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(NO MODEL.)

C. T. J. VAUTIN.
ELECTROLYTIC CELL.

Patented Jan. 30, 1894.

No. 513,661.

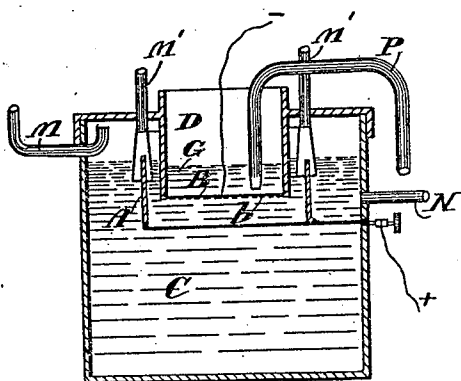


Fig. 1.



Fig. 2.

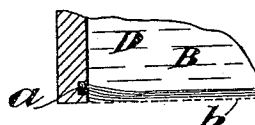


Fig. 3.

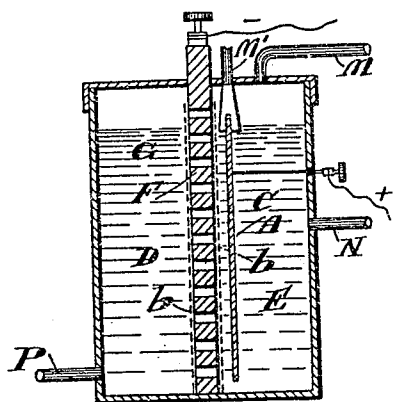


Fig. 4.

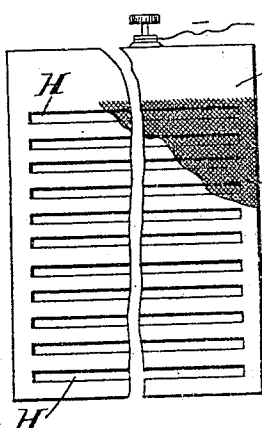


Fig. 5.

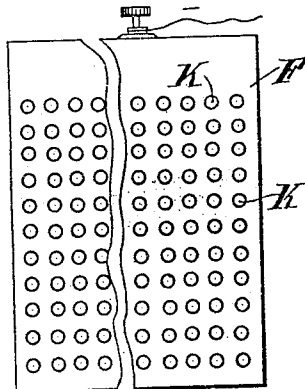


Fig. 6.

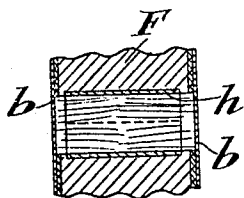


Fig. 7.

Witnesses:
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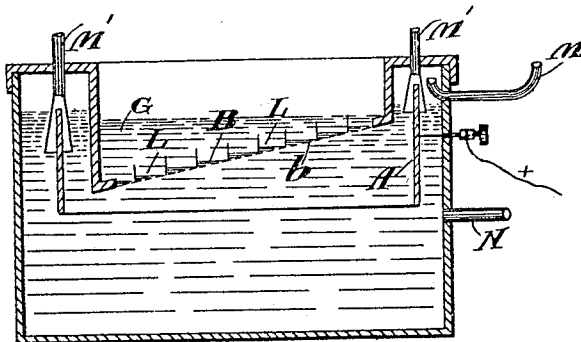


Fig. 8.

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UNITED STATES PATENT OFFICE.

CLAUDE THEODORE JAMES VAUTIN, OF LONDON, ENGLAND.

ELECTROLYTIC CELL.

SPECIFICATION forming part of Letters Patent No. 513,661, dated January 30, 1894.

Application filed April 19, 1893. Serial No. 471,023. (No model.)

To all whom it may concern:

Be it known that I, CLAUDE THEODORE JAMES VAUTIN, residing at London, England, have invented an Improvement in Electrolytic Cells, of which the following is a specification.

My invention relates to apparatus for use in cells for the separation of bases from their salts, or of constituents from chemically combined compounds, by electrolysis, and consists in the arrangement and construction of a mercury electrode, whereby actual metallic contact between such an electrode and the electrolyte is secured, with minimum internal resistance to the passage of the current, and with valuable commercial results in the treatment of certain electrolytes; whereas it is known that the employment of a mercury cathode in the electrolysis of certain solutions in which the base will form an amalgam with mercury, or will pass through the mercury, offers great advantages for the separation of the base from the electrolyte, preventing it from re-combining therewith, or decomposing water that may be present;—but no means for supporting a fixed mercury electrode has hitherto been known, except porous pots, or diaphragms of earthenware, parchment, gelatinous material, or materials impregnated with starch; all of which offer great resistance and waste energy to the passing of the electrical current, and in no way afford a true metallic contact between the electrolyte and the mercury cathode.

