**Feb. 16, 1943.** C. B. SAWYER ET AL **2,311,257**

ELECTROLYTIC BERYLLIUM AND PROCESS

Filed Aug. 2, 1939 2 Sheets-Sheet 1

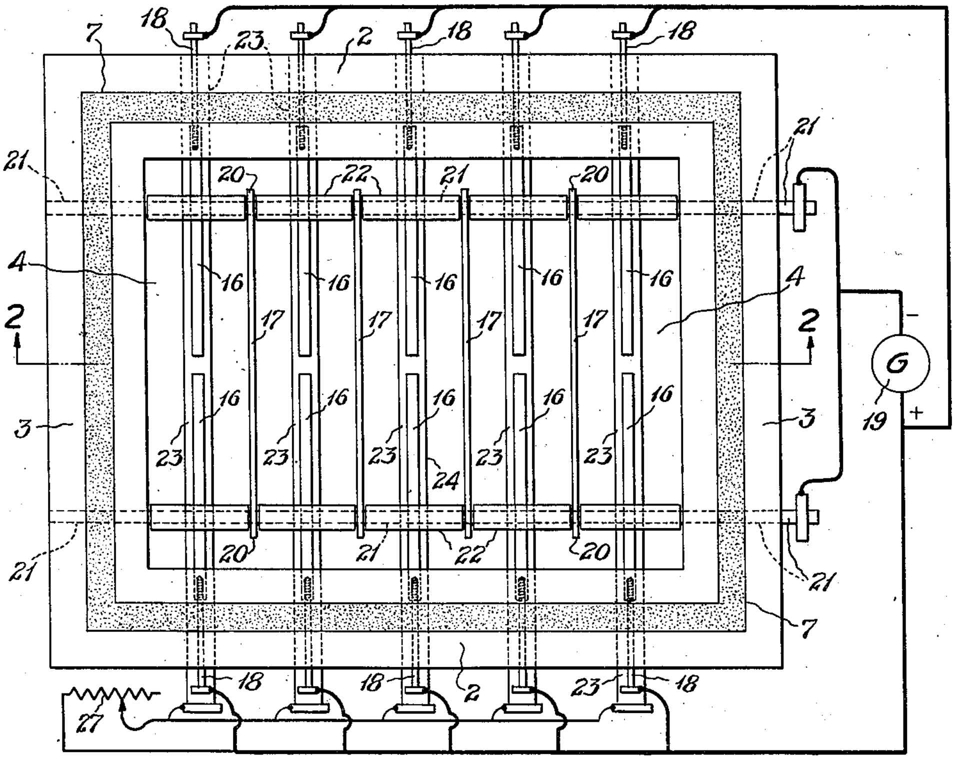

FIG. 1.

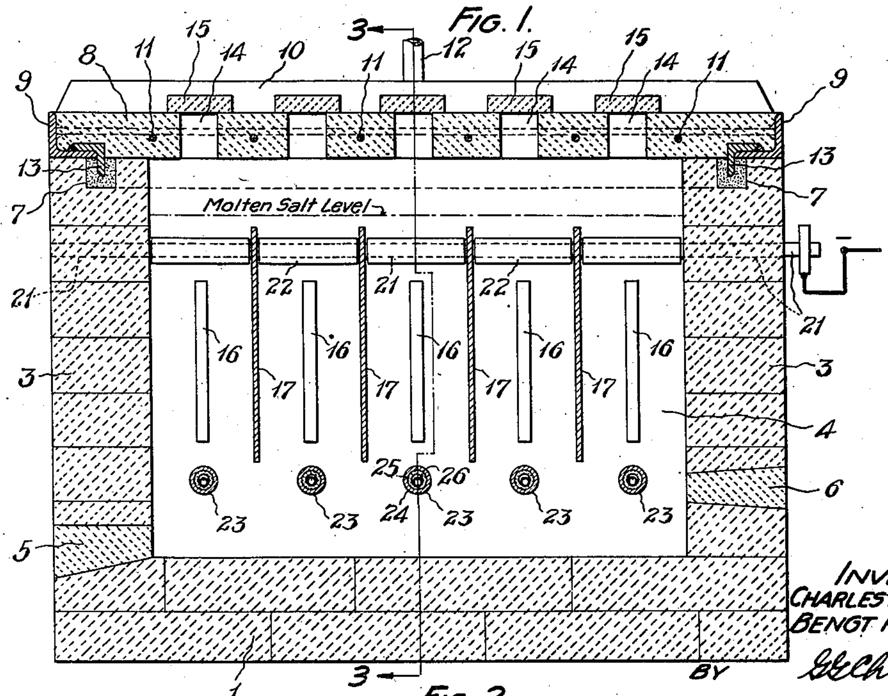

FIG. 2.

