No. 770,140. PATENTED SEPT. 13, 1904.

A. C. WOOD & J. A. McMULLAN.

ELECTRODE FOR BATTERIES.

APPLICATION FILED APR. 22, 1902.

NO MODEL. 2 SHEETS—SHEET 1.

Fig. 1.

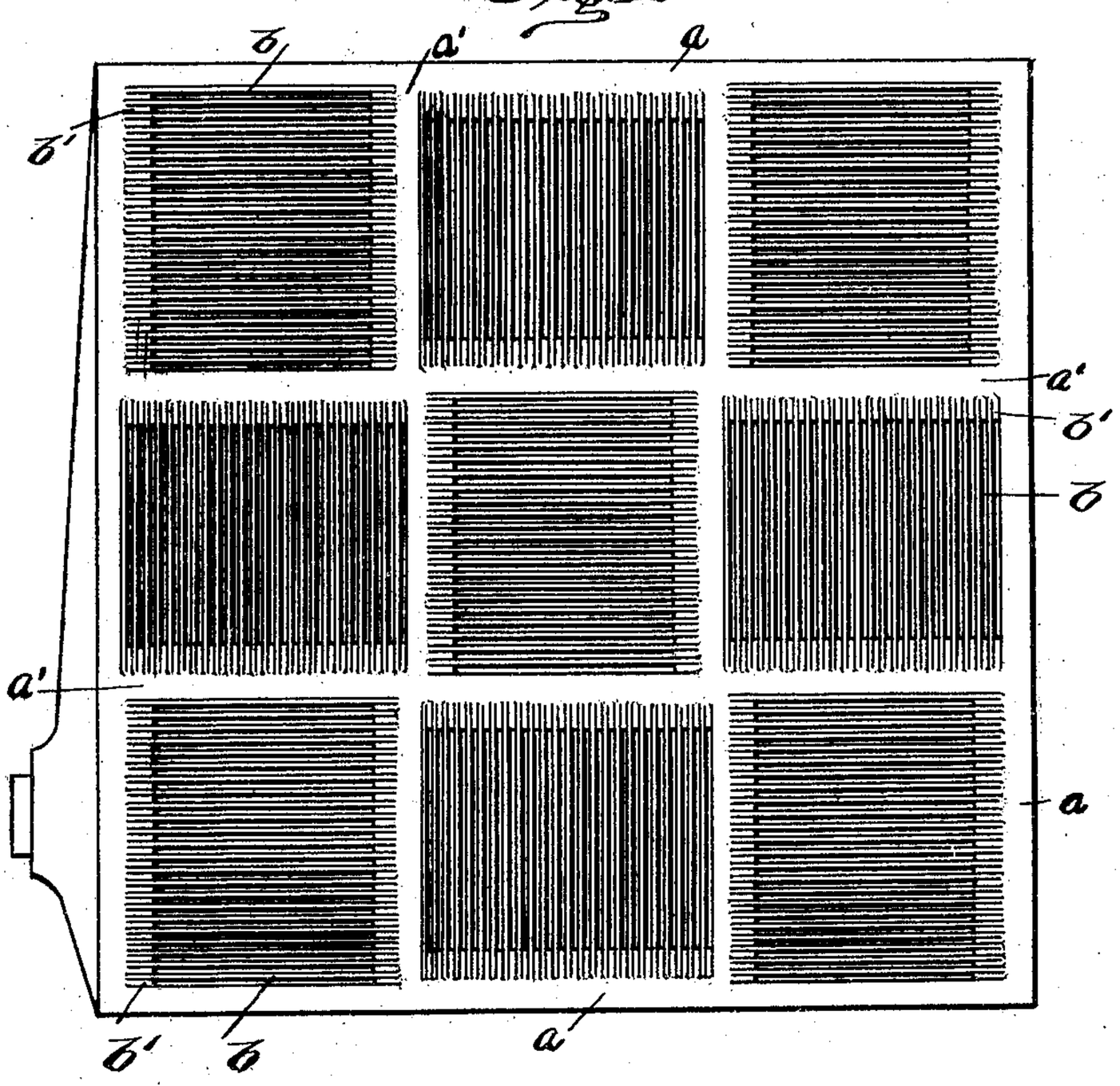


Fig. 4.

