

UNITED STATES PATENT OFFICE

2,270,194

MAGNESIUM BASE ALLOY

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

No Drawing. Application December 23, 1940,
Serial No. 371,377

3 Claims. (Cl. 75-168)

The invention relates to magnesium base alloys and more particularly concerns an alloy of this nature having a high degree of formability associated with other desirable physical properties, such as improved 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

properties is found in those alloys having from 3 to 8 per cent of silver, 3 to 6 per cent of aluminum, 5 to 10 per cent of cadmium, 0.2 per cent of cerium, and 0.2 to 0.5 per cent of manganese. The following table, listing some of the properties of rolled sheet metal made from my new polynary alloy and comparing these properties with those of some related parent alloys, illustrates the improvement in yield and tensile strengths of the new alloy. Further the per cent elongation which is to be regarded as a measure of the formability of the alloy is of a high order and thus renders the alloy suitable for use in connection with conventional forming operations.

Table

Nominal composition in percent (magnesium=remainder)					Annealed			Cold rolled	
Ag	Al	Ce	Cd	Mn	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.
---	3	0.3	5	0.5	19	25,000	38,000	42,000	49,000
3	3	0.3	5	---	21	18,000	37,000	43,000	48,000
3	3	0.3	5	0.5	19	25,000	40,000	47,000	54,000

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 magnetism 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 about 0.3 to 10 per cent of silver, 0.3 to 10 per cent of aluminum, 1 to 15 per cent of cadmium, 0.01 to 1 per cent of cerium, and from 0.01 to 1 per cent of manganese possesses the aforementioned desirable properties. The term "magnesium" used herein and in the appended claims is intended to include magnesium containing the ordinary impurities found in the commercially pure metal, such as traces of iron, nickel, copper and silicon. While the property of excellent formability associated with high tensile and yield strengths is manifest over the entire range of composition indicated, the most desirable combination of

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.

From a comparison of the properties listed in the table it will be seen that the tensile strength and yield strength in both the annealed and cold rolled state are superior to those of the related alloys. At the same time it will be observed that the per cent elongation which serves as a measure of the ductility is of a sufficiently high order to enable the alloy to readily undergo forming operations, such as bending, drawing, and the like without danger of developing cracks. The improvement shown by the particular composition, illustrated in the table, is exhibited

throughout the percentage range of the alloying ingredient indicated.

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 in any of the ways 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 should be mentioned that the amount of manganese that may be present in a given composition is dependent upon the amount of aluminum present. For example, when about 0.5 per cent aluminum is present, it is difficult to obtain an alloy containing more than 1.0 per cent of manganese. In compositions containing more

aluminum, such as from 8 to 10 per cent, it is difficult to obtain an alloy containing more than about 0.5 per cent of manganese.

It is to be understood that the invention is not limited to the specific composition 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, 0.3 to 10 per cent of aluminum, 1 to 15 per cent of cadmium, 0.01 to 1 per cent of cerium, and from 0.01 to 1 per cent of manganese, the balance being magnesium.

2. A magnesium base alloy containing from about 3 to 8 per cent of silver, 3 to 6 per cent of aluminum, 5 to 10 per cent of cadmium, 0.2 per cent of cerium, and from 0.2 to 0.5 per cent of manganese, the balance being magnesium.

3. A magnesium base alloy containing from about 0.3 to 10 per cent of silver, about 0.3 to 10 per cent of aluminum, about 1 to 15 per cent of cadmium, about 0.01 to 1 per cent of cerium, and about 0.01 to 1 per cent of manganese and characterized by highly improved yield strength and tensile strength in the cold rolled state as compared to a similar magnesium-silver-aluminum-cadmium-manganese alloy devoid of cerium.

JOHN C. McDONALD.