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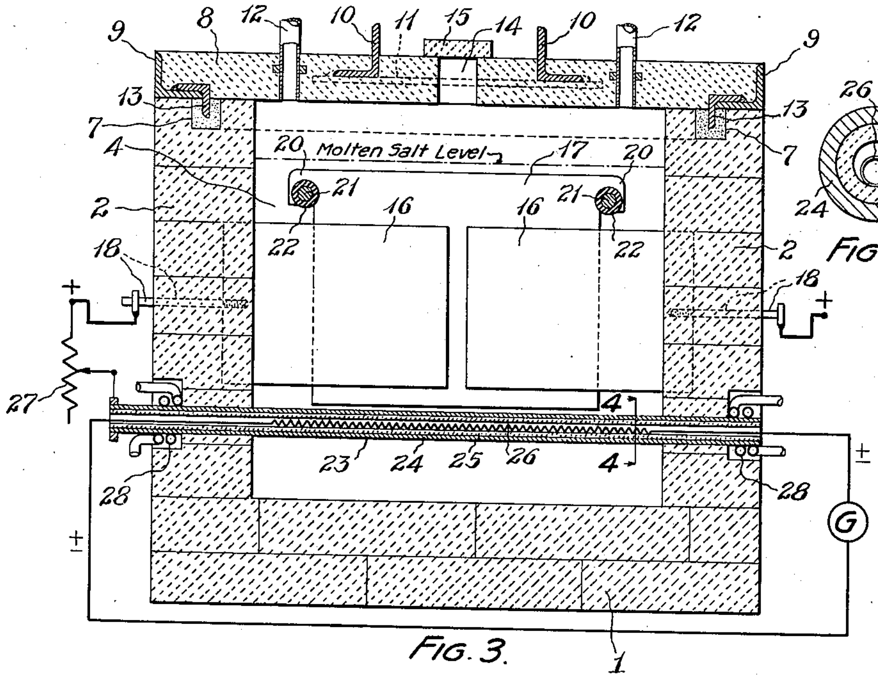

FIG. 3.

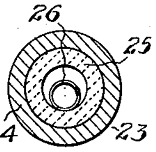

FIG. 4.

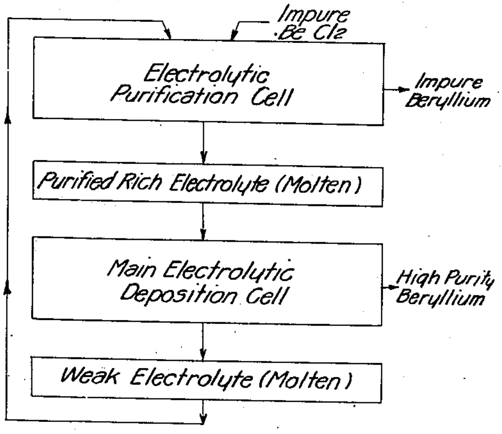

FIG. 5.

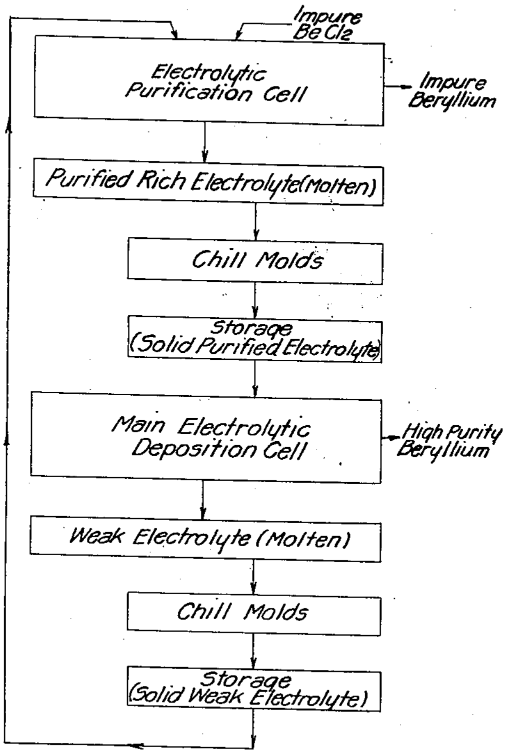

FIG. 6.

