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ELECTROLYTIC APPARATUS.

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**1,003,456.**

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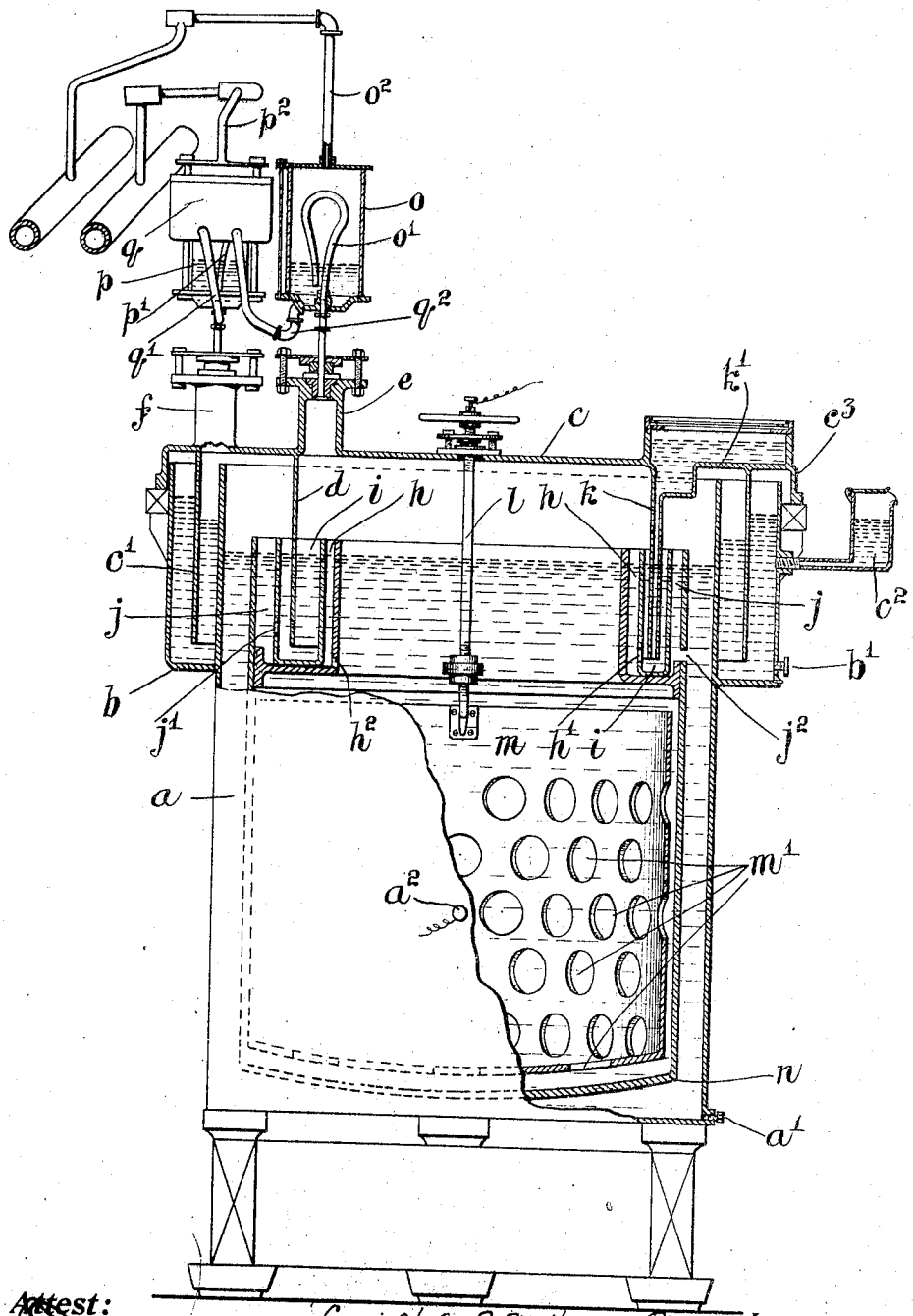


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# UNITED STATES PATENT OFFICE.

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## ELECTROLYTIC APPARATUS.

1,003,456. Specification of Letters Patent. Patented Sept. 19, 1911.

Application filed February 6, 1911. Serial No. 606,810.

