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# UNITED STATES PATENT OFFICE.

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## ALUMINUM ALLOY CONTAINING LITHIUM.

No Drawing. Application filed December 7, 1923. Serial No. 679,262.

My invention relates to aluminum alloys containing lithium, of the type described in application Ser. No. 392,494, filed June 28, 1920, by myself and George Welter. Alloys of this type are especially adapted for mechanical or constructional purposes, particularly if they have been subjected to suitable heat treatment.

I have discovered that the hardening of aluminum by lithium can be produced by the addition of exceedingly small quantities of lithium, such as from mere traces up to one-half of one per centum.

By adding other metals it is possible to further improve the qualities of the aluminum alloys containing lithium. The effects produced depend upon the metals used.

Thus, if the alloys are to have a high tensile strength as well as ductility and great capacity for elongation, zinc or tin should be added. Such an alloy, especially suited for the manufacture of sheets comprises zinc, 8 to 12%, lithium, from mere traces up to 0.5%, and the rest aluminum.

The zinc can, in this alloy, be wholly or partly replaced by tin.

If the main desideratum is an alloy having a high tensile strength with less ductility and capacity for elongation, then other metals should be added. Thus, an alloy of high tensile strength may have advantageously the following composition: zinc, 1 to 12%; copper, up to 4%; lithium, from a trace up to 0.5%.

In this alloy, the copper may be wholly or partly replaced by nickel, cobalt, manganese, tin, chromium, or silver.

These alloys may be made by melting in a crucible the pure aluminum, and then adding the copper and/or other metals, either separately or in the form of previously made alloys. The crucible is then removed from the furnace and the lithium metal added, preferably by enclosing it in an aluminum jacket, and submerging it under the surface of the molten metal.

Products such as rods, bars, wire, sheets, shapes of all kinds, rivets, etc., can be made from such aluminum alloys by pressing, rolling, forging, drawing, or other such operations. These products can be greatly improved if after they have been manufactured, they are subsequently subjected to a heat-treatment which consists in heating them to a temperature above 100° C. and then permitting them to cool slowly or rapidly chilling them. It is not possible to specify a definite maximum temperature for this heating (but it should not in general be above 500° C.) as it varies according to the composition of the alloy, and can readily be determined by test for each particular alloy. So also, the characteristics of the product as to tensile strength or elongation can be varied according to the manner of cooling. Rapid chilling tends to produce alloy products of higher tensile strength, while by slow cooling, alloy products capable of greater elongation and ductility are obtained.

The cooling or chilling may be carried out in an oil or water bath, in an air current, or in any other suitable medium. The temperature of the cooling medium may be varied according to requirement; and the heat-treatment may be repeated if necessary or desired.

I am aware of the patent to Pacz, No. 1,387,900, patented Aug. 16, 1921, which describes an alloy of aluminum and silicon, containing 8% or more of silicon. My alloy contains no silicon except perhaps that small amount which sometimes occurs as an impurity in commercially pure aluminum. My alloy is therefore substantially free from silicon.

I claim:

1. The hereindescribed alloy consisting predominantly of aluminum and substantially free from silicon, and containing an appreciable amount of lithium in less proportion than one-half of one per centum.

2. The hereindescribed alloy consisting predominantly of aluminum, with a minor proportion of a metal having the properties hereinabove described of zinc and tin, and containing an appreciable amount of lithium in less proportion than one-half of one per centum.

3. Aluminum alloys containing zinc, 1 to 12%; lithium in quantity varying from a trace to one-half of one percentum and the balance chiefly aluminum.

4. Alloys according to claim 3 containing

up to 4% of additional alloying metal whose presence tends to increase the tensile strength of the alloy.

5. Alloy according to claim 3, containing up to 4% of copper.

6. Articles of manufacture made from an aluminum alloy containing zinc, 1 to 12%, lithium in quantity varying from a trace to one-half of one percentum and the balance chiefly aluminum, which articles have been subjected to a heat-treatment comprising the steps of heating to a temperature above 100° C. and then cooling them.

7. Articles as claimed in claim 6 in which the alloy contains up to 4% of an additional alloying metal whose presence tends to increase the tensile strength of the alloy.

8. Articles as claimed in claim 6 in which the alloy contains up to 4% of copper.

In testimony whereof, I affix my signature.

JOHANN CZOCHRALSKI.