

No. 617,002.

Patented Jan. 3, 1899.

T. A. WILLARD.

MEANS FOR PRODUCING BATTERY ELECTRODES.

(Application filed May 4, 1896.)

(No Model.)

3 Sheets—Sheet 1.

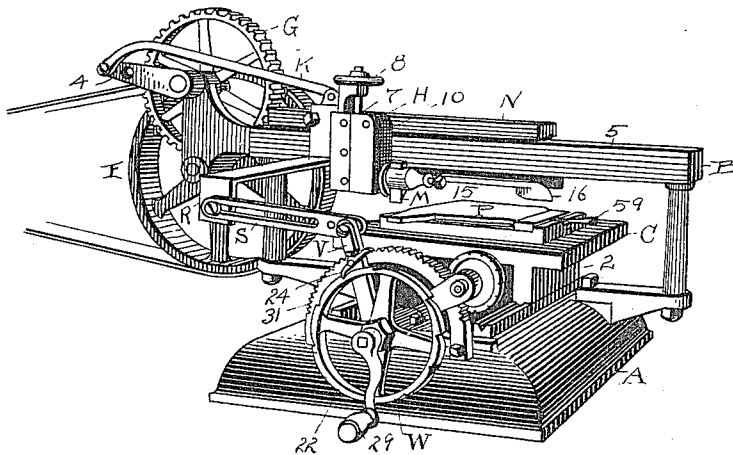
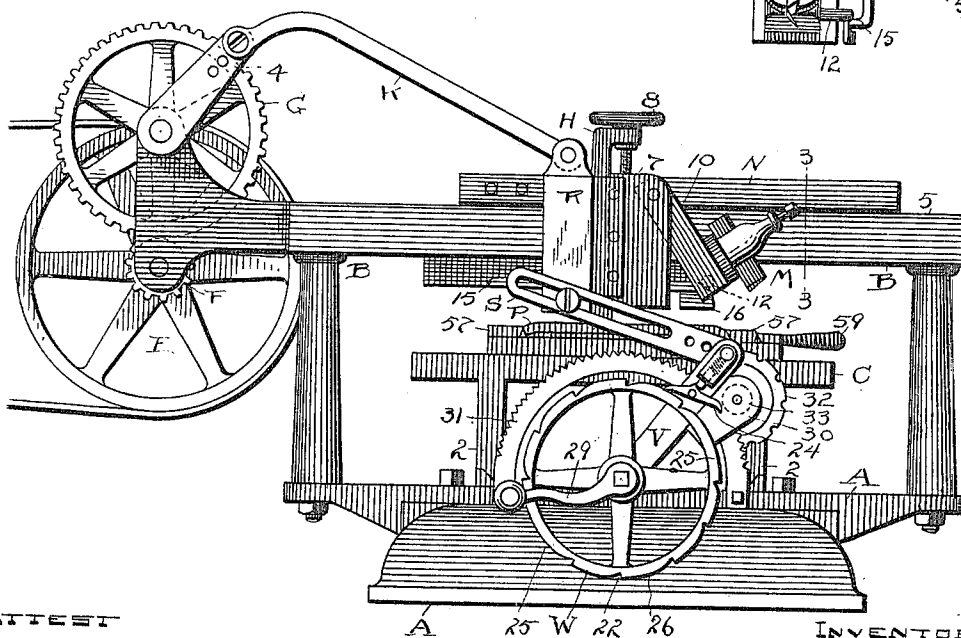
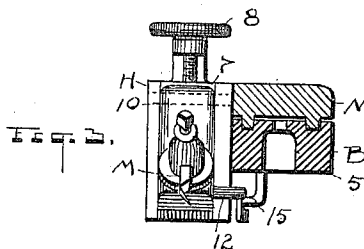


Fig. 1.

Fig. 2.



