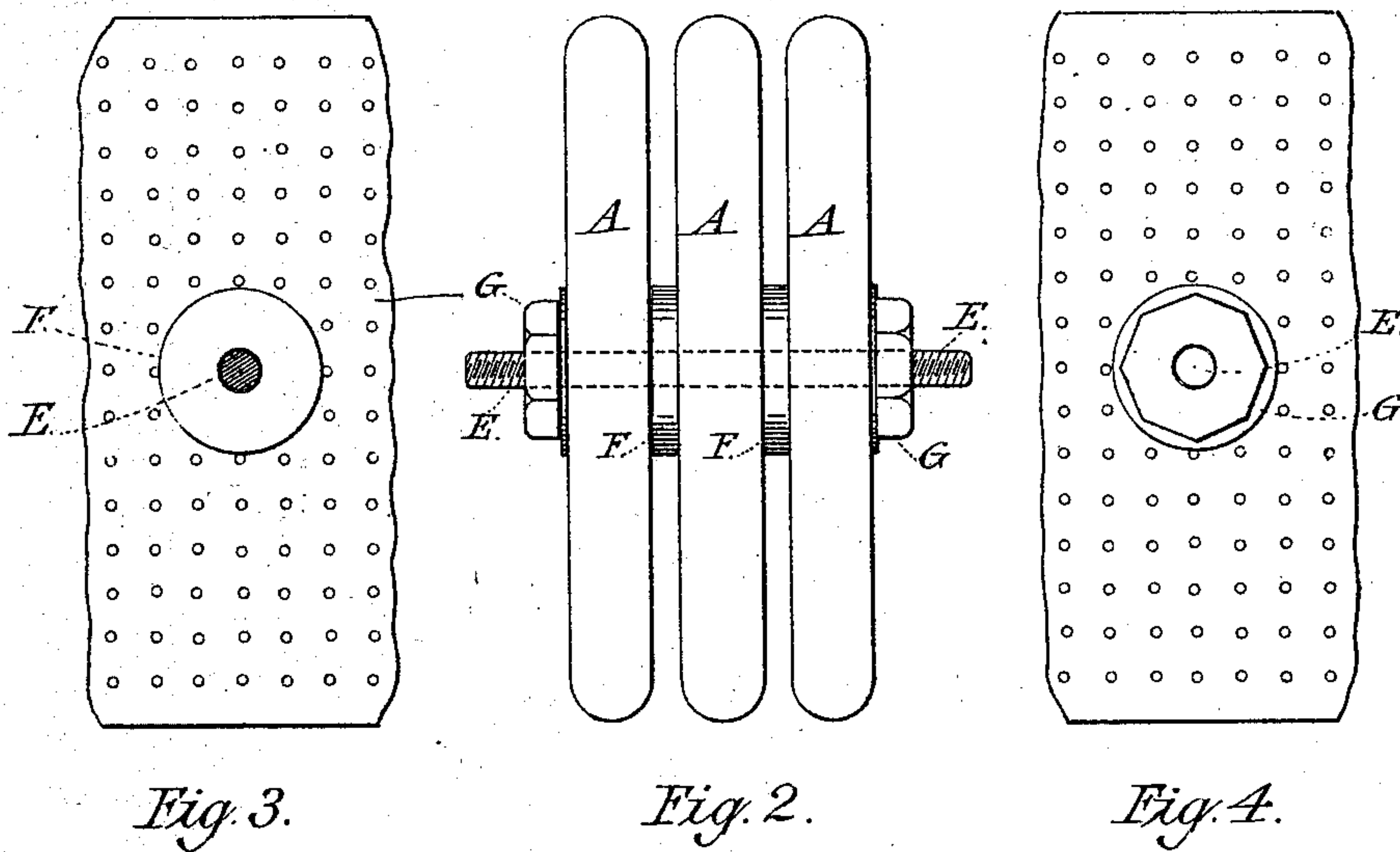
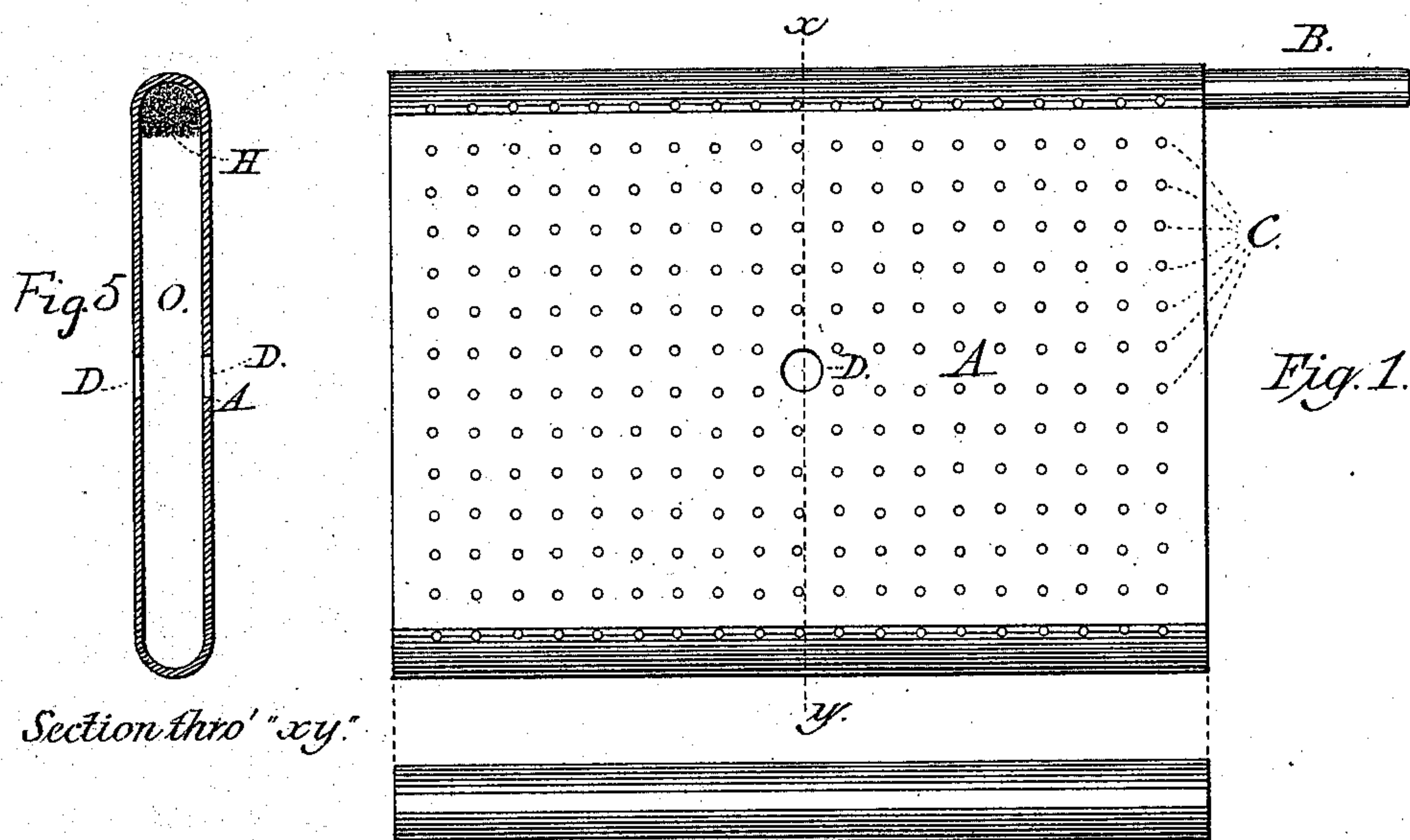


