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CONTACTING ELEMENT

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This invention relates to electrical contacting members.

It is an object of the invention to provide an improved circuit making and breaking contact that has a substantial current carrying capacity, as well as a relatively low and uniform contact resistance throughout a long period of circuit interrupting service.

It is also an object of this invention to provide a contact material which will be highly resistant to sticking or welding.

It is a further object of this invention to provide a contact member which is resistant to mechanical wear and to material 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 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 combination of elements, without departing from the spirit of the invention.

The contacts may be composed of copper and metallic thallium accordingly. The ingredients may be present in approximately the following proportions:

	Per cent
Thallium	.05 to 20
Copper	Predominantly the balance

Copper and thallium are almost insoluble in each other in the solid state, and therefore the final structure of alloys of the type described in the present invention, show a matrix of almost pure copper with thallium particles imbedded therein, in a more or less uniform manner. The distribution of the thallium particles will depend on the melting, pouring and solidifying conditions. It is also influenced by the addition of ternary ingredients.

We have found that copper-thallium alloys of the type described in the present application can be made still more effective for electrical contacting purposes, if elements are added, which are characterized by low boiling point, and more particularly by boiling points which are below 1200 degrees C. Elements of that nature are cadmium, which has a boiling point of 767 degrees C., zinc, which has a boiling point of 907 degrees C., selenium, which has a boiling point of 688 degrees C., arsenic, which has a sublimation point of 615 degrees C., calcium, having a boiling point of 1170 degrees C., mercury, having a boiling point of 356.9 degrees C., sulfur, having a boiling point of 444.6 degrees C., magnesium having a boiling point of 1110 degrees C.

I have found that a structure in which two metals are present, which have entirely different melting, wetting, oxidizing and evaporating conditions, are extremely well suitable for electrical contact purposes. In many cases, it is desired to have solid solution alloys for contact purposes. This is primarily the case where noble metals are being used, to which baser materials are added. If, in such alloys, base metals are taken up in solid solution, and are held within certain proportions, then the resulting alloy will have characteristics similar to those of the noble metal. In other words, physical properties, such as oxidation resistance and corrosion resistance, are improved by the formation of a solid solution; on the other hand, the electrical conductivity is usually considerably decreased.

The recent developments in contact materials have shown that metals of a duplex structure, and particularly metals in which a refractory material is present, in combination with a lower melting point material, have given outstanding performance as far as sticking and welding characteristics are concerned. At the same time, the erosion of such mixtures is greatly reduced as compared with that of solid solution alloys. This can be explained by the fact that when a solid solution alloy is used for contact materials, and such solid solution alloy contains ingredients of the nature of cadmium, which will readily evaporate, then such evaporation will destroy the solid solution and cause a breakdown of the crystal structure, resulting in increased electrical wear. If, on the other hand, cadmium would be present as free cadmium and the balance of the structure would be made up of a metal not alloying with cadmium, then only the cadmium particles can evaporate, but the main structure of the material is retained undisturbed.

In the case of the present invention, the two metals which perform the contact functions are thallium and copper, thallium being a soft metal of good corrosion resistance. Thallium forms an oxide readily. In performing as a contacting element in a mixture of copper and thallium, the heat created by arcing or sparking conditions, will convert the exposed thallium particles to thallium oxide, since the air will be ionized be-

tween the contacts so that the oxygen becomes highly active.

Since thallium particles are uniformly dispersed between the copper particles, they will tend to act as a non-wetting constituent as soon as they have been converted into oxides and provide a contact material which will have a much greater resistance to welding or fusing under very severe electrical loads. For this purpose again, it is of great importance that the two metals are present in their free state. If thallium would be taken up in solid solution by the copper, the oxidizing conditions during arcing would affect the solid solution crystals and the separation of metallic particles by oxide layers would not be obtained.

We have found that binary copper-thallium alloys are extremely well suited for electrical contacts and the above reasoning seems to offer a satisfactory explanation for this behaviour. This reasoning, however, is at present only a theory, since there are no physical laws or definitions which will account for the superiority of our improved compositions over the alloys of the prior art. We want it to be understood, therefore, that the theory explained in the present teaching is of a preliminary nature only and may be superseded later on by further research.

We have also found that the addition of low boiling point constituents to the present composition is highly beneficial. This may also be due to the formation of oxides because the metal vapors will probably oxidize very readily, during arcing conditions, and more generally during the make and break of the contact. At the same time, the actual metal vapors may have what is usually termed as arc quenching properties.

Some of the compositions that we have found to be particularly useful are the following:

		Per cent
(a)	Copper	97
	Thallium	3
(b)	Copper	90
	Thallium	10
(c)	Cadmium	2
	Thallium	3
	Copper	95
(d)	Zinc	1
	Thallium	2½
	Copper	Balance
(e)	Selenium	.5
	Thallium	3
	Copper	Balance
(f)	Sulfur	.3
	Thallium	3½
	Copper	Balance
(g)	Arsenic	.75
	Thallium	2½
	Copper	Balance
(h)	Magnesium	2
	Thallium	3
	Copper	95

The above compositions are given by way of an example, and within the scope of the present invention there are a number of other compositions that can be selected for specific purposes.

The alloys can be made according to standard melting procedures and can be cast into molds. If the thallium content is low enough, these alloys can be extruded into suitable shapes, from which, for instance, contactor contacts can be manufactured. If the contents of thallium and the other low boiling point constituents are too high, then these copper base alloys must be cast directly into the shape in which they are going to be used.

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 contacting element formed of a copper base alloy containing .05% to 20% thallium.

2. An electrical contacting element composed of an alloy containing .05 to 20% thallium and the balance substantially all copper.

3. A contacting element composed of an alloy containing .1 to 10% thallium and the balance substantially all copper.

4. A contacting element composed of an alloy containing 1 to 5% thallium and the balance substantially all copper.

5. An electrical contacting element composed of a copper base alloy containing .05 to 20% thallium and up to 10% of an element having a boiling point below 1200 degrees C., comprising the elements cadmium, zinc, selenium, arsenic, calcium, magnesium, mercury and sulfur.

6. A contacting element composed of a copper base alloy containing .1 to 10% thallium and up to 10% of an element having a boiling point below 1200 degrees C., comprising the elements cadmium, zinc, selenium, arsenic, calcium, magnesium, mercury and sulfur.

7. A contacting element composed of a copper base alloy containing 1 to 5% thallium and up to 10% of an element having a boiling point below 1200 degrees C., comprising the elements cadmium, zinc, selenium, arsenic, calcium, magnesium, mercury and sulfur.

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