ELECTROLYTIC APPARATUS FOR PRODUCTION OF MAGNESIUM

Filed Oct. 28, 1950 2 SHEETS—SHEET 1

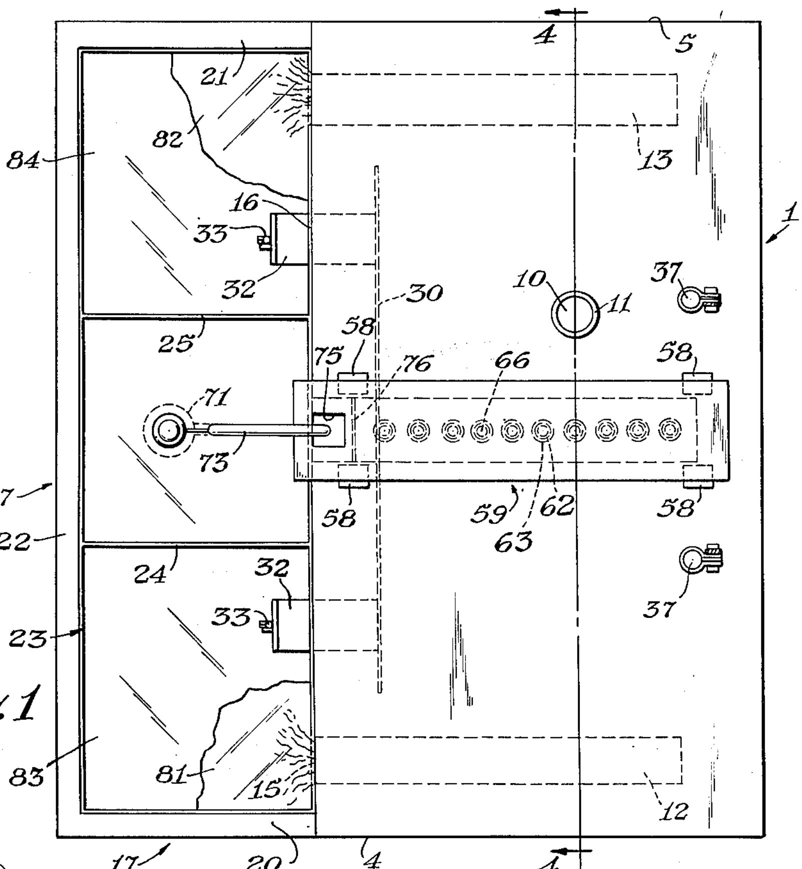

Fig.1

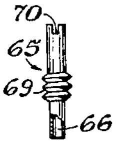

Fig. 5

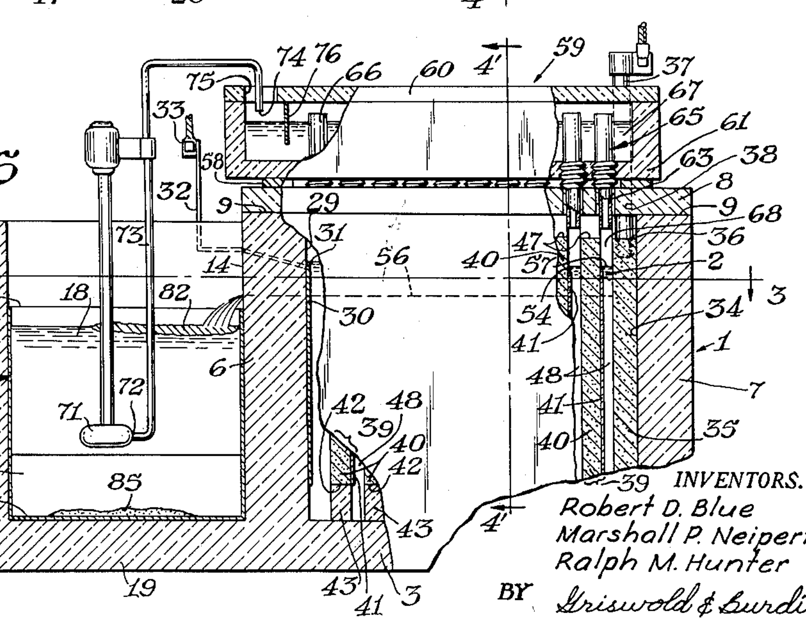

Fig.2

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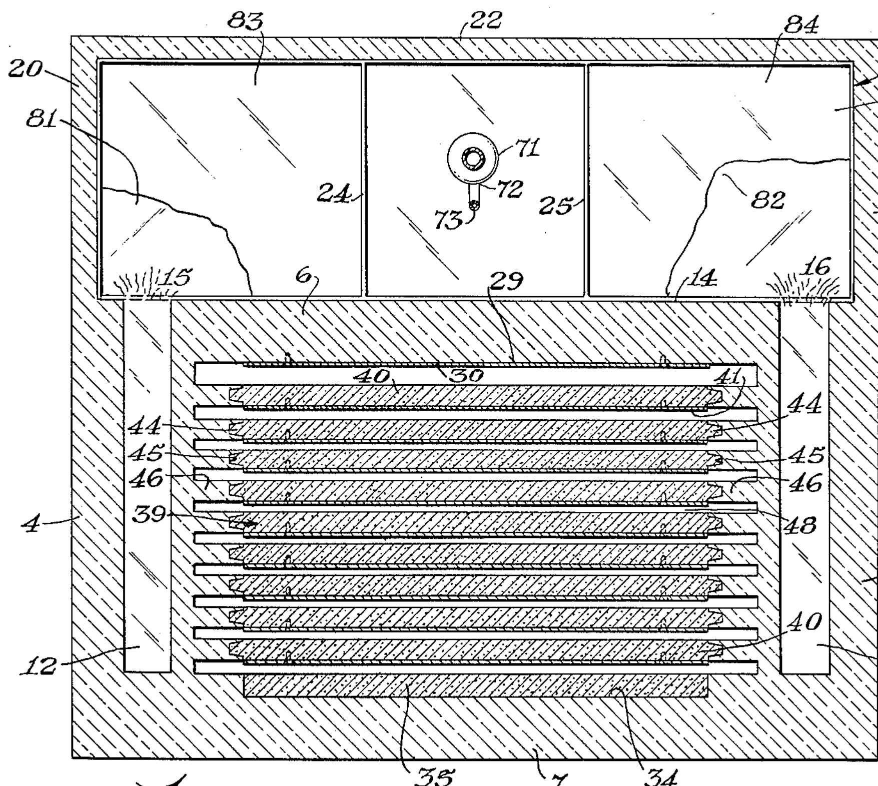

Fig. 3

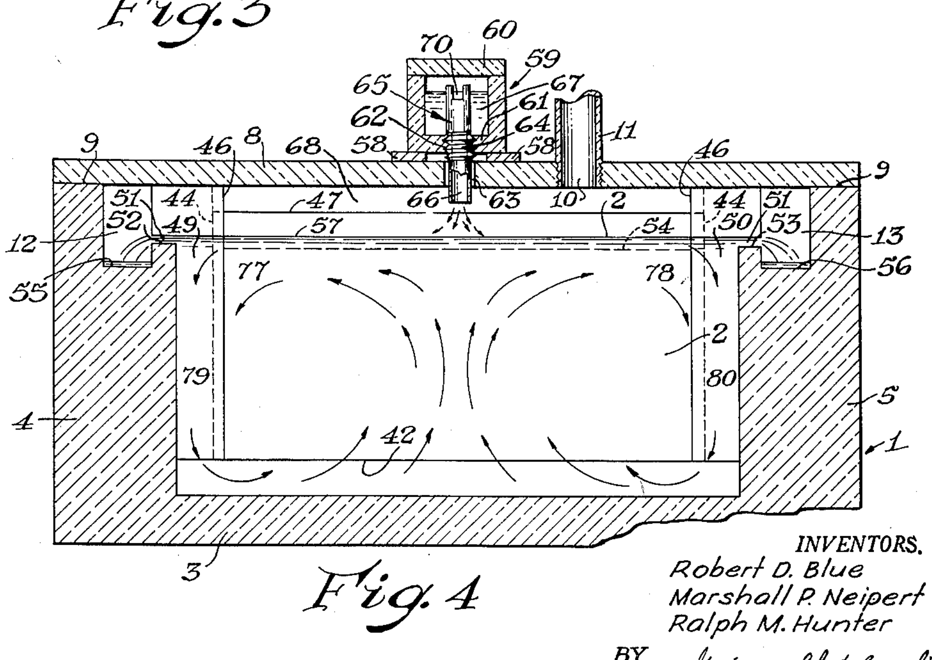

Fig. 4

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ELECTROLYTIC APPARATUS FOR PRODUCTION OF MAGNESIUM

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The invention relates to improvements in the electrolytic production of magnesium from a fused electrolyte. It more particularly concerns an improved bipolar electrolytic apparatus in which to electrolyze a fused electrolyte containing magnesium chloride to produce metallic magnesium in the molten state.

