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MAGNESIUM BASE ALLOY

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3 Claims. (Cl. 75—168)

This invention relates to light weight magnesium alloys and more particularly to those containing a minor percentage of antimony.

A large number of magnesium alloys have been developed and many of them have been used commercially. While certain of these alloys have tensile strengths that are satisfactory for a wide variety of uses, their yield strengths are often so low that the magnesium alloy articles will deform and assume a large permanent set at a stress considerably below the stress corresponding to the ultimate tensile strength.

The principal object of my invention is to produce magnesium alloys having improved physical properties. A more specific object is to produce magnesium alloys having improved ratios of yield strength to tensile strength. Other objects and advantages will appear as the description proceeds.

I have discovered that the binary magnesium-antimony alloys as described in my co-pending application, Serial No. 126,526, filed February 18, 1937, may be improved so that they possess highly desirable combinations of properties and that such results are obtained by adding at least one of the heavy metals selected from the group copper, nickel, to these binary magnesium-antimony alloys.

I have found, for example, that the addition of approximately 0.5 to 15 per cent of at least one of the metals copper, nickel, to the magnesium-antimony alloys containing approximately 0.5 to 10 per cent of antimony, so as to give resultant polynary alloys containing at least 75 per cent of magnesium, yields new alloys having tensile strength, yield strength, and ratios of yield strength to tensile strength that are distinctly superior to those of the corresponding parent binary alloys. Extruded binary magnesium-antimony alloys containing 0.5 to 10 per cent of antimony have tensile strengths ranging from about 31,000 to 36,000 pounds per square inch, and yield strengths ranging from about 14,000 to 25,000 pounds per square inch. Extruded binary magnesium-copper alloys containing 0.5 to 12 per cent of copper or binary magnesium-nickel alloys containing 0.5 to 10 per cent of nickel have tensile strengths ranging from about 31,000 to 38,000 pounds per square inch and yield strengths ranging from about 13,000 to 27,000 pounds per square inch. On the other hand, my new polynary alloys consisting of magnesium plus antimony plus at least one of the metals copper and nickel in the proportions specified above have, in the extruded condition, tensile strengths ranging from about 38,000 to 45,000 pounds per square inch and yield strengths ranging from about 28,000 to 39,000 pounds per square inch.

These new polynary alloys are likewise characterized by having very high ratios of yield strength to tensile strength and in this characteristic surpass both of their parent binary alloys. The yield strength to tensile strength ratio for the extruded binary magnesium-antimony alloys ranges from about 0.43 to 0.69; for the extruded binary magnesium-copper or binary magnesium-nickel alloys from about 0.52 to 0.71. On the other hand, my new improved polynary alloys have yield strength to tensile strength ratios ranging from about 0.75 to 0.88.

Specific examples of the property improvements in magnesium alloys due to the simultaneous presence of antimony and at least one of the metals copper, nickel are given in the following table:

Composition	Tensile strength, lb./sq. in.	Yield strength, lb./sq. in.	Ratio, yield strength to tensile strength
Mg+2% Cu	33,000	17,000	0.52
Mg+4% Sb	34,200	21,900	0.64
Mg+2% Cu+4% Sb	37,900	28,300	0.75
Mg+4% Cu	35,700	20,500	0.58
Mg+2% Sb	33,300	19,200	0.58
Mg+8% Sb	36,100	24,900	0.69
Mg+4% Cu+2% Sb	38,000	33,200	0.87
Mg+4% Cu+8% Sb	41,500	35,700	0.86
Mg+8% Cu	37,700	23,500	0.63
Mg+4% Sb	34,200	21,900	0.64
Mg+8% Cu+4% Sb	44,500	39,200	0.88
Mg+2% Ni	37,700	26,600	0.71
Mg+2% Ni+3% Sb	41,100	31,300	0.76
Mg+2% Ni+6% Sb	42,200	31,900	0.75
Mg+3% Sb	31,400	13,700	0.43
Mg+4% Ni+3% Sb	43,300	33,800	0.78
Mg+8% Ni+3% Sb	44,700	37,900	0.85
Mg+3% Cu+2% Ni+6% Sb	43,500	33,100	0.76

The alloys of this invention may be prepared by the usual methods of alloying metals with magnesium, such as adding the antimony, copper, and nickel to a bath of molten magnesium protected from oxidation by a cover of fluid flux. Because of the vigorous action between antimony and the molten magnesium and the accompanying heat evolution, the antimony should be added slowly. Antimony may likewise be introduced as a magnesium-antimony master

alloy or as an antimony-copper of antimony-nickel alloy. The preparation of such intermediate alloys is of assistance in the production of alloys with exact predetermined analyses. For many purposes, I prefer to use alloys containing at least 85 per cent of magnesium. In such instances the alloys should contain from about 2 to 8 per cent of antimony plus from about 2 to 8 per cent of copper; from about 2 to 8 per cent of antimony plus from about 2 to 8 per cent of nickel; and from about 2 to 8 per cent of antimony plus 2 to 8 per cent of copper plus nickel.

Other modes of applying the principle of my invention may be employed instead of those explained, change being made as regards the ingredients and the steps herein disclosed, provided those stated by any of the following claims or their equivalent may be employed.

I particularly point out and distinctly claim as my invention:

1. A magnesium-base alloy consisting of from about 0.5 to 10 per cent of antimony and from about 0.5 to 12 per cent of copper, the balance being magnesium.

2. A magnesium base alloy containing about 0.5 to 10 per cent of antimony, about 0.5 to 15 per cent of copper, the balance being magnesium.

3. A magnesium base alloy containing about 2 to 8 per cent of antimony, 2 to 8 per cent of copper, the balance being magnesium.

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