Patented July 26, 1938 2,124,974

UNITED STATES PATENT OFFICE

2,124,974

CONTACTOR ELEMENT

Franz R. Hensel, Indianapolis, Ind., assignor to P. R. Mallory & Co., Inc., Indianapolis, Ind., a corporation of Delaware

No Drawing. Application February 5, 1937, Serial No. 124,231

6 Claims. (Cl. 219—4)

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 hard contact which is highly resistant to mechanical wear.

It is a further object of this invention to provide a contact member which will have a relatively low and uniform electrical resistance combined with great mechanical hardness in the "as cast" state. Such contact members can, therefore, be produced by either die casting or sand casting processes.

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.

Alloys of copper and cadmium with or without the addition of silver have been made in the past and have been used with some success for contactor contacts, welding electrodes, trolley wires and for other purposes where an alloy of high electrical conductivity, hardness and resistance to electric arcing was desired. While these prior art alloys are harder than copper after cold working this degree of hardness is very limited. This cold work hardness is lost completely if the alloys are heated above 350° C. Furthermore in the "as cast" condition the improvement of the alloys as far as tensile properties are concerned is negligible as compared with pure copper. The physical properties are very poor and the material "as cast" has almost no elastic properties at all.

According to one aspect of the present invention an improved electrical contactor is made of copper, cadmium, nickel and silicon.

For the production of electrical contacting members according to this invention an alloy of the following composition range is permissible:

	Percent
Cadmium	.25–10
Nickel	.5–7
Silicon	.2–3
Copper	Balance.

It is preferred, however, for the best physical characteristics and performance, that the ingredients be present in substantially the following ranges of proportions:

	Percent
Cadmium	.75–5
Nickel	1.5–3
Silicon	.4–1
Copper	Balance.

In some instances silver may also be present in small percentages, thereby improving the hardness somewhat without seriously reducing the electrical conductivity. The silver, if present, is preferably kept within the range 0.05% to 0.5%.

As an example of an alloy made according to the present invention, the following may be cited:

	Per cent
Cadmium	1.5
Nickel	2.45
Silicon	0.57
Copper	Balance.

In carrying out the present invention any of the conventional procedures for producing the alloy may be used.

A special method of manufacture however has been developed which is preferred since it allows a very close control of the composition. This method consists in taking nickel powder, silicon powder, copper powder and cadmium powder in the desired proportions, mixing them properly, compressing them to a briquet and coating the latter with a thin and protective slag coating. A definite quantity of these briquets is added to molten copper, and dissolved in the copper, and then the finished melt is poured into suitable moulds. Deoxidizers, fluxes and degasifying reagents may be added to the compressed hardener.

Where silver is added it may also be incorporated as a powder.

With the present composition it is possible to make cast contactors which can be heat-treated. It is thus feasible, without cold working, to produce a hardened contactor of castmetal. This is impossible with the prior straight copper-cadmium and copper-cadmium-silver alloys mentioned. With these prior alloys it was only possible to harden them by cold working.

It is also possible, according to the present invention to produce age-hardenable contactors by casting containing higher proportions of cadmium such as 2.5% or 5%. Alloys containing over 1.25% cadmium cannot be hot or cold-worked satisfactorily and so heretofore it would not have been practicable to produce a hardened contactor of the prior copper-cadmium alloys where the percentage of cadmium was much greater than 1%.

In the heat treatment of the alloy it may be first heated to a temperature of 700° C. to 1,000° C., for a short period of time such as from 10 to 30 minutes. After the metal has reached the desired temperature it may be cooled quickly from the high temperature. The next step is preferably to heat the quenched alloy at a temperature of 300° C. to 600° C. for a period of from 10 to 30 minutes, depending on the temperature and the percentage of nickel and silicon used for hardening. An alloy prepared in such manner will not soften in use up to a temperature of 550° C., thus it will withstand 200° C. higher temperatures than the alloys of copper and cadmium used formerly.

Where desired, if the smaller percentages of cadmium are used, the age-hardened alloy may be cold worked to further increase its hardness. Such aged and cold worked alloys will withstand the same high temperatures without softening as the aged alloys without cold working. The mechanical hardness and strength of the cold-worked alloy contactor of the present invention is more than 100% greater than that of the cold-worked prior art alloys mentioned.

The increased hardness imparted by the age-hardening is also of advantage where large sections of metal are used that can be cold worked only a small amount and hence with the prior alloys could not be very much hardened by the cold working.

The age-hardened and cold worked material can be produced with a hardness of 250 Brinell as compared with 120 Brinell of the hardest straight copper-cadmium or copper-cadmium-silver alloys.

The contactor of the present invention may take any one of several forms such as resistance welding electrodes, electrical make-and-break contacts, trolley wheels or wire, trolley shoes, commutator segments, collector rings and the like. It is contemplated that small proportions of other ingredients, such as silver, as hereinabove set forth, which do not materially affect the desirable characteristics of the articles, are within the purview of the claims.

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 scope and spirit of the appended claims.

What is claimed is:

1. An electrical contacting member composed of .25 to 10% cadmium, 0.5 to 7% nickel, 0.2 to 3% silicon and the balance substantially all copper.

2. An age-hardened electrical contacting member composed of .25 to 10% cadmium, 0.5 to 7% nickel, 0.2 to 3% silicon and the balance substantially all copper characterized by an obtainable hardness in the order of twice that of the hardest straight copper-cadmium alloys and the ability to maintain its hardness at temperatures in the order of 500° C.

3. A resistance welding electrode composed of .25 to 10% cadmium, 0.5 to 7% nickel, 0.2 to 3% silicon and the balance substantially all copper.

4. An electrical contacting member composed of .75 to 5% cadmium, 1.5 to 3% nickel, .4 to 1% silicon and the balance substantially all copper.

5. An age-hardened electrical contacting member composed of .75 to 5% cadmium, 1.5 to 3% nickel, .4 to 1% silicon and the balance substantially all copper characterized by an obtainable hardness in the order of twice that of the hardest straight copper-cadmium alloys and the ability to maintain its hardness at temperatures in the order of 500° C.

6. A resistance welding electrode composed of .75 to 5% cadmium, 1.5 to 3% nickel, .4 to 1% silicon and the balance substantially all copper.

FRANZ R. HENSEL.