

UNITED STATES PATENT OFFICE

TURE ROBERT HAGLUND, OF STOCKHOLM, SWEDEN

PROCESS FOR THE MANUFACTURE OF ALUMINUM AND ALUMINUM ALLOYS

No Drawing. Application filed May 14, 1930, Serial No. 452,524, and in Sweden May 25, 1929.

The present invention relates to a process for the manufacture of aluminum and aluminum alloys. This process mainly consists in firstly producing a primary or preliminary alloy of aluminum and tungsten or an aluminum alloy containing tungsten; in the second step aluminum or a high grade aluminum alloy is recovered from this primary tungsten aluminum alloy by separation or precipitation e. g. in a mechanical or electrolytical way of the entire tungsten content or part thereof.

Suggestions have been previously made for the manufacture of aluminum by refining primary aluminum alloys; of such processes may be mentioned the production of a copper-silicon-aluminum alloy and its refining by electrolysis in a molten condition.

In comparison with these known processes the production of aluminum or aluminum alloys over a primary alloy containing tungsten possesses great advantages. In the first instance the use of an admixture of tungsten in the production of high grade aluminum alloys by electrothermic processes causes a much quieter furnace operation and a smoother reduction. In fact disturbances occur, as is wellknown, in electrothermic processes for the production of aluminum first and foremost owing to the fact, that the alloy, which is produced by the reduction, by reason of its low specific gravity easily remains in the reduction zone, where under the action of the electric arc and the reducing agency of the carbon present it starts to boil, causes disturbances and leads to the formation of carbides, which may easily choke the furnace.

A tungsten content in the aluminum alloy has now to a very high degree proved itself capable to prevent the said drawbacks and difficulties. Owing to the fact, that tungsten raises to a remarkable degree the specific weight of the produced alloy, the presence of the same facilities to a great extent the possibilities of working with slag, which protects the alloy, which is recovered by the reduction process and this has proved to be of vast importance. The use of a primary alloy with tungsten content has, however,

also been found to facilitate the refining process materially. In contradistinction, to what is known with respect to copper, it is actually possible, already by a simple process of liquation to practically altogether separate the tungsten content of the alloy. This liquation can be carried out in such a way that only a part of the tungsten content is separated. Liquation tests carried out with tungsten-aluminum alloys, with approximately 8% tungsten, have resulted in an aluminum metal with a tungsten content of only about 0.07%. It is perfectly obvious that the possibility of so completely separating the tungsten means a very great advantage.

A primary aluminum alloy with tungsten content according to the present method is produced suitably in such a manner that aluminum oxide or material containing aluminum oxide is smelted in an electrical furnace together with a reducing agent, preferably carbon and with the introduction of admixtures, which contain tungsten, e. g. in the shape of metal, alloy or compound, such as oxide ore; slag forming admixtures may also be added.

It is of advantage to return the rich tungsten alloy obtained in the ensuing refining process into the process for the purpose of producing the primary alloy. The reduction process is preferably conducted in such a way, that an alloy with a high aluminum content is obtained, containing preferably between 50 and 90% of aluminum. The tungsten content may vary from a few percent up to 50% or more. A tungsten content of approximately 10 to 30% has proved to produce very good results.

As an aluminum oxide containing material bauxite may be used. As, however, bauxites mostly contain a large amount of iron, and iron is a very undesirable component in the primary alloy, because it binds aluminum in the form of the specifically light compound FeAl_3 , which also has a high percentage of aluminum, as a rule bauxite which in some way or other, e. g. by some reduction smelting process, has been freed from iron and possibly also from other impurities, is used.

The purification of the bauxite from silica is, however, not so essential, because in certain instances a silicon content in the primary alloy means an advantage in the refining treatment.

It has been found suitable to subject the primary aluminum alloy to a liquefying treatment. The alloy is accordingly cooled down and kept for a certain time at such a temperature, that those alloys with a higher smelting point are solidified and can be separated from the remaining alloy, which remains in a molten condition. The high specific gravity of tungsten and its high melting-point have in this respect proved to facilitate greatly the separation of tungsten from aluminum alloys containing the same.

After the solidification of the tungsten aluminum alloy, the same is separated from the remaining metal bath by centrifugation, pressing or similar means.

