No. 609,298. Patented Aug. 16, 1898.

W. ROWBOTHAM.

PRIMARY BATTERY.

(Application filed Feb. 24, 1898.)

(No Model.) 5 Sheets—Sheet I.

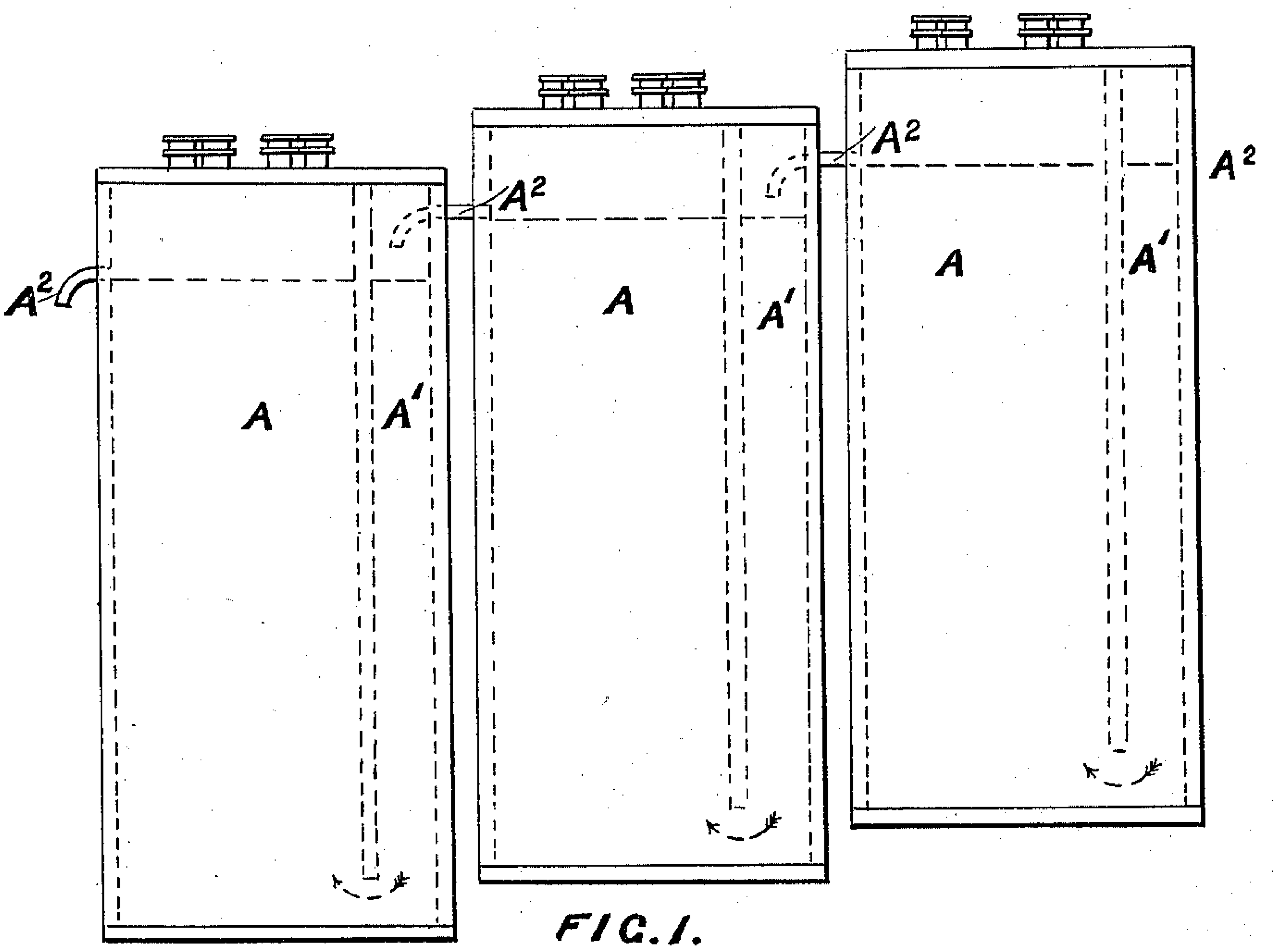

FIG. 1.

