E. J. KNAPP & E. D. McLAUGHLIN.

STORAGE BATTERY.

APPLICATION FILED MAR. 28, 1910.

990,274.

Patented Apr. 25, 1911.

2 SHEETS—SHEET 1.

Fig. 1.

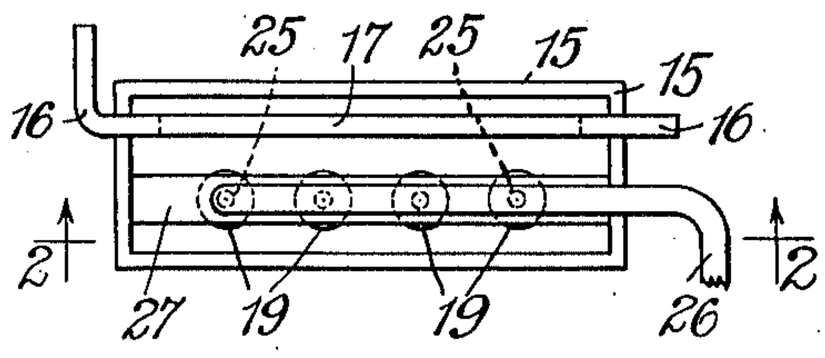


Fig. 4.

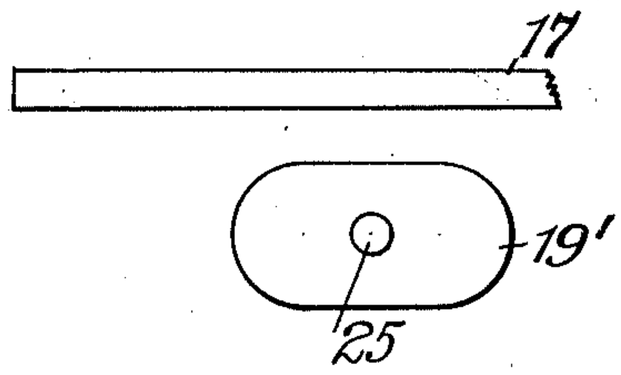


Fig. 3.

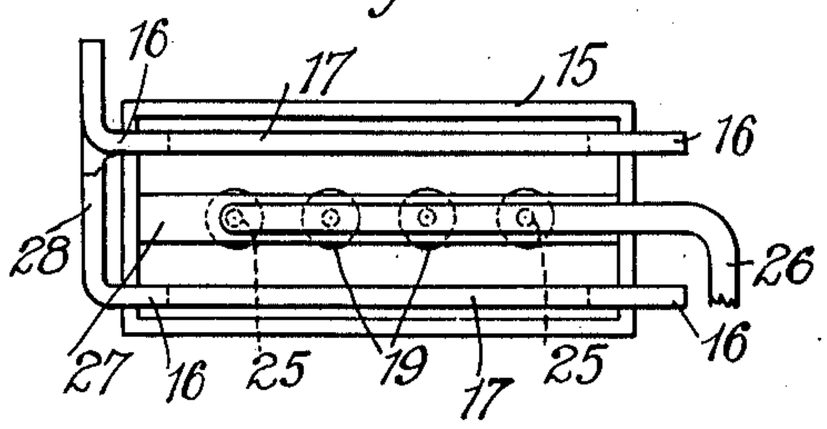


Fig. 5.

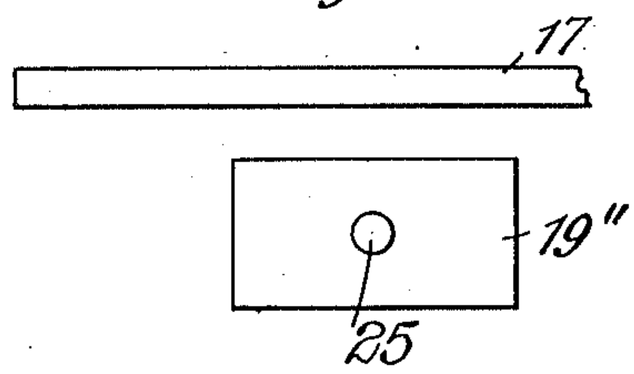


Fig. 2.