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# UNITED STATES PATENT OFFICE

2,311,257

## ELECTROLYTIC BERYLLIUM AND PROCESS

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**Application August 2, 1939, Serial No. 287,868**

**10 Claims. (Cl. 204—39)**

This invention relates to the production of metallic beryllium by electrolytic decomposition of beryllium chloride dissolved in a low-melting fused-salt bath, the electrolysis being performed in such a manner that metallic beryllium may be deposited and recovered in the form of coherent sheet-like layers.

It is an object of this invention to carry out the electrolysis at relatively low temperatures and to form electrolytic deposits of metallic beryllium which have sufficient strength, coherence and ductility to permit them to be stripped from the cathode surface in the form of sheets.

It is a further object to provide a process by which high-purity metallic beryllium may be obtained from a relatively impure fused electrolyte.

It is another object to provide a method by which such an electrolysis may be maintained in substantially continuous operation.

Attempts have been made in the past to deposit metallic beryllium from a fused electrolyte at low temperatures, but heretofore the deposits so formed have been granular, pulverulent, nodular, or flaky and by reason thereof have been difficult to recover and melt to a compact form. Furthermore, in numerous instances the deposits have adhered so loosely to the cathodes that portions thereof have dropped off and become lost to the process, thereby lowering the effective recovery and raising the operating cost. On the contrary, our process entirely avoids losses resulting from poor adherence while at the same time producing dense ductile deposits of metallic beryllium, the individual grains of which cohere together with such strength that the whole deposit may be stripped from the cathode and handled thereafter much like a sheet of solid metal.

This application is a continuation in part of our copending application Serial No. 59,096, filed March 16, 1936, which has matured into Patent No. 2,188,904 dated February 6, 1940. In that application we have disclosed various fused salt electrolytes containing beryllium chloride which are particularly suitable for use in electrolytic cells in which metallic beryllium is deposited at temperatures below the boiling point of beryllium chloride. One electrolyte which we have disclosed therein consists of a mixture of beryllium chloride and a ternary eutectic of sodium, potassium and lithium chloride, the relative proportions of the beryllium chloride and the eutectic being variable over ranges which vary the melting point of the bath from about 230° C. up to about 400° C. We have disclosed in the above mentioned application that metallic beryllium may be deposited electrolytically from this bath at temperatures ranging from about 230° C. to above 500° C.

Now we have found that when the various electrolytes referred to above are operated under certain conditions of temperature, current density and beryllium chloride concentration and with cathodes composed of certain materials, it becomes possible to produce dense coherent deposits which adhere strongly to the cathodes but which may be readily stripped or peeled therefrom. We have found that the temperature factor is especially influential. When the electrolysis baths described in the application referred to above are operated below a temperature of about 290° C. the beryllium deposit is apt to be spongy and non-coherent and can easily be brushed off of the cathode. If, however, the temperature is maintained above 290° C. and preferably between 325° C. and 500° C., the deposit is very dense and strong and may be peeled off of the cathode in relatively large sheets.

The current density which is used at the preferred temperature is also influential in determining the character of the deposit. We have found that cathode current densities around 4 amperes per square decimeter may be used without stirring the bath. If, however, the electrolyte is stirred, much higher densities can be used. We have also found that the cathode current density should be maintained substantially below the anode current density since otherwise "trees" grow upon the cathodes around their edges. The preferred anode current density is about 25% greater than the cathode density with no stirring of the electrolyte, but may be reduced considerably if the electrolyte is stirred. It will be understood that a higher anode density is obtained most readily by making the effective anode areas smaller than the effective cathode areas.

We have also found that by starting the deposition upon clean cathodes and using a low current density on the order of about .1 to .25 ampere per square decimeter, an initial deposit may be formed consisting of very fine crystals of beryllium which adhere together to form a strong dense sheet. After this starting layer has been formed the current density may be increased to four or more amperes per square decimeter without loss of density and strength in the subsequent deposit. The fine grained starting layer appears to permit the use of higher current density than would otherwise be possible without harmful effect. Without wishing to be limited by the theory expressed, it is believed that this effect results from a "seeding" action, and from the extensive increase of the effective cathode area resulting from this starting layer. The "seeding" action is analogous to that which occurs when saturated solutions are caused to precipitate dissolved salts upon a multitude of particles introduced for that purpose. Each such particle acts as a crystallization nucleus with the result that crystals grow from each of them, and in growing, interfere with the formation of individual large crystals on any one. The grain size of the whole deposit is thereby controlled and kept small.

