

(No Model.)

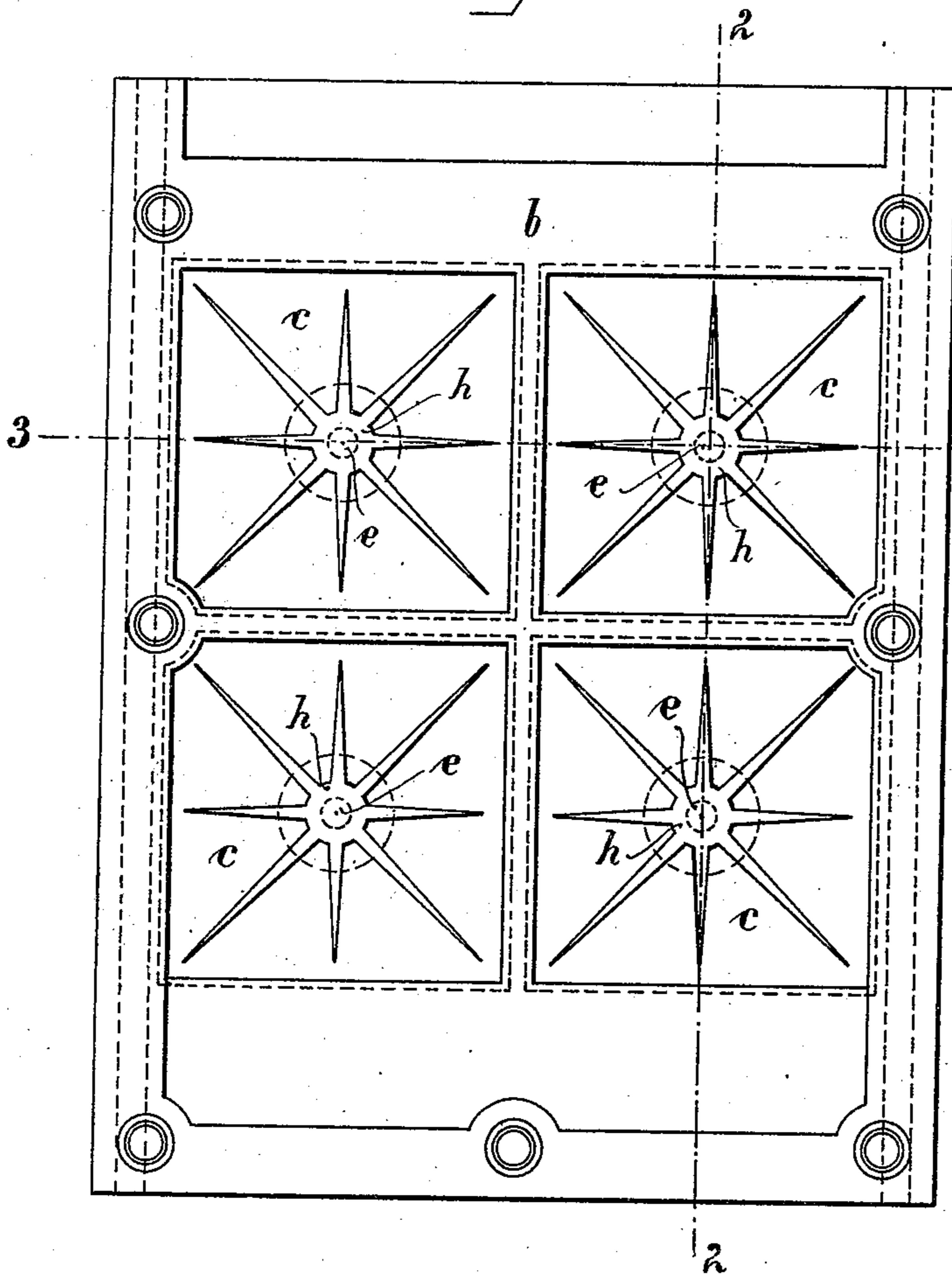
2 Sheets—Sheet 1.