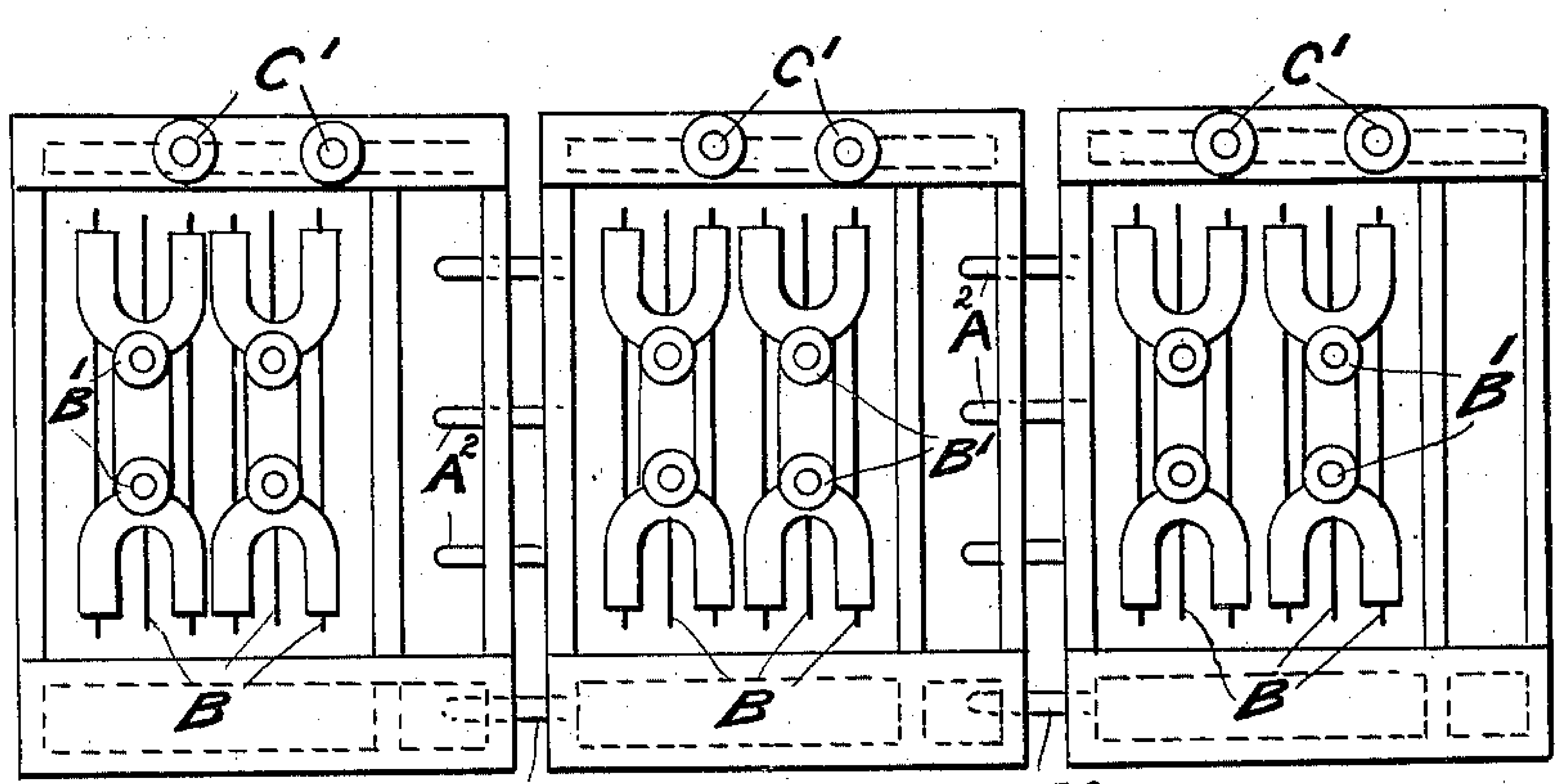

FIG. 2.

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Inventor:
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THE NORRIS PETERS CO., PHOTO-LITHO., WASHINGTON, D. C.

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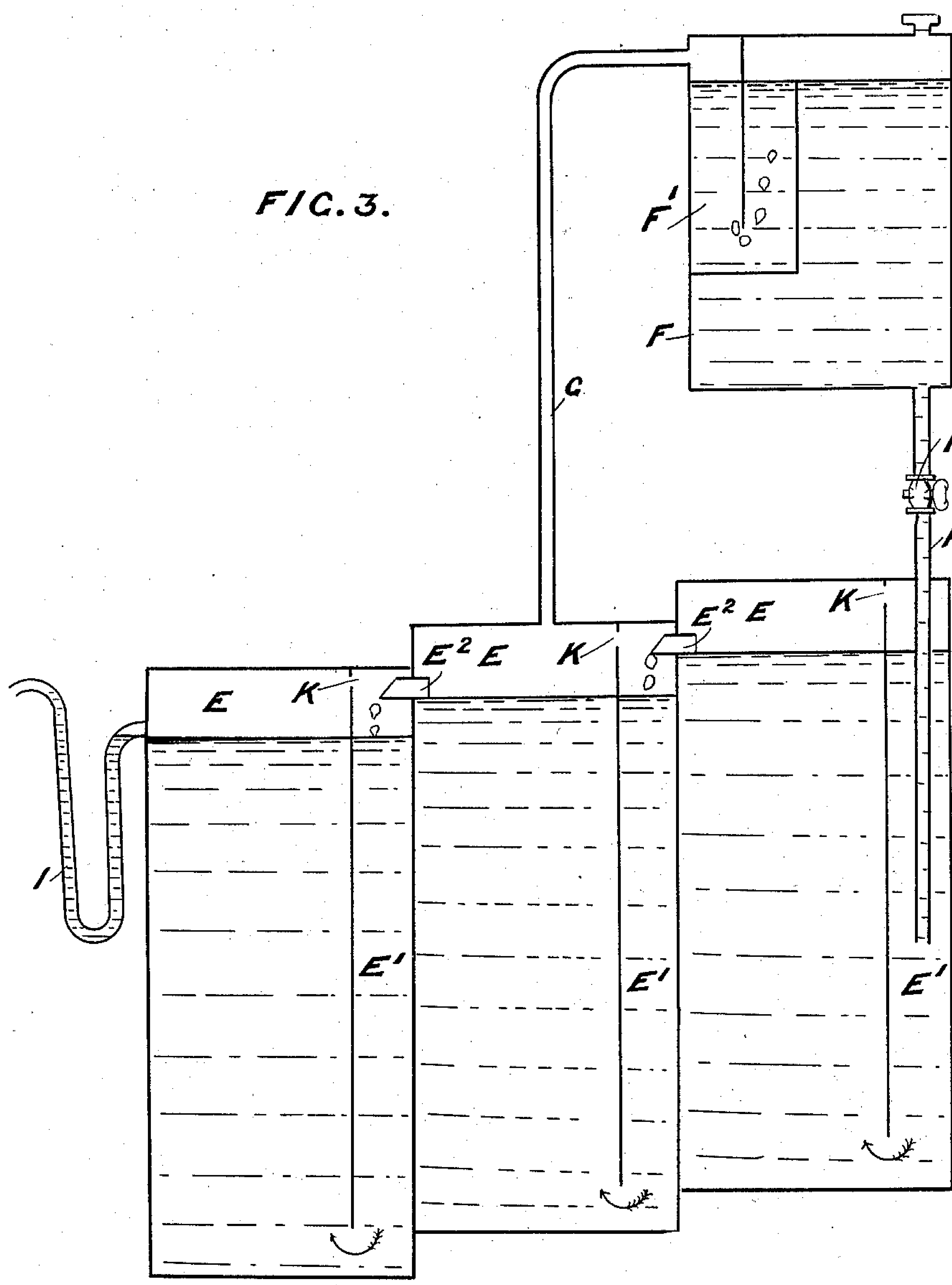
FIG. 3.



