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MAGNESIUM ALLOYS

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Our invention relates to multiple-substance alloys of magnesium and has for its object to produce magnesium alloys of the kind described that are better able to fulfill up-to-date requirements with respect to the mechanical properties of magnesium alloys than the magnesium alloys that were known heretofore.

Our invention substantially resides in that 0.5 to 8% bismuth and 0.2 to 4% titanium are added to magnesium alloys, irrespective of their composition in other respects. In this manner we obtain magnesium alloys having tensile strengths of 33 to 35 kg per squ. mm, 17 to 24% elongation and 30 to 35% reduction of area.

An alloy according to our invention, consequently, contains 0.5 to 8% bismuth and 0.2 to 4% titanium, and the remainder consists of magnesium and any suitable alloying elements.

A magnesium alloy containing 6% aluminium, 1% zinc, 0.3% manganese, remainder magnesium, has, in extruded condition, a tensile strength of 29 to 32 kg per squ. mm and 12 to 8% elongation.

By adding to this alloy 3% bismuth and 0.5% titanium, its tensile strength is raised to 32 to 34 kg per squ. mm, and its elongation to 17 to 18%.

By adding to the first-mentioned alloy 5% bismuth and 2% titanium, its tensile strength becomes 33 to 34 kg per squ. mm, and its elongation is again 17 to 18%.

An alloy containing 6% aluminium, 3% zinc, 2% cadmium, 0.5% manganese, remainder magnesium, has, in forged condition, a tensile strength of about 29 to 32 kg per squ. mm, and 12 to 8% elongation.

By adding to this alloy, in conformity with our invention, 4% bismuth and 1% titanium, its tensile strength becomes 33 to 35 kg per squ. mm, and its elongation is 20 to 24%.

As to reduction of area, this is 20 to 28% in the old alloys referred to, and is increased to about 30 to 33% by the additions of bismuth and titanium according to our invention.

As a further development of our invention, we have found that an addition of silver at the rate of 0.1 to 5% is favorable in our novel alloys since it increases the tensile strength without appreciably influencing its elongation and reduction of area. In the alloys referred to by way of example, addition of silver results in tensile strengths of 35 to 37 kg per squ. mm, with about 26 to 18% elongation.

The hardness of our alloys can be improved by adding lithium at the rate of 0.02 to 3% by which, in the alloys aforesaid, the hardness is increased for about 10 to 15%.

It will now be understood that our invention comprises adding to a magnesium alloy of any desired composition in other respects, bismuth and titanium at the respective rates of 0.5 to 8%, and 0.2 to 4%. To these alloys we may add 0.02 to 3% lithium and/or 0.1 to 5% silver.

Considering the usual magnesium alloys, an alloy according to our invention contains aluminium, cadmium, lead, tin, zinc, thallium, etc., each at the rate of 0.1 to 14%, and the said elements may be added separately or collectively. To an alloy of this usual kind, we add 0.5 to 8% bismuth and 0.2 to 4% titanium. If desired, we may also add 0.1 to 5% silver and/or 0.02 to 3% lithium.

The remainder in our novel alloys is substantially all magnesium. The phrase "substantially all magnesium" is intended to include magnesium and magnesium with minor amounts of customary impurities and auxiliaries. Such auxiliary alloying elements are, for instance, 0.1 to 2% each of manganese, calcium, silicon, or one of the metals of the iron group (iron, nickel, and cobalt) separately or collectively. Such and other auxiliaries are usual in magnesium alloys and they do not influence the characteristic properties of our novel alloys. However, the magnesium base must be at least 50% of the alloy, and preferably is 75 to 80%.

Preferably, an alloy according to the invention contains, besides 0.5 to 8% bismuth and 0.2 to 4% titanium, as described, one or more metals selected from the group comprising aluminium, cadmium, lead, tin, zinc, and thallium, at the rate of 0.1 to 49.3%, preferably 0.1 to 24.3%. The remainder of the alloy is substantially all magnesium and, as stated above, must be at least 50%. Preferably, it is 75%.

A preferred alloy according to our invention is one with 0.5 to 8% bismuth, 0.2 to 4% titanium, and 0.1 to 19.3% of one or more metals selected from the said group. The remainder which must be at least 80%, is substantially all magnesium.

Preferably, the alloys according to our invention contain, besides the said 0.5 to 8% bismuth and 0.2 to 4% titanium, 0.1 to 14% aluminium, under all conditions. To this may be added cadmium, lead, tin, zinc, and thallium, at the rate of 0.1 to 14% each, separately or collectively, but the base of substantially all magnesium must again not be less than 50% and preferably 75 to 80%.

Besides the auxiliaries in the remainder of substantially all magnesium that were mentioned above, the remainder may also contain, if desired, 0.1 to 3% zinc, or 0.1 to 5% silver, or 0.02 to 3% lith-ium. As mentioned, the said auxiliary elements may be added, in the proportions indicated, separately, or two or more of them together, in any selected combination. They are intended to improve certain properties of the alloys but do not influence the characteristic properties of the novel alloys according to our invention.

In the following tabulation, some more examples of alloys according to our invention are given, it being understood that for all alloys in the tabulation the remainder is substantially all magnesium as defined above, that is, magnesium with or without the aforesaid minor amounts of customary impurities and/or auxiliaries.

Examples

[Content of constituents, per cent]

No.	Bi	Ti	Al	Zn	Cd	Pb	Sn	Tl
1	0.5-8	0.2-4	0.1-10					
2	0.5-8	0.2-4	--------	0.1-5				
3	0.5-8	0.2-4	0.1-10	0.1-5				
4	0.5-8	0.2-4	1-14	1-14	1-14			
5	0.5-8	0.2-4	1-14	1-14	1-14	1-14		
6	0.5-8	0.2-4	1-14	1-14	1-14	------	1-14	
7	0.5-8	0.2-4	1-14	1-14	1-14	------	------	1-14
8	Alloys Nos. 1 to 7, with 0.1 to 2% of one or more of the auxiliary metals, Mn, Ca, Si, Fe, Ni, Co, and similar combinations.							

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