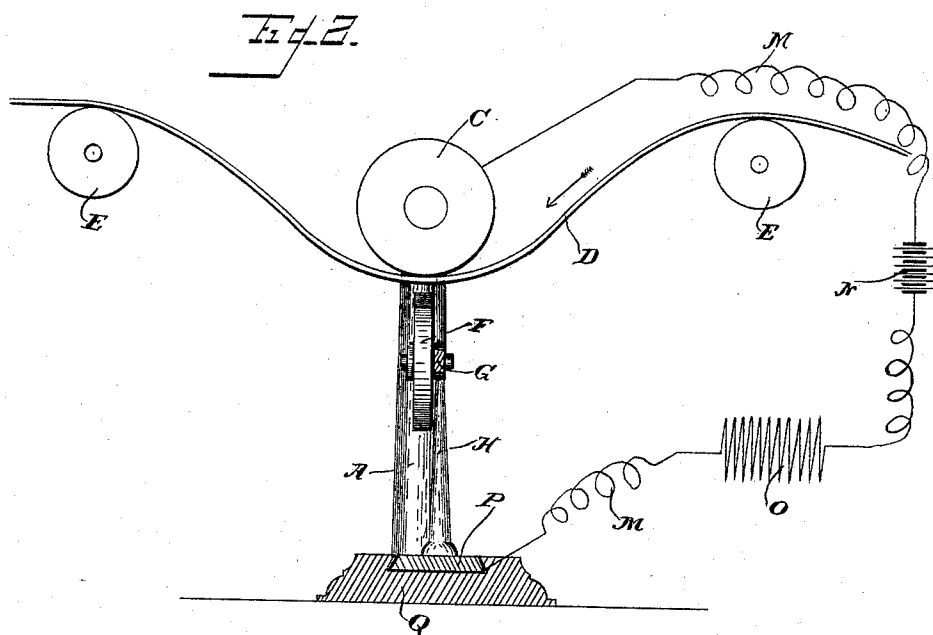
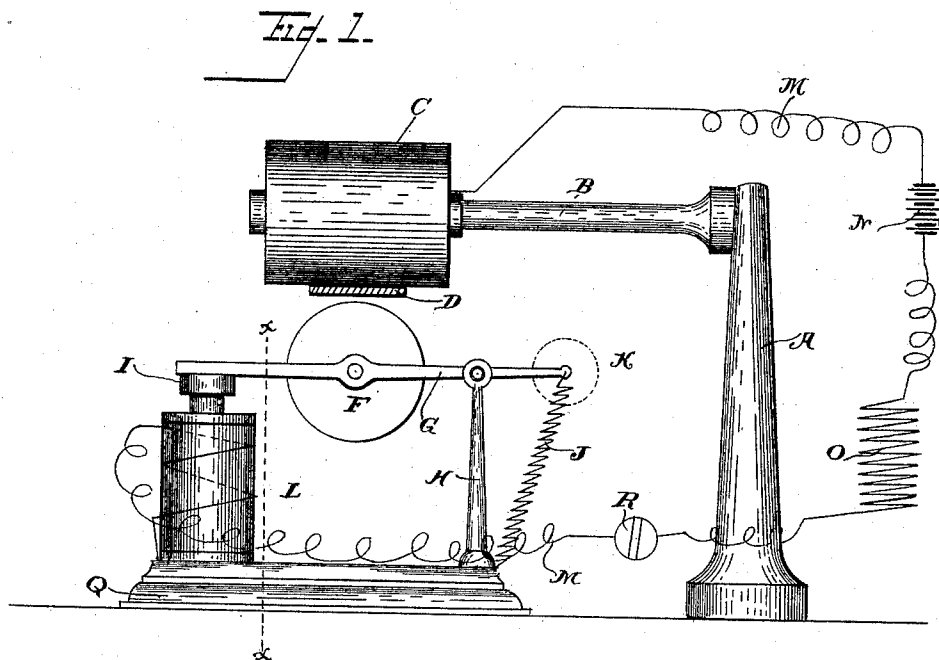


(No Model.)

A. RECKENZAUN.
SECONDARY BATTERY ELECTRODE AND PROCESS OF MAKING THE SAME.
No. 475,797.
Patented May 31, 1892.



Witnesses
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UNITED STATES PATENT OFFICE.

ANTHONY RECKENZAUN, OF LONDON, ENGLAND.

SECONDARY-BATTERY ELECTRODE AND PROCESS OF MAKING THE SAME.

SPECIFICATION forming part of Letters Patent No. 475,797, dated May 31, 1892.

Application filed September 13, 1890. Serial No. 365,120. (No model.) Patented in England November 22, 1889, No. 18,755; in France July 30, 1890, No. 207,332; in Belgium July 30, 1890, No. 91,462; in Germany August 7, 1890, No. 57,085; in Victoria October 11, 1890, No. 8,155; in Italy July 8, 1891, No. 409, and in Spain July 24, 1891, No. 12,213.

