

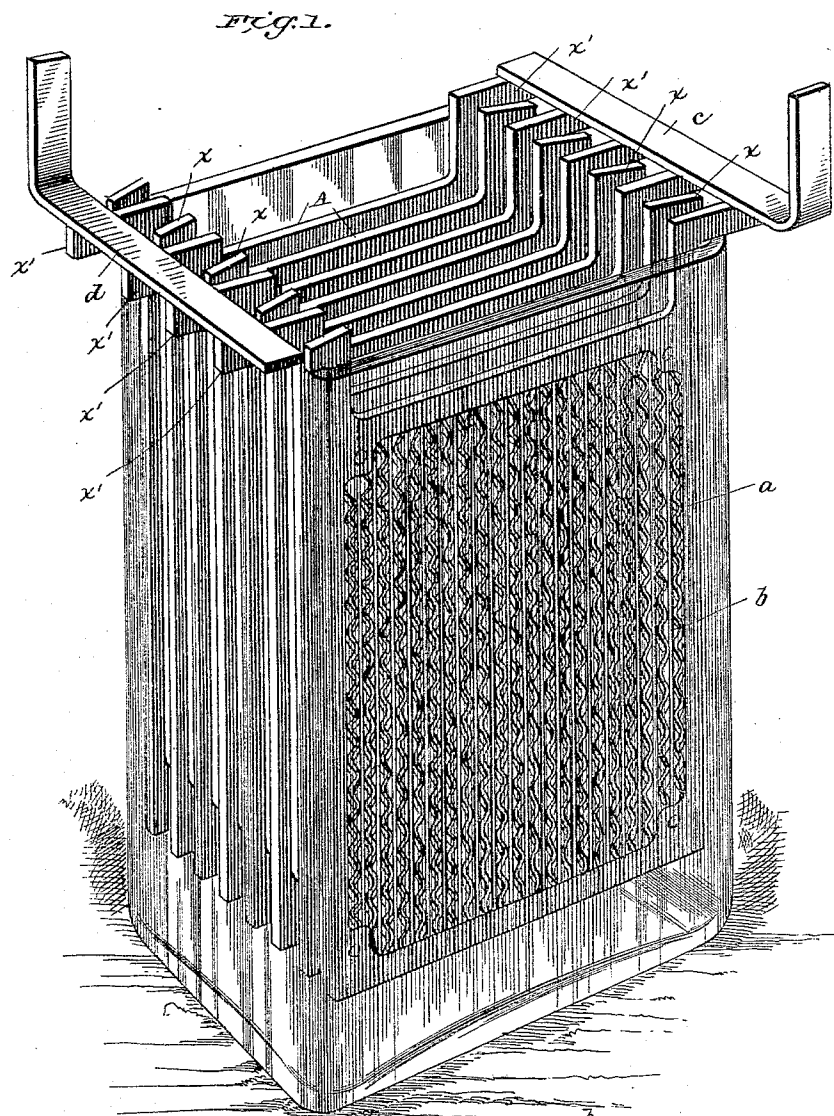
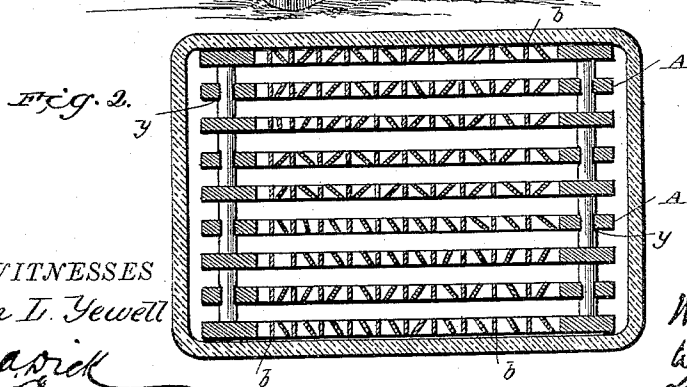
(No Model.)

2 Sheets—Sheet 1.

N. DE BENARDOS.
SECONDARY BATTERY.

No. 380,554.