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(No Model.) 5 Sheets—Sheet 3.

Fig. 6.

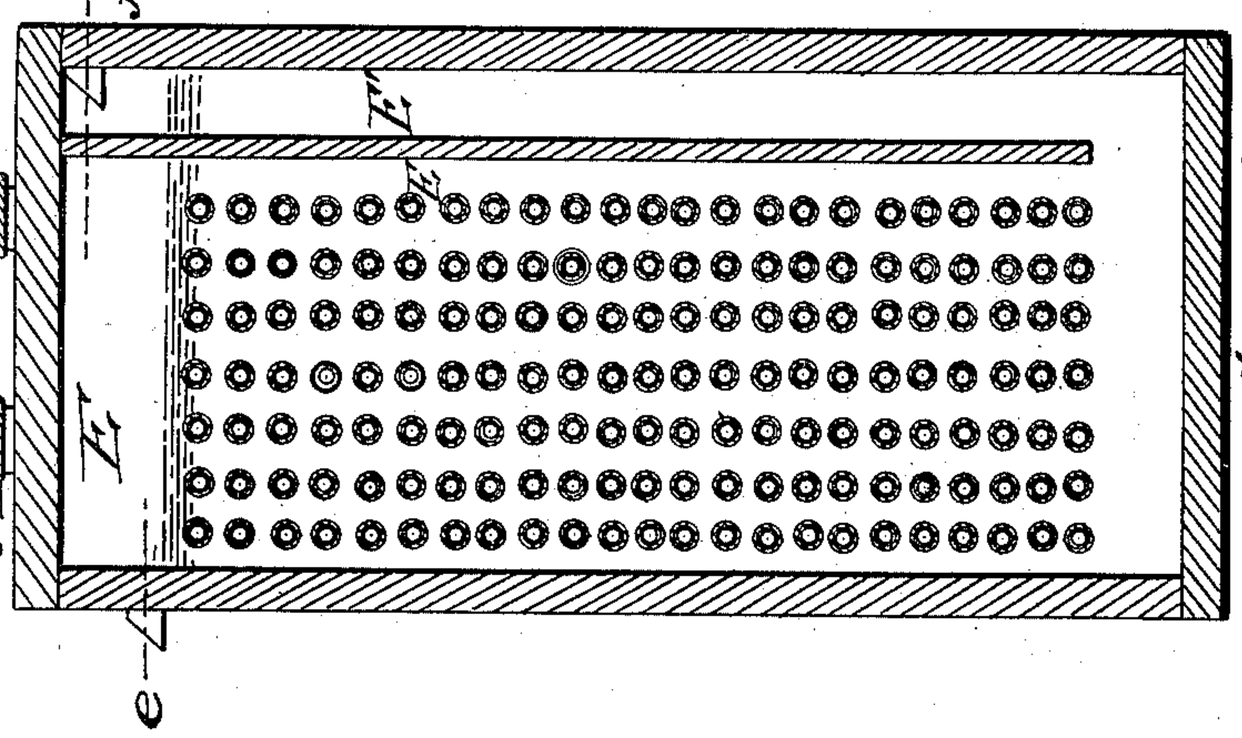

Fig. 8.

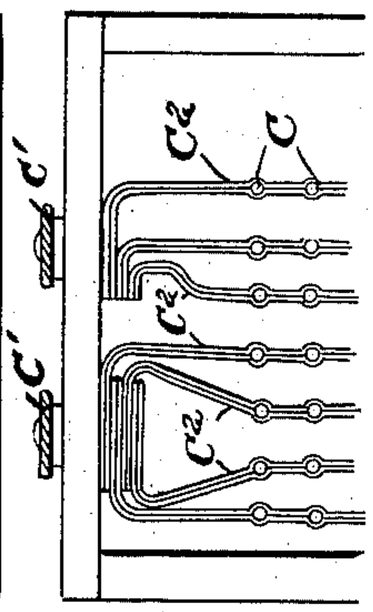

Fig. 5.