The primary alloy or primary alloy refined in the said manner can, however, also be treated electrolytically for the recovery of its aluminum content. Such electrolytical refining can suitably be carried out at temperatures, which are below the fusing-point of the aluminum metal or aluminum alloy, i. e. with anodes and cathodes in a solid aggregated condition, but can of course also be carried out at higher temperatures. The refining can also be carried out by heating the primary alloy under a vacuum at such a temperature, that the aluminum is distilled away.

What I claim is:

1. A process for the manufacture of aluminum and aluminum alloys from aluminum-oxide and aluminum-oxide containing materials consisting in first producing from the same under the addition of tungsten containing substances by means of an electrothermic reducing smelting treatment a tungsten aluminum alloy and separating from this alloy by cooling a tungsten freed aluminum and leaving a tungsten aluminum alloy in a solidified state, which is enriched in tungsten.

2. A process for the manufacture of aluminum and aluminum alloys from aluminum-oxide and aluminum-oxide containing substances consisting in first producing from the same under the addition of tungsten containing substances by means of an electrothermic reducing smelting treatment a tungsten aluminum alloy and producing from this alloy by cooling and liquefying a practically pure aluminum and a tungsten aluminum alloy with a higher percentage of tungsten.

3. A process for the manufacture of aluminum and aluminum alloys from aluminum-oxide and aluminum-oxide containing materials consisting in first producing from the same under the addition of tungsten containing substances by means of an electrothermic reducing smelting treatment a tungsten aluminum alloy and producing from this alloy

by cooling and centrifugation a tungsten freed aluminum-alloy with a higher percentage of aluminum and a tungsten aluminum alloy with a higher percentage of tungsten.

4. A process for the manufacture of aluminum and aluminum alloys from aluminum oxide and silica containing materials consisting in first producing from the same under the addition of tungsten containing substances by means of an electrothermic reducing smelting treatment a tungsten silicon aluminum alloy and separating from this alloy by cooling an alloy with a high percentage of aluminum and leaving in a solidified state an alloy with a higher percentage of tungsten.

5. A process for the manufacture of aluminum and aluminum alloys from aluminum-oxide containing substances consisting in first producing from the same under the addition of tungsten containing substances by means of an electrothermic reducing smelting treatment a tungsten aluminum alloy and producing from this alloy by cooling and pressing a tungsten freed alloy with a higher percentage of aluminum and a tungsten aluminum alloy with a higher percentage of tungsten.

6. A process for the manufacture of aluminum and aluminum alloys from aluminum oxide containing substances consisting in first producing from the same under the addition of tungsten containing substances by means of an electrothermic reducing smelting treatment a tungsten aluminum alloy, which contains up to about 50% tungsten and producing from this alloy by cooling and liquefying a tungsten freed alloy with a high percentage of aluminum and a tungsten aluminum alloy with a higher percentage of tungsten.

7. A process for the manufacture of aluminum and aluminum alloys from aluminum-oxide containing materials consisting in first producing from the same under the addition of tungsten containing substances by means of an electrothermic reducing smelting treatment a tungsten aluminum alloy, which contains between 10 to 30% tungsten and producing from this alloy by cooling and liquefying an alloy with a high percentage of aluminum and a tungsten aluminum alloy with a higher percentage of tungsten.

8. A process for the manufacture of aluminum and aluminum alloys from aluminum oxide containing materials consisting in first producing from the same under the addition of tungsten containing substances by means of an electrothermic reducing smelting treatment a tungsten aluminum alloy, producing from this alloy by cooling and liquefying an alloy with a high percentage of aluminum and a tungsten aluminum alloy with a higher percentage of tungsten and sub-

jecting the former alloy to an electrolytical refining treatment.

9. A process for the manufacture of aluminum and aluminum alloys from aluminum-oxide containing materials consisting in first producing from the same under the addition of tungsten containing substances by means of an electrothermic reducing smelting treatment a tungsten aluminum alloy producing from this alloy by cooling and liquefying an alloy with a high percentage of aluminum and a tungsten aluminum alloy with a higher percentage of tungsten and recovering from the former alloy the aluminum by distillation.

10. A process for the manufacture of aluminum and aluminum alloys from aluminum-oxide containing materials consisting in first producing from the same under the addition of tungsten containing substances by means of an electrothermic reducing smelting treatment a tungsten aluminum alloy, producing from this alloy by cooling and liquefying an alloy with a high percentage of aluminum and a tungsten aluminum alloy with a higher percentage of tungsten and recovering from the former alloy the aluminum by distillation in a vacuum.