The usual fused salt baths employed for the electrolysis are heavier than magnesium, hence the metal floats on the surface of the bath as it accumulates during the electrolysis. This circumstance has long caused a problem in satisfactorily separating the magnesium from the chlorine simultaneously formed and evolved at the surface of the bath. Various expedients have been shown in the art for separating the products of the electrolysis, which generally depend upon partitioning the space above the surface of the bath in the electrolytic cell to form separate chambers for collecting the chlorine apart from the magnesium. The structure of such cells is further complicated by reason of the general practice of suspending the anodes from above to immerse their lower end in the bath. Such construction has given rise to a practical problem of positioning the anodes closely enough to the cathode to reduce the internal electrical resistance of the cell to a reasonable value and at the same time spacing the anodes and cathodes far enough apart to provide the necessary space for the partition which segregates the chlorine from the accumulated magnesium at the surface of the bath. Another problem is to distribute uniformly the attack on the anodes by oxygen liberated during electrolysis from moisture inevitably present in the electrolyte so that the anodes do not waste or wear away more in one place than another. Sealing the joints where the anodes enter the cell through a cover at the top, so as to prevent leakage of gas into or out of the cell, presents a problem. Leakage of chlorine causes a nuisance in the cell room, while if the cell is put under suction to prevent escape of chlorine, air is drawn in and dilutes the chlorine. In cells of large capacity this problem is aggravated by the large number of anodes necessarily employed to carry the current. Each of the anodes must be connected to the source of current, and the multiplicity of current-carrying leads causes still further complication in the cell superstructure, as well as in the operation of the cell.

The invention is intended to accomplish various objects in dealing with the aforesaid problems, so as to overcome or mitigate the disadvantages or limitations of the cell structures

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known to the art. Among the objects are the following: (1) to obviate the necessity for a multiplicity of movable depending anodes, each with its separate electrical connection; (2) to insure a tighter and more permanent closure of the cell to prevent leakage of gases; (3) to simplify the internal structure of the cell and reduce the hand labor required for its operation; (4) to dispense with partitions within the cell for segregating the anode and cathode products; (5) to provide a close spacing of adjacent anode and cathode surfaces without interfering with the separation of the electrolysis products and their removal from the cell; (6) to secure greater accessibility of those parts of the cell in connection with which manual operations may be required during use; (7) to make feasible the construction and operation of units of greater capacity than have heretofore been considered practical in the art; (8) to reduce the power consumption per unit of product; (9) to assure uniformity of wear over the anode surfaces. These and other objects and advantages will become apparent from the following specification and annexed drawing illustrating a preferred embodiment of the invention.

Fig. 1 is a plan of the apparatus according to the invention.

Fig. 2 is a side elevation of the apparatus of Fig. 1, partly in section.

Fig. 3 is a horizontal section of the apparatus on the line 3—3 of Fig. 2.

Fig. 4 is a transverse section of the apparatus on the line 4—4 of Fig. 1, the section corresponding to the vertical section on the line 4′—4′ of Fig. 2.

Fig. 5 is an elevation partly in section of an element of the electrolyte feeding device.

In the several views, like numerals designate like parts.

Referring to the drawings in detail, the electrolytic cell structure comprises a cell chamber, indicated generally by numeral 1, which contains the fused magnesium chloride electrolyte 2 and the electrolyzing electrodes (to be described later in detail). The cell chamber 1 is defined by a bottom 3, side walls 4 and 5, respectively, front end wall 6, and back end wall 7. The cell chamber is provided with a cover 8 resting on the top 9 of the walls of the chamber 1. The cover is provided with an opening 10 to which is attached the chlorine vent pipe 11. The chamber 1 and cover 8 are formed of a suitable non-conducting refractory material. A pair of troughs 12 and 13, respectively, is formed in the top of side walls

4 and 5, respectively. Each of the troughs extends from near the back end wall 7 where the ends are closed to the outer face 14 of the front end wall 6 where trough ends 15 and 16, respectively, are open.

