

UNITED STATES PATENT OFFICE

1,986,210

COPPER ALLOY FOR CONDUCTING ELECTRICITY

Frederick J. Maas, Chicago, Ill., assignor of five per cent to Albert W. Langkau, five per cent to Adolph Kokoefer, and five per cent to Edward Csar, all of Chicago, Ill.

No Drawing. Application April 20, 1934
Serial No. 721,460

1 Claim. (Cl. 75—1)

This invention relates to improvements in copper alloys, and particularly, to a type of alloy capable of serving as a highly efficient carrier or conductor for electricity; the nature of the alloy being such that the same may be economically and practically fabricated as wire, contact points, contact terminals, switches, etc.

An equally important object of the invention resides in the provision of a copper alloy which may be advantageously substituted for the now prevalent class of electrical conductors, such for example, as those species of electrical conductors made of copper; the alloy being effectually resistant to those detriments resulting from subjection of electrical conductors to atmospheric conditions, which, as is well known in the art, brings about a progressive coating of the conductors, and especially, copper electrical conductors, with carbon-copper-oxide and corrosion, and hence, prematurely decreases the conductivity efficiency of the same to a degree such as to render them inefficient for continued usage.

Another object of the invention is to provide a copper alloy especially advantageous for usage in the manufacture of electrical conductors, which possess a hardness materially greater than that commonly found in pure or substantially pure copper, as used at the present time, consequently, imparting to the alloy, a most desirable quality, i. e., so rendering the alloy that it will maintain its original or substantially original degree of hardness over a prolonged period of time, and against the aforesaid adverse conditions.

As is well known to persons skilled in this art, electrical conductors made of pure or substantially pure copper, rapidly decrease in their conductivity efficiency. This is mainly due to corroding and oxidation of such conductors, and in part, is because of the fact that with such coatings, the conductors present a most undesirable resistance to electricity traversing the same, and hence, the heat thereby created anneals the copper, softening it to a degree which is found in virgin copper, and by consequence, is impractical for the conduction of electricity.

For example, rolled sheet copper, when fabricated into electrical switches, will in its initial performance amiably function. However, with exposure to those conditions incident to usage of switches, corrosion and oxidation of the copper takes place, and consequently upon this, its electrical conductivity is decreased to a material extent. That is to say, when the switch is in usage, arcing at its points of contact occurs and

the heat thus transmitted to the switch causes the electrical conducting metal thereof to lose its desirable and necessary qualities of hardness, as well as its limited spring qualities. The switch becomes flabby and soft; its conductivity efficiency is greatly impaired. I have found, through extended experimentation, that under conditions such as above referred to, the electrical conductivity of the copper is lost to such an extent that a switch element constructed therefrom actually becomes an element of resistance to the electricity traversing the same, rather than functioning as an efficient conductor for the electricity. It is, therefore, manifest that a switch or other conductor made of ordinary copper affords but a comparatively brief period of efficient usage, and in addition to this, its continued usage involves major hazards, such as fire and the like, as well as entailing considerable loss of power upon part of a user thereof.

Through the usage of an alloy constituted in accordance with my invention, I am enabled to produce a highly efficient electrically conductive metal, which is not only non-corrosive and non-oxidizing, but which affords electrical conductivity efficiency far better than that of ordinary copper. An alloy constituted in accordance with my invention will be found to be considerably harder than ordinary copper, and additionally, the improved alloy possesses a greater degree of ductility. Because of such structural characteristics, the alloy may be satisfactorily forged, extruded, rolled, or fabricated in accordance with such industrial methods as are now known.

In order that the invention and the mode of production of the improved alloy may be thoroughly understood by workers skilled in the art, I have, in the following detailed description set out a satisfactory embodiment of the same.

A typical formula for producing one form of the improved alloy is—

	Percent
Silver.....	1
Aluminum.....	4
Silicon.....	½ 45
Aluminum-titanium.....	½
Calcium molybdate.....	1
Iron molybdenum.....	1
Copper—of an amount to complete a 100% mass.	50

Through the usage of silver in the alloy, its conductivity is greatly bettered. The silver component furthermore serves to impart effectual corrosion and oxidizing resistant properties to the alloy. It also functions, by reason of its

