

UNITED STATES PATENT OFFICE

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MAGNESIUM BASE ALLOYS

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The present invention relates to improved light weight alloys in which magnesium is the predominating constituent. One object of our invention is to produce magnesium base alloys having the characteristic low specific gravity approaching that of magnesium that at the same time possess a combination of useful properties among which may be cited toughness, malleability, and tensile strength, so as to make these alloys valuable for use in the mechanical arts where lightness and strength are essential. Other objects and advantages will appear as the description proceeds.

The binary alloys of magnesium and cadmium, wherein magnesium is present in excess of 80 per cent, are known and some of their properties have been investigated. Insofar as we are aware, however, no one has produced or investigated the ternary alloys containing over 80 per cent of magnesium which may be made by adding relatively small amounts of zinc to the aforesaid binary magnesium-cadmium alloys. We have discovered that by adding varying amounts of zinc to the above mentioned binary alloys, useful alloys may be obtained that exhibit a combination of valuable properties not possessed by either of the parent binary alloys, i. e. magnesium-cadmium or magnesium-zinc.

Accordingly, the alloys which are the subject of our invention contain the metals magnesium, cadmium and zinc, wherein the magnesium content is in excess of 80 per cent and cadmium and zinc are present each in amounts of over 0.5 per cent and the quantity of cadmium and zinc together is less than 20 per cent of the total.

Examples of our improved ternary alloys are given in the table showing their properties measured on extruded samples of the alloys, together with the properties of the parent binary alloys of cadmium and magne-

um, and of zinc and magnesium for comparison.

Table

Tensile strength— lbs./sq. in.	Yield point— lbs./sq. in.	Elongation per cent in 2 inches	Impact toughness— foot lbs.	Hardness— Brinell
Binary alloy—Mg 94%, Cd 6%				
33,000	16,000	11	12	37
Binary alloy—Mg 96%, Zn 4%				
36,000	20,000	14	12	45
Ternary alloys—Mg 90-98%, Cd 6%, Zn 1-4%				
37,500	22,500	17	14	40-44

The data of the table indicates that the tensile strength, yield point (defined as the load in lbs./sq. in. at which the stress-strain curve deviates 0.1 per cent elongation from the modulus line), elongation and toughness are improved by adding zinc to the binary magnesium-cadmium alloys without sacrificing hardness appreciably.

The malleability of these alloys is superior to the parent binary alloys. For example, the binary alloys of magnesium containing from 2 to 6 per cent of cadmium may be forged, but in so doing slight cracking develops, especially at the outermost edges, when the forgings are made either by pressing between dies or by hammering and employing the most suitable working temperatures. This cracking phenomenon is exhibited also in the case of the binary magnesium-zinc alloys containing from 3 to 4 per cent of zinc, but in greater degree on being forged by pressing between dies, and it is, moreover, practically impossible to produce a useful forging of such alloys by hammering, since almost complete shattering occurs under hammer blows. On the other hand,

by employing our new ternary alloys containing both cadmium and zinc, for example, where the zinc content is from 1 to 4 per cent and that of cadmium about 6 per cent and the balance magnesium forgings can be made readily without cracking.

The hereindescribed magnesium base alloys may be cast, extruded, or wrought or otherwise shaped by methods commonly used for such alloys, but the proportions of cadmium and zinc are to be governed by the particular application or shaping procedure preferred in a given case. For example, alloys coming within the scope of this invention, which are particularly adaptable to hammer forging, may have a zinc content preferably of from 0.5 to 2 per cent and cadmium from 1 to 10 per cent. If the slower method of working, such as by press forging or rolling, is used, then the zinc content may be somewhat greater, e. g. from 0.5 to 4 per cent, while the cadmium content may be 1 to 10 per cent. Extrusion may be employed on our alloys with zinc content of 0.5 to 8 per cent while containing from 1.0 to 12 per cent of cadmium, the amount of cadmium being preferably in excess of the zinc. Alloys suitable for casting may have cadmium and zinc present each in amount exceeding 0.5 per cent and under 12 per cent, the total of the two alloying metals being less than 20 per cent of the alloy.

In comparison with the present commercially available magnesium base alloys, we have found our new alloys to be very resistant to corrosion. Tests made in 3 per cent salt solutions by the well known alternate immersion method indicate these new alloys are well adapted to uses in which superior resistance to corrosion is required.

The known methods for heat treating magnesium base alloys may be applied to our new alloys with advantageous improvement in mechanical properties such as tensile strength, yield point, and hardness, particularly where the zinc content is over approximately 2 per cent.

Other modes of applying the principle of our invention may be employed instead of the one explained, change being made as regards the proportions of the ingredients employed within the limits specified, provided the ingredients stated by any of the following claims or the equivalent of such stated ingredients be employed.

We therefore particularly point out and distinctly claim as our invention:—

1. As a new product, a magnesium base alloy composed of the metals magnesium, cadmium, and zinc, wherein the magnesium content is in excess of 80 per cent and cadmium and zinc are present each in amounts of over 0.5 per cent and the amount of cadmium and zinc together is less than 20 per cent of the total.

2. As a new product, a magnesium base alloy composed of in excess of 80 per cent magnesium and from 0.5 to 8 per cent of zinc and from 1 to 12 per cent of cadmium, the amount of the cadmium being in excess of the zinc.

3. As a new product, a magnesium base alloy composed of from 0.5 to 4 per cent of zinc and from 1 to 10 per cent of cadmium, the balance being magnesium.

4. As a new product, a magnesium base alloy composed of from 1 to 4 per cent of zinc, about 6 per cent of cadmium and the balance magnesium.

5. As a new product, a magnesium base alloy composed of from 0.5 to 2.0 per cent of zinc, from 1 to 10 per cent of cadmium and the balance magnesium.

6. As a new product, a magnesium base alloy composed of in excess of 80 per cent of magnesium and from 0.5 to 12 per cent of each of the metals cadmium and zinc, the total amount of the cadmium and zinc being less than 20 per cent of the alloy.

Signed by us this 9th day of February, 1932.

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