

UNITED STATES PATENT OFFICE.

WILLARD E. CASE, OF AUBURN, NEW YORK.

PROCESS OF MAKING ELECTRODES FOR SECONDARY BATTERIES.

SPECIFICATION forming part of Letters Patent No. 309,293, dated December 16, 1884.

Application filed April 23, 1884. (No specimens.)

To all whom it may concern:

Be it known that I, WILLARD E. CASE, of Auburn, Cayuga county, New York, have invented a new and useful Process of Making Electrodes for Secondary Batteries, of which the following is a specification.

The invention relates to a process of making that class of secondary-battery electrodes which are produced by first melting a suitable material and then stirring it while in molten condition until it assumes a viscid state on gradually cooling, when it is pressed into molds, and also to that class of secondary-battery electrodes which are produced by melting a suitable material and then stirring in other ingredients while the first is in a melted state, and finally molding.

The invention consists, first, in the process of making the electrodes by melting the material and stirring it while cooling in a vessel maintained in certain uniform temperature by steam, and then molding said electrodes.

In United States Patent No. 289,386, granted to me December 4, 1883, I have fully set forth my process of making electrodes by melting a suitable material and then stirring the same while cooling, to render it porous, and to enable it to present a large active surface, and finally forming it into shape in molds; and in United States Patent No. 292,469, granted to me January 29, 1882, I have described a process of melting a suitable material and stirring in other substances, and then molding, to which patents I refer as fully explaining examples of the classes of electrodes to which this invention is intended more particularly to relate.

I have found by experiment that when a suitable material for constituting an electrode, to be made as above set forth—as, for example, lead or a lead alloy—is melted in a ladle directly over a fire, several disadvantages and difficulties become manifest.

First. The material is very apt to become overheated, often considerably beyond its melting-point. To bring it to the proper viscid state for molding while on the fire by simply stirring it necessitates a considerable waste of time.

Second. If other ingredients are to be added, the too hot material may injure them—as, for example, if mercury is to be introduced, as is

done in the process set forth in my Patent No. 292,469, that metal is very apt to become vaporized by the high temperature, and so wasted, besides exposing the operator to the effects of its deleterious fumes.

Third. It is not possible to regulate the temperature of the molten material with any certainty when over the fire. The lower part of the crucible is apt to be hotter than the upper part, and the material may be of unequal consistence, so that the uniform dissemination through it of other ingredients may thus be retarded or prevented.

Fourth. When the crucible is removed from the fire and the material then stirred, it cools more rapidly, but without uniformity. The portion nearest the outside of the crucible may become partially solidified and stick to the sides while the inner portion is still liquid or nearly liquid. This greatly increases the labor of stirring, and also prevents uniform dissemination of the added ingredients. Now, in making solid electrodes for storage-batteries, it is exceedingly important that they should be uniformly porous throughout, and filled with as many minute pores as possible; and if other ingredients than that originally melted are contained, it is also important that these ingredients should be distributed uniformly throughout the mass. When this is not the case, the full efficiency of such an electrode cannot be gained.

In order to overcome the above-mentioned difficulties, I have devised the following process: I first melt the material in the ordinary way in a ladle or crucible over a fire. As soon as it is melted I turn it out into a vessel of any desired form or construction, which is provided with a jacket or surrounded with a coiled pipe through which steam or superheated steam is caused to circulate. The arrangement and construction of this apparatus are not material so long as they be such that the inner vessel may receive heat from the steam circulating around it. By means of the steam, the supply of which may be regulated by a suitable hand-valve or by any apparatus operating automatically to shut off the steam when a certain temperature is attained, I heat the inner vessel as nearly as possible to the temperature of the material to be treated when it shall have cooled down to a pasty or viscid

state. This can easily be found by simply measuring the temperature of a sample of the material melted, and then cooled as stated. When the molten material is introduced into
5 the vessel, it is stirred, and as it is stirred it cools; but, by reason of the temperature of the vessel, it is not permitted to solidify or to cool down below or much below the pasty state. It follows, then, that the stirring pro-
10 cess can be efficiently and rapidly done, and that as the material is maintained throughout at a uniform temperature and in a uniform state, all parts of it will be equally affected, and if other ingredients be added they can be
15 completely incorporated with it. After the stirring process is finished, I press the material or the compound, while hot, in molds. I do not cast it in the sense of running it into a mold and allowing it to assume permanent
20 form by natural solidification. It is essential that the material should be put into the molds in a hot or pasty state, and, while so hot and pasty, that it should be pressed into form.

When the electrodes are made in the man-
25 ner above described, their structure is very homogeneous, and any tendency they may have to crumble or break in the battery by use is reduced to a minimum.

I claim as my invention—

1. The process of making electrodes for sec- 30
ondary batteries, consisting in first melting the material of which the electrode is to be composed; second, cooling said material in a vessel heated by steam at or near the temper-
35 ature of said material while in a pasty or viscid state, and stirring said material in said vessel while cooling until it reaches said viscid state; third, pressing said material, while in said viscid state, in form in a suitable mold or molds, substantially as described. 40

2. The process of making electrodes for sec-
ondary batteries, consisting in first melting a material which the electrode is to contain; second, cooling said material in a vessel heated
45 by steam at or near the temperature of said material while in a pasty or viscid state, stirring said material in said vessel while cooling until it reaches said viscid state, and at the same time adding any other ingredient or
50 ingredients which it is desired to combine with said material; third, pressing said compound, while in said viscid state, in form in a suitable mold or molds, substantially as described.

WILLARD E. CASE.

Witnesses:

W. A. FRENCH,
F. W. SMITH.