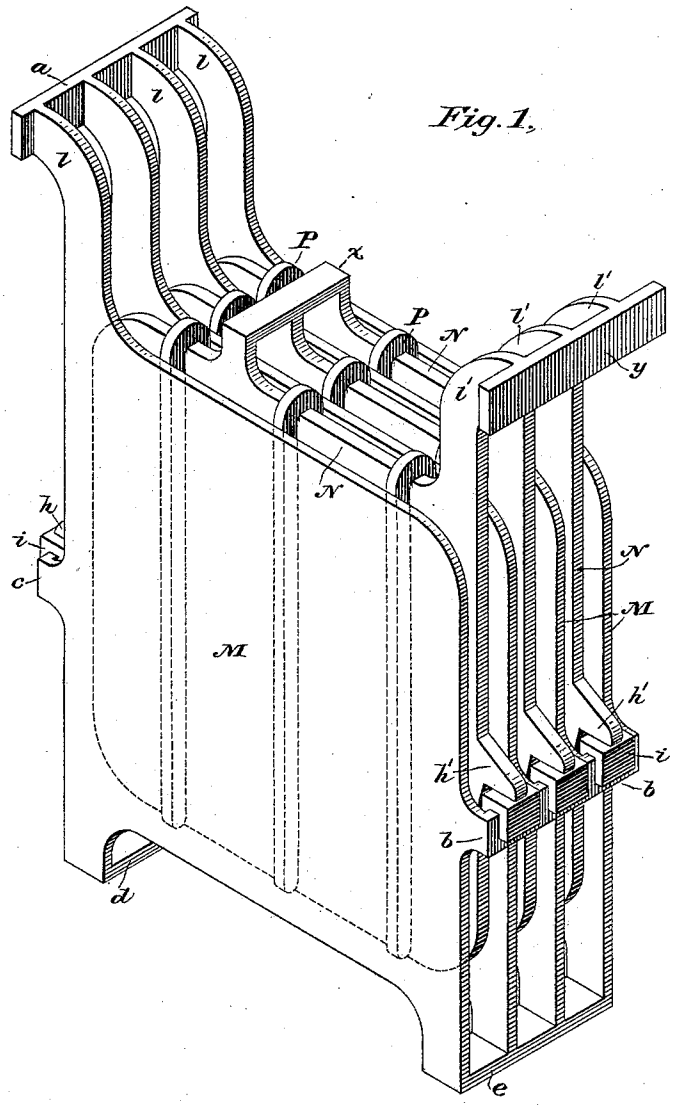
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F. KING.

SECONDARY BATTERY.

No. 385,558. Patented July 3, 1888.

Fig. 1.



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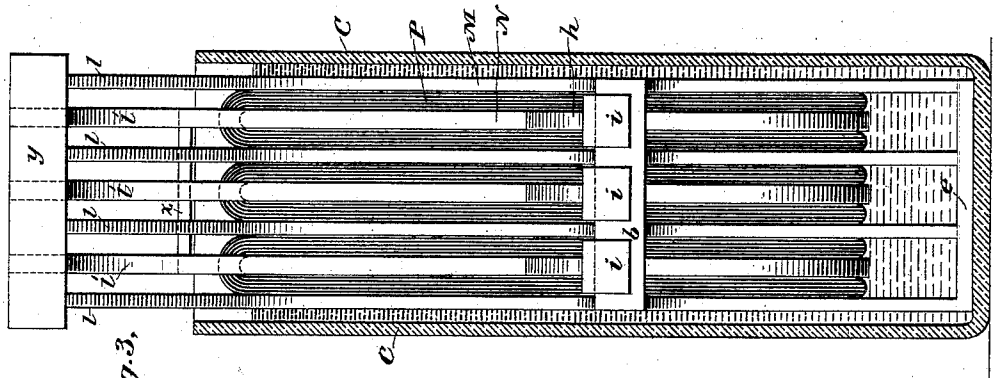


Fig. 3.