11. A process for the manufacture of aluminum and aluminum alloys from aluminum-oxide containing materials consisting in first producing from the same under the addition of tungsten containing substances by means of an electrothermic reducing smelting treatment a tungsten aluminum alloy separating from this alloy by cooling a tungsten freed aluminum, leaving a tungsten aluminum alloy with a higher percentage of tungsten in a solidified state and returning the tungsten containing product in the process as admixture for the production of the first tungsten aluminum alloy.

12. A process for the manufacture of aluminum and aluminum alloys from aluminum-oxide containing materials consisting in first producing from the same under the addition of tungsten containing substances by means of an electrothermic reducing smelting treatment a tungsten aluminum alloy, producing from this alloy by cooling and liquefying an alloy with a high percentage of aluminum and a tungsten aluminum alloy with a higher percentage of tungsten and returning the tungsten containing product in the process as admixture for the production of the first tungsten aluminum alloy.

13. A process for the manufacture of aluminum and aluminum alloys from aluminum-oxide containing materials consisting in first producing from the same under the addition of tungsten containing substances by means of an electrothermic reducing smelting treatment a tungsten aluminum alloy and producing from this alloy by cooling and centrifugation an alloy with a high percentage of

aluminum and a tungsten aluminum with a higher percentage of tungsten and returning the tungsten containing product in the process as admixture for the production of the first tungsten aluminum-alloy.

14. A process for the manufacture of aluminum and aluminum alloys from aluminum-oxide containing materials consisting in first producing from the same under the addition of tungsten containing substances by means of an electrothermic reducing smelting treatment a tungsten aluminum alloy and producing from this alloy by cooling and pressing an alloy with a high percentage of aluminum and a tungsten aluminum alloy with a higher percentage of tungsten and returning the tungsten containing product in the process as admixture for the production of the first tungsten aluminum-alloy.

15. A process for the manufacture of aluminum and aluminum alloys from aluminum-oxide containing materials consisting in first producing from the same under the addition of tungsten containing substances by means of an electrothermic reducing smelting treatment a tungsten aluminum alloy, which contains up to about 50% tungsten, producing from this alloy by cooling and liquefying an alloy with a high percentage of aluminum and a tungsten aluminum alloy with a higher percentage of tungsten and returning the tungsten containing product in the process as admixture for the production of the first tungsten aluminum alloy.

16. A process for the manufacture of aluminum and aluminum alloys from aluminum-oxide containing materials consisting in first producing from the same under the addition of tungsten containing substances by means of an electrothermic reducing smelting treatment a tungsten aluminum alloy, which contains between 10 to 30% tungsten, producing from this alloy by cooling and liquefying an alloy with a high percentage of aluminum and a tungsten aluminum alloy with a higher percentage of tungsten and returning the tungsten containing product in the process as admixture for the production of the first tungsten aluminum alloy.

17. A process for the manufacture of aluminum and aluminum alloys from aluminum-oxide containing materials consisting in first producing from the same under the addition of tungsten containing substances by means of an electrothermic reducing smelting treatment a tungsten aluminum alloy, producing from this alloy by cooling and liquefying an alloy with a high percentage of aluminum and a tungsten aluminum alloy with a higher percentage of tungsten, subjecting the former alloy with the high percentage of aluminum to an electrolytical refining treatment and returning the tungsten containing product in the process as admixture

ture for the production of the first tungsten aluminum alloy.

18. A process for the manufacture of aluminum and aluminum alloy from aluminum-oxide containing materials consisting in
5 first producing from the same under the addition of tungsten containing substances by means of an electrothermic reducing smelting treatment a tungsten aluminum alloy,
10 producing from this alloy by cooling and liquefying an alloy with a higher percentage of aluminum and a tungsten aluminum alloy with a higher percentage of tungsten, recovering from the former alloy the aluminum by distillation and returning the tungsten containing product in the process as admixture for the production of the first tungsten aluminum alloy.

19. A process for the manufacture of aluminum and aluminum alloys from aluminum-oxide containing materials consisting in
20 first producing from the same under the addition of tungsten containing substances by means of an electrothermic reducing smelting treatment a tungsten aluminum alloy,
25 producing from this alloy by cooling and liquefying an alloy with a high percentage of aluminum and a tungsten aluminum alloy with a higher percentage of tungsten, recovering from the alloy the aluminum by distillation in a vacuum and returning the tungsten containing product in the process as admixture for the production of the first tungsten aluminum alloy.

35 In testimony whereof I affix my signature.
TURE ROBERT HAGLUND.

40

45

50

55

60

65