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SILVER CONTACT

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This invention relates to electric contacts.

An object of the invention is to improve the characteristics of the electric contact elements containing silver.

Another object of the invention is to provide a silver base contact material which will retain a very low contact resistance.

A still further object is to provide a new contact material which can be used under severe electrical loads without welding or sticking.

It is a further object of the invention to provide a contact capable of operating on high frequency at heavy current values, without objectionable metal transfer.

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

The present invention comprises the 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 a considerable variation may be made in the matter of procedure, and the combination of elements, without departing from the spirit of the invention.

The present invention comprises an improvement in silver base electric contact elements and especially in contact elements, formed of at least 70% silver. According to the invention, the contacts are improved by the addition of magnesium.

The contacts may be composed of silver and magnesium accordingly. The ingredients may be present in approximately the following proportions:

Magnesium	per cent .05–20
Balance	Predominantly silver

The preferred range of magnesium is .1–8%. Up to that percentage, the magnesium is taken up in alpha solution in silver.

It is likewise possible to improve the characteristics of silver alloys, containing additional ingredients, by the addition of magnesium. Thus, silver alloys containing beryllium, tin, zinc, cadmium, copper, gold, nickel, manganese, palladium group elements, platinum group elements, silicon, titanium, zirconium, indium, uranium, thorium, arsenic, antimony, selenium, can be improved by the addition of magnesium in the substantial proportions indicated above.

We have found that silver and magnesium, up to 8% magnesium, can be alloyed very readily and the cast ingots can be easily swaged and drawn into the form of wires or rolled into the form of sheet, from which contacts may be prepared by a punching operation, screw machine operation or by cold heading.

In an exhaustive study of silver base contact materials, a number of tests were devised to study their suitability for electrical contacting 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 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 the other was also used as a method of comparison.

In order to present comparative figures, values are given for alloys of silver, containing 5% by weight of the materials listed.

Contact material	Limiting current	Height of material transferred
	Amperes	
Fine silver	12	.010
Silver plus 5% copper	12	.011
Silver plus 5% zinc	10	.014
Silver plus 5% cadmium	13	.028
Silver plus 5% molybdenum	12	.062
Silver plus 5% manganese	8	.007
Silver plus 5% nickel	12	.028
Silver plus 5% tungsten	13	.056
Silver plus 5% magnesium	17	.002

From the above table, the outstanding performance of our new contact alloy is very evident. Furthermore, the small transfer is so uniform in the present alloy and it does not occur in the form of needle points, so that the material can be used for extremely sensitive relay applications as well as for heavy duty applications. This is also indicated by measurements which were made on the contact resistance of this new alloy combination. Experiments consisted in a test of 1000 operations on a relay with 50 grams contact pressure, 1330 operations per hour, with a resistive load. The contact resistance at 110 D. C., 1.9 amp. current, was 2.06 milliohms. After another 5000 operations with the same load, the contact resistance was 2.73 milliohms. At 110 volt A. C., and 6.5 amp. current, the contact resistance after 1000 opera-

tions, was 2.08, and after 5000 operations, was 2.27 milliohms. At 220 volt A. C., and 10 amps., the contact resistance after 1000 operations was 1.71 milliohms and after 5000 operations, 2.13 milliohms. The above results show that extremely low values of contact resistance are retained over long periods of operation. For a comparison, contact resistance values are given on alloys of the prior art. Standard coin silver will have a contact resistance of 10 milliohms, when tested under the same conditions at 110 volt D. C. and 1.9 amps.

An alloy of 95% silver and 5% molybdenum, showed a contact resistance of 27 milliohms under the same conditions.

The contact resistance of the present alloy is as low as that of fine silver, or even lower. The alloy has the definite advantage that the contact resistance values are not erratic, but very constant. Very often it is experienced that in service a high contact resistance will be built up after a short period of operation, and if the contacts continue in operation, the contact resistance might drop down again to lower values and vary as much as 10 milliohms with fine silver.

These three most outstanding values pointed out by the above investigations, namely, high limiting current, extremely low transfer and extremely low contact resistance, make this new material superior to almost any known silver base alloy of the prior art.

In addition it should be pointed out that 5 weight percent of magnesium amounts to as much as 30 volume per cent of magnesium. The specific gravity of the finished alloy is therefore considerably reduced for a 5% alloy and amounts to approximately 8.89. This factor will contribute materially to obtain a considerable reduction of price in the finished contact, because a larger number of contacts can be produced from a unit weight of contact wire and contact sheet.

The alloy has an electrical conductivity which is high enough to be satisfactory for electrical contacting purposes. A 5% alloy has an electrical conductivity of at least 20% (I. A. C. S.). In contact applications the specific resistance is considerably less important than the contact resistance, as long as it is high enough to carry the current satisfactorily. The thermal conductivity of the new alloy is also quite high and therefore will prevent over-heating of the contacts. The alloys can be hardened by a combination of suitable heat-treating and cold working. The alloys are ductile enough so that they can be very easily heated and will flow readily in the cold working operations.

The fact that magnesium has a boiling point which is about 1100 degrees C., and which is considerably lower than the boiling point of silver, which is in the neighborhood of 1950° C., is also a contributing factor for the excellent performance of the new contact alloy combination.

The silver-magnesium alloys can readily be prepared in the form of contact bi-metals in which one side consists of a base metal, such as an alloy of iron, nickel or a copper base material of silver-magnesium on the other side. The alloy lends itself readily to the formation of an electrical contact by a "beading" or fusing the alloy directly to the surface of the base metal blank, such as a rivet, screw or disc.

When operated on voltage regulators, such as used in the regulation of automotive generators, the material of the present invention, maintained perfect regulation. After continuous operations, exceeding many hundred hours, the resistance value of the new alloy was considerably below that normally encountered on alloys previously adopted for this type of service.

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 electrical contacting member formed of an alloy containing as an essential ingredient, silver to which has been added magnesium, in quantities ranging from .05 to 20%.

2. An electrical contact member formed of an alloy of .1 to 8% magnesium and balance substantially all silver.

3. An electric contact formed of an alloy of .1 to 8% magnesium, balance silver.

4. An electric contact formed of a silver base alloy containing .1 to 20% magnesium, said contact being characterized by low contact resistance and the ability to retain said low resistance throughout long periods of operation, low tendency toward metal transfer and relatively great freedom from welding or sticking during operation on high frequency or at heavy current values.

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