No. 665,784. Patented Jan. 8, 1901.

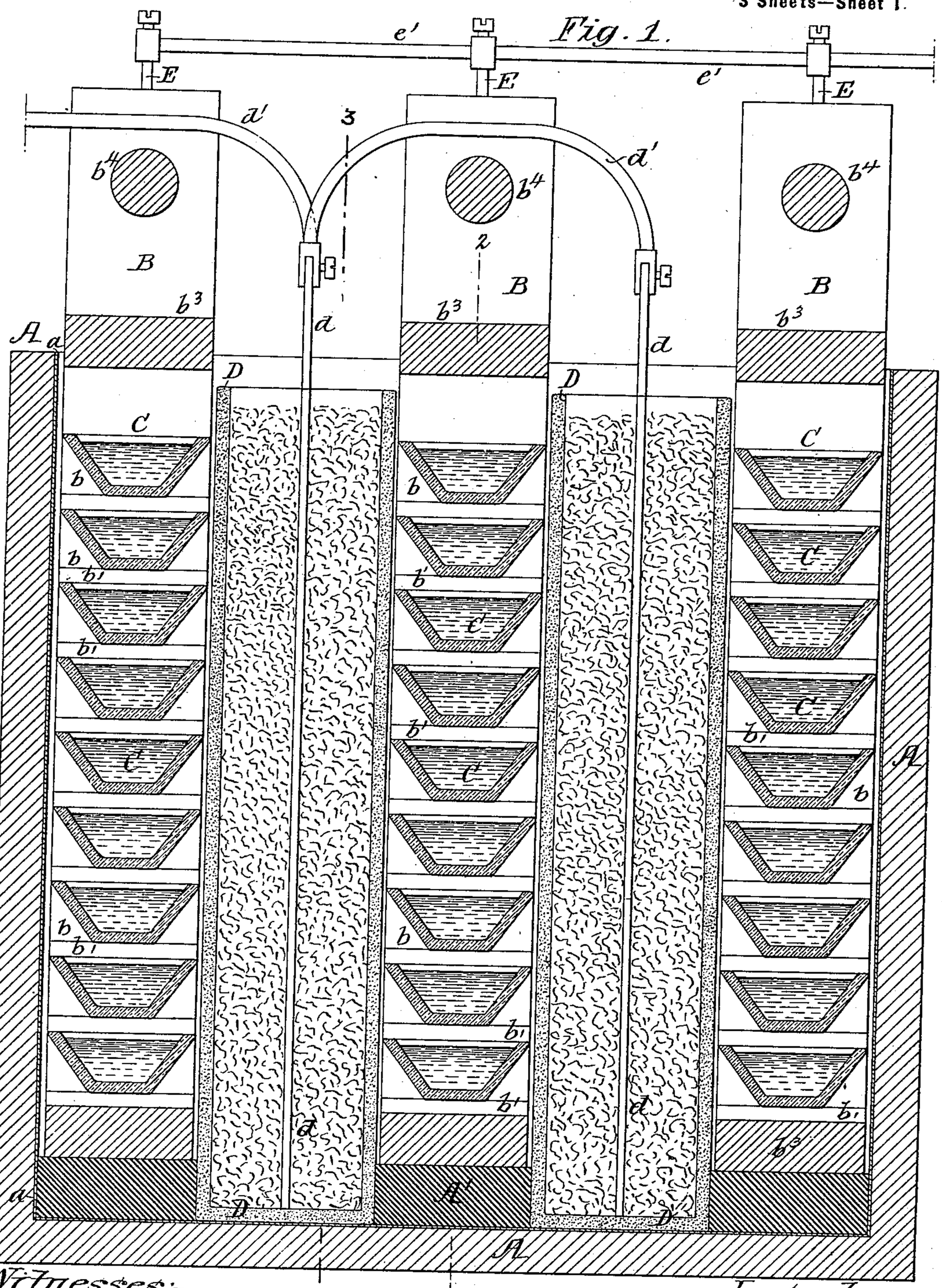
H. K. HESS.

APPARATUS FOR REGENERATING SPENT ELEMENTS OF PRIMARY BATTERIES.

(Application filed Aug. 9, 1899.)

(No Model.) 3 Sheets—Sheet 1.

Fig. 1.



Witnesses:-
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Fig. 2.

