

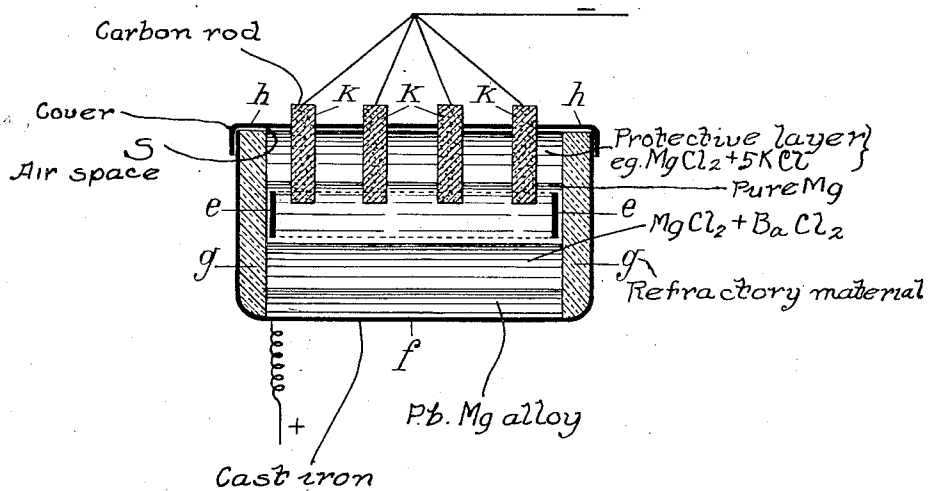
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MANUFACTURE AND PURIFICATION OF MAGNESIUM

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UNITED STATES PATENT OFFICE

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MANUFACTURE AND PURIFICATION OF MAGNESIUM

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It has already been proposed to prepare certain "light metals" (by which term I refer to metals lighter than aluminum) by first producing an alloy or impure mixture containing the metal desired in a primary electrolytic cell and then treating the metal so produced in the type of electrolytic cell generally known as a "secondary" and thus obtaining pure metal. In this secondary cell the metal which it is desired to purify is electrolytically transferred from one electrode to the other, the impure metal or alloy serving as the anode, the pure metal being deposited on the cathode.

The present invention has for its object a process of secondary electrolysis, and a cell designed to realize the same, the process and cell being both specially applicable to the purification of magnesium by this method.

The process consists in superposing the following layers (in the order stated) in the secondary cell.

(a) the alloy or impure metal serving as anode.

(b) above this, a layer containing the chloride of the metal to be purified, to which is added if necessary heavier chlorides of metals which are more electropositive, in such a manner that this layer is denser at the working temperature than the molten metal which one desires to obtain pure.

(c) above this again, a layer of pure metal serving as a cathode, to which the electric current is led by any appropriate means.

(d) and lastly at the top, a protective covering for example of light fused chlorides, which must be lighter at the working temperature than the metal and may be liquid or solid at that temperature.

This top layer serves as a protective covering against oxidation for the pure metal layer, and the two upper layers again serve as a protective covering for the electrolysis preventing the formation of oxychlorides in the electrolyte and their deposition on the anodic surface of the alloy which is highly deleterious.

Preferentially the electrolysis should take place in a closed cell. and the possibility of keeping an atmosphere of some neutral gas inside the cell can also be envisaged.

In the case of the purification of magnesium in this secondary cell, using as anode say for example an alloy of lead and magnesium previously obtained in a primary cell, the electrolytic bath may be constituted as follows.

(a) at the bottom an anode of lead magnesium alloy.

(b) a layer of magnesium chloride to which is added barium chloride, this layer serving as the electrolyte.

(c) a layer of molten magnesium serving as the cathode.

(d) a protective covering of light chlorides, such for example as a mixture of potassium and magnesium chlorides have the composition $5KCl.MgCl_2$, or a mixture of potassium and sodium chlorides, say $KClNaCl$.

The proportions of barium and potassium or sodium chlorides are regulated according to the density of the lead-magnesium alloy and the working temperature so that one may obtain a consecutive decrease in the specific gravities permitting the superposition and maintenance of the four layers as before described.

The cell in which this secondary electrolysis may be realized can be of any form which permits of the superposition of the four above described layers. An example has been shown on the annexed figure.