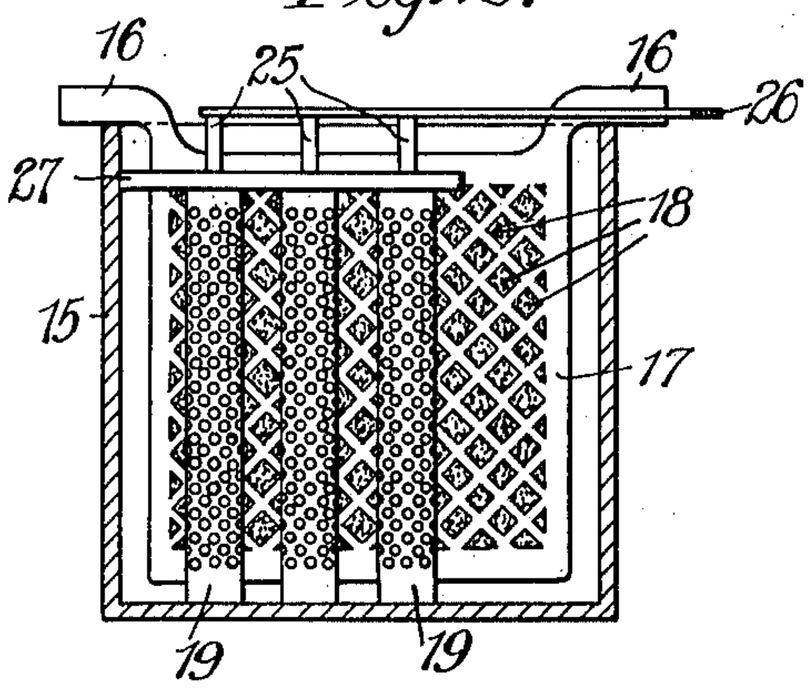
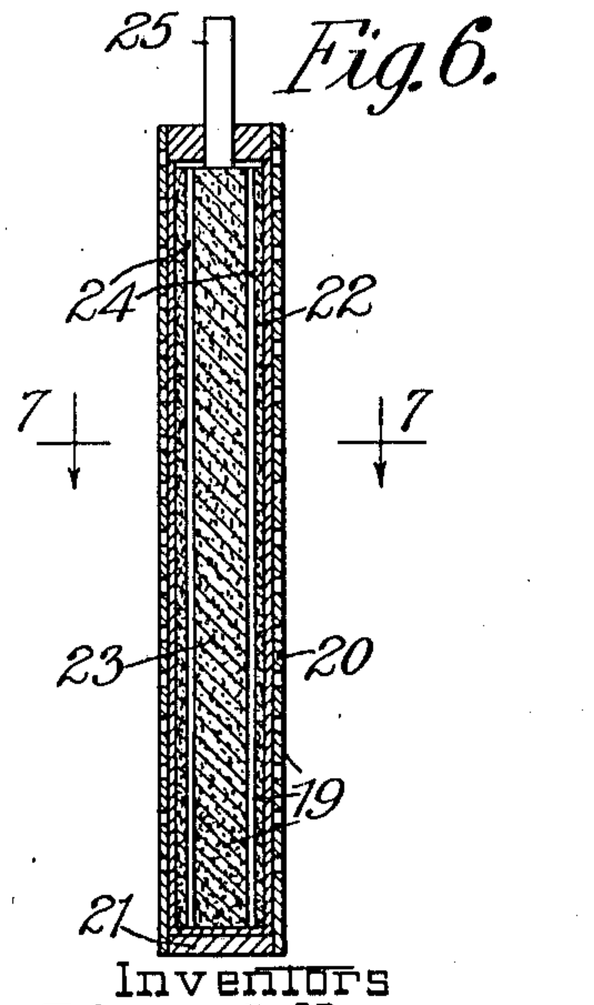


Fig. 6.



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2 SHEETS—SHEET 2.

Fig. 7.

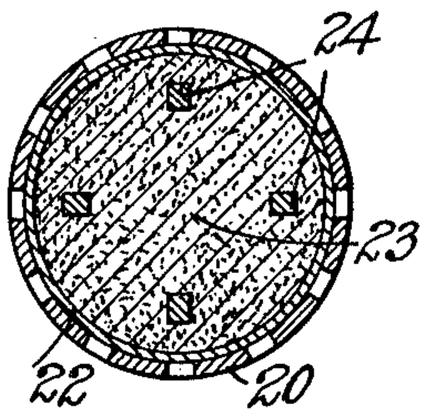

Fig. 8.