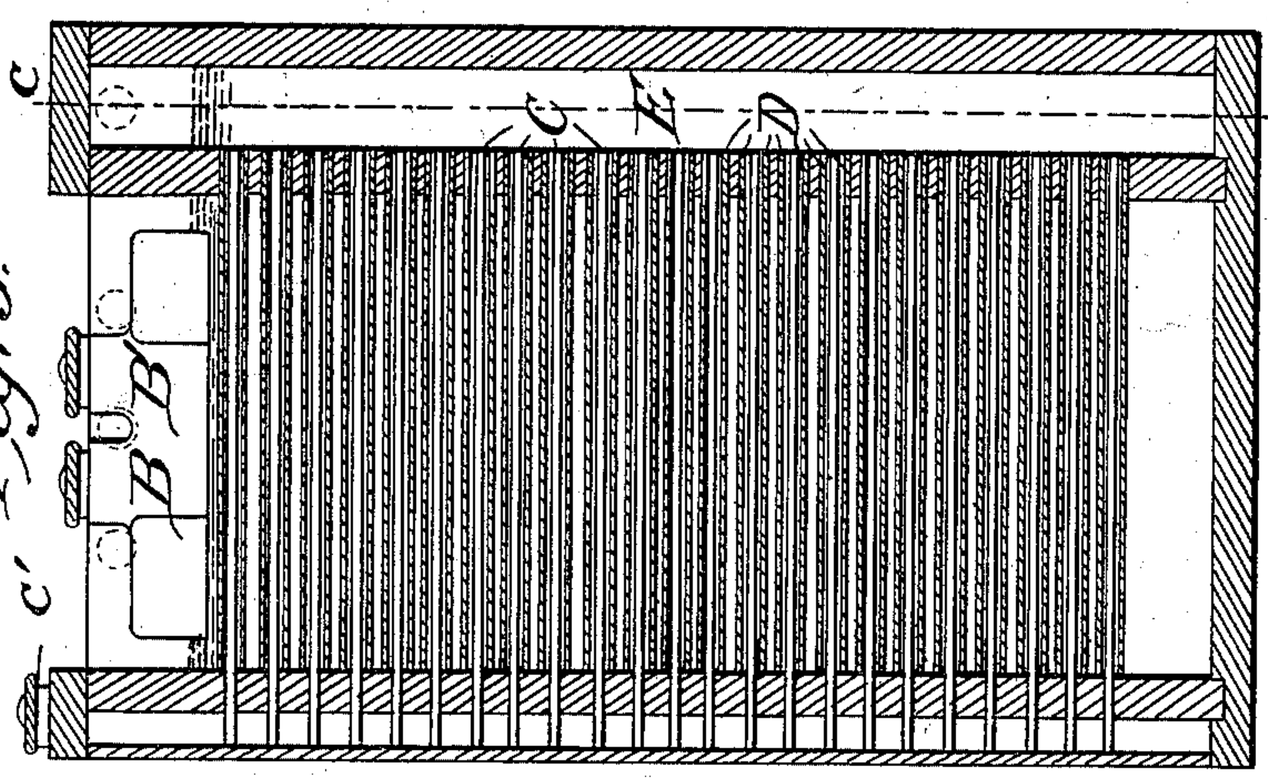

Fig. 9.

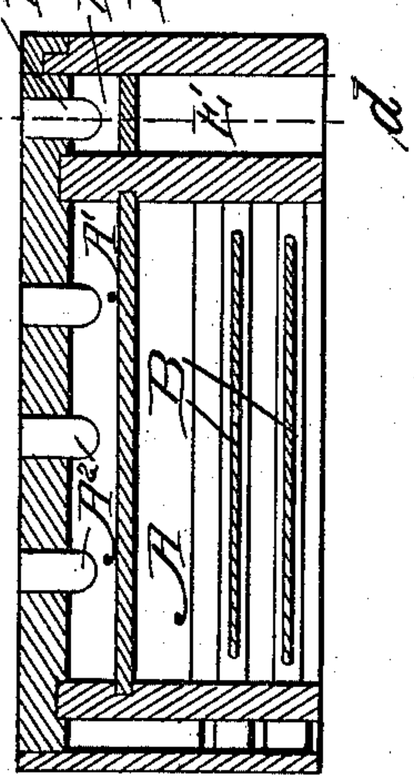

Fig. 4.

