(Specimens.)

2 Sheets—Sheet 1.

C. PAYEN.

PROCESS OF PRODUCING POROUS CRYSTALLIZED METAL PLATES.

No. 440,267. Patented Nov. 11, 1890.

Fig. 4.

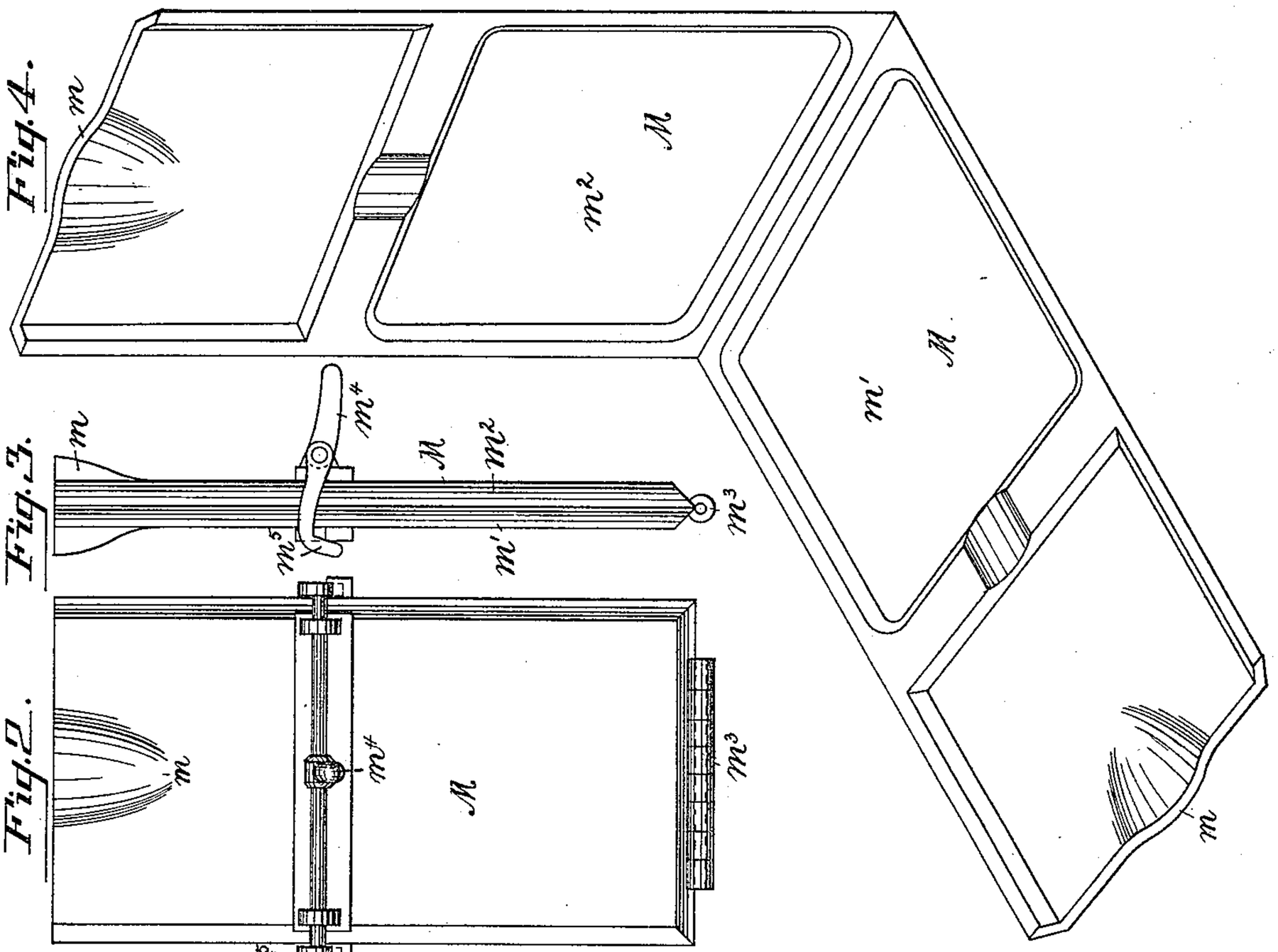
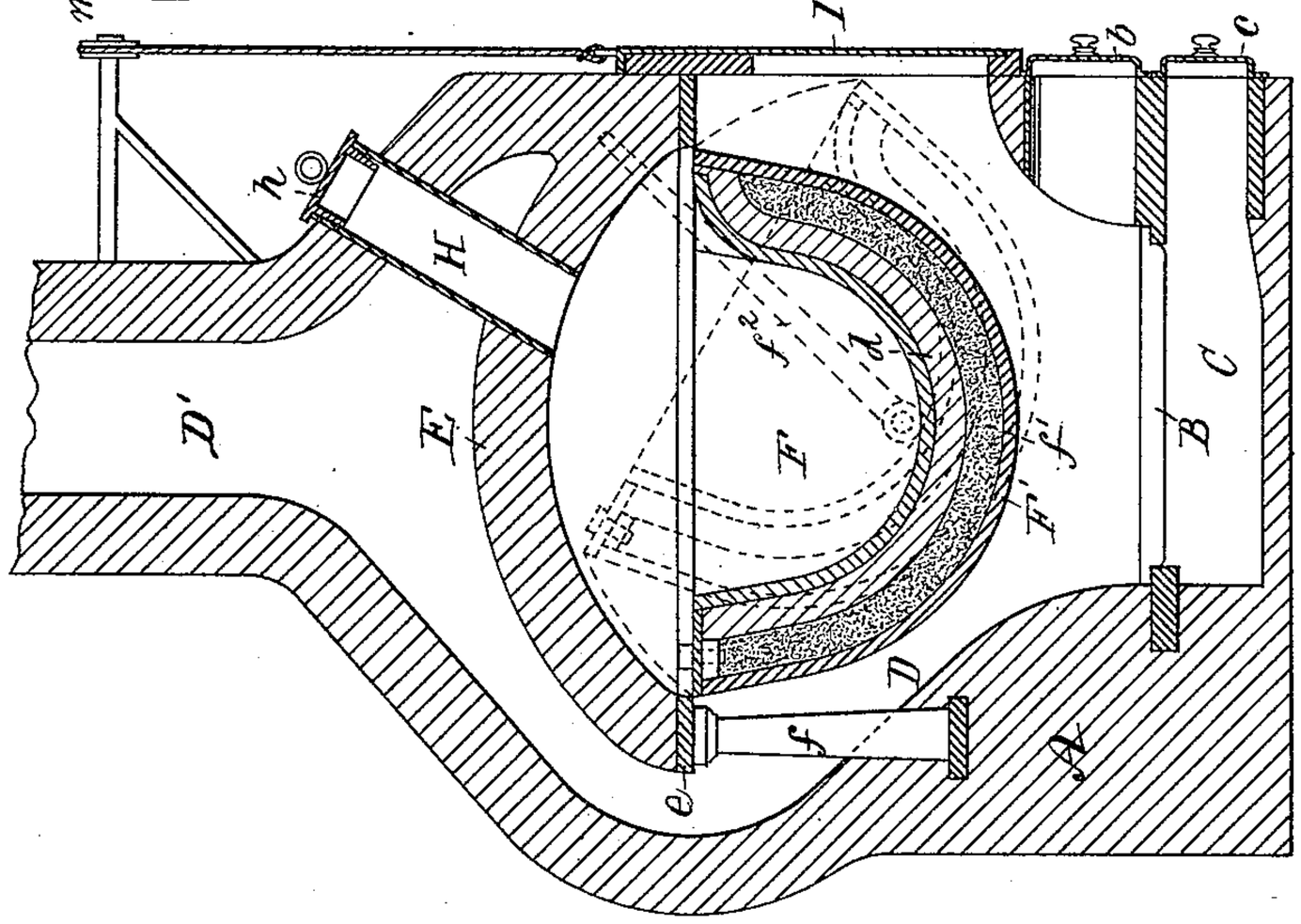