Patented Apr. 3, 1888.



WITNESSES
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Charles A. Smith

INVENTOR
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by Marshall Bailey
his Attorney.

(No Model.)

2 Sheets—Sheet 2.

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Fig. 3.

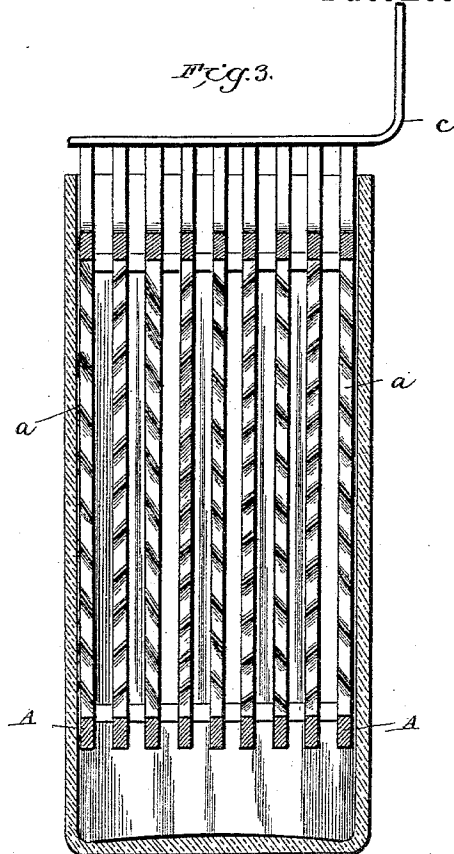
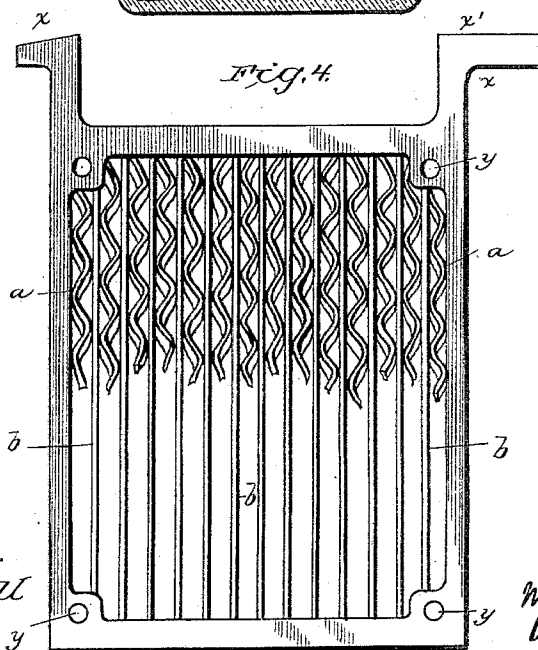


Fig. 4.



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UNITED STATES PATENT OFFICE.

NICHOLAS DE BENARDOS, OF ST. PETERSBURG, RUSSIA.

SECONDARY BATTERY.

SPECIFICATION forming part of Letters Patent No. 380,554, dated April 3, 1888.

Application filed December 28, 1887. Serial No. 259,205. (No model.)

To all whom it may concern:

Be it known that I, NICHOLAS DE BENARDOS, of St. Petersburg, in the Empire of Russia, have invented certain new and useful Improvements in Accumulators or Secondary Batteries, of which the following is a specification.

In this invention it has been primarily my object to obtain an efficient and comparatively inexpensive accumulator for use in the process of working metals by the direct application of the electric current which is the subject of Letters Patent of the United States No. 363,320, issued to Stanislas Olszewski and myself on May 17, 1887. The accumulator, however, is of course adapted for use in any of the connections in which such batteries are now commonly employed.