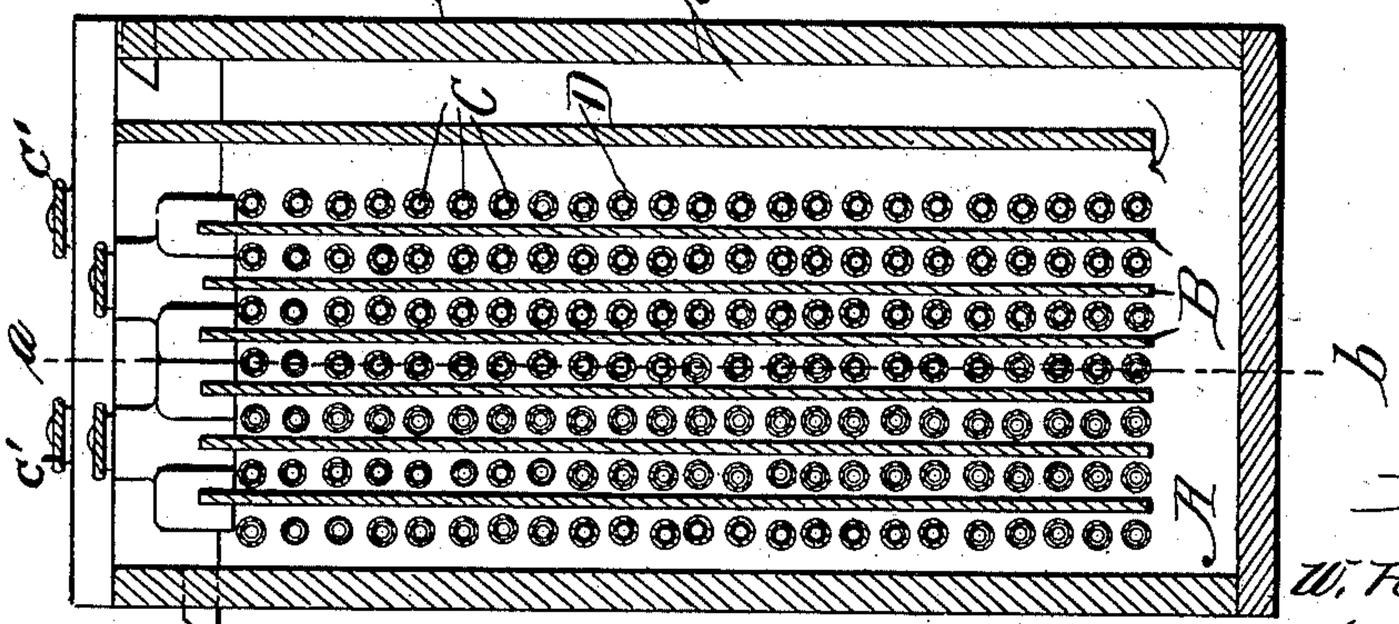

Fig. 7.

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PRIMARY BATTERY.

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(No Model.)

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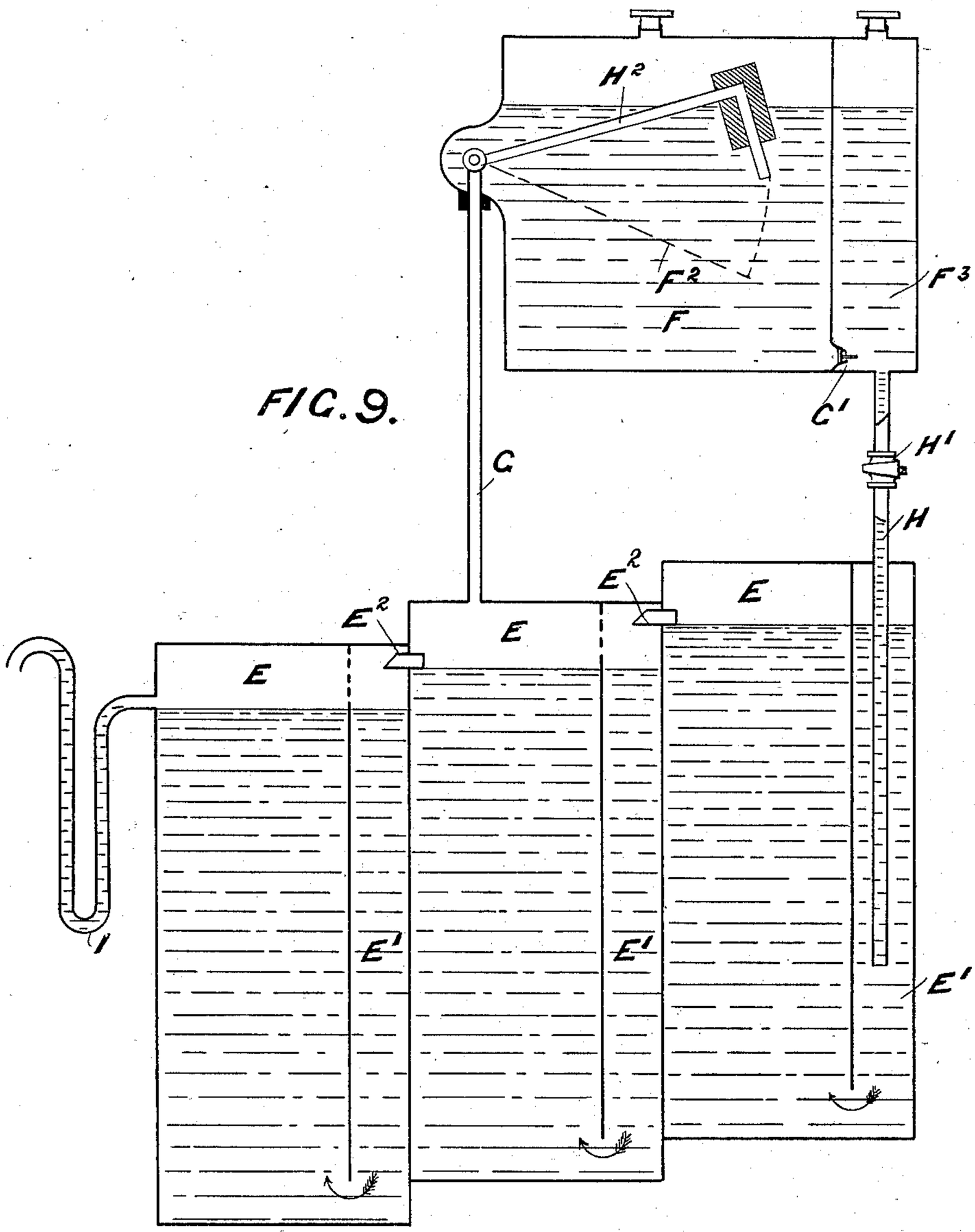
FIG. 9.