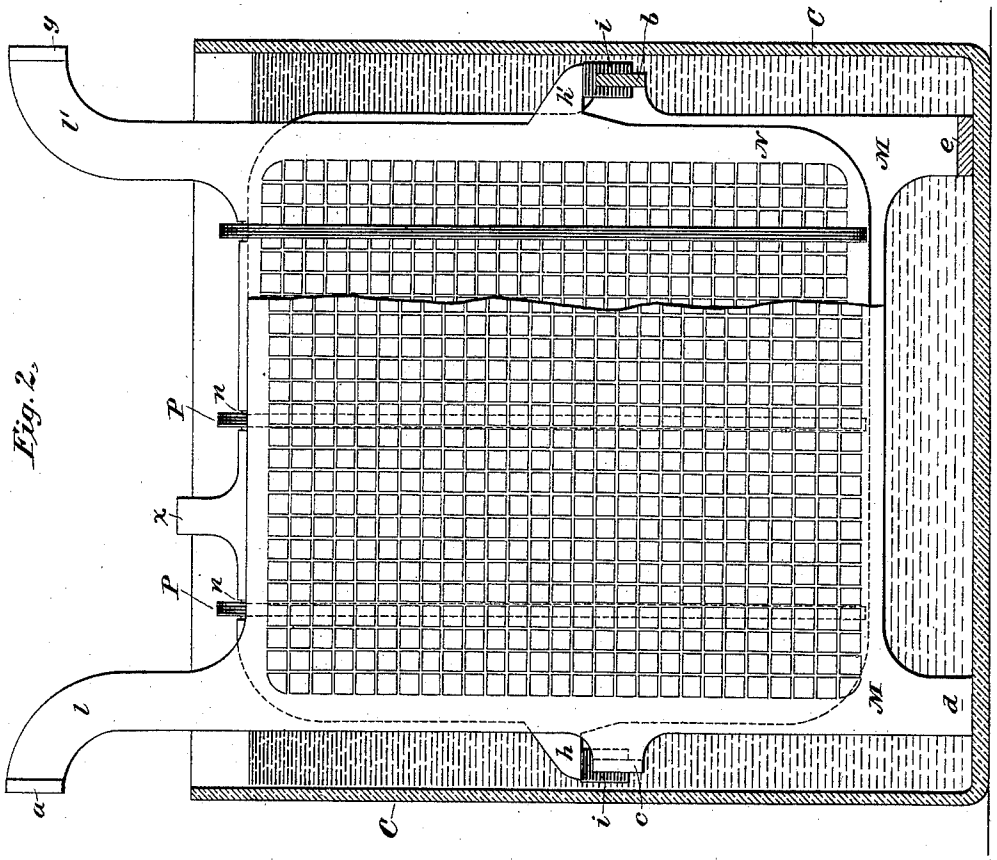


Fig. 2.

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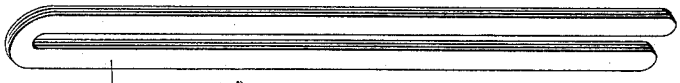


Fig. 5.

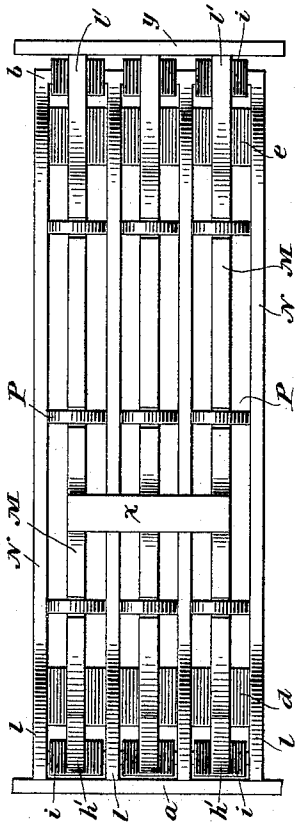


Fig. 4.

Fig. 6.



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UNITED STATES PATENT OFFICE.

FRANK KING, OF FULHAM, COUNTY OF MIDDLESEX, ENGLAND.

SECONDARY BATTERY.

SPECIFICATION forming part of Letters Patent No. 385,558, dated July 3, 1888.

Application filed April 4, 1888. Serial No. 269,605. (No model.) Patented in England December 10, 1887, No. 17,047.

To all whom it may concern:

Be it known that I, FRANK KING, a subject of the Queen of Great Britain and Ireland, and a resident of Fulham, in the county of Middlesex, England, have invented certain new and useful Improvements in Secondary Batteries, (for which I have obtained Letters Patent in Great Britain, No. 17,047, dated December 10, 1887,) of which the following is a specification.

My invention is an improvement in secondary batteries.

The improvement relates to the arrangement or construction of the battery whereby the two series of plates of opposite name or characteristics are firmly, compactly, and durably assembled together to form the two elements of the couple, while one element may be removed without disturbing the other.

The object of my improvement is to prevent buckling of the positive-pole plates when such plates are subjected to overdischarge or ill usage, as sometimes happens, and to provide for removing said plates for repair or substitution.

I have shown and described my invention as applied to a battery in which plates of lead containing numerous cells or perforations are pasted with an oxide of lead. One series of such plates are provided with projections at their lower corners. The projections on each of these corners are united by "burning" to a strip of the same material, so that they are firmly united, a regular interval or space being maintained between each pair of plates. There are similar projections on each side about midway the distance to the top corners, and the projecting lugs on one of the upper corners are likewise united. This arrangement provides at five points for firmly and durably uniting with considerable mechanical strength the hydrogen, spongy metallic lead, or negative-pole plates. The peroxide or positive-pole plates are only united in two places—at the lugs projecting from an upper corner and at a point on the upper edge between the corners. They are provided with projections between the upper and lower corners on the edge of the plates, which rest upon the bars of lead uniting the first-named plates. Suitable sections of insulating material are used to electrically separate them at these points.

