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A. G. BASILEVSKY

ELECTROCHEMICAL PROCESS AND APPARATUS WITH PURIFICATION OF MERCURY

Filed March 2, 1960

3,091,579

FIG. 1

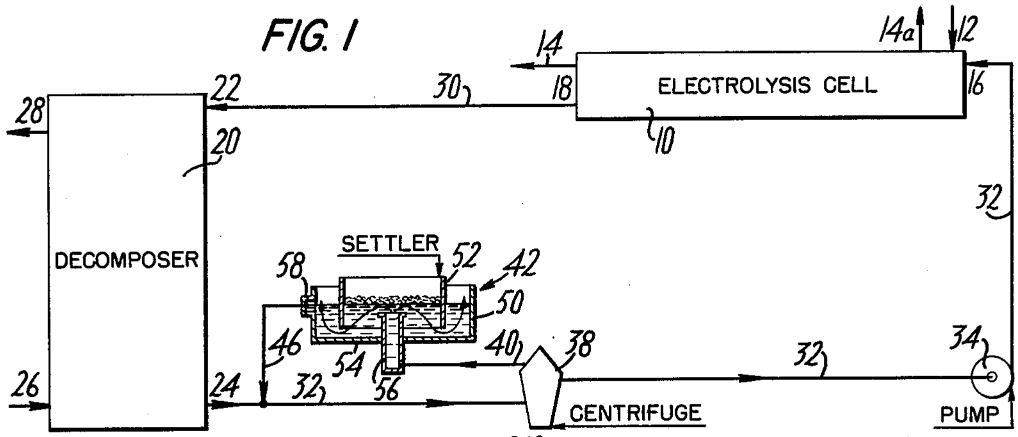
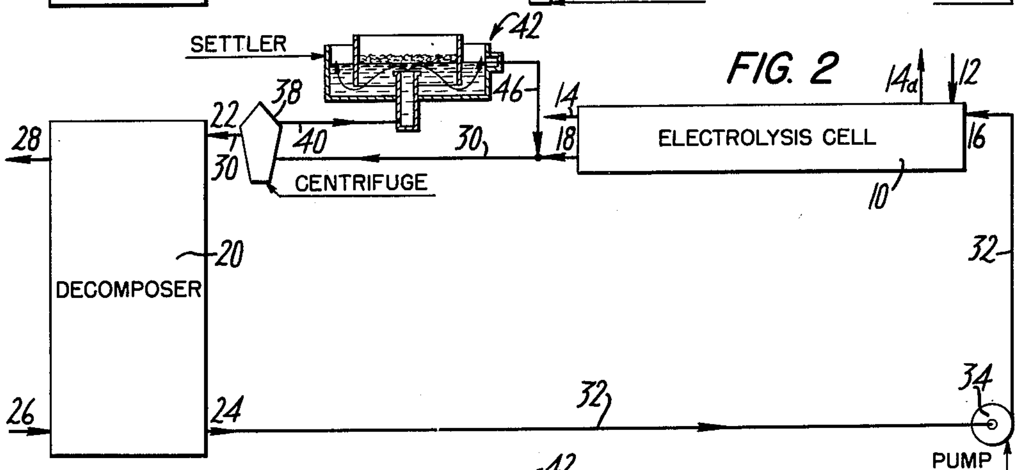


