Patented Nov. 21, 1939 2,180,827

UNITED STATES PATENT OFFICE

2,180,827

ELECTRIC CONTACTING ELEMENT

Franz R. Hensel and Kenneth L. Emmert, Indianapolis, Ind., assignors to P. R. Mallory & Co., Inc., Indianapolis, Ind., a corporation of Delaware

No Drawing. Application June 2, 1939, Serial No. 277,076

5 Claims. (Cl. 200—166)

This invention relates to alloys and metal compositions and is concerned more particularly with alloys which have improved physical and electrical characteristics.

It is one of the objects of the invention to provide a silver base material which can be used for electrical make and break contacts, retaining very low contact resistance, having negligible material transfer, and having great resistance under severe electrical loads, to welding and sticking.

Another object of the invention is to provide a new silver base alloy which has increased tensile properties and which shows a high resistance to tarnishing and corrosion.

Other objects of the invention will be apparent from the following description, taken in connection with the appended claims.

While a preferred embodiment of the invention is described herein, it is contemplated that a considerable variation may be made in the method of procedure and the combination of elements without departing from the spirit of the invention.

The present invention contemplates a composition which is basically silver, to which has been added magnesium and zinc. In the formation of the new alloy, it is preferable to provide a composition of the materials specified in the following proportions:

	Per cent
Magnesium	.05 to 15
Zinc	.5 to 25
Silver	Substantially the balance

The preferred range of magnesium is .1 to 8%, because up to that percentage, the magnesium is taken up in alpha solid solution in silver and we have found that silver and magnesium, up to 8%, can be alloyed very readily, and the cast ingots can be rolled, swaged or drawn into desirable shapes, such as sheet, bar stock, wire, strip and the like. Silver and zinc form a solid solution up to approximately 25%.

The class of alloys described in the present invention are ternary solid solutions of magnesium-zinc-silver, except in the case of the high magnesium percentages where a duplex structure will exist. We have investigated a series of compositions and have found that the following alloys, which are given by way of example only, have shown very excellent results when used for electrical contacts:

	Per cent
(1) Magnesium	3.5
Zinc	7
Silver	Balance
	Per cent
(2) Magnesium	6
Zinc	15
Silver	Balance
	Per cent
(3) Magnesium	3
Zinc	3
Silver	Balance
	Per cent
(4) Magnesium	2
Zinc	20
Silver	Balance

The ingredients in the proportions named above, or other suitable proportions falling within the broad specifications of this patent, may be melted together by conventional methods and poured into suitable molds.

It was found desirable to add the magnesium in the form of a silver-magnesium master alloy of high magnesium concentration. Alloys of this type have a lower melting point, and therefore will go readily into the silver melt. Since silver-magnesium has a tendency to oxidize and form a dross, it has been found desirable to melt such alloys either in a reducing or neutral atmosphere, or to use suitable fluxes which cover the melt.

The addition of magnesium in the form of a master alloy has also reduced the loss of magnesium and therefore has made it possible to hold closer tolerances in chemical composition. The resultant alloys have improved physical properties, particularly the alloys with a higher magnesium content. It was found that by raising the magnesium content up to about 10%, a tensile strength could be reached which exceeded 60,000 p. s. i., with elongation values in excess of 30%. The amount of zinc used in these alloys was in the neighborhood of 2 to 10%.

It was possible with an alloy containing 3% zinc and 3% magnesium, to obtain a Brinell hardness of 110 after cold swaging. At the same time, the tensile properties were raised similarly. The electrical conductivity of alloys of such compositions are in the neighborhood of 20% I. A. C. S. Tests were made to study the tarnish resistance of these materials. These tests were carried out by passing hydrogen sulphide of various concentrations into a bell jar in which the samples of the alloys were suspend-

ed. In this test also the effect of humidity and mixtures of hydrogen sulphide with air were studied. It was found that alloys of zinc and magnesium showed an extremely high resistance to sulphide tarnishing.

