United States Patent

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[33] **Japan**
[31] **42/21227**

[54] **ALKALI SALT ELECTROLYSIS BY MERCURY PROCESS AND APPARATUS THEREFOR**
2 Claims, 5 Drawing Figs.

[52] U.S. Cl. 204/220, 204/99, 204/250
[51] Int. Cl. C01d 1/08
[50] Field of Search 204/219–221, 250, 251

[56] **References Cited**
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ABSTRACT: In an alkali salt electrolysis operation by the mercury process in which mercury recovered in a denuding tower is recirculated with wash water through a return passageway to return to an electrolysis vessel, a large portion of this mecury is thus returned to the electrolysis vessel, and the remainder portion of the mercury, together with the wash water and mecury emulsion floating and flowing above it, undergo auxiliary recirculation back to the denuding toward.

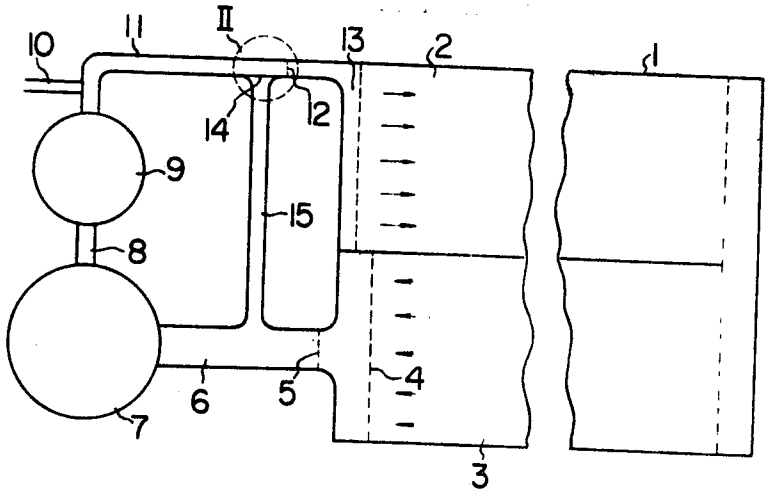

FIG. 1

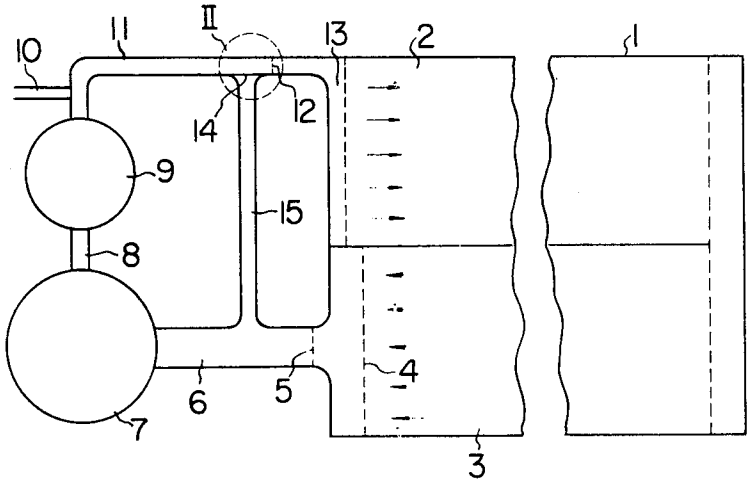

FIG. 2

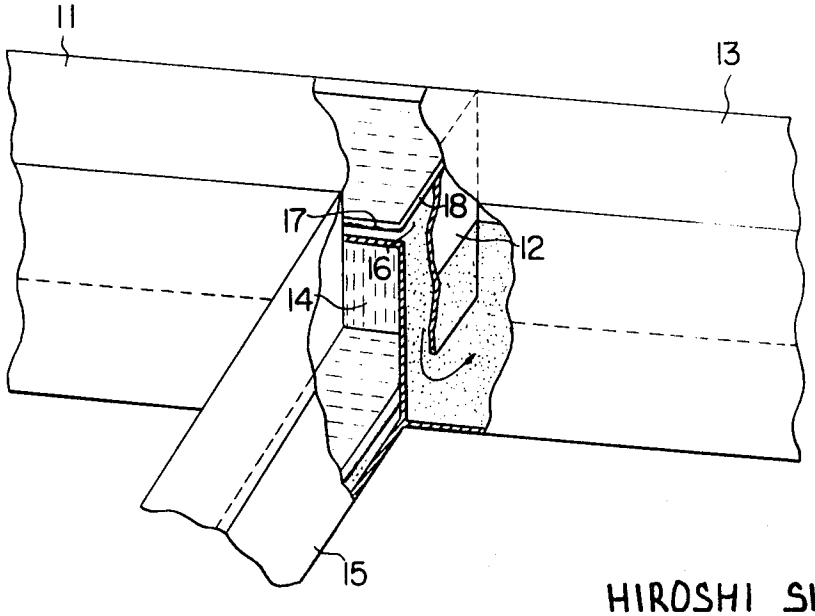

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FIG. 3

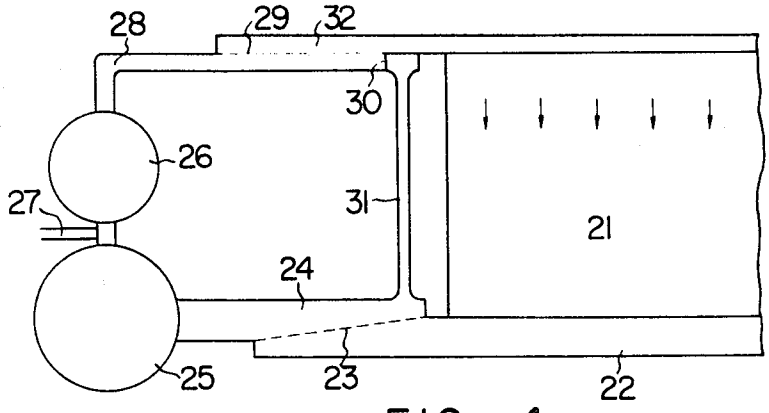


FIG. 4

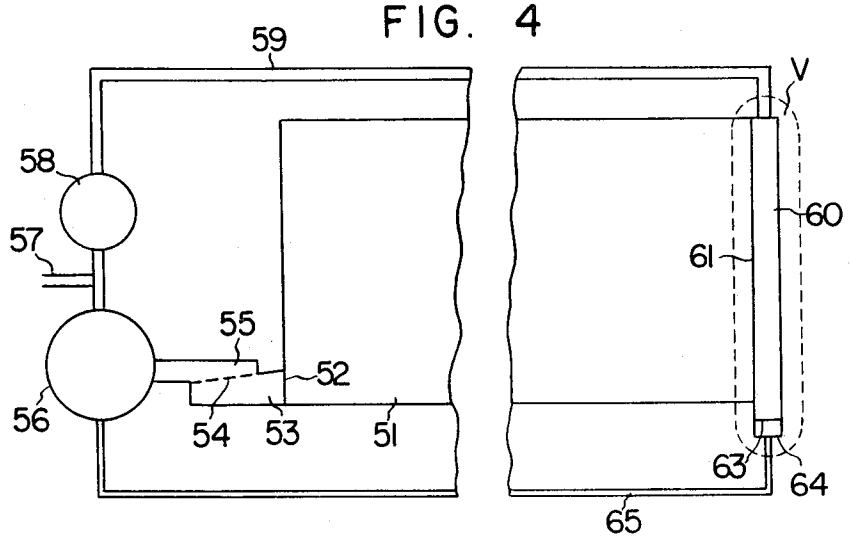
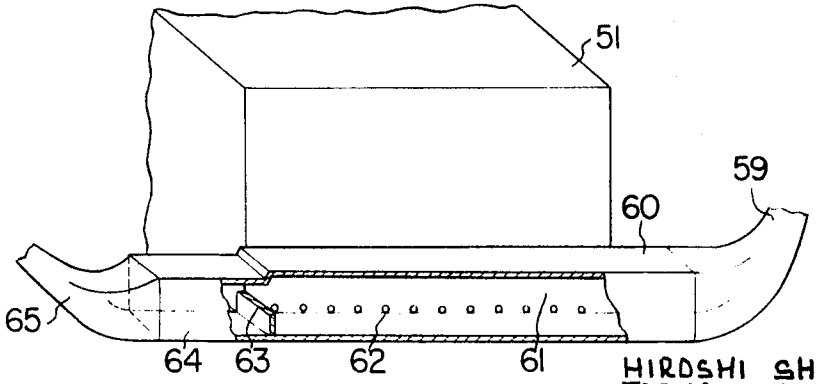