P. F. RIBBE.  
SECONDARY BATTERY.

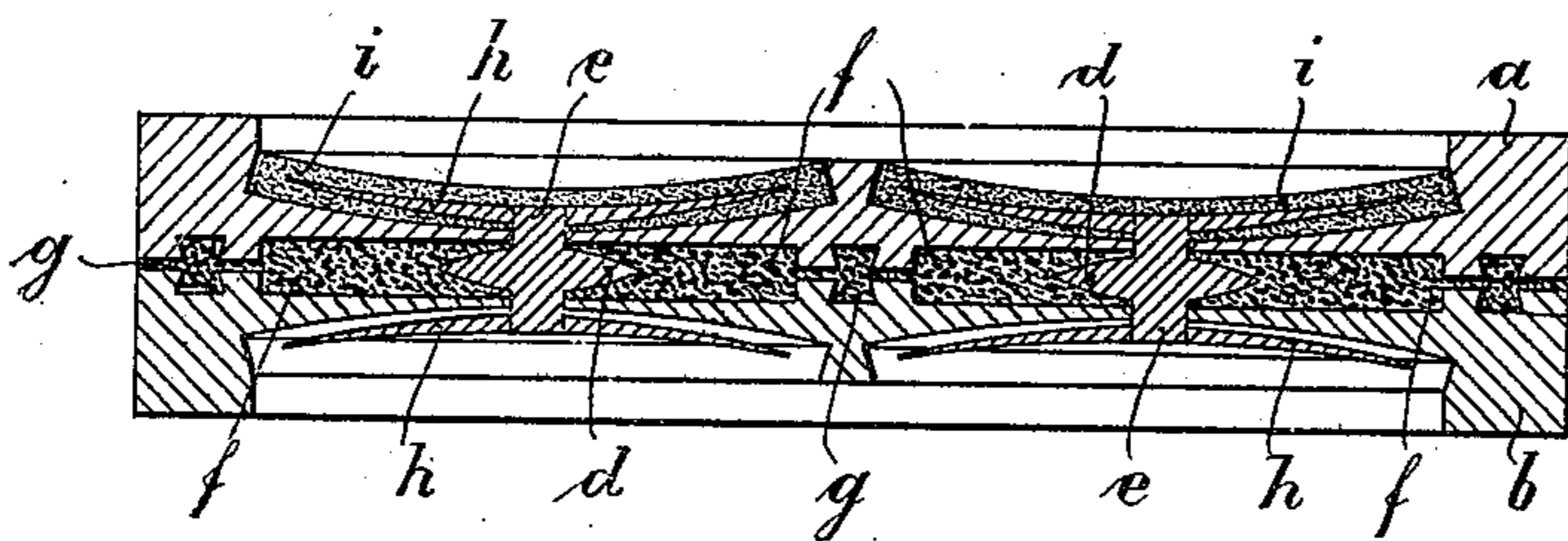
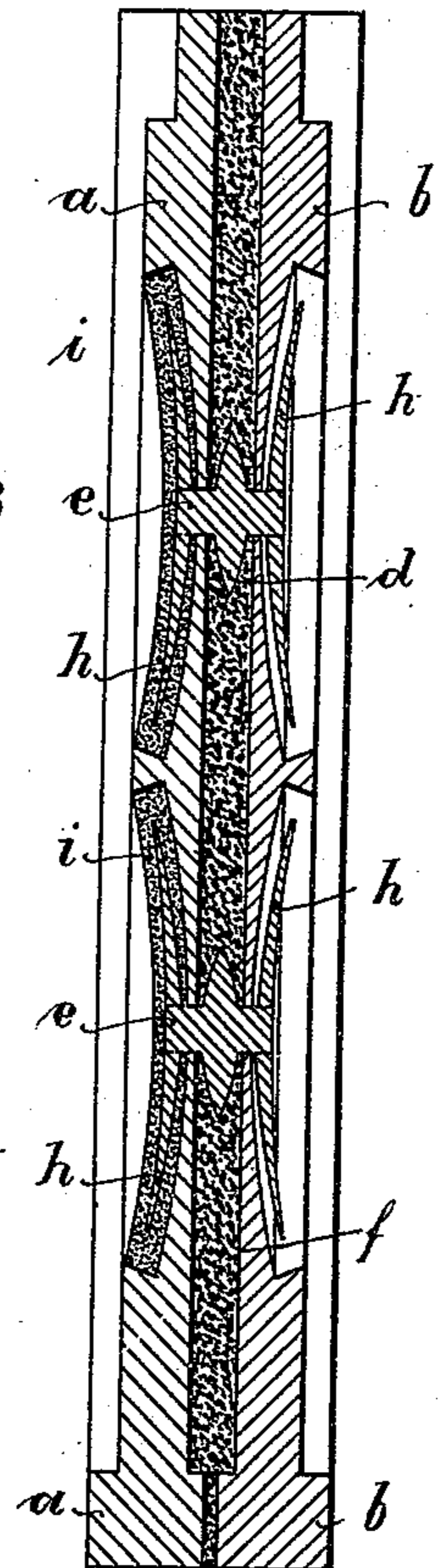
No. 553,596.

Patented Jan. 28, 1896.

