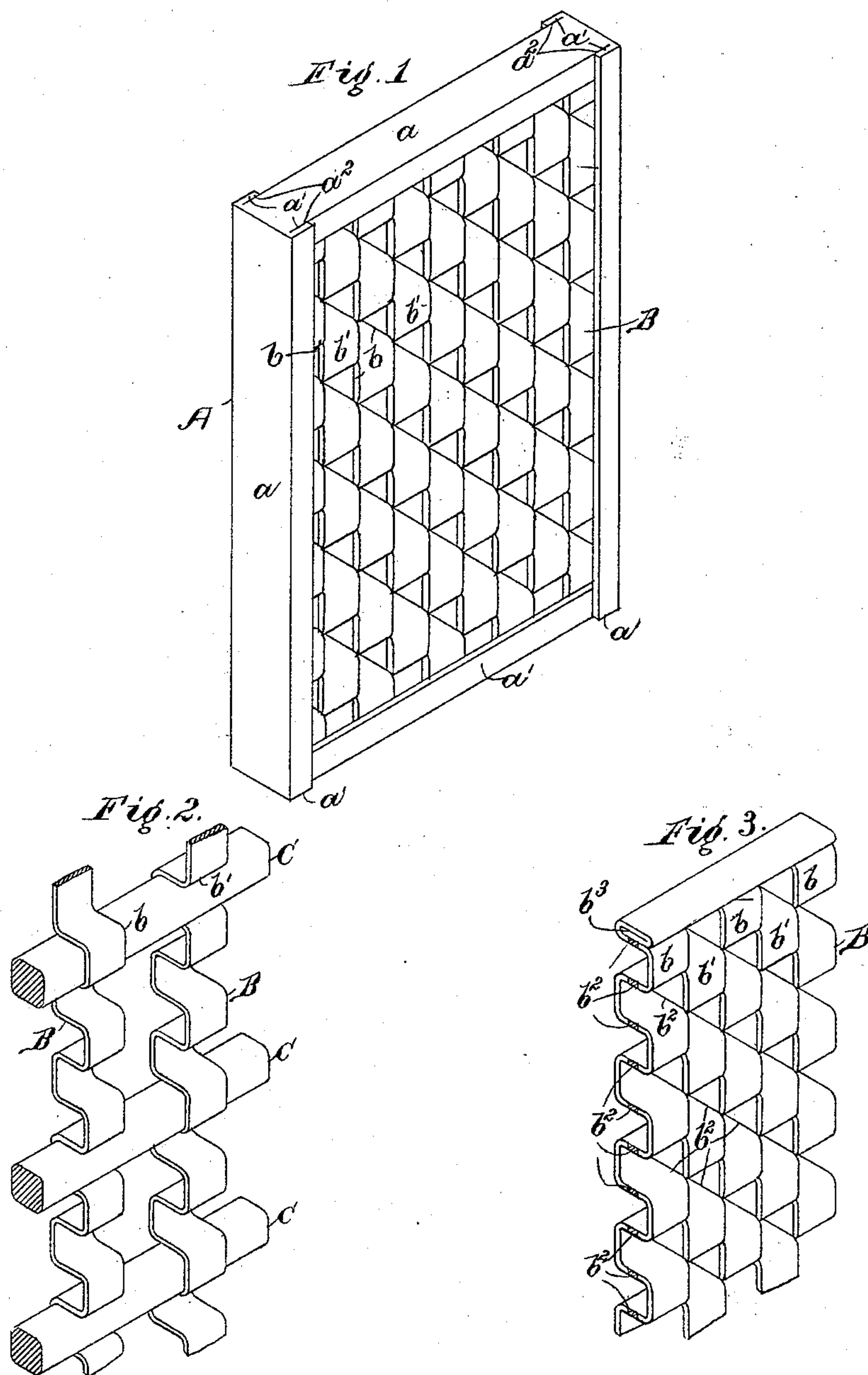


(No Model.)

J. Y. BRADBURY & F. J. STONE.
ELECTRODE FOR SECONDARY BATTERIES.

No. 441,818.

Patented Dec. 2, 1890.



WITNESSES.

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UNITED STATES PATENT OFFICE.

JOSEPH Y. BRADBURY AND FRANK J. STONE, OF LOWELL, MASSACHUSETTS.

ELECTRODE FOR SECONDARY BATTERIES.

SPECIFICATION forming part of Letters Patent No. 441,818, dated December 2, 1890.

Application filed November 16, 1889. Serial No. 330,514. (No model.)

To all whom it may concern:

Be it known that we, JOSEPH Y. BRADBURY and FRANK J. STONE, both citizens of the United States, residing at Lowell, in the
5 county of Middlesex and Commonwealth of Massachusetts, have invented a certain new and useful Improvement in Electrodes for Storage-Batteries, of which the following is a specification.

10 Our invention relates to electrodes for storage or secondary batteries; and it consists in an electrode comprising a plate of supporting material having its opposite faces formed into alternate projections and depres-
15 sions for the reception of active material, two opposite sides of each of said depressions being open and laterally adjacent projections opening into each other, and said plate being preferably formed of strips of supporting
20 material arranged side by side, and each offset alternately in opposite directions for the reception of active material.

