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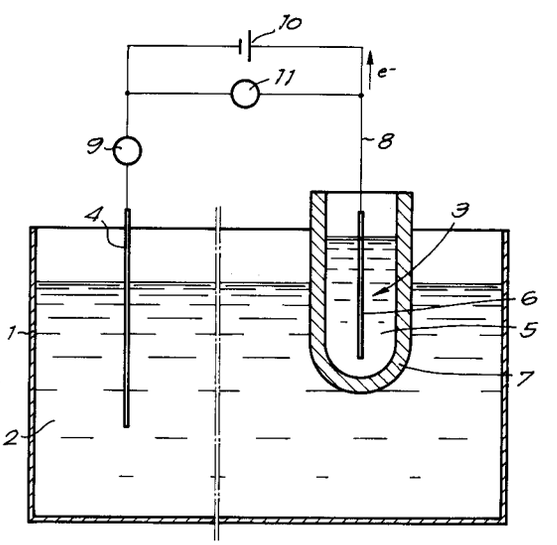
(54) Method for adding traces of sodium to a melt of aluminium or an aluminium alloy

(57) Method for adding traces of sodium to a melt (2) of aluminium or an aluminium alloy, characterized in that an electrode (3) is immersed in the melt (2) which contains molten sodium or a molten sodium compound (5) which is separated from the melt (2) by a solid-state electrolyte (7) conducting sodium ions, and by providing a direct voltage between said electrode (3) and the melt (2).



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The invention concerns a method for adding traces of sodium to a melt of aluminium or an aluminium alloy.

By traces of sodium should be understood amounts smaller than 1,000 ppm and usually even smaller than 150 to 200 ppm.

It is known that the adding of such traces of sodium to aluminium or to most aluminium alloys such as aluminium-silicon alloys, the so-called doping with sodium, considerably improves the castability and the quality of the castings. The castings can be removed more easily, the shrinkage is smaller and the structure is finer.

The conventional manner for adding said sodium consists in throwing tablets of sodium which is vacuum-packed in aluminium and which thus contain relatively large amounts of sodium, for example 6 percent by weight, in the melt of aluminium or the aluminium alloy. The amount of sodium from the tablet which ends up in the melt is very small, however, in practice only about 0.05%. This can be explained in that the livid metal starts to bubble heavily as soon as the tablet is thrown in and a large amount of the sodium starts to oxidize when exposed to the air. Due to this sodium combustion there is much smoke development, which is environmentally harmful, and there is a great loss of sodium, as a result of which the output of this method is very low. Moreover, the amount of sodium which is absorbed in the melt will be gradually reduced as a result of the evaporation of sodium, so that a new tablet has to be thrown in regularly, and it will be difficult to determine the exact amount of sodium at a given moment.

The invention aims to remedy these disadvantages and to provide a method for adding traces of sodium to the melt of aluminium or an aluminium alloy which is not only simple and ecologically sound, but which also consumes only a little amount of sodium and allows for an almost constant concentration of sodium in the aluminium.

This aim is reached according to the invention by immersing an electrode in the melt of aluminium or the aluminium alloy which contains molten sodium or a molten sodium compound which is separated from the melt by a solid-state electrolyte conducting sodium ions, and by providing a direct voltage between said electrode and the melt.

The alteration of the concentration of an element of the group Ia of the periodic table of the elements in aluminium in an electrochemical manner is known as such from Belgian patent No. 1.005.251, but an electrode of molten bismuth or a bismuth alloy is used in this method which can absorb sodium ions. Moreover, this patent concerns the refining of aluminium and in particular the removal of lithium and sodium from the aluminium.

In a particular embodiment of the invention, an additional electrode is provided in the melt, and a direct voltage is created between said additional electrode and the first-mentioned electrode.

According to a particular embodiment of the invention, beta alumine or beta'' alumine is used as a solid-state electrolyte.

Other particularities and advantages of the invention will become clear from the following description of a method for adding traces of sodium to a melt of aluminium or an aluminium alloy according to the invention. This description is given as an example only and does not restrict the invention in any way. The figures refer to the accompanying drawing which provides a schematic representation of an aluminium melt during the adding of sodium according to the invention.

The figure shows a vessel 1 filled with a melt 2 of aluminium or an aluminium alloy such as an aluminium-silicon alloy, at a temperature of about 750ÞC.

