

(No Model.)

H. H. CARPENTER.
ELECTRODE FOR SECONDARY BATTERIES.

No. 421,666.

Patented Feb. 18, 1890.

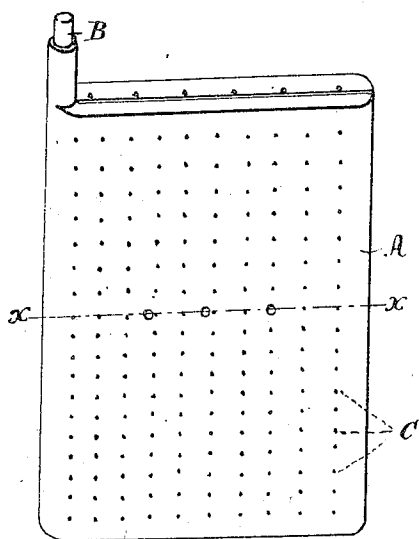


Fig. 1.



Fig. 2.

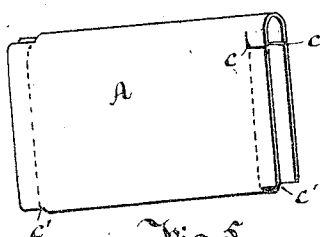


Fig. 5.

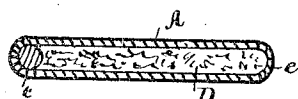


Fig. 7.

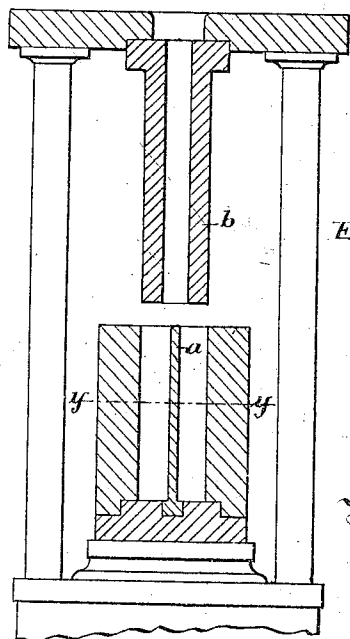


Fig. 3.

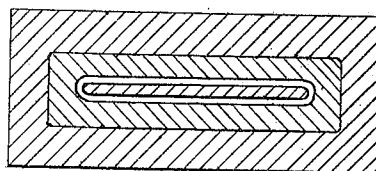


Fig. 4.

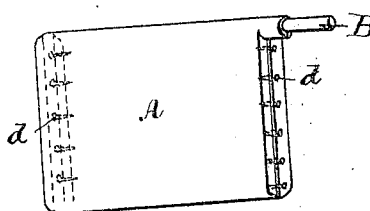


Fig. 6.

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UNITED STATES PATENT OFFICE.

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ELECTRODE FOR SECONDARY BATTERIES.

SPECIFICATION forming part of Letters Patent No. 421,666, dated February 18, 1890.

Application filed December 2, 1889. Serial No. 332,251. (No model.)

To all whom it may concern:

Be it known that I, HIRAM H. CARPENTER, a citizen of the United States of America, residing at New York, in the county of New York and State of New York, have invented certain new and useful Improvements in Secondary or Electric Storage-Batteries, of which the following is a specification, reference being had therein to the accompanying drawings.

My invention relates to the formation, construction, and protection of plates for secondary or electric storage-batteries, and particularly to that sort in which the active matter is inclosed in a supporting case or envelope, and the electrolytic fluid is brought into contact with the active matter by means of perforations through the plate, such as is described in the Letters Patent of the United States, No. 412,727, issued to me and bearing date October 15, 1889.

In the drawings, letters of like name and form refer to like parts in each of the figures.

The object of my present invention is to provide a supporting case or envelope for the active matter which will be practically indestructible, and at the same time combine the greatest efficiency with a minimum of weight.

Figure 1 is an elevation of my improved secondary-battery plate. Fig. 2 is a cross-section thereof through the line *xx* of Fig. 1. Fig. 3 is a vertical section of the machine for drawing out the envelope from molten metal under hydraulic pressure. Fig. 4 is a cross-section of the same machine on the line *yy*, showing the shape of the mandrel and the forming-die. Fig. 5 is an elevation showing the tubular envelope after it has come from the drawing-machine cut into suitable lengths and showing the various incisions necessary to fashion the tubular envelope so that it will inclose the active matter. Fig. 6 is an elevation showing method of sealing up the case or envelope after the active matter has been placed within it. Fig. 7 shows a cross-section of the plate represented in Fig. 6 after its exterior surface has been covered with a protecting-coating.

A represents the envelope or case.

B represents the post by means of which the different plates of a cell are electrically connected.

C represents the perforations in the plate passing through and through the plate from side to side.