My invention has relation more particularly to the construction of the plates. Each plate consists of a lead frame in which are strung or secured lead ribbons or strips alternately straight or plain and corrugated, attached individually by their ends to the frame. By alternating the flat strips with the corrugated strips the latter are well spaced and no difficulty is experienced in preserving the openings (due to the corrugations or bends of the corrugated plates) to be entered by the battery-liquid. By securing the strips individually at their ends to the opposite bars of the strip-containing frame they are held firmly and in such way as to be thoroughly and completely exposed, as they would not be were they held between side plates or plates (whether perforated or not) covering their longitudinal edges. I prefer, in order to attach the strips to the frame, to weld their ends thereto in accordance with the process described in the patent hereinbefore referred to. The corrugations or bends in the corrugated strips extend not at right angles with the longitudinal edges of said strips, but obliquely thereto, the object being to facilitate the passage and discharge of the globules of gas generated when the battery is in action.

In the accompanying drawings, Figure 1 is a perspective view of a single-cell battery embodying my improvements. Fig. 2 is a horizontal section of the same. Fig. 3 is a vertical section of the same in a plane transverse

to the plates. Fig. 4 is a side elevation of one of the plates.

Each plate consists of a lead frame, A, the space inclosed by which is filled by the plain or straight lead strips or ribbons *b* and the corrugated or bent lead strips or ribbons *a*, these strips extending between opposite sides of the frame, and being individually secured thereto at their ends, which are for this purpose preferably welded to the top and bottom cross-bars of the frame by the patented process hereinbefore referred to. The strips are placed closely together, the straight strips *b* alternating with the corrugated or bent strips *a*, as shown plainly in Fig. 4. The corrugated or bent strips can be readily formed into this shape from plain straight strips by passing the latter between rolls having peripheral ribs and grooves of proper form and arrangement to corrugate or bend the strip in the desired way. The corrugations or bends are not at right angles to the longitudinal edges of the strips *a*, but, as shown in Figs. 2 and 4, are oblique or slanting in relation thereto.

The frame A is provided at the top on opposite edges with hooks *x*, by which it may be conveniently hung and supported upon the upper edge of the cell, which, as usual, is made of glass or some non-conducting and acid-resisting material. They are also provided at top and bottom with holes *y*, which receive the spacing bars or rods used when a number of such plates are placed in one cell.

All of the plates constituting an element are connected together by a conducting bar or strip, which is united to said plates preferably by the patented welding process aforesaid. One of the hooks *x* has an extension, *x'*, for this purpose. In the cell shown in Fig. 1 there are nine plates in all. The conducting strip or bar (lettered *c*) on the right of the cell is welded to and connects four plates, which constitute the positive element. The other bar or strip, *d*, on the left of the cell is secured in a similar way as the five remaining plates which constitute the negative element.

The plates are placed with faces opposed to one another, and are so arranged that the positive plates alternate with the negative.

The liquid used in the cell is dilute sulphuric

acid, the mixture usually being in the proportion of one of sulphuric acid to ten of water. The proportions, however, can be varied.

Having described my improvements, I state in conclusion that I am aware that lead strips, whether corrugated or plain, or both corrugated and plain, have been arranged together in a variety of ways for the production of secondary-battery plates, and this I do not broadly claim; but

What I do claim herein as new and of my own invention is—

1. A plate for accumulators or secondary batteries, consisting, essentially, of the frame A and the corrugated or bent strips or ribbons *a* and straight or plain strips or ribbons *b*, arranged alternating with each other in the space inclosed by the frame and secured individually at their ends to opposite sides of the frame, as and for the purposes hereinbefore set forth.

2. In an accumulator or secondary-battery

plate, the combination, with plain strips or ribbons *b*, of corrugated or bent strips or ribbons *a*, alternating with strips *b*, and having their corrugations or bends oblique to their longitudinal edges, as and for the purposes hereinbefore set forth.

3. An accumulator-plate consisting of the circumscribing frame A, the plain strips *b*, and the strips *a*, alternating with the plain strips and formed with oblique corrugations or bends, as described, said strips being placed in the space inclosed by the frame and individually secured at their ends to said frame, as hereinbefore set forth.

In testimony whereof I have hereunto set my hand this 25th day of October, A. D. 1887.

NICHOLAS DE BENARDOS.

Witnesses:

N. TSCHERKALOFF,

L. VOSS.