No. 835,229. PATENTED NOV. 6, 1906.

J. H. ROBERTSON.

PLATE FOR SECONDARY BATTERIES.

APPLICATION FILED FEB. 1, 1904. RENEWED MAR. 3, 1905.

Fig. 2.

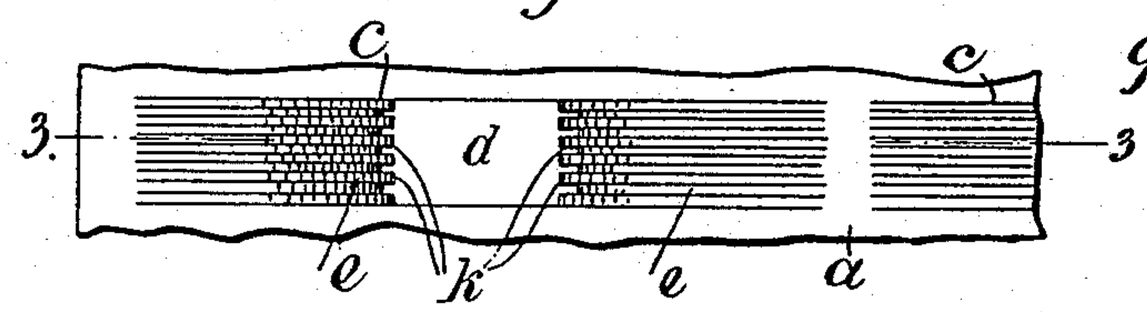

Fig. 3.

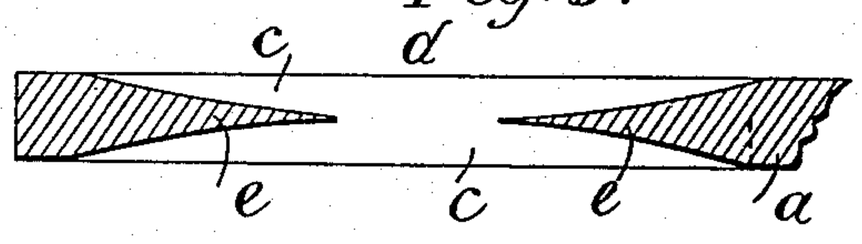

Fig. 4.

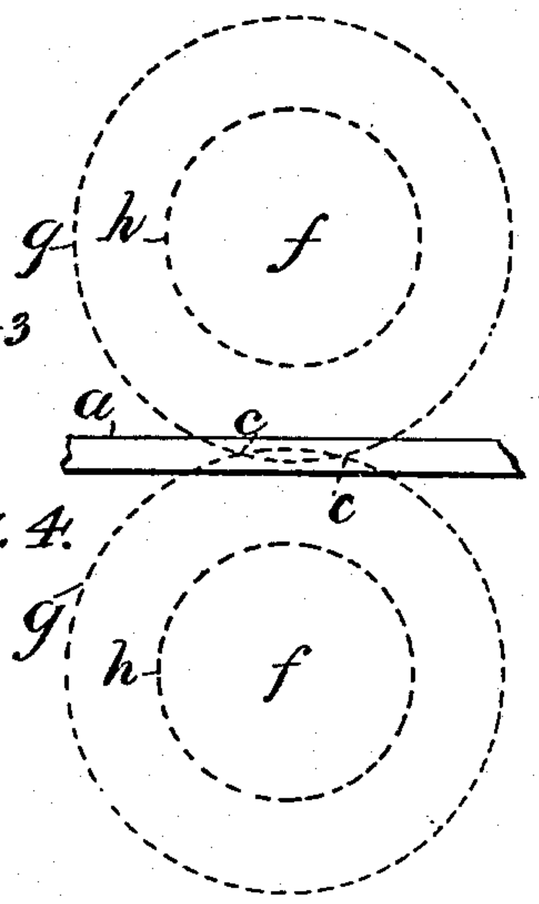

Fig. 6.

Fig. 1.