Witnesses:
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(No Model.)

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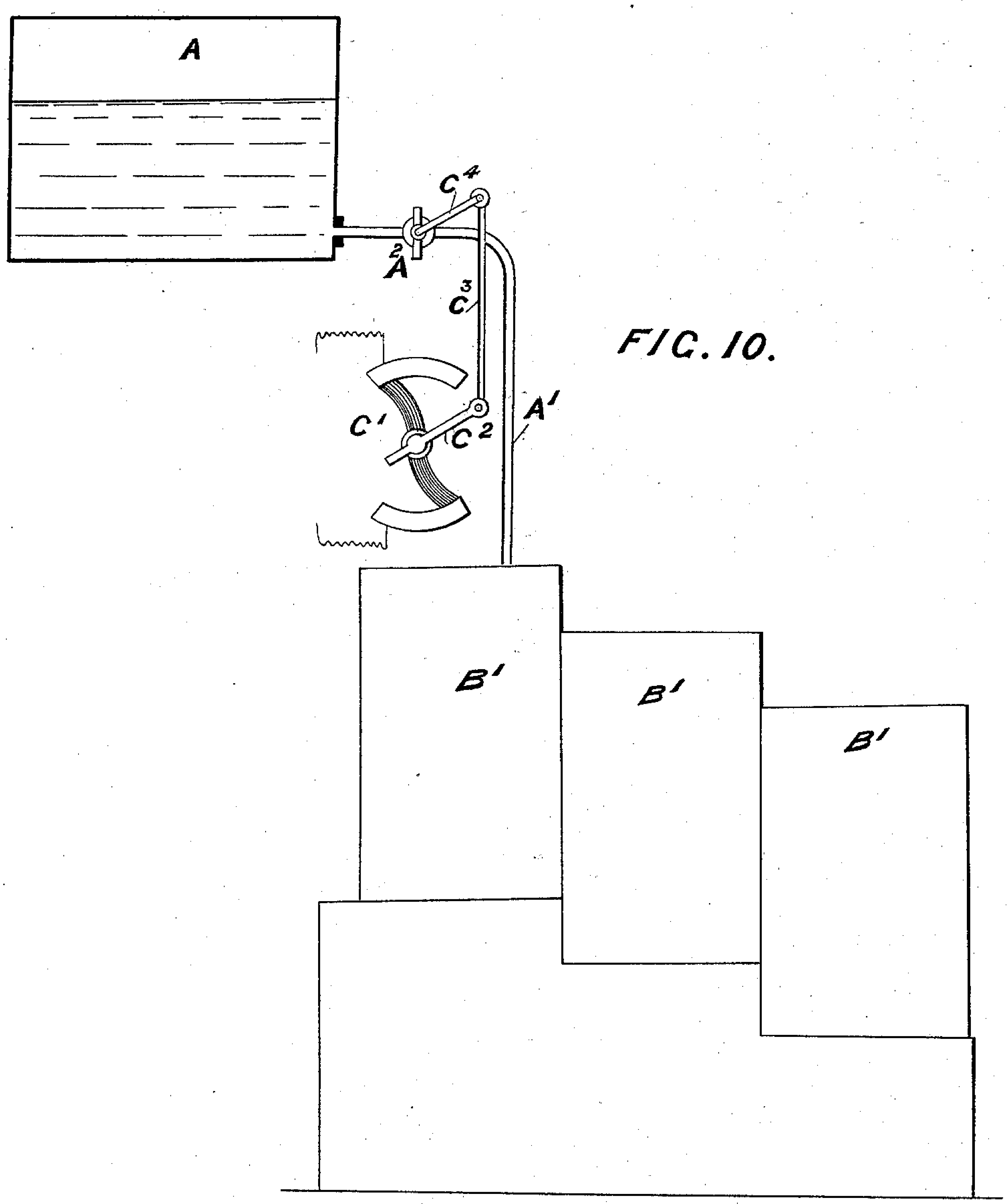

FIG. 10.

Witnesses:
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Inventor:
Walter Rowbotham
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his Attorneys.

UNITED STATES PATENT OFFICE.

WALTER ROWBOTHAM, OF LONDON, ENGLAND.

PRIMARY BATTERY.

SPECIFICATION forming part of Letters Patent No. 609,298, dated August 16, 1898.

Application filed February 24, 1898. Serial No. 671,504. (No model.)

To all whom it may concern:

Be it known that I, WALTER ROWBOTHAM, engineer, a subject of the Queen of Great Britain and Ireland, residing at 75 Bethune road, Stamford Hill, London, England, have invented certain new and useful Improvements in and Relating to Primary Electricity-Batteries, of which the following is a specification.