FIG. 2



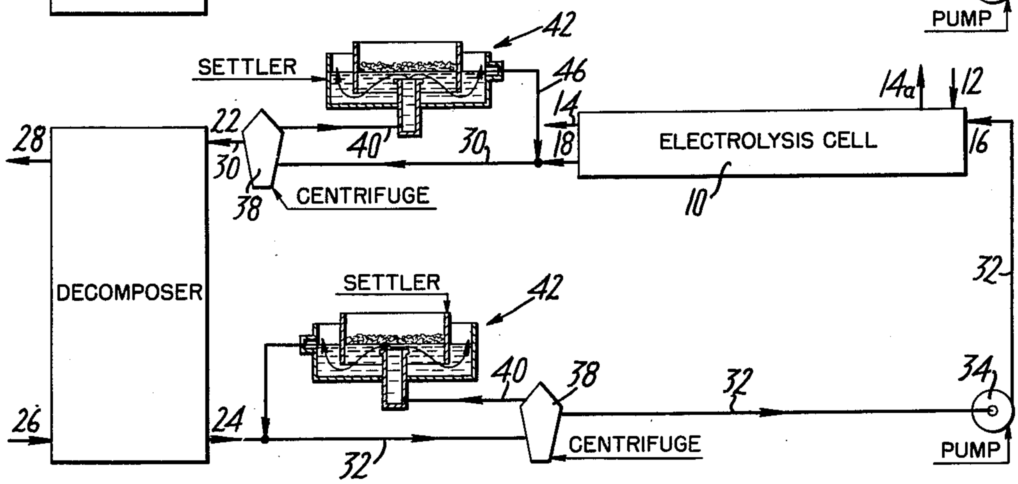


FIG. 3

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ELECTROCHEMICAL PROCESS AND APPARATUS WITH PURIFICATION OF MERCURY

Alexis G. Basilevsky, Sea Cliff, N.Y., assignor to Electrochemical Processes, Inc., New York, N.Y., a corporation of New York

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This invention is concerned with electrolysis apparatus of the mercury cathode type and, while not limited thereto, is more particularly concerned with apparatus of the character indicated for the electrolysis of aqueous solutions of alkali metal salts, for example the electrolysis of an aqueous sodium chloride solution.

The electrolysis of sodium chloride in aqueous solutions to liberate chlorine and sodium is carried out in various types of electrolysis apparatus. The mercury cathode electrolytic cell has been found particularly effective for carrying out this reaction and is extensively used in commercial electrolysis installations. In the mercury cathode cell, in which the salt solution to be decomposed is continuously circulated, a stream of metallic mercury is caused to flow through the cell, generally over the bottom thereof, in contact with the brine. As metallic sodium is liberated during the electrolysis reaction, it combines with the flowing mercury stream to form an amalgam therewith and the thus-formed amalgam is removed from the electrolysis cell and later decomposed in a denuding cell to liberate mercury, which is recycled to the electrolysis cell, and to form sodium hydroxide and hydrogen by reaction of the liberated metallic sodium with water. The chlorine liberated in the electrolysis cell is removed in any convenient manner. The anodes of the electrolysis cell are generally formed from graphite and are electrically connected to a source of electrical current.

To achieve economical and effective operation of the mercury cathode eletrolytic installation, it is important to insure that the alkali metal amalgam will decompose only in the denuding cell, or decomposer, and not in the electrolysis cell. It is important to prevent decomposition in the electrolysis cell because any such decomposition would liberate alkali metal hydroxide and hydrogen in that cell and this not only would diminish the current efficiency of the cell, thus increasing the consumption of electric power per unit of final useful product of electrolysis, but ^{-}OH and ^{-}OCl ions would be discharged at the anode and graphite consumption would be increased, with the further serious danger that the liberated hydrogen and the chlorine evolved at the anode could produce an explosive mixture of gases.

It has been found that certain metallic impurities when present in the electrolysis cell have a marked effect on the electrolysis operation by promoting the decomposition of the amalgam in the cell, often to the extent of making practical electrolysis impossible because of the dangerous evolution of hydrogen gas.

The most dangerous impurities are metals such as vanadium, chromium, molybdenum and titanium. Other metals such as nickel and iron are also dangerous, but to a lesser degree. Apparently the most dangerous metals are those which can exist in a form which is not readily soluble in the mercury or amalgam. The mechanism of their adverse action is not fully understood, their action has long been known.

The amount of impurities of the character indicated above which are deposited, along with the alkali metal, on the mercury cathode at any one time is extremely small and this amount does not adversely affect the electrolytic process to any significant extent and can be readily tolerated. However, the precipitated impurities remain with

