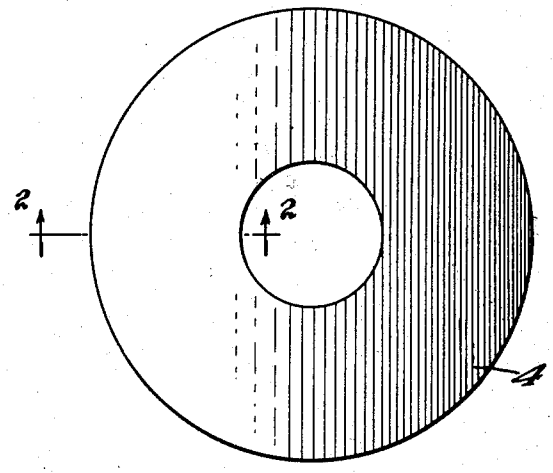
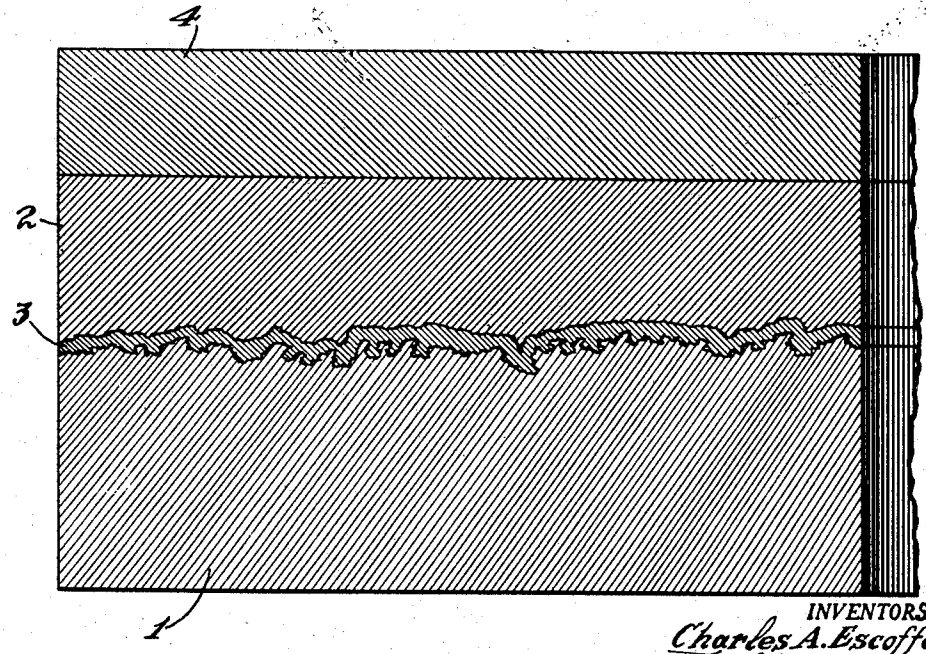


Fig. 2



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METHOD OF ROUGHENING THE SURFACE OF FERROUS ELEMENTS

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5 Claims. (Cl. 41—42)

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This invention relates to novel articles of manufacture and to methods for preparing the same. In its more specific aspect, the invention is directed to novel rectifiers, parts thereof and to methods for preparing the same. The rectifiers with which this invention is more particularly concerned are those generally known as the dry or dry disc type.

These dry rectifiers generally consist of a ferrous base plate carrying thereon a layer of selenium on top of which is an eutectic alloy, such as Wood's alloy. In some instances between the ferrous base and the selenium layer there may be a thin layer of nickel, iron or the like.

Figure 1 is a top plan view of a dry rectifier embodying the present invention.

Figure 2 is a cross sectional view taken on line 2—2 of Figure 1, said view being greatly magnified.

The general process employed in producing a selenium rectifier consists in applying a layer of selenium to a metallic base plate, such as iron and usually steel and then spraying on to the layer of selenium a layer of a fusible eutectic alloy, such as Wood's alloy. The metallic base plate and the alloy constitute the two electrodes of the rectifier.

In practice, no serious difficulties are ordinarily encountered in applying the alloy, but experience has shown that in order to insure the adherence of the selenium to the base plate, it is necessary to roughen the surface of the latter. This surface roughening generally has been accomplished by blasting with an abrasive such as sand, during which treatment surface oxides may also be removed.