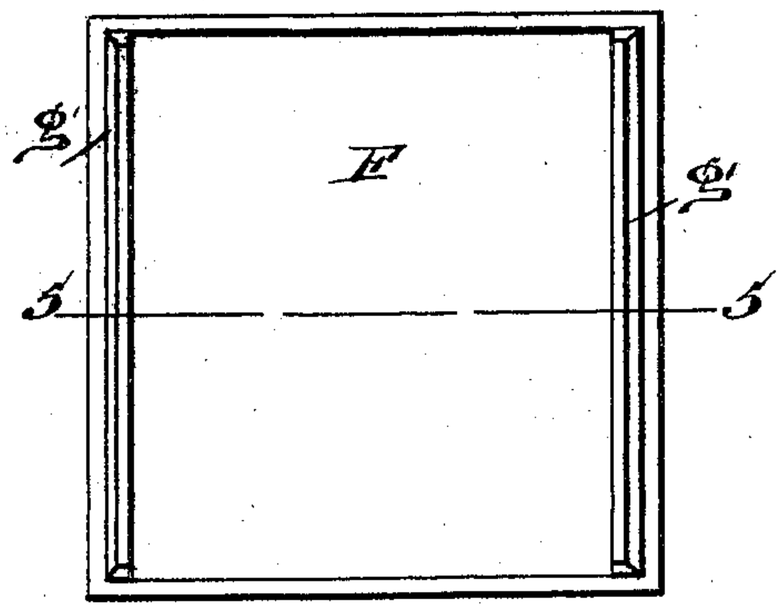


Fig. 5.

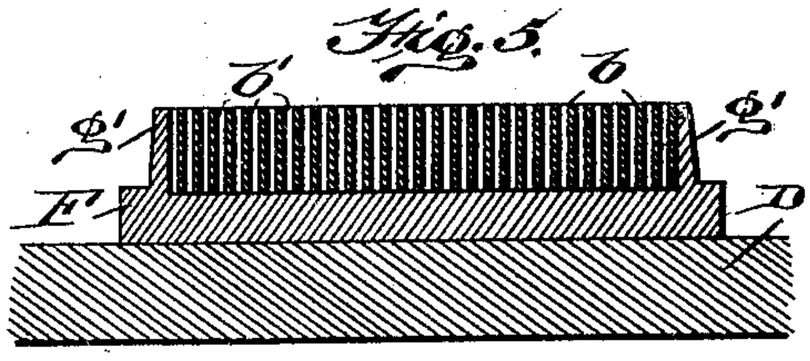


Fig. 6.

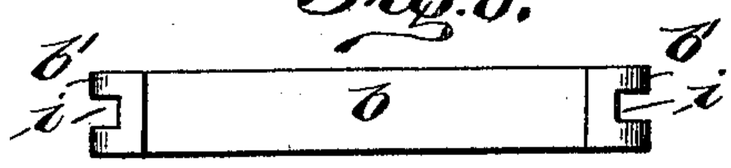


Fig. 7

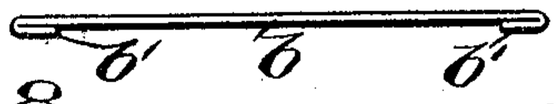
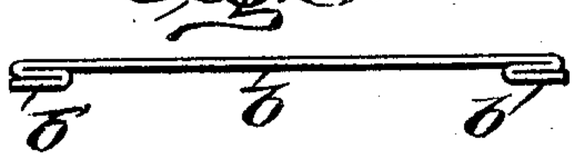


Fig. 8.



Witnesses

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ELECTRODE FOR BATTERIES.

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NO MODEL. 2 SHEETS—SHEET 2.

Fig. 2.