It will also be appreciated that the deposition of beryllium upon the cathode greatly increases its effective area. The cathode when initially immersed in the electrolyte may have quite smooth surfaces, but after a small amount of beryllium has been deposited on it, the surfaces exposed to the electrolyte will be found to be very rough if examined under a microscope. The roughness, of course, enlarges the effective area of the cathode actually in contact with the electrolyte, and correspondingly reduces the current density. The nominal cathode current density may therefore be raised correspondingly without raising the actual current density.

The concentration of beryllium chloride in the bath has also been found to influence the character of the deposit, apparently through its effect upon the viscosity of the bath and upon the conductivity. In our copending application we have shown that a beryllium chloride concentration of from about 40% to 50% produces the lowest melting mixtures obtainable in the ternary eutectic-beryllium chloride system. A concentration within this range accordingly gives the most fluid electrolyte at the preferred operating temperatures stated above and consequently is the most economical range of concentration. However, other ranges of concentrations in this system such as 30% to 90%, or 35% to 65%, may be used equally successfully by operating the cell in the higher regions of the above mentioned temperature range.

A number of other systems which include beryllium chloride as one of their components have been mentioned as suitable electrolytes in the invention of the above application. These systems are also satisfactory for use in this invention. As yet another example of a suitable electrolyte, we may mention that beryllium chloride mixed with alkali metal chlorides produces a low melting electrolyte which may be operated successfully within the above-mentioned temperature range. Thus electrolytes melting below about 450° C. may be obtained in a mixture of beryllium chloride with a minimum of about 30% alkali metal chloride, such as sodium or potassium chloride, or a mixture of sodium and potassium chloride. A mixture composed of 50 parts beryllium chloride and 50 parts sodium chloride produces an electrolyte which may be operated successfully at about 375° C.

With regard to materials which are suitable for the cathodes, we have found that only a few conductive materials have the required characteristics. Aluminum and beryllium appear to be most suitable since they are not corroded by the melt nor by the relatively low concentrations of chlorine normally present near the surface of the melt when the electrolysis is carried out in an open cell and furthermore, these metals have desirable surface characteristics which permit the beryllium deposit to adhere very strongly to them. Tungsten is also suitable from the corrosion standpoint, but the deposit does not adhere to a tungsten surface quite as well as to an aluminum surface. Copper, stainless steel, chrome iron and iron are all corroded severely at the surface of the melt and by the chlorine fumes. Cathodes made of magnesium are wholly unsuitable since they react with the melt even though protected cathodically by the deposition current. All of these latter metals have the further disadvantage that in the preferred temperature range the beryllium adheres so loosely to them that it nearly falls off. It will therefore be understood that cathode surfaces composed predominantly of aluminum, beryllium, or tungsten are most suitable Of these three metals, aluminum is preferred at present because of the good adherence which it permits, its ready availability in sheet form and its moderate cost. It will be recognized, of course, that the cathodes need not be of homogeneous composition throughout. Only in the surface portions which contact the electrolyte need the aluminum, beryllium or tungsten predominate.

It has been mentioned above that chlorine is generated during the electrolytic decomposition of the beryllium chloride. When no attempt is made to recover this chlorine, as when an open cell is used, the fumes have but little corrosive effect upon aluminum, beryllium or tungsten cathodes. If, however, the cell is operated so that the chlorine may be recovered, as by using a closed cell, the corrosive effects on aluminum and beryllium then become very severe, particularly upon those portions of the cathode which are exposed directly to the fumes. In the latter case the corrosive effects of the chlorine may be substantially avoided by totally immersing the cathodes and their supporting structure in the melt.

The process may be carried out with parallel electrical operation in a cell such as that shown in the drawings, in which:

Fig. 1 is a plan view if a suitable electrolytic cell structure, with cover removed.

Fig. 2 is a vertical sectional view taken on line 2—2 of Fig. 1, and showing the cover in place thereon.

Fig. 3 is a vertical sectional view taken on line 3—3 of Fig. 2.

Fig. 4 is an enlarged sectional view of a heating tube taken on line 4—4 of Fig. 3.

Fig. 5 is a diagrammatic flow sheet of a process permitting beryllium to be deposited in a substantially continuous operation.

Fig. 6 is a diagrammatic flow sheet of a modification of the process indicated in Fig. 5.