Adjacent to the front end wall 6 of the cell chamber 1 is an electrolyte chamber, indicated generally by numeral 17, which contains a supply of fused magnesium chloride electrolyte 18 to be electrolyzed. The electrolyte chamber comprises a bottom 19 as an extension of the cell chamber bottom 3, side walls 20 and 21 as extensions of the cell chamber walls 4 and 5, respectively, and outer end wall 22. The front end wall 6 of the cell chamber forms the inner end wall of the electrolyte chamber. The electrolyte chamber is preferably lined with steel or iron plate to form a fluid tight box indicated generally by numeral 23 within the chamber 17. The upper portion of the box 23 is compartmented with a pair of baffles 24 and 25, respectively, extending from the top 26 of the box to within a short distance of the bottom 27 of the box leaving openings 28 under each baffle.

To the inside face 29 of the front end wall 6 is secured off the bottom 3, as with pegs, an iron or steel terminal cathode plate 30, the top 31 of which is a short distance below the top 9 of the cell chamber. Plate 30 is provided with current leads 32 having terminals 33 for connection to the negative terminal (not shown) of the source of electrolyzing current. Secured to the inside face 34 of the back end wall 7 off the bottom 3 is a graphite terminal anode plate 35, the top 36 of which is also a short distance below the top 9 of the cell chamber. Electrical connection from the positive terminal (not shown) of the source of the electrolyzing current to the terminal anode plate 35 is made through graphite rods 37 which pass through holes 38 in the cover 8 and are screw threadedly connected to the top of the terminal anode plate 35.

In the cell chamber 1 between the terminal cathode plate 30 and the terminal anode plate 35 are disposed in alignment and parallel to each other at evenly spaced intervals, the bipolar electrodes, indicated generally by numeral 39. Each bipolar electrode is formed of a graphite anode plate 40 having secured thereto on one side, as with pegs, a smaller cathode facing 41 of an iron or steel plate. The bottoms 42 of the bipolar electrodes are supported off the bottom 3, the same distance as the terminal cathode and anode plates 30 and 35, respectively, on insulating spacers 43 which extend across the bottom from one side of the chamber 1 to the other. The sides of each graphite plate of each bipolar electrode are provided with a tongue 44 which engages a groove 45 in refractory insulating spacers 46 which extend outwardly from the side walls 4 and 5, respectively, and space therefrom the bipolar electrodes. The spacers 46 reach from the spacers 43 to the top 9 of the cell chamber. The tops 47 of the graphite plates 40 extend above the facings 41 to within a short distance of the top 9 of the cell chamber. The bipolar electrodes 39, together with their side spacers 46 and bottom spacers 43, form partitions which divide the cell chamber, below the tops of the graphite plates 40, into a number of individual compartments or electrolysis cells 48.

The upper portion of each of the side walls 4 and 5 is left out at the places adjacent to each side 49 and 50, respectively, of the electrolysis cells 48 to form passages 51 leading from the top of each side of each electrolysis cell to the adjacent troughs 12 and 13, respectively. The bottoms 52 and 53 of each of the passages 51 are above the tops 54 of the facings 41 but below the tops 47 of the graphite plates 40. The bottoms 55 and 56, respectively, of the troughs are below the bottoms of passages 52, thereby permitting electrolyte from each cell 48 to overflow between adjacent spacers 46 into the troughs when the cells are sufficiently filled with electrolyte. When the cells are thus filled, the anode plates 40 protrude above the surface 57 of the normal level of electrolyte 2, but the cathode facings 41 are submerged in the electrolyte 2 below the surface 57 for protection against the chlorine liberated during the electrolysis.