Fig. 3.

Fig. 2.

Fig. 1.



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(Specimens.)

2 Sheets—Sheet 2.

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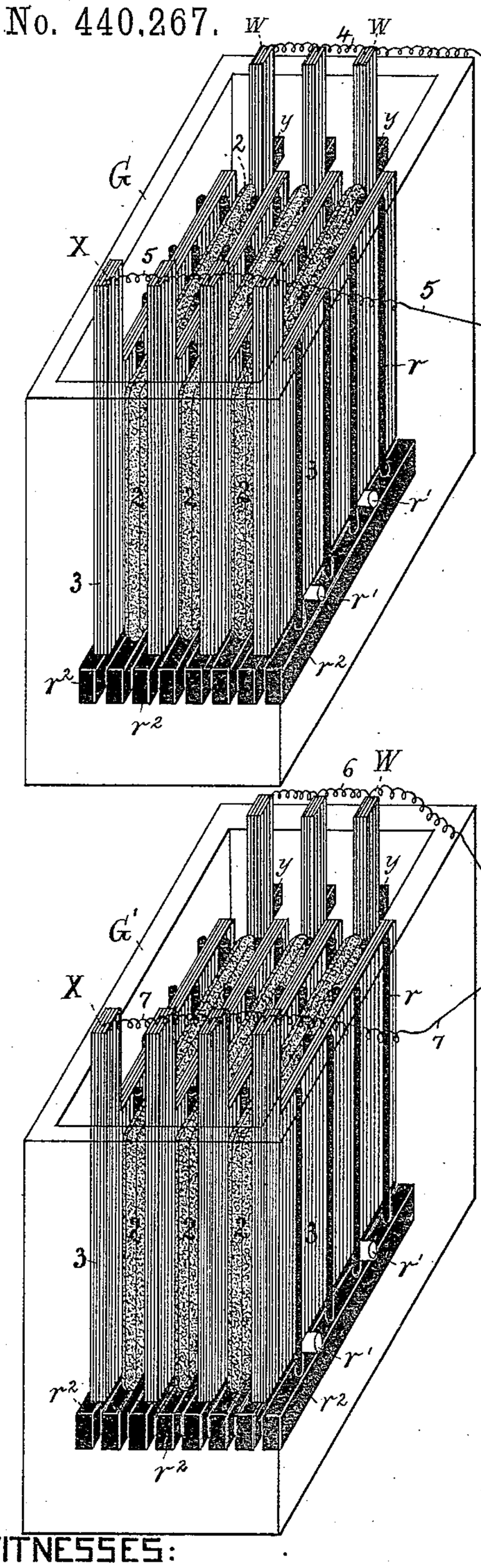


Fig. 5.

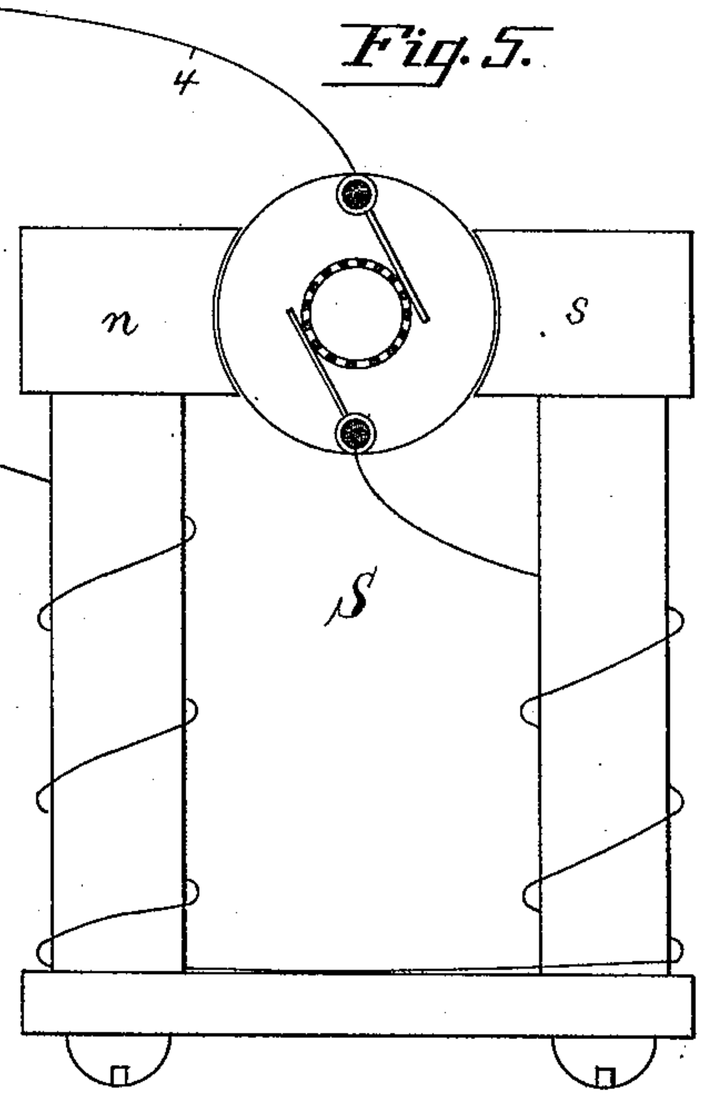
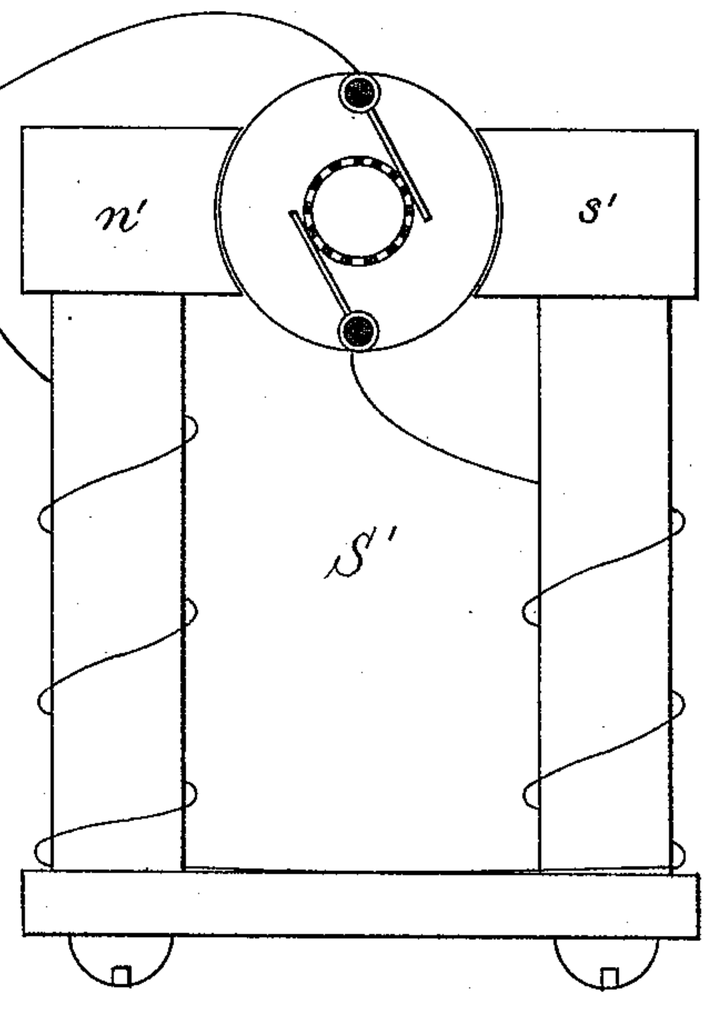


