

# UNITED STATES PATENT OFFICE.

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## SECONDARY BATTERY.

No. 815,828.

Specification of Letters Patent.

Patented March 20, 1906.

Application filed April 11, 1905. Serial No. 255,007.

*To all whom it may concern:*

Be it known that I, EMIL LAURENCE OPPERMAN, a subject of the King of Great Britain and Ireland, residing at London, England, have invented a new and useful Improvement in and Relating to Electric Secondary Batteries, of which the following is a specification.

This invention relates to the manufacture of plates for secondary batteries or accumulators, and has for its object the formation of an active material for such secondary plates which shall eventually after charge and discharge become exceedingly porous and at the same time hard and tenacious, thus giving high efficiency in charge and discharge per weight of material employed, and at the same time a plate of great endurance which will not buckle or distort under abnormal conditions of charge and discharge. To effect this, I make a mixture of the usual active oxid with animal hair or wool or equivalent material in a finely-subdivided condition, preferably when both are in a dry condition, so as to obtain as far as possible an intimate mixture with the hair or wool permeating the oxid in every direction.

In order to get the hair or wool into a proper subdivided condition ready for mixture with the oxid, I grind the same in any suitable manner, so as to insure the length of any individual hair is not more than one sixteenth of an inch; but the bulk is substantially in the form of powder. For example, I take hair felt and subject it to the grinding action of the moving surface of an emery-wheel, by which treatment the hair of the felt is reduced to powdered hair and short hair. The mixed material is then formed into a paste in the usual way. It has been found from actual experience that if the hair forms from one-half to one and one-half per cent. of the mixture this is a proportion which gives satisfactory working results. The mixture can be built up into a plate on any convenient metallic grid foundation or frame. The plate is then dried and formed by charge and discharge in the usual way.

It is found that the porosity of the active material is steadily increased by successive series of charge and discharge until the maximum porosity is obtained and that this effect appears to be due to the gradual destruction

of the hair or wool throughout the active mass under the electrolytic action. At the same time the active material becomes tenacious and metallic, and thereby eminently durable, although perforated throughout its mass by capillary holes, offering an immense active surface to the electrolyte.

It has further been found that the active material so formed is capable of internal expansion and contraction during charge and discharge without the buckling or deformation of the plate as a whole.

I am aware that hair, wool, and other substances have been used in combination with active oxid as binding agents; but I have found that when so used without subdivision referred to the important results as hereinbefore described are not obtained and the plate is practically no better as to working capacity and life than ordinary plates in common use.

Having now particularly described and ascertained the nature of this invention and in what manner the same is to be performed, I declare that what I claim is—

1. A composite material for secondary electric battery-plates, consisting of active paste containing finely-subdivided filaments of material destructible by the electrolytic action of battery liquid, said filaments not exceeding one-sixteenth of an inch in length.

2. A composite material for secondary electric battery-plates, consisting of an active paste containing hairs not exceeding one-sixteenth of an inch in length.

3. A secondary-battery plate having an applied active paste containing short hairs not exceeding one-sixteenth of an inch in length.

4. A secondary-battery plate having an applied active paste containing finely-subdivided filaments of material destructible by the electrolytic action of the battery liquid, said filaments not exceeding one-sixteenth of an inch in length.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

EMIL LAURENCE OPPERMAN.

Witnesses:

RICHARD A. HOFFMANN,  
CHARLES CARTER.