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ELECTROLYTIC CELL OF THE MERCURY TYPE

Filed Nov. 14, 1930

Fig. 1

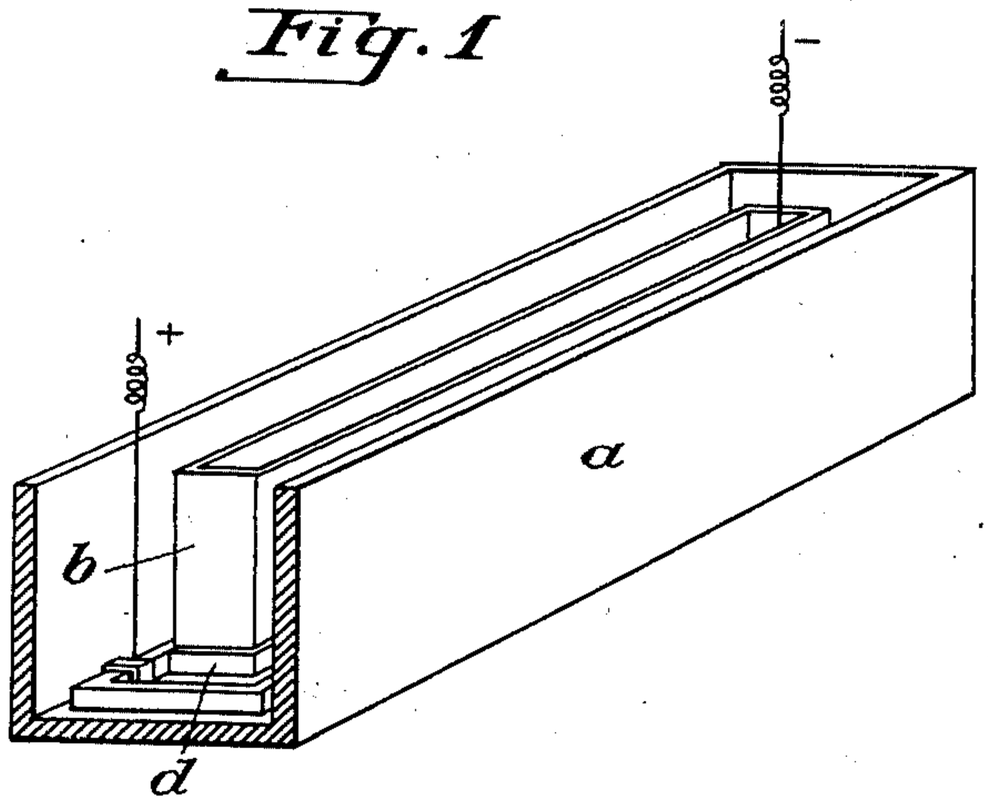
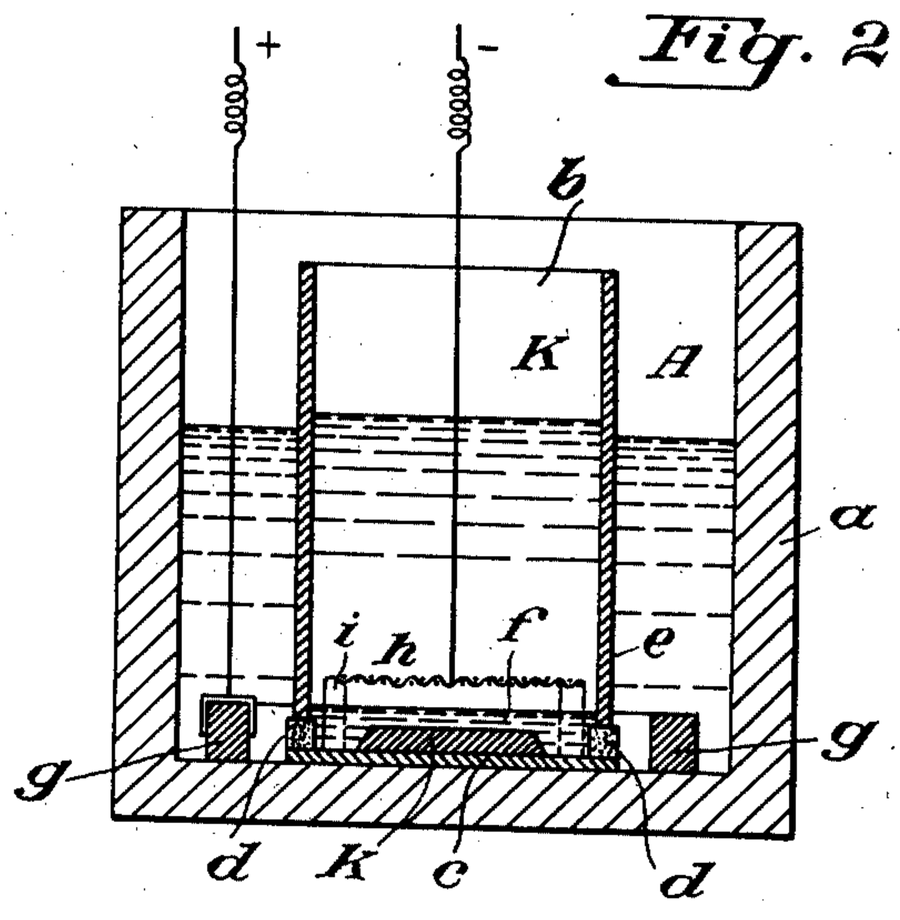