the flowing mercury cathode throughout its cycle in the apparatus and they gradually accumulate in quantity as additional amounts are precipitated, during continuous operation of the electrolysis cell, until they reach a concentration which does seriously affect the electrolytic reaction and the adverse reactions referred to above begin to take place. It is necessary, therefore, either to discard the mercury when the impurity concentration reaches a dangerous value or it is necessary to separate the impurities from the mercury and restart the mercury cycle through the apparatus with purified mercury. Obviously, the first alternative is impossible from an economical standpoint, since a typical mercury cathode electrolytic installation involves tons of mercury, and discarding of the mercury when the impurity concentration became too high would be prohibitive in cost. It is, therefore, necessary to resort to purification and many proposals for this purpose have been made. The impurities, however, occur in extremely finely-divided form and their effective separation is not without very serious difficulty and prior proposals have involved both physical means or chemical precipitating treatments. Heretofore, a common procedure has been to remove the mercury from the cells at certain intervals and to purify it in a separate installation by distillation. Such a procedure has the great disadvantage that it is necessary to shut down one or more cells, leading not only to a consequent reduction of production but also exposing the empty cells to the deleterious effects of rapid corrosion, with the concomitant formation of impurities that are particularly difficult to remove subsequently from the mercury. Furthermore, the mercury vapors formed during distillation are very poisonous and extreme care must be taken to insure against their escape into the work areas. In addition, the undesired impurities remain as a hot solid mass in the still and their removal presents many problems. While, therefore, distillation has been proposed as a means of purification, in British Patent 665,225 for example, it is far from a satisfactory solution of the problem.

Chemical procedures have also, as mentioned, been proposed, as in U.S. Patent 1,970,974 but not only do these involve substantial expeditures for reagents to effect removal of the impurities but, like the distillation procedure referred to above, they involve the treatment of large quantities of mercury since all of the mercury must be processed if effective separation of impurities is to be achieved and a large excess of mercury must be provided in the system in order to permit sufficient mercury to be cycled through the electrolytic apparatus while the contaminated mercury is being purified. This, of course, requires a substantial additional investment in mercury and, since there is necessarily some loss of mercury during treatment whether by chemical or by physical means, the known methods of treatment leave much to be desired from from a practical standpoint.

There is, therefore, an important need in this art for a purification procedure which will effectively remove the undesired impurities and prevent their accumulation to dangerous proportions in the electrolytic cell, which will require a minimum amount of excess mercury and which at the same time can be effected without complicated operations. It is also imporatant that any purification procedure be continuous. Previous continuous processes have, as mentioned, been complicated, non-economical, and have often involved serious operating problems such as the problem of handling mercury vapor. While, as mentioned, a certain amount of impurities can be tolerated without adverse effect from a practical standpoint, the adverse action begins and gradually increases with increasing quantities of impurities even before the truly dangerous concentration of impurities is reached.

Consequently, in procedures which wait for the dangerous concentration to occur before effecting purification still leave in the cell a period of adverse impurity activity. Continuous treatment, on the other hand, would completely eliminate this period of incremental impuritiy growth and minimum impurity concentration would be maintained at all times so that optimum cell operation could be insured and the above-described adverse influence of the impurities could be held to a negligible minimum.

It is, accordingly, an object of the present invention to provide an improved process for removing impurities from the mercury cathode of a mercury cathode electrolytic installation.

It is another object of the invention to provide a process of the character indicated which can be carried out continuously.

It is another object of the invention to provide a process for purifying a mercury cathode which requires a minimum additional amount of mercury in the system.

It is another object of the invention to provide a process of the character indicated which is effective to maintain the impurity concentration in the mercury cathode at a negligible minimum at all times.

It is a further object of the invention to provide an improved system for electrolysis using a moving mercury cathode.

In accordance with the invention, the electrolytic process involving an electrolysis step in the presence of a moving mercury stream, and a decomposition step wherein the amalgam formed in the electrolysis step is decomposed to release the mercury for recycling to the electrolysis step, is combined with a purification operation which comprises the steps of centrifuging the liquid mercury stream, at at least one point in its closed circuit between the electrolysis step and the decomposing step, to remove a light fractional portion containing substantially all of the impurities contained in the mercury, returning the heavy substantially impurity-free mercury to the liquid mercury stream, separating the impurities from the light portion by settling, and returning the thus-purified fraction of the light portion to the centrifuging step. In the foregoing, the mercury which serves as the cathode in the electrolysis step and then flows as an amalgam to the decomposing step, to be subsequently returned as freed mercury to the electrolysis step to repeat the cycle is referred to as the "mercury stream" although it will be appreciated that it is actually free mercury only during part of its cycle.

