

UNITED STATES PATENT OFFICE

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REFINING METALS

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The invention relates to the refining of metals, such as tin or lead alloys, for the purpose of eliminating therefrom, or reducing therein, the proportions of certain impurity metals regarded as undesirable or as 5 impurities and commonly such as antimony, copper, arsenic and iron, but including any others to which the process applies. Its object is to accomplish such removal, or reduction of proportions, with a maximum recovery of the product metal and particularly when it contains tin or some other metal of predominating value.

According to this invention a mush compound is produced in the metal under treatment and after separation therefrom the molten metal which clings to or wets the mush particles is washed off by the use of a molten metal different from the wetting metal and 15 having a lower melting point than the mush compound, and otherwise selected to conform to the objects sought.

An exemplification of the invention is as follows as applied to the purification of 25 metals by the use of aluminum to which process it is particularly related. By test or otherwise, the existing proportions of the impurity metal or metals in the metal to be treated are ascertained and such metal is melted and brought into reaction with an 30 appropriate amount of aluminum, as later explained. Ordinarily the aluminum is added to the molten metal in the form of flat or substantially flat pieces, such as the cuttings from aluminum sheets although this is not indispensable. When used they spread 35 over the molten metal and form a protective blanket on the metal excluding air and thus prevent burning during the raising of the metal to the reaction temperature. Whether introduced in this way or otherwise, the aluminum is actively stirred into the metal when the latter has reached the proper temperature of say 620° C. by the use of a power- 45 driven stirrer, preferably a so-called cone

stirrer having a propeller in the cone which maintains a constant circulation downward at the center of the kettle and upwards along its side walls, thus keeping the aluminum in constant motion.

The resulting reaction is exothermic and results in the formation of certain chemical compounds of aluminum with the impurity metal or metals having a composition corresponding to the general formulas, $AlSb$, $AlCu_2$, etc., according as to which of the impurity metals were present in the original metal. So-called white metal scrap commonly contains a considerable portion of antimony which is thus, in most cases, the principal and frequently the only impurity to be removed.

Instead of adding the aluminum alone, an alloy of aluminum with another metal can be used in those cases where the introduction of the companion metal is not incompatible with the process or the result desired. That is to say, if the metal under treatment contains tin, the process may be performed by adding a tin-aluminum alloy, for example one-third aluminum and two-thirds tin, in place of straight aluminum, because the tin thus introduced is merely in addition to that already present and may therefore not be inconsistent with the desired result.

The amount of aluminum added, whether as straight aluminum or alloy, depends on the amount of impurities to be removed, and for complete removal of the ordinary run of the impurities mentioned, is from two to three ninths of the amount of such impurities by weight more or less, or slightly more than the theoretical combining power of aluminum with the particular impurity metal or metals, thus avoiding any substantial excess of aluminum after the reaction is complete.

Following the aluminum reaction, the metal is cooled to a point below that at which the aluminum compounds referred to are soluble therein and preferably to 300° C. or

less, the point being variable according to the tin content in the alloy and being lower as such tin content is larger, and the practical rule being to cool to within about 100° C. of the freezing point of the metal. This causes the products of the reaction between the aluminum and the mentioned impurity metal or metals to separate sharply, in the form of a thick mush, floating on the molten mass and containing all the compounds of aluminum with the impurity metal or metals as stated.

The metal and mush are then separated, which is the next step, and this is accomplished by skimming or draining or by passing the metal with the mush in it through a hot filter, which latter may consist of any suitable container having a foraminous bottom, preferably removable, and having a charging entrance which can be closed so that fluid pressure, such as air pressure, can be used to force the liquid through, and also to blast off a part at least of the "mother liquor" metal which adheres to and wets the mush particles.

The "mother liquor" metal may be relatively valuable because of its content of tin or the like originally present in the metal under treatment or it may be mainly tin and in such cases according to this invention, it is all recovered from the mush. While the latter is in the filter or in any other suitable receptacle it is rinsed or washed with molten lead or lead-alloy or some less valuable molten metal, as the case may be, thus washing out and carrying off the more valuable metal and leaving in its place the cheaper or different metal as the wetting metal of the mush. The molten metal used as the washing medium is selected with reference to the desired product metal, so that its presence therein will conform to the desired or permitted formula for the latter, and the washing is best done in a filter in which the washing metal can be forced through the mush by the air pressure if desired and in which the portion of it which wets the mush after washing can then be blasted off, fairly completely, by the further use of the air pressure, as above described. The washing can be repeated if necessary and in this way practically all of the tin value in the original metal or alloy can be retained in the product metal.

The small portion of aluminum, remaining in the metal after separation from the mush, as above described, is eliminated by introducing or mixing with it while still liquid, a proper portion of some material capable of selective reaction with aluminum in preference to the tin or lead or metals desired to remain in the product and adapted to produce a dross thereof which can be removed. Sulphur, sal ammoniac, caustic soda, coal, vegetable materials like wood saw-dust, and also CO₂ gas and water, have been found

suitable for removing the residual aluminum, being applied or stirred into the metal, at an appropriate temperature to produce dross of the contained but small amount of aluminum, after which the metal quite free of that metal is ready to be poured for market or further use.

The values in the filter cake material are recoverable by ordinary processes of smelting in a blast furnace and such material also lends itself to specially satisfactory smelting in a reverberatory furnace in contact with oxides of metals such for example as the metals other than aluminum which the filter cake material holds in chemical combination, and resulting in the production of oxides of aluminum as slag and a metal or metallic alloy which is available for use according to its particular composition.

It will be understood that within the principle of the invention as above disclosed, it is possible to depart more or less from the materials and details of procedure which have been described without sacrifice of the underlying benefits referred to or departure from the scope of the invention as set forth in the following claims.

I claim:

1. In the process of refining or purifying metal wherein a mush compound is separated from liquid metal, the step which consists in removing the adhering or wetting metal of the mush by washing it with a molten different metal.

2. In the process of refining or purifying metal, wherein a mush compound is formed and separated from the liquid metal, the step which consists in removing the adhering or wetting metal of the mush by forcing a molten different metal through a cake of such mush under pressure.

3. In the process of refining or purifying metal by producing a mush compound therein, the steps which comprise collecting the mush in a filter, removing excess liquid metal therefrom by passing a gaseous medium through it and then washing said mush with liquid metal.

4. In the process of reducing the content of Sb, As, Cu or Fe present as impurity in tin or lead-base alloys which consists in reacting with aluminum on the molten alloy and cooling the mixture to produce a mush compound of the aluminum with such impurity metal or metals; the steps which comprise collecting the mush from the body of liquid metal at such cooled temperature, and clearing it of the residual wetting metal by washing it with a molten different metal, having a lower melting point than said compound.

5. In the process of removing Sb, As, Cu, or Fe from tin-containing alloys which consists in reacting with aluminum on a molten body of the alloy and cooling the mixture to

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produce a mush aluminum compound; the steps which comprise collecting the mush at such cooled temperature in a filter, and therein blasting off the residual wetting metal from the mush by passing a gaseous medium through it, and then washing the mush by passing a molten metal other than tin or aluminum through the mush and thereafter blasting off the residual portion of the latter metal by the use of gaseous medium.

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10 In testimony whereof, I have signed this specification.

GUSTAVE W. THOMPSON.

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