Patented Feb. 8, 1949 2,461,229

UNITED STATES PATENT OFFICE

2,461,229

METHOD OF PRODUCING MAGNESIUM BASE ALLOYS

Alfred John Murphy, Petts Wood, and Ronald James Malcolm Payne, New Malden, England, assignors to Magnesium Elektron Limited, London, England, a company of Great Britain

No Drawing. Application July 4, 1945, Serial No. 603,276. In Great Britain July 11, 1944

1 Claim. (Cl. 75—168)

1

This invention relates to improvements in magnesium alloys and the manufacture thereof.

A serious difficulty in the practical manipulation of magnesium-cerium-zirconium alloys in the foundry is the reactivity of cerium and zirconium with the fluxes normally used to protect molten magnesium alloys. This reactivity gives rise to erratic and expensive losses of cerium and zirconium when the alloys are melted for casting.

In order to avoid these difficulties the present improvements make use of the protection against oxidation conferred by the addition of beryllium to magnesium alloys. This protection is sufficiently effective to allow the alloys to be melted in air without flux or with a greatly reduced proportion of flux, or without flux in an atmosphere containing a gas such as sulphur dioxide.

Processes for the production of binary alloys of magnesium and beryllium cannot be operated at present on an economic basis and according to the present improvements, therefore the beryllium is introduced through the medium of some pre-alloy made with a third metal, which can itself be alloyed with magnesium. It is also difficult, if not impossible, to cause alloying directly between magnesium and zirconium metal, and in this case also the present improvements provide for the making of a preliminary alloy of the zirconium with a third metal, other than magnesium. The nature of this third metal is restricted in the present connection, however, by the consideration that the beneficial grain-refining action of zirconium is prevented if certain specific metals are also present as alloying constituents. In carrying out this invention silver is adopted as a suitable third metal, for it can be alloyed with beryllium and also with zirconium and it does not interfere with the grain-refining influence of zirconium in magnesium alloys.

The improved procedure, then, is to prepare pre-alloys of silver with beryllium and with zirconium respectively. The silver-beryllium pre-alloy is added to magnesium which has been protected from combustion during melting as by flux in the normal manner or by any other suitable medium. Sufficient silver-beryllium alloy is added to introduce a proportion of beryllium in the order of 0.01 to 0.1 per cent. When the silver-beryllium has been incorporated in the magnesium the flux, if present, is removed from the surface of the molten metal which has now become, by virtue of its beryllium content, so resistant to oxidation that the protection of the flux or other covering is no longer required. The silver-zirconium pre-alloy, in sufficient amount to introduce about 0.75 per cent zirconium, is added to the melt, and finally the desired amount of cerium (between 1.0 and 4.0 per cent) as cerium metal (or mischmetall) or as magnesium-cerium alloy is incorporated. The final product is thus a magnesium-base alloy containing silver, beryllium, zirconium and cerium. A typical composition is:

2

	Per cent
Silver	2
Beryllium	0.05
Zirconium	0.75
Cerium	3.0
Magnesium	Remainder

In any treatment the silver-zirconium alloy is proportioned so as to introduce an addition of zirconium equal to 0.1 per cent to 0.8 per cent by weight of the magnesium base. This introduction of zirconium would involve the introduction of silver in amounts between 0.5 and 5.0 per cent.

The functions of the constituent metals in this alloy are as follows: the cerium and zirconium together confer useful mechanical properties at ordinary temperatures and resistance to creep under load at elevated temperatures, the zirconium is particularly beneficial in refining the grain size, and the beryllium produces a high resistance to oxidation, enabling the alloy to be remelted without the use of fluxes, thus avoiding serious loss of the alloy constituents cerium and zirconium. The silver is present as a consequence of the method of producing the alloy but it has, incidentally, a beneficial effect in strengthening the alloy at ordinary and at elevated temperatures.

In some circumstances it may not be desired to forego the use of fluxes entirely in the manufacture of these alloys. It may not be convenient for example to protect the molten metal by sulphur dioxide or it may be desired to treat the metal with flux for the removal of dross. In such a case it would be permissible to use flux and to make good any loss of alloying constituent by an addition of such constituent at the end of the melting operations. The alloy thus prepared would still possess the advantage that it could be remelted for casting in the foundry without the use of protective flux.

The present improvements are not specially concerned with the method of making the pre-alloys of silver with beryllium and zirconium, but such pre-alloys can be produced conveniently by melting silver with massive beryllium on the one hand, and with zirconium metal powder or

zirconium hydride powder on the other, in vacuo in a high-frequency electric furnace.

We claim:

Process for the manufacture of a magnesium base alloy containing additions of cerium and zirconium, comprising melting a body of magnesium under protection of a flux cover, introducing into the molten body a silver beryllium pre-alloy in such quantity as to incorporate in the base between 0.01 to 0.1 per cent by weight of beryllium, removing the flux cover from said body, introducing into said body a silver-zirconium pre-alloy, and finally introducing the desired amount of cerium.

ALFRED JOHN MURPHY.
RONALD JAMES MALCOLM PAYNE.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
2,224,151	Gauthier	Dec. 10, 1940
2,226,550	Burkhardt	Dec. 31, 1940
2,228,781	Sauerwald	Jan. 14, 1941
2,235,508	Von Zeppelin et al.	Mar. 18, 1941
2,250,687	Von Zeppelin	July 29, 1941
2,261,906	Nelson et al.	Nov. 4, 1941
2,270,193	McDonald	Jan. 13, 1942
2,272,936	Dallenbach	Feb. 10, 1942
2,286,311	Sauerwald	June 16, 1942
2,306,033	Beck	Dec. 22, 1942
2,380,200	Stroup	July 10, 1945
2,383,281	Willmore et al.	Aug. 21, 1945

FOREIGN PATENTS

Number	Country	Date
511,137	Great Britain	Aug. 9, 1939

OTHER REFERENCES

Alien Property Custodian application of Sauerwald, Serial Number 369,749, published June 15, 1943 (abandoned).

Beck, Technology of Magnesium and Its Alloys, by F. A. Hughes and Co., London, England; published 1940, page 317.