

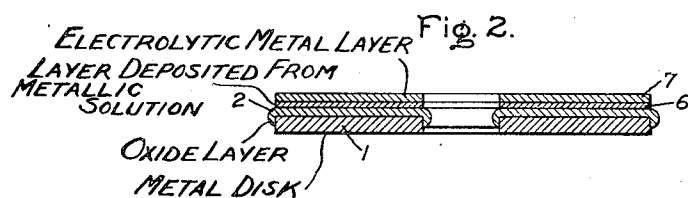
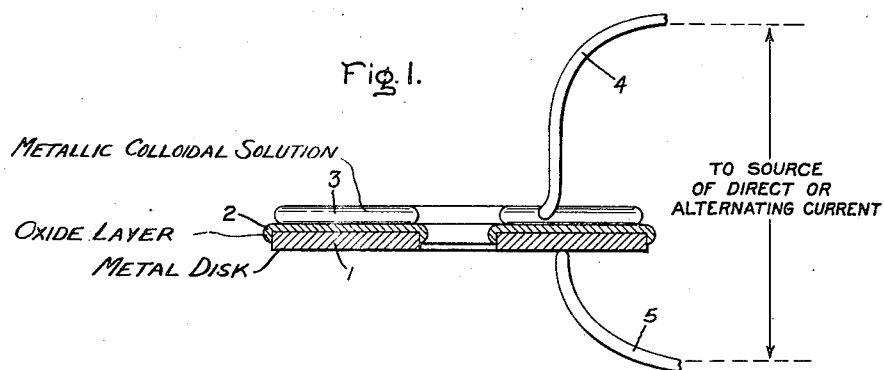
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M. MASNOU

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RECTIFIER

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Inventor:
Maurice Masnou,
by *Harry E. Dunham*
His Attorney.

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RECTIFIER

Maurice Masnou, Paris, France, assignor to
General Electric Company, a corporation of
New York

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The present invention relates to rectifiers of the contact or so-called dry type, and its object is to provide a new method of manufacturing and assembling rectifiers of this type, this method being readily carried out in practice and providing very compact rectifier arrangements of low cost, the efficiency of rectifiers made in accordance with the new method being higher and their characteristics being more nearly constant than is usual in the case of rectifiers heretofore known.

Dry rectifiers of all types are constituted by metal plates or discs, one surface of which is uncoated while the other is covered by a layer consisting of a suitable chemical composition whereby unilateral conductivity is obtained. This layer may be applied to the plate, as in the case of selenium rectifiers, or it may be formed thereon by a chemical process such as oxidation or sulphuration of the plate. The contact between the metal of the plate and the corresponding chemical composition provides more or less pronounced asymmetrical conductivity. The metal of the plate constitutes the cathode of the rectifier and the layer of chemical composition which covers the plate constitutes the anode. Such a coated plate constitutes a rectifier element.

In order to establish the external connections of a rectifier of the above mentioned type, or in order to connect it in series with other elements identical therewith, it is necessary to establish a good electrical contact between this anode, or second pole, which is usually poorly conductive, and any metal piece which serves as a connecting or terminal member. In most cases this electrical contact has been established by applying under heavy pressure to the anode layer a plate or disc of soft metal, lead for example. Notwithstanding the heavy pressure, it was often found that the contact was not satisfactory, and in order to improve the contact, a layer of graphite or of other conductive and pulverulent material has been interposed between the anode layer and the lead or other soft metal member.

However, it has been found that rectifiers constructed in accordance with this latter method are in some cases characterized by a rather high contact resistance, and become unduly heated when carrying current. When it is desired to transmit a large amount of power, the size and weight of the rectifiers thus constructed may in some instances be considerable, thereby increasing their cost and limiting their field of application. Further, considerable variations of the characteristics of such rectifiers in accordance with variation, often unavoidable, of the

pressure have been encountered in certain cases.

To overcome these disadvantages several methods have been proposed. It has been suggested to treat chemically the layer of composition which covers the metal plate or cathode, with a view to obtaining, by a reducing process, a metal coating on this layer. This latter method requires in its application very delicate operations and is restricted to certain oxides. It has also been proposed to cover the active layer with a pulverulent coating, but in some cases the adhesion of the coating is deficient and the contact is not entirely satisfactory.

