

UNITED STATES PATENT OFFICE

2,136,549

COPPER-URANIUM ALLOYS

Franz R. Hensel and Earl I. Larsen, Indianapolis, Ind., assignors to P. R. Mallory & Co., Inc., Indianapolis, Ind., a corporation of Delaware

No Drawing. Application September 15, 1937,
Serial No. 164,035

4 Claims. (Cl. 219-4)

This invention relates to alloys, and more particularly to copper alloys of improved characteristics.

An object of the invention is to produce a copper alloy of high electrical and heat conductivity, combined with suitable hardness.

Another object of the invention is to provide an alloy which, in the form of a casting, will have a very high electrical conductivity.

Further objects are to improve the cold working and crystallizing characteristics of the alloy.

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

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.

While the 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 invention relates to alloys consisting basically of copper and uranium, to which third elements are added to further improve the characteristics. While these alloys may vary in their physical characteristics, according to the specific compositions, they will generally be characterized by high conductivity and improved hardness. The alloys are further characterized by desirable electrical properties, such as being a material of low work function, which might be useful for special contacting purposes, or applications, such as neon sign electrodes, and similar applications where high electrode emissivity is required.

It is contemplated that alloys may be produced according to the invention, having the ingredients combined in the following range of proportions:

	Per cent
Uranium-----	0.005 to 10
Elements of the 2nd group of the periodic system selected from the group consisting of cadmium, zinc, beryllium, magnesium, calcium, strontium, barium in the least useful amount to-----	30
Copper-----	Balance.

It has also been possible to add small percentages of any one of the following ingredients without changing materially the characteristics

of our new alloy: aluminum, silicon, phosphorus, manganese, iron, cobalt, nickel and tin.

In alloys consisting predominantly of copper and uranium, it is found that additions of uranium to copper have very little effect on lowering the electrical conductivity. Alloys consisting of uranium and copper have an extremely high electrical conductivity. The addition of .1% of uranium will produce an alloy with 98% electrical conductivity, while .2-3% uranium will decrease the conductivity to 94-95% and 1/2% of uranium will still produce an alloy above 92% conductivity.

We have found that alloys of copper and uranium apparently show what is generally known as an eutectic structure. With higher percentages of uranium present, such as 10-20%, a microscopic analysis shows a definite copper-uranium compound similar in structure to that noted in copper-uranium alloys of lower uranium content. This compound is one constituent of the eutectic.

It appears that it is due to the formation of this eutectic and the small amount of uranium, taken up in solid solution by the copper, which is responsible for the high electrical conductivity values. It is remarkable, however, to find that even with high uranium contents, the alloys remain easily workable and can be hot and cold worked.

The additions of elements taken from the second group of the periodic system and particularly the element cadmium, tend to improve considerably the cold worked characteristics of the copper-uranium alloy. By adding both cadmium and uranium to our improved copper alloy, it is possible to produce a material for electrical purposes, of outstanding merit. Similar results are obtained by adding the other materials contained in this group, such as magnesium or zinc. By adding a high enough amount of beryllium, alloys can be made susceptible to heat treatment, generally known as age hardening, and characterized by the fact that the heat treatment consists in two steps; namely, the quenching operation, followed by the aging operation, with or without cold working.

In carrying out the present invention, an alloy of copper and an element taken from the second group of the periodic system may be made according to the conventional alloy making procedure of the prior art, and then uranium may be added in any convenient form, such as cupro-uranium, pure uranium, or any other uranium alloy or compound. We have found it even possible to use ferro-uranium, provided that impuri-

ties of iron are not objectionable for the specific application under consideration.

5 The great deoxidizing power of uranium can be judged from the heat of formation of the oxide. This heat amounts to 304,000 calories per gram atomic weight of metal. By comparing this with another material, which is generally known as a good deoxidizer, such as manganese, superiority is clearly shown. The heat of formation of the 10 manganese oxide is only 91,000 calories per gram atomic weight of metal. This high heat of formation of oxides also points to the fact that if alloys of copper and uranium are to be made which contain appreciable quantities of uranium, 15 the molten bath must be free of oxides, particularly of copper oxides; otherwise a certain quantity of the uranium will be lost in reducing the copper oxide to pure copper with the resulting formation of uranium oxide.

20 The presence in the alloy of small proportions of other ingredients which do not substantially alter its characteristics is contemplated as within the purview of the invention.

25 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 within the spirit and scope of the appended claims.

What is claimed is:

1. An alloy consisting of copper and from 0.005% to 10% uranium, to which an element has been added, taken from the second group of the periodic system, the latter elements being present in quantities from more than traces up to 30%. 5

2. An alloy composed of 0.005% to 20% uranium, from the least useful amount up to 30% of a material selected from the group consisting of cadmium, zinc, beryllium, magnesium, calcium, 10 strontium and barium, and the balance copper.

3. An electric current conducting member formed of an alloy composed of 0.005% to 20% uranium, from the least useful amount up to 30% of a material selected from the group consisting 15 of cadmium, zinc, beryllium, magnesium, calcium, strontium and barium, and the balance copper.

4. An electrical contacting member of the type comprising resistance welding electrodes and the like formed of an alloy composed of 0.005% to 20% uranium, from the least useful amount up to 30% of a material selected from the group consisting of cadmium, zinc, beryllium, magnesium, calcium, strontium and barium, and the balance 20 copper.

FRANZ R. HENSEL.
EARL I. LARSEN. 25