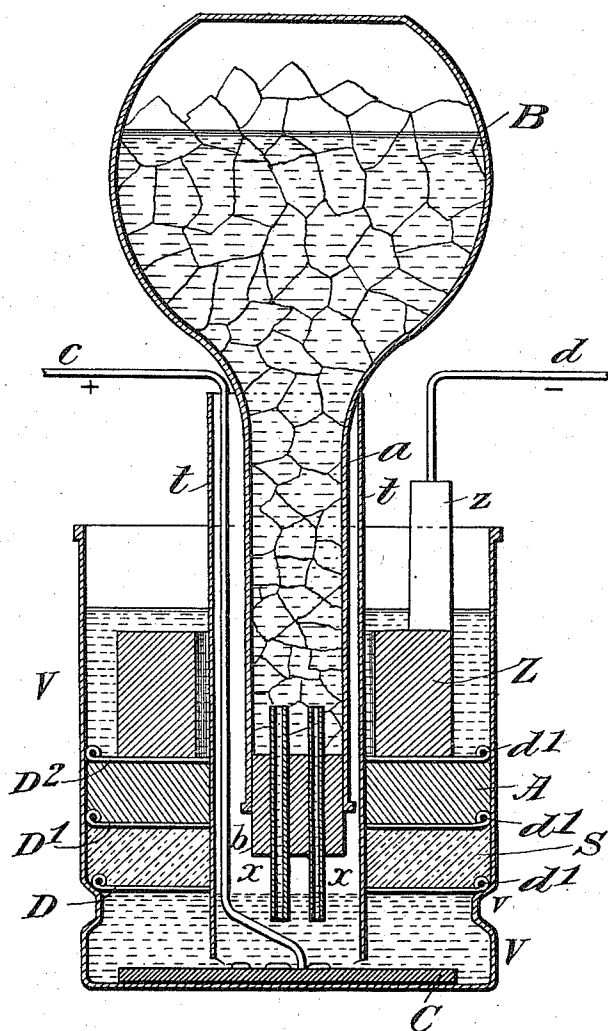


(Model.)

G. LAURA.
GALVANIC BATTERY ELEMENT.

No. 580,497.

Patented Apr. 13, 1897.



Witnesses.

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UNITED STATES PATENT OFFICE.

GIAMBATTISTA LAURA, OF TURIN, ITALY.

GALVANIC-BATTERY ELEMENT.

SPECIFICATION forming part of Letters Patent No. 580,497, dated April 13, 1897.

Application filed February 27, 1895. Serial No. 539,855. (Model.) Patented in England February 27, 1895, No. 4,245; in France February 27, 1895, No. 245,419; in Italy February 27, 1895, XXIX, 38,253, and LXXV, 105, and in Germany February 28, 1895, No. 84,715.

To all whom it may concern:

Be it known that I, GIAMBATTISTA LAURA, a subject of the King of Italy, residing at Turin, in the Kingdom of Italy, have invented certain new and useful Improvements in Galvanic-Battery Elements, (for which I have obtained Letters Patent in England, dated February 27, 1895, No. 4,245; in Germany, dated February 28, 1895, No. 84,715; in France, dated February 27, 1895, No. 245,419, and in Italy, dated February 27, 1895, Vol. XXIX, No. 38,253, and Vol. LXXV, No. 105;) 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 appertains to make and use the same, reference being had to the accompanying drawing, and to letters of reference marked thereon, which forms a part of this specification.

My invention has relation to double fluid-cells for galvanic batteries, and more particularly to the copper and zinc cells.

The double fluid-cells as heretofore constructed present serious difficulties, which consist, chiefly, in a speedy polarization, consequently in a rapid reduction in the intensity of the current generated; in a comparatively large consumption of sulfate of copper and of zinc; in the care and attention such elements require; in the cost of construction and in the costs arising from frequent unavoidable repairs, and in the inconvenience of transporting or shipping these elements, owing to their peculiar form and liability to breakage.

My invention has for its object to obviate these difficulties, and this I attain as follows: by separating the cathode from the anode fluid by a diaphragm that is impermeable to the salts of the metals held in solution in said liquids, whereby the electrolytic decomposition of the salt in the cathode liquid is absolutely prevented; by electrically or conductively connecting the two liquids through the medium of a conductive substance combined or intimately mixed with the diaphragm, whereby osmotic action or osmotic currents are avoided and the constancy of the cell insured; by the use of a depolarizing agent whereby polarization is avoided and

whereby the function of the cell is rendered automatic for a period of time depending upon the energy developed, and in so constructing the cell that all its internal parts, except one of the electrodes, may be firmly secured in position, thereby facilitating the handling and transportation and reducing the risks of breakage.