In order to add traces of sodium to this melt 2, two electrodes 3 and 4 are immersed in it. A first electrode 3 consists of molten sodium or a molten sodium compound 5 which, due to the temperature of the melt 2, has liquefied, and a of a nickel conductor 6 which sticks in the sodium or the sodium compound 5.

This electrode 3 is contained in a tubular recipient of solid-state electrolyte 7 which is immersed for a large part in the melt 2.

The other additional electrode 4 is a carbon electrode. This carbon electrode 4 and the conductor 6 are electrically connected to one another via a line 8 in which a current meter 9 and a DC source 10, for example a battery, are connected. In the parallel circuit with the DC source is connected a voltmeter 11.

If pure, molten sodium is used for the electrode 3, this sodium has to be cut off from the air in order to prevent the combustion thereof. The solid-state electrolyte recipient must be entirely closed.

This is why preference is usually given to a sodium compound which does not automatically combust when it is exposed to the air. NaOH can be used as a sodium compound, a sodium salt or a mixture of sodium salts such as sodium chloride, sodium carbonate, etc.

Naturally, the solid-state electrolyte recipient 7 must be impermeable to the melt 2 and to the liquid sodium or the liquid sodium compound 5, but it must form a sodium ion conductor. A suitable solid-state electrolyte is beta alumine or beta'' alumine.

The direct current which is created between the electrodes 3 and 4 depends on the construction as such and varies from a few volt to dozens of volt.

By immersing the solid-state electrolyte recipient 7 in the melt 2, the solid-state sodium or the solid-state sodium compound will liquefy due the heat of the melt 2, as a result of which Na^+ ions and electrodes are formed. The sodium ions migrate through the solid-state electrolyte recipient 7 to the surface thereof which makes contact with the melt 2, as a result of which the ions are neutralized into sodium. The electrodes of the liquid sodium or the liquid sodium compound 5 flow via the line 8 to the carbon electrode 4 and thus into the melt 2 in order to neutralize the sodium ions.

In this way, sodium is continuously provided into the melt 2, which results in sodium concentrations of up to 1,000 ppm and preferably of no more than 150 to 200 ppm.

Initially, there is little sodium in the melt 2. A relatively large part of this sodium evaporates at the surface of the melt 2, but an oxide film is formed after a while which increases in thickness thanks to the constant supply of sodium. After a sufficient length of time, the supply of sodium from the electrode 3 as a result of the electrochemical reaction and the loss of sodium due to evaporation will be more or less constant, so that the concentration of sodium in the melt 2 will reach a constant value.

The above-described method is relatively simple and the loss of sodium is limited. This method offers a great efficiency and a minimal environmental impact and makes it possible to control the concentration of sodium with relatively much accuracy. Already as of a concentration of 10 to 30 ppm there is a clear improvement of the quality of the castings cast with the doped aluminium or the doped aluminium compound.

The invention is by no means limited to the above-described embodiment; on the contrary, within the scope of the invention, many changes can be made to the embodiment described.