Supported above the cover 8 by supports 58 over the middle of the electrolysis cells 48 transversely of the bipolar electrodes 39 is the electrolyte distributing box, indicated generally by numeral 59, for distributing electrolyte to the individual electrolysis cells 48. The box 59 is provided with a removable cover plate 60. Both the bottom 61 of the box and the cover 8 of the cell chamber are provided with a row of registering holes 62 and 63, respectively, directly above the middle of each electrolysis cell 48, those (63) in the cover 8 being of larger diameter than those (62) in the bottom 61. Holes 62 are provided with an internal screw thread 64 into each of which is fitted a tubular weir member indicated generally by numeral 65. As shown, each tubular weir member 65 has an externally threaded boss 69 intermediate its ends, the thread on which engages the thread 64 in the holes 62 in the bottom 61. The weir members are of sufficient length to form a passage 66 connecting the inside 67 of the box with the space 68 above the surface 57 of electrolyte in each of the electrolysis compartments 48. The upper end of each tubular member is provided with a slot 70 adapted to receive the blade of a screw driver or similar tool by which each weir member 65 may be rotated one way or the other so as to raise or lower the level of the upper end with respect to the bottom 61 of the feed box.

Electrolyte 18 is conveyed from the electrolyte chamber 17 to distributing box 59 by means of a lift pump 71 disposed in the lower portion of the box 23 between baffles 24 and 25. The discharge outlet 72 of the lift pump is connected by pipe 73 to the box 59, the outlet end 74 of the pipe being arranged to pass through opening 75 provided in the one end of the cover 60 of the box. A baffle 76 depends from the cover of the box adjacent to the outlet end 74 to reduce the turbulence in the electrolyte entering the feed box.

In starting the apparatus, before the electrolyte is introduced, it is desirable, if not necessary, to heat the interior of the cell chamber 1, and the electrodes therein, as well as the interior of the electrolyte supply chamber 17 and insides of box 59, as by gas torches or other means, until sufficiently hot for the admission of the molten salt electrolyte. A typical electrolyte composition contains approximately the following percentages by weight of the respective salts: $15MgCl_2$, $20CaCl_2$, 15KCl, 49NaCl, and $1CaF_2$. This salt mixture has an initial freezing point of about 610° C. Both the electrolyte supply chamber 17 and the cell chamber 1, after being heated, are filled to the desired level with the molten salt mixture to be electrolyzed. This may be accomplished by introducing molten electrolyte into the supply chamber and transferring electrolyte from it by pump 71 to the distributing box 59. When the box becomes filled thereby, as shown, to the level of the slots 70 in the upper ends of the weir members, the electrolyte overflows through each of the passages 66 in the weir members and is thereby distributed into the individual electrolysis compartments 48 directly below. As the electrolyte flows into the electrolysis compartments, they become filled and then the electrolyte overflows the bottoms 52 through passages 51 on either side of each electrolysis compartments into the adjacent troughs 12 and 13, respectively, and thence out the trough ends 15 and 16, respectively, back to the supply chamber 17.

Simultaneously with the introduction of the electrolyte into the electrolysis cells 48, the electric current is switched on from the source of electrolyzing current permitting the electrolysis to begin immediately and heat the electrolyte so that its temperature is raised and maintained above the melting point of magnesium. It is desirable also to make the potential of box 23 the same as the cathode plates so as to avoid a potential difference across the end wall 6, as by connecting the box to the cathode terminal 33. After the electrolysis compartments 45 have become filled and circulation of the electrolyte is established from the supply chamber 17 to the compartments 48 and from the compartments 48 to the supply chamber 17 by the pump 71, and the electrolysis is under way, molten magnesium is liberated on the terminal cathode plate 30 and the cathode facings 41 and chlorine on the terminal anode 35 and anode plates 40.

The chlorine is evolved as a continuous stream of bubbles which rapidly rise to the surface 57 where the gas escapes into the space above the electrolyte 2 below the cover 8 and is removed through the vent pipe 11. This rising stream of gas bubbles induces an upward current of the molten electrolyte in each of the electrolysis cells 48 between the opposed faces of the anode and cathode therein. As the electrolyte is thus caused to stream upwardly in each of the cells between the opposed anode and cathode faces, the stream divides near the surface 57 into two laterally moving streams, 77 and 78, which take downward courses 79 and 80, respectively, in the spaces between adjacent insulating spacers 46 where no electrolysis products form. At the bottom of the downwardly flowing streams, their courses 79 and 80 flow inwardly over the bottom of the electrolysis cells 48 through the spaces between adjacent spacers 43 and rejoin to again rise upwardly between the opposed anode and cathode faces, thus completing the circulation of the electrolyte internally of the electrolysis cells, as indicated by the arrows in Fig. 4.