The electrolysis system for carrying out this process is defined by an electrolysis cell, a decomposing cell, a conduit connecting the amalgam discharge end of the electrolysis cell with the amalgam inlet end of the decomposition cell, a conduit connecting the mercury discharge end of the decomposing cell with the mercury inlet end of the electrolysis cell, a centrifuge connected in at least one of these conduits, and a settling unit connected with each centrifuge.

It is a feature of the invention that continuous separation of impurities can be effected from the circulating mercury stream without in any way interrupting operation of either the electrolytic step or the decomposing step.

It is a further feature of the invention that purification of the circulating mercury stream is effected by treatment of only a very minor fraction of the total volume of the mercury circulating in the system.

It is another feature of the invention that solely physical means are employed to effect the desired purification without vaporization of the mercury and without chemical treatment.

It is a further feature of the invention that the purification operation is effected substantially automatically with a minimum of supervision.

Other objects and features of the invention will be readily apparent from the following detailed description of illustrative embodiments of the invention and from the accompanying drawings wherein

FIG. 1 shows an electrolysis system embodying the features of the present invention and illustrating a typical assembly of units by means of which the process of the invention can be effectively carried out;

FIG. 2 shows a modified form of the system illustrated in FIG. 1; and

FIG. 3 shows another modified form of the system of FIG. 1.

Referring to FIG. 1 of the drawings, there is shown at **10** an electrolysis cell of the mercury cathode type having an electrolyte inlet **12**, an electrolyte outlet **14**, a mercury inlet **16** and an amalgam outlet **18**. At **20** is shown a decomposing cell having an amalgam inlet **22** and a mercury outlet **24** with a water inlet **26** and an alkali outlet **28**. The amalgam outlet **18** of the cell **10** is connected to the amalgam inlet **22** of the cell **20** by a conduit **30**. Similarly, the mercury outlet **24** of the cell **20** is connected by a conduit **32** with the mercury inlet **16** of the cell **10** to keep the circuit for the moving mercury cathode. In the conduit **32** is found a pump **34** to effect the necessary raising of the liberated mercury to the mercury inlet of the electrolysis cell **10**. In accordance with the invention, a centrifuge connected to a settling unit is interposed in at least one of the conduits **30** and **32**. In the embodiment illustrated in FIG. 1 of the drawing, the centrifuge is shown at **38** in the conduit **32** and it will be seen that all of the liberated mercury issuing from the decomposing cell **20** passes into the centrifuge **38** wherein the mercury is separated into a lighter fraction containing the impurities and a heavier fraction consisting of substantially pure mercury, the heavier fraction continuing on through conduit **32** for return to the electrolysis cell **32** under the action of the pump **34**. A branch conduit **40** for the lighter fraction of the mercury separated in the centrifuge **38** passes to a gravity settler **42**. In the settler the impurities rise to the surface and are readily skimmed off from time to time. The impurity-free mercury settles and flows through a return conduit **46** back to the conduit **32**. It will be observed that the return conduit **46** discharges into the conduit **32** between the decomposing cell **20** and the centrifuge **38**, i.e. upstream of the centrifuge. As a result, if any impurities still remain in the mercury they will again be subjected to centrifugation and the mercury flowing on to pump **34** will be essentially impurity-free.

As shown in FIG. 1, the settler illustrated at **42** comprises an outer tank **50**, which is suitably circular, and an inner concentric circular baffle **52** which extends downwardly to a level slightly above the bottom **54** of the tank **50**. The conduit **40** carrying the lighter fraction separated in the centrifuge **38** discharges into an inlet tube **56** which extends centrally through the bottom **54** and rises into the baffle **52** to a level substantially above the level of the lower edge of the baffle. The level of mercury in the tank **42** is determined by an overflow outlet **58** which communicates with conduit **46** to lead the settled mercury back to the main conduit **32** of the mercury circuit. As is known, mercury has a very high specific gravity. The impurities, however, have a substantially lower specific gravity so that they tend to rise to the surface of the mercury when they are given the opportunity. As the impurity-rich mercury fraction enters through the conduit, it is discharged into the chamber defined within the baffle **52**. The impurities gradually move to the surface of the mercury body in this chamber and the mercury gradually moves downwardly and escapes below the baffle into the annular pool between the baffle and the tank wall and overflows through the outlet **58**. The impurities collect on the surface of the mercury interiorly of the baffle and are readily skimmed off at intervals. In will be understood that other settler constructions may be employed in this phase of my process and the process is not limited by the particular construction of the settler or of the other apparatus units in the system shown in the drawing.