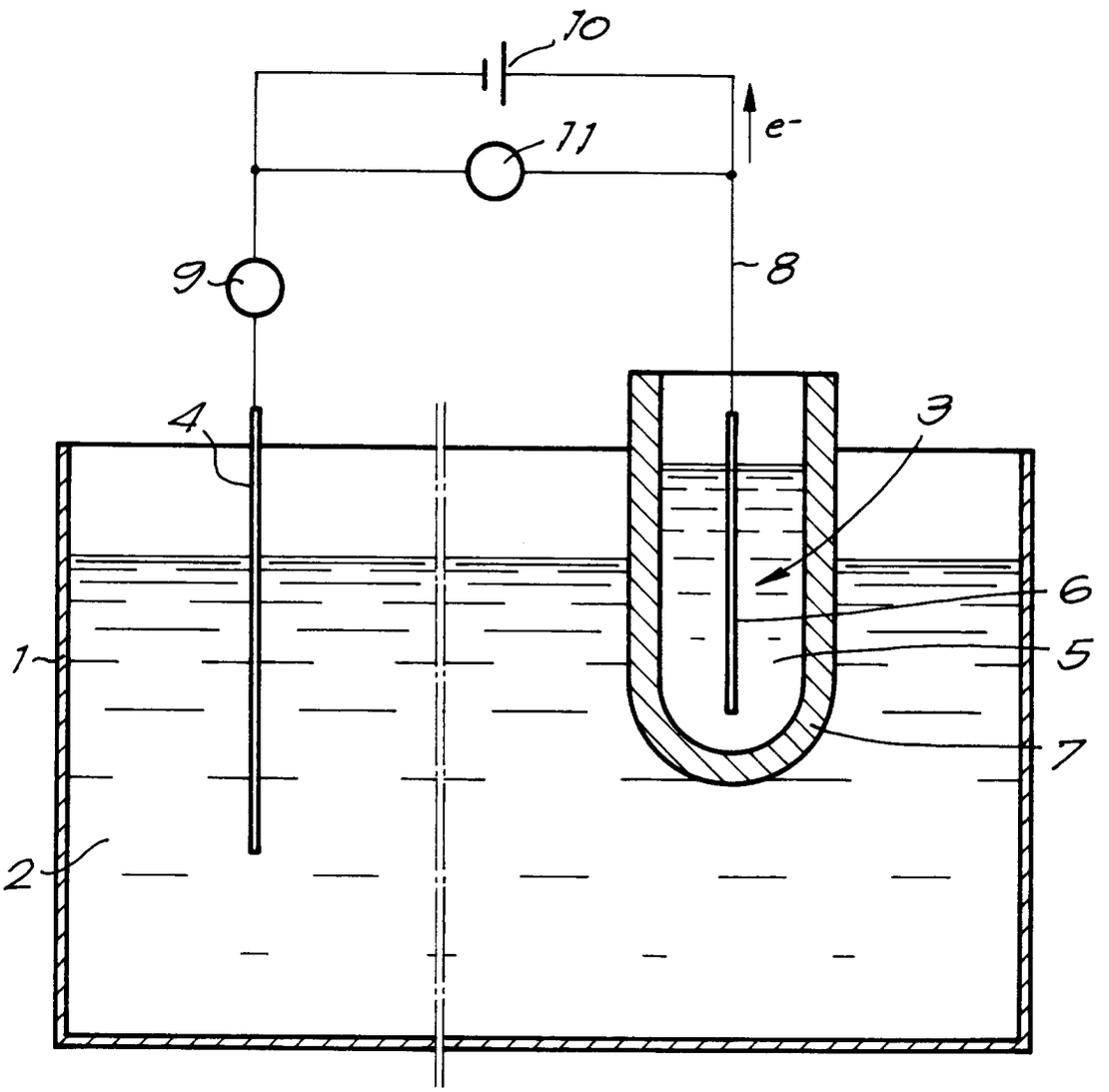
Claims

1. Method for adding traces of sodium to a melt (2) of aluminium or an aluminium alloy, characterized in that an electrode (3) is immersed in the melt (2) which contains molten sodium or a molten sodium compound (5) which is separated from the melt (2) by a solid-state electrolyte (7) conducting sodium ions, and by providing a direct voltage between said electrode (3) and the melt (2).

2. Method according to the preceding claim, characterized in that an additional electrode (4) is immersed in the melt (2), and in that a direct voltage is provided between said additional electrode (4) and the first-mentioned electrode (3).

3. Method according to the preceding claim, characterized in that as an additional electrode (4) a carbon electrode is immersed in the melt.

4. Method according to any of the preceding claims, characterized in that beta-alumineor beta'' alumine is used as a solid-state electrolyte (7).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EUROPEAN SEARCH REPORT

Application Number
EP 95 20 0958

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
D,A	EP-A-0 497 410 (STUDIECENTRUM VOOR KERNENERGIE) 5 August 1992 * claims 1-6 * ---	1-4	C22C21/04 C22C1/02 C25C3/24
A	DATABASE METADEX ASM/IOM AN 92(5):34-408, 1992 M.SUN ET AL 'ACTIVITY OF SODIUM IN LIQUID ALUMINIUM' * abstract * & JOURNAL OF CENTRAL-SOUTH INSTITUTE OF MINING AND METALLURGY (CHINA), vol. 23, no. 1, February 1992 pages 99-104, ---	1	
A	EP-A-0 446 152 (ALUMINIUM PECHINEY) 11 September 1991 -----		

TECHNICAL FIELDS SEARCHED (Int.Cl.6)
C22C C22B C25C

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	1 September 1995	Gregg, N

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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