ATTEST

R. B. Moser.
H. E. Mydra.

INVENTOR

Theodore A. Willard

By H. J. Fisher ATTORNEY

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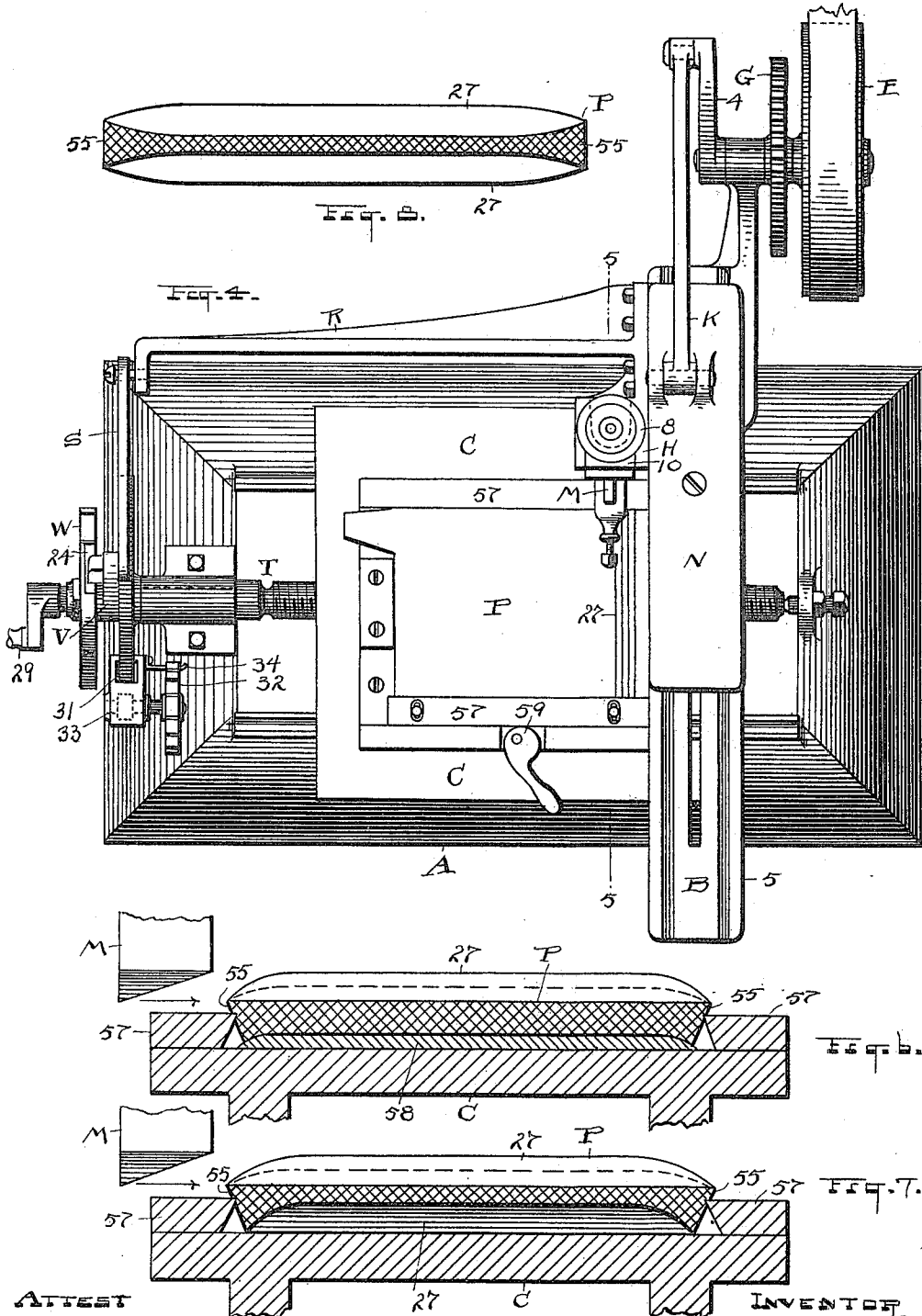
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3 Sheets—Sheet 3.