*To all whom it may concern:*

Be it known that I, LOUIS H. A. B. M. HAZARD-FLAMAND, a citizen of the French Republic, residing at Boulogne-sur-Seine, France, have invented certain new and useful Improvements in Electrolytic Apparatus, of which the following is a specification, reference being had therein to the accompanying drawings, which form a part thereof.

My invention relates to electrolytic apparatus and more particularly to a type thereof, adapted to disassociate oxygen and hydrogen in commercial quantities by electrolysis, and embodying therein a diaphragm for maintaining a gas proof partition between the electrodes.

The main object of the invention is to provide an apparatus of this character which will operate continuously and produce substantially pure oxygen and substantially pure hydrogen without likelihood of a commingling of these gases after the decomposition of the electrolyte.

A further object is to provide an apparatus wherein the electrolyte will be maintained at substantially uniform strength to insure uniformity in the operation of the apparatus.

A still further object is to provide an apparatus of this character, wherein the electrolyte will not be exposed to the air, so as to avoid an increase in the resistance of the current through a chemical change in the electrolyte due to such exposure or contact.

A still further object is to provide an apparatus wherein the body of the electrolyte adjacent to the anode and that adjacent to the cathode will be prevented from commingling freely, and thus minimize likelihood of the bubbles formed by the hydrogen gas or by the oxygen gas passing about the water seal separating those parts of the apparatus which may be termed the hydrogen take-off chamber and the oxygen take-off chamber.

A still further object is to provide an apparatus of this character wherein the electrodes will have sufficient surface capacity to minimize the resistance thereof, and will be so constructed as to prevent the formation of a scale thereon from continued operation of the apparatus.

A still further object is to provide an apparatus wherein the take-off mechanism will embody therein means for washing the respective gases, and at the same time afford visual indicators for determining the efficiency of the apparatus at any time.

A still further object is to provide an apparatus wherein the generating apparatus proper will be protected against back-firing through take-off mechanism in case of the accidental firing of the stored gases.

A still further object is to provide an apparatus wherein the electrolyte may be circulated freely in and about the anode and the oxygen formed upon said anode may find a free course to the out-take.

A still further object is to provide a take-off mechanism which will maintain a constant pressure within the generator irrespective of any variation in the pressure of the holder.

A still further object is to provide an apparatus wherein, in case of stoppage of the take-off mechanism, the gases will be automatically vented to avoid the development of dangerous pressure within the apparatus. And a still further object is to provide an apparatus which will not require the constant attention of the operator.

The invention consists in the novel features of construction and combination of parts hereinafter set forth and described, and more particularly pointed out in the claims hereto appended.

In the accompanying drawing, I have shown an apparatus embodying my invention, said apparatus being shown partly in elevation and partly in section to disclose the interior construction thereof.

In the embodiment of my invention shown in the drawings, the cathode *a* is in the form of a tank having an open top about which is formed a trough *b* adapted to coöperate with a pendant flange *c'* upon a closure *c*, in forming a gas tight joint about the top of said tank, said trough being filled

with oil in sufficient quantity to form a perfect liquid seal about the flange $c'$. Communicating with this trough is a tank $c^2$ by means of which the quantity of oil in the trough may be determined and the oil in said trough may be replenished if required. The top of this trough is inclosed by an overhung lip $c^3$, by means of which the closure is supported from the trough $b$ by means of insulating material. The trough $b$ is provided with a drain port, normally closed by the closure plug $b'$. The cover $c$ has pendant therefrom, parallel to, and concentric with the flange $c'$, a second flange $d$ adapted to separate the interior of said cover so as to form two distinct chambers, an oxygen chamber within the flange $d$ and a hydrogen chamber between said flange and the flange $c'$.

