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ELECTRIC CONTACTING ELEMENT

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This invention relates to a new copper base contacting element of improved characteristics.

An object of the invention is to improve the electrical characteristics of the element, such as the electrical conductivity.

Another object is to improve the temperature resistant characteristics of such an element, such as the annealing temperature and the hardness values of the alloy at temperature.

Another object of the invention is to improve the hardness and tensile properties of copper base elements of the type disclosed.

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 product 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 combinations of elements, without departing from the spirit of the invention.

The present invention contemplates a contacting element formed of an alloy of copper, silver and lithium.

The alloy may preferably contain the essential ingredients, in the following proportions:

Silver	per cent	.02 –15
Lithium	do	.002– 1
Copper		Balance

Within these compositions ranges, there are a number of specific alloys which have been found to be of particular importance. Several of these alloys are listed below:

(1)	Silver	per cent	.03 –.08
	Lithium	do	.002–.01
	Copper		Balance
(2)	Silver	per cent	.5
	Lithium	do	.002–.01
	Copper		Balance
(3)	Silver	per cent	2
	Lithium	do	.002–.01
	Copper		Balance
(4)	Silver	per cent	6
	Lithium	do	.002–.01
	Copper		Balance
(5)	Silver	per cent	8 –12
	Lithium	do	.1– .25
	Copper		Substantially the balance

In some instances, it may be desirable for certain uses, to effect an improvement in the alloy by adding small percentages of additional ingredients, such as:

Cadmium	Zirconium
Zinc	Thorium
Magnesium	Uranium
Beryllium	Chromium
Calcium	Cobalt

Copper-silver alloys have heretofore been used for many purposes, particularly where high electrical conductivity was of importance, or where it was necessary to improve the physical properties of pure copper.

One of the outstanding effects of small amounts of silver in copper is that the annealing temperature of such materials is raised considerably. At the same time, silver has a variable solid solubility in copper and therefore, by proper heat treating, or by a proper combination of working and heat treating, almost all of the silver can be made to precipitate from the copper solid solution and therefore, the electrical conductivity can be raised to very high values. While at 779 degrees C., 8% of silver is held in solid solution, this amount is decreased to 4.5% at 700 degrees; 2.4% at 600 degrees; 1.2% at 500 degrees, .5% at 400 degrees; .25% at 300 degrees, and less than .1% at 200 degrees. The electrical conductivity is decreased by the formation of solid solutions. Whenever a solid solution is formed, the conductivity will be decreased greatly, due to the specific molecular arrangement of the solid solution crystals. If these solid solutions are decomposed by heat treatment or by a combination of cold work and heat treatment, then the resulting alloy will consist primarily of two ingredients and the electrical conductivity can be determined by applying a simple rule of mixtures. In cases where the two ingredients have extremely high conductivity, such as copper and silver, then the resulting electrical conductivity will be proportionally very high.

We now have discovered that this precipitation of silver from a copper solid solution, is greatly enhanced by the addition of lithium. The lithium forms a series of alloys and compounds with silver, while it is almost completely insoluble in copper, therefore tending to promote a more com-

plete precipitation of the silver phase from the copper matrix.

Our experiments have shown that the addition of lithium in alloys which contain only small percentages of silver, will result in a material which actually has a higher conductivity than pure copper. An alloy, for instance, containing .05% silver, .002% lithium, and the balance copper, will have an electrical conductivity of 101% International Annealed Copper Standard. At the same time, the annealing temperature of such alloys, after severe cold working, is in the neighborhood of 350 to 400 degrees C. If such alloys are used, for instance, for spot welding electrodes, a highly improved performance will result, due to the combination of the extremely high electrical conductivity, the improved Rockwell B hardness, and the increased annealing temperature. Whereas, pure copper will mushroom very rapidly, this new alloy will withstand mushrooming for a much longer time and will allow at least 3 to 5 times the number of welds to be made with a single electrode.

The addition of lithium also eliminates impurities and particularly oxides which may be contained in the melt, and it therefore eliminates the use of such highly detrimental deoxidizers as phosphorus, silicon, etc., which will decrease the electrical conductivity very materially, if present even in small proportions, which are generally classified as impurities.

We do not, however, contemplate the addition of lithium as a deoxidizer only. Sufficient lithium is added to the copper base to insure that the residue thereof, retained in the copper-silver alloy, does not amount to less than the certain desired percentage.

For deoxidizing purposes only, it is also possible to add other elements of the alkali group, or alkaline earth group, or alloys thereof, such as, for instance, sodium or calcium.

The improvements of the alloys of the present invention, characterized by the addition of lithium, are very pronounced also in the case where higher silver contents are used in order to obtain higher strength alloys.

We have found that alloys of this type give excellent performance, if used for electrical contacts and more particularly, contactor contacts. The lithium will tend to keep the surface of the alloy clean, and therefore reduce the contact resistance to a minimum, while the presence of silver improves the hardness and wear resistance of the contacts against mechanical abrasion.

The alloy is exceptionally well adapted to the production of resistance welding electrodes, seam welding wheels and welding dies and fixtures in general.

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. A resistance welding electrode characterized by high electrical conductivity and high hardness, formed of an alloy composed essentially of .002 to 1% lithium, .03 to 8% silver and the balance substantially all copper.

2. An electric contacting element of the type comprising contactor contacts, work-engaging pressure exerting electrodes and the like, said element being characterized by high hardness and high electrical conductivity and formed of an alloy composed essentially of .002 to 1% lithium, .02 to 15% silver and the balance substantially all copper.

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