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ELECTRICAL CONDUCTOR

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1 Claim. (Cl. 117—130)

1

This invention relates to electrical conductors and electrical components composed in part of such conductors. It relates in particular to conductors which have good electrical conductivity per unit of weight combined with low temperature coefficient of electrical resistance.

To be useful for example in aircraft instruments such conductors must be stable in air between low temperatures such as —100° C. and high temperatures such as 200° C. They must also be capable of effective insulation in this range.

I have found that certain alloys of lithium and magnesium have an electrical conductivity on a weight basis at least 50% of that of copper. These alloys also have a very low temperature coefficient of electrical resistance, not more than one-tenth that of copper. The composition range in which this combination of properties is found is 30–45% lithium balance magnesium.

The electrical conductivity and temperature coefficient of electrical resistivity of several of the alloys of this invention are given in the following table.

Alloy Composition, Percent Lithium	Conductivity, Percent Copper on Weight Basis (Ave. 100–200° C.)	Temperature Coefficient of resistivity, Percent Copper (Ave. 100–200° C.)
30	50	15.
35	65	8.
40	80	Zero.
45	85	—2.

The lithium magnesium alloys of this invention are oxidized in the atmosphere even at low temperatures and much more rapidly at elevated temperatures. I have found that this difficulty may be overcome by producing a substantially pure magnesium surface layer on the lithium-magnesium alloys. This may be done in several ways, including immersion in organic solutions containing magnesium. The preferred organic solution is an ether solution of an alkyl magnesium halide- the so-called Grignard reagent.

Another method of producing a substantially pure magnesium coating on the lithium magnesium alloys of this invention is to heat the alloys to 200–250° C. in certain fats and oils whereby the lithium is removed from the surface of the alloy leaving a substantially pure magnesium surface. This magnesium surface may be smoothed by rolling the alloy. The preferred fats for the practice of this invention are the hydrogenated vegetable oils commonly used as cooking fats.

2

The magnesium surface formed on the lithium alloys may be treated by any of the methods known in the art to improve its corrosion resistance. For example, the magnesium-surfaced alloy may be chromated.

The lithium-magnesium alloys of this invention are quite soft and ductile. For some purposes it is desirable to have the alloys in harder and stronger form. I have found that this may be accomplished by the action of an oxidizing atmosphere at temperatures up to 230° C. The time required to produce this hardening by internal oxidation depends on the temperature. The maximum hardening is produced in about 48 hours at room temperature, 24 hours at 100° C. and 4–5 hours at 230° C. This treatment produces a surface coating of oxide or nitride which, however, does not prevent further attack by atmospheric moisture. This surface coating must be removed by abrasion or otherwise before treating with organic magnesium solutions to produce the magnesium surface. One method of removing the surface coating is to make the alloy an anode in a solution of calcium chloride.

If the alloys are to be treated by heating in hydrogenated vegetable oils the oxidized coating need not be removed as it diffuses into the alloy and is also dissolved from the surface leaving a pure metallic magnesium surface of somewhat matte appearance.

Having now described the general features of my invention, I will illustrate it by an example which is not, however, to be taken as limiting the scope of my invention to this particular example.

Example

I take redistilled magnesium 60 lbs. and pure low-sodium lithium 40 lbs. and melt these together in a pure iron crucible under an atmosphere of purified helium. I superheat this alloy to 900° C. and stir thoroughly. I then cool the alloy to 750° C. and cast it in a water cooled iron mold all within the purified helium atmosphere. I take the ingot so cast and immediately subject it to reduction under the hammer to a strip about ⅜" thick. I roll this strip to the desired thickness and split it to the desired width to form an electrical conductor for use in an electrical component as a transformer. I take one portion of this strip and clean it by mechanical abrasion under light oil. Without removing the oil coating, I dip the brightened strip in a normal solution of magnesium ethyl bromide in ethyl ether.

I allow the strip to remain immersed in the solution for ten minutes. I then remove it and wash it thoroughly with ether. This strip is now coated with pure magnesium of a thickness of about .0002 inch. The magnesium may be identified by X-ray spectrometry. The strip so treated is stable in air to the same extent as magnesium itself. I take another portion of the strip and immerse it without surface cleaning in "Crisco," a hydrogenated vegetable oil used for cooking. I heat it under Crisco to 250° C. for 15 minutes. The strip which was originally black from the coating of oxide and nitride has become bright and the outer layer to a depth of .0005 inch is found by X-ray spectrometry to be pure magnesium. As the surface of the strip is now matte, I pass it through rolls with a very slight reduction. The rolled strip is bright smooth and has the same resistance to atmospheric corrosion as pure magnesium. I take another portion of the strip and heat it for 5 hours at 200° C. This treatment substantially hardens and strengthens the alloy. I then reheat this alloy to 250° C. for one hour in "Crisco." The result is a strip with a metallic magnesium surface but increased hardness and strength as compared to the original strip.

The procedures of this example are applicable

to other alloys within composition range of this invention. Although the preferred alloys of this invention contain only lithium and magnesium, other elements may be present in incidental amounts without departing from the invention.

What is claimed is:

The method of increasing the corrosion resistance of magnesium-lithium alloys suitable for electrical conductors, containing from 30–45% lithium which consists in subjecting said alloys to the action of a solution of a magnesium alkyl halide in an aliphatic ether.

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