Patented Oct. 7, 1941

2,258,492

UNITED STATES PATENT OFFICE

2,258,492

ELECTRIC CONTACTING ELEMENT

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

No Drawing. Application June 5, 1939, Serial No. 277,495

1 Claim. (Cl. 200—166)

This invention relates to a new silver base electric contacting element.

It is concerned more particularly with a contacting element which has improved physical and electrical characteristics. It is one of the objects of the invention to provide a silver base contact which has improved physical properties, such as hardness and tensile strength.

It is a further object to provide a contact which has improved corrosion resistance. It is a further object of the invention to provide a silver electrical make and break contact where high mechanical wear resistance is desired.

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

The present invention comprises a combination of elements, methods of manufacture and the products thereof, brought out and exemplified in the disclosure hereinafter set forth, the scope of the invention being indicated in the appended claims.

While a preferred embodiment of the invention is described herein it is contemplated that 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 an electric contacting element of silver, aluminum and a third element, taken from the group consisting of magnesium and cadmium, belonging to the second group of the periodic system. In the formation of the new contact alloy, it is preferable to provide a composition of the materials specified in the following proportions:

	Per cent
Aluminum	.1 to 10
Metal taken from the group comprising magnesium and cadmium	.1 to 25
Silver	Substantially the balance

It is possible to add to the contact alloy small percentages of such ingredients as zinc, tin, copper, gold, nickel, manganese, palladium group elements, platinum group elements, silicon, titanium, zirconium, indium, uranium, thorium, arsenic, antimony and selenium.

Silver and aluminum form a solid solution up to approximately 5%. Above that percentage, two phases exist at room temperature which are usually called alpha and gamma. At higher temperatures, there exists a range which is called beta, and which decomposes in cooling down, into the two constituents alpha and gamma. The percentage of 7.7 aluminum corresponds to the compound silver-aluminum. The alloys can be subjected to a heat treatment consisting in quenching and tempering by means of which the hardness can be very materially increased and raised to values in the neighborhood of 300 to 360 Brinell, with aluminum percentages ranging from 5 to 10%. These alloys, however, are quite brittle. The grain size at room temperature is usually quite fine, due to the fact that there is an eutectoid reaction at 600 to 610 degrees C., at which the beta constituent decomposes into alpha and gamma.

We have found that by adding to binary aluminum alloys a third constituent, taken from the group of magnesium and cadmium, the characteristics, and particularly the workability and ductility of the alloys, can be materially improved. At the same time, the resistance to corrosion and more particularly to tarnishing, is increased. The alloys to which both aluminum and magnesium have been added have furthermore the advantage of having a very low density and therefore a commercial advantage is gained, because more finished pieces can be produced per unit weight of the material.

We have found that alloys containing approximately 5% aluminum and cadmium have a remarkably high tensile strength and at the same time, retain a higher elongation. Materials of this type can be rolled satisfactorily to sheet. The alloys with higher aluminum contents are difficult to work, due to the very high hardness of the materials. An alloy was prepared, for instance, containing 2.5% aluminum and 7% cadmium. While the cast hardness of this material was 23 Rockwell F., cold working 25% raised this hardness to 98 Rockwell F. The electrical conductivity of this material was only 13.3%. Aluminum has a very pronounced tendency to decrease the conductivity of silver.

Another alloy was prepared containing 1½% aluminum and 3% magnesium. This alloy had a cast hardness of 24 Rockwell F., which was increased to 93 Rockwell F., by a cold reduction of 25%. The hardness of the material after annealing 15 minutes at 750 degrees C., was 33 Rockwell F. The electrical conductivity of this alloy in either the annealed or swaged condition was approximately 12.5%. The elements which are used as additions to silver-aluminum have considerable similarity. Both metals, the magnesium and the cadmium, form an alpha solution with silver, the alpha range being small in the silver-magnesium system and high in the

silver-cadmium system. In adding cadmium and magnesium to the alloys of the present invention, more consistent results are obtained if the substitution of the elements is carried out by volume percentage, rather than by weight percentage. This automatically indicates that a smaller percentage of magnesium added, corresponds to a higher percentage of cadmium because the specific gravities of the two materials are quite different. The specific gravity of magnesium, for instance, is 1.75, while the specific gravity of cadmium is 8.648. This is a ratio of about 1:4.

In other words, in order to have the same volume percentage of magnesium and cadmium present in the alloys of the present invention, based on silver-aluminum, it would be necessary in one case to add about 3 weight percent of magnesium, and in the other case, 15 weight percent of cadmium. By changing the weight percent to volume percent, it can be found that the alpha solutions of magnesium in silver, or cadmium in silver, are very nearly the same if they are plotted in volume percentage, rather than in weight percentages.

In the alloys which are designed for highest corrosion resistance, it is desirable to have a complex solid solution of silver and aluminum and a metal taken from the group of magnesium and cadmium.

By forming an alloy of silver with both aluminum and magnesium, greatly improved strength properties are obtainable.

It was found that the contacts of the present invention would resist sticking and also have a comparatively small material transfer. The contact resistance of the alloys was found to be higher than in the case of fine silver and therefore, wherever these alloys are used for contact applications, increased pressures should be used to compensate for the increase in contact resistance.

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 claim.

What is claimed is:

An electric contacting element formed of an alloy consisting of .1 to 10% aluminum, .1 to 25% cadmium and the balance substantially all silver.

FRANZ R. HENSEL.
KENNETH L. EMMERT.
JAMES W. WIGGS.