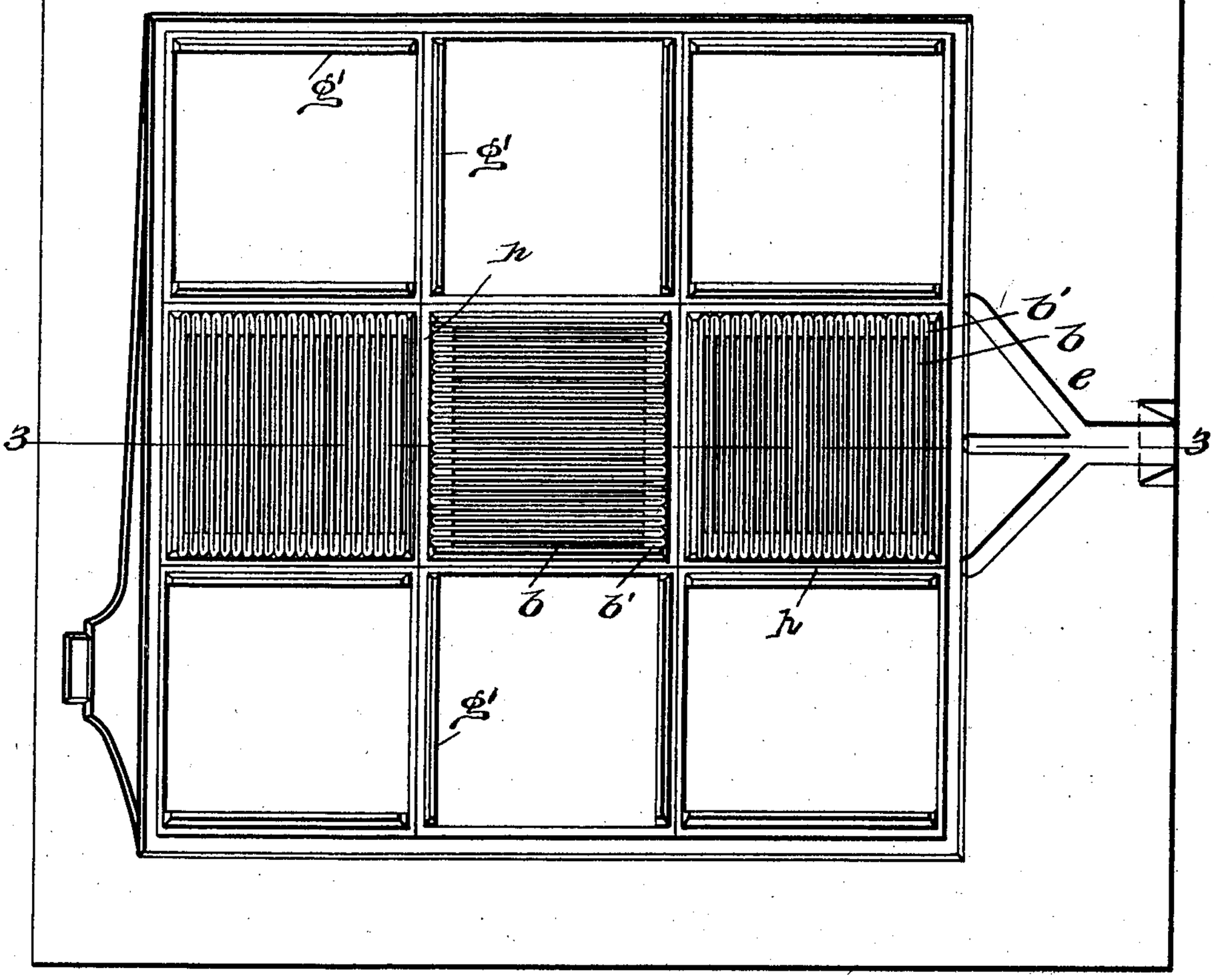
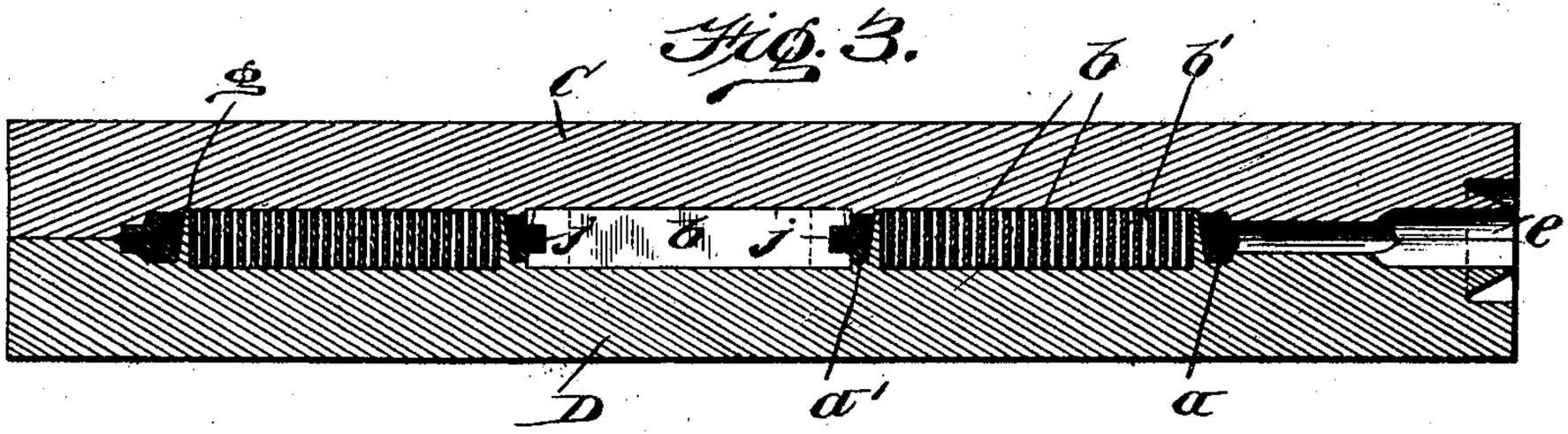