It has long been known that while this sandblasting treatment provided a surface on the base plate which provided a better adherence surface for selenium thereto than the untreated base plate, this adherence characteristic was only moderately good and therefore was far from being completely satisfactory. Other disadvantages of sandblasting are: sometimes sand particles are embedded in the so treated base, high cost, time consuming, noisy, inconvenient and presents a silicosis hazard. Consequently, various attempts have been made to treat the base metal in various manners in order to provide a better adhering surface between the base and the selenium. All of these have failed for one reason or another and generally because such treatments introduce an electrical resistance in the completed rectifier which is reflected as a low forward grade or a low forward conductivity characteristic.

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In the course of our experimentations, we have discovered that we may produce dry disc rectifiers which are superior to the prior art rectifiers of this type. We have further found that we may treat the base metal to provide a surface which has improved adherence where selenium is deposited thereon. This treatment is silent, fast, easily controlled and relatively inexpensive. In addition it presents no hazard to health and does not introduce an additional electrical resistance in the rectifier.

We have further discovered that an improved etched surface may be produced by simply immersing the base metal in a novel bath for a limited period of time. After this immersion step, the base metal has a smut thereon. Most or practically all of this smut may be readily and easily removed by simply treating the smut covered surface with water.

Briefly, in carrying out this invention we prefer to employ a ferrous base plate 1 and preferably one whose carbon content is no greater than about .5%. While pure iron may be employed, for economic reasons we prefer to employ steel having a hardness no greater than 85 on the Rockwell B scale and a carbon content no greater than about .5%. The carbon content of the steel may vary between .05% and .5% and these steels have S. A. E. numbers between 1010 and 1050. The base plate 1 may be first made to shape and size in any desired manner.

This so-called ferrous base blank 1 is then subjected to a cleaning operation to remove the oil, grease and dirt thereon. While any number of different methods may be employed for this purpose, we prefer to accomplish that purpose by employing either an alkali soak cleaning or an alkali electrocleaning step and more preferably the latter. For this cleaning step we prefer to employ an alkali cleanser, such as "Oakite #90" manufactured by the Oakite Products, Inc., of New York, New York. A water solution of said "Oakite #90" is made up with the concentration of said solution being about 8 ounces "Oakite #90" per gallon of water. The solution is heated to about its boiling point or about 5 to 10 degrees F. therebelow and said blanks 1 are placed therein and are connected to the positive pole of a source of E. M. F. and the negative pole is connected to the container of said solution and this container may also be steel. It is preferable to employ separate steel elements immersed in said solution as the cathodes. The current density

of the anode or blank 1 being treated in said solution at said temperature is about 50 amperes per square foot. At the end of three minutes, the blanks 1 will be found to be clean and are removed from said solution. Then the blanks are rinsed in a hot water bath. By whatever method employed, the cleaned ferrous base blanks 1 are now ready for treatment to roughen or deep etch the exterior surface thereof.

According to this invention, these cleansed ferrous base blanks 1 are immersed in a novel etching solution in order to etch or roughen the same. This solution consists of an aqueous solution of nitric acid and acetic acid and for best and most efficient operation and results, the solutions consist of 50 to 55 parts by volume of acetic acid, 40 parts by volume of concentrated nitric acid (42° Baumé) and 40 to 55 parts by volume of water. During treatment of said blanks 1 in any of said solutions, the temperature of said solution is maintained in any convenient manner in the range of about 15° C. to 45° C. and more preferably in the range of about 19° C. to 32° C. The bath or solution may be constantly stirred or agitated by means of a mechanical stirrer or by air agitation to improve the appearance of the discs or blanks, to prevent stratification and to aid in leveling the temperature of the solution throughout its mass. After a period of about .5 to about 6 minutes in said solution, the blanks 1 are removed and immediately thereafter are treated with water, by spraying or rinsing to remove the smut therefrom. The rinse or spray water may be at room temperature, but we prefer it be higher and about 150° F.

