No. 676,334. Patented June 11, 1901.

G. J. MILLER.

METHOD OF MAKING ELECTRODES FOR STORAGE BATTERIES, &c.

(Application filed Feb. 8, 1900.)

(No Model.)

FIG. I.

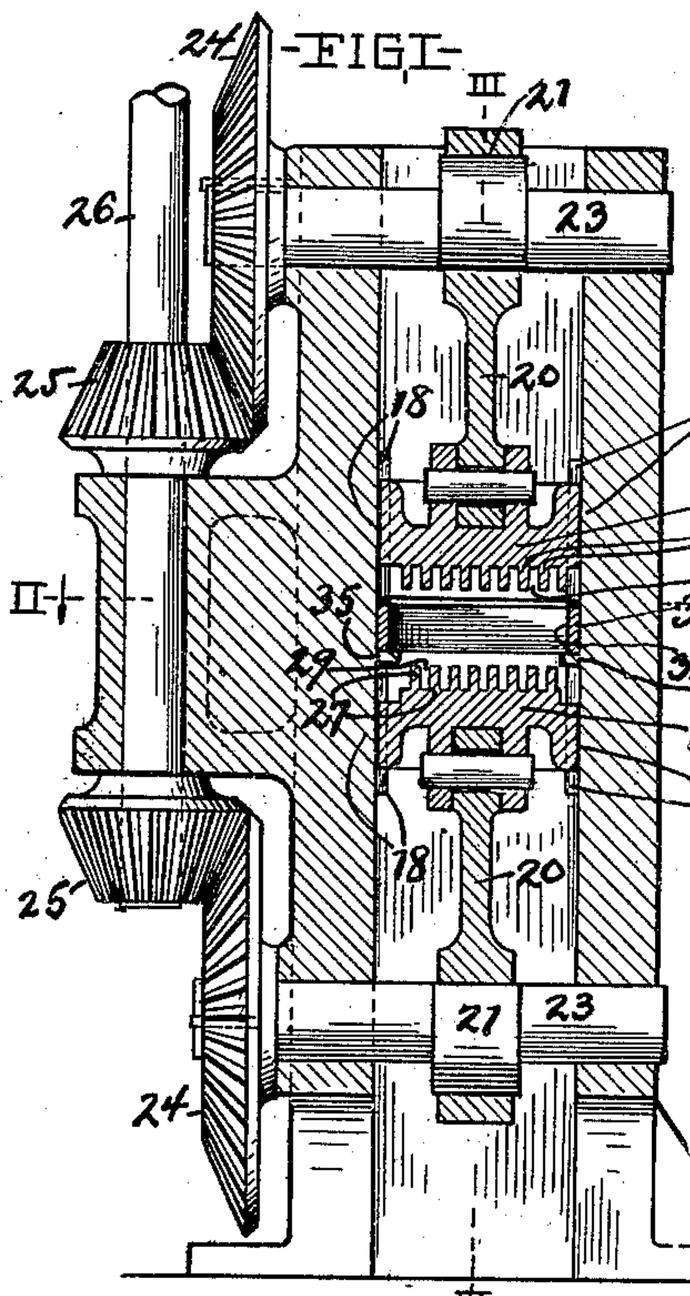


FIG. III.