*Fig. I.*



*Fig. II.*



*Fig. III.*

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*Emil Mueller.*

*P. F. Ribbe* Inventor.  
by his Attorney:  
*Oscar F. Tunn.*

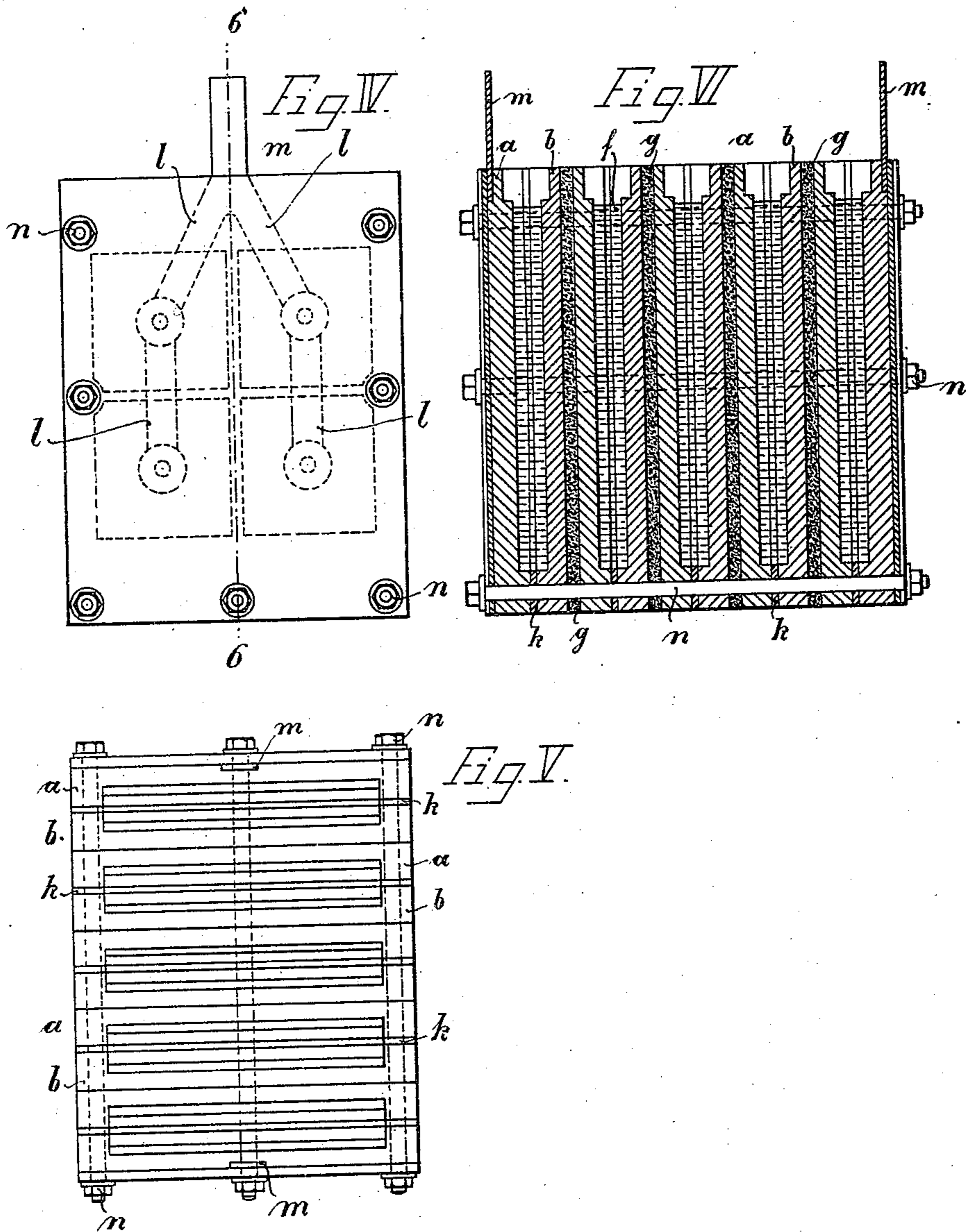
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*Oscar F. Gutz*

# UNITED STATES PATENT OFFICE.

PAUL FERDINAND RIBBE, OF BERLIN, GERMANY.

## SECONDARY BATTERY.

SPECIFICATION forming part of Letters Patent No. 553,596, dated January 28, 1896.

Application filed July 10, 1895. Serial No. 555,463: (No model.)

*To all whom it may concern:*

Be it known that I, PAUL FERDINAND RIBBE, engineer, a subject of the King of Prussia, German Emperor, residing at 19 Lessing Street, Berlin, Kingdom of Prussia, Germany, have invented certain new and useful Improvements in Secondary Batteries, of which the following is a specification.