- high degree of electrical conductivity, as a means for compensating for those probable electrical conductivity losses which would be otherwise occasioned to the alloy in usage by reason of the
- 5 presence of molybdenum and iron therein. The aluminum content serves to not only increase the alloy properties of hardness and corrosion and oxidation resistance, but it also materially improves the alloy ductility.
- 10 The silicon component of the alloy provides the same with high acid and corrosion resistant properties; also, it materially improves the alloy fluidity, rendering the same capable of efficient and practical casting.
- 15 The aluminum-titanium in the alloy insures an advantageous hardening of the same, especially, in combination with its molybdenum content. The usage of calcium molybdate and iron molybdenum improves its corrosion and stain
- 20 resisting properties besides effecting a desirable age hardening of the same. The molybdenum content of these several components also prevents undesirable softening of the alloy and insures a desirable, but not too great a degree of fluidity of the same; the latter being especially
- 25 advantageous in instances where the alloy is to be cast. Furthermore, the molybdenum content of the calcium molybdate and iron molybdenum not only renders the alloy materially less subject to deterioration with exposure and usage,
- 30 but it also insures homogeneousness thereof, and at the same time, eliminates intercrystalline brittleness of the product when it is subjected to material temperatures.
- 35 At this point, it is to be noted that all, or substantially all of the molybdenum, from the calcium molybdate and iron molybdenum, will enter into the alloy, together with the iron. However,
- 40 the calcium, at the temperature of the molten metal will not enter the same, but rather, will produce an efficient slag for the charge during the alloying process, sealing the "heat" and by consequence, preventing oxidation thereof.
- 45 It is to be also understood that whereas different formulas of calcium molybdate and iron molybdenum may be used in my improved alloy, I preferably employ formulas of these particular components which, respectively, consist of molybdenum 43.90; silicon 0.18, and calcium 55.92;
- 50 and molybdenum 68.50, iron 31.20, and carbon 0.30.

The aluminum-titanium component preferably consists of aluminum, approximately 60%, and titanium, approximately 40%.

55 The final alloy consists of:

	Percent
Silver.....	0.84
Aluminum.....	3.81
60 Silicon.....	0.44
Titanium.....	0.42
Molybdenum.....	0.37
Iron.....	0.18
Calcium.....	0.06
75 Copper of an amount to complete a 100% mass.	

The molybdenum and iron content, it will be understood, will depend upon the particular formulas of calcium molybdate and iron molybdenum introduced into the charge.

The copper base of the improved alloy, through the usage of the heretofore specified components, becomes possessed of a comparatively high melting point, and at the same time, its electrical conductivity efficiency is in no way impaired. 5

The ductility of the copper base is enhanced by the use of the aluminum component therewith, and also, the copper base appears to be hardened to an advantageous degree by the use of the molybdenum and iron thereof, as well as having 10

its electrical conductivity efficiency increased because of the compensating affect produced by the silver component. The silver component also serves to compensate for possible loss of electrical conductivity efficiency by reason of the titanium content of the alloy. In effecting a charge for the production of my improved alloy, the components—silver, silicon, aluminum-titanium and iron molybdenum are preferably introduced therinto through master alloys. The 20

calcium molybdate is added, alone, to the charge. The quantity of copper, sufficient to complete a 100% mass (when including the aluminum component) is added. A charge so constituted is brought to a temperature of from 2100 to 2200 25

degrees Fahrenheit, being agitated to insure proper alloying of the components. When the proper alloying is effected, heating of the charge is discontinued and approximately simultaneously therewith, the aluminum component is introduced into the mass and caused to be thoroughly alloyed therewith by agitation. In this way, the full content of the aluminum component will be retained in the alloy, i. e., the "burning off" 35

of the aluminum due to the high temperature of the molten charge will be prevented.

Under some manufacturing conditions or requirements, it may become desirable to impart or maintain a maximum degree of hardness to the alloy. In such instances, I have found it 40

desirable to resort to a process of heat treatment of the alloy, to wit, heat treating the alloy and then quenching or rapidly cooling the same in order that the previously dissolved non-metallic matters of the alloying components will be 45

brought into a solid solution. Also, it may be noted at this point, that with re-melting of stock material constituted in accordance with my invention, articles or devices manufactured therefrom will possess the original qualities or 50

properties of the alloy, in that re-melting of the same will not disturb or distort its original advantageous properties.

I claim:

55 An alloy of the character described, comprising the following elements in approximately the respective relative quantities indicated:

	Percent
Silver.....	0.84
Aluminum.....	3.81
60 Silicon.....	0.44
Titanium.....	0.42
Molybdenum.....	0.37
Iron.....	0.18
Calcium.....	0.06
65 Copper.....	90.74

FREDERICK J. MAAS.