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LIGHT METALS AND THEIR ALLOYS

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It is known that gaseous impurities, and, in particular the products formed by their reaction with metals or alloys of metals, are very harmful and have a very bad effect on the mechanical properties of the said metals or alloys. As a result of this condition, it has been proposed, with a view to purifying metals, to incorporate to them, in the course of their treatment, substances or other metals which have a great affinity for these gaseous impurities. But it is known and easy to prove, by thermodynamics, that this method can not be very successful when applied to light metals and their alloys.

It has also been proposed to treat light metals and alloys with complex slags basically composed of chlorides and fluorides, but this addition frequently caused the formation of aluminates and other very fusible complex salts which gathered on the surface of the metal which condition prevents a complete purification and degassing.

Efforts have also been made to eliminate these impurities by means of gases such as chlorine, nitrogen, carbonic acid, carbon oxide, etc., but these processes have not obtained a practically complete degasing, due to the chemical inertia of these gases with respect to such impurities as nitrides, carbides, etc.

To obtain the elimination of gases, oxidation processes have been proposed. Undoubtedly, these processes are more efficient than the bubbling of the gases mentioned above, with respect to nitrides and carbides, but they are relatively slow and incomplete.

Finally, the treating of aluminum and magnesium alloys with water vapor has been tried. But the reactions obtained with water vapor were also incomplete and insufficient under normal atmospheric conditions, the contact with the liquid metal being insufficient and being, moreover, rendered imperfect by the formation of a film of oxide on the surface of the metallic bath.

The object of my invention is a process which allows the efficient elimination of gaseous impurities, such as carbides and nitrides, from light metals, particularly aluminum and magnesium as well as from the alloys of these metals.

The process is based on the application of H^2O according to the following classical reactions:

$$2AlN+3H^2O=2NH^3+Al^2O^3$$
$$Mg^3N^2+3H^2O=2NH^3+MgO$$
$$Al^4C^3+6H^2O=3CH^4+2Al^2O^3$$

etc. etc.

A particularity of this process which distinguishes it from known processes, consists in that the water is progressively evolved in the very midst of the bath of molten metal.

According to one embodiment of this process, the water is incorporated to the bath of molten metal in the form of water of hydration of certain salts added to this bath. This water of hydration is entirely released only at the fusion temperature of these salts, which fusion temperature is substantially superior to that of aluminum, of magnesium and of their alloys. The preceding reactions then take place and NH^3 and CH^4 gases are freed by the molten metal.

By way of examples of suitable salts, the following may be indicated: chlorides of hydrated alkaline-earthy metals, borax, alkaline carbonates which have a rather high heat of absorption of the water of crystallization, so that this water is freed and becomes available for the above reactions only at high temperatures, as indicated hereabove.

The same result may also be obtained by a chemical reaction of decomposition of acid salts such as carbonates, sulphites, sulphates, phosphates, for instance CO^3NaH, CO^3KH, SO^3NaH, SO^4KH, PO^4NaH^2, etc. When, for instance, CO^3NaH is added to the molten metal, this salt decomposes under the action of heat, according to the well known reaction:

$$2CO^3NaH=CO^3Na^2+CO^2+H^2O$$

The carbon dioxide gas goes off and the water formed gives, with the nitrides and carbides, the reactions given hereabove.

Any other means producing the same result could be utilized, for instance, a substance or a mixture of substances, not containing water in an isolated state (as is the case for hydrated salts) but providing this water by a chemical reaction.

By a mixture of alkaline-earthy chlorides, for instance, magnesium chloride, calcium chloride and barium chloride, or of their complex salts, such as for instance, hydrated carnallite, in proportions judiciously chosen, a practically complete elimination of carbides and nitrides is obtained. The reaction takes place at from 600° to 800°.

Another factor of the process is the action of the simultaneous formation of the oxides, aluminates and other complex salts which are formed on the surface of the metallic bath and for the absorption of which a suitable flux-acting slag is indispenable. Slags may be used which are basically composed of a mixture of fluorides, chlorides and carbonates of alkaline and alkaline-earthy metals or of their complex salts.

By way of example, not inclusive of all cases, the process, when applied to the fabrication of alloys of the duralumin type, may be practically realized in the following manner:

The first step consists in melting the various metals constituting the alloy by customary methods up to and including the incorporation of magnesium.

The temperature of the molten metal is raised and maintained between 600° and 800° as limits.

A charge is then laid on the surface of the

bath, the said charge having a weight of from 1 to 5% of the total weight of the metal, and being constituted as follows:

	Per cent
Hydrated magnesium chloride	10 to 25
Chloride of potassium anhydride	7 to 20
Hydrated barium chloride	12 to 25
Hydrated calcium chloride	5 to 15
Cryolite or alkaline fluoride	20 to 50

and the mixture is then well stirred.

Similar mixtures of other salts may also be utilized, such as:

	Per cent
Hydrated magnesium chloride	15 to 40
Hydrated calcium chloride	10 to 30
Hydrated sodium carbonate	5 to 25
Calcium fluoride	10 to 30
Sodium fluoride	10 to 30
Sodium chloride	10 to 25

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