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PROCESS FOR IMPROVING THE RESISTANCE TO CORROSION OF ARTICLES MADE OF MAGNESIUM-MANGANESE-ALLOYS

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The present invention relates to high percentage magnesium alloys containing manganese and is particularly concerned with a treatment resulting in an improved resistance to corrosion, of alloys consisting of magnesium and small amounts of manganese ranging between about 0.5 and 2.5 percent, when in shaped, and particularly in sheet form.

It has been ascertained that the anti-corrosive properties of the cast blocks or ingots of these alloys which are known to be excellent, are more or less diminished when the cast shapes are subjected to plastic deformation at elevated temperatures in any known manner, for instance by rolling into sheets. An object of the present invention is therefore to restore the original resistance to corrosion, in these alloys, after working, to a more or less pronounced degree.

According to the invention the plastically deformed work pieces are subjected to an annealing process which is preferably followed by a quenching in the case of pieces having a considerable thickness. The temperature during the annealing stage is maintained within a range upwards of about 400° C. but always below the point of, if only partial, fusion and varies according to the manganese content: thus the lower limit of the annealing temperature is the higher the higher the manganese content of the alloy. With an alloy containing 1.5 percent of manganese, for instance, it is necessary to select an annealing temperature of at least 410° C., and preferably as high as 470° C., so as to produce the desired effect. The duration of the annealing process depends to some extent upon the shape and size of the pieces to be treated. On the one hand, as regards the effect of the annealing upon the resistance to corrosion, it is preferable to extend the treatment over as long a period as possible. On the other hand, however, the annealing of articles produced by a mechanical deformation also causes a growing of the grains by recrystallization and it is thus advisable not to prolong the duration of the annealing so far as to produce a decline in the mechanical properties which regularly occurs when the size of the individual crystal grains becomes excessive.

As a rule it will be necessary to extend the annealing treatment over at least about 24 hours and preferably even longer in all cases in which the particular article has not, in the course of its working or forming operation, already previously undergone a similar annealing treatment. On the other hand, when an article of this kind has once been subjected to the annealing treatment in accordance with the present invention and has then been again subjected to a temperature above about 200° C., but below the lower temperature limit of the present treatment, for instance for the purpose of carrying out a final shaping process, the duration of the annealing treatment following that process may be curtailed considerably, a heating during about two hours generally sufficing for restoring the original resistance to corrosion. However, it is also possible to eliminate the final annealing treatment in the latter case altogether by carrying out any plastic deformation subsequent to the original annealing treatment within the temperature range already specified for attaining the purpose of the present invention.

When a subsequent quenching is required or desirable this may be effected by means of any of the known quenching media and in the known manner.

To obtain the improvement of the worked pieces according to the present invention it is not always indispensable to carry out the annealing as a separate process step. It is also frequently possible to combine the annealing treatment with a plastic shaping operation by carrying out the latter at a higher temperature than otherwise necessary, namely at a temperature within the range required to simultaneously produce the improvement of the resistance to corrosion as described.

Example

A cast rolling ingot consisting of an alloy of magnesium with 1.4 percent of manganese besides the usual impurities, which after being immersed in sea water for about six weeks showed practically no signs of attack, was rolled into sheets of 1.2 millimeters thickness at about 350° C. The rolled sheets, in contact with sea water, showed signs of attack after one week, and after about four weeks some sections of the sheet were even locally perforated owing to the action of the sea water. On the other hand, a sheet of the same series when subjected to an annealing at about 500° C. for 48 hours in an annealing furnace and then allowed to cool in the open air, displayed practically the same resistance to corrosion as the cast ingot from which it has been produced: even after six weeks' contact with sea water, the signs of attack were scarcely perceptible.

An annealed sheet was subsequently subjected to a bending process at 350° C. during about one hour. As a result of this procedure, the resistance to corrosion was again reduced so far that the sheet after six weeks' contact with sea water showed a large number of holes owing to corrosion. When the same sheet, subsequent to the bending at 350° C., was again annealed at 500° C. for two hours, the resistance to corrosion was restored so far that the sheet in contact with sea water after six weeks showed practically no signs of attack.

I claim:

1. A method of improving the resistance to corrosion of articles produced by plastic deformation at elevated temperatures from high percentage magnesium alloys consisting of between about 0.5 and 2.5 percent of manganese, balance magnesium, which comprises subjecting said articles to an annealing treatment at a temperature of 470° C.

2. A process of producing shaped articles, having a high resistance to corrosion, of high percentage magnesium alloys, consisting of between about 0.5 and 2.5 percent of manganese, balance magnesium, by plastic deformation at elevated temperatures which comprises carrying out deformation while subjecting the alloy to a temperature of at least 400° C.

3. A process of producing shaped articles, having a high resistance to corrosion, of high percentage magnesium alloys, consisting of between about 0.5 and 2.5 percent of manganese, balance magnesium, by plastic deformation at elevated temperatures which comprises carrying out deformation while subjecting the alloy to a temperature of 470° C.

4. In a process of producing shaped articles, having a high resistance to corrosion, of high percentage magnesium alloys consisting of between about 0.5 and 2.5 percent of manganese, balance magnesium, by plastic deformation at elevated temperatures, the steps which consist in first plastically shaping said alloy at a temperature below about 400° C., and then subjecting the shaped alloy to a temperature of at least 400° C. for a period of time sufficient to produce an increase in the resistance to corrosion of said alloy.

5. In a process of producing shaped articles, having a high resistance to corrosion, of high percentage magnesium alloys consisting of between 0.5 and 2.5 percent of manganese, balance magnesium, by plastic deformation at elevated temperatures, the steps which consist in first plastically shaping the alloy at a temperature below about 400° C., then subjecting the shaped alloy to a temperature of at least 400° C. for a period of time sufficient to produce an increase in the resistance to corrosion of said alloy, and finally quenching the shaped alloy.

6. In a process of producing shaped articles, having a high resistance to corrosion, of high percentage magnesium alloys consisting of between 0.5 and 2.5 percent of manganese, balance magnesium, by plastic deformation at elevated temperatures, the steps which consist in first plastically shaping said alloy at a temperature below about 400° C., and then subjecting the shaped alloy to a temperature of at least 400° C. for at least about 24 hours.

7. A method of improving the resistance to corrosion of articles produced by plastic deformation at elevated temperatures from high percentage magnesium alloys consisting of between about 0.5 and 2.5 percent of manganese, balance magnesium, which comprises subjecting said articles to an annealing treatment at a temperature of at least 400° C., the temperature being the higher the higher the manganese content of the alloy.

8. A plastically shaped and annealed article consisting of an alloy of about 0.5 to 2.5 per cent of manganese, balance magnesium, said article having, owing to an annealing treatment at a temperature of at least 400° C., a resistance to corrosion which is not substantially lower than that of the same alloy as originally cast.

9. A rolled sheet consisting of an alloy of between about 0.5 and 2.5 per cent of manganese, balance magnesium, and having, owing to an annealing treatment at a temperature of at least about 400° C., a resistance to corrosion not substantially lower than that of the alloy as originally cast.

10. A rolled sheet consisting of an alloy of 1.4 per cent of manganese, balance magnesium, and having, owing to an annealing treatment at a temperature of at least about 400° C., a resistance to corrosion not substantially lower than that of the alloy as originally cast.

11. A method of improving the resistance to corrosion of articles produced by plastic deformation at elevated temperatures from high percentage magnesium alloys consisting of between about 0.5 and 2.5 per cent of manganese, balance magnesium, which comprises heating said articles to a temperature within a range upwards of about 400° C. but always below the point of fusion.

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