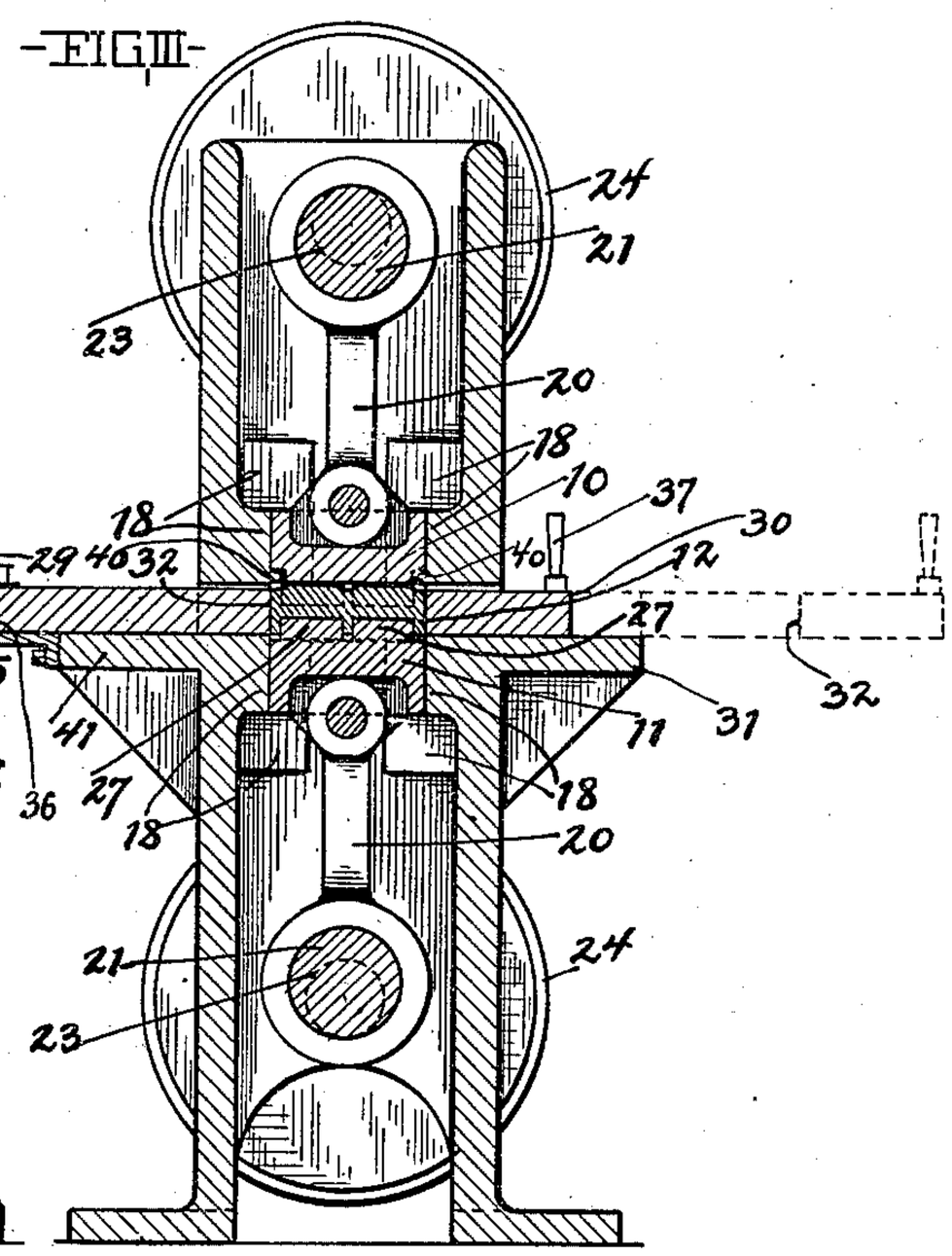


FIG. II.

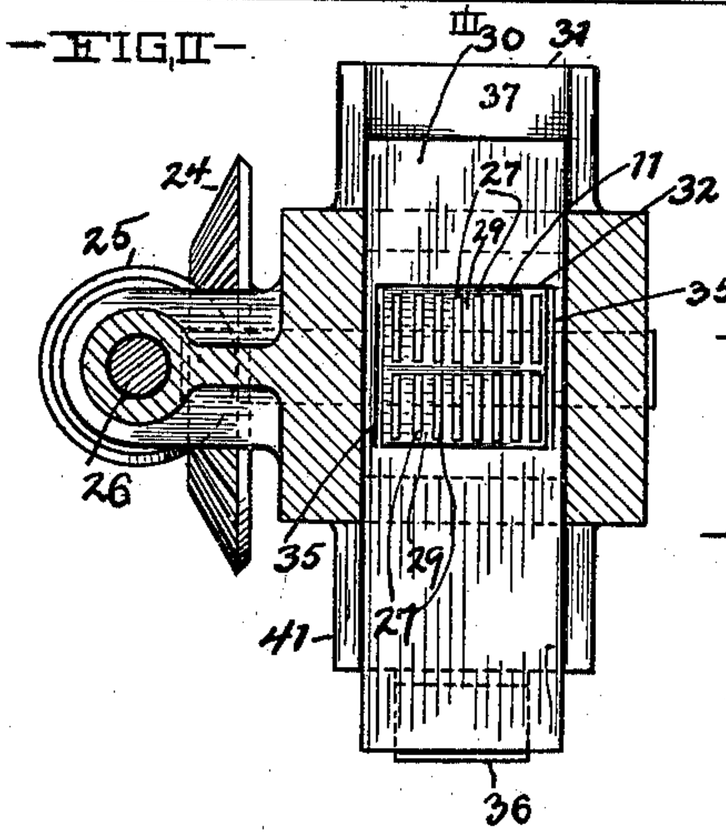


FIG. IV.

