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[54] **INCENDIARY ALLOYS EXISTING AS A DISPERSION OF INCENDIARY PARTICLES IN A NON-INCENDIARY ATMOSPHERIC ATTACK-RESISTANT MATRIX**

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[51] **Int. Cl.²** .. **C22C 9/00;** C22C 11/00; C22C 13/00; C22C 18/00; C22C 19/00; C22C 21/00; C22C 22/00; C22C 28/00

[58] **Field of Search** ..... 149/17, 134 N; 75/152, 75/153, 168 J, 134 M, 170, 166 R, 175 R, 178 R, 138, 122, 134 S, 123 E, .5 R

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[57] **ABSTRACT**

A class of alloys comprising a dispersion of pyrophoric particles in a non-incendiary, atmospheric-attack-resistant matrix. The pyrophoric particles are one of the rare earth metals or a mixture of these such as Mischmetal and the matrix material is one of the more common metallic elements having good corrosion resistance properties. The dispersion of the pyrophoric particles in the matrix may be accomplished either by solidification from the melt or precipitation and growth from solid solution.

2 Claims, No Drawings

INCENDIARY ALLOYS EXISTING AS A DISPERSION OF INCENDIARY PARTICLES IN A NON-INCENDIARY ATMOSPHERIC ATTACK-RESISTANT MATRIX

BACKGROUND OF THE INVENTION

This invention relates to incendiary alloys and more particularly to incendiary alloys having good corrosion resistance and adequate mechanical strength.

Mischmetal, which has excellent incendiary properties, has been proposed and used in the past as an incendiary material for projectile liners; but in unalloyed form possesses certain drawbacks. The principle disadvantage of unalloyed Mischmetal is that it is susceptible to relatively rapid corrosion or oxidation when exposed to the atmosphere. Unalloyed Mischmetal also possesses relatively little mechanical strength and is somewhat brittle which poses problems in manufacture and handling.

Various techniques have been utilized in an attempt to overcome the aforementioned drawbacks. Coatings have been provided on Mischmetal incendiaries in an attempt to preclude atmospheric attack and small amounts (e.g. 4 wt percent) of Aluminum have been alloyed with Mischmetal to produce intermetallics in an attempt to cope with these problems. However, these techniques have had very limited success.

SUMMARY OF THE INVENTION

Applicants have discovered that alloys comprising a dispersion of pyrophoric particles in a non-incendiary, atmospheric-attack-resistant matrix make excellent incendiary materials. This dispersion is accomplished by solidification from the melt, or precipitation and growth from the solid solution which yields a finer dispersion. The amount of pyrophoric phase present can be altered by selecting the desired composition from within the ranges given below:

Matrix		Pyrophoric
Cu 74–99 wt.%	Sn 72–88 wt.%	Balance Lanthanum,
Mg 75–99 wt.%	Zn 82–99 wt.%	Cerium, Praseodymium,
Mn 50–99 wt.%	Al 60–90 wt.%	Neodymium, Promethium
Ni 68–99 wt.%	Si 47–99 wt.%	or Mischmetal
Pb 82–99 wt.%	Fe 35–99 wt.%	

These alloys possess good mechanical strength, are substantially free from corrosion problems and are characterized by spontaneous ignition upon explosive or impact fragmentation.

OBJECTS OF THE INVENTION

It is the primary object of this invention to provide new and improved incendiary alloys having superior corrosion resistance properties.

It is another object of this invention to provide new and improved incendiary alloys possessing superior mechanical strength attributes.

It is a further object of this invention to provide new and improved incendiary alloys characterized by spontaneous ignition upon explosive or impact fragmentation.

Other objects, advantages and novel features of the invention will become readily apparent from consideration of the following detailed description of the invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

The alloys of the present invention, as set forth in the summary, may be prepared by melting in a proper crucible the appropriate percentages of the selected materials under vacuum or in an inert atmosphere to a temperature above the liquidus temperature for the materials involved. The melt is then agitated to insure homogeneity. The melt is allowed to slowly cool through the 2-phase region (liquid-solid) if the pyrophoric particles are to be grown from the melt. The melt is quickly solidified and held for several hours at a temperature just below the solidus temperature if precipitation of the pyrophoric particles from the solid phase is desired. The precipitation technique will generally yield finer dispersions if this should be desired. The rate of cooling and hold times can be varied to vary particle size, distribution, etc. Of course, varying the composition will affect the volume of the pyrophoric particles present.

The following examples are illustrative of the invention:

EXAMPLE 1

75 wt. percent Aluminum, balance Mischmetal was melted in a Quartz crucible in vacuuo at about 800°C and agitated to insure homogeneity. The melt was then slow cooled (approximately 100°C per hour) to a temperature of approximately 680°C, within the two-phase region, and then removed from the furnace and air quenched. A portion of the solidified melt was then machined into a ½-inch cube and explosively projected against a witness structure which was essentially a hollow metal cube approximately one foot on a side. Impact of the cube with a side of the cube caused the cube to disintegrate and rapidly expose large fresh surface areas of the Mischmetal to atmosphere. The spontaneous ignition of the Mischmetal generated a gas pressure of 70 psi within the cube, as measured by a Bikini gage, demonstrated that the particular alloy was indeed an incendiary.

The remainder of the solidified melt was machined into a liner for a 40mm projectile and the projectile was then detonated within an arena surrounded by a plurality of gasoline containers. Ignition of the gasoline again demonstrated the incendiary properties of the alloy since earlier tests had shown that projectile fragments alone would not ignite the gasoline.

EXAMPLE 2

The procedure of Example 1 was repeated using 85 wt. percent Lead, balance Mischmetal. The melt was heated to about 1100°C, agitated, and then slow cooled to a temperature of approximately 350°C, within the two-phase region. The melt was then removed from the furnace and air quenched. Microscopic examination of the melt revealed a fine dispersion of Mischmetal crystals distributed throughout a Lead matrix and thus another alloy which possesses incendiary properties upon fragmentation.

EXAMPLE 3

A mixture of 50 wt. percent Iron, balance Mischmetal was melted in an arc melting furnace and then removed and air quenched. The melt was reheated to approximately 600°C to cause precipitation of Mischmetal particles from the solid phase. Microscopic ex-

amination of the melt revealed a very fine dispersion of Mischmetal crystals distributed evenly in an Iron matrix and thus was still another alloy which upon rapid fragmentation would spontaneously ignite.

Obviously many modifications and variations of the present invention are possible in the light of the above teachings. It is therefore to be understood that within the scope of the appended claims the invention may be practiced otherwise than as specifically described.

What is claimed is:

1. An incendiary alloy consisting essentially of a dispersion of pyrophoric particles in a non-incendiary matrix wherein the matrix material is selected from the group consisting of:

Cu 74–99 wt.%	Sn 72–88 wt.%
Mn 50–99 wt.%	Zn 82–99 wt.%
Ni 68–99 wt.%	Al 60–90 wt.%
Pb 82–99 wt.%	Si 47–99 wt.%

and the pyrophoric material is selected from the group consisting of La, Ce, Pr, Nd, Pm, or Mischmetal, said alloy being characterized by spontaneous ignition upon explosive fragmentation.

2. An incendiary alloy as defined in claim **1** wherein the pyrophoric material is Mischmetal.

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