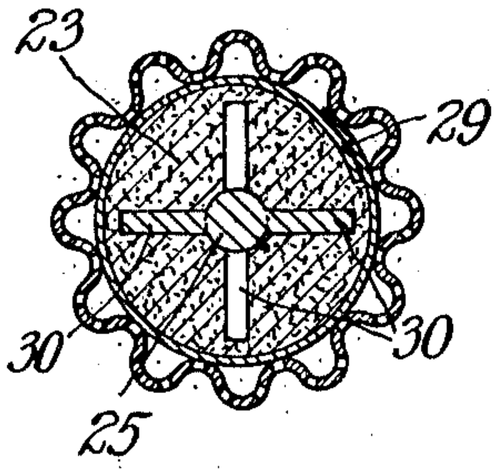

Fig. 9.

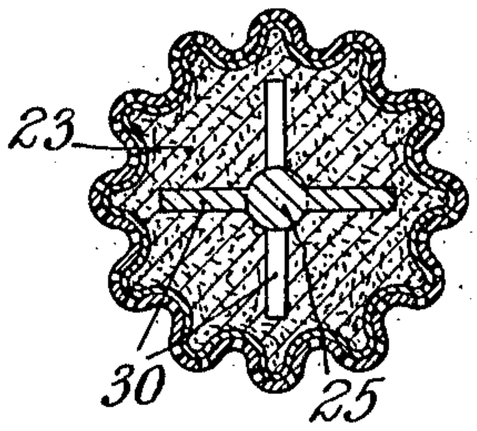

Fig. 10.

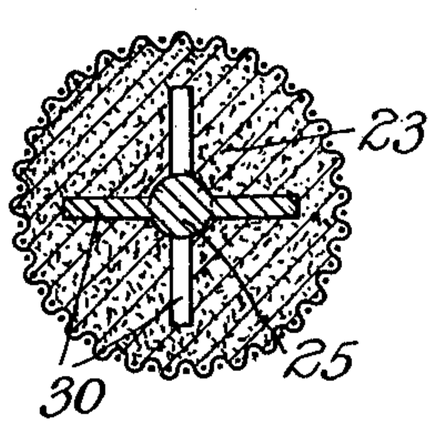

Fig. 11.

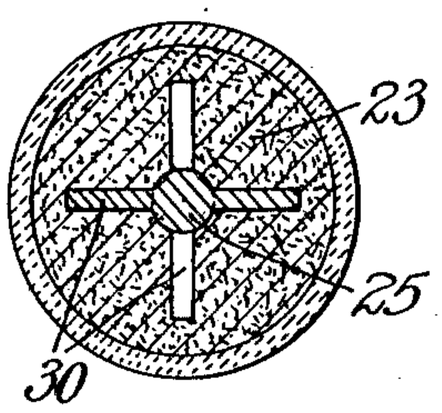

Fig. 14.

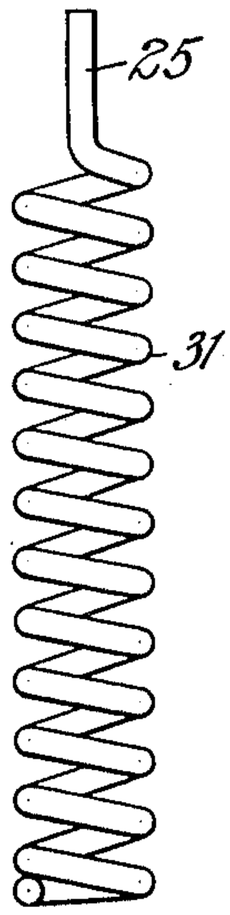

Fig. 12.

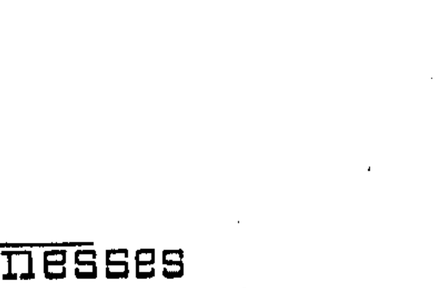

Fig. 13.