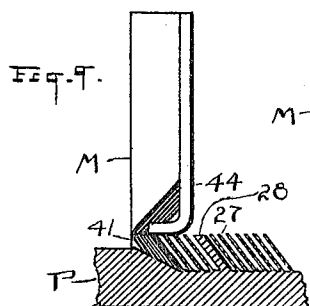
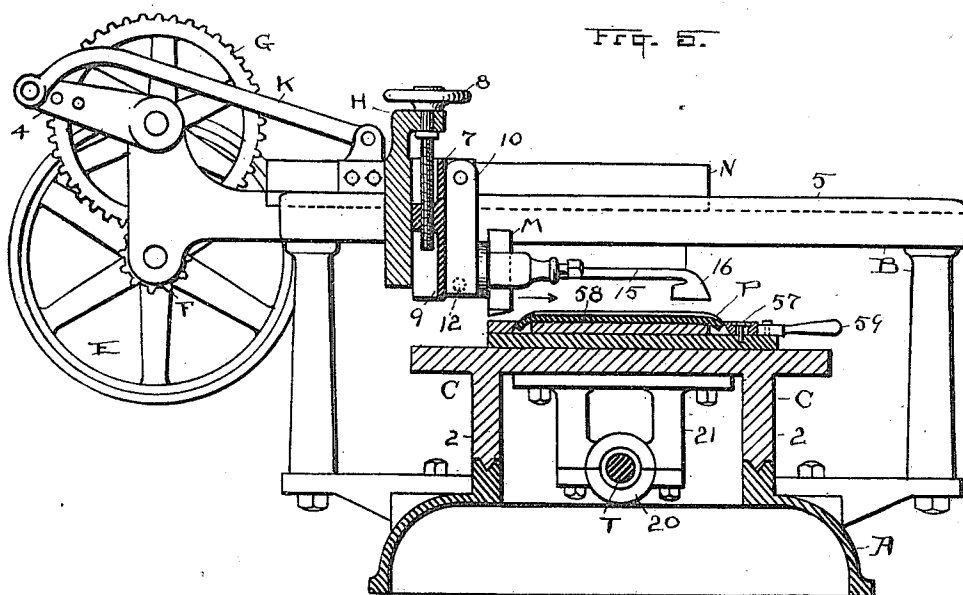


Fig. 10.

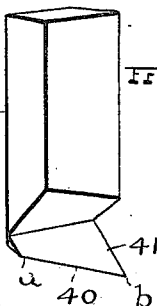


Fig. 11.

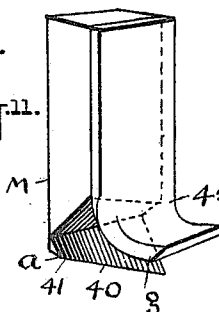


Fig. 12.

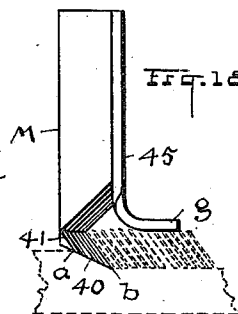


Fig. 12 1/2.

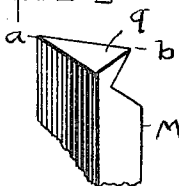


Fig. 13.

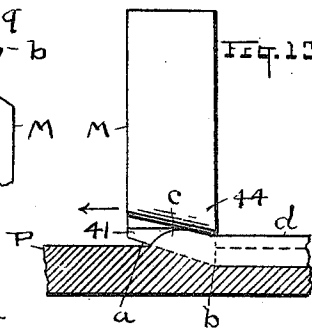


Fig. 14.

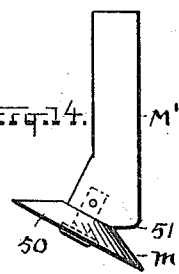
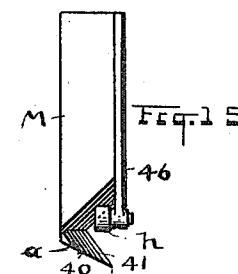


Fig. 15.



ATTEST
R. B. Moore
H. S. Munday.

INVENTOR
Theodore A. Willard

By H. T. Fisher ATTORNEY

UNITED STATES PATENT OFFICE.

THEADORE A. WILLARD, OF NORWALK, OHIO, ASSIGNOR, BY DIRECT AND MESNE ASSIGNMENTS, TO SIPE & SIGLER, OF CLEVELAND, OHIO.