FIG. 5



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ALKALI SALT ELECTROLYSIS BY MERCURY PROCESS AND APPARATUS THEREFOR

BACKGROUND OF THE INVENTION

This invention relates generally to the field of the mercury process (or amalgam process) and more particularly to improvements in salt electrolysis by the mercury process and to new and improved apparatus thereof.

In general, the sodium amalgam, which is formed within a mercury process, using a slat electrolysis bath, is separated from the electrolyte and contaminants and then denuded in a denuding tower to recover mercury, which is separated from the caustic soda formed, washed with water, and then recirculated by a pump to the electrolysis bath. In this process, a portion of the mercury recovered in the denuding tower is rendered into minute particles by the agitation of the pump and becomes mixed with water or (and) contaminants, such as graphite powder which is produced by disintegration of denuding or decomposing granular graphite within the denuding tower, to form a butterlike emulsion, which floats on the surface of the mercury.

Ordinarily, this butterlike emulsion and the butterlike emulsion formed in the electrolysis bath by the intermixing of impurities such as magnesium salts and calcium salts within the electrolyte and disintegrated particles from the graphite anode with the mercury amalgam are collectively referred to as "-mercury butter." In the present disclosure, however, these two emulsions are differentiated, the former being referred to as "-mercury emulsion," and the latter being referred to as "amalgam butter."

When the mercury emulsion enters the electrolysis bath vessel, it is transformed into amalgam butter and produces various deleterious effects with respect to the electrolytic process, such as lowering of the electrical current efficiency and generation of hydrogen. Accordingly, a common countermeasure practiced heretofore has been to place an underflow baffle plate in the path of the mercury emulsion upstream from the electrolysis vessel to cause only mercury to pass under and past the baffle plate and flow to the electrolysis vessel, and to remove by scooping from time to time the mercury emulsion which collects on the upstream side of the baffle plate.

By this method, however, not only has there been the necessity of additional labor for scooping off the mercury emulsion, but there has also been the difficulty of preventing the mercury emulsion which accumulates on the upstream side of the baffle plate from being drawn and swept along with the mercury passing under the baffle plate and entering the electrolysis vessel to become intermixed with the electrolyte.

SUMMARY OF THE INVENTION

It is an object of the present invention to provide improvements in alkali salt electrolysis operation by the mercury process and apparatus therefor whereby the above stated difficulties can be overcome.

According to the present invention, briefly summarized, there are provided a mercury process, salt electrolysis method and apparatus in which, in the path of the mercury recovered in the denuding tower and being sent by a pump to the electrolytic bath vessel, most of this mercury is separated out, to be sent to the electrolysis vessel, by an underflow baffle plate (which may also constitute a part of the sidewall of the path in some cases) having at the lower part thereof a mercury passage for separating only mercury, while the contaminants, such as mercury emulsion, floating in the path on the upstream side of the baffle plate are caused to overflow continuously, together with a small quantity of mercury and wash water, over an overflow weir provided in the path into an auxiliary mercury circulation path and sent to the denuding tower thereby to prevent stagnant accumulation of mercury emulsion of the upstream side of the baffle plate and to thereby prevent mercury passing under and past the baffle plate.

BRIEF DESCRIPTION OF THE DRAWINGS

The nature, principle, detains, and utility of the invention will be more clearly apparent from the following detailed description with respect to preferred embodiments of the invention when considered in conjunction with the accompanying drawings, in which like parts are designated by like reference numerals.

In the drawings:

FIG. 1 is a diagrammatic plan view, with a part cut out for foreshortening, showing one example of an electrolytic apparatus embodying the invention;

FIG. 2 is a fragmentary, relatively enlarged perspective view, with parts cut away and parts in section showing the details of the part designated by Roman numeral II in FIG. 1;

FIG. 3 is a diagrammatic plan view, with a part cut away, showing another example of an electrolytic apparatus embodying the invention;

FIG. 4 is a diagrammatic plan view, with a part cut out for foreshortening, showing still another example of an electrolytic apparatus embodying the invention; and

FIG. 5 is a fragmentary, relatively enlarged perspective view, with parts cut away and parts in section, showing the part designated by Roman numeral V in FIG. 4.