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UNITED STATES PATENT OFFICE.

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STORAGE BATTERY.

990,274. Specification of Letters Patent. **Patented Apr. 25, 1911.**

Application filed March 28, 1910. Serial No. 552,106.

To all whom it may concern:

Be it known that we, EDGAR JONAS KNAPP and EDWARD DANIEL MCLAUGHLIN, citizens of the United States, residing at Milwaukee, in the county of Milwaukee and State of Wisconsin, have invented a certain new and useful Improvement in Storage Batteries, of which the following is a full, clear, concise, and exact description, reference being had to the accompanying drawings, forming a part of this specification.

Our invention relates to electrical batteries, particularly secondary or storage batteries, and resides in improved features of construction and arrangement for the purpose of increasing the accumulative efficiency, and to provide a structure which will admit of building such batteries of different capacities along the same general lines and without proportionately increasing all the dimensions of the device. To the ends above pointed out, we provide an electrode in the form of a unit, any number of which may be provided in association with a corresponding and opposite blanket electrode to secure any desired capacity. It is, of course, well known that, outside of the character of the electrodes, the porosity thereof, the density of the electrolyte, and the temperature, the capacity of a secondary or storage battery depends on and varies directly with the area of the electrodes exposed to the action of the electrolyte. Relying upon this fact, we provide, as one of the electrodes, an arrangement comprising one or more structural units, all preferably of the same size and construction, and associate with this arrangement an opposite electrode sufficient in size to give a corresponding exposure to the electrolyte. In this way we provide a definite plan of construction which may be followed out to secure any desired capacity without changing more than one dimension of the containing vessel. This dimension varies with the number of units employed, and, consequently, with the size of the associated blanket electrode. The arrangement is a simple one, and such that an accumulator of high efficiency is obtained.

Our invention is embodied in the structures shown in the accompanying drawings, in which—

Figure 1 is a plan view thereof; Fig. 2 is a vertical sectional view taken on the line 2—2 of Fig. 1, one of the units being removed to show more of the opposite electrode; Fig. 3 is a view similar to Fig. 1, showing, however, two blanket electrodes instead of one; Fig. 4 is a view illustrating a modified form of unit; Fig. 5 is a view showing still another modified form of unit; Fig. 6 is a longitudinal sectional view of one of the units employed; Fig. 7 is a cross-sectional view taken on the line 7—7 of Fig. 6 and on a larger scale; Figs. 8, 9, 10, 11, 12 and 13 are views similar to Fig. 7, showing modified forms of the unit electrode, and Fig. 14 shows a modified form of core used in the unit electrode.

Referring first to Figs. 1, 2, 6 and 7, the vat or containing vessel, which is preferably of glass or rubber, or some other non-corrosive material, is shown at 15, being preferably rectangular in form. Disposed lengthwise in the vessel 15 and hanging from preferably integral lugs 16, 16, which rest on the top edges of the vessel, is a plate 17 in the form of a grid, which is adapted to carry the usual finely divided sponge lead formed into a paste by the use of some suitable liquid and filled in the grid, as indicated at 18. This member then becomes the negative electrode.

The positive electrode comprises one or more of the units indicated at 19, 19. Each of these units is preferably of substantially circular cross-section, although, as shown in Figs. 4 and 5, it may be of rectangular, elliptical, or some other cross-section, and comprises essentially means for mechanically retaining the comminuted lead in exposure to the electrolyte, this lead, in the charging of the battery, being changed to lead peroxid, as is well known.