Thus, it will be understood that the electrolysis cell **10**, the decomposing cell **20**, the centrifuge **38** and the pump **34** may be of known construction. For example, the electrolysis cell **10** may be of the construction shown in the patent of Charles Deprez and Alexis Basilevsky No. 2,550,231 or it may have the construction shown in the patent to Charles Deprez No. 2,704,743. The decomposing cell, on the other hand, may be of the vertical type and have the construction set forth in my Patent No. 2,588,469 or it may be of the horizontal type and have the construction set forth in the patent of Charles Deprez and Alexis Basilevsky No. 2,610,908. In the embodiment shown in the drawing, the decomposing cell **30** is shown as a vertical unit but this may be readily replaced by a horizontal unit of any known construction. The centrifuge is suitably of the liquid-liquid separator type illustrated, for example, on page 1000 of "The Chemical Engineers' Handbook" by John H. Perry, 3rd ed.

In carrying out the invention, the mercury and amalgam in the cathode cycle flow in the usual manner through the electrolysis cell **10**, wherein the mercury is formed into an alkali metal amalgam, through the decomposing cell **20** wherein the amalgam is decomposed to liberate the mercury and to form alkali metal hydroxide, and through the conduits **30** and **32**. The mercury and amalgam flow through the electrolysis cell **10**, the conduit **30** and the decomposing cell **20** by gravity and the decomposed mercury is then elevated by the pump **34** to the level of the mercury inlet of the cell **10**. In passing through the conduit **30** the amalgam enters the centrifuge **38** which is continuously in operation and the heavy portion of the two-phases separated in the centrifuge leaves the outlet of the centrifuge and continues in conduit **30**. The light fraction which suitably represents 5% or less of the total amalgam entering the centrifuge **38**, but which may, of course, be greater, e.g. 10 or 15% depending upon the degree of centrifuging, passes into conduit **46** and enters the settling tank **42** wherein the fraction is settled to allow the impurities to rise to the top of the settler from which they are easily skimmed off and settled amalgam is then returned to the inlet side of the centrifuge. As mentioned, the impurities separated in the settler will float on the top of the mercury body in the settler and can be removed from time to time, e.g. once a day, without any problem. These impurities can be stored and, if desired, later distilled in known manner to recover the small amount of mercury which they generally contain. Naturally, the amount of impurities thus separated will depend solely on the amount of impurities introduced into the system with the salt to be electrolyzed, the graphite anodes, and the water which is introduced into the decomposer and, therefore, can vary very much from one plant to the other.

The electrolysis cell and the decomposing cell are suitably operated in conventional manner to effect efficient electrolysis and subsequent denuding of the amalgam formed during electrolysis. Flow rates, current densities, proportions and temperatures are those conventionally employed in this art in plants which do not contain the purification system which characterizes the present invention.

In the foregoing description the centrifuge and the pump have been shown as separate units. However, the functions of the pumps and the centrifuge may be combined, if desired, and the mercury stream may be propelled back to the electrolysis cell by the force provide in the combined unit.

As previously indicated, the centrifuge **38** may be interposed in the conduit **32**, rather than in the conduit **30**, so that the decomposed mercury rather than the newly-formed amalgam is treated, or two centrifuges may be employed, one being provided in the conduit **30** and the other being provided in the conduit **32**. These modifications are illustrated in FIGS. 2 and 3 of the drawing, with like parts being indicated by the same reference numerals.

Thus, in FIG. 2, the centrifuge **38** is interposed in the line **30** leading from the electrolytic cell outlet **18** to the decomposing cell inlet **22**. The lighter fraction passes to the settler **42** and the settled fraction returns through line **46** to the line **30** upstream of the centrifuge **38**.

In FIG. 3, a centrifuge **38** is interposed in the line **30** and a second centrifuge **38** is interposed in the line **32** leading from the decomposing cell **20**. Each centrifuge is connected to a settler **42** in an assembly such as shown in FIGS. 1 and 2. Thus, the first centrifuge is connected in line **30** in the same manner as shown in FIG. 2 and the second centrifuge is connected in line **32** in the same manner as shown in FIG. 1.