DETAILED DESCRIPTION OF THE INVENTION

In one embodiment of the invention as illustrated in FIG. 1, the principal part of the electrolytic apparatus is a salt electrolytic bath vessel 1 having an entrance-pass electrolysis chamber 2 and an exit-pass electrolysis chamber 3. Mercury which has flowed through these electrolysis chambers and has become a sodium amalgam passes through a gas baffle 4 and a mercury baffle 5, thereby being separated from electrolyte and amalgam butter, and then passes through an amalgam outlet passageway 6 to enter a denuding tower 7. In the denuding tower 7, denuding is accomplished, and, as caustic soda is formed, mercury is recovered.

The mercury thus recovered passes through path or conduit 8, is pumped by a pump 9, and enters a mercury return passageway 11, where the mercury is washed by wash water supplied into the passageway 11 through a wash water inlet 10. Then, at a mercury underflow baffle 12, only mercury is separated out and is recirculated to a mercury inlet passageway 13 of the electrolysis vessel 1.

According to the present invention, an auxiliary circulation path 15 connected through an overflow weir 14 to the mercury return passageway 11 is provided, and over this weir 14, as shown in detail in FIG. 2, mercury emulsion 17 which would otherwise accumulate in a stagnant state on the upstream side of the mercury baffle 12 and wash water 18 together with a small quantity of mercury 16 are caused to overflow and, flowing through the path 15, enter the aforementioned amalgam passageway 6 to recirculate to the denuding tower 7.

Thus, according to the invention, the labor required for operation is reduced since there is no necessity for scooping off accumulated mercury emulsion. Furthermore, there is no loss of mercury which would inevitably occur in the refining of the mercury emulsion if it were to be removed by scooping.

Another feature of this separation method and means is that, since a small quantity of mercury 16, together with mercury emulsion 17 and wash water 18, is constantly overflowing over the weir 14, the surface part of the mercury on the upstream side of the baffle 12 is flowing continuously toward the weir 14, and, therefore, even if there is a tendency of the greater portion of the mercury which passes under and past the baffle 12 to exert a pull on the mercury in the upper part, the induced flow of or on the mercury surface acts as a barrier whereby the mercury emulsion and wash water floating above the mercury are prevented from accompanying the mercury passing through the baffle 12. This mercury separation can be made even more effective by constructing the baffle member so that it forms a part of a sidewall of the passageway 11 and is, therefore, parallel or nearly parallel to the mercury flow

path. An example of such a construction is illustrated in FIG. 3.

Mercury emulsion is not separated in the practice of the present invention for the following reason. Since mercury emulsion has a lower viscosity than amalgam butter containing metallic salts such as magnesium salts and calcium salts, there is no possibility of mercury emulsion clogging parts of the denuding tower when it is introduced into the denuding tower. Furthermore, since it is relatively easy to separate mercury out of mercury emulsion, almost all of the emulsion is broken down during its passage through the denuding tower, and mercury is separated out.

Most of the contaminants such as graphite particles formed in the denuding tower have, even heretofore, been discharged together with the caustic soda formed in the denuding tower and have been removed by means such as filters. Accordingly, contaminants such as graphite particles contained in the mercury emulsion can also be discharged and removed together with the caustic soda.

Furthermore, since the mercury emulsion is recirculated in the aforedescribed manner by means of the auxiliary circulation path **15** in accordance with the invention, there is no necessity of being concerned with an increase to some extent in the formation of mercury emulsion within the mercury pump, and it has also become possible to reduce the quantity of mercury accumulating in the pump by using a high-speed pump.

A further feature of the invention is that all of the wash water is recirculated to the denuding tower and used as amalgam denuding water, whereby a high recovery rate of caustic soda is obtained.

