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MAGNESIUM BASE ALLOY

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This invention relates to magnesium alloys and more specifically to those containing a minor percentage of mercury.

The object of the invention is the production of magnesium alloys with improved physical properties and the production of alloys that are amenable to heat treatment. Other objects and advantages will appear as the description proceeds.

My invention is based on the discovery that highly desirable and useful alloys can be prepared by alloying mercury with magnesium alloys and that such alloys possess good strength characteristics and that these strength characteristics can be further improved by heat treatment.

I have discovered that the properties of binary magnesium-mercury alloys may be improved by the addition of aluminum and that the properties of the binary magnesium-aluminum alloys may be improved by the addition of mercury or, in other words, that the resultant ternary magnesium-aluminum-mercury alloy has physical properties which are superior to those of either parent binary alloy. I have discovered that this beneficial result is obtained in alloys containing from about 1 to 15 per cent of aluminum and from about 0.5 to 10 per cent of mercury, the balance being substantially magnesium. Where castings are to be prepared requiring maximum yield strength and hardness, I normally prefer alloys containing 8 to 12 per cent of aluminum and 2 to 8 per cent of mercury. Where toughness is required, or if plastic deformation is essential, the alloy should preferably contain 2 to 8 per cent of aluminum and 0.5 to 4 per cent of mercury. The properties of these magnesium-mercury-aluminum alloys are retained, in general, and in many instances may be improved when the alloy likewise contains other alloying ingredients. For most purposes, the alloy should normally contain more than 80 per cent of magnesium and less than 20 per cent of total added metals.

Examples of the property improvements obtained in these new ternary magnesium-aluminum-mercury alloys in the as cast condition, as compared to the parent binary alloys, are given in the accompanying tables. It will be noted that the magnesium-aluminum-mercury alloys are superior to both the binary magnesium-aluminum and binary magnesium-mercury alloys from the standpoint of various physical characteristics, specifically tensile strength, yield strength, and percentage elongation. It should likewise be noted that the magnesium-aluminum-mercury alloys are superior to the magnesium-aluminum and the magnesium-mercury alloys when com-

parisons are made on heat treated and heat treated and aged alloys.

Properties of cast alloys

Composition	Tensile strength, lb./sq. in.	Yield strength, lb./sq. in.	Brinell hardness
Mg+10%Al.....	21,600	12,700	51.8
Mg+1-8%Hg.....	13,300-19,800	2,800-3,300	30.7-33.0
Mg+10%Al+1-8%Hg....	22,500-23,600	14,500-15,900	54.6-58.2

Properties of heat treated alloys

Mg+10%Al.....	26,500	11,200	49.4
Mg+1-8%Hg.....	11,100-21,100	2,700-3,500	30.7-35.2
Mg+10%Al+1-8%Hg....	27,800-30,900	13,200-15,000	51.8-56.5

Properties of heat treated and aged alloys

Mg+10%Al.....	26,400	17,500	68.0
Mg+1-8%Hg.....	13,200-22,400	2,900-3,500	30.9-35.9
Mg+10%Al+1-8%Hg....	28,700-32,600	18,500-20,000	69.2-75.0

Similar property improvements are likewise obtained in alloys containing relatively low percentages of aluminum. These alloys are differentiated from those described above in that they are not amenable to heat treatment but do lend themselves to fabrication by plastic deformation processes.

The beneficial results obtained by the simultaneous presence of aluminum and mercury in cast alloys containing a low percentage of aluminum are illustrated by the following data.

Properties of cast alloys

Composition	Tensile strength, lb./sq. in.	Yield strength, lb./sq. in.	Elongation, percent	Brinell hardness
Mg+3%Al.....	22,700	5,200	10.5	36.2
Mg+0.5-8%Hg.....	13,000-19,800	2,800-3,300	5.6-9.6	30.0-33.0
Mg+3%Al+0.5-8%Hg....	26,600-30,100	6,200-8,300	12.6-15.1	36.8-40.5

These ternary magnesium-aluminum-mercury alloys may be prepared by the well known methods of alloying metals with magnesium, such as by adding the respective alloying ingredients to a bath of molten metal protected from oxidation by a cover of a fluid flux. In general, however, it is preferable to add the mercury as a magnesium-mercury amalgam prepared by digesting mercury with magnesium shavings at or near room temperature. Castings may be prepared by die casting or the like, or by sand casting in molding sand

5 treated with an oxidation inhibitor, such as sulfur or ammonium fluoride. Heat treatment may be carried out by heating the alloy for about 18 hours at 750-775° F. Aging may consist of a
10 subsequent heating for 16-18 hours at approximately 350° F. Plastic deformation operations are best conducted in the temperature range of 600-750° F.

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

I particularly point out and distinctly claim as my invention:

1. A magnesium-base alloy containing from about 1 to 15 per cent of aluminum and from about 0.5 to 10 per cent of mercury, the balance
5 being magnesium.

2. A magnesium-base alloy containing from about 8 to 12 per cent of aluminum and from about 2 to 8 per cent of mercury, the balance
10 being magnesium.

3. A magnesium-base alloy containing from about 2 to 8 per cent of aluminum and 0.5 to 4 per cent of mercury, the balance being magnesium.

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