Fig. 3.



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No. 770,140. Patented September 13, 1904.

UNITED STATES PATENT OFFICE.

ALBERT C. WOOD AND JAMES A. McMULLAN, OF PHILADELPHIA, PENNSYLVANIA.

ELECTRODE FOR BATTERIES.

SPECIFICATION forming part of Letters Patent No. 770,140, dated September 13, 1904.

Application filed April 22, 1902. Serial No. 104,215. (No model.)

To all whom it may concern:

Be it known that we, ALBERT C. WOOD and JAMES A. McMULLAN, citizens of the United States, residing at Philadelphia, in the county of Philadelphia and State of Pennsylvania, have invented certain new and useful Improvements in Electrodes for Batteries, of which the following is a specification, reference being had therein to the accompanying drawings.

Our invention has for its object the economic and easy formation of storage or secondary battery plates or electrodes into the construction of which enter thin strips of lead or lead alloy known as "lead tape."

In the accompanying drawings, Figure 1 is a plan view of an electrode made according to our invention. Fig. 2 is a plan view of one section of a mold adapted for use in the casting of the electrode shown in Fig. 1, some of the strip-holding sections of the mold being represented as being filled and others as being empty. Fig. 3 is a sectional view of a complete mold in which the strip-holders are integral with one mold-section, the plane of the section being indicated by the line 3 3, Fig. 2. Fig. 4 is a top plan view of a strip-holder which is independent of the mold. Fig. 5 is a vertical section of such strip-holder, taken on the line 5 5 and represented as filled with lead strips and supported upon a mold-section. Figs. 6 and 7 are respectively a side and an edge view of one of the lead strips which we have invented and employ. Fig. 8 is an edge view of a lead strip differently constructed from that illustrated in Figs. 6 and 7.