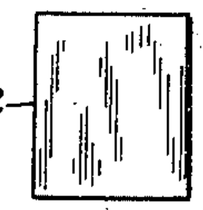


FIG. V.

FIG. VI.

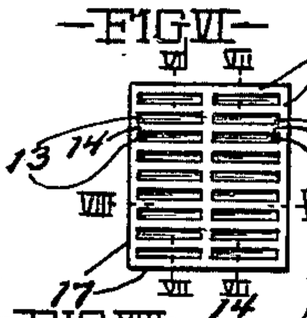


FIG. VII.

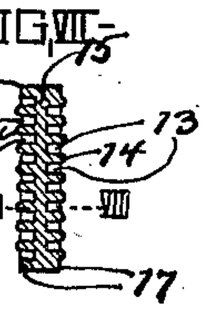


FIG. VIII.

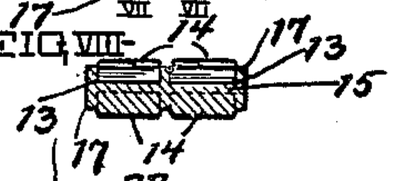
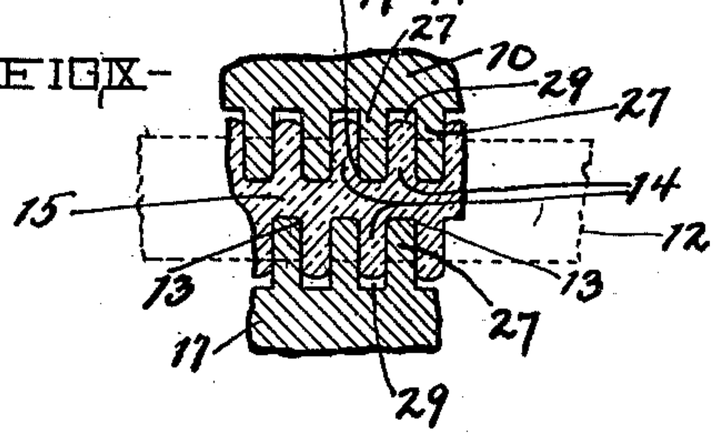


FIG. IX.



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UNITED STATES PATENT OFFICE.

GEORGE J. MILLER, OF KENTON, OHIO.

METHOD OF MAKING ELECTRODES FOR STORAGE BATTERIES, &c.

SPECIFICATION forming part of Letters Patent No. 676,334, dated June 11, 1901.

Application filed February 8, 1900. Serial No. 4,543. (No specimens.)

To all whom it may concern:

Be it known that I, GEORGE J. MILLER, a resident of Kenton, in the county of Hardin and State of Ohio, have invented a certain new and useful Method of Making Electrodes for Storage and other Batteries; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it pertains to make and use the same.

This invention relates to an improved method or process of making electrodes for use in storage or other batteries.

The primary object of this invention is to make an electrode of the character indicated that is exceedingly durable and inexpensive in construction, that has a large surface exposed to the active material of a battery of which the electrode is to form a part, that has each side thereof provided with numerous grooves, channels, or recesses alternating with the grooves, channels, or recesses formed in the plate's opposite side, and has the walls between the adjacent grooves or recesses upon each side of the plate enlarged laterally of the plate by material displaced from the opposite side of the plate.

With this object in view my invention consists in steps or peculiarities hereinafter described, and pointed out in the claims.

In the accompanying drawings, Figure I is an elevation, mostly in vertical section, of the machine suitable for use in carrying out my improved method. Fig. II is a top plan in section on line II II, Fig. I. Fig. III is a side elevation in vertical section on line III III, Fig. I, except that in Fig. III the coöperating plunger-heads are shown as having operated upon a blank introduced between them. Fig. IV is a side elevation of a blank adapted to be operated upon by the machine illustrated in the preceding figures. Fig. V is a lower end elevation of the blank. Fig. VI is a side elevation of an electrode produced by my improved method. Fig. VII is a longitudinal section on any one of lines VII VII, Fig. VI. Fig. VIII is a transverse section on line VIII VIII, Figs. VI and VII. Fig. IX is an enlarged sectional view more clearly showing the coöperation of the plungers of one of the plunger-heads with the alternating plungers of the other plunger-head.

A machine suitable for use in carrying out my improved method comprises two coöperating plunger-bearing heads or slides 10 and 11, movable simultaneously toward or from each other and arranged as required to render them capable of operating simultaneously upon opposite sides, respectively, of a blank-forming plate introduced between them.