Fig. 2



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UNITED STATES PATENT OFFICE

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ELECTROLYTIC CELL OF THE MERCURY TYPE

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Our invention relates to electrolytic cells, and more particularly electrolytic cells for the electrolysis of alkali or alkaline earth metal halides by the mercury process.

The hitherto employed electrolytic cells for the electrolysis of alkaline metal halides according to the mercury process require generally considerable quantities of mercury or constant supervision and attendance.

The object of our invention is to provide a cell in which these drawbacks are effectively eliminated. Our improved cell requires only a very small quantity of mercury and no constant supervision and thus ensures a particularly high economy. We attain this end in view by designing only a portion of the vertical partition dividing the anode compartment from the cathode compartment adjacent to the bottom of the electrolyser as a porous diaphragm. The preferably rigid diaphragm need only be very low, for instance a few millimetres high. The diaphragm which at the same time serves as a support for the considerably larger impermeable portion of the partition is advantageously designed as a closed circular ring or as polygon and the mercury is arranged on the inside of the ring or polygon. The anode, which may be of similar shape, is located at the outside of the diaphragm. The height of the mercury is chosen slightly higher than the height of the diaphragm. The anode is preferably also slightly higher than the diaphragm. The mercury itself or a special metal body located above the mercury may be employed as cathode. This special cathode may also be electrically connected to the mercury. The satisfactory operation of the improved cell depends to a high degree upon the choice of the metal used in its manufacture. It has already been suggested to accelerate the decomposition of the amalgam by employing specially selected substances, such as vanadium, molybdenum or tungsten, as well as high-resistance alloys. These known processes invariably used such metals or alloys which accelerated the decomposition of the amalgam as much as possible. This has the advantage, it is true, that such processes could in themselves be carried through continuously with comparatively small quantities of mercury, but in practice the serious drawback arises that, in consequence of the strong action of the metal employed, an oxidation of the mercury is liable to occur and thus cause a considerable disturbance of the process.

The object of our invention is to eliminate this drawback and thus to render the process much more reliable. Numerous experiments and thorough researches have shown that the speed of decomposition of the amalgam can be considered as a function of two values, viz. 1 the distance of the respective metal from the mercury in the electromotive series of the elements and 2 the reciprocal value of the overpotential of the metal.

On the basis of these experiments and deliberations it has been found advantageous to employ such a metal connected to the negative pole of the source of current that the speed of decomposition of the amalgam is equal to or better still a little less than its speed of formation. In this way we attain the result that an oxidation of the mercury is rendered entirely impossible in our improved process and that the operation is rendered much more reliable than in prior art processes.

In carrying out our improved process the metal selected in accordance with the required output of the plant can be connected to the mercury cathode through a suitable resistance. The metal is, for instance, employed in the form of wire netting supported upon feet of graphite. The wire netting or gauze may preferably consist of iron wire upon which, according to the output of the respective plant, a corresponding metal coating is electrolytically deposited, for instance a coating of cadmium with or without application of one or more intermediate layers.

In the drawing affixed to our specification and forming part thereof one embodiment of our invention, an electrolytic cell, is illustrated by way of example.

In the drawing shows:

Fig. 1, a perspective view, partly in section, and

Fig. 2, a cross-section through our improved cell.

Like parts are indicated by like letters of reference in both figures of the drawing.