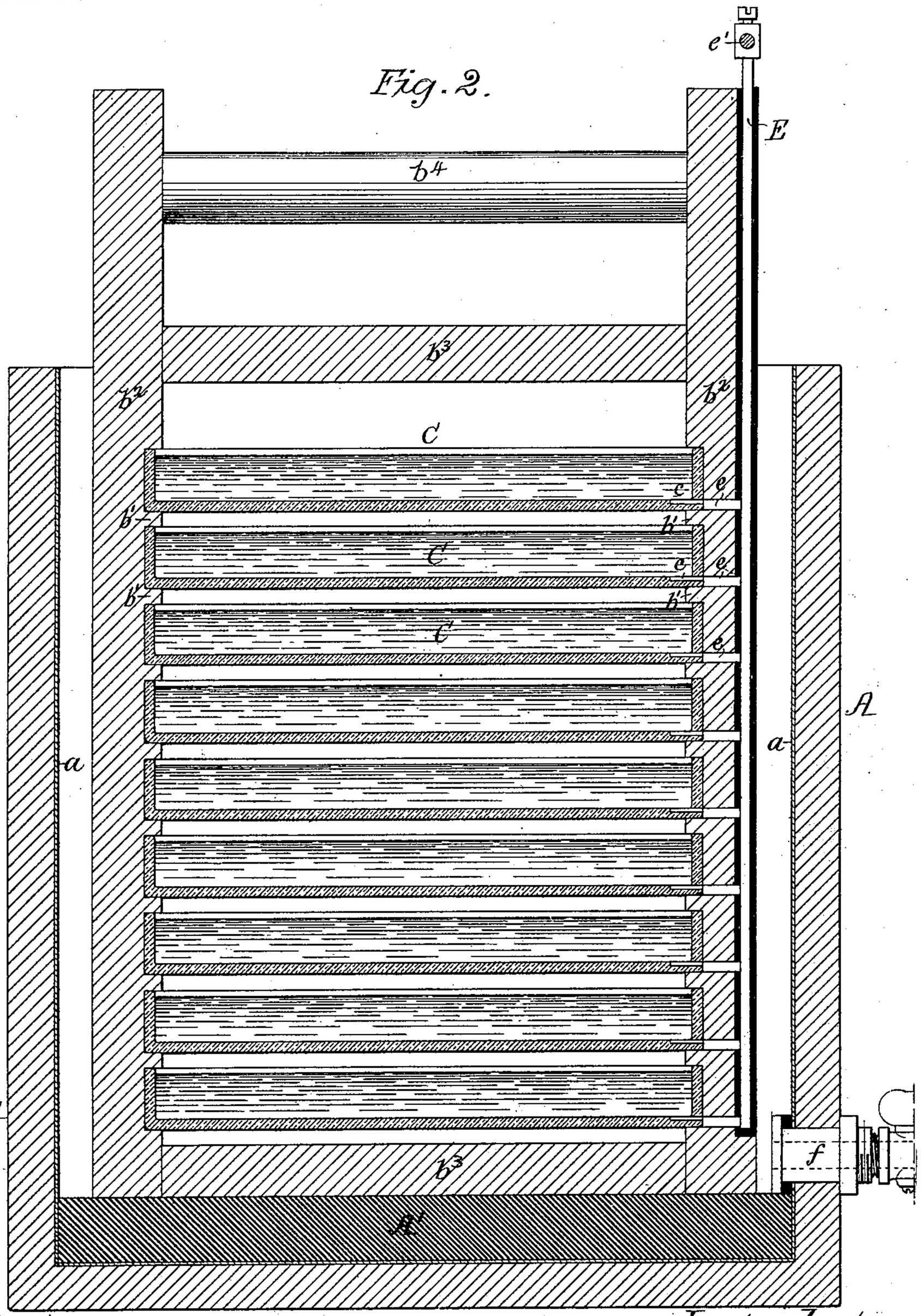

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Fig. 4.

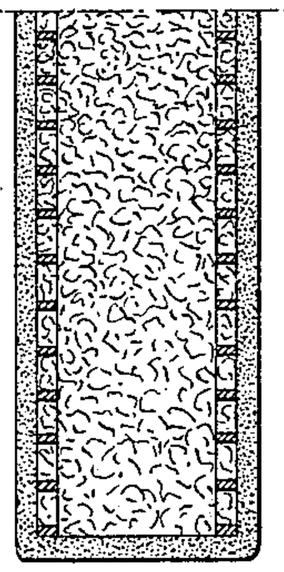


Fig. 3.