The following specific example is further illustrative of the process of this invention.

In an electrolysis cell **1** of the mercury cathode type as disclosed in Patent No. 2,550,231, brine of 25% by weight NaCl concentration is introduced into inlet **12** at a rate of 45 gallons per minute. Simultaneously, mercury is introduced at inlet **16** and is caused to flow over the sole of the cell at a rate of 895.5 lbs. per minute. Electric current is supplied to the cell at a load of 150,000 amperes.

The evolved gases are removed through gas outlet **14*a*** and the electrolyzed electrolyte is removed through outlet **14** at a rate corresponding to that of the entering brine. At the same time, amalgam formed in the cell, which contains about 0.5% sodium by weight, is removed from the cell through amalgam outlet **18** at the rate of about 900 lbs. per minute and is introduced into a decomposing cell **20** such as, for instance, the one shown in my Patent No. 2,558,469.

The mercury issuing from the decomposing cell **20**, stripped of its sodium content but still containing all the impurities collected in the electrolytic cell **10** in a concentration of about 6 p.p.m., is directed at a rate of 895.5 lbs. per minute to the centrifuge **38**. On its way to the centrifuge it mixes with the mercury coming through line **46** from the settler at a rate of about 47.5 pounds per minute and the total amount of 943 lbs. per minute enters the centrifuge.

In the centrifuge the mercury is separated into two portions, viz. a lighter portion and a heavier portion. The lighter portion flows at a rate of 47.5 lbs. per minute and contains substantially all the impurities present in the incoming mercury, as well as those impurities not completely separated in the settler. These impurities will be present in the lighter fraction in a concentration somewhat above 120 p.p.m. The heavier portion or fraction, substantially free of impurities, is directed to the inlet of the mercury pump **34** at a rate of 895.5 pounds per minute and is pumped back into the electrolytic cell **10** through the inlet **16**.

The lighter fraction separated in the centrifuge enters settling tank **42** in which the impurities, which are much lighter than mercury, will separate from the mercury and accumulate on the surface of the mercury body in the settler. The mercury, substantially freed from its impurities, returns as mentioned, at a rate of about 47.5 lbs. per minute and is mixed with the mercury coming from the decomposer **20** and the mixed mercury is introduced into the centrifuge.

The introduction of the effluent from the settler into the mercury stream upstream of the centrifuge compensates for the fact that the settler may not effect a complete separation of impurities and thus impurities which might not have been separated in the settler are prevented from being reintroduced into the electrolytic cell **10**. The amount of impurities removed from the cell in the present example is about 8.2 lbs. per day.

The foregoing example illustrates the process of the present invention when carried out in an apparatus assembly as shown in FIG. 1. It will be understood, however, that the process can be similarly carried out in the apparatus assemblies of FIGS. 2 and 3 with corresponding results, using the same flow rates and the same conditions of operation.

It will also be understood that various changes and modifications may be made in the embodiments described above and illustrated in the drawing without departing from the scope of the invention as defined in the appended claims. It is intended, therefore, that all matter contained in the foregoing description and in the drawing shall be interpreted as illustrative only and not as limitative of the invention.

What I claim and desire to secure by Letters Patent is:

1. An electrolysis system of the mercury cathode type for continuous electrolysis of a salt of a metal forming an amalgam with mercury with continuous purification of the mercury cathode which comprises, in combination, an electrolysis cell, a decomposing cell, a conduit connecting the amalgam discharge end of the electrolysis cell with the amalgam inlet end of the decomposition cell, a conduit connecting the mercury discharge end of the decomposing cell with the mercury inlet end of the electrolysis cell, a centrifuge connected in at least one of said conduits for receiving the fluid flowing therethrough, and a settling unit connected with each centrifuge for receiving a fraction of said fluid, said centrifuge being effective to separate the fluid which it receives into a heavier fraction and into a lighter fraction, and said settling unit being connected with the centrifuge to receive the lighter fraction therefrom.