My invention therefore consists in means for so supporting the mercury cathode, that it is retained in stable position, and yet affords a considerable percentage of area for actual metallic contact with the electrolyte; and further affords a distinct barrier against the passage of the electrolyte through it, while any base which is capable of amalgamation with the mercury, or capable of passing through the mercury, either in a free state, or as an amalgam, will pass through the mercury cathode without re-contact with the electrolyte.

In order that my invention may be the better understood, I now proceed to describe the same in reference to the drawings hereto annexed, and to the letters marked thereon.

Figure. 1 is a sectional view of an electro-

lytical cell, with specially supported horizontal mercury cathode. Fig. 2 is an enlarged detail of the sieve supporting the mercury cathode. Fig. 3 is a further enlarged corner of said sieve showing amalgam locking joint. Fig. 4 is a sectional view of an electrolytical cell, with specially supported vertical mercury cathode. Fig. 5 is a side elevation of the vertical mercury cathode. Fig. 6 is a modification of same. Fig. 7 is an enlarged detail section of one mercury chamber in vertical electrode, showing internal amalgam locking joint. Fig. 8 is a sectional view of an electrolytic cell with specially supported diagonal mercury cathode.

I find, that mercury, by reason of what is termed "its surface tension," will not pass through the apertures of a reticulated mesh or sieve, or a finely perforated sheet, up to a coarseness of about sixty meshes to the inch, or equivalent fineness of perforations, without considerable shock or pressure; and that the "surface tension" of the mercury, or its resistance to such passage, will support a small layer, or "head" of mercury from falling through the sieve, in obedience to the ordinary law of gravity. I find that such a mesh or sieve, which may be constructed of metallic wire, silk, or any other convenient fiber, will, while supporting a certain layer or "head" of mercury, expose a surface of metallic mercury through the apertures of the sieve, of about sixty per cent. of the whole area of the sieve or mercury layer. I therefore employ such a mesh or sieve or perforated plate as an external support of a mercury cathode, for employment in an electrolytical cell, and I find that such mesh must be made of a material non-conducting to electricity; or, if of metal, must be protected by a non-conducting coating, so as not to interfere with, or substitute itself for, the desired action of the mercury electrode in the electrolyte.

In Fig. 1 I show an electrolytic cell provided with an anode A, and a mercury cathode B, in an electrolyte C, the cathode being supported by a mesh or perforated plate b, (as herein above described) in a chamber D, from which the electrolyte C is entirely excluded by the cathode and the side walls of the chamber D. Any other suitable liquid,

such as water G, may be introduced into the chamber D, above the cathode B, to produce any secondary chemical action with the cation, which if of lighter density than, or forming an amalgam with, the mercury, will pass through it, and rise into the chamber D. As the said "surface tension" of the mercury causes it to assume a spheroidal shape at its side periphery touching the walls of the chamber D, the actual surface contact of the mercury, under these circumstances, with the walls of the chamber D, would be of small area, compared with the depth of mercury resting upon the supporting sieve, and might allow the electrolyte to leak through. I therefore apply a strip of metal *a* (Figs. 2 and 3) about the edge of the chamber containing the mercury; such strip to be of a metal, which will form with the mercury an amalgam, so as to seize and attract the mercury to such locking joints, making a secure liquid-tight joint, and enabling me to use a very shallow layer of mercury over the body of the mesh or sieve *b*. I prefer to use a strip of iron coated with sodium amalgam, because the iron metal strip does not become deteriorated by the action of the sodium amalgam upon it, and the sodium amalgam has a great affinity for the mercury; or, the vessel may be made of metal, iron preferred, and insulated except at the lower inner bottom edge, in line with the sieve surface.

The bottom or surface of the mercury supporting vessel must be made flush, without engagement pockets, to admit of the free escape of the hydrogen or other gas that may be freed upon the under face of the mercury electrode.

