Patented June 16, 1942

2,286,311

UNITED STATES PATENT OFFICE

2,286,311

MAGNESIUM-ZIRCONIUM ALLOY

Franz Sauerwald, Breslau, Germany, assignor, by mesne assignments, to Magnesium Development Corporation, a corporation of Delaware

No Drawing. Original application October 28, 1939, Serial No. 301,827. Divided and this application May 2, 1940, Serial No. 332,964. In Germany November 8, 1938.

1 Claim. (Cl. 75—168)

This invention relates to magnesium-zirconium alloys.

This application is an application divided out of application Ser. No. 301,827, entitled "Process for the production of magnesium-zirconium alloys," which was filed by the present applicant on the 28th of October, 1939.

In the production of magnesium alloys containing zirconium, whether by the direct introduction of metallic zirconium into molten magnesium or by the reduction of salts of zirconium, it has hitherto been found impossible, even when employing the measures usually adopted for the incorporation of metals difficult to alloy with magnesium, to increase the zirconium content in the magnesium beyond about 2 per cent., even when the temperature of the melt has been raised to near the boiling point of magnesium.

Since, on the other hand, hitherto unpublished experiments have shown that, in the solid state, the solubility of zirconium in magnesium increases with the temperature, attempts were made to obtain true alloys of magnesium having higher contents of zirconium, by diffusion in the solid condition. With this object, plates of pure magnesium were embedded in zirconium powder and treated, for protracted periods at temperatures only slightly below the melting point of pure magnesium. In this manner alloys have been produced which contain up to about 4 per cent. of zirconium in solid solution in the magnesium.

Such a cementation process is, however, obviously useless for the production of magnesium-zirconium alloys on a manufacturing scale.

The present invention provides a process of producing magnesium-zirconium alloys in the form of pieces of any convenient size and shape, which comprises preparing a suspension of elementary zirconium in molten magnesium, and transforming said suspension by rapid cooling, into the solid state, so that the suspension of zirconium in the magnesium is still retained therein. Thereafter, the solidified suspension is subjected to prolonged heat treatment at high temperatures, such as 600° C., which completes the diffusion of the zirconium suspended in the magnesium, with formation of a true alloy.

The same effect is obtained by stirring zirconium powder into the molten magnesium, or magnesium alloy, and thereafter cooling the mixture to a temperature slightly exceeding the solidus point, and stirring the crystalline pulp energetically, for a considerable time, at that temperature. The mixture is finally cooled until completely solidified, and is then preferably again annealed, for some little time, at a temperature closely below the solidus point.

The suspension of elementary zirconium in molten magnesium can also be prepared by stirring metallic zirconium, in an extremely fine state of division, into the molten magnesium and also by the introduction, into the molten magnesium, of zirconium salts which are then reduced to the metallic state.

The process is also specially adapted for the production of pre-alloys of magnesium and zirconium which are high in the latter component.

Example 1.—15 kgs. of pure magnesium are fused, after which 1.2 kgs. of zirconium powder are stirred into the melt at a temperature of about 700° C. The stirring of the suspension thus formed is continued up to the time of pouring it into iron moulds, in which it undergoes rapid quenching. The cast ingots are afterwards placed in an annealing furnace and maintained therein at a temperature of 620° C. for 112 hours. The alloy treated in this manner contains 3.68 per cent. of zirconium in solution.

Example 2.—Into 15 kgs. of pure molten magnesium are stirred 1.5 kgs. of zirconium powder, and the suspension thus formed is cooled down to a temperature of 650° C. the stirring of the crystalline pulp being continued, at that temperature, for 2 hours, and followed by cooling to a temperature of 645° C., at which the alloy solidifies completely. The annealing is continued at said temperature for 4 days, the alloy then containing 4.52 per cent. of zirconium in solution, whilst 4.33 per cent. remains undissolved.

What I claim is:

A binary magnesium-zirconium alloy, said alloy containing between about 2.1 and about 5 per cent of zirconium in a state of solid solution in the magnesium base matrix.

FRANZ SAUERWALD.