Fig. 6.



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UNITED STATES PATENT OFFICE.

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PROCESS OF PRODUCING POROUS CRYSTALLIZED METAL PLATES.

SPECIFICATION forming part of Letters Patent No. 440,267, dated November 11, 1890.

Application filed July 26, 1887. Serial No. 245,378. (Specimens.)

To all whom it may concern:

Be it known that I, CLÉMENT PAYEN, a citizen of the Republic of France, but now residing at the city of Philadelphia, in the county of Philadelphia and State of Pennsylvania, have invented certain new and useful Improvements in the Process of Producing Porous Crystallized Metal Plates, of which the following is a specification.

The principal object of my invention is to provide a porous crystallized metal plate of substantial strength for use as an element of a secondary or storage battery.

My invention consists in fusing two or more metallic salts together, then pouring the mass into a mold and allowing the same to cool and crystallize therein, and then reducing the structure to a metallic state and eliminating foreign matter therefrom.

In the accompanying drawings is shown apparatus for the conduct of the several steps of the process, in which—

Figure 1 is a vertical central section through a melting-furnace of my improved construction with a crucible pivotally supported therein. Fig. 2 is a top or plan view of a two-part mold. Fig. 3 is an end view thereof. Fig. 4 is a perspective view showing the shape and interior formation of the mold, and Figs. 5 and 6 are diagrammatic views of electrolytic baths for reducing the crystallized plates to a metallic state.

Referring to the drawings, A is the furnace, and B the grate in the lower part thereof.

D is the draft-flue leading to the chimney D′.

E is an arch in the upper part of the furnace.

F is the crucible or melting-pot, open at the top, and around the circumference thereof is formed a layer *d* of amianthus, asbestus, or other material, and between this layer *d* and the metal pot F′ is a layer of sand *f′*. The metal capsule F′ is pivotally supported within the furnace and actuated by a lever f^2, attached to one of the journals of the metal-pot F′, whereby the crucible is tilted to discharge its contents into a receptacle for further treatment.

H is an inclined hopper with a removable stopper *h*, and I is a door to allow of the melted mass being discharged into a mold, wherein the fused mass in cooling assumes a crystallized form.