Where I desire to use a mercury cathode in a vertical position to divide the cell absolutely into two liquid-tight compartments (as in Fig. 4), one of which compartments E may be filled with the electrolyte C, on one side of the mercury cathode F, and the other compartment D may be filled with water G or other liquid,—I construct the mercury electrode in the following manner:—I take a plate of metal, which is a conductor of electricity, preferably iron, and protect the faces and edges by non-conducting material such as vulcanized india-rubber, &c. I form transverse slots H, Fig. 5, or orifices K, Fig. 6, of any desired shape in the said plate to contain mercury, each portion of mercury being thus distinct from the other, and only subject to a small "head" of liquid mercury pressure when placed vertically. I cover the faces of the electrode by the before-described non-conducting mesh, articulated tissue, or perforated plate *b*, making secure joints between the mesh and the metal faces of the plate around the slots or orifices. I find this mesh or tissue sufficient by the "surface tension" of the mercury to retain the liquid mercury in its individual recesses or compartments; and, to further assist the retention of the mer-

cury, and to make a close liquid-tight joint around the walls of the mercury compartments, I apply around the interior of the compartment (Fig. 7) sodium amalgam, or amalgamate the inner surface of the compartments, so that they attract the mercury and form a secure locking joint, also helping to retain the mercury in the compartment.

Where an oblique electrode is desired, I arrange it in the form shown in Fig. 8, where the mercury is supported on the said mesh, sieve, or perforated plate *b*, and I divide the mercury into a series of steps or terraces by intermediate divisions L, (each side of the partition to be amalgamated) so that the actual liquid head of mercury, on the sieve or mesh, is reduced to any desired minimum, by the closeness of the terrace divisions; and this arrangement allows an easy escape for the gases formed on the under-face of the electrode. A solution of water or other liquid may be placed over the said mercury electrode.

In the above arrangement of cells any suitable anode A may be used, and any convenient arrangement for the removal of gaseous anions or cations by pipes M and hoods and pipes M' from a closed chamber in the upper part of the cell, or constant supply of the electrolyte E by pipes N, or removal by pipes P of the water or other liquid G, separated from the electrolyte by the mercury cathode F, may be used.

It is obvious that this improved mercury electrode will be of extreme utility in the electrolysis of saline solutions, such as NaCl, whereby the sodium is deposited upon the mercury cathode, and passes through it as a sodium amalgam, which may be collected as it issues from the mercury; or if water is present at the back of the cathode the sodium of the amalgam is at once converted into caustic soda, which is entirely separated from the original electrolyte. I therefore find I can obtain a solution of caustic soda, entirely free from the electrolyte, and of any strength; thus avoiding any intermediate process that might otherwise be required for the separation of the caustic soda from the electrolyte; and I find that I can effect this separation by my improved apparatus at a low cost, owing to the low internal resistance of the cell, and the exceptionally small electromotive force of current required. I may however employ my improved mercury cathode, as herein above described in any form of electrolytical cell, for which it is adaptable, without departing from the essence of my invention.

It will be noticed that the arrangement and construction of the mercury electrode shown in Figs. 4 to 8 are in effect formed by duplicating the arrangement and form of the single electrode cell shown in Fig. 1 or in other words by providing a series of said single electrode cells or pockets.

The terms non-conducting as used herein in

connection with the reticulated sieve relate to the sieve either formed of non-conducting material or insulated by a covering.

5 The non-conducting material of which the mesh may be composed is silk or finely perforated vulcanite or celluloid plates.

The mesh when metallic may be protected by the usual enameling process so as to be electrically non-conducting.

10 Having now described my invention, what I desire to claim, and secure by Letters Patent, is—

15 1. A mercury electrode for use in electrolytic cells, comprising liquid mercury supported by a non-conducting reticular mesh or sieve or perforated plate, substantially as described.

20 2. A mercury electrode comprising a chamber or pocket with mercury therein, the metallic joint internally surrounding said chamber, and capable of amalgamation with mercury and the non-conducting reticulated mesh sieve or perforated plate extending over the

opening of the said chamber to hold the mercury in place, substantially as described.

25 3. A mercury electrode comprising a series of chambers or pockets carried by a suitable supporting plate, the mercury in said pockets and the non-conducting reticulated plate or plates for closing the openings of said pockets, substantially as described.

30 4. A mercury electrode comprising the series of chambers or plates arranged in inclined position in the form of terraces and having the openings covered by a non-conducting reticulated mesh or perforated plate and the mercury in said pockets, substantially as described.

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

CLAUDE THEODORE JAMES VAUTIN.

Witnesses:

REGINALD WILLIAM JAMES,
RICHARD A. HOFFMANN.

