Patented Dec. 6, 1938 2,139,497

UNITED STATES PATENT OFFICE

2,139,497

COPPER ALLOY

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No Drawing. Application April 20, 1937, Serial No. 137,987

3 Claims. (Cl. 75—160)

This invention relates to copper base alloys.

An object of the invention is to improve the temperature resistant properties of the alloys, and more specifically to raise the annealing temperature of the alloys.

Another object is to improve the electrical and heat conductivities of such alloys.

Other objects of the invention will be apparent from the following description taken in connection with the appended claims.

Alloys of copper which are improved by adding cobalt and iron have been known for some time although they have never found great commercial use. One of the reasons for this is that such alloys could not be produced with consistently high physical properties in the "as cast" condition. The alloys seem to be susceptible to intercrystalline cracking and after heat treatment sand castings show very low tensile strength even though the hardness might be sufficiently high. To prove satisfactory in actual service conditions it is necessary that alloys be prepared which are uniform and consistent as far as tensile, impact, fatigue and electrical properties are concerned.

It was furthermore found that the copper-cobalt-iron alloys when melted are extremely susceptible to temperature conditions and furnace atmosphere conditions as encountered in ordinary melting procedures. If the alloy is not very carefully prepared and melted under strictly controlled conditions, the resultant casting or forging is liable to severe cracking and therewith low tensile, impact and fatigue strength. The present invention contemplates the provision of a new and improved alloy of the copper-cobalt-iron type which is free of the shortcomings mentioned above.

The present invention comprises a 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.

The alloy of the present invention consists predominantly of copper, with additions of iron-cobalt, silicon and beryllium. In the formation of the alloy it is permissible to provide a composition of the materials above specified in the following proportions by weight.

	Per cent
Iron	1 –5
Cobalt	.1 –5
Silicon	.05–5
Beryllium	.05–2.5
Copper	Balance

We have found that in the ranges given above there exist at least three types of alloys each of which have outstanding merits for certain uses. The preferred range of composition for each type is:

		Per cent
(I)	Cobalt	.1– .75
	Iron	.1– .75
	Silicon	.1– .5
	Beryllium	1. –2.5
	Copper	Balance

		Per cent
(II)	Cobalt	.5–2
	Iron	.5–2
	Silicon	.2–1
	Beryllium	.1– .75
	Copper	Balance

		Per cent
(III)	Cobalt	.15–.75
	Iron	.15–.75
	Silicon	.05–.25
	Beryllium	.10–.50
	Copper	Balance

The above alloys have been found to be susceptible to improvement by heat treating and the following ranges of physical properties can be obtained depending on the selection of alloys from either one of the above groups.

Hardness ranges (Brinell)	160–450
Conductivity ranges—per cent	25– 65

An alloy of the composition—

	Per cent
Cobalt	.5
Iron	.5
Beryllium	.4
Silicon	.3
Copper	Balance

gave 240 Brinell hardness after quenching from 950° C. and aging for two hours at 450° C. and 38 per cent conductivity after complete heat treatment.

By modifying the above composition to—

	Per cent
Iron	.3
Cobalt	.3
Silicon	.3
Beryllium	2.0

a hardness of 400–450 Brinell is obtained with an electrical conductivity of 20–30%.

This invention makes it possible to obtain excellent physical properties at a moderate cost.

In many castings the sections can be decreased and weight can be saved by using our new and improved alloy. If these parts have to conduct electricity and heat this reduction in area will not hinder the current or heat flow since our new alloys have also a higher electrical and heat conductivity than the alloys previously used.

The heat treatment of the alloys is slightly different. The case where a high percentage of beryllium, say for example 1–2%, is present, somewhat lower quenching and aging temperatures are employed than in cases where only a smaller percentage of beryllium is added. In both cases the quenching temperatures will be above 700 degrees C. and the aging temperature below 700 degrees C.

The alloys may also contain small percentages of nickel and manganese up to .5%.

The alloys can be prepared by melting together the various ingredients. Our preferred method however, consists in mixing and pressing together copper, iron, cobalt and silicon powder, in the correct proportions and to add briquettes of this mixture as a hardener to the melted copper. The beryllium is usually added in the form of a copper-beryllium hardener.

The alloys can be readily forged and fabricated in the usual manner. These compositions also lend themselves excellently for sand casting or permanent mold castings.

The alloys were found to be of uniform and small grain size.

The alloy of the present invention is suitable for a variety of electrical and other uses and particularly for electric contacting members such as resistance welding electrodes, trolley wires, trolley shoes, commutator bars and the like. The alloys having in the order of 99% copper are generally preferred where the strength and hardness is sufficient because of their generally higher electrical conductivity.

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 alloy composed of—

	Per cent
Iron	.1 –5
Cobalt	.1 –5
Silicon	.05–5
Beryllium	.05–2.5
Copper	Balance

2. An alloy composed of—

	Per cent
Iron	.5–2
Cobalt	.5–2
Silicon	.2–1
Beryllium	.1– .75
Copper	Balance

3. An age-hardened resistance welding electrode containing

	Per cent
Iron, about	.1 –5
Cobalt, about	.1 –5
Silicon, about	.05–5
Beryllium, about	.05–2.5

and the balance copper, said electrode being characterized by the combination of high hardness and high electrical conductivity.

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