MEANS FOR PRODUCING BATTERY-ELECTRODES.

SPECIFICATION forming part of Letters Patent No. 617,002, dated January 3, 1899.

Application filed May 4, 1896. Serial No. 590,156. (No model.)

To all whom it may concern:

Be it known that I, THEADORE A. WILLARD, a citizen of the United States, residing at Norwalk, in the county of Huron and State of Ohio, have invented certain new and useful Improvements in Means for Producing Battery-Electrodes; and I do hereby declare that the following is a full, clear, and exact description of the invention, which will enable others skilled in the art to which it appertains to make and use the same.

In the accompanying drawings, Figure 1 is a perspective elevation of my new and improved machine, the parts being in starting position. Fig. 2 is a side elevation of the machine, showing the same side as Fig. 1 and the parts as they appear on the return movement after a leaf has been produced in the electrode. Fig. 3 is a cross-section of a portion of the machine on line 3 3, Fig. 2, and looking to the left toward the cutter or tool. Fig. 4, Sheet 2, is a plan view of the machine with the parts situated about as they appear in Figs. 1 and 5. Fig. 5, Sheet 3, is a vertical central sectional elevation of the machine, substantially on line 5 5, Fig. 4. Fig. 6, Sheet 2, is a cross-section of the supporting-bed of the machine and of an electrode thereon in position and condition to receive the cutter or cutting-tool, a section of which is shown at the left of the figure. Fig. 7 is a similar section of the supporting-bed and a cross-section of the electrode, as above; but in this case one side thereof has been developed and the other side is under development. Fig. 8, at the top of the sheet, is an edge view of the electrode after it has been turned from the machine and its edges have been straightened. Figs. 9 to 15, inclusive, Sheet 3, are views of the leaf-cutting tool alone or associated with other parts and in different positions and relations, as hereinafter described. Thus in Fig. 9 we have a front elevation of the cutting and forcing tools together as in use and a section of a plate on which they are operating. Fig. 10 is a perspective view of the cutting-tool alone. Fig. 11 is a perspective view of the same tool as in Fig. 10 with a modified form of associated tool, and Fig. 12 shows the parts seen in Fig. 11 in working position on a section of plate. Fig. 12½ is a

perspective view of the lower portion of the leaf cutting or shaving tool inverted so as to disclose the flat inclined bottom surface thereof, which travels on the uncut stock. Fig. 13 is a side elevation looking in from the right on Fig. 9, the tool traveling in the direction of the arrow. Fig. 14 is an elevation of a modified form of tool having a rotating blade. Fig. 15 shows the same cutting-tool as in Fig. 12 and other figures, but with a still further modification of forcing-tool.

A represents the base or bed of the machine, and B the general framework thereof. As shown, the base A is a substantial bed which is adapted to be placed upon any suitable support and carries the horizontal sliding table C, Fig. 1. For this purpose the said base A has transverse grooves or channels adapted to receive the tongues 2 of the table C, which slide therein, thus giving a lateral movement to the table, as is required to feed the stock or plate to the cutting-tool. Obviously the tongues might be on the base A and the channels in part C, if preferred, or an equivalent mechanism might be used.

Two distinct sets of mechanisms are now necessary to do the work, one to actuate the table C, as just indicated, and the other to actuate and operate the cutting-tool. Both mechanisms receive power from the drive-wheel E, pinion F, and gear-wheel G, having a crank-arm 4, which operates the head H through connecting-rod K. With this head which operate the feed mechanism of the carrying-table C, as hereinafter described, and the said head is fixed rigidly to the sliding support N, which has tongue-and-groove or equivalent connection with the longitudinal bar 5 of the frame B, Fig. 3, and slides back and forth thereon, subject to the limitations of the crank 4 and connecting-rod K. Greater or less stroke of these parts is obtained by adjusting the rod K into one or another of the series of holes in the crank-arm 4. The head H carries the cutting-tool M, and the said tool is provided with two special supports in said head to give it the requisite adjustments and movements. Thus to set the tool to the desired depth of work in the stock or electrode I provide the part 7, adapted to