The cover $c$ is gas tight and is provided with off-take ducts $e$ and $f$ upon opposite sides of the flange $d$, through which respectively, the oxygen and the hydrogen are drawn from the chambers above referred to. Pendant from, and sustained by, the cover $c$ is a distributer for the electrolyte comprising three concentric troughs, $h$ $i$ $j$, one of which, as $i$, communicates with the other two at one point of the circumference thereof through the ports $j'$ $h'$, and the other which troughs $h$ and $j$, communicate through the ports $h^2$ $j^2$ respectively, with the oxygen chamber and with the hydrogen chamber at a point substantially diametrically opposite to the ports $j'$ $h'$, thus causing the maximum circulation of the electrolyte or diluent prior to its commingling with the electrolyte already within the apparatus. Discharging into the trough $i$ adjacent to the ports $h^2$ and $j^2$ is a duct $k$, leading from a tank $k'$ formed upon, and opening upwardly of, the closure $c$. By this means the electrolyte in the first instance, or a fresh supply of distilled water, to replace the water in the decomposed electrolyte, may be charged into the apparatus; and in case of stoppage of the off-take mechanism or pipe, said gases are permitted to escape into the atmosphere to prevent the development of dangerous conditions within the apparatus. The supports for this distributer consist of a plurality of screw threaded rods $l$. These rods are supported from the closure $c$ by means of an insulated joint and are attached to the said distributer by a similar joint, so as to permit them to be used as poles for the anode $m$ which they also support. If desired, however, separate supports may be used for this anode and this distributer, although such are not necessary when the distributer and the closure are properly insulated from a support common to both of these parts.

The anode $m$ comprises a steel cup having a plurality of openings $m'$ therethrough, both as to the sides and bottom thereof, so as to permit a free circulation of the electrolyte in and about it, steel being used to cause any deposit formed through the decomposition of the electrolyte to fall from the surface of the anode instead of accumulating thereon in the form of a scale and thus increasing the resistance of the anode. The free circulation of the electrolyte about the anode tends to preserve a uniform condition and strength of electrolyte. The anode $m$ is open at the top as shown in the drawings.

Encircling and attached to the distributer is a cup-shaped diaphragm $n$ completely inclosing, but spaced slightly away from, the anode $m$, which diaphragm is of absorptive material, preferably pure asbestos, so as to become impregnated with the electrolyte to an extent to form a conductor for the electric current and at the same time form a gas tight partition between the anode and the cathode.

By the foregoing description it will be seen that the anode and the diaphragm always have a fixed relative position as they are both supported from the distributer.

The tank $a$ is provided with a drain port, closed by the plug $a'$, and carries a binding post $a^2$ by means of which it may be connected to the negative pole of a source of electrical supply. The tank $a$ constitutes the cathode of the couple forming the cell, and it is therefore essential to insulate this tank to avoid short circuiting, or the grounding of the current.

To indicate the operating conditions within the apparatus and also to wash the gases, I provide the lanterns $o$—$p$, communicating respectively with the off-take leads $e$ $f$. Within each of these lanterns is a looped extension $o'$—$p'$ of the leads $e$ $f$ respectively, which opens downwardly below the level of a body of water maintained in said lanterns. Preferably the entire cylindrical portion of the lanterns $o$ $p$ is of transparent glass to enable the operator to determine visually the level of the water within the lantern, and also the apparent volume of gas passing therethrough as indicated by the bubbles. Said lanterns are gas tight and extending from the tops thereof, respectively, are pipes $o^2$ and $p^2$ leading to a gasometer or other point of delivery of the gases. Mounted adjacent to the lanterns $o$ $p$ is a water tank $q$ from which water is supplied to the said lanterns through the pipes $q'$ $q^2$. This tank is so placed as to cause a water feed to the lanterns by gravity, which also permits the determination of the pressure of gas within the apparatus, by the relative water levels in the lanterns and in the tank. All of the fittings in and about the lanterns $o$ $p$ and the off-takes $e$—$f$ are gas tight, the details

of the various joints being immaterial to the invention.

The operation of the herein described apparatus is substantially as follows:—The anode *m* and diaphragm *n* are secured within the closure *c* by the rods *l*, and the said closure mounted upon and insulated from the tank or cathode *a*. The various connections with the lanterns *o p* are then made and the apparatus is ready for use.

