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# UNITED STATES PATENT OFFICE

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## MAGNESIUM BASE ALLOY

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The invention relates to magnesium base alloys and more particularly concerns an alloy of this nature having highly improved tensile and yield strengths together with satisfactory formability for forming operations.

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 about 0.1 to 5 per cent of gallium and from 0.01 to 3 per cent of manganese possesses the aforementioned desirable characteristics. 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 nickel, copper, silicon, and iron. While the properties of highly improved tensile and yield strengths associated with a satisfactory degree of formability and ductility are manifest over the entire range of the composition indicated, I have found that, in general, a preferred composition range wherein the most desirable combination of properties exists is one containing from about 0.5 to 2.0 per cent of gallium and from 1.0 to 3.0 per cent of manganese. A particularly desirable composition consists of 1.0 per cent of gallium and 2.0 per cent of manganese, the balance being magnesium.

The following table listing some of the properties of rolled sheet metal made from my new ternary alloy and comparing these properties with those of related alloys illustrates the improvement in yield and tensile strengths of the new alloy over those of related alloys. At the same time the table shows that the elongation which is to be regarded as a measure of the formability or ductility of the alloy is satisfactory. In the table per cent elongation is to be regarded as a measure of the formability or ductility of the alloy.

*Table*

| Nominal composition in percent (magnesium=remainder) | | Annealed | | |
|---|---|---|---|---|
| Mn | Ga | Percent elongation in 2 inches | Yield strength in lbs./sq. in. | Tensile strength in lbs./sq. in. |
| ------- | 1 | 21 | 19,000 | 33,000 |
| 2 | ------- | 5 | 22,000 | 32,000 |
| 2 | 1 | 16 | 24,000 | 37,000 |

The properties set forth above under the term "annealed" were obtained by first rolling the alloys at a temperature of 400° 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.

A comparison of the properties listed in the table shows that the alloy has markedly improved tensile and yield strengths in the annealed state together with a satisfactorily high formability to permit its being subjected to forming operations.

While the new alloy is most useful in the wrought form, such as sheets due to its high yield and tensile strengths associated with satisfactory formability characteristics it may also be used for making castings, forgings, extruded forms, and the like. It is further pointed out that the 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.

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 0.1 to 5 per cent of gallium and from 0.01 to 3

per cent of manganese, the balance being magnesium.

2. A magnesium base alloy containing 0.5 to 2 per cent of gallium and from 1 to 3 per cent of manganese, the balance being magnesium.

3. A magnesium base alloy containing 1 per cent of gallium and 2 per cent of manganese, the balance being magnesium.

4. A magnesium base alloy containing from about 0.1 to 5 per cent of gallium and about 0.01 to 3 per cent of manganese and characterized by highly improved tensile strength and yield strength in the annealed condition as compared to a magnesium-manganese alloy devoid of gallium.

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