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REFINING OF ALUMINUM

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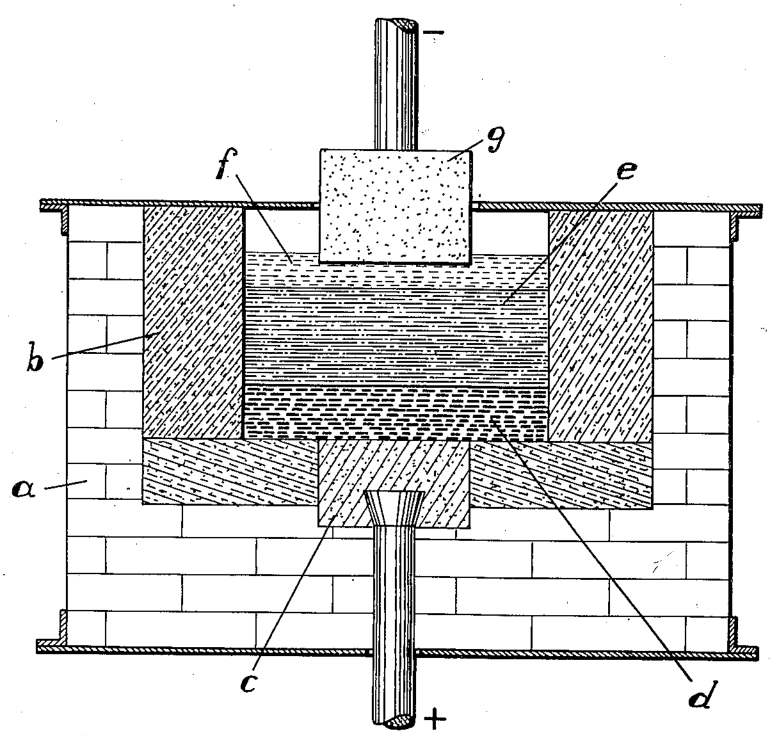

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REFINING OF ALUMINUM

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5 Claims. (Cl. 204—20)

The present invention relates to processes in which the aluminum to be refined alloyed with a heavy metal, copper for instance, is at the bottom of the apparatus, forming a melted anode, denser than the electrolyte, while the aluminum resulting from the electrolysis forms a liquid layer, which floats on the electrolyte and acts as a cathode.

It was first proposed, in processes of that kind, to utilize an electrolyte consisting of cryolite and barium chloride.

But it was subsequently found that such a bath is not well adapted to the electrolytic refining of aluminum, that is to say is not selective. Furthermore it was remarked that such a bath, when it contains an amount of barium chloride sufficient for giving it a density higher than that of aluminum, produces, at temperatures averaging 1000° C., an excessive quantity of smoke.

Finally an exclusive preference was given to baths containing alkali-earth fluorides, it being however well known that with an electrolyte containing a mixture of cryolite and of alkali-earth fluoride there is formed at the cathode an objectionable deposit of metallic sodium. In order to eliminate this last mentioned drawback, the percentage of aluminum fluoride was increased, so that the amount of this body present in the bath, as compared with that of sodium fluoride, was higher than in cryolite.

Now, according to the present invention, it has been found that, contrary to the indications published previously, a bath containing aluminum fluoride, sodium fluoride, and an alkali-earth chloride possesses all the qualities of selectivity that are required, provided that the amount of aluminum fluoride present therein should be such that the ratio of said amount and of that of sodium fluoride in the bath is greater than that corresponding to cryolite.

Such a bath is less expensive than those containing only fluorides, since alkali-earth chlorides are cheaper than the corresponding fluorides. Furthermore, and this is a more important advantage from the technical point of view, it permits of working at a temperature of about 700–800° C. instead of 1000° C. with baths containing only fluorides. This possibility of working at a lower temperature eliminates substantially the production of smoke.

It makes it possible to utilize a tank without a water jacket, which does away with the permanent dangers and the difficulties inherent in this element. On the other hand, it very much reduces the loss by oxidation of the upper layer of refined and melted aluminum. Furthermore, due to the fact that it very much reduces the production of metallic sodium, the wear and tear of the carbon cathodes through which current is fed to the layer of melted aluminum is greatly diminished.

Of course it is necessary that the electrolyte should have a density ranging between that of aluminum and that of the alloy utilized as anode, which determines the percentage of alkali-earth chloride, the composition of the electrolyte being further chosen with a view to giving it a melting point as low as possible.

This is, by way of example, the composition of an electrolyte complying with the conditions above stated:

	Per cent in weight
F_3Al	23
F Na	17
Cl_2Ba	60

This electrolyte, the melting point of which is 750° C., is very selective. It volatilizes only to a moderate degree and permits the industrial refining of aluminum.