While the invention has been described above with respect to an electrolytic bath vessel **1** with a doubled back electrolysis circuit (i.e., a 2-pass circuit) **2, 3** as illustrated in FIG. **1** and auxiliary circulation path **15** confluently joining the amalgam passageway **6**, the present invention is not limited in application to the mercury circuit of such a specific organization. That is, the invention can be applied with equal effectiveness to the mercury circulation paths of many other apparatus organizations as, for example, a horizontal electrolysis vessel of single-pass type which is being widely used or a long narrow electrolysis vessel as illustrated in FIG. **3** in which the flow is transversely directed across the width of the vessel. Furthermore, the auxiliary circulation path may be connected directly to the denuding tower.

In the apparatus illustrated in FIG. **3** and constituting another example of embodiment of the invention, the mercury which has flowed through an electrolysis chamber **21** in the arrow direction and become an amalgam flows along a passageway **22** and out of the vessel and, at a mercury underflow baffle **23**, is separated from the electrolyte and amalgam butter. The mercury amalgam thus separated enters a passageway **24**, where it confluently joins wash water, mercury emulsion, and other substances flowing into passageway **24** through an auxiliary circulation path **31** to enter a denuding tower **25**. Amalgam butter and other substances accumulating on the upstream side of the mercury baffle **23** are removed by a suitable method.

The resulting mercury leaving the denuding tower **25**, together with wash water supplied through an inlet **27**, is pumped by a pump **26** into a passageway **28** having a sidewall which is partly formed by a mercury underflow baffle **29**.

A weir **30** is provided at the downstream extremity of the passageway **28**, and matter overflowing this weir into the upstream end of the aforementioned auxiliary circulation path **31**.

Most of the mercury flowing through passageway **28** passes under and past the baffle **29** and enters a passageway **32** and, passing therethrough, is recirculated to the electrolysis vessel **21**. In this separation operation, a small portion of the mercury, together with mercury emulsion and wash water, is constantly overflowing over the weir **30**. The mercury flowing through passageway **28** and arriving at the weir **30** has high kinetic energy, and the mercury at the upper part of this flow which overflows over the weir **30** retains its kinetic energy. Therefore, even when the main body of the mercury flows under and past the baffle **29** at a high flowrate, the flow thereabove is unaffected thereby and is not drawn and swept into the flow under the baffle **29**.

In the example apparatuses described above and illustrated in FIGS. **1, 2,** and **3**, the mercury sent from the mercury pump (**9** or **26**) through the return passageway (**11** or **28**) is separated out by a mercury baffle (**12** or **29**) and, after first entering a mercury supply passageway (**13** or **32**) outside of the electrolysis vessel, is then sent therefrom into the electrolysis vessel. However, it is also possible in some cases to use an organization wherein a part of the mercury path on the delivery side of the mercury pump serves additionally as a mercury supply passageway at the inlet side of the electrolysis vessel, this passageway adjoining and communicating with the electrolysis vessel through a common sidewall constituting a baffle plate therebetween and provided at its lower part with one or more mercury separating openings, and an overflow weir and an auxiliary circulation path are provided at the downstream end of this mercury supply passageway. One example of such an organization according to the invention is illustrated in FIGS. **4** and **5**.

In this example apparatus, the mercury amalgam which has been formed in an electrolysis vessel **51** flows out through outlet **52** into a passageway **53** and is separated from electrolyte and amalgam butter at a mercury baffle **54**. The mercury amalgam thus separated flows through a passageway **55** to a denuding tower **56**. The mercury leaving the denuding tower is pumped, together with wash water supplied through an inlet **57**, by a pump **58** into a return passageway **59** having a downstream part **60** which constitutes the above mentioned mercury supply passageway.

This passageway **60** is parallely adjacent to the inlet side of the electrolysis vessel **51** and has therewith a common sidewall **61** having along its lower part a large number of openings **62** for separating mercury through which the passageway **60** communicates with the interior of the electrolysis vessel **51**. Most of the mercury supplied through the passageway **60** passes through these openings **62** into the vessel **51**.

A weir **63** is provided a cross the downstream end of the passageway **60**, and a small portion of the mercury flowing along this passageway overflows, together with mercury emulsion and wash water floating thereabove, over this weir **63** to fall into a chamber **64** and, passing through an auxiliary circulation path **65** connected to this chamber **64**, is recirculated directly to the denuding tower **56**.