The electrode, which is represented in its complete form in Fig. 1, comprises a sufficiently rigid framework of lead or other suitable material and a series of thin lead strips arranged parallel to each other and in groups or masses separated from each other by the cross-pieces of the frame. The masses or groups of thin strips are preferably arranged so that the strips of one mass are disposed at right angles to those of the adjacent masses for well-known reasons.

The outer rim of the frame of the electrode is designated *a* and the intermediate cross pieces or bars *a'*. The lead strips are represented by *b*, being spaced apart in the usual manner to permit the electrolyte to freely pass through the electrode. To facilitate the proper and uniform spacing apart of the strips and to render it easy to set them in the mold, we have made these strips of a peculiar construction, as illustrated in Figs. 6 and 7. Each end portion of the strip is folded back upon itself, as indicated at *b'*, which results in doubling the thickness of the strip at its ends. If a number of strips thus formed be arranged on edge and grouped or massed together, as represented in Fig. 2, they will support and properly space one another and the necessity of employing skilled workmen to set the strips and specially-devised molding apparatus to hold the strips is rendered unnecessary. We thus by the use of strips of a novel form and construction reduce the labor and expense incident to the making of the electrode, besides being able to secure other advantages which we will later point out.

The mold is formed of two sections C and D, adapted to be brought together face to face, as represented in Fig. 3, when a casting is to be made. Each section is formed with a central cavity or recess of a size and contour corresponding with the plate to be formed and with suitable channels *e*, through which the fluid metal is forced into the casting-chamber. The mold-sections C and D are formed to contain the desired number of groups of strips for the size and kind of electrode to be cast, that shown in the drawings being adapted to receive nine groups. The strips may be arranged in independent strip-holders F, like that represented in Figs. 2, 4, and 5, or one of the mold-sections may be provided with a number of cells or compartments arranged to support and hold the separate groups of strips *b*, as represented in Fig. 3. The cells or compartments are formed by the walls or partitions *g*, which rise from the base of the mold. The flanges or walls *g* are arranged along two sides only of the cells or compartments, and the strips are spaced between such walls or partitions and parallel therewith, as indicated in Fig. 3. We prefer to arrange the walls or partitions of adjacent cells or compartments at

right angles to each other, so that the strips of adjacent groups shall be disposed in the same relation relative to each other. When the several cells or compartments of the mold are filled with strips, there will be formed channels *h* between the several groups of strips, as indicated in Fig. 2, the channel between each adjacent group of strips being bounded upon one side by one of the walls or partitions *g* and on the opposite side by the ends of the strips.

By forming the strips *b* with thickened end portions we insure that while the main intermediate portions of the strips are separated from each other the exposed ends of the group of strips are in engagement, so that when the fluid metal is forced into the mold and follows the channels *h* it cannot enter and fill the spaces between the strips.

It is very desirable to have as intimate a union as possible between the frame portion of the electrode and the strips *b*, and we provide means whereby during the casting operation these parts become united to each other by fusion, so that the resulting product is integrally constructed, the strips being fused at each end to a part of the frame. In order to the more perfectly secure this result, we notch the strips *b* at their ends, as indicated at *i*, these notches being preferably formed in the thickened end portions of the strips. When the strips thus formed are set up on edge and parallel to each other, the registering notches *i* form a channel communicating with the adjacent channel *h*, and when the fluid metal is forced into the mold it fills the channel *i* and fusing the contiguous portions of the ends of the strips causes a perfect union of the frame and strips when the casting cools. It will thus be seen by reference to Fig. 3 that the frame of the electrode extends inward beyond the ends of the strips of each group and that the strips are united to the rib *j* thus formed by fusion.

It will be seen, particularly by reference to Figs. 3 and 6, that the notches *i* that are formed in the thickened end portions of the strips do not extend entirely through the thickened portions. It follows when a group of strips are arranged and placed in the mold that the thickened portions of the strips abut and serve both to space apart the intermediate portions of the strips and also to close the ends of such spaces, so that when the fluid metal for the frame is forced into the mold it cannot enter the spaces between the strips, notwithstanding the fact that the metal flows freely into the grooves formed by the notches *i*.