To all whom it may concern:

Be it known that I, ANTHONY RECKENZAUN, a subject of the Queen of Great Britain, residing at London, in the county of Surrey, England, have invented certain new and useful Improvements in Secondary Batteries, (for which I have obtained Letters Patent of Great Britain, No. 18,755, dated November 22, 1889; in Victoria, No. 8,155, dated October 11, 1890; in France, No. 207,332, dated July 30, 1890; in Belgium, No. 91,462, dated July 30, 1890; in Germany, No. 57,085, dated August 7, 1890; in Spain, No. 12,213, dated July 24, 1891, and in Italy, No. 409, dated July 8, 1891;) and I do declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same, reference being had to the accompanying drawings, and to the letters of reference marked thereon, which form a part of this specification.

My invention has for its object the production of active material upon the surfaces of plates by means of the electric spark or arc. The surfaces of metals become oxidized and physically changed under the influence of electric sparks. An electric spark is generally followed by a stream of air or other surrounding medium. The points of discharge may also be partially evaporized and the resultant vapors enter more or less intimately into combination with the surfaces to be treated, and I have found that not only the electric spark but also the electric arc produces similar results.

Now in accordance with my invention I utilize the phenomena to which I have above referred for the production of oxides and other compounds upon metallic plates for batteries.

In carrying out my invention I proceed as follows—that is to say, I place a plate, sheet, strip, ribbon, wire, or other form of lead or other suitable metal in contact with one pole of a dynamo or other source of electricity, some other suitable conductor being connected with the other pole of the source of supply, and I produce sparks or arcs between these two terminals. At the same time I cause either the plate to travel under the

conducting-point or I allow the latter to pass over the plate, or both may be made to have some relative motion, in order to distribute the action of the spark or arc over either the whole or any portion of the surface of the plate. In the one case I allow a more or less rapid make and break between the surface to be operated upon and the conducting-point, whereupon a succession of electric sparks will ensue. In the other case I produce an electric arc between the two elements and maintain such arc for any length of time while one or other of the elements is traveling along. The action is more energetic under this latter mode of procedure, owing to the higher temperature maintained by the employment of the arc. Particles of the surfaces under treatment become melted, and they combine with surrounding matter. The final effect will depend upon the nature of the conductors forming the spark or arc, as the case may be, as also upon the surrounding medium. Atmospheric air produces good results; but the effect is enhanced by oxygen gas, and various combinations may be effected by the employment of other gases, vapors, or liquids, which can be led to the points of application.

The surfaces to be treated with the electric spark or arc, or for more rapid work a series of sparks or arcs, may also previously be coated with any suitable material which by heat or by evaporation may promote the desired changes on the surfaces, and instead of oxides various other compounds may be produced, according to the nature of such substances. Hence in accordance with my invention it is not only possible to effect the oxidation of metals, but deposits may be produced varying in nature according to the material of which the conducting-points are made, as also according to the properties of any substance in the vicinity of and influenced by the spark or arc. Even the relative arrangement of polarity influences the results. Thus it will be found that in the case of a sheet of lead when under treatment in atmospheric air by means of an arc from continuous currents the surface of the lead will assume a porous or spongy form, either brown or light yellow in color, accordingly as the

plate formed the positive or negative pole of the source of supply, whereas the effect of color with alternating currents is not distinctly defined.

5 It will be readily understood that the arc in any case must be of sufficient strength to insure the desired effect, not so powerful as to destroy the plate, sheet, strip, ribbon, or wire, nor so weak as to make but little im-
10 pression. I find that a current of about two amperes gives good results on rather thin metal without burning it through, with an electro-motive force of about forty volts. The voltage can be varied according to the most
15 suitable length of arc, and the current strength depends in a measure upon the thickness of the material to be treated, and generally the current, as well as the potential difference, must be adjusted to the nature and dimensions
20 of the elements. The current is regulated by suitable resistances in the circuit, formed of a coil or of coils, which may at the same time be utilized for actuating the make and break whether in the case of sparking or for pro-
25 ducing the arc. In the one case the armature of the make and break will resemble the trembler of an induction-coil and in the other that part of an arc lamp which starts the arc at the moment of making circuit and
30 maintains it a convenient length of time. With the object of maintaining a tolerably-constant current I may, instead of using a dead-resistance in the electric circuit, insert an electric motor whose speed and counter
35 electro-motive force will vary with the resistance of the arc between the surface under treatment and the conducting point or points and thus tend to automatically equalize the current strength.

40 One of the resultant advantages of preparing plates in this manner is that the "active" material can be made with rapidity and in the desired parts of the surface. Thus for mechanical or electrical reasons any portion
45 of the surface can be left unattacked and in its normal condition, while the remaining portion can, wherever desired, be converted into an active or porous mass, being in an integral union with its metallic base.