This cell has a bottom of cast-iron *f* which conducts the current to the layer of lead-magnesium alloy serving as the anode.

The sides of the cell are covered with a refractory lining *g*.

On the inside of this refractory lining is placed a piece, of metal *e*, (for example in the form of a hollow cylinder) which may occupy roughly the height of the cathodic layer of pure metal, but which must on no account project below into the layer of the electrolyte. This piece of metal is best formed of a metal or alloy which most advantageously can readily be wetted by molten magnesium, with the result that the upper and lower layers of chlorides cannot diffuse along the cell walls owing to the effects of

surface tension, and in particular of the exaggeratedly high surface tension of molten magnesium. It will be understood that if the said metal piece is made of a metal which readily alloys with magnesium, at the melting point of the latter, then an alloy will be formed; whereas if said metal does not alloy with magnesium, then pure magnesium can be formed.

10 At a certain height, rods of carbon *k*, or graphite, iron, or any other conducting material insoluble in magnesium and unattacked by it, project into the cathodic layer of pure magnesium *c*.

15 It is further to be noted that this metal band or cylinder *e* may be replaced by a piece of any other desired shape, such as a plate, grid etc., of a similar composition and placed always at the height of the layer of pure magnesium. This metallic piece can also if convenient constitute the sole cathodic element, thus dispensing with the carbons *k*.

The cell is covered with a cover *h* which may be air-tight so as to keep the surface of the bath protected from the air. In the modification shown in the drawing, a space at *s* is left to constitute insulation from the cast iron receptacle *f*. A suitable insulating gasket can be used to separate these, when the cover is to fit air-tight, as when an inert gas is to be used in the receptacle above the liquid level therein.

To start up the cell, the various layers including that of magnesium are poured into the cell one after another in the order of their respective densities. After the addition of the top layer one can commence to pass the electric current.

Or again one may commence by only adding the first two layers and "tin" (or electrodeposit) the magnesium on to the metallic piece *e* by using it first as the cathode. When this piece is properly coated, one can then add the two upper layers, and continue passing the current.

I claim:

1. A process of starting up the electrochemical purification of magnesium in a secondary cell which comprises first pouring only two heavy layers into the cell, one of such layers consisting of magnesium alloy and the other consisting of a magnesium salt and a heavy metal compound readily miscible therewith when molten, the alloy being heavier than the salt, then starting the current while using a metal piece destined to separate the two chloride layers as the cathode in order to insure its thorough coating with magnesium, and when this object has been achieved, adding a layer of fused light magnesium metal, and a layer of light protective salt, whereupon the cell will commence to function normally.

2. An electrolytic cell suitable for the electrolytic purification of magnesium having a

bottom of conducting material for the anodic current, walls provided with a refractory lining, cathodic conductors extending downwardly into the cell only to the normal height of the refined metal layer therein and a metal piece of such material that magnesium can electrodeposit upon it, said metal piece being positioned at about the normal height of the refined metal layer.

3. An electrolytic cell suitable for the electrolytic purification of magnesium in which a metallic piece located in between the two chloride layers, is located in the cathode portion of the cell, this piece being of such material that magnesium can electrodeposit upon it.

4. In the process of electrolytic manufacture of magnesium involving primary and secondary electrolysis, the improvement consisting in collecting the metal formed in the secondary vat as a homogeneous liquid layer above the electrolyte between parts of the vat provided with a covering of a material wettable by the metal, and in positioning above the said layer of metal a liquid layer of light salts inert to said metal, to avoid contact of the metal with the atmosphere.

5. In the process of electrolytic manufacture of metal lighter than aluminum by secondary electrolysis, the improvement consisting in collecting the metal formed in the secondary vat in a homogeneous liquid layer above the electrolyte between the parts of the vat provided with a covering of material wettable by the said metal in a molten state and serving as a cathode, and in maintaining upon the said layer of metal, a liquid layer of light salts inert to said metal, to avoid contact of the metal with the atmosphere.

6. In conducting secondary electrolysis of magnesium from alloys of such metal with a heavy metal, supporting within the cell, a material wettable by the metal obtained, at the height predetermined for the formation of a liquid light metal layer.

In testimony whereof I have affixed my signature.

ALFRED JESSUP.