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ALLOY, PARTICULARLY ADAPTED FOR ELECTRICAL PURPOSES

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The invention relates to an alloy, particularly adapted for electrical purposes including contacts and welding electrodes. Furthermore, the alloy concerned by this invention is adapted as a pre-alloy for electrical material.

According to previous suggestions an alloy resistive to mechanical wear and oxidation, particularly adapted for electrical purposes including contacts and welding electrodes and as a pre-alloy for electrical material, suitably consists of about 0.1% to 10% cadmium and at least one metal of the copper group which, as it is well known in this art, consists of copper, silver and gold. Manganese, aluminum, calcium, tin, beryllium, silicon, zinc, phosphorous, tantalum, tungsten, molybdenum, can be suitably added for some purposes, either singly or in mixtures.

According to another suggestion, boron in an amount of about 0.1% to about 5% may be added to the alloy.

In all the cases mentioned above copper should be present in the alloy, selected from the copper group in a minimum amount of about 80% or sometimes 85%.

It is an object of the invention to improve the quality of an alloy of the type mentioned above as to its resistance to oxidation at high temperatures.

It is another object of the invention to increase the hardness of an alloy of the type referred to above.

It is still another object of the invention to increase both the resistance to oxidation and the hardness of an alloy of the type referred to above at high temperatures in such a way that the alloy neither oxidizes nor softens when exposed to higher temperatures for some considerable time.

It is a further object of the invention to provide for an alloy of the type referred to above in which the constituents are evenly and uniformly distributed.

It is still a further object of the invention to facilitate the manufacture of a homogeneous alloy of the type referred to above and to reduce the cost.

According to our present invention we are adding chromium in an amount of about 0.1 to 5% to an alloy of the type referred to above, and metal of the iron group in an amount of about 0.1% to 5%.

By an addition of chromium we obtain the advantage that the resistance to oxidation of the alloy referred to above as well as its hardness is substantially increased. Experiments and experience show that such an alloy softens with greater difficulty at high operation temperatures and that it does not substantially oxidize although exposed to such high temperatures for a considerable period of time.

It is difficult, however, to admix chromium to an alloy which has a high copper content. Indeed, chromium and copper mix in their liquid state only and then not more than to a limited extent.

However, by forming a quaternary mixture containing aside from copper, cadmium and chromium also iron, we found that, surprisingly, the chromium content can be incorporated into the alloy and mixed thoroughly with all its constituents, including copper, in the liquid state. Furthermore, if the melt is cooled, the chromium remains evenly and uniformly admixed to the other constituents, and upon solidification a homogeneous alloy is obtained which comprises evenly distributed all the constituents referred to.

In addition thereto, we found that the addition of iron does not only facilitate the admixture of chromium to that alloy but that it also facilitates the production. It is possible to make the alloy by melting the components at normal melting temperatures without overheating and without extending the melting period for an undue time. Furthermore, we found that a homogeneous alloy can also be obtained by highly sintering the finely powdered constituents. By such sintering the lower melting constituents become liquid and alloy with the highest melting constituents, i. e. chromium, if an alloy of the type of cadmium, copper, iron and chromium is concerned.

An alloy according to our present invention is harder and more resistant to mechanical wear than an alloy of the same composition but without chromium and iron. In operation it can be highly heated without oxidizing or softening. The alloy is well desoxidized, due to its cadmium content, and it is ductile to a high degree which means that it possesses great mechanical strength and can be worked and shaped mechanically both in the cold and heat.

If chromium is added to an alloy of the type containing boron, the resistance of the alloy to oxidation is still further increased and it can be successfully used under conditions where local sparking or arc formation occurs. The alloy does not oxidize when heated by such a spark or arc. If used to form a contact, or welding electrode, it appears that when the contacts or electrodes are separated the gap between them is quickly deionized, which we attribute to the presence of boron in the contact surface.

A suitable composition according to our invention consists e. g. of 3% chromium, 1.5% iron, 1% cadmium and 94.5% copper.

Another suitable composition consists e. g. of 2.8% chromium, 1.5% iron, 3% cadmium, 0.5% boron and 92.2% copper.

Another suitable composition consists e. g. of 0.5% chromium, 0.5% iron, 1% cadmium, 4% silver, 0.3% boron and 93.7% copper.

To an alloy of the type concerned by our invention 0.1% to 5% of beryllium, cadmium, aluminum, silicon, manganese, zinc, phosphorus and tin, singly or in suitable mixture of two or three of these elements, may be admixed. Preferably the total amount of these admixtures does not exceed 5%. Other admixtures in similar amounts can consist of at least one representative of the second and at least one representative of the sixth group of the periodical system other than chromium.

An alloy according to our invention can be manufactured in any suitable way.

In particular, the alloy can be manufactured in such a way that the components are comminuted as finely as possible, intimately mixed, pressed into the desired shape and thereupon highly sintered. The body thus obtained may then be mechanically worked such as rolled, swaged, drawn, if desired. This process may also be carried out in such a way that first comminuted chromium is coated with the chosen metal of the iron group which consists of iron, nickel, cobalt, or with several of these metals, and then be admixed to the other components and highly sintered. Instead of covering the particles of comminuted chromium with a metal of the iron group, a film of copper can be applied to these particles in well known ways, and then the other constituents can be admixed.

If a melting process is applied, the constituents, preferably somewhat comminuted, are melted in a crucible or mold and allowed to cool whereby an alloy is obtained in which the chromium is uniformly and thoroughly admixed to the copper due to the presence of at least one metal of the iron group. However, comminuted chromium coated with a metal of the iron group, or copper, may also be used for the melting process.

Another way consists therein to form a pre-alloy of copper and of at least one metal of the iron group and to add it to the other constituents in the crucible, whereupon the batch is melted.

Chromium and metal of the iron group should be present in a total minimum amount of about 0.5%.

We found that the alloy according to our present invention possesses a good electrical conductivity which is not substantially below that of an alloy of the type referred to above in which neither chromium nor iron is present. The alloy is well desoxidized, homogeneous and highly resistive to oxidation and mechanical wear, and offers great hardness and resistance against corrosion during operation at relatively high temperatures for a relatively long time.

An alloy according to our invention can either be obtained in the desired shape for immediate use or it can be obtained in the form of a small ingot or bar or the like, which is then transformed into the desired shape by suitable mechanical and possibly thermal treatment. The latter can be conducted in a way to retain the grain structure of the alloy or affecting the latter, if desired.

The invention is not limited to any of the examples given above but is to be understood in its broadest scope from the appended claims.

What we claim is:

1. A composition of matter consisting of 3% chromium, 1.5% iron, 1% cadmium and 94.5% copper.

2. An alloy resistive to mechanical wear and oxidation, particularly adapted for electrical purposes including contacts and welding electrodes and as a pre-alloy for electrical material, consisting substantially of about 0.1% to about 10% cadmium, 0.1% to 5% chromium, 0.1% to 5% metal selected from a group consisting of iron, nickel and cobalt, balance selected from the group consisting of silver, gold and copper and of which copper is always present in a minimum amount of 79%.

3. An alloy as described in claim 2 in which silver is present in an amount of 0.1% to 14%.

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