(No Model.)

H. H. CARPENTER.
SECONDARY BATTERY.

No. 412,727.

Patented Oct. 15, 1889.



WITNESSES:

Wm. M. Ward
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UNITED STATES PATENT OFFICE.

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SECONDARY BATTERY.

SPECIFICATION forming part of Letters Patent No. 412,727, dated October 15, 1889.

Application filed December 26, 1888. Serial No. 294,689. (No model.)

To all whom it may concern:

Be it known that I, HIRAM H. CARPENTER, a citizen of the United States, residing in the city of Denver, in the county of Arapahoe and State of Colorado, have invented new and useful Improvements in Secondary or Electrical Storage Batteries; and I do hereby declare the following to be a full, clear, and exact description of my invention, which will enable others skilled in the art to which it appertains to make and use the same, reference being had to the accompanying drawings, in which—

Figure 1 shows the face or surface of my improved electrode for secondary or electric storage batteries punctured with innumerable small holes, with a larger hole in the center for the insertion of an insulating bolt or rod, and a cross-section of the same on a plane parallel to the end lines thereof; Fig. 2, a cell composed of three of my improved electrodes joined and firmly bound together by means of an insulating bolt or rod, with intervening insulating-washers between the respective electrodes fastened and held in position by means of insulating-nuts at either end of the rod or bolt. Fig. 3 represents a fraction of my electrode or plate, with insulating bolt or rod and insulating-washer in place. Fig. 4 is a like fraction of my electrode or plate, showing insulating bolt or rod and insulating-nut in place. Fig. 5 is a section on line $x y$ of Fig. 1.

Letters of like name and form refer to like parts in each of the figures.

The object of my invention is to provide certain improvements in secondary or electric storage batteries; and to this end my invention consists in the electrode, the construction thereof, the composition, the use or application, and the use or application of the material cerussite therein.