It is necessary, of course, that the active material just referred to be contained in some such way that the electrolyte, which may be any proper substance, although preferably dilute sulfuric acid, may have proper and complete access thereto. To this end

we provide, first, a containing member sufficiently resistant mechanically to hold the comminuted material, and, secondly, a porous element whose sole function is to contain the comminuted material without primarily lending support thereto and without interfering with the passage of the electrolyte. In the form shown in Figs. 6 and 7, the positive electrode unit comprises a reticulated cylindrical shell of rubber, celluloid, cellulose, or any other non-corrosive substance having the proper inherent mechanical resistance. This reticulated shell is indicated at 20, and is preferably closed at the bottom by means of a plug 21 held rigidly in place in any suitable manner. The member which prevents the comminuted lead or lead peroxid from passing through the apertures in the shell 20 but which permits of the passage of the electrolyte is indicated at 22, and may be of canvas, paper, wood, asbestos, or any other non-corrosive material which is sufficiently porous for the purpose set forth. The containing member 22 may or may not, as desired, extend over the bottom 21. The comminuted lead or lead peroxid is indicated at 23, and the core 24, which may be of any suitable form, extends into this material, as clearly shown in Fig. 6. This core may be of pure lead, or may be chemically formed, if preferred, and, at its upper end, terminates in a rod 25, which extends upwardly and to which a connecting ribbon or other member 26 may be attached, as indicated in Figs. 1, 2 and 3. A wood strip 27 may be set in the containing vessel through which the studs or rods 25, 25 may pass, so that the units may be properly spaced apart.

All the units are connected together, as indicated in Figs. 1, 2 and 3, and the positive terminal of the battery thus results. The grid provided in association with these units is, preferably, of sufficient size to be at least co-extensive with the units, and we contemplate the preparation of a number of sizes of such grids, each size being adapted for association with a certain number of units and being quite indicative of the capacity of the battery which will result. When, as shown in Fig. 3, two grids are employed instead of one they are connected together by extensions 28, or in some other suitable manner to form a common terminal, which is the opposite or negative terminal of the battery.

In Fig. 8 we have shown a modified form of unit which provides for the expansion and contraction of the containing members due to temperature and other causes. In this modification the supporting container is fluted, while the porous container overlaps, as indicated at 29, and it is clear that these members may contract and expand within considerable limits without breakage. In this instance the core is shown as of a slightly modified form, the member 25 extending practically the entire length of the unit and being provided with radial arms 30, 30.

The structure of Fig. 9 is similar to that of Fig. 8, except that the porous container is also fluted to follow the contour of the supporting container, and it is apparent that the same result is secured.

In Fig. 10 we have shown a fine mesh metal screen which serves both purposes—that is, properly supporting the active material, and also preventing loss thereof while still admitting the electrolyte. In this case it would be necessary to use an alkaline electrolyte instead of an acid bath, for obvious reasons.

In Fig. 11 we provide one member which serves both purposes, in this case being of earthenware or other similar porous material.

In Fig. 12 we have shown both the supporting shell and the porous member overlapped to provide for expansion and contraction, as described relative to Figs. 8 and 9.

The structure of Fig. 13 is similar to that of Fig. 12, except that one edge of the supporting shell is slit to receive the other edge thereof, as indicated, to provide a more substantial connection.

In Figs. 9 to 13 the cores are similar to the core described and shown in Fig. 8.

In Fig. 14 we have shown a modified form of core, the member 25 extending from a coiled rod, indicated at 31.

We claim as new and desire to secure by Letters Patent:

1. In a storage battery, an electrode comprising a supporting member in the form of an over-lapping shell, an over-lapping porous container disposed inside said shell, and active material contained by said container.

2. In a storage battery, an electrode comprising a supporting member in the form of a substantially cylindrical shell, one edge of said shell being slit for the reception of the other edge, a porous containing member inside said shell, and active material contained by said porous member.

3. In a storage battery, an electrode comprising a container in the form of a substantially cylindrical shell, one edge of which is slitted for the reception of the other edge, and active material contained by said container.

4. In a storage battery, an electrode comprising a supporting member in the form of an expansible shell, an expansible porous container disposed inside said shell, and active material contained by said container.

5. In a storage battery, an electrode comprising a supporting member in the form of an over-lapping shell, an expansible porous

container disposed inside said shell, and active material contained by said container.

6. In a storage battery, an electrode comprising a supporting member in the form of an expansible shell, an overlapping porous container disposed in said shell, and active material contained by said container.

In witness whereof, we hereunto subscribe our names, this 21st day of March, A. D. 1910.

EDGAR JONAS KNAPP.
EDWARD DANIEL McLAUGHLIN.

Witnesses for both:
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FRANK E. SCUDDER.