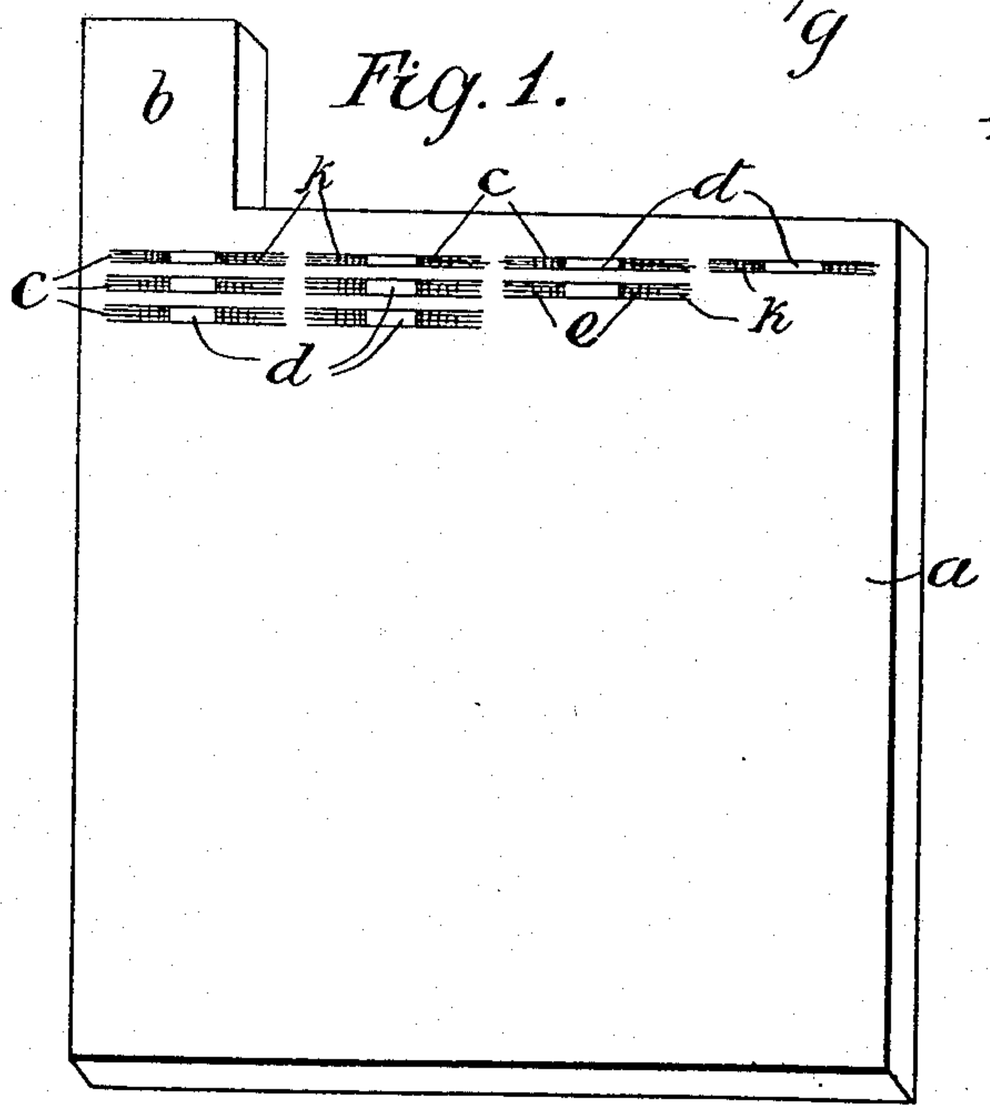

Fig. 5.

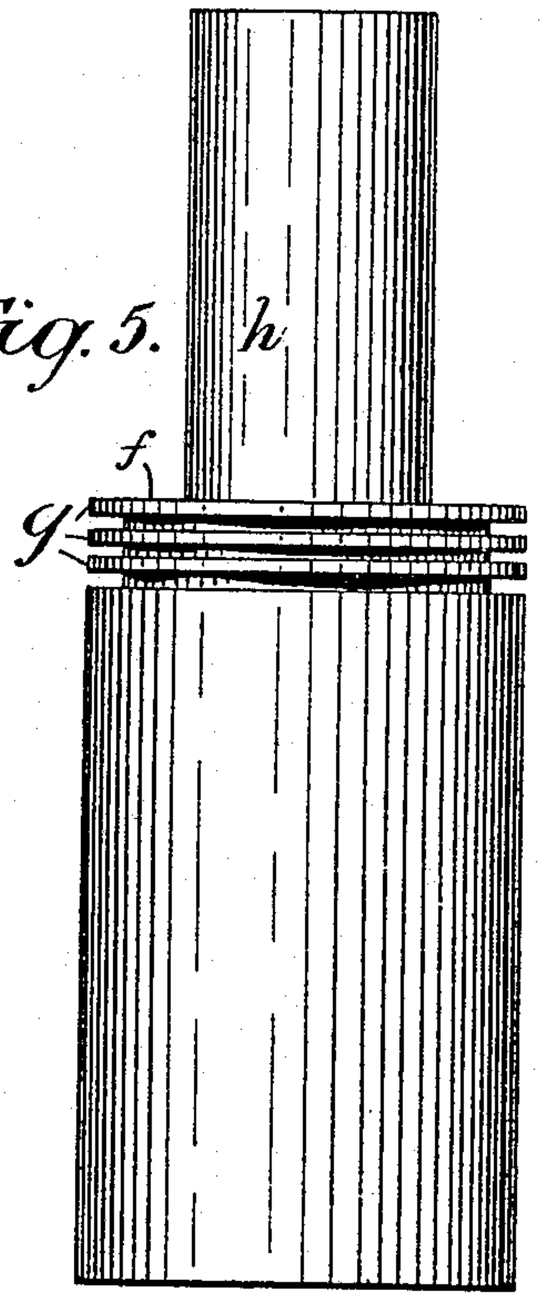

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PLATE FOR SECONDARY BATTERIES.