To the internal circulation of electrolyte in the electrolysis cells 48 induced by the rising chlorine bubbles, there is added the electrolyte circulated by the pump 71. In this circulation, electrolyte is pumped continuously from the supply chamber 17 into the distributing box 59 from which it flows through the weir members 65 in substantially equal amounts into each individual electrolysis cell 48. In order to ensure a uniform rate of feed of electrolyte to each electrolysis cell, the height of each weir member 65 is adjusted by turning the member one way or the other to either raise or lower the upper end with respect to the level of the electrolyte in the box 59 until a suitable flow rate is obtained from each weir member. The electrolyte thus

entering each electrolysis cell meets the upwardly circulating electrolyte at the upper mid-point of the circulating path where it divides and joins the two lateral streams, 77 and 78, and augments these flows. The upward flow of electrolyte, circulating in the electrolysis compartments 48, dislodges the electrolytically produced molten magnesium from the face of the cathodes in droplets or globules which rise to and float on the surface 57 of the electrolyte and are carried to the sides 49 and 50 of the electrolysis compartments by the laterally moving streams 77 and 78, respectively, of electrolyte. On reaching the sides of the electrolysis cells, the flowing electrolyte overflows the bottoms 52 and 53 into the troughs 12 and 13, respectively, and thence along the troughs to the trough ends 15 and 16, respectively, where it falls into the electrolyte supply chamber 17 carrying the floating molten globules of magnesium with it.

The magnesium globules thus conveyed to the electrolyte supply chamber coalesce into unified floating bodies of molten metal 81 and 82 which are retained in baffled areas 83 and 84, respectively, below the trough ends 15 and 16, respectively. The electrolyte flowing to the supply chamber with the magnesium globules passes through the openings 28 under the baffles 24 and 25 to return to the pump 71.

The accumulation of metal in the areas 83 and 84 is removed from time to time by any convenient means, as by dipping, siphoning, or pumping.

As electrolyte is consumed, additional quantities are added to the electrolyte chamber 17. Such replenishment can be made from a melting tank (not shown). The chamber 17 also serves as a settling basin for non-metallic solid substances such as magnesium oxide, which may be suspended in the bath. Such oxide impurities are mostly derived from the more or less dehydrated magnesium chloride used as the source of magnesium chloride in the electrolyte, but may in part be formed by decomposition of magnesium chloride by air and water vapor in the ambient atmosphere. It is an advantage of the mode of operation of the apparatus that the continuous circulation of electrolyte through the electrolysis cells 48 carries out most of the suspendable solid impurities which settle to the bottom of the electrolyte supply chamber as a sludge 85 and may be removed from time to time.

The design of the electrolytic apparatus of the invention permits close spacing of the bipolar electrodes without incurring difficulties of separating the liberated magnesium from the fused electrolyte and without difficulty from the normal tendency of the liberated chlorine to recombine with the liberated magnesium which is substantially protected by the electrolyte and removed from each electrolysis cell with great rapidity by the assistance of the central feeding of electrolyte to each electrolysis cell. The close spacing of the bipolar electrodes also facilitates the scavenging of the electrolysis cells of the liberated magnesium. In addition, the close spacing results in a lower voltage drop between successive pairs of electrodes, which is in the order of five volts. This results in a saving of resistance loss which may amount to as much as 0.9 to 1.3 volts for each bipolar unit when operated at a sufficient current density to maintain the cell at a suitable working temperature. A suitable current density is about 2.8 to 3 amperes per square inch of electrode area in contact with electrolyte.

Among the advantages of the invention are that the graphite electrodes are mostly below the surface of the electrolyte where they are protected from the ambient chlorine atmosphere which sometimes may contain a small amount of air drawn into the cell chamber; while the iron or steel electrodes are completely submerged in the electrolyte. An important advantage of the apparatus is the symmetry of the electrolyte circulation and rapidity and uniformity of the distribution of electrolyte entering the individual cells. These features assure uniformity in the rate of wear of the graphite electrodes, thereby prolonging their useful life. A particular advantage of the new apparatus is the large capacity of output obtained on a single compact unit which is devoid of complicated separators for segregating the products of the electrolysis. Another important advantage is the high electrical efficiency of the apparatus which is at least 80 per cent with an energy consumption of 6 kilowatts per pound of magnesium produced, calculated upon the voltage measured between the terminal anode and cathode. Although a considerable number of bipolar electrodes are shown in the apparatus illustrated, it is evident that more or less may be used. If desired, two or more electrolysis chambers with their bipolar electrodes may be arranged in combination with a single electrolyte supply chamber for collecting the metal and distributing and recirculating the electrolyte. In addition, to the foregoing advantages, all the working parts of the cell are easily accessible. The maintenance of the cell and the removal of metal product are not attended by any substantial exposure of the operator to extreme heat or to noxious fumes.