For separators I use two parallel strips of insulating material united at one end like a hair-pin or tuning-fork. These are slipped onto the peroxide plates and held in position by a notch or by notches in or on said plates.

The accompanying drawings illustrate my invention.

Figure 1 is a complete perspective view. Fig. 2 is a section parallel with a plate or element. Fig. 3 is a cross-section. Fig. 4 is a plan view showing details in position. Fig. 5 is a view of the separator employed in this arrangement, and Fig. 6 is a section of insulating material upon a series of which the plates of one element rest.

The two elements M and N are composed of a series of perforated lead plates, each perforation containing an active or absorptive material, as an oxide of lead. The plates are arranged alternately or interleaved, and they are immersed in an electrolytic liquid within a containing-cell, C. These interleaved plates are necessarily separated by insulating material. I prefer to use separators in the form of parallel strips united at one end, P, Fig. 5, and the plates are notched, as at *n*, to prevent displacement of these separators, which are placed on the plates forming one element, N, so that the two parallel pieces are upon opposite sides of the plate. I prefer to use hard rubber for this purpose.

There are usually more plates in the negative than in the positive element. As shown, there are three positives and four negatives. These positives are sometimes deformed by unfavorable conditions, ignorance, or abuse, and in such cases it becomes necessary to temporarily remove them, besides providing means to prevent this deformation or buckling. To make a mechanically strong pile, while at the same time allowing one element to be removed without disturbing the other, I unite the series of plates forming the negative element in five places by lugs or strips of lead, as at *a b c d e*.

d and *e* are at the bottom of feet or projections, which raise the plates from the bottom of the cell and afford free circulation for the liquid. The plates forming the other element, M, are united at two points only, *x* and *y*, and they are furnished with projections, as shown at *h h'*, which rest upon the straps *b* and *c*,

uniting the first-named series of plates, thus suspending the plates of element M above the bottom of the cell, so that finely-divided lead dropping out of the perforations and falling to the bottom of the cell cannot electrically unite the two elements. At points where the projections *h h'* rest upon the straps or lugs of the other element I place saddles *i*, of insulating material, as hard rubber. (Shown in Fig. 6.)

It is intended that the element M, united electrically and mechanically at five points, shall remain fixed in position, and that by placing one hand upon each strap *x* and *y* of the element N that element may be readily removed, repaired, and replaced.

The lugs *l* and *l'* form the electrical terminals of the cell.

What I claim, and desire to secure by Letters Patent, is—

1. In a secondary battery, an element consisting of two or more plates mechanically united at two or more points, combined with a second element consisting of plates interleaved or alternating with the plates of the first element, both elements being located in an inclosing-cell containing an electrolytic liquid.

2. In a secondary battery, the combination of two series of vertically-disposed plates forming the two elements, one series having feet or projections at the lower edge thereof to provide free circulation for the electrolyte, the second series of plates having projections resting upon the first series, but insulated therefrom, substantially as described.

3. In a secondary battery, two or more plates or elements having feet or projections at the lower corners thereof, combined with strips of conducting material uniting such projections and securing them at a uniform distance, substantially as described.

4. In a secondary battery, two or more plates or elements united at one or more points intermediate the upper and lower edges by bars or strips of conducting material, whereby they are united and secured at a uniform distance apart.

5. In a secondary battery, two or more plates mechanically secured together at two or more points below the upper edge thereof, whereby they are maintained at a uniform distance with respect to each other.

6. In a secondary battery, two or more plates mechanically and electrically united at two or more points upon or in proximity to the upper edge, in combination with two or more plates alternating therewith and electrically united at two or more points below the upper edge, substantially as described.

7. In a secondary battery, the combination of two series of plates forming the two elements of the battery interleaved or alternating with each other, one series being mechanically and electrically united at two or more points between the upper and lower edges, the other series being mechanically and electrically united at or about their upper edge and having projections resting upon the first-named series, whereby they are supported in a movable position, substantially as described.

8. In a secondary battery, the combination of two series of plates alternating with each other and forming, respectively, the two elements, one series being mechanically and electrically united at two or more points below their upper edge, the other series being similarly united at two or more points above the points of union in the first plates and having projections resting upon the first plates, but insulated therefrom.

9. In a secondary battery, the combination of two series of vertically-disposed interleaved plates forming the two elements, one series being supported by the other, but insulated therefrom, substantially as described.

10. In a secondary battery, two or more plates or elements and one or more separators therefor, each consisting of a separate and independent pair of strips of insulating material, located, respectively, upon opposite sides of a plate and united at the upper ends, whereby said separator may be removed and replaced without disturbing the elements.

11. In a secondary battery, the combination of a plate or element and one or more separators therefor, each consisting of a separate and independent pair of strips of insulating material united at one end, and one or more notches or seats formed in said plates to receive said separators and prevent displacement thereof, substantially as described.

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