Patented June 6, 1933 1,912,382

UNITED STATES PATENT OFFICE

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METHOD OF MAKING AND CASTING ALUMINUM ALLOYS

No Drawing. Application filed September 5, 1931. Serial No. 561,508.

This invention relates to a process for improving the internal structure and physical characteristics of aluminum and aluminum base alloys, by which latter term is meant alloys containing more than about 50 per cent of aluminum. The invention is particularly applicable to such metal or metallic alloys as are characterized by a coarse grain structure in either the cast or wrought condition.

To those skilled in the art it is well known that metal having a coarse grain or coarsely crystalline structure is usually undesirable, sand castings made therefrom containing cracks or faults and ingots made therefrom being difficult to roll. Mechanical working may break down such coarse structures, but only with difficulty, and if the metal is to be used in cast form the benefits of mechanical working cannot be realized. Consequently, the refinement of grain size in aluminum or aluminum base alloys is usually accomplished by the addition to the metal of an alloying element which will tend to reduce the grain size of the metal. Titanium is such an alloying element and recently has been widely used for such purposes. The grain-refining effect produced by the addition of titanium to aluminum of its alloys has not, however, been found, in practice, to be uniform and the grain-refining effect is quite often not so pronounced as to be commercially effective.

The present invention is predicated upon my discovery that the grain-refining effect produced by titanium may be considerably increased and made uniform if titanium is added to the molten metal or alloy immediately prior to the time that the metal or alloy is solidified or cast. In the practice of my invention I prefer to first obtain a preliminary aluminum alloy containing titanium in such quantities that the addition of small amounts of this preliminary alloy into the molten metal will produce a final alloy containing the quantity of titanium desired. This preliminary aluminum-titanium alloy or "hardener" may also contain other alloying elements which it is desired to add to the final alloy. The preliminary alloy is then added in solid form to the molten aluminum or molten aluminum base alloy that it is desired to treat and the whole is thereupon immediately cast into the desired form. It is upon this immediate casting of the metal after the addition thereto of titanium that the beneficial results of my invention depend and by the word "immediate" I mean a short time, preferably not later than about 1 to 5 minutes after the aluminum-titanium alloy has been added to the metal.

It will thus be understood that in order to obtain the significant advantages of my invention the metal or alloy to be treated should be brought into the molten condition, preferably but not necessarily, at a temperature somewhat higher than the desired pouring temperature, and that then the preliminary aluminum-titanium alloy, in solid form, should be added in required amounts, stirred in if necessary, and the heat immediately cast into the molds. From a series of experiments I have determined that the beneficial effect of the addition of titanium in accordance with my invention disappears if the titanium is added more than 30 minutes prior to casting, and that the greatest and the desired beneficial refining effect is obtained if the titanium be added not more than about 5 minutes before pouring.

The amount of titanium that is thus added to the total melt should be the amount which it is desired to obtain in the final alloy. I prefer a titanium cortent of about 0.03 per cent in the final alloy, although a refining effect is apparent if the preliminary alloy which is added immediately prior to casting the melt introduces a titanium content into the metal equal to about 0.01 per cent of the total melt. The preliminary alloy may contain enough titanium to produce a final melt containing as much as 1 per cent or more

of that metal, but since I have observed that the proper grain-refining effect is obtained when the titanium content of the total melt is not much above 0.5 per cent, and since amounts in excess of that amount apparently have deleterious effects upon other properties of the metal or alloys to which it is added, I prefer, in the practice of my invention, to add amounts not greater than 0.5 per cent.

Although I have described my invention with reference to, and I prefer, the addition of titanium to the melt in the form of an aluminum-titanium preliminary alloy, the advantages of my invention may also be obtained if the titanium is added in some other manner such as, for instance, by the addition to the molten metal of a titanium salt which is reduced by aluminum to metallic titanium or by the addition to the molten metal of a mixture of compounds, including titanium compounds, which at the temperature of the molten metal will react to produce metallic titanium.

In this specification and the appended claims the term "aluminum base alloy" denotes an alloy containing more than about 50 per cent of aluminum. Such an alloy may contain such other constituents as are usually and intentionally added to produce certain desired properties in the alloy and also small quantities of other constituents, not intentionally added, but usually present as impurities in the aluminum ingot or in the other metals which may form a part of the alloy.

Having thus described my invention, what I claim is:

1. In the art of casting aluminum or aluminum base alloy articles of fine grain structure, the process comprising melting the aluminum or aluminum alloy, introducing into the molten metal sufficient amounts of titanium to produce in the final melt a titanium content from about 0.01 per cent to about 1.0 per cent and immediately thereafter casting the resultant melt.

2. In the art of casting aluminum or aluminum base alloy articles of fine grain structure, the process comprising melting the aluminum or aluminum alloy, introducing into the molten metal sufficient amounts of titanium to produce in the final melt a titanium content from about 0.01 per cent to 0.5 per cent and immediately thereafter casting the resultant melt.

3. In the art of casting aluminum or aluminum base alloy articles of fine grain structure, the process comprising melting the aluminum or aluminum alloy, introducing into the molten metal sufficient amounts of titanium to produce in the final melt a titanium content of about 0.03 per cent and immediately thereafter casting the resultant melt.

4. In the art of casting aluminum or aluminum base alloy articles of fine grained structure, the process which comprises separately melting a quantity of aluminum or aluminum base alloy and a preliminary alloy containing titanium in sufficient quantity to produce in the final melt a titanium content from about 0.01 per cent to 0.5 per cent, combining the melted aluminum base alloy and the preliminary alloy and immediately thereafter casting the resultant melt.

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