There are other very important advantages derived from my invention, namely: that I am enabled to construct cells of different intensities according to the requirements or conditions of use, that the primary cost and cost of maintenance of a cell constructed in accordance with my invention is trifling, so to speak, when compared with the like costs of efficient double fluid-cells as heretofore constructed, while cells of my invention require practically no attention for long periods of time, in contradistinction to the constant attention required to maintain the required efficiency of cells as heretofore constructed. Finally, my improved double fluid-cell is of such a construction to enable any one of ordinary intelligence to construct or reconstitute the same whenever this becomes necessary, while such reconstitution is necessary only after a lapse of time proportionate to total energy developed by the cell, generally about once a year.

The essential difference between my improved cell and those heretofore used is that in the latter osmotic action generally takes place, so-called "osmotic" currents being produced, while in the cell under consideration electric energy is excited solely by the difference of tension between the two electrodes, and this enables me to use a diaphragm of the simplest construction. On the other hand, I believe I am the first to arrange the electrode-cells one above the other, divide the same by a diaphragm impermeable by the salts of the metals in either chamber, and connect the liquids in the chambers electrically or conductively, by which arrangements many of the defects inherent to double fluid-cells heretofore used are avoided.

In a long series of experiments, particularly with starchy substances, I have found that none would answer the purposes in view

except those derived from the plants of the order of *Malvaceae*, because of the slight hygroscopic properties of starchy substances in general as compared with the great hygroscopic powers of those derived from the plants of the order of *Malvaceae*, which even when reduced to an almost impalpable powder still greedily absorb liquids, and which, when kneaded with a liquid, swell considerably and form a medium impermeable by a substance held in solution in a liquid.

I have stated above that in my improved cell there is no osmotic action, the electric energy being due to the difference in the tension of the electrodes, and that the liquids in the electrode-cells are electrically or conductively connected. The latter feature I attain by saturating the diaphragm, as well as its supporting-bed, if such is used, and herein-after to be described, by a conductive substance, as, for instance, a solution of sodium chlorid, the pulverized *Malvaceae*, as an *Althaea*, (hollyhock, marsh-mallow, or rose of Sharon,) being converted into paste by kneading with a saturated solution of such liquid; but that my invention may be fully understood I will describe the same in detail, reference being had to the accompanying drawing, which shows a construction of double fluid element embodying my invention by a vertical section.

V indicates a vessel of any suitable material and form in cross-section, preferably of glass and of cylindrical form in cross-section, and provided at a suitable point above its bottom with an inwardly-projecting annular shoulder *v* for the support of the diaphragm.

C is the copper or negative electrode, in this case of discoidal form, resting upon the bottom of the vessel, and having soldered or otherwise secured thereto one of the conductors *c*, the vessel V being divided into two electrode-chambers by a diaphragm which, I may say, is absolutely impermeable by the sulfate of copper.

In the construction or assembling of the parts of the element a coarse sufficiently stout textile fabric of the same outer configuration as the inner configuration of the vessel V, in the case in point of circular form, is provided with a central aperture and with a peripheral stiffener *d'*, as a strip or piece of cane or other sufficiently flexible material that will remain unaffected in the solution of sulfate of copper. This textile supporting-diaphragm D is first threaded upon an open-ended cylinder or tube *t* of any suitable material, preferably glass, the lower edge of which is scalloped or otherwise recessed, so as to establish communication between the interior of such tube and the cathode-chamber, when said tube is set upright on the cathode C, and in order that a good fit of the diaphragm D upon the tube *t* may be obtained I preferably make the central aperture of said diaphragm of slightly less diameter than the outer diameter of the tube *t*. After the diaphragm is fitted on the

tube *t* and the conductor *c* threaded through the same said tube is placed on end upon the lower electrode C and the diaphragm D is adjusted so that its stiffened or reinforced periphery *d'* will be firmly seated upon the shoulder *v* of vessel V. A layer of a mixture of sawdust and sodium chlorid is now placed upon the diaphragm D and suitably packed thereon, after which a similar diaphragm D' is threaded upon the glass tube and firmly and evenly pressed upon the porous diaphragm of sawdust S, and then the impermeable diaphragm A of a paste of *Althaea* powder is applied to the second diaphragm D', firmly and evenly packed thereon and about the central tube, and covered by a third diaphragm D² of textile material, after which the zinc or positive electrode Z, which in the case in point will also be of discoidal form in conformity with the vessel V, is threaded on the tube *t*, said electrode being provided with a central aperture of greater diameter than that of said tube *t*, and placed on diaphragm D². The zinc electrode Z is provided with a post *z*, to which the other conductor *d* is connected. A solution of sodium chlorid is now poured into the anode-chamber, while the cathode-chamber is supplied with a solution of sulfate of copper sufficient to saturate the diaphragm D and fill the chamber between it and the bottom of the vessel V.