Attempts have also been made to form the metallic coating by electrolysis, but the electrolyte has tended to penetrate between the metal plate or cathode and the layer of active material, through fissures or other breaks in the continuity of the active surface, thereby causing irregular and unpredictable changes in the contact resistance.

In accordance with the present invention, the difficulties encountered heretofore in providing a conducting layer or metallic coating in contact with the active layer are avoided. The metal to be deposited on this active or asymmetric layer is preferably, though not necessarily, a noble metal. In accordance with my invention this metal is first brought into a state of neutral colloidal solution, for example by the method described by Brédig. The metal, thus held in the state of colloidal suspension or solution, is deposited by any known method on the surface to be metallized. Preferably the deposition is performed by the electric transfer method, as will be better understood later in this description.

In accordance with my invention colloidal suspensions or solutions of copper, palladium, silver, gold, etc., are employed. It is preferable, but not essential, that the metallic particles be at a positive potential. These chemically neutral colloids do not attack the supporting metal, or cathode, or the layer of active material which covers the cathode. Under these conditions the normal operation of the rectifiers is not affected by the presence of the colloids during the process of treatment.

The precipitation of the metal upon the rectifier element may be performed in many ways. The colloidal solution may be deposited upon the element, after which the liquid may be evaporated. Likewise, the metal, finely divided in the colloidal solution may be precipitated by centrifugation. The depositing of the solution upon the rectifier may, finally, be accomplished by

means of drop-counters or by the "gun" process. Preferably, however, the depositing of the solution and the forming of the metallic layer are accomplished by a method which will be set forth hereinafter.

My invention will be better understood from the following further description thereof when considered in connection with the appended drawing, and its scope will be set forth in the appended claims.

Referring to the drawing, Fig. 1 is a sectional view of a rectifier element of the dry type embodying my invention, and Fig. 2 is a sectional view of a rectifier element similar to that of Fig. 1 but having an additional conductive member or layer.

In Fig. 1 the metal disc 1 and the active layer thereon of chemical composition 2 are comprised in a usual rectifier element. In accordance with my invention, a few drops of a colloidal suspension or solution are deposited upon the layer 2, for example a colloidal solution consisting of particles of silver in distilled water, the drops which are deposited forming a liquid layer 3. By means of the leads or wires 4 and 5 a suitable difference of potential, either direct or alternating and from any convenient source, is applied between the liquid layer 3 and the metal element comprising plate 1 and active layer 2. The best results are obtained when the colloidal layer 3 is positively charged, since the rectifier then acts with its minimum resistance and the deposit of metal from the colloidal layer is very rapid. With the colloidal layer at a negative potential the deposit is also formed, but slowly. With an alternating potential impressed upon the colloidal layer the metal is deposited at a rate intermediate between that corresponding to positive and negative potentials respectively, impressed as above described upon the layer 3.

In all cases the metal held in suspension (colloidal silver for example) is deposited immediately upon the active layer 2 and forms thereon a hard covering 6, as shown in Fig. 2, which is continuous and very adherent. After the excess of liquid is removed and after drying of the rectifier element, comprising cathode plate 1 and active layer 2 having thereon the conductive layer 6, the rectifier washers, discs or plates thus treated may then be superposed to form rectifier stacks. Since the contact between adjacent rectifier elements of a stack is made between two metal surfaces, it is, therefore, no longer necessary to employ the lead washers or contact members hereinbefore mentioned or to employ the intermediate graphite layers, etc. Further, it is no longer necessary to apply a heavy clamping pressure to the rectifier stack; the total resistance of a rectifier stack constituted by rectifier elements in accordance with the present invention no longer depends on that clamping pressure. The characteristics of the rectifiers thus constructed in accordance with my invention are constant and such that the rectifiers may be employed for supplying measuring apparatus for example.

The contact resistance being lower, a higher efficiency is obtained and a smaller generation of heat. Finally, the elimination of the electrically inactive lead washers permits a considerable reduction in weight, size and cost of the rectifiers. Thus, a given copper-oxide rectifier apparatus designed for 6 volts and 3 amperes weighs 1800 gr. when built in the conventional manner, but when built in accordance with the present inven-

tion the apparatus weighs only 250 gr. and its volume is reduced by more than 70%.