A suitable electrolytic cell may be constructed as shown in the drawings, particularly when confinement of the chlorine evolved during the electrolysis is desired. According to this construction, an electrolytic cavity of suitable size is defined by a brick structure comprising a brick base **1** and brick side and end walls **2** and **3** respectively. The brick may be composed of common refractory materials such as fire-clay, mullite, or beryllium oxide, magnesia, etc., and they may be joined with mortars of similar composition. The central electrolytic cavity **4** is suitably dimensioned to accommodate the desired electrodes. A tap-hole **5** passes thru one of the walls and communicates with the chamber

4 at the surface of base 1. A second tap-hole 6 positioned at a slightly higher level may also be provided. A channel 7 is provided adjacent the upper surface of the cell, and is filled with sand or similar pulverulent material suitable for providing a gas seal. The cell is closed at the top by means of a refractory cover 8 which may be reinforced at its periphery by an angle iron rim 9, and by beams 10 secured to rim 9. Chaplets, wire, rod or similar reinforcing elements 11 may be secured to beams 10 and embedded in the refractory material of the cover to reinforce the latter. Outlets 12 extend thru the cover to provide an escape for gases. Flanges 13, 13 are positioned in the lower face of the cover so as to extend downwardly therefrom and become embedded in the sealing material retained in channel 7.

The cover may be provided with a plurality of feed openings 14 extending thru the cover at positions which are approximately directly above the anodes 16. They may be closed by means of covers 15 composed of refractory material and which are fitted to the cover so as to make a tight closure therewith to prevent the escape of chlorine gas except when electrolyte is being introduced into the cell thru the openings 14. It will be seen that the whole construction of the cell is such as to make it substantially gas-tight so that the gases evolved during the electrolysis may be thoroughly confined against escape except thru outlets 12.

The electrolysis occurs between anodes 16 and cathodes 17 which are positioned within cavity 4. The anodes are preferably graphite plates of moderate thickness, and are embedded part way into the side walls 2 so as to be supported rigidly therein. They should be spaced from each other a suitable distance which will prevent the chlorine liberated at the anodes from coming into contact with the cathodes as it rises thru the electrolyte, but the spacing should also be kept as small as possible so as to reduce the power consumption. We have found that a spacing of about 4 inches between centers is satisfactory. The end anodes may be spaced from the end walls 3 a distance of about 2 inches or more. The anodes may be composed of a single plate of graphite extending from one side wall to the other, but in order to provide freer circulation of the melt and to prevent cracking of the anodes due to temperature distortion of the brick structure or of the anodes themselves, it is preferable that they be composed of two pieces, each of which is cantilevered from its supporting side wall as shown in Figs. 1 and 3. Contact members 18, which may be rods threadably secured to the anodes, or mere lugs which are formed integrally with the anode, extend thru the side walls and are connected at their outer ends to the positive side of a source of direct current, such as a generator 19.

Cathodes 17 are positioned midway between two adjacent anodes, and are preferably composed of moderately thin sheets of aluminum or beryllium. They may be of generally rectangular or other shape, but should be dimensioned so that the area of each face is greater than the area of the opposing faces of adjacent anodes. Lugs 20 may be provided on the upper half of each cathode to act as supports therefor. A convenient mode of support is found in a pair of parallel bars 21 positioned parallel to side walls 2 but spaced outwardly therefrom a small distance. The bars 21 preferably extend thru the opposite end walls 3, 3 of the cell, and are composed of a material which conducts electric current. Aluminum, beryllium, stainless steel or nichrome bars are suitable although other conductive materials may also be used. The bars should be spaced from each other such a distance as will permit the cathodes to pass vertically between them with a small lateral clearance, but such that the lugs 20 will engage both bars to thereby suspend the cathodes from them. Electrical contact between the bars 21 and the cathodes is provided by the physical contact between them at the points of suspension. In order to prevent the leakage of current from those portions of bars 21 which lie between the cathodes, a plurality of insulating sleeves 22 of fireclay, quartz, sillimanite, or beryllium oxide are slipped over the bars, the sleeves being of such length as to permit the cathodes to pass downwardly between their ends to contact bar 21. The ends of bars 21 which extend beyond walls 3, 3 are connected electrically to the negative side of the direct current generator 19.