My invention relates to primary batteries; and my object is to produce an easily-manipulated primary battery capable of giving a large and constant output at a low cost per unit.

My invention consists in a new construction and arrangement of battery whereby local action is quite avoided when the battery is at rest and in details intended to permit of the battery being continuously charged and discharged of its working fluids while using iron instead of zinc for the active plates.

In carrying my invention into effect according to one modification I construct my battery as shown in the four accompanying sheets of drawings.

Figure 1 is a side elevation showing the step-by-step arrangement of the batteries. Fig. 2 is a plan corresponding to Fig. 1. Fig. 3 is a diagrammatic section showing the feed and other arrangements in connection with the depolarizing fluid. Fig. 4 is a transverse section through the active plates of the battery, showing the arrangement of the carbons within their porous tubes. Fig. 5 is a section at right angles to the preceding figure on the line *a b*, Fig. 4. Fig. 6 is a section on the line *c d*, Fig. 5, or *c d*, Fig. 7. Fig. 7 is a sectional plan on the line *e f*, Fig. 6. Fig. 8 is an elevation of the outside of the partition with the cover removed, showing the metallic connections which couple the ends of all the carbon rods to the terminals; and Fig. 9 is a section showing the operation of a modified method of absorbing acid fumes. Fig. 10 shows a diagrammatic view of my new battery with one form of apparatus for automatically preventing waste of the active electrodes by causing water to flow over them when the battery is on open circuit.

Each cell of the battery is divided into two compartments. One compartment, which is sealed so as to be gas-tight under some pressure, contains the exciting and depolarizing fluid, and the other, the active compartment, contains the electrodes, preferably of iron. The exciting and depolarizing liquid which I preferably use consists of a mixture of sulfuric and nitric acids with water. The sealed compartment carries projecting into the active compartment a number of porous tubes. These tubes contain within them carbon rods, and the carbon rods are connected at the ends to metal connections leading to one terminal or set of terminals. The active plates or electrodes consist of iron, and they pass between the different rows of tubes in the active compartment. The active compartment is fed with pure water, while the sealed compartment is supplied with an exciting and depolarizing fluid, as mentioned. When the battery is in action, the flow of water through the active compartment is reduced or stopped, and so the acid diffusing through the porous tubes from the sealed compartment acidulates the water and causes the solution to act upon the iron plates and generate current. As the current is taken from the cell nitrous gases or fumes are generated from the nitric acid in the depolarizing fluid, and these fumes cause some pressure within the closed compartment. With increase of current increased volumes of nitrous fumes are generated, which increase the pressure, and so the amount of acid sent through the porous tubes increases with increased demand upon the battery. The nitrous fumes are collected by a pipe and passed through an acid-trap at the upper part of an acid-reservoir, which reservoir is in communication with the sealed compartments. The fumes are absorbed in the acid-reservoir and assist in strengthening the acid solution to assist in depolarizing.

In Fig. 1 I have shown a series of three cells, one mounted above the other, and each cell leading to the next lower one by a pipe.

In Fig. 1, A A A are the active compartments, each having a division and a second compartment A′. The water passes by pipes A^2 from vessel to vessel, finally discharging at a similar pipe A^2 after having completed the course of all the cells. In passing from cell to cell the water drops through an airspace in each case, and so no electric communication is made by the water from one cell

to another, and in each case the water has to pass down to the bottom of the partition, so that it enters at the bottom of the active division A, and thus tends to displace the whole of the contents by a discharge-pipe A^2 into the next cell or away altogether.

In Fig. 3 I have shown diagrammatically the course of the exciting and depolarizing fluids through the sealed compartments E. The action is as follows: The exciting and depolarizing fluid is contained in the large reservoir F. It flows through the pipe H by way of the regulating-tap H′. It passes down to the bottom of the chamber E′ and around the partition into E, as shown by the arrows. Then it displaces the acid already in the space and causes it to drop by way of the pipes E^2 into the succeeding spaces E′. The acid after performing its work is finally discharged by the siphon arrangement I, which provides for keeping the whole of the contents of the compartments E under any desired pressure. A pipe G leads from the upper part of one of the compartments E, and the nitrous fumes generated in the depolarizing fluid by the action of the battery ascend the pipe G and enter an acid-trap F′. The fumes are absorbed in the acid there or bubble under a partition and are absorbed in the acid in the main body of the reservoir. The acid fed to the battery is thus strengthened by the nitrous fumes added to it as it flows in. At the same time the pressure generated within the sealed compartments E forces the acid through the porous tubes and renders the solution in contact with the active plates capable of exciting the current and acting on those plates. This arrangement has also the advantage of preventing the evolution of nitrous fumes into the air.

In a modification of the arrangement for absorbing nitrous fumes I provide the devices shown diagrammatically at Fig. 9. Here I construct a reservoir F, divided into two compartments F^2 F^3. One compartment F^2 is considerably larger than the other. I find that five volumes to one volume is a working proportion; but I do not confine myself to that proportion. The large compartment I fill with a mixture of sulfuric acid and water. A suitable mixture is seventy per cent. H_2SO_4 and thirty per cent. water. The smaller compartment I fill with nitric acid, sulfuric acid, and water, a suitable proportion being HNO_3, eighteen per cent.; H_2SO_4, fifteen per cent., and water fifty-eight per cent. The compartments communicate by a valve, as G′, which closes toward F^3. The compartment F^2 is filled to a greater extent than F^3, and the pressure closes the valve. The battery is fed at first from the smaller compartment; but the nitrous fumes rise by way of the pipe G, bubble through the pivoted float H^2, as shown, and nitrate the sulfuric-acid mixture. After a time the pressure rises in F^3 and acid passes by way of the valve G′ to the compartment F^2, and thence to the battery. The float H^2 follows the falling level of the acid in F^3, and so the nitrous fumes are continuously bubbled through the liquid at a constant pressure.