This invention relates to electrodes for storage-batteries; and the object of my invention is to provide a new and improved double electrode, which avoids serious defects which were found to exist heretofore in storage-batteries.

In the accompanying drawings, forming a part of this specification, and in which like letters of reference indicate like parts in all the views, Figure 1 is an elevation of my improved double electrode for storage-batteries. Fig. 2 is a vertical transverse sectional view on the line 2 2 of Fig. 1. Fig. 3 is a horizontal sectional view on the line 3 3 of Fig. 1. Fig. 4 is an end view of a storage-battery composed of my improved double electrodes. Fig. 5 is a plan view of the same. Fig. 6 is a vertical longitudinal sectional view of the same on the line 6 6 of Fig. 4.

The symmetrically-shaped plates *a* and *b* are made from a non-conducting material—for example, hard rubber—and are each provided in one face with four specially-shaped recesses *c* for receiving the active mass. The recesses *c* are curved toward the central plane of the double electrode, and in the manner of an arched vault are bounded by inclined edges, so that the active mass filled into the recess *c* forms an arched vault, and any tension or pressure produced by changes in volume are taken up by the inclined edges, which act as abutments.

Between the plates *a* and *b* the disks *d*, having central pins *e* on both faces, are so arranged that the pins *e* project at the centers of the recesses *c* through suitable holes and extend some distance into said recesses.

The adjacent faces of the plates *a* and *b* are provided with recesses *f* and *g*, as shown in Figs. 2 and 3, of which the recesses *g* are dovetailed. After the disks *d* have been inserted the plates *a* and *b* are pressed firmly together and the recesses *f* and *g* are filled with a substance that can resist acids—for exam-

ple, asphaltum—the plates being preferably warmed before pouring in this filling.

By the cooling and solidifying of the asphaltum or other filling substance the two plates *a* and *b* form one body and the disks *d* are fully embedded in an acid-resisting substance.

On the projecting pins *e* spider-frames *h* are applied and in some suitable manner are soldered to the pins *e*. These spider-frames are not essential and merely serve for facilitating the conducting of the current to and from the electrode.

The recesses *c* are filled with active mass *i*, in the manner shown in Figs. 2 and 3, so that the spider-frames are entirely embedded in the active mass, and the active mass itself has the shape of an arched vault.

The electrodes prepared in this manner are placed side by side, as shown in Figs. 4, 5, and 6, packing-plates *k* being inserted between them along the edges. The end plates need be single only. For the purpose of conducting the current to and from the battery the end plates have disks *d* with a single pin *e* only, which are connected with each other and with the contact-piece *m* by bars or bands *l*.

The several electrodes are held together by bolts *n* and the spaces between the several electrodes filled with the electrolytic fluid.

My improved storage-battery has several technically very important features and advantages. The active mass need not hold by itself, nor must it be carried by a grating; but on the contrary it is held reliably by a non-conductor and the active mass is subdivided into sections of such size that the durability is assured. Furthermore, a most perfect isolation of the negative from the positive side is obtained and the acid cannot pass from one side of the double electrode to the other, nor can oxidation from one side to the other take place. The double electrode permits of connecting the electrodes in series in an effective manner without requiring an exterior intermediary connection. For parallel circuit the electrode possesses the great advantage that the current is distributed uniformly throughout the plate and the distributor is fully embedded. For parallel connection the disks *d* belonging to one and the same dou-

ble electrode are connected with each other and with a contact-piece in the manner described above for series connection. Of course more than four recesses *c* may be provided in each plate without in any way affecting the invention.

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

10 1. A double electrode for storage batteries composed of two plates of non-conducting material held together by an acid resisting substance between them, which plates have curved recesses for receiving the active mass, substantially as herein shown and described.

15 2. In a double electrode for storage batteries, the combination with two plates of non-conducting material held together by an acid resisting substance between them, which plates have recesses for receiving the active mass, disks between the plates, pins project-

ing from the disks into the recesses and spider frames attached to said pins and embedded in the active mass in the recesses, substantially as herein shown and described. 25

3. In a double electrode for storage batteries, the combination with two plates of non-conducting material having recesses in the outer surfaces and recesses in the inner adjacent surfaces, of which inner recesses some are dovetailed and an acid resisting substance cast in between the plates and their inner recesses to hold the two plates, together, substantially as herein shown and described. 30

In testimony that I claim the foregoing as my invention I have signed my name, in presence of two witnesses, this 14th day of June, 1895. 35

PAUL FERDINAND RIBBE.

Witnesses:

D. HÄBERLEIN,

HERMANN OHLERT.