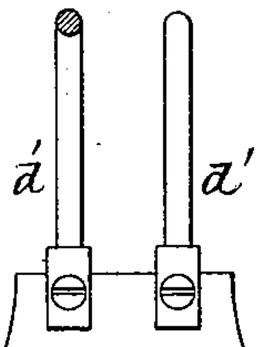
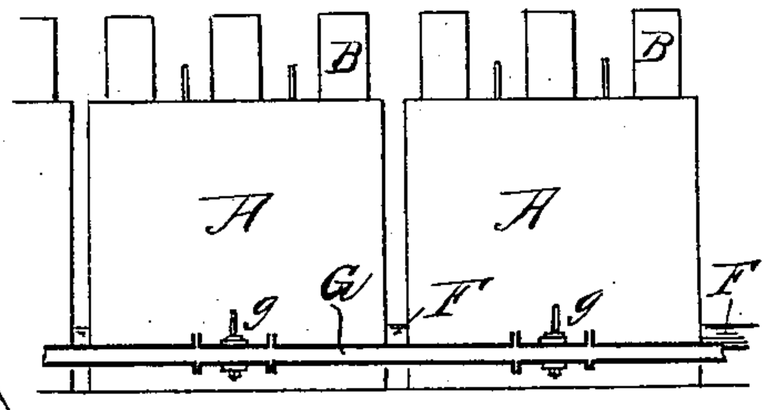
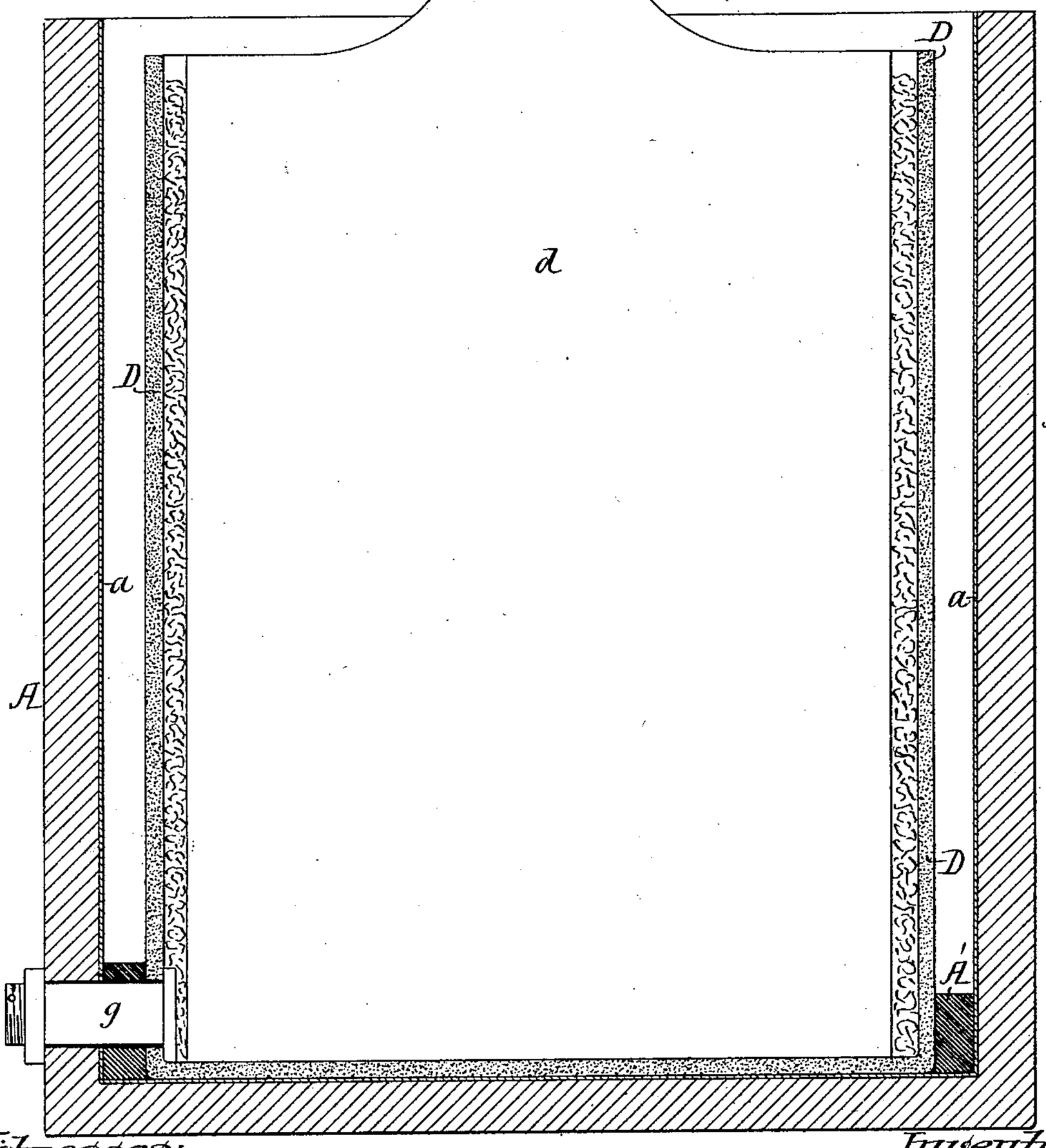


Fig. 5.