2. An electrolysis system of the mercury cathode type for continuous electrolysis of a salt of a metal forming an amalgam with mercury with continuous purification of the mercury cathode which comprises, in combination, an electrolysis cell, a decomposing cell, a conduit connecting the amalgam discharge end of the electrolysis cell with the amalgam inlet end of the decomposition cell, a conduit connecting the mercury discharge end of the decomposing cell with the mercury inlet end of the electrolysis cell, a centrifuge connected in at least one of said conduits for receiving the fluid flowing therethrough, and a settling unit connected with each centrifuge for receiving a fraction of said fluid, said settling unit being connected to receive the lighter fraction from the centrifuge and to return said fraction after settling to the inlet side of said centrifuge.

3. An electrolysis system of the mercury cathode type for continuous electrolysis of a salt of a metal forming an amalgam with mercury with continuous purification of the mercury cathode which comprises, in combination, an electrolysis cell, a decomposing cell, a first conduit connecting the amalgam discharge end of the electrolysis cell with the amalgam inlet end of the decomposition cell, a second conduit connecting the mercury discharge end of the decomposing cell with the mercury inlet end of the electrolysis cell, a centrifuge connected in said first conduit for receiving the fluid flowing therethrough, and a settling unit connected with said centrifuge for receiving a fraction of said fluid, said centrifuge being effective to separate the fluid which it receives into a heavier fraction and into a lighter fraction, and said settling unit being connected with the centrifuge to receive the lighter fraction therefrom.

4. An electrolysis system of the mercury cathode type for continuous electrolysis of a salt of a metal forming an amalgam with mercury with continuous purification of the mercury cathode which comprises, in combination, an electrolysis cell, a decomposing cell, a first conduit connecting the amalgam discharge end of the electrolysis cell with the amalgam inlet end of the decomposition cell, a second conduit connecting the mercury discharge end of the decomposing cell with the mercury inlet end of the electrolysis cell, a centrifuge connected in said first conduit for receiving the fluid flowing therethrough, and a settling unit connected with said centrifuge for receiving a fraction of said fluid, said settling unit being connected to receive the lighter fraction from the centrifuge and to return said fraction after settling to the inlet side of said centrifuge.

5. An electrolysis system of the mercury cathode type for continuous electrolysis of a salt of a metal forming an amalgam with mercury with continuous purification of the mercury cathode which comprises, in combination, an electrolysis cell, a decomposing cell, a first conduit connecting the amalgam discharge end of the electrolysis cell with the amalgam inlet end of the decomposition cell, a second conduit connecting the mercury discharge end of the decomposing cell with the mercury inlet end of the electrolysis cell, a centrifuge connected in said second conduit for receiving the fluid flowing therethrough, and a settling unit connected with said centrifuge for receiving a fraction of said fluid, said centrifuge being effective to separate the fluid which it receives into a heavier fraction and into a lighter fraction, and said settling unit being connected with the centrifuge to receive the lighter fraction therefrom.

6. An electrolysis system of the mercury cathode type for continuous electrolysis of a salt of a metal forming an amalgam with mercury with continuous purification of the mercury cathode which comprises, in combination, an electrolysis cell, a decomposing cell, a first conduit connecting the amalgam discharge end of the electrolysis cell with the amalgam inlet end of the decomposition cell, a second conduit connecting the mercury discharge end of the decomposing cell with the mercury inlet end of the electrolysis cell, a centrifuge connected in said second conduit for receiving the fluid flowing therethrough, and a settling unit connected with said centrifuge for receiving a fraction of said fluid, said settling unit being connected to receive the lighter fraction from the centrifuge and to return said fraction after settling to the inlet side of said centrifuge.

7. An electrolysis system of the mercury cathode type for continuous electrolysis of a salt of a metal forming an amalgam with mercury with continuous purification of the mercury cathode which comprises, in combination, an electrolysis cell, a decomposing cell, a first conduit connecting the amalgam discharge end of the electrolysis cell with the amalgam inlet end of the decomposition cell, a second conduit connecting the mercury discharge end of the decomposing cell with the mercury inlet end of the electrolysis cell, a centrifuge connected in each of said conduits for receiving the fluid flowing therethrough, and a settling unit connected with each centrifuge for receiving a fraction of said fluid, said centrifuge being effective to separate the fluid which it receives into a heavier fraction and into a lighter fraction, and said settling unit being connected with the centrifuge to receive the lighter fraction therefrom.