The trough *b* is first filled with oil by means of the tank $c^2$, and electrolyte discharged into the tank *a* upon both sides of the diaphragm by means of the tank *k'* and duct *k*. The electrolyte passing to the tank first enters the trough *i* in which it flows to a point diametrically opposite the point of delivery to said trough until it reaches the ports *j' h'* through which it flows to the troughs *h j* in which it must circulate an equal distance before reaching the discharge ports $h^2$ and $j^2$ through which it flows upon opposite sides of the diaphragm. It will be observed that while the electrolyte flows from one original source, the tank *k'*, the electrolyte is so divided by means of the trough *i* as to form a liquid seal about this said trough, and that the two branches of the divided current are caused to respectively traverse an open trough between the point of delivery to the trough and the point of discharge therefrom, for a distance sufficient to cause either the hydrogen or the oxygen to separate themselves from the current in the trough before they reach a point where they may enter the trough *i*. Each day a supply of distilled water is discharged into the apparatus to replace that decomposed by the continued operation of the apparatus, and the construction and arrangement of troughs above referred to operate at all times to prevent a commingling of the oxygen and hydrogen within the trough *i* whence either gas might pass to the chamber designed to receive the other.

The flange *d* at all times prevents the commingling of oxygen and hydrogen rising to the top of the apparatus.

While the current is on, it passes from the anode *m* to the cathode *a*, the diaphragm *n* offering no material resistance to said current. This flow of the current decomposes the electrolyte, the oxygen being dissociated from the hydrogen adjacent to the anode *m*, and the hydrogen being dissociated from the oxygen adjacent to the cathode *a*, the freed gases accumulating upon the surface of their respective electrodes in the form of bubbles which rise through the volume of electrolyte and accumulate respectively within the flnage *d* and between said flange and the flange *c'*, the diaphragm *n* holding the said gases apart below the said flange *d*. The oil seal in the trough *b* prevents the escape of such gas about the top of the tank *a*. Oil may be safely used in this connection as only hydrogen can contact therewith.

As the gases accumulate within their respective chambers, they flow to the lanterns *o p* where they are washed and delivered or withdrawn through the pipes $o^2$ $p^2$. The gas delivered to the lanterns raises the pressure therein above the normal water level to an extent to force some of said water to the tank *q*, the leads *q'*—$q^2$ being normally open. Inasmuch as the pressure developed rarely exceeds from 3 to 4 ounces to the square inch, there will always be a water level within said lanterns sufficiently high to cover the discharge ends of the extensions *o' p'*. These lanterns remove any trace of the electrolyte carried by the gases, the product drawn from the lanterns being substantially pure, any impurities being merely traces in one gas of the other gas.

If stoppage should occur in the off-take system, the pressure in the gas chambers will rise until both gases will force their way to atmosphere through the trough *i* and duct *k*, the gases within the apparatus never commingling. The same result follows if the level of the electrolyte raches below the discharge of the duct *k*.

The diaphragm *n* being cup-shaped, eliminates any possibility of the gas bubbles forming in the bottom of the tank *a* passing to the oxygen chamber, and at the same time permits the increase of the effective surface of both the anode and the cathode by the use of a cup-shaped anode.

The openings in the anode permit a free circulation of the electrolyte about same, and also permit the oxygen accumulating upon the anode to have an easy course to the accumulating chamber at the top of the tank *a*, where it may readily pass through the off-take.

It is not my intention to limit myself to the exact details of construction shown in the drawings, it being apparent that such may be varied without departing from the spirit and scope of the invention.

Having described my invention, what I claim as new and desire to have protected by Letters Patent, is:—

1. In an electrolytic apparatus of the character described, the combination with the electrodes, of an absorbent diaphragm between said electrodes, a fluid seal about both sides of the top of said diaphragm, and means simultaneously delivering the agent to be decomposed on opposite sides of said diaphragm.

2. In an electrolytic apparatus of the character described, the combination with the electrodes of a diaphragm between said electrodes, a fluid seal about both sides of the top of said diaphragm, means constantly delivering the agent to be decomposed to the inner of said seals, said inner

seal being in communication with opposite sides of said diaphragm, and means whereby said agent is caused to circulate about said inner seal between the point of delivery thereto and of discharge therefrom.

3. In an electrolytic apparatus of the character described, the combination with the electrodes, of a diaphragm between said electrodes, a fluid seal about both sides of the top of said diaphragm, the inner of said seals being a double seal, and means constantly delivering the agent to be decomposed to one of the seals of said double seal, one of said seals being in communication with the other, and said other seal having an opening therein communicating respectively with opposite sides of said diaphragm whereby said agent is caused to circulate from one portion of said double seal to the other before being discharged therefrom about the electrodes.