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UNITED STATES PATENT OFFICE.

HENRY K. HESS, OF PHILADELPHIA, PENNSYLVANIA, ASSIGNOR TO HERMAN J. DERCUM, TRUSTEE, OF SAME PLACE.

APPARATUS FOR REGENERATING SPENT ELEMENTS OF PRIMARY BATTERIES.

SPECIFICATION forming part of Letters Patent No. 665,784, dated January 8, 1901.

Application filed August 9, 1899. Serial No. 726,663. (No model.)

To all whom it may concern:

Be it known that I, HENRY K. HESS, a citizen of the United States, residing in Philadelphia, Pennsylvania, have invented certain Improvements in Apparatus for Regenerating Spent Elements of Primary Batteries, of which the following is a specification.

My invention consists in an improved apparatus for the regeneration of the elements consumed by the generation of electricity in a primary battery.

In the accompanying drawings, Figure 1 is a sectional view of one form of my improved apparatus. Fig. 2 is a sectional view on the line 2 2, Fig. 1. Fig. 3 is a sectional view on the line 3 3, Fig. 1. Fig. 4 is a view of a modified arrangement of the porous cup and the conductors, and Fig. 5 is a view showing a series of containers.

My invention relates particularly to apparatus for the regeneration of the elements used in a two-liquid primary battery in which dilute sulfuric acid is the electrolyte contained in one compartment, and the depolarizing agent, such as chromic acid, is contained in another compartment. The partitions in this battery are in the form of carbon plates, which act as one terminal, while zinc plates are immersed in the electrolyte of dilute sulfuric acid, forming the other terminal. It is customary to throw away the spent liquors and the exhausted materials in this form of battery, as it is not practical to restore a primary cell by electrolysis where carbons are used in view of the disintegrating effect of the electrolytic oxygen on the carbon, and it is not practical to restore a primary battery by electrolysis when acid is used as the electrolyte with carbon and zinc electrodes, as the free acid generated reacts on the zinc and consumes the same as it is deposited. By my invention I provide an independent regenerator, in which the spent liquors, with the decomposed zinc, are placed, so that when the electric current from the dynamo or other suitable source of electric energy is passed through the regenerator the chromic and sulfuric acids will be regenerated and the zinc will be collected in suitable pans, as fully described hereinafter.

Referring to the drawings, A is a container, preferably lined with sheet-lead *a*. This container may be made of wood or other suitable material, and mounted within the same are racks B, three in the present instance. These racks being grooved at *b* form ledges *b'*, on which rest the removable trays C, containing mercury. These trays are preferably formed as shown in Fig. 1, having inclined sides and flat bottoms, so as to form a space for the liquid above each tray. The trays may be made in other shapes without departing from the main feature of my invention, and they may be of any suitable non-conducting material not affected by the acid—such, for instance, as porcelain.

In one end of each tray is a conductor *c*, which is in contact with the mercury in the tray when the tray is in place, and it is also in contact with a branch conductor *e* of the conducting-wire E, secured in any suitable manner to the side of each rack. This conductor E is thoroughly protected, as illustrated in Fig. 2, to prevent the deposition of metal thereon during regeneration. Mercury is placed in the trays, as shown in Fig. 1. The rack in the present instance is made of wood protected from the action of the acid and consists of two side members b^2 and two cross-pieces b^3, one at the top and the other at the bottom, and a handle b^4, so that the rack can be removed bodily from the container A and the trays removed from one side and their contents discharged, after which they can be replaced. In some instances the trays may be fixed to the racks, in which case the rack is simply tilted so as to discharge the mercury and the zinc held therein, and the racks can then be refilled with mercury and replaced.

Alternating with the racks are porous vessels D, in which is placed granular lead or lead-scrap and a central conducting-plate *d*, preferably of sheet-lead, by which a large active surface is obtained for the regeneration of the exhausted chromium. In some cases perforated lead grids may be used in close proximity to the sides of the porous vessel and granular lead filled in between, as shown in Fig. 4. The conducting-plates *d* are con-

nected together by conductors d', and the several conducting-wires are connected together by conductors e'. These conductors d' and e' are connected to the dynamo or other source of electric energy.

