Patented Nov. 24, 1942

2,302,968

UNITED STATES PATENT OFFICE

2,302,968

MAGNESIUM BASE ALLOY

John C. McDonald, Midland, Mich., assignor to The Dow Chemical Company, Midland, Mich., a corporation of Michigan

No Drawing. Application June 15, 1940, Serial No. 340,786

3 Claims. (Cl. 75—168)

This invention relates to magnesium base alloys. It more particularly concerns an alloy of this nature having desirable physical properties, such as excellent yield and tensile strengths, coupled with good formability.

Magnesium alloys are being extensively employed in the various structural and mechanical arts where the use of a light weight metal is highly advantageous, such as for use in making castings, forgings, and the like. However, the use of magnesium alloys in rolled form to make sheet metal articles requiring forming operations, such as bending, drawing, and the like, has not progressed as rapidly due to the fact that in general alloys of good formability, permitting relatively sharp bends to be made without the article developing external cracks, usually lack desirable strength characteristics.

It is, accordingly, the principal object of the invention to provide a magnesium base alloy having high yield and tensile strengths and possessing sufficient ductility or formability to be sharply bent, drawn or otherwise shaped.

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

My invention resides in the discovery that a magnesium base alloy composed of from 1 to 20 per cent of thallium and from 0.01 to 1 per cent of cerium, the balance being magnesium, possesses the aforementioned properties. The term "cerium" used herein and in the appended claims is intended to include not only elemental cerium, but also the so-called "Misch-metal" of commerce, which is a commonly used source of cerium and contains, besides cerium, varying amounts of other rare earth metals. As an example, the following is considered an average composition of Misch-metal as commercially obtainable: cerium 40–50 per cent, lanthanum 30–40 per cent, dysprosium and samarium and other rare earth metals 10 per cent, and iron 5 per cent. 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 good formability or ductility associated with excellent tensile and yield strengths are manifest over the entire range of the composition indicated, I have found that the most satisfactory combination of properties is obtained when the alloy contains from about 3 to 12 per cent of thallium and from about 0.1 to 0.3 per cent of cerium. The specific proportion of each alloying metal and the total amount of alloying metals to be added to the new alloy depends upon the use for which the alloy is intended. For example, when an alloy having exceptionally high ductility or formability coupled with good yield and tensile strengths is desired, the alloy should preferably be made up containing from about 2 to 8 per cent of thallium and from about 0.1 to 0.3 per cent of cerium. In those instances when it is desirable to form an alloy of exceptionally high yield and tensile strengths coupled with satisfactory ductility, the thallium content of the alloy should be increased to about 12 to 20 per cent.

The following table lists some of the properties of rolled sheet made from my new alloy and compares these properties with those of rolled sheet made from related alloys. A comparison of the properties illustrates the improvement in strength characteristics of my new alloy over those of the closely related alloys. In the table, the per cent elongation is to be regarded as a measure of the ductility or formability of the specimen.

Table

Nominal composition in % (magnesium = remainder)		Annealed			Cold rolled	
Tl	Ce	Elongation in 2 inches	Yield strength	Tensile strength	Yield strength	Tensile strength
		Per cent	*Lbs./sq. in.*	*Lbs./sq. in.*	*Lbs./sq. in.*	*Lbs./sq. in.*
5.0	----	10	21,000	33,000	28,000	32,000
----	0.18	16	16,000	32,000	24,000	32,000
5.0	0.18	21	23,000	35,000	30,000	38,000
10.0	----	16	20,000	33,000	29,000	33,000
----	0.16	16	16,000	32,000	24,000	32,000
10.0	0.16	17	21,000	35,000	35,000	39,000

The properties listed in the above table under the section headed by the term "annealed" were obtained by first rolling the alloys in a temperature range of from 550°—600° F. and thereafter annealing them at various temperatures in the temperature range from 400° to 800° F. The properties selected for the table were those of the annealed specimens which exhibited the maximum elongation. Properties set forth in the table under the section headed "cold rolled" were obtained by subjecting specimens of the alloy which had first been hot rolled at a temperature of from 550° to 600° 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 properties of my new alloy are superior to those of the related alloys having similar percentages of alloying ingredients. For example, it will be noted that the alloys containing lower percentages of alloying ingredients have excellent elongation coupled with markedly superior strength properties in both the annealed and the cold rolled state. In the higher percentages of alloying ingredients, the strength characteristics of the new alloy in the annealed and the cold rolled state also show a high degree of improvement while exhibiting a high degree of formability. Similar improvement will be noted throughout the entire percentage range of alloying ingredients.

While the new alloy is most useful in the wrought form, such as sheets, due to its formability characteristics, it may also be suitably used in making castings, forgings, extruded forms, and the like.

My new alloy may be prepared by any of the methods employed for melting and alloying metals with magnesium, such as by adding the respective alloying metals singly or jointly to a bath of molten magnesium which is preferably protected from oxidation by a suitable flux.

The 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. An amount of Misch-metal is employed such as will give the desired percentage of elemental cerium in the alloy. 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.

I claim:

1. A magnesium base alloy containing from 1 to 20 per cent of thallium and from 0.01 to 1 per cent of cerium, the balance being magnesium.

2. A magnesium base alloy containing from 2 to 8 per cent of thallium and from 0.1 to 0.3 per cent of cerium, the balance being magnesium.

3. A magnesium base alloy containing from 12 to 20 per cent of thallium and from 0.1 to 0.3 per cent of cerium, the balance being magnesium.

JOHN C. McDONALD.