By this method of operating I save a large quantity of nitric acid. The float device is very convenient, as it permits the gases to pass through at constant pressure.

I so arrange my water-supply connections that when the battery ceases acting—that is, when current is no longer taken from it—the water supply at once increases. This may be done in a variety of ways.

Figure 10 shows, diagrammatically, the step-by-step arrangement of batteries and the cistern for supply of water. A is the cistern for the supply of water, which may be kept full by the usual ball-cock arrangement. The water flows from it by means of a pipe A′ and a cock A^2 into the batteries B′. The cock A^2 is controlled by the switch C′ through an arm C^2, connecting-rod C^3, and an arm C^4, so that when switch C′ is operated to break the battery-circuit the cock A^2 will be opened to a greater or less extent, as desired. In this way when the battery-circuit is broken a fairly large volume of water is caused to flow through the battery, replacing the solution around the active elements, and thus preventing action on the active elements when no current is being taken from the battery. When the switch C′ is closed, the cock A^2 is also closed, and the battery goes into action, as before, by the percolation of the acid through the porous cells and its diffusion in the water around the active elements. The increased current of water at once washes away all acid which has been forced through the porous tubes and thus stops local action upon the active plates. At the same time when the battery stops the gases within the closed cell become absorbed in the acid and the pressure falls until the battery is again started.

In the drawings Figs. 4, 5, 6, 7, and 8 I have clearly shown the arrangement of the porous tubes, the carbon rods, and the metal plates. I have also shown clearly the water and acid admission pipes and the two compartments with partitions. The active compartment containing the iron plates and the water is marked on these drawings A, and opening into it is a smaller compartment A′, fed with water by the tube A^2.

The battery-plates are marked B and the carbon rods C, while the porous tubes are marked D. The porous tubes are firmly cemented into two partitions, (shown clearly in Fig. 5,) and thereby no acid finds its way from the closed compartment E to the active compartment A except through the pores of the porous tubes. The carbon rods C pass through one of the partitions, and metallic connection is made between all of them by the metal plates or strips C^2, which are all connected together, as shown at Fig. 8, and carried to the terminals C′. The plates C^2 are embedded in cement and closed up by an outer cover. This outer cover is clearly seen in Fig. 5. By

these arrangements whenever the battery is put in action more and more acid finds its way into the active part containing water because of the increase of pressure due to the production of nitrous fumes, and as the current taken increases the water flow is diminished, so that the solution becomes stronger at its active part.

In the drawings I have shown plate anodes of iron; but in some cases I use turnings or scrap-iron contained within a metal case, such as a lead case. This case is perforated with holes, and it serves as a current-collector, collecting current from turnings of scrap metal contained within it. Other metals may be used for this current-collector. Sometimes for my exciting and depolarizing fluid I use water saturated with chlorin gas, to which sometimes a little hydrochloric or other acid has been added.

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

1. A primary battery comprising a plurality of cells having each an open and a closed compartment, porous tubes extending through the open compartment and opening into the closed compartment, the negative-electrode rods located in said tubes, a closed tank for the exciting and depolarizing fluid having flow and return pipe connections to the closed compartments, and means for supplying water to the open compartments, substantially as described.

2. A primary battery comprising a plurality of cells having each an open and a closed compartment, with the compartments of each cell communicating with the complemental compartments of the next succeeding cell, porous tubes extending through each open compartment and opening into each closed compartment, a closed tank for the exciting and depolarizing fluid having flow and return pipe connections to the closed chambers of the first and last cells of the series and a water-supply to the open compartment of the first cell of the series, substantially as described.

3. A primary battery comprising a plurality of cells having each an open and a closed compartment, said closed compartments being in communication with each other, porous tubes in each open compartment opening only into the closed compartments, carbon rods in said tubes, a tank for exciting and depolarizing fluid having pipe connections to the first and last closed compartments of the series, a water-supply to the first open compartment of the series, a passage from the open compartment of each cell opening into the next succeeding cell above the water-line thereof, a switch included in the electric circuit from said battery, and means for controlling the flow of water from said water-supply, said means being operatively connected with the switch whereby the operation of the switch controls the water-supply, substantially as described.

4. A primary battery comprising a plurality of cells having each an open and a closed compartment in communication with the complemental compartments of the next succeeding cell, porous tubes in the open compartments opening only into the closed compartments, a water-supply for said open compartments, a closed tank for the exciting and depolarizing fluid opening, a partition dividing said tank into two compartments, a pipe from one of said compartments to the closed compartment of the first cell, and a pipe from the other compartment to the closed compartment of the last cell of the series, substantially as described.

In witness whereof I have hereunto set my hand in presence of two witnesses.

WALTER ROWBOTHAM.

Witnesses:

WILLIAM EDWARD EVANS,

ALBERT EDWARD PARKER.