The zinc-sulfate solution is placed in the container A, while the reduced chrome liquor is placed in the porous vessels D, the tray C being previously filled with mercury, and when the elements are subjected to the action of an electric current the reduced chromium liquid will be reoxidized and the zinc will be precipitated or deposited into the trays containing mercury, and the mercury therein will protect the zinc from the action of the free sulfuric acid generated. When this charge is generated, the racks containing the trays are removed and the mercury and zinc discharged therefrom and the trays refilled.

In obtaining the amalgam of zinc and mercury it is not contemplated having to effect a perfect separation and the extraction of a zinc free from mercury. The pasty amalgam is to be pressed and mechanically freed from the excess of mercury. The amalgam may be pressed into plates of amalgamated zinc suitable for use in a battery, if desired.

The porous vessels may be removed from the container and discharged and emptied, and the container may also be emptied; but in order to facilitate the operation I provide a discharge-pipe f, opening into the container A, so that the free sulfuric acid may be discharged therefrom, and I provide a discharge-pipe g for each of the porous vessels to discharge the reduced chrome. This discharge-pipe is preferably insulated from the container A and the electrolyte therein.

When a permanent structure is made, I preferably embed the porous vessel and pipe connections in a body of asphalt A′ in the bottom of the container A, so that the vessels are held permanently in position and the racks and their trays can be readily removed and replaced at will. The racks rest directly upon the asphalt in the bottom of the container.

When the regeneration is carried on on a large scale, I may fill the container and the porous vessels through the pipes f and g, as well as discharge the regenerated liquid therefrom. The pipes $f\,f$ are coupled to a main F at the side of the container, and the pipes $g\,g$ are coupled to a main G at the opposite side of the container, as shown in Fig. 5. Stop-valves are provided at each connection, as shown in Fig. 2. The mains F and G are preferably made of non-conducting material, such as porcelain, or may have non-conducting linings.

I claim as my invention—

1. The combination of a container, a series of porous vessels mounted therein, an anode of spongy or other finely-divided lead in each porous vessel, a conducting-plate embedded in the lead anode, removable racks, trays mounted in the racks, said trays containing mercury, and a conductor coupled to the trays and in contact with the mercury therein, substantially as described.

2. The combination of a container, a porous vessel therein, an anode of spongy or other finely-divided lead within the porous vessel, a conducting-plate embedded within the lead anode, a removable rack mounted in the container and having ledges, with trays resting on the ledges and removable therefrom, and a conductor in electrical contact with the mercury within the trays, substantially as described.

3. The combination of a container, a series of porous vessels, spongy or other finely-divided lead therein, a conductor embedded within the lead and connected to one terminal of an electrical generator, a series of racks alternating with the porous vessels and having ledges, a series of trays mounted on the ledges, said trays containing mercury, an electrical conductor at each tray in contact with the mercury and an electrical conductor on the rack in contact with the conductors of the trays, substantially as described.

4. The combination of a container, a porous vessel within the container, a pipe communicating with the bottom of the container and a pipe communicating with the bottom of the porous vessel, an electrical conductor within the porous vessel, and a mercury-tray within the container, the mercury being connected to one terminal of an electric generator and the contents of the porous vessel being connected to the other terminal of an electric generator, substantially as described.

5. The combination of a container having a lead lining, and a body of asphalt in the bottom of the container, porous vessels having their lower portions embedded in the asphalt, a series of racks alternating with the porous vessels and removable from the container, trays containing mercury carried by the racks, conductors on the racks in contact with the mercury in the trays, and a conductor within the porous vessels, substantially as described.

6. The combination in a regenerating apparatus, of a series of containers, porous vessels within the containers, a lead anode in each porous vessel trays also within the containers, mercury in said trays, electrical conductors in contact with the mercury, inlet-pipes communicating with the porous vessels, inlet-pipes communicating with the containers, feed and discharge pipes at the side of the series of containers, one pipe connecting with the several containers, the other pipe connecting with the several porous vessels, the pipes being insulated in such a manner that there will be no electrical connection between the several containers through the pipes, substantially as described.

7. The combination in a regenerator, of a container, a porous vessel therein, a lead anode in the porous vessel a series of trays

within the container one mounted above another, said trays containing mercury, and electrical conductors in contact with the mercury, the sides of the trays being inclined so as to form a space for the liquid above each tray, substantially as described.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

HENRY K. HESS.

Witnesses:
WILL. A. BARR,
JOS. H. KLEIN.