4. In an electrolytic apparatus of the character described, the combination with the electrodes of a diaphragm between said electrodes, an outer fluid seal about said diaphragm and an inner fluid seal comprising a plurality of concentric troughs arranged one within the other, the inner of said troughs having ports therein communicating with the outer trough and the outer trough having ports therein whereby fluid delivered to said first named trough will be caused to circulate in said last named trough and to be delivered upon opposite sides of said diaphragm, and means constantly delivering the agent to be decomposed into said first named trough.

5. In an electrolytic apparatus of the character described, the combination with an outer cup-shaped electrode, and an inner cup-shaped electrode, of a cup-shaped diaphragm disposed between said electrodes, a fluid seal about both sides of the top of said diaphragm, and means simultaneously delivering the agent to be decomposed upon opposite sides of said diaphragm.

6. In an electrolytic apparatus of the character described, the combination with an outer cup-shaped electrode, and an inner cup-shaped electrode, having a plurality of openings extending therethrough, of a cup-shaped diaphragm disposed between said electrodes, a fluid seal about both sides of the top of said diaphragm, and means simultaneously delivering the agent to be decomposed upon opposite sides of said diaphragm.

7. In an electrolytic apparatus of the character described, the combination with the electrodes of an absorbent diaphragm between said electrodes, a fluid seal about both sides of the top of said diaphragm, said seal having ports therein whereby the agent to be decomposed is simultaneously delivered upon both sides of said diaphragm, a tank containing the agent to be decomposed, and a duct whereby the agent is delivered from said tank to the inner of said seals.

8. In an electrolytic apparatus of the character described, the combination with a tank forming one electrode, of a cup-shaped steel electrode suspended within said tank, a cup-shaped absorbent diaphragm between said electrodes, a trough about the top of said tank, a closure having a pendant flange entering said trough whereby a fluid seal is formed about the top of said tank, a trough inclosed by the top of said diaphragm and pendant from said closure, said closure having a pendant flange concentric with said first named flange whereby a second fluid seal is formed about the top of said diaphragm, said flanges forming independent gas chambers at the top of said tank, take-off means communicating respectively with said chambers, and means delivering the fluid to be decomposed to the trough about the top of said diaphragm whereby said fluid is simultaneously discharged upon opposite sides of said diaphragm.

9. In an electrolytic apparatus of the character described, the combination with the electrodes of a diaphragm between said electrodes, a fluid seal about the top of one of said electrodes and about the top of said diaphragm, means in conjunction with said last named seal forming non-communicating gas chambers upon opposite sides of said diaphragm, off-take pipes leading from said chambers respectively, lanterns into which said off-take pipes respectively discharge, said lanterns containing a washing fluid, an inverted looped discharge end of said off-take pipes within said lanterns whereby the gases are discharged into the water in said lanterns, and take-off pipes communicating with said lanterns above the water level therein.

10. In an electrolytic apparatus of the character described, the combination with the electrodes of a diaphragm between said electrodes, a fluid seal about the top of one of said electrodes and about the top of said diaphragm, means in conjunction with said last named seal forming non-communicating gas chambers upon opposite sides of said diaphragm, off-take pipes leading from said chambers respectively, lanterns into which said off-take pipes respectively discharge, said lanterns containing a washing fluid, an inverted looped discharge end of said off-take pipes within said lanterns, whereby the gases are discharged into the water in said lanterns, take-off pipes communicating with said lanterns above the water level therein, a tank containing said washing fluid, and pipe leads from said tank to said lanterns whereby the fluid lev-

in said lanterns may be automatically varied by the pressure of the gases discharged thereinto.

11. In an electrolytic apparatus of the character described, the combination with the electrodes of a cup-shaped absorbent diaphragm inclosing one of said electrodes, a fluid seal about both sides of the top of said diaphragm, and means simultaneously delivering the agent to be decomposed upon opposite sides of said diaphragm.

In witness whereof, I have hereunto affixed my signature, in the presence of two witnesses, this 24th day of January, 1911.

LOUIS H. A. B. M. HAZARD-FLAMAND.

Witnesses:

DEAN B. MASON,

SAMUEL KELLLER.