be raised and lowered by the hand-screw 8. Then in order that the tool may be raised from the electrode on the return stroke, so that it will not drag over the work and injure the same, the tool is fixed in a pivoted and swinging member 10, suspended from its top and adapted to bear against the part 9 in its forward movement and to be swung and carried, as in Fig. 2, in its return movement. To thus carry the tool at an inclination over the electrode or lead plate P, I provide the support 10 with a laterally-projecting pin 12, Fig. 3, which is adapted to engage over the top of the spring-metal carrier 15, secured along the lower inner edge of frame-bar 5, and which in any event is equal in length to the width of plate P. The outer free end of this spring-carrier 15 is bent inward into the path of pin 12, and the carrier is so constructed that when the said pin passes to the front of the point 16 the said point will spring in behind the bin. Then to enable the pin to ride up onto the carrier on its return stroke the point 16 is inclined downward to engage beneath the pin. Then when the head reaches the starting position again, as in Fig. 1, the tool M swings off the carrier and is ready for work, as before. Obviously this is but one of a number of ways to return the cutting-tool free from the work, and hence my invention is not limited to what I show, but extends to any sufficient means to accomplish this result.

Now in order that the feed of the bed C may be carried on simultaneously and automatically with the operations of the tool M, I have arranged feed mechanism comprising, primarily, the laterally-extending bar or plate R, which is engaged rigidly with head H or the sliding bar N, or both, and connect with the free end of said bar the slotted link S, which operates the ratchet mechanism that governs the feed. Thus supported in suitable bearings on the base A is journaled a transverse shaft T, and on the near end of this shaft is keyed a ratchet-wheel W, having occasional teeth 22. On the same shaft by the side of wheel W is a free rotating arm V, with the upper end of which is connected the link S. This arm has a spring-pressed pawl or dog 24 at its side adapted to engage the teeth 22 and to turn the wheel W more or less by such engagement, according to the space between the teeth. This particular wheel is subdivided with two long spaces 25 between teeth and four short spaces 26 between the long ones. Hence when the dog engages over a long space it will rotate the wheel W farther than when it engages or compasses one of the shorter spaces, and this gives the desired movement to the table C, which carries the electrode. Thus, for example, suppose I desire every fifth leaf thrown up by the cutting-tool to be materially heavier than the intermediate ones, so as to form a support for the active material when the said leaves are converted, which is desirable. This arrangement or spacing of the teeth assures

such construction and a perfect uniformity of action over the entire plate. I might have different sizes of wheels with different arrangements of teeth and so cut more or fewer leaves 27 between the supporting-ribs 28, if desired. So might I also arrange to cut thinner or thicker intermediate leaves, if desired. All these and other effects can be accomplished by mechanism adaptable to these purposes.

The slotted link S is an important factor in the present style of mechanism, because, among other things, it enables me to stop the arm V in its back throw wherever I desire, and thus cause the dog 24 to have more or less sweep or movement back over the wheel W. As it is shown here, the stop is so arranged that the dog has sweep enough to traverse the space 25 between teeth 22 when it reaches said space, but not enough to cover the greater distance there is between two of the shorter-spaced teeth. The difference is seen in Fig. 2, where the dog is at the limit rearward and must go forward to engage the next teeth. The stop 30 is adjustable over the fine-toothed segment 31 by thumb-wheel 32 and pinion 33, and a spring-lock 34, Fig. 4, engages in the notches in the periphery of wheel 32 to prevent its turning. Here, again, it must be suggested that the means shown and described are readily substituted by others that will do the same work equally well, and may therefore be varied in all their details without departing from the spirit of the invention.