We claim:

1. In an electrolytic apparatus for electrolyzing a molten magnesium chloride-containing electrolyte to produce molten magnesium and chlorine gas, the combination of a cell chamber having vertical parallel side walls and vertical parallel front and back walls; a terminal anode plate against the inside of the back wall and a terminal cathode plate against the inside of the front wall; bipolar electrodes disposed in alignment and parallel to each other at evenly spaced intervals between and parallel to the said terminal anode and cathode plates; a spacer under each bipolar electrode spacing it from the bottom of the cell chamber; a spacer between each side of each bipolar electrode and the adjacent sides of the chamber, the said side and bottom spacers forming with the bipolar electrodes partitions dividing the cell chamber into a plurality of electrolysis cells; an electrolyte supply chamber; a trough in the top of each side wall, each of said troughs being closed at one end and open at the other, the open end extending to the outer face of the front wall and discharging into the electrolyte supply chamber, and each of said troughs being parallel to the sides of the cell chamber; passages in the upper portion of each side wall between the cell chamber and each trough connecting the sides of each electrolysis cell with the adjacent trough; a cover over the cell chamber and troughs, said cover having an opening over the middle of each electrolysis cell; and pumping means for conveying electrolyte from the supply chamber to each electrolysis cell through said openings.

2. In an electrolytic apparatus for electrolyzing a molten magnesium chloride-containing electrolyte to produce molten magnesium and chlorine gas, the combination of a cell chamber having vertical parallel side walls and vertical parallel front and back walls; a terminal anode plate against the inside of the back wall and a terminal cathode plate against the inside of the front wall; bipolar electrodes disposed in alignment and parallel to each other at evenly spaced intervals between and parallel to the said terminal anode and cathode plates; a spacer under each bipolar electrode spacing it from the bottom of the cell chamber; a spacer between each side of each bipolar electrode and the adjacent sides of the chamber, the said side and bottom spacers forming with the bipolar electrodes partitions dividing the cell chamber into a plurality of electrolysis cells; an electrolyte supply chamber; a trough in the top of each side wall, each of said troughs being closed at one end and open at the other, the open end extending to the outer face of the front wall and discharging into the electrolyte supply chamber, and each of said troughs being parallel to the sides of the cell chamber; passages in the upper portion of each side wall between the cell chamber and each trough connecting the sides of each electrolysis cell with the adjacent trough; a cover over the cell chamber and troughs, said cover having an opening over the middle of each electrolysis cell; an electrolyte distributing box over the cell chamber, said box having a bottom provided with openings registering with the said openings in the cover; and pumping means for conveying electrolyte from the supply chamber to the electrolyte distributing box.

3. In an electrolytic apparatus for electrolyzing a molten magnesium chloride-containing electrolyte to produce molten magnesium and chlorine gas, the combination of a cell chamber having vertical parallel side walls and vertical parallel front and back walls; a terminal anode plate against the inside of the back wall and a terminal cathode plate against the inside of the front wall; bipolar electrodes disposed in alignment and parallel to each other at evenly spaced intervals between and parallel to the said terminal anode and cathode plates; a spacer under each bipolar electrode spacing it from the bottom of the cell chamber; a spacer between each side of each bipolar electrode and the adjacnt sides of the chamber, the said side and bottom spacers forming with the bipolar electrodes partitions dividing the cell chamber into a plurality of electrolysis cells; an electrolyte supply chamber; a trough in the top of each side wall, each of said troughs being closed at one end and open at the other, the open end extending to the outer face of the front wall and discharging into the electrolyte supply chamber, and each of said troughs being parallel to the sides of the cell chamber; passages in the upper portion of each side wall between the cell chamber and each trough connecting the sides of each electrolysis cell with the adjacent trough; a cover over the cell chamber and troughs, said cover having an opening over the middle of each electrolysis cell; an electrolyte distributing box over the cell chamber, said box having a bottom provided with openings registering with the said openings in the cover; a tubular weir member screw threadedly secured in each said opening in the distributing box; and pumping means for conveying electrolyte from the supply chamber to the distributing box.