No. 835,229. Specification of Letters Patent. Patented Nov. 6, 1906.

Application filed February 1, 1904. Renewed March 3, 1905. Serial No. 248,330.

To all whom it may concern:

Be it known that I, JAMES HART ROBERTSON, a citizen of the United States, residing in the borough of Brooklyn, city of New York, State of New York, have invented certain new and useful Improvements in Plates for Secondary Batteries, of which the following is a specification, reference being had to the accompanying drawings, forming a part hereof.

This invention relates to metallic plates or electrodes for secondary batteries which, after being formed mechanically, are supjected to an electrochemical formation in which the substance of the plates is so transformed as to make them capable of serving the intended purpose in storage batteries.

The object of the invention is to increase the desired qualities of such a plate, and particularly to produce a plate which shall have the requisite strength without undue weight, shall expose a very large surface to the action of the electrolyte, shall have conductive body enough to meet the requirements of use, and in general shall possess in an exceptional degree the qualities necessary for the development of large electrically-absorptive capacity.

The invention will be more fully described hereinafter with reference to the accompanying drawings, in which, for the purpose of explanation, it is illustrated in detail.

In the drawings, Figure 1 is a view in perspective of a plate mechanically formed in accordance with the invention. Fig. 2 is a detail view of a portion of the plate on a larger scale than that of Fig. 1. Fig. 3 is a detail view, in section, on the plane indicated by the line 3 3 of Fig. 2. Fig. 4 is a diagrammatic view illustrative of the manner of forming the plate. Fig. 5 is a view in elevation of a partly-formed cutter which may be employed in the production of the plate. Fig. 6 is a detail view in section of one of the cutter blades or knives, illustrating a feature to be referred to hereinafter.

The blank *a* for the plate may be of any suitable material and shape, being usually rectangular, as represented in Fig. 1, and provided with a lug or tongue *b* for convenience in connecting. The blank when formed is subjected to the action of a suitable tool by which is formed in each side a series of recesses or cuts *c*, the corresponding recesses or cuts on opposite sides of the plate registering, so that an opening *d* is formed through the plate. The cuts or recesses are shallow, but relatively long, so that a finely-tapering wall *e* is formed between the end portion of the corresponding cuts or recesses at each side of the aperture *d*. The cuts or recesses may be formed by any suitable means and are conveniently formed by a tool *f*, which is represented partly formed in Fig. 5, such tool consisting of a series of cutters or saws *g* upon a common shaft *h*, a sufficient number of cutters or saws being employed to form at one operation a range of cuts or recesses *c*, extending entirely across the plate. The plate is subject to the action of such a tool first on one side, the depth of the cut being slightly greater than half the thickness of the plate, and then is subjected to the action of the tool on the other side in the same manner, the relation of the cutter to the plate in the successive operations being indicated by dotted lines in Fig. 4. For the purpose of increasing the surface of the plate for the action of the electrolyte each cutter or saw is grooved circumferentially, as indicated in an exaggerated manner at *i* in Fig. 6, whereby the surface of each recess *c* is minutely subdivided by grooves and ribs *k*, thereby substantially increasing the surface exposed directly to the action of the electrolyte.

It will be obvious that by the use of such a milling-tool as that indicated the recesses may be quickly formed throughout the extent of the plate and that while the surface exposed to the action of the electrolyte in the completed plate is very large, nevertheless the strength of the plate is retained in a sufficient degree to make it very durable, while its storage capacity is fully equal to that of plates which are much heavier, and the cross-section of metallic lead or other material is great enough to carry all of the stored energy without increasing unduly the internal resistance. The minute grooving of the bottom surface of the recesses not only contributes to the increase of the surface exposed to the action of the electrolyte, but presents the metal so finely divided that the metal is very quickly transformed into active material when subjected to an electrochemical bath. The provision of the aperture *d* facilitates the circulation of the forming-bath as well as of

the electrolyte, and therefore promotes the formation of the plate and the processes of charging and discharging.

When the plate has been formed mechanically, as already described, it is subjected to the action of a suitable electrochemical forming-bath for the purpose of transforming part of the metal of the plate into active material. It is obvious that such forming-bath may be of any suitable character. If it is desired after this electrochemical formation process to apply mechanically extra active material, it can be done to advantage even if by doing so the openings in the central parts of the inner ribs should be entirely closed, for the electrochemical formation process above referred to has placed the electrochemically active material in a condition to quickly and thoroughly amalgamate with any active material that should be afterward added, and it is to be understood that the mere addition of extra active material after the plates have been formed by an electrochemical process is not a departure from the spirit of this invention.

I claim as my invention—

A plate for secondary batteries having formed in each side thereof registering and oppositely-communicating recesses, each being formed in the arc of a circle, whereby finely-tapering parts are formed between the ends of the recesses and at each side of a central aperture, the bottom surface of each recess being longitudinally grooved.

The specification signed and witnessed this 29th day of January, A. D. 1904.

JAMES HART ROBERTSON.

In presence of—

ANTHONY N. JESBERA,

LUCIUS E. VARNEY.