Upon removal of the smut, the surface of each blank 1 presents an exposed surface characterized by a number of pits, elevations and irregularities for locking the selenium thereto and thus provide good adherence characteristics. The deep etching produced by this invention exhibits a marked degree of undercutting (shown in Figure 2) which is probably the cause of the excellent adherence thereto of a selenium layer 2 added thereto: and in addition shows a much greater surface area when compared with a sandblasted surface. If desired, an intermediate layer of nickel, iron, cobalt 3 or the like may be deposited on the etched surface of said ferrous base 1 after which the layer 2 of selenium may be deposited thereon. Ordinarily, a layer of nickel is electro-deposited thereon and when this is to be done, we prefer to immerse the blank 1, after the smut has been removed therefrom, into an aqueous solution of hydrochloric acid for a short time in order to "activate" the etched surface thereof before electroplating. The hydrochloric acid solution may have a concentration of about 10–20% and the time of immersion therein is between about one to three minutes. Either with or without the intermediate layer, the selenium layer will have good adherence to said roughened surface and good electrical characteristics. On to said selenium layer 2 may be deposited a layer 4 of a fusible eutectic alloy, such as Wood's alloy.

The following are illustrative examples of specific solutions which we have found to be particularly efficacious in the practice of this invention:

Solution I

	Parts by volume
Glacial acetic acid	50
Concentrated nitric acid (42° Baumé)	40
Water	40

Solution II

	Parts by volume
Glacial acetic acid	55
Concentrated nitric acid (42° Baumé)	40
Water	45

Solution III

	Parts by volume
Glacial acetic acid	55
Concentrated nitric acid (42° Baumé)	40
Water	50

Solution IV

	Parts by volume
Glacial acetic acid	50
Concentrated nitric acid (42° Baumé)	40
Water	55

In the practice of this invention, into a glass or other appropriate container may be poured 40 to 55 parts by volume of water and then there is added thereto 40 parts by volume of concentrated nitric acid (42° Baumé) and 50 to 55 parts by volume of glacial acetic acid. Then into said solution is immersed a metallic base blank 1 and preferably a carbon steel blank having a carbon content no greater than about 0.5% and preferably between about 0.05 and 0.5% and a hardness no greater than 85 and preferably no lower than 30 on Rockwell B scale. The steel blank 1 is allowed to remain in one of said solutions for a period of about 1 to 6 minutes during which time said solution is agitated and maintained between about 15° C. and 45° C. Then the so-treated blank is removed therefrom and is subjected to a water rinsing or spraying operation whereby the smut is removed therefrom. After the smut has been removed from said blank, the blank may be immersed for a period of about 1 to 3 minutes in an aqueous solution of hydrochloric acid. This aqueous solution of hydrochloric acid may be prepared by adding 20 parts by volume of concentrated hydrochloric acid to 80 parts by volume of water. Then the disc is ready for nickel plating, after which a layer of selenium is deposited thereon and onto said layer of selenium may be deposited a layer of a fusible eutectic alloy, such as Wood's metal. The nickel may be completely substituted by electrolytic iron, cobalt or the like and in some instances, no intermediate layer need be present between the base material and the selenium. The dry rectifiers whose ferrous electrodes and particularly, those of the type heretofore defined, have been etched in accordance with this invention and with or without an intermediate layer between the selenium and the so-etched surface have improved electrical and mechanical properties.

While this invention has been described in considerable detail, it is not to be limited thereby because various changes and modifications may be made within the scope of this invention without departing substantially from the spirit thereof.

We claim:

1. The method of etching a ferrous element comprising treating said element with a solution comprising 50 to 55 parts by volume of acetic acid, 40 parts by volume of concentrated nitric acid and 40 to 55 parts by volume of water.

2. The method comprising treating a ferrous element with a solution maintained in the range of 15° C. to 45° C. and comprising 50 to 55 parts by volume of acetic acid, 40 parts by volume of concentrated nitric acid and 40 to 55 parts by volume of water.

3. The method of etching a ferrous element comprising treating said element with a solution comprising 50 to 55 parts by volume of acetic acid, 40 parts by volume of concentrated nitric acid and 40 to 55 parts by volume of water, said element being treated with said solution until smut is produced on one surface thereof and then treating said smut with water to remove said smut from said surface.

4. A method comprising treating a ferrous element with a solution maintained in the range of 15° C. to 45° C. and comprising 50 to 55 parts by volume of acetic acid, 40 parts by volume of concentrated nitric acid and 40 to 55 parts by volume of water, said element being treated with said solution until smut is produced on one surface thereof and then treating said smut with water to remove said smut from said surface.

5. A method comprising roughening a surface of a low carbon steel having a carbon content no greater than 0.5% with a solution of 50 to 55 parts by volume of acetic acid, 40 parts by volume of concentrated nitric acid and 40 to 55 parts by volume of water.

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