The hereinbefore described method of precipitating metals in colloidal suspension or solution is applicable to the surfaces of rectifiers regardless of their form and dimensions. This method therefore permits an increase of the surface and of the power of the rectifiers, at present limited by the admissible rate of compression. The layer 6 of silver, or of similar metal substantially not subject to deterioration, lasts indefinitely; furthermore, notwithstanding its very slight thickness this layer 6 will withstand current intensities at least equal to those which the active layer 2 of chemical composition will withstand, and, in general, even still higher current intensities.

As illustrated in Fig. 2, the adherent metallic layer 6, derived from the colloidal solution 3, may be reinforced if necessary by an additional layer 7 prepared by electrolysis, the metallic layer 6, on which layer 7 is deposited by the electroplating process, serving during this latter process to protect the active layer 2 from the chemical action of the electrolyte.

What I claim as new and desire to secure by Letters Patent of the United States, is:

1. A rectifier element comprising a metal member forming a cathode, a layer of active material on said plate forming an anode, and a metallic layer deposited upon said layer of active material from a solution wherein the metal of said metallic layer is in a state of colloidal suspension, the liquid in said solution being completely evaporable whereby said metallic layer comprises only said last-named metal.

2. A rectifier element of the dry type comprising a cathode electrode, a layer of active material thereon, and a conductive coating deposited upon said layer from a colloidal solution of a metal, the liquid in said solution being completely evaporable whereby said coating comprises only said metal.

3. A rectifier element comprising a metal plate having a layer of active material thereon, and a conductive layer deposited upon said active layer from a colloidal solution of a metal, the liquid in said solution being completely evaporable whereby said conductive layer comprises only said last-named metal.

4. A rectifier element comprising a metal plate having a layer of active material thereon, and a conductive layer deposited upon said active layer from a colloidal solution of silver, the liquid in said solution being water only.

5. A rectifier element comprising a copper member and a layer of an oxide of copper thereon, and a conductive layer deposited upon said oxide from a colloidal solution of a metal, the liquid in said solution being completely evaporable whereby said conductive layer comprises only said metal.

6. A rectifier element comprising a copper plate and a layer of copper oxide thereon, and a conductive layer deposited upon said oxide from a colloidal solution of silver, the liquid in said solution being water only.

7. A rectifier element of the dry type comprising cathode and anode members, and a conductive layer deposited upon one of said members from a colloidal solution of a metal, the liquid in said solution being completely evaporable whereby said layer comprises said metal only.

8. In a rectifier element comprising a coating of active material upon a metallic plate, the method of forming a conductive element in con-

tact with said coating, which includes bringing a metal to a state of colloidal solution, the liquid in said solution being completely evaporable and depositing said metal only upon said coating from said solution.

9. In a rectifier element comprising a coating of active material upon a metallic plate, the method of forming a conductive element in contact with said coating, which includes bringing a metal to a state of colloidal solution in a completely evaporable liquid, placing said solution upon said coating, and evaporating the liquid to deposit said metal only upon said coating.

10. In a rectifier element comprising a metallic plate having thereon a coating of active material, the method of forming a conductive member in contact with said coating, which includes bringing metal particles to a state of colloidal solution in a liquid, impressing a potential upon said metal particles in suspension in the solu-

tion, and evaporating said liquid to deposit said metal in a hard adherent layer upon said coating.

11. A rectifier element comprising a metal plate having a layer of active material thereon, a conductive coating deposited upon said active layer from a colloidal solution of a metal, the liquid in said solution being completely evaporable whereby said coating comprises only said last-named metal, and a reenforcing conductive layer electroplated upon said coating.

12. The method of forming a rectifier element comprising a metallic plate having thereon a coating of active material which includes, bringing metal particles to a state of colloidal solution, the liquid in said solution being completely evaporable, placing said solution upon said coating, evaporating the liquid to deposit said metal only in a hard adherent layer upon said coating, and electroplating said layer to form a reenforcing conductive plate thereon.

MAURICE MASNOU.