Excellent results have also been obtained with a bath containing a still higher percentage of aluminum fluoride, that is as follows:

	Per cent in weight
F_3Al	27
F Na	13
Cl_2Ba	60

Of course the examples that have just been given are not limitative in any way and any mixture of F_3Al with alkali and alkali-earth fluorides and chlorides of a suitable density and melting point can be utilized according to the present invention, provided that the ratio of F_3Al and of the alkaline fluorides is greater than that corresponding to the formula of cryolite.

The process according to the present invention may be carried out in various kinds of apparatus previously proposed for the refining of aluminum through the known method of the three melted layers of anodic alloy, electrolyte, and cathodic aluminum.

But, as the baths according to the present invention permit working at lower temperature, and as the said baths contain a large proportion of chlorides noncorrosive for the magnesia, it becomes possible to use a tank merely coated with bricks of magnesia without any water jacket.

A preferred embodiment of an apparatus according to the present invention will be hereinafter described, with reference to the appended drawing, given merely by way of example, and in which:

The only figure is a vertical sectional view of a tank permitting the electrolytic refining of aluminum without involving any of the dangers and difficulties caused by the presence of the water jacket in apparatus of the usual type.

This apparatus includes a tank *a*, of circular shape, the inner wall of which is merely made of bricks of magnesia *b*. The bottom of the tank is provided with a sole *c*, preferably plane, of compact carbon, connected to the positive terminal of the electrolytic circuit. This sole serves to feed current to the anodic alloy *d* located above it.

The melted electrolyte *e* floats on the anode. It has been ascertained that this electrolyte does not attack the bricks of magnesia of the tank in which it lies, while it is known that such bricks are severely attacked by the ordinary baths of fluoride utilized at temperatures close to 1000° C. As there is no cold wall, the whole of the electrolyte remains in the melted state, its composition does not vary and there is no formation of scum on the anodic alloy.

The pure cathodic metal *f* floats on the electrolyte and current is supplied thereto through a carbon rod *g* or through any other suitable means.

It is not absolutely necessary to utilize very pure magnesia. It has been possible to obtain very good results with a tank coated with very ordinary bricks of magnesia, containing several percents of silica and iron oxide. After discharging a small amount of impurities for some days, the bricks no longer yield any impurity. It was possible to obtain in such a tank made of ordinary bricks of magnesia aluminum assaying 99.995%.

As above stated the invention is not limited in any way to the specific examples above given or to the apparatus above described, as changes might be made thereto without departing from the principle of the present invention as comprehended within the scope of the appended claims.

What I claim is:

1. A method of refining aluminum which comprises superposing in an electrolytic apparatus a layer of a molten alloy containing aluminum, forming the anode, a layer of melted electrolyte, and a layer of aluminum forming the cathode, in which the electrolyte comprises 23 per cent in weight of aluminum fluoride, 17 per cent sodium fluoride, and 60 per cent barium chloride.

2. A method of refining aluminum which comprises superposing in an electrolytic apparatus a layer of a molten alloy containing aluminum, forming the anode, a layer of melted electrolyte, and a layer of aluminum forming the cathode, in which the electrolyte comprises 27 per cent in weight of aluminum fluoride, 13 per cent sodium fluoride, and 60 per cent barium chloride.

3. A method of electrically refining aluminum which comprises superposing in an electrolytic apparatus a layer of a molten alloy containing aluminum forming the anode, a layer of melted electrolyte, and a layer of aluminum forming the cathode, in which the elctrolyte comprises a mixture of aluminum fluoride, an alkaline fluoride and an alkali-earth chloride, the ratio of the amount of aluminum fluoride to that of the alkaline fluoride being greater than the ratio of the amount of aluminum fluoride to that of sodium fluoride in cryolite, said electrolyte having a melting point between 700° C. and 800° C.

4. A method of electrically refining aluminum which comprises superposing in an electrolytic apparatus a layer of a molten alloy containing aluminum forming the anode, a layer of melted electrolyte, and a layer of aluminum forming the cathode, in which the electrolyte comprises a mixture of aluminum fluoride, sodium fluoride and an alkali-earth chloride, the ratio of the amount of aluminum fluoride to that of sodium fluoride being greater than the corresponding ratio of the same bodies in cryolite, said electrolyte having a melting point between 700° C. and 800° C.

5. A method of refining aluminum which comprises superposing in an electrolytic apparatus a layer of a molten alloy containing aluminum forming the anode, a layer of melted electrolyte, and a layer of aluminum forming the cathode, in which the electrolyte comprises a mixture of aluminum fluoride, sodium fluoride, and barium chloride, the ratio of the amount of aluminum fluoride to that of sodium fluoride in the electrolyte being greater than the corresponding ratio of the same bodies in cryolite, said electrolyte having a melting point between 700° C. and 800° C.

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