Now having the details of the operating mechanism and referring to Figs. 9 to 15, we see in Fig. 10 the present preferred style of leaf-cutting tool. It should be understood that the electrode produced by this machine is designed to be formed electrically or by what is known as the "Planté" method, in contradistinction of an electrode in which active material is applied as a paint, paste, or cement, and the material so applied is formed and becomes the active material of the cell. In my construction of element I produce leaves so thin that they are gradually converted into active material by electrolysis, and there is no paint, paste, or cement whatever used. To do this, the leaves which are to be converted necessarily are very thin, and I can make them as thin as a sheet of paper. Not only this, but they are made uniformly thin from edge to base and with each other, so that all parts of a leaf and all the leaves will form together. Obviously to produce such work on both sides of a flat lead plate of less, probably, than a fourth of an inch of thickness requires specially and well adapted tools. The tool shown is of this character and has an inclined undercutting edge 40 and an inclined front side 41, retreating laterally and upwardly from the said edge, said inclined side corresponding substantially to the angle of inclination which it is desired to give to the leaf that is thrown up by the tool. The inclination of the edge 40 from its enter-

ing-point *a* to its deepest point at *b* is equal to the depth to which the leaf is to be cut, and the entire length of edge 40 therefore engages in shearing or shaving out the leaf 27.

5 The rear and bottom side *q* or surface of the tool *M* is flat and inclined laterally, as seen in the inverted perspective view of the lower end of the tool, Fig. 12 $\frac{1}{2}$, and the angle of inclination of the bottom side *q* is different
10 from the front side 41. The cutting edge 40 is therefore inclined two ways, from entering-point *a* to deepest point *b* and also in respect to the line of travel; but in the production of the leaves in this way I have encountered
15 the difficulty of ragged and uneven edges unevenly projected edgewise from the plate, which is very objectionable, and hence have employed with the cutting-tool what I term a "forcing-tool," or a tool adapted to even
20 and square the edges of the leaves. One form of such tool is shown at 44, Figs. 9 and 13, where an otherwise flat tool is shown having its lower end bent inward at right angles into the recess in tool *M* across the line
25 of its cutting edge. The effect or operation of this tool on the leaf is seen in Fig. 13, where the original elevation of the leaf after it comes from the blade is shown at *c*, and its depressed and evened edge after it passes the forcing-tool is seen at *d*. The effect of this
30 tool on the leaves is further seen in Fig. 9, where the edges are shown both even and square. In Figs. 11 and 12 are modifications of the forcing-tool, in which the said tool 45 has its lower end bent outward and its front engaging edge *g* beveled, as shown.

Fig. 15 shows still another modification of forcing-tool 46, having a roller *h* at its bottom to engage and even the edge of the leaf.

40 Fig. 14 shows a modification of cutting-tool having a standard *M'* and an inclined circular or disk-shaped rotating blade 50, with an inclined or beveled upper edge *m*, corresponding to the inclination 41 in the other tool.
45 Of course still other modifications of both tools could be suggested, but these do the work exceptionally well, and especially the cutter *M*.

In Figs. 6 and 7 I show the table *C* and the
50 lead plate *P* from which the electrode is produced. In Fig. 6 the plate *P* is supposed to be under the action of tool *M*, and leaves 27 are being thrown up therefrom, while in Fig. 7 this side is completed and turned to the
55 bottom, and leaves 27 are being cut on the other side, which is now above. It will also be noticed that in Fig. 6 the edges of plate *p* are bent downward, while when the plate is inverted the same edges are again shown as
60 bent downward, as appears in Fig. 7. This is done in both cases in order to leave a thickened edge for the electrode, as seen in a finished element, Fig. 8, above. In the first place a suitable tool is used to hammer or
65 bend down the two edges, as in Fig. 6, and one side of the plate being then cut into leaves

the plate is reversed and the edges are forcibly bent in the other direction and then the other side is reduced to leaves. In this way I can cut practically the whole body of the
70 plate into leaves, and yet allow sufficient support about the sides to give the requisite strength to the element. Indeed I have cut the leaves entirely through the center of the plate and obtained excellent results, the supporting-ribs 28 in that case being frequent and
75 strong enough to support the active material developed from the leaves.

When the plate is handled, as in Fig. 6, and the edges thereof are bent, as shown, to engage between the side cleats or jaws 57, I place a board or like support 58 under the plate; but this board is removed when the plate is reversed and the cut surface is put
80 below. Then when both sides have been 85 shaved or reduced to leaves the edges 55 are forced back again to central position as originally and as seen in Fig. 8, and the electrode is ready for the forming process.