It was further found that alloys of zinc and magnesium retained considerable strength even after complete annealing. The tensile strength of alloys containing 2 to 5% magnesium and 3 to 10% zinc, exceeding values of 35,000 to 40,000 p. s. i. tensile strength, and at the same time the elongation of the materials, was very high.

The alloys of the class described have shown very excellent qualities when used for electrical contact purposes. A comparison test was conducted, wherein contacts of similar physical dimensions were tested on a resistive inductive circuit at 470 cycles per minute, and wherein the current flowing in the circuit was increased periodically to obtain the definite current values of alloys in the nature described above, in comparison with contact materials produced in the prior art. The amount of material transfer from one contact to another was used as the prime method of comparison.

An alloy was tested containing 3% zinc and 3% magnesium under these conditions, and it was found that the limiting current of this material was 15 amps. as compared with 12 amps. for fine silver or coin silver, and the material transfer was .005 as compared with .010 to .012 for fine and coin silver.

The final contact resistance of these new alloys, the scope of the compositions of which are given above, did not substantially exceed the values obtained for fine silver under identical test conditions.

We have further found that the wear resistance of our alloys may be increased by adding small amounts of such elements as copper, nickel, cobalt, iron or manganese. Such additions raise the softening point of the alloys and have no appreciable detrimental electrical effects.

The improved alloys described in the present invention have been found useful for a large number of electrical contact applications, such as, for instance, sensitive direct current relays, overload cut-outs, voltage regulators, indicating and recording guagers, thermostatic controls and the like. Our improved alloy is also very useful for applications which must operate in sulphurous atmospheres, such as railway signal equipment, telegraph apparatus, circuit breakers in smelting plants and chemical factories, etc.

We have also found that alloys of the compositions covered by the present invention are very suitable for use in differential contact combinations. Such combinations have the advantages of obtaining very low contact resistance, negligible transfer and great resistance to welding or sticking under heavy current loads and high operation frequencies. We have also found it advisable to add alloys of the compositions described, to refractory metals or mixtures, such as metals taken from the tungsten and molybdenum group, and their compounds, such as carbides, nitrides and borides, and the metals of the group nickel, iron and cobalt. Instead of making metal compositions in which fine silver is added to such refractory bases, we have found that superior performance can be obtained by using our improved alloy for bonding the pressed or pressed and sintered refractory material. The final composition of mixtures which we have under consideration may be for instance, 60% tungsten, 2% magnesium, 5% zinc, balance silver; or, 40% nickel, 2% magnesium, 7% zinc, balance silver.

The alloys of the present invention also have a commercial advantage, because the addition of magnesium in the percentages contemplated, provides a material of low specific gravity and therefore it is possible, with such low tensile alloys, to produce a large number of contacts per unit weight of material.

While the present invention as to its objects and advantages has been described herein as carried out in specific embodiments thereof, it is not desired to be limited thereby, but it is intended to cover the invention broadly, within the spirit and scope of the appended claims.

What is claimed is:

1. An electric contact formed of an alloy composed of .05 to 15% magnesium, .5 to 25% zinc, and the balance substantially all silver.

2. An electric contact formed of an alloy composed of .05 to 8% magnesium, .5 to 25% zinc, and the balance substantially all silver.

3. An electric contact formed of an alloy composed of 1 to 4% magnesium, .5 to 25% zinc, and the balance substantially all silver.

4. An electric contact formed of a metal composition of particles of refractory material selected from the group consisting of tungsten and molybdenum and their compounds interspersed and bonded with an alloy of .05 to 15% magnesium, .5 to 25% zinc and the balance substantially all silver.

5. An electric contact formed of a metal composition of metal selected from the group consisting of nickel, cobalt and iron in finely divided state interspersed and bonded with an alloy of .05 to 15% magnesium, .5 to 25% zinc and the balance substantially all silver.

FRANZ R. HENSEL.
KENNETH L. EMMERT.