50 For convenience in manufacture I prefer to use continuous metal ribbons, strips, or wires, which can be treated on being caused to run over rollers while subjected to the action of the electric current. These strips,
55 sheets, ribbons, or wires are afterward shaped into electrodes for batteries, which are placed into the usual electrolytes and charged in any of the well-known methods.

60 I wish it to be understood that the mere shape of the electrodes forms no part of my invention, and also that part of the hereinbefore-described process of manufacture is available in connection with primary batteries, and likewise for other industrial purposes.

65 There may be very many forms and variations of mechanism for carrying this method into effect. I will, however, describe only one

form as illustrative of means that may be employed.

In the accompanying drawings, of which 70 Figure 1 is a side elevation and Fig. 2 an end elevation of suitable mechanism, partly in cross-section, on the line *xx* of Fig. 1, the letter A designates a standard supporting a horizontal arm B, which carries a roller C, 75 preferably of metal, across which passes a strip D, which may be a lead strip, whose surface is to be oxidized. This strip in Fig. 2 is represented as passing over guide-rolls E and may be moved along by any suitable means, 80 hand or mechanism, at the desired speed—say at the rate of six inches per minute—and which may be wound upon a suitable roll: (Not shown.)

In proximity to the strip D is supported a 85 suitable conductor F of any appropriate form and substance—say a disk of carbon or lead—which preferably is made to turn, so as to present new or fresh surfaces as it wears away. This conductor is sufficiently close to 90 the strip D to permit a spark or an arc to be formed between them to act upon the strip and may be supported in any suitable way. It is illustrated as pivotally secured to a swinging arm G, pivoted or hinged to the 95 standard H, which carries an armature I at one end and at the other end is connected to a spring J or provided with a weight K (shown by dotted lines) to restore the conductor to one position from which it may 100 have been moved. The armature I is adjacent to the core of an electro-magnet L, which may be energized when in circuit, so as then to attract the armature I and draw the conductor F away from contact with the strip D, 105 thus establishing an arc which will act upon the material of the strip so as to change its surface, and thus oxidize it, if the strip be lead. As soon as the circuit is broken the spring or weight referred to restores the con- 110 ductor into contact with the strip ready to establish an arc again when the magnet is energized. If desired, the conductor F may be given a tremulous movement by hand or otherwise, so as to produce a series of sparks 115 to act as the arc upon the strip D. When the electro-magnet is employed, as described, the action is automatic; but the magnet may be dispensed with and the action made dependent entirely upon the will of the operator. 120

The letter M designates the wires for transmitting the current from the source N, and O designates a resistance-coil to prevent any excess of current; but it may be replaced by a motor of suitable form, which may be used 125 to move the strip D and actuate the conductor F, which is illustrated as having its standard mounted upon a carriage P, which can travel back and forth, so as to move the conductor F across the width of strip D. The base Q of 130 this carriage will be insulated from any bed beneath it. A switch R may be employed to switch on and off the current. It may also be stated that any number of arcs may be made

by mounting conductors side by side. It is also obvious that the strip whose surface is to be changed may be caused to travel, or the conductor F may be caused to travel, or both the strip and the conductor may travel.

I have in the apparatus shown and in the description given thereof meant merely to give an illustration of suitable means for carrying out the method described and to be claimed herein. I do not lay any claim in this application to the mechanism shown, and for that reason a more minute description and illustration of the same need not be given; but I intend to claim herein the described process in which the material on the surface of a battery-plate is subjected to the action of an electric arc, so that it becomes oxidized or physically changed, or, as it may be said, "burned," and I intend to claim, moreover, as an article of manufacture a battery-plate having its surface burned, as by the action of an electric arc.

More specifically what I intend to claim, and desire to secure by Letters Patent, is—

1. The method of forming a battery-plate, which consists in progressively subjecting its surface to the action of the electric arc or spark, whereby said surface will become oxidized or physically changed, substantially as set forth.

2. The method of forming a battery-plate,

which consists in progressively subjecting its surface to the action of the electric arc or spark in the presence of a suitable material with which it is desired to have the substance of the plate combined, substantially as set forth.

3. The method of forming a battery-plate, which consists in placing it in contact with one pole of a dynamo or other source of electricity and causing an electric arc or spark to be produced between successive portions of the surface of the plate, and a contact-point connected to the opposite pole of the source of electricity, whereby the said surface is progressively subjected to the action of the arc, substantially as set forth.

4. As an article of manufacture, a battery-plate having its surface formed by burning the material of the plate.

5. As an article of manufacture, a battery-plate having its surface burned by subjecting the material of the plate to the action of an electric arc.

In testimony whereof I affix my signature in presence of two witnesses.

ANTHONY RECKENZAUN.

Witnesses:

OLIVER R. JOHNSON,
Consulate-General U.S.A., London, England.
S. J. CHAMBERLAIN.