A blank-forming plate 12 is shown in Figs. IV and V, wherein it will be observed that the blank consists of a quadrangular plate composed, preferably, of lead, because lead is non-corrosive and constitutes a good support for the active material in a battery of which the said electrode forms a part. An electrode-forming plate, into which the said blank is to be converted, is illustrated in Figs. VI, VII, and VIII, and is provided upon each side with a plurality of upright rows of horizontally-arranged channels, grooves, or recesses 13, that extend transversely of the plate. Each side of the electrode-forming plate illustrated is provided with two upright rows of grooves or recesses 13, and the grooves of each row of grooves or recesses are arranged close together, so that the partitions 14 formed between adjacent grooves or recesses of each row of grooves or recesses are not too thick. The main or central core, partition, or body portion 15 of the plate is compressed to toughen it; but the partitions or walls 14 between adjacent grooves or recesses of the several rows of grooves or recesses are preferably left untoughened, and are consequently composed of material that is less dense than the material composing the core or body portion of the plate. The plate illustrated has the grooves or recesses of each row of grooves or recesses upon each side of the plate alternating with the grooves or recesses of a row of grooves or recesses in the plate's opposite side. The electrode-forming plate has also a margin 17 extending along the edges of the plate and surrounding the grooved or recessed portion of the plate.

The two coöperating plunger slides or heads 10 and 11 are arranged, the one above the other, in the same vertical plane at the top and bottom, respectively, of the path of the work, and each plunger-head engages vertically-arranged slideways 18, formed upon the stationary framework of the machine. Each

plunger-head is operatively connected with the rod 20 of an eccentric 21, formed upon a shaft 23, that is arranged horizontally and at right angles to the path of the work and a suitable distance from the outer end of the head. The two shafts 23 and 23 are parallel, therefore, and supported from the upper portion and lower portion, respectively, of the stationary framework of the machine. Each shaft 23 is operatively provided at one and the same side of the machine with a bevel-gear 24, that corresponds with the bevel-gear 24 upon the other shaft. The two gears 24 and 24 mesh with different bevel-gears 25 and 25, respectively. The gears 25 and 25 correspond diametrically and are oppositely arranged and operatively mounted upon an upright shaft 26, that is driven in any approved manner. It will be observed that the throw of the eccentrics of both of the shafts 23 is the same, and that the said shafts are driven at the same speed, but in opposite directions, respectively, and that the two plunger-heads substantially correspond in construction, as will hereinafter more fully appear, and have the same relative arrangement to the work's path or space in which the blank is operated upon. Obviously, therefore, a blank-forming plate introduced between the inner and plunger-bearing ends of the heads 10 and 11 when the latter are separated has opposite sides thereof uniformly and simultaneously operated upon when the said heads are moved inwardly or toward each other into their extreme inner position, as shown in Fig. III. The upper or plunger-bearing end or face of the lower head 11 is shown in Fig. II, and the plunger-bearing face or end of the upper head 10 is arranged opposite to the said end of the lower head 11. Each plunger-head has as many rows of plungers 27 arranged transversely of the head as there are rows of grooves or recesses to be formed in each side of the blank, and the relative arrangement of the plungers of each row of plungers and the relative arrangement of the rows of plungers of each plunger-head are as required to render them capable of forming during one operation all of the grooves or recesses required to be formed in a side of the blank. Each plunger-head in the machine illustrated is provided, therefore, with two rows of plungers 27. The two rows of plungers are parallel. The plungers of each row of plungers of each plunger-head alternate with the plungers of a row of plungers of the other plunger-head. Adjacent plungers of each row of plungers are separated the distance required to render them capable of forming the desired thickness of wall or partition 14 between adjacent grooves or recesses 13 adapted to be formed in the blank by the said plungers, and the depth of the space 29 between adjacent plungers of each row of plungers, as shown more clearly in Fig. IX, is great enough to accommodate the displacement of material of the blank laterally between the said plungers during the latter's operation upon the blank. The blank is introduced between the coöperating plunger-heads in any approved manner, and preferably by a blank-feeding plate or slide 30, with which the machine is provided. The slide 30 rests upon two tables 31 and 41, with which the machine's stationary framework is provided. The tables 31 and 41 are arranged at opposite ends, respectively, of the space in which the blank is operated upon. The slide 30 is provided with an aperture 32, adapted to receive the blank. The slide 30 is operated by hand or in any other approved manner. In Figs. I and II the blank-feeding slide is empty and shown in position with its aperture 32 between the plunger-heads. Fig. III shows a blank being operated upon. In dotted lines, Fig. III, the slide 30 is shown in position with its aperture arranged to discharge at the outer end portion of the table 31. Obviously the slide 30 in its inner position, as shown in Figs. I and II, has its aperture 32 in perfect registry with the paths of the plunger-heads.