To obtain a crystallized metal lead plate of six to twelve inches square, (more or less,) I take a charge of chloride of lead and add thereto a small quantity of chloride of zinc or chloride of cadmium, or I add both chlorides thereto. The quantity of chloride of zinc or of chloride of cadmium, or both chlorides, added to the charge of chloride of lead may be varied, which will depend upon the strength and degree of porosity required in the product.

It may be remarked that a salt or salts of a metal or metals other than those mentioned may be added to or combined with the base salt in the production of a porous crystallized metal plate having substantial strength for use as an element of an electric battery.

The above-mentioned mass is brought to a state of fusion in the crucible F without permitting ebullition or bubbling of the mass to take place, and the crucible is then tilted by means of the lever f^2, and at the same time the sliding door I is raised to permit of the discharge of the mass into a mold M through the mouth *m*, when the two sections *m′* and m^2, hinged together at m^3, have been clamped together by means of a lever m^4, secured to a rod m^6, provided with pawls m^5, which engage with the rim of the section *m′* of the mold. This mold may be constructed of either equal or unequal thicknesses of metal, as desired.

When a fused mass is poured into a two-part mold of equal thicknesses of metal, the mass will commence to cool from each side and the crystals composing the same will meet or unite with each other at their summits, sides, or facets, forming columns throughout the mass, and the columns of crystals thus formed from the respective sides of the mold meet or unite at a median line of the plate or other structure. On the other hand, if the two parts of the mold are of unequal thicknesses of metal the crystals of the mass will commence to cool therein from the side having the greater thick-

ness of metal, and will meet the mass forming in columns from the opposite side of the mold beyond a median line of the plate or other structure.

The mass having assumed a solid crystallized form in the mold M and having become cool therein after being framed in any preferred manner, may be reduced to a metallic state, as follows: In a vase G, containing sulphuric acid and water a series of the crystallized chloride plates are mounted on insulators r', held in the grooves of bars r^2, of rubber or other insulating material, provided with vertical bars r, the system of crystallized chloride of lead plates 2, mounted in the vase G, being alternated with plates 3, of equal dimension, composed of lead, charcoal, or other material provided with lugs or conductors X. Against one of the edges of the crystallized plates 2 are placed bars of lead or other material, forming conductors. These bars are held to place by means of strips y of rubber or other material inserted between them and the vase G. The two systems of plates insulated from each other and the vase G are mounted without play, in order that bulging, warping, or cracking of the crystallized chloride plates may be obviated, for if such were permitted during the reduction of the plates to a metallic state their utility for subsequent use would be much impaired. The two systems of plates 2 and 3 having been mounted in the vase G in an electrolytic bath in the manner described, the wires 4 and 5, in contact with the conductors X and W, are connected with the positive and negative electrodes n and s of the dynamo S. The system of crystallized chloride plates 2 is connected through the wire 4 with the negative electrode s of the dynamo S, while the system of lead, charcoal, or other plates 3 is connected through the wire 5 with the positive electrode n of the dynamo S, and in the ensuing electrolytic action which takes place the oxygen and chlorine will be liberated and on the system of crystallized plates will remain zinc and cadmium, both metallic. The now crystallized metal lead plates are then removed from the vase G into another vase G′, containing a fluid or electrolytic bath. In this second vase G′ the crystallized plates are again alternated with others of ordinary lead or charcoal, as in the previous instance. The two systems of plates insulated from each other and the vase G′ are again connected through two separate wires 6 and 7 with the positive and negative electrodes of the dynamo S, as before, with this exception, that the negative electrode is connected with the system of crystallized metal plates, as illustrated in Fig. 6. By the second electrolytic action ensuing the metallic zinc and cadmium are eliminated from the crystallized plates, thereby leaving them free from impurities and in a porous state. The crystaliized metal plates thus treated may then be washed and dried by a gentle heat, whereby they will be brought to a chemically-pure condition. Crystallized metal plates obtained in the manner described will have not only substantial strength, but will be exceedingly porous, thereby especially adapting the same for use as the elements of a secondary or storage battery.

Having thus described the nature and objects of my invention, what I claim as new, and desire to secure by Letters Patent, is—

1. The method of producing a porous crystallized metal plate for use as an element of a secordary battery, which consists in fusing two or more metallic salts together, then pouring the mass into a mold and allowing it to crystallize therein, and then reducing the structure to a metallic state and eliminating foreign matter therefrom, substantially as and for the purposes set forth.

2. The method of producing a porous crystallized metal plate for use as an element of a secondary battery, which consists in fusing two or more metallic salts together, then pouring the mass into a mold and allowing it to cool and crystallize therein, and then reducing electrolytically the structure to a metallic state, substantially as and for the purposes set forth.

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