As already intimated, groups of strips may be supported in an independent strip-holder F, like that indicated in Figs. 2, 4, and 5. Such strip-holders when filled are placed in a mold-section, and when the mold is filled the appearance will be similar to that represented in Fig. 2.

g' represents the walls arranged at two of the opposite sides of the strip-holder and arranged to hold the strips *b* in place.

We have shown the form of strip we prefer to use—that is, one in which the ends are thickened by doubling over the end portions *b'* of the strip. It will be evident, however, that the ends of the strip may be otherwise thickened. By increasing the number of bends or folds, as indicated in Fig. 8, the spaces between the strips when arranged in the holder will be correspondingly increased.

We believe that we are the first to have produced an electrode of the character described—that is, having a rigid cast frame with an outer rim and divided by cross-bars into a number of cells or compartments in which are arranged groups or series of rolled or otherwise formed lead strips that are united to the frame by fusion during the process of casting the latter. The advantages incident to the use of formed lead strips are well known, and these advantages we retain and it will be observed that according to our invention each group of such strips is square and that the strips are not only equally spaced apart, but that the spaces between the outermost strips of each group and the adjacent ribs are substantially the same as those between the strips themselves, thus entirely avoiding the comparatively large open spaces which have been incident to electrodes of this character—that is, those having a rigid cast frame and formed lead strips arranged in cells or compartments of the frame and united thereto in the process of casting the latter, as such electrodes have heretofore been constructed. Our construction permits the strips of adjacent groups being arranged at right angles to each other, as illustrated in the drawings, with the advantages incident to that arrangement.

Having described our invention, what we claim, and desire to secure by Letters Patent, is—

1. As a new article of manufacture, the herein-described strip for use in the manufacture of electrodes for secondary batteries formed with its end portions thickened and notched, the notches extending from the edges inward part way only through the said thickened portions, substantially as set forth.

2. As a new article of manufacture, a thin strip of lead having its end portions doubled back upon themselves and notched as at *i*, the depth of the notches from the edges inward being less than the length of the doubled-back portions of the strips, substantially as set forth.

3. The herein-described electrode for secondary batteries, comprising a series of groups of thin strips, a rigid frame, the frame extending inward into each group of strips beyond the ends thereof and being united to the strips at such points, and means for closing

the ends of the spaces between the strips arranged inside of the portions of the frame which are united to the strips, substantially as set forth.

4. The herein-described electrode, comprising a group of strips with their ends thickened and in contact with each other, whereby the intermediate portions of the strips are spaced apart and the spaces between the strips are closed at their ends, the thickened portions of the strips having notches extending inward part way only through them, and an integral cast-metal frame, a portion of the metal extending into the notches formed in the thickened portions of the strips and thus uniting the strips with the frame, substantially as set forth.

5. The herein-described electrode for secondary batteries, comprising a rigid supporting-frame of cast metal and a series of groups of metallic strips supported by such frame, the strips being thickened at their ends and arranged to embrace the frame, substantially as set forth.

6. An electrode for a secondary battery, consisting of several series of parallel strips of lead tape, the strips in one series extending in a direction at right angles to the strips in the next adjacent series, and an integral cast-metal supporting-frame in which the said series of strips are arranged, such strips having a width equal to the thickness of the frame, and the ends of the strips of each series being fused to the said frame, substantially as set forth.

7. The herein-described electrode for secondary batteries, comprising a series of groups of metallic strips having their ends thickened and notched, said notches extending but for a part of the distance through said thickened portions of the strips, a supporting-frame of cast metal having a series of cells or compartments each adapted to receive a group of metallic strips, the walls of said cells or compartments adjacent to the ends of said strips having ribs which enter the said notches in the ends of the strips, substantially as set forth.

In testimony whereof we affix our signatures in presence of two witnesses.

ALBERT C. WOOD.
JAMES A. McMULLAN.

Witnesses:
WINFIELD S. WALKER,
WALTER H. WOOD.