Referring to the drawing *a* is an oblong, rectangular tank, vat or the like constructed of concrete, slate, impregnated wood or any other suitable material, into which is placed *a* likewise rectangular smaller vessel *b*. The vessel *b* serves as a cathode compartment while the remaining space in the electrolyser *a* is utilized as anode compartment. Unlike the tank *a*, which is preferably constructed of a single material, the vessel *b* is composed or built up of a plurality of different parts. On a bottom plate *c* is placed the diaphragm *d* of only a few millimetres height which in its turn carries or supports the considerably higher impermeable partition *e*. The said three parts *c*, *d* and *e* are preferably combined into a single structure. At the inner side of the diaphragm *d* there is arranged a quantity of mercury *f* and at the outer side of the diaphragm there is located the anode *g*. The heights of the quantity of mercury *f* and the anode *g* are slightly greater than that of the diaphragm *d*. In the example illustrated a framework *h* the feet *i* which consist of graphite, for example, rest upon the bottom *c* of the inner vessel *b* and this dip into the mercury *f*, serving as leads for the supply of current to the mercury cathode. A bipolar connection to the mercury *f* may be effected by placing a cathode secured in position merely by a suspension or by resting upon non-conducting blocks at some distance above the mercury. Into the anode compartment A there is introduced in the usual manner the solution of the alkali halide and into the cathode compartment K preferably pure water.

In order to obtain a decomposition speed adapted to the output of the plant for the amalgams forming cathodically, by paying attention to the above considerations, a suitable metal may be chosen, for example, cadmium.

Preferably a coating of cadmium is electrolytically deposited upon a netting of iron wire. The thus prepared wire gauze *h* is provided with feet of graphite *i* and placed on the bottom of the receptacle *b*. The graphite members *g* then serve simultaneously as leads to the mercury cathode *d*.

If desired the rate of decomposition of the amalgam which occurs when employing a certain metal may be controlled by varying the resistance located between the metal gauze *h* and the mercury cathode *f*, in the example illustrated the resistance of the rods of graphite *i*. This may, for instance, be effected by impregnating or coating the rods of graphite *i* with a liquid insulating agent, such as a suitable varnish. The resistance may also be omitted altogether so that the mercury is then in bipolar connection.

As diaphragms porous plates of sufficient strength to resist chemical actions are used, for instance plates of chromic oxide, aluminum oxide, infusorial earth (Kieselguhr), vulcanite and the like.

It is also possible to arrange displacement bodies *k* in the mercury whereby a further substantial saving in mercury can be effected. For this purpose the bottom of the vessel *b* may be provided with suitable projections, for instance. The mercury may then be arranged in the shape of a ring, for example. As numerous tests extending over a long time have shown our improved cell works very economically and entirely free from any objections although only a very small quantity of mercury is required.

It will be understood that structural modifications and changes may be made without departing from the spirit of our invention and the scope of the appended claims.

We claim as our invention:

1. In an electrolytic cell for the electrolysis of alkalis or alkaline-earths of the halogens according to the mercury process, in combination, an anode compartment, a cathode compartment, a partition dividing said anode compartment from said cathode compartment only the portion of which adjacent to the bottom of the electrolyser is porous, mercury within the cathode compartment covering the entire porous portion of said partition, and a cathode located above the mercury, which is electrically connected to the mercury through high-ohmic resistances.

2. In a cell for the electrolytic decomposition of alkaline metal halides, a containing vessel forming an anode compartment, an interior cathode compartment resting on the bottom of said containing vessel, the walls of said cathode compartment being impermeable for the greater part of their height but having a narrow, porous, horizontal section adjacent the said bottom of said containing vessel.

3. The electrolyte cell of claim 2 in which the porous, horizontal section of the cathode compartment is annular and has a height of the order of a few millimeters.

4. The electrolytic cell of claim 2 in which the cathode compartment is filled with mercury to a height just above the said porous, horizontal section.

5. The electrolytic cell of claim 2 in which the anode rests on the bottom of said containing vessel, the said anode extending to a height somewhat above that of the said porous, horizontal section of said cathode compartment.

6. In a cell for the electrolytic decomposition of alkaline metal halides, a cathode

compartment containing a shallow layer of mercury amalgam and a metal cathode, the said amalgam and the said cathode being electrically connected by a resistance element whose resistance is capable of being varied, whereby the rate of decomposition of the amalgam may be controlled.

7. The electrolytic cell of claim 2 wherein the cathode compartment contains a shallow layer of mercury and displacement members in the bottom of said compartment of size sufficient to effect a substantial saving in mercury.

8. The structure of claim 2 in which a cathode is employed in said cathode compartment, said cathode being free from metallic connection with the amalgam in the cathode compartment.

9. In a cell for the electrolytic decomposition of alkaline metal halides by formation and subsequent decomposition of an alkaline metal amalgam, a cathode comprising a wire gauze coated with cadmium.

10. In a cell for the electrolytic decomposition of alkaline metal halides by the formation and subsequent decomposition of an alkaline metal amalgam, a cathode having a composition comprising cadmium.

In testimony whereof we affix our signatures.

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