Provision is made for heating the electrolyte internally, as by means of a plurality of heating tubes 23 positioned under and parallel to the anodes and extending across the cavity 4. These tubes are of composite construction, consisting of an outer metal tube 24, of stainless steel, nichrome, beryllium, or other moderately high melting point metal which is lined internally with a layer 25 of electrically insulating refractory, such as beryllium oxide, sillimanite, quartz, or fire clay. These tubes are heated internally by means of gas or by an electric heating element 26 positioned inside this refractory lining. In order to prevent attack of the metal tubes 24 by the electrolyte, they are connected electrically so as to be made the cathodes of an auxiliary electrolytic circuit in which the main electrodes 16 act as the anodes. By this means a potential gradient may be applied between the main anodes and tubes 24 and a small current caused to pass between them. In this way a slight amount of beryllium may be deposited continuously upon the surfaces of the tubes, thereby protecting them from attack. The potential between anodes 16 and tubes 24 may be obtained from the main electrolytic circuit thru a suitable resistance 27. By varying the resistance, the current flowing thru the circuit may be reduced to a very small value which is just sufficient to provide the desired cathodic protection.

The heating tubes are preferably placed beneath the anodes since in this position they create a thermal circulation of the electrolyte in the vicinity of the anode surfaces, which circulation aids in carrying the chlorine vertically upward to the surface of the electrolyte, thus preventing it from reaching the cathodes. The thermal circulation also aids in preventing the growth of "trees" upon the cathodes should the temperature or current density accidentally change to such values as would ordinarily permit "trees" to grow.

It has been found that the electrolyte tends to creep or seep thru porous materials such as fire brick, graphite and the like when the temperature of these materials is above the melting point of the electrolyte. This creeping action may be prevented by keeping the temperature below the melting point, and this is conveniently done wherever necessary by inserting water-cooled tubing. Units 28, 28 of this kind are shown embedded in the walls 2, 2 around heating tubes **23**, but it should be understood that additional units may be provided in similar manner at any point in the construction where creepage occurs.

During operation of the electrolytic cell a sludge containing basic beryllium chloride forms slowly and settles to the bottom of the melt. It has been found that this sludge is a poor heat conductor and that if it is permitted to surround the heating tubes, they become overheated and fail within a moderately short time. For this reason it is desirable that the cell be made deep enough under the heating tubes to prevent the accumulation of sludge from contacting them. The cell may be cleared of this sludge periodically by draining out the clear melt thru tap hole **6**, and then draining out the remaining melt and sludge thru tap hole **5**.

In preparing the cell for operation, tap holes **5** and **6** should be plugged tightly with suitable refractory material. Enough electrolyte should then be melted outside of the cell and poured into it to bring the level of the melt at least up to the heating tubes. Heat may then be suplied thru the tubes **23** to maintain the electrolyte molten while additional electrolyte is added to fill the cell. Enough electrolyte should be introduced to completely cover the cathodes and to rise above them about an inch. When thus submerged, the cathodes are adequately protected against attack by chlorine.

After the electrolyte has been introduced and brought to the proper working temperature, the aluminum cathodes may be inserted. They should have been cleaned thoroughly to remove dirt and grease, and preferably should have been scratch-brushed or buffed lightly to ensure clean surfaces. Of course they may be preheated, if desired, to the melting temperature of the electrolyte before being inserted to prevent the melt from solidifying upon them. After making sure that lugs **20** on the cathodes make electrical contact with bars **21**, cover **8** may be put in place and the electrolytic circuit closed to start the electrolysis. The voltage of the generator may then be adjusted to control the current flowing in the circuit. As pointed out previously, this should preferably be such as to give a cathode current density of up to 4 or more amperes per square decimeter where no starting layer is desired, or it may be adjusted to give a density of about ¼ ampere per square decimeter when it is desired that a starting layer be formed, and later increased to below that at which the deposit fails to retain the coherence which permits it to be stripped. After the current in the main circuit has thus been adjusted, the auxiliary circuit may be adjusted by varying resistance **27** to bring the current in this circuit to as low a value as practicable to provide the desired protection. The heat applied thru tubes **23** may be adjusted from time to time so as to hold the electrolyte at the proper temperature.

Now if it is known that the electrolyte contains impurities which would be harmful to the beryllium deposit, such for example, as iron, those metals which are more electropositive than beryllium may be electrolyzed out first by operating the cell at approximately the current density used in the final stages of a beryllium deposition. Lower densities may be used equally well, but the higher densities deposit the impurities more rapidly and are equally effective for the purpose. After a short time the impurities will have been removed almost completely from the bath, and collected at the cathodes together with beryllium in the form of an impure beryllium deposit. The electrolysis may then be stopped temporarily, while the cathodes are removed and replaced with fresh ones. The electrolysis may then be resumed and continued until further additions of impure electrolyte or impure beryllium chlorine are made. When operated in this way, the electrolysis produces beryllium having a purity upwards from 99.8%.

