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MAGNESIUM BASE ALLOY

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The invention relates to magnesium base alloys and more particularly concerns alloys of this nature having a high degree of formability associated with excellent tensile and yield strengths.

Magnesium base alloys are being widely used in the structural arts where a light weight metal is highly desirable, such as for use in making castings, forgings, and the like. However, the use of these alloys in the rolled form to make sheet metal articles requiring forming operations, such as bending and drawing, has not progressed as rapidly due to the fact that, in general, alloys having good formability or ductility permitting relatively sharp bends to be made without the article developing external cracks, usually have inferior characteristics as regards their tensile and yield strengths.

It is, accordingly, the principal object of the invention to provide a magnesium base alloy which can be made into rolled sheet and the like possessing a sufficient degree of ductility or formability at ordinary temperatures to be sharply bent, drawn or otherwise shaped, while having good tensile and yield strengths.

Other objects and advantages will be apparent as the description of the invention proceeds.

My invention resides in the discovery that a magnesium base alloy containing from 0.3 to 10 per cent of silver, from 0.01 to 1 per cent of cerium, and from 1 to 15 per cent of thallium possesses the aforementioned properties. The term "magnesium" used herein and in the appended claims is intended to include magnesium containing the ordinary impurities that are found in the commercially pure metal, such as traces of iron, copper, nickel, and silicon. While the properties of high yield and tensile strengths associated with excellent formability are manifest over the entire range of composition indicated, I have found that, in general, a preferred composition range wherein the most desirable combination of properties exists in one containing from about 2 to 8 per cent of silver, 0.1 to 0.5 per cent of cerium, and 5 to 10 per cent of thallium.

The following table lists some of the properties of rolled sheet metal made from my new quaternary alloy and compares these properties with those of related alloys. The new alloy shows improvement in yield and tensile strengths and is also shown to possess a sufficient degree of formability, to permit its being subjected to forming operations. In the table the per cent elongation is to be regarded as a measure of the ductility or formability of the alloy.

Table

Nominal composition in percent (remainder = magnesium)			Annealed			Cold rolled	
Ag	Ce	Tl	Percent elongation in 2 inches	Yield strength in lbs./sq. in.	Tensile strength in lbs./sq. in.	Yield strength in lbs./sq. in.	Tensile strength in lbs./sq. in.
--	0.3	5	21	23,000	35,000	30,000	38,000
1	------	5	23	18,000	33,000	33,000	39,000
1	0.3	-----	19	18,000	34,000	36,000	43,000
1	0.5	5	21	25,000	36,000	39,000	45,000
--	0.3	5	21	23,000	35,000	30,000	38,000
3	0.3	5	20	16,000	33,000	43,000	49,000
6	0.3	-----	20	16,000	35,000	----------	---------
6	0.5	5	21	19,000	37,000	----------	---------

The properties set forth above under the term "annealed" were obtained by first rolling the alloys at a temperature of 550° F. and thereafter annealing them at various temperatures through a range of from 400° to 800° F. The properties selected for the table were those of the annealed specimens which exhibited the maximum elongation. The properties set forth under the term "cold rolled" were obtained by subjecting specimens of the alloys which had first been hot rolled at a temperature of 550° F. to additional rolling in the cold state. The properties selected for the table were those of the cold rolled specimens which showed the greatest tensile and yield strengths, while having at least a 1 per cent elongation in 2 inches.

A comparison of the properties listed in the table shows that the combined strength proper-

ties of the new alloy show a high degree of improvement over similar properties of related alloys. In addition the new alloy possesses a high degree of formability so as to render it highly adaptable to forming operations.

While the new alloy is most useful in wrought form, such as sheets, due to its formability characteristics, it may also be used for making castings, extruded forms, and the like. It is further pointed out that my new alloy is amenable to solution and precipitation heat treatments, which accordingly modify its properties.

The new alloy may be compounded by any of the methods usually employed for melting and alloying metals with magnesium, such as by adding the alloying ingredients singly or jointly to a bath of molten magnesium which is preferably protected from oxidation by a suitable flux. Cerium may be added to the alloy as such, or in the form of Misch-metal. Magnesium-cerium alloys are commonly made up by employing Misch-metal as a source of cerium. It is sometimes desirable to add more than the theoretical amount of Misch-metal since the alloying efficiency is not always 100 per cent and some loss may be incurred.

It is to be understood that the invention is not limited to the specific compositions herein described, but may take other forms without departing from the scope of the invention.

I claim:

1. A magnesium base alloy containing from about 0.3 to 10 per cent of silver, 0.01 to 1 per cent of cerium, and from 1 to 15 per cent of thallium, the balance being magnesium.

2. A magnesium base alloy containing from about 2 to 8 per cent of silver, 0.1 to 0.5 per cent of cerium, and from 5 to 10 per cent of thallium, the balance being magnesium.

3. A magnesium base alloy containing from 0.3 to 10 per cent of silver, from 0.01 to 1 per cent of cerium, and from 1 to 15 per cent of thallium and characterized by improved tensile strength and yield strength as compared to similar magnesium-silver-thallium alloy devoid of cerium.

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