8. An electrolysis system of the mercury cathode type for continuous electrolysis of a salt of a metal forming an amalgam with mercury with continuous purification of the mercury cathode which comprises, in combination, an electrolysis cell, a decomposing cell, a first conduit connecting the amalgam discharge end of the electrolysis cell with the amalgam inlet end of the decomposition cell, a second conduit connecting the mercury discharge end of the decomposing cell with the mercury inlet end of the electrolysis cell, a centrifuge connected in each of said conduits for receiving the fluid flowing therethrough, and a settling unit connected with each centrifuge for receiving a fraction of said fluid, said settling unit being connected to receive the lighter fraction from the centrifuge and to return said fraction after settling to the inlet side of said centrifuge.

9. In an electrolytic process comprising an electrolysis step in the presence of a moving mercury stream and a decomposition step wherein the amalgam formed with

the mercury stream in the electrolysis step is decomposed to release the mercury and the mercury stream is recycled to the electrolysis step, a purification operation to separate from said stream metallic impurities selected from the group consisting of vanadium, chromium, molybdenum, titanium, nickel and iron which comprises the steps of centrifuging the steps of centrifuging the liquid mercury stream at at least one point in its circuit between the electrolysis step and the decomposing step, removing in said centrifuging step a lighter fractional portion of said stream containing substantially all of the impurities in said stream subjected to centrifuging, directing the heavier substantially impurity-free fractional portion from said centrifuging step into the liquid mercury stream, separating the impurities from the lighter portion by settling, and returning the thus-purified fraction of the lighter portion to the contrifuging step.

10. In an elecrolytic process comprising an electrolysis step in the presence of a moving mercury stream and a decomposition step wherein the amalgam formed with the mercury stream in the electrolysis step is decomposed to release the mercury and the mercury stream is recycled to the electrolysis step, a purification operation to separate from said stream metallic impurities selected from the group consisting of vanadium, chromium, molybdenum, titanium, nickel and iron which comprises the steps of centrifuging the liquid mercury stream as it flows from said electrolysis step to said decomposing step, removing in said centrifuging step a lighter fractional portion of said stream containing substantially all of the impurities in said stream subjected to centrifuging, directing the heavier substantially impurity-free fractional portion from said centrifuging step into the liquid mercury stream, separating the impurities from the lighter portion by settling, and returning the thus-purified fraction of the lighter portion to the centrifuging step.

11. In an electrolytic process comprising an electrolysis step in the presence of a moving mercury stream and a decomposition step wherein the amalgam formed with the mercury stream in the electrolysis step is decomposed to release the mercury and the mercury stream is recycled to the electrolysis step, a purification operation to separate from said stream metallic impurities selected from the group consisting of vanadium, chromium, molybdenum, titanium, nickel and iron which comprises the steps of centrifuging the liquid mercury stream as it flows from said decomposing step to said electrolysis step, removing in said centrifuging step a lighter fractional portion of said stream containing substantially all of the impurities in said stream subjected to centrifuging, directing the heavier substantially impurity-free fractional portion from said centrifuging step into the liquid mercury stream, separating the impurities from the lighter portion by settling, and returning the thus-purified fraction of the lighter portion to the centrifuging step.

12. In an electrolytic process comprising an electrolysis step in the presence of a moving mercury stream and a decomposition step wherein the amalgam formed with the mercury stream in the electrolysis step is decomposed to release the mercury and the mercury stream is recycled to the electrolysis step, a purification operation to separate from said stream metallic impurities selected from the group consisting of vanadium, chromium, molybdenum, titanium, nickel and iron which comprises the steps of centrifuging the liquid mercury stream as it flows from said electrolysis step to said decomposing step, removing in said centrifuging step a lighter fractional portion of said stream containing substantially all of the impurities in said stream subjected to centrifuging, directing the heavier substantially impurity-free fractional portion from said centrifuging step to the liquid mercury stream, separating the impurities from the lighter portion by settling, and returning the thus-purified fraction of the lighter portion to the centrifuging step, centrifuging the liquid mercury stream as it flows between said decomposing step and said electrolysis step, removing a lighter fractional portion of said stream containing substantially all of the impurities in said stream subjected to centrifuging, directing the heavier substantially impurity-free fractional portion from the second centrifuging step into the liquid mercury stream, separating the impurities from the lighter portion from the second centrifuging step by settling, and returning the thus-purified fraction of the lighter portion to the second centrifuging step.

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