In the drawings, A in all cases represents the electrode proper, or the case or envelope wherein the active matter H is inclosed, which may be made of any size, dimensions, or thickness desirable. The case or envelope A may be made of any desired material, such as sheet-lead or an alloy of lead. The edges of the case A need not necessarily be rounded, as shown in the drawings, but may as well be square or any other desired shape, so as to

fit the vessel containing the electrolytic liquid in which it is intended to be immersed.

B represents the "post," and is made of the same material and from the same sheet of metal as the envelope or case A. The post may be of any desired length or size, both case and post being of one piece.

C represents the perforations or small punched holes piercing the entire electrode through and through, the active or filling matter H as well as the case A. These holes C, I make about the size of a pin, but may be made larger or smaller, and of an indefinite number. These little perforations are pierced with a punch made for that special purpose, and the punch I am now using is capable of piercing nine hundred and eighteen holes at one impression. The entire electrode may be perforated by one impression of the punch, or the case or envelope may be perforated by itself and the active or filling matter perforated after being inserted into the perforated case by setting the punches in the holes already made in the case or envelope, and then puncturing the filling matter. I prefer to employ the latter method, inasmuch as the punches are necessarily very slender and brittle, and by perforating the case and the filling matter separately less strain is brought to bear upon them. The object of the perforations C is to gain exposed surface of the active or filling matter H, as well as to reduce the size of the electrode; also, to reduce the internal resistance of a cell to a minimum. The electrolytic liquid in which the electrode is immersed infiltrates the perforations C and acts upon the inclosed active matter H, as well as the case A, thus affording a very much increased surface of the electrode for the action of the solution. By this means I gain about five or six times the surface over pasted plates of the same size.

D represents a hole through the center of the electrode, as well through the active matter H as the case A, through which is intended to be passed an insulating bolt or rod, or a bolt or rod of any non-conducting material, as a means of fastening several electrodes together, forming a cell of any number of electrodes. The hole D is made by the same punch, and at the same impression as the perforations C.

In Fig. 5, which is a section through $x y$, is shown the comparative thickness of the electrode and the comparative thickness of the case A, and the position of the active or filling matter H. O shows simply the inside of the case A, which is filled up solid with cerussite. H represents the cerussite or other active matter. The cerussite H is made into compressed tablets of the required size and inserted into the case A, either end of which is left open so as to receive the same. After being inserted in this manner the projecting ends of the case A are simply folded snugly against the cerussite or other active matter inclosed, or the active matter may be first inserted in the case and then perforated.

I do not confine myself to any particular method of perforation of the active matter, the essential feature being the provision of a multiplicity of small holes extending through and through the electrode. The active matter, cerussite, when compressed ready for use, becomes very hard and substantial and forms its own support. The case or envelope A is used principally as a means of conducting the current to and through the post B.

Fig. 2 represents a cell composed of three plates or electrodes, as represented in Fig. 1, fastened together by means of E E, an insulating rod or bolt, composed of vulcanite or any insulating or non-conducting material, passed through the hole D, as shown in Fig. 1, with threads at either end. This cell is immersed in a vessel of electrolytic liquid in the usual way. F F represent washers of the same insulating material, used to insulate or separate the several electrodes placed upon the bolt or rod E E. G G represent insulating or non-conducting nuts screwed onto either end of the bolt E E by means of a thread in the ordinary way, for the purpose of holding the electrodes A A A and washers F F firmly in place. These nuts G G, like the washers, may be made of any insulating material, but vulcanite is preferable.

Fig. 3 shows the position of the vulcanite or non-conducting bolt E and washer F. As before stated, the washer F may be made of any dimensions desirable to keep the electrodes from warping or twisting out of place.

Fig. 4 shows the position of the vulcanite bolt E and the nut G. It is optional how many of the bolts E E, with nuts and washers as described, are used in uniting the electrodes A A A, the number used depending upon the size of the plates or electrodes; and as many plates may be joined in this manner as required in one cell.

Having thus described my invention, what I claim, and desire Letters Patent to issue for, is—

1. A perforated electrode for secondary batteries, composed of cerussite made into compressed tablets and inclosed in a perforated case composed of lead or any alloy thereof.

2. A perforated electrode for secondary or storage batteries, made or composed of cerussite, substantially as described.

3. An electrode for secondary or storage batteries, perforated through and through with a multiplicity of small holes, composed entirely of active matter, with a conducting support or case A, also perforated, as and for the purpose intended, substantially as described.

4. An electrode for secondary batteries, composed of cerussite, and perforated as herein described, in combination with a perforated envelope or case having a post made integral therewith, substantially as described.

In testimony that I claim the foregoing I have hereunto set my hand this 22d day of December, A. D. 1888.

HIRAM H. CARPENTER.

Witnesses:

WM. E. DOYLE,

WM. W. SHAW.