It should be understood, of course, that the foregoing disclosure relates to only preferred embodiments of the invention and that it is intended to cover all changes and modifications of the examples of the invention herein chosen for the purposes of the disclosure, which do not constitute departures from the spirit and scope of the invention as set forth in the appended claims.

1. In an apparatus system for conducting an alkali salt electrolysis by mercury process, which apparatus embodies an electrolysis vessel (**1**) having sidewalls and portions constituting an inlet side and an outlet side; a denuding tower (**7**) having inlet and outlet sides for receiving and exiting mercury and related fluid flow media, and operable for denuding mercury amalgam evolved in the process as received from said electrolysis vessel (**1**) in order to recover mercury; conduit means forming circulation passageways a portion of which connects said vessel (**1**) with said denuding tower, and for otherwise conducting mercury and mercury amalgam and other related fluid including mercury emulsion toward and away from said vessel and tower; said conduit means also including a mercury return passageway (**11**) operably connected to said vessel: means (**10**) for introducing wash water into the system; and pump means (**9**) for positively conveying said mercury together with wash water through said system including passage through said mercury return passageway (**11**) leading

to said vessel (1); the improvement comprising in combination therewith:

a. a weir (12) disposed in a lower portion of said mercury return passageway (11), so as to separate and help collect a large amount of mercury within the lower portion of said passageway (11), while permitting weir overflow of relatively small amounts of the separated mercury together with wash water and mercury emulsion fluid flowing above said mercury responsive to a flow induced by the pump means (9) to convey the mercury and amalgam fluid;

b. means (13) channeling said large amount of separated mercury into said electrolysis vessel;

c. branch conduit means (15) constituting part of said conduit means, and forming an auxiliary mercury emulsion circulation passageway for conducting the combined smaller amounts of mercury, wash water and mercury emulsion back to said denuding tower (7);

d. said auxiliary circulation passageway (15) interconnected with said return passageway (11) adjacent said weir (12) and connected with the input side of said tower (7);

e. said means (9) to convey the fluid mercury and mercury amalgam include a high-speed circulating pump having an input side and an output or delivery side, said pump interposed between said tower (7) and vessel (1), at the output side of said tower (1), and operably connected with said mercury return passageway (11) preceding the latter's connection with said vessel (1);

f. said mercury return passageway (11) including a portion downstream of said pump serving also as a mercury supply passageway (60) at the inlet side of said vessel (1); said latter-mentioned mercury supply passageway being elongated and disposed to adjoin and communicate with a sidewall of said electrolysis vessel (1) by means of a common wall portion which constitutes a baffle plate therebetween, said baffle plate provided at its lower part with at least one mercury-separating opening; and

g. said apparatus further including an overflow weir (63) disposed transversely to the elongated direction of flow in a lower portion of said latter mercury supply passageway (60) at the downstream end beyond said mercury-separating opening, and said auxiliary recirculation passageway (15) of paragraphs (c) and (d) being connected with the downstream end of said mercury supply passageway (60) beyond said weir (63) in an arrangement interconnecting it operatively back with said inlet side of said tower (7).

2. For use in an apparatus system for conducting an alkali salt electrolysis by mercury process, which apparatus comprises an electrolysis vessel and a denuding tower, each having an inlet and outlet side, and said tower serving to denude mercury amalgam evolved from said vessel to recover mercury; conduit means connecting said vessel and tower in a fluid flow circuit into which wash fluid media is introduced; and pump means for imparting a positive flow to intermixed mercury and wash media through the circuit, the improvement in the combination of an electrolysis vessel having adjoined integrally therewith an elongated tubular mercury supply passageway adaptable to constitute a portion of said conduit means; said mercury supply passageway and vessel having a common elongated sidewall constituting a baffle plate therebetween at the inlet side of said vessel, and which baffle plate is provided with a series of mercury-separating openings along its lower part; said mercury supply passageway further having at its downstream end an overflow weir disposed transversely thereacross so as to have a predetermined space thereabove for predeterminable overflow of a mercury and wash flow media; and said mercury supply passageway downstream of said weir constituting at least an initial part of an auxiliary circulation conduit adapted to be connected in the circuit to recirculate the flow media operably back to said denuding tower.