The supply of sulfate-of-copper solution to the element is maintained by the use of a storage vessel B, having preferably or conveniently the form of a Florence flask, whose neck *a* is of such length that when the vessel is inverted into the tube *t* the latter will support the same with the outlet at a proper distance from the cathode C, the discharge from the flask taking place through a tube or tubes *xx* of comparatively small interior diameter, whose outer end dips into the solution in the cathode-chamber, as shown.

It is necessary to the proper working of the element that there should be no air-cushion between the solution in the cathode-chamber and the textile diaphragm D and that the air should be expelled from the latter, this being, in fact, the only care that has to be taken in assembling the parts of the cell irrespective of the proper packing of the materials constituting the diaphragms S and A, while such air can be readily expelled by supplying the cathode-chamber with sufficient solution to saturate the textile diaphragm, a slight excess of solution being in no way detrimental to the good working of the cell. The supply of an excess of solution of sulfate of copper to the cathode-chamber may, however, be readily obviated if the solution is introduced before the diaphragm D and tube *t* are inserted, as any excess of said solution would then be forced into said tube in packing the material for the diaphragm S.

When the diaphragm A is of considerable thickness, as shown in the drawings, it is advisable not to pack the sawdust bed too firmly,

so that it may readily become saturated with the cathode solution and this latter brought into contact with the *Althaea* diaphragm A.

I have found that the electromotive force of an element constructed according to my invention can be made to reach 0.8 volts, while its internal resistance may be varied at will. In my experiments I have constructed cells having an internal resistance varying from five to 0.5 ohms, of an intensity varying from 0.1 to one ampere and of a constancy that is astonishing, as I have not detected any variation either in the electromotive force or in the internal resistance of one of my elements kept continuously short-circuited for a period of fourteen days.

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

1. The herein-described diaphragm for double liquid-cells, consisting of a paste composed of a pulverized plant of the order of *Malvaceae* and a conductive substance, as a solution of sodium chlorid, for the purpose set forth.

2. The herein-described diaphragm for double liquid-cells consisting of a paste composed of pulverized *Althaea* and a conductive substance as a solution of sodium chlorid, for the purpose set forth.

3. A double liquid element comprising a vessel, a diaphragm composed of a paste made of a pulverized plant of the order of the *Malvaceae*, as *Althaea*, and a conductive substance as a solution of sodium chlorid, and a more or less porous supporting-bed for said diaphragm, for the purpose set forth.

4. A double liquid-cell comprising a vessel, a horizontal diaphragm made of a paste of a plant of the order of the *Malvaceae*, and a conductive substance as a solution of sodium chlorid, a suitable cathode in the lower chamber of the vessel, an open-ended cylinder extending fluid-tight through the diaphragm into said cathode-chamber and a suitable anode supported from the diaphragm, for the purpose set forth.

5. A double liquid-cell comprising a vessel, an axially horizontal perforated diaphragm consisting of a paste made of a pulverized plant of the order of *Malvaceae* and a conduct-

ive substance as sodium chlorid, a more or less porous axially-perforated bed for said diaphragm, said bed composed of an absorbent and a conductive substance, as a solution of sodium chlorid, in combination with suitable electrodes in said chambers, and an open-ended cylinder of greater length than the height of the vessel extending fluid-tight through the diaphragm and its bed into the lower electrode-chamber, for the purpose set forth.

6. A double liquid-cell comprising a vessel, an axially-perforated horizontal diaphragm consisting of a paste made of a pulverized plant of the order of *Malvaceae* and a conductive substance as a solution of sodium chlorid, a more or less porous axially-perforated bed for said diaphragm, said bed composed of an absorbent and a conductive substance, as sodium chlorid, in combination with suitable electrodes in said chambers, an open-ended cylinder of greater length than the height of the vessel extending fluid-tight through the diaphragm and its bed into the lower electrode-chamber, and a storage-chamber having substantially the form of a Florence flask seated on said cylinder and provided in its closed neck with a discharge tube or tubes, for the purpose set forth.

7. The vessel V having near its bottom an inwardly-projecting seat-flange, a textile diaphragm seated on said flange, a bed of a porous material saturated with a conductive agent, as a solution of sodium chlorid on said diaphragm, a second textile diaphragm on said porous bed, a diaphragm composed of a paste made of a pulverized plant of the order of *Malvaceae* and a conductive substance on said second diaphragm, and a third textile diaphragm, in combination with an open-ended cylinder extending fluid-tight through the above-mentioned diaphragms and porous bed into the chamber below said bed, for the purpose set forth.

In witness whereof I have hereunto signed my name in the presence of two subscribing witnesses.

GIAMBATTISTA LAURA.

Witnesses:

HUGO PIZZOTTI,
ANTONIO MELLOY.