One or both of the jaws 57 are adjustable, 90 as seen in Fig. 4, and a cam 59 serves to press them into engagement with the plate and hold it firmly to action of the cutting-tool.

In operation the movement of the table *C* which feeds the plate *P* to the tool occurs 95 when the tool is on its return stroke, so that the requisite movement of the plate has occurred by the time the tool is ready to make a new stroke. The entire operation is automatic from start to finish, and the machine 100 requires no personal attention except to change or reverse the plate when one or both sides are finished. The machine is necessarily stopped for this purpose.

I have described the plate *P* as a "lead" 105 plate, and such it is in my present use; but the character of the material is not limited to lead if other material or compounds of material are found to be equally available for this purpose.

It will be noticed that I cut or shave the 110 leaves from plate *P* at even less than an angle of forty-five degrees, as seen in Fig. 9, and that these leaves are thrown out to an inclination which still allows considerable open space between them. This space is usually 115 greater than the thickness of the leaves, and yet when the battery is formed it fills with active material from the sides of the leaves long before the body of the leaf itself is converted, though it be as thin as paper. 120

The shaft *T* is threaded, as seen in Fig. 4, and engages nut 20 in the hanger 21, pendent from table *C*. Wheel *W* being keyed on shaft *T*, the rotation of said shaft will act on nut 21 and correspondingly move the table *C*. The 125 shaft *T* has a crank-handle 29, through which said shaft may be rotated in either direction independently of the wheel *W*, the dog 24 being raised when a reverse movement occurs.

It will be noticed that while the tools shown 130 in Figs. 10 and 14 are totally different in construction they still have in common the in-

inclined cutting edge and the differently-inclined flat side, which gives inclination to the leaf. In Fig. 14, in the absence of other means to even and square the edges of the leaves as they are produced by the blade 50, the shoulder 51 of the standard M' can be made to serve that purpose.

If preferred, the forcing medium for the edge of the leaves may be made integral with the standard of the cutting-tool, and in Figs. 11 and 12 this tool takes on the character more especially of a blade, which by its bevel edge *g* shaves off the ragged edge of the leaf before the said edge passes beneath the tool. This bevel edge, furthermore, is lower than the opposite or rear edge, so that it will do practically all the work that is done to the leaf. In Figs. 9 and 13 the front edge of tool 44 is highest and the rear lowest; but in this case no metal is cut away from the edge of the leaf.

What I claim as new, and desire to secure by Letters Patent, is—

1. In a machine to develop leaves from the surface of metal plates, the table and means on the table to support and lock a flat plate, in combination with a sharp-edged cutter having its cutting edge at an angle to the plane of the plate and gradually deepening from front to rear, and means to cause said cutter to operate on the plate at varying distances apart at fixed intervals, substantially as described.

2. A cutter for producing leafed battery-plates having a cutting edge inclined downward from front to rear and a bearing-surface on its bottom inclined laterally and

an inclined top surface, substantially as described.

3. A cutter for producing battery-electrodes from metallic plates, having a cutting edge at an inclination to a vertical plane and gradually sloping from its highest to its lowest cutting-point and having a flat-bottom bearing-surface inclined laterally to ride on the plate and an inclined top surface at a different inclination from said bottom surface to turn the leaf, substantially as described.

4. A leaf-cutting tool for battery-plates, having a flat bottom and an inclined top surface at an inclination to said bottom, in combination with a tool to even the edges of the leaves located within said recess, substantially as described.

5. The combination of a leaf-cutting tool having an inclined cutting edge and an inclined top surface, in combination with a leaf-evening tool supported by the side of the said cutting-tool and having its engaging portion above the said inclined top surface in position to even the edges of the leaves as they are cut, substantially as described.

6. In a machine for making battery-plates, a tool to shave the plate into thin leaves, in combination with a tool to even the edges of the leaves as they are cut, substantially as described.

Witness my hand to the foregoing specification this 15th day of April, A. D. 1896.

THEADORE A. WILLARD.

Witnesses:

H. T. FISHER,
H. E. MUDRA.