After sufficient pure metallic beryllium has been deposited upon the cathodes they may be removed from the cell, and fresh cathodes inserted in their place. The beryllium chloride concentration may be restored to a proper value at the same time, whereupon the cell is ready for a repetition of the cycle. The cathodes with their adhering deposits of beryllium may be cleaned by dipping them in a weak solution of sodium or ammonium bicarbonate to dissolve the electrolyte adhering thereto, and may then be rinsed and dried in any suitable manner. The beryllium adhering to the aluminum surfaces of the cathodes is loosened by prying up a corner of the deposit and peeled or stripped off as a tough, coherent, ductile sheet. When enough of this stripped beryllium has been accumulated to form a convenient charge, it may be melted down and cast into desired shapes or the sheets of beryllium may be otherwise utilized, as by fabricating into marketable articles.

The electrolysis performed in accordance with the preferred practice, as disclosed above, is highly efficient. Current efficiencies of more than 90% may be obtained readily, while operations made under less favorable conditions result in efficiencies of at least 85%.

The following table represents a log of a typical electrolysis in which metallic beryllium is deposited in the form of dense, coherent sheets which may be stripped or peeled from the cathodes. In this example, the electrolyte contained 49.5% beryllium chloride at the start, and the metallic beryllium was deposited on 5 aluminum cathodes having a total effective area of 40 square decimeters.

| Time (hrs.) | D. C. | | Heating amps., (A. C.) | Temp. |
|---|---|---|---|---|
| | Volts | Amps. | | |
| | | | | °*C.* |
| 0 (start) | 2.25 | 3 | 30.5 | 330 |
| ⅓ | 2.25 | 8 | 30.5 | 330 |
| 5⁄12 | 2.25 | 10 | 30.5 | 330 |
| 1 | 2.25 | 20 | 32.2 | 318 |
| 2 | 2.25 | 28 | 32.2 | 324 |
| 3 | 2.25 | 33 | 32.2 | 332 |
| 6 | 2.25 | 33 | 30.5 | 350 |
| 9 | 2.25 | 35 | 30.8 | 350 |
| 18 | 2.25 | 35 | 30.5 | 353 |
| 25 | 2.25 | 35 | 30.8 | 357 |
| 31.5 | 2.25 | 34 | 30.9 | 365 |
| 43 | 2.25 | 35 | 30.5 | 370 |

In order to make the process substantially continuous in its operation, it is desirable to have a main electrolytic cell wherein pure beryllium is deposited continuously at high current densities. This cell may be supplied with purified electrolyte obtained from an auxiliary electrolytic cell whose primary function is to remove the impurities. The main cell should also be supplied with cathodes on which a starting layer of metallic beryllium had already been deposited, as for example, from a second auxiliary cell wherein the clean, stripped cathode sheets are coated with a thin seed layer of beryllium deposited thereon at a low current density. When operated in this manner, the main cell need be stopped only when substituting fresh cathodes for those removed therefrom for the purpose of stripping off the deposited beryllium.

The flow sheet of Figure 5 shows a cyclical process in which beryllium is recovered in a substantially continuous operation and in which the chlorine evolved as a byproduct of the electrolysis may be recovered. Starting at the main electrolytic cell, the process is carried out as follows, assuming that the cell already contains starting cathodes and is filled with enough electrolyte containing the desired proportions of beryllium chloride to submerge the cathode supporting structure and the cathode:

The cell is closed up and the electrolysis started. As the electrolysis proceeds the electrolyte becomes impoverished with respect to beryllium chloride, the concentration of which ultimately approaches the lower limit conducive to proper operation. It thereupon becomes necessary that the beryllium chloride concentration be restored to a proper value. This is done in the following manner:

A quantity of the impoverished electrolyte may be tapped out of the cell without opening it or stopping the electrolysis, while or after which a corresponding quantity of molten, purified rich electrolyte is introduced into the cell, the added quantity of rich electrolyte and its contained beryllium chloride being such that when it has become mixed with the weak electrolyte retained in the cell the beryllium chloride concentration will have been restored to the desired value. By making such additions from time to time as needed, the electrolysis may be continued indefinitely until sufficient beryllium has been deposited upon the cathodes to require their removal and stripping. At this point the electrolysis may be stopped temporarily, if desired, and the electrodes with their deposits of beryllium removed and replaced with fresh starting cathodes. The electrolysis may then be resumed and maintained in operation in the same manner until the cathodes again need to be stripped. It will thus be seen that when the electrolysis is operated in this manner it is substantially continuous in point of time, although involving a cycle of intermittent operations.