4. In an electrolytic apparatus for electrolyzing a molten magnesium chloride-containing electrolyte to produce molten magnesium and chlorine gas, the combination of a rectangular cell chamber of insulated refractory material having vertical parallel side walls and vertical parallel front and back walls; a terminal anode plate against the back wall and a terminal cathode plate against the front wall inside the cell chamber; bipolar electrodes disposed in alignment and parallel to each other at evenly spaced intervals between and parallel to the terminal anode plate and the terminal cathode plate; an insulating refractory support under each bipolar electrode spacing it from the floor of the chamber; insulating refractory spacers between the sides of each of the bipolar electrodes and the adjacent sides of the chamber, the insulating refractory supports and insulating refractory spacers forming with the bipolar electrodes partitions dividing the cell chamber into individual electrolysis cells; an electrolyte supply chamber; a trough in the top of each side wall extending from the back wall to the outer face of the front wall and discharging into the electrolyte supply chamber, each of said troughs being parallel to the sides of the cell chamber, each of said side walls having passages in the upper portion thereof connecting the sides of each individual electrolysis cell with the trough adjacent thereto, the bottom of each said passage being above the bottom of the said troughs; a cover over the cell chamber and troughs, said cover having an opening over the middle of each electrolysis cell; an electrolyte distributing box over the cell chamber, said box having a bottom provided with internally threaded holes registering with the said openings in the cover; an externally threaded tubular weir member in each internally threaded hole in the bottom of the said box, each said tubular member extending through one of the said openings in the cover and providing a passage from the inside of the said box to an individual electrolysis cell; a lift pump in the electrolyte supply chamber; and conduit means connecting the discharge of the lift pump with the said box for conveying electrolyte from the electrolyte supply chamber to the said box.

5. In an electrolytic apparatus for electrolyzing a molten magnesium chloride-containing electrolyte to produce molten magnesium and chlorine gas, the combination of a rectangular cell chamber of insulated refractory material having vertical parallel side walls and vertical parallel front and back walls; a terminal anode plate against the back wall and a terminal cathode plate against the front wall inside the cell chamber, the top edge of said terminal cathode plate being slightly below that of the said terminal anode plate; bipolar electrodes disposed in alignment and parallel to each other at evenly spaced intervals between and parallel to the terminal anode plate and the terminal cathode plate, each of said bipolar electrodes comprising an anode plate having its top edge at the same height as that of the said terminal anode plate and a cathode plate secured to one face of the said anode plate, the top edge of the said cathode plate being at the same height as that of the said terminal cathode plate; an insulating refractory support under each bipolar electrode spacing it from the floor of the chamber; insulating refractory spacers between the sides of each of the bipolar electrodes and the adjacent sides of the chamber, the insulating refractory supports and insulating refractory spacers forming with the bipolar electrodes partitions dividing the cell chamber into individual electrolysis cells; an electrolyte supply chamber; a trough in the top of each side wall extending from the back wall to the outer face of the front wall and discharging into the electrolyte supply chamber, each of said troughs being parallel to the sides of the cell chamber, each of said side walls having passages in the upper portion thereof connecting the sides of each electrolysis cell with the trough adjacent thereto, the bottom of each said passage being above the top edge of each of the said cathode plates but below the top edge of each of the said anode plates, and the bottom of said troughs being below the bottom of each of the said passages; a cover over the cell chamber and troughs, said cover having an opening over the middle of each electrolysis cell; an electrolyte distributing box over the cell chamber, said box having a bottom provided with internally threaded holes registering with the said openings in the cover; an externally threaded tubular weir member in each internally threaded hole in the bottom of the said box, each said tubular member providing a passage from the inside of the said box to an electrolysis cell; a lift pump in the electrolyte chamber; and conduit means connecting the discharge of the lift pump with the said box for conveying electrolyte from the electrolyte chamber to the said box.

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REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
679,050	Girouard	July 23, 1901
1,269,666	Wheeler	June 18, 1918
2,468,022	Blue et al.	Apr. 26, 1949