D represents the active matter with which the envelope A is filled

E represents the machine for drawing out the envelope A from molten metal under hydraulic pressure.

a represents the mandrel, and *b* represents the hydraulic plunger.

cc' show the incisions in the envelope A, by means of which the upper portion of the envelope is fashioned so as to inclose the active matter and at the same time form the connecting-post B integral with the envelope A. The closure at the bottom of the plate is made in substantially the same manner as at the top, except that it is not necessary there to provide for the connecting-post.

d show the pins extending through the flaps formed by the incisions *cc'*, by means of which the folds are kept in place.

e shows the protecting-coating with which I cover the exterior surface of the envelope A.

Heretofore one of the difficulties attending the use of secondary or electric storage-batteries has been the rapid disintegration of the inactive matter by reason of the corrosion of the metal by the electrolytic fluid. I have discovered that if the metal be rendered very hard by compression its condition as to its capacity to resist the corrosive action is very much improved. Cast-lead, which has been much used for the purpose, is honeycombed with minute indentations, the mass is "spongy," and affords opportunity for the corrosive action of the electrolytic fluid in which it is immersed. Metal rolled into sheets under moderate pressure is slightly improved but when the metal is subjected to very great pressure it becomes solidified, its spongy condition altogether disappears, and if then protected by a coating of asphalt or a plumbic oxide deposited from a hot solution of litharge and caustic soda it becomes practically indestructible, and effectually resists the corrosive action of the fluid. Another desideratum in such batteries is that the ratio of weight of the inactive matter to that of the active matter should be as small as possible, and the method of manufacture of the plate which I have invented enables the use of a

very thin and consequently very light envelope or case.

The formation, construction, and protection of the plates proceeds by the following steps: The metal of which the envelope is to be made is molten and introduced into the flask of the machine for drawing out the envelope surrounding the mandrel *a*. The plunger *b* is a tube whose exterior surface exactly fits into the retort and whose inner surface forms the exterior surface of the envelope. The diameter of the bore of the die exceeds the diameter of the mandrel by the measurement which may have been determined upon for the thickness of the wall of the envelope. In my process I make the relation of the diameter of the bore of the die to that of the mandrel such that a very thin wall to the tubular envelope is the result. The molten metal having been introduced into the flask the plunger *b* is caused to descend by hydraulic pressure and the molten metal is forced upward into the die around the mandrel, and in this manner the tubular envelope is fashioned to any desired length.

I am aware that many machines have been in use for the drawing of tubes from molten liquid, and am aware that where the wall of the tube is required to be thin great pressure must be imparted to the die, and I therefore do not claim, broadly, the process or apparatus for forming this tube in the way specified, only claiming the application of this or some analogous device for the production of a thin tube of great density and consequent solidity to the manufacture of battery-plate envelopes of the sort hereinbefore specified.

I am aware that ordinary lead pipe has been used as a casing or support for the active matter in storage-batteries; but the casing which I propose is prepared under very much greater pressure, whereby the metal becomes extremely dense and at the same time it is lighter and stronger.

The tubular envelope having been formed by the above-described process is then in condition to be cut up into any length that may be desired. This tends to economy in manufacture, for the plates may be cut to any length from the same tube, and the necessity of different dies and apparatus for each size of plate is avoided. Incisions *c c'* are then made in the section of the tubing, the part across the thickness of the upper portion at the corner where the post *B* is not located being entirely removed, as also are the same portions at the corners of the bottom of the

envelope to facilitate the folding of the flaps without superimposing one part upon the other. The envelope is then filled with the active matter. The flaps formed by the incisions are folded down, as plainly shown in Fig. 6. The pins *d* are then inserted to retain the flaps in place, or the edges may be held by burning. The small flap shown at the upper left-hand corner is then formed into a tube, the part not integral with the envelope-case being joined thereto by burning, thus forming the post *B* or a support therefor. The active matter having thus been solidly inclosed in the envelope I apply to the exterior surface an electrically-insulating coating or paint *e*, having the chemical quality of resisting the action of the electrolytic fluid. The plate is now in readiness to be perforated which is accomplished through the medium of the punching-machine for which I have received Letters Patent of the United States, No. 414,288, dated November 5, 1889. The plate is now ready to be formed into a cell and immersed in the electrolytic fluid in the usual way.

Having thus described my invention, what I claim, and desire to secure by Letters Patent, is—

1. That improvement in the art of making secondary-battery electrodes which consists in forming a thin strong casing or support for the active material by submitting metal in a suitable mold to a heavy pressure, whereby a casing or support of great density and durability is obtained, substantially as described.

2. In secondary or electric storage-batteries, an external case of inactive matter having an insulating and acid-resisting coating applied to its surface.

3. In secondary or electric storage-batteries composed of an external case or envelope and an internal filling of active matter and perforated through and through from side to side, the combination of an external case or envelope *A*, rendered dense and solid by severe compression with an external coating or paint *e*, which is at the same time electrically insulating and acid-resisting, as and for the purpose intended, substantially as described.

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

HIRAM H. CARPENTER.

Witnesses:

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