The impoverished electrolyte tapped out of the main electrolytic cell may be passed in the molten state into the purification cell where its beryllium content is increased by the addition of impure beryllium chloride. The electrolyte thus enriched with respect to beryllium may then be purified in the same cell in the manner already described above, after which the rich pure electrolyte may be passed in the molten state into the main deposition cell.

Fig. 6 shows a modified flow sheet wherein it is not necessary to handle the materials in the molten state as in the above cycle. According to the cycle of Fig. 6, the impoverished electrolyte tapped out of the main deposition cell may be cast in chill molds and held in storage until needed. Since beryllium chloride is quite deliquescent it should be stored in a container having a very dry atmosphere. When needed, this stored weak electrolyte may be treated to restore it to the proper beryllium chloride content, this being done in batches and at the same time that the batch is purified. For example, a batch of solid weak electrolyte may be taken from storage, melted and passed into the purification cell where impure beryllium chloride is added. After the desired beryllium chloride concentration has been obtained, the batch may be purified in the manner described, and then tapped out of the cell into chill molds where it is solidified rapidly. The solid purified enriched electrolyte may then be retained in storage until it is needed to restore the beryllium concentration of the electrolyte in the main deposition cell. It may be introduced into the main electrolytic cell in either the solid or molten state for this purpose.

It will be seen that the flow sheets of both Figs. 5 and 6 provide a cycle of operations which permits the electrolysis to be carried on indefinitely and with a minimum of lost time since the deposition of pure beryllium may be carried on without interruption except perhaps when stripped cathodes are substituted for those which have acquired their proper thickness of deposited beryllium.

Having now explained our invention, what we claim is:

1. A process for producing sheets of electrolytic beryllium, said process comprising the steps of: providing a conductive fused chloride electrolyte which contains at least about 30% of beryllium chloride and which is substantially free from elements which, if present, would tend to be deposited electrolytically with the beryllium; providing an insoluble anode, and a cathode surface composed predominantly of a metal selected from the group consisting of aluminum and beryllium; electrolytically decomposing said electrolyte to deposit beryllium upon said cathode surface at a nominal cathode current density of about .1 to 4 amperes per square decimeter while maintaining the temperature of the electrolyte and the cathode between about 290° C. and 500° C.; continuing said decomposition and deposition to form a layer of the desired thickness; and thereafter stripping the deposited layer from said cathode.

2. A process for producing fine-grained sheets of electrolytic beryllium, said process comprising the steps of: providing a conductive fused chloride electrolyte which contains at least about 30% of beryllium chloride and which is substantially free from elements which, if present, would tend to be deposited with the beryllium; providing an insoluble anode, and a cathode having surface portions composed predominantly of a metal selected from the group consisting of aluminum and beryllium; electrolyzing said fused electrolyte at temperatures between about 290° C. and 500° C. and at a cathode current density of between about .1 and .25 ampere per square decimeter to form an initial seed deposit of beryllium upon said surfaces of the cathode; subsequently increasing the current density to between about .25 and 4 amperes per square decimeter and continuing the deposition to form a layer of the desired thickness; and thereafter stripping the deposited layer from said surfaces of said cathode.

3. A process as claimed in claim 1 wherein said electrolyte consists of a fused mixture of beryllium chloride and alkali metal chloride, the beryllium chloride constituting at least 30% of the mixture.

4. A process as claimed in claim 1 wherein said electrolyte consists of a molten mixture of beryllium chloride and a ternary eutectic of sodium chloride, potassium chloride, and lithium chloride.

5. A process as claimed in claim 1, wherein said electrolyte contains between about 40% and 50% beryllium chloride, and the balance consists substantially of a ternary eutectic of sodium chloride, potassium chloride, and lithium chloride.

6. A process as claimed in claim 1 wherein said cathode surface is composed of aluminum.

7. A process as claimed in claim 2 wherein said fused electrolyte contains alkali metal chloride in addition to beryllium chloride.

8. A process as claimed in claim 2 wherein said electrolyte consists of a molten mixture of beryllium chloride and a ternary eutectic of sodium chloride, potassium chloride, and lithium chloride.

9. A process as claimed in claim 2 wherein said electrolyte contains between about 40% and 50% beryllium chloride, and the balance consists substantially of a ternary eutectic of sodium chloride, potassium chloride, and lithium chloride.

10. A process as claimed in claim 2 wherein said cathode surface is composed of aluminum.

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