The stationary framework is provided with two flanges 35 and 35, arranged and extending between the inner ends of the tables 31 and 41 below opposite sides, respectively, of the blank's path and having their upper surfaces flush with the upper surface of the said tables. The blank is fed from the table 31 to and upon the said seat-forming flanges 35, upon which it rests during its conversion into an electrode-forming plate. The aperture 32 of the blank-feeding slide of course extends vertically through the slide and has the dimensions required to render it capable of nicely but easily receiving a blank, and of course the outline of the said aperture corresponds with the outline of the blank-forming plate.

The stationary framework of the machine is provided with a stop-forming lug or member 36, (see Figs. II and III,) arranged as required to render it capable of being engaged by the rear end of the slide 30 when the latter is in position with its aperture 32 in registry with the path of the plunger-heads. The slide 30 has its forward end provided with a handle 37.

The arrangement and dimensions of the flanges 35 relative to the path of the work are such that only those portions of the blank that form the side edges and contiguous margin of the electrode shall rest upon the said flanges during the operation upon the blank by the groove-forming and material-compressing plungers.

It will be observed that by the machine hereinbefore described the blank is confined edgewise by the walls of the blank-engaged aperture of the blank-feeder during the operation upon the blank by the plunger-heads, and the material that requires displacement for the formation of the grooves or recesses in each side of the blank is pressed or forced

inwardly, so as not only to form a core or body portion that is more dense than the walls or partitions between adjacent grooves or recesses of each row of grooves or recesses, but so as to displace material into partitions formed between adjacent grooves or recesses in the opposite side of the blank, and thereby enlarge the active-material-holding surfaces of the resulting electrode that is remarkable for its strength, for its large capacity to hold active material, and for its comparative lightness.

Fig. IX clearly discloses how a pair of plungers at one side of the path of the blank cooperates with the plunger that is arranged at the opposite side of the said path and between the plungers of the said pair of plungers. The pair of plungers at one side prevent the material displaced between them by the plunger at the other side from spreading edgewise of the plate and compel the said material to pass outwardly between the plungers of the said pair of plungers. I would remark, also, that the supporting-framework of the machine next above the blank-receiving space between the plunger-slides is provided with lugs or members 40, that overlap the upper side of the margin-forming portion of the blank-forming plate. The said members 40 and the flanges 35 positively release from the plungers an electrode-forming plate that has a tendency to adhere to the plungers when the plunger-slides are moved apart after the plungers' operation.

My improved method embraces, broadly, the displacement of material from one side of the blank inwardly, so as not only to compress the core or body portion of the resulting plate, but so as to be instrumental in forming the wall between two grooves or recesses formed in the opposite side of the plate.

What I claim is—

1. The herein-described method of producing an electrode-forming plate having each side thereof provided with grooves or recesses and having the grooves or recesses upon one side alternating with the grooves or recesses upon the other side, consisting in simultaneously pressing or forcing material required to be displaced in the formation of the said grooves or recesses inwardly and thereby widen the walls between adjacent grooves or recesses formed in each side of the blank by the inward displacement of the material required to form the grooves in the blank's opposite side, substantially as and for the purpose set forth.

2. The herein-disclosed method of producing an electrode-forming plate having each side thereof provided with grooves or recesses alternating with grooves or recesses in the opposite side of the plate, consisting in inwardly displacing material requiring removal in forming the grooves or recesses in each side of the blank and displacing the material requiring displacement in the formation of all of the said grooves or recesses simultaneously so that material is simultaneously displaced inwardly from one side of the blank at points alternating with the points at which material is displaced inwardly from the other side of the blank, substantially as and for the purpose set forth.

3. The herein-disclosed method of producing an electrode-forming plate having each side thereof provided with grooves alternating with grooves in the opposite side of the plate, consisting in inwardly displacing the material requiring displacement in the formation of the grooves in each side of the blank on lines alternating with the lines of displacement of material from the opposite side of the blank.

4. The herein-disclosed method of producing an electrode-forming plate having each side thereof provided with rows of grooves alternating with grooves in the opposite side of the plate, consisting in the formation of the walls between adjacent grooves in each side of the plate by the inward displacement of material from the opposite side of the plate.

Signed by me at Cleveland, Ohio, this 20th day of October, 1899.

GEORGE J. MILLER.

Witnesses:
C. H. DORER,
A. H. PARRATT.