In the accompanying drawings, Figure 1 is an isometric perspective view of an electrode
25 constructed according to our improvement; Fig. 2, an isometric perspective view of two non-adjacent strips of the supporting material and some pencils of active material arranged in the offsets of said strips; Fig. 3, an
30 isometric perspective view of parts of some strips of supporting material formed from a single sheet of metal and not entirely separated from each other in the process of formation.

35 In Fig. 1, A represents the frame, which may be made of the same conducting material as the supporting-strips, preferably thin sheet-lead, a strip *a* of which is turned at each edge to form flanges *a'*, which are then
40 cut vertically at *a*² to allow the portions of the flanges adjacent to the cuts *a*² to pass each other, and thereby to allow the strip *a* to be bent into the form of a rectangle. The ends of the strip *a* after being so bent are
45 united by solder, and the overlapping parts of the flanges at the corners of the frame may also be united by solder, or in both the cases the parts may be burned together instead of being soldered; but before the frame is thus

united the strips *b b'*, which make up the
50 body of the plate-electrode B, are formed.

The strips *b b'* are each strips of conducting material, preferably sheet-lead, offset alternately in opposite directions, as shown in
all the figures, to form a succession of pro-
55 jections and depressions on opposite sides like the teeth and interdental spaces of a rack-bar. The strips *b b'*, when so bent, are arranged side by side in such a manner that
60 the depressions and projections on each side of the electrode alternate with each other like the different-colored squares of a checker-board and the depressions in each strip opening into the depressions of the contiguous
strips.

65 The strips *b b'* may be separately formed and slightly united by solder or burned together where they come in contact with each other. It is possible, however, to make all the strips of a single electrode from a single
70 sheet by punches arranged above and below or on opposite sides of the sheet, which alternately raise and depress the surface of the sheet and separate the strips from each other,
75 except where the portions of contiguous strips after bending lie in the same plane, as at *b*³ in Fig. 3; but this specific construction is not herein claimed. The ends of the strips may
80 be bent or rolled over, as shown at *b*³ in Fig. 3, to stiffen the upper and lower edges of the plate B, whether they are formed from a sheet without separation from each other, or whether they are separately formed, in which
85 last case the ends of the strips may be wrapped around one or more strips of lead and burned or soldered to said last-named strips.

In the depressions of the plate B, formed in either of the ways above described, may be placed the active material by any well-known process, as in the form of paste or in
90 the form of powder, compactly pressed into the depressions of the plate. We prefer, however, to make the active material into bars or pencils C, as shown in Fig. 2, by compressing
95 said material in molds under hydraulic or other heavy pressure, and then inserting said pencils endwise into the side of the plate, so that contiguous strips of the supporting ma-

terial pass alternately in front and back of said pencils, and the pencils will thereby be retained in place and will be prevented from moving endwise by the frame after said plate B is placed in the frame.

The plate B may be formed by casting in a mold, preferably under pressure.

The pencils are represented in the drawings as being rectangular in cross-section; but obviously the shape of their cross-section is immaterial, as the pencils may be round, triangular, or hexagonal, or otherwise shaped in cross-section, without departing from the spirit of our invention; but they are preferably rectangular in cross-section, merely because this shape allows of a great amount of active material in an electrode of a given uniform thickness.

We claim as our invention—

1. An electrode for secondary batteries, comprising a plate of supporting material having lateral perforations and openings at intervals from said perforations through the faces of said plate, said perforations and openings being adapted for the reception of active material, and the faces of said plate being unbroken except by said openings, said openings and the closed spaces in each face alternating with each other like the different-colored squares of a checker-board, as and for the purpose specified.

2. An electrode for secondary batteries, comprising a plate of supporting material having lateral perforations and openings at intervals leading from said perforations through the opposite faces of said plate, said openings alternating with each other on the opposite faces of said plate, and said perforations and openings being for the reception of active material, as and for the purpose specified.

3. An electrode for secondary batteries, comprising a plate of supporting material having its opposite faces formed into alternate projections and depressions for the reception of active material, two opposite sides of each of said depressions being open, the laterally-adjacent depressions opening into each other, as and for the purpose specified.

4. An electrode for secondary batteries, comprising a plate consisting of strips of supporting material arranged edge to edge and each offset alternately in opposite directions for the reception of active material, as and for the purpose specified.

5. An electrode for secondary batteries, consisting of a plate of supporting material having its opposite faces formed into alternate projections and depressions, two opposite sides of each of said depressions being open, the laterally-adjacent depressions opening into each other, and pencils or bars of active material inserted in said depressions, as and for the purpose specified.

6. An electrode for secondary batteries, consisting of a plate made up of strips of supporting material arranged edge to edge and each offset alternately in opposite directions, and pencils or bars of active material inserted in said offsets, as and for the purpose specified.

In witness whereof we have signed this specification, in the presence of two attesting witnesses, this 7th day of November, A. D. 1889.

JOSEPH Y. BRADBURY.
FRANK J. STONE.

Witnesses:

ALBERT M. MOORE,
JOHN I. COGGESHALL.