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# UNITED STATES PATENT OFFICE

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## COPPER BASE ALLOY

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1 Claim. (Cl. 75—160)

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This invention relates to an alloy of copper base metal having high hardness and electrical conductivity.

One of the objects of the invention is to provide a copper base alloy having higher hardness and higher electrical conductivity than present-day so called high conductivity alloys of copper.

Another object of the invention is to provide a copper base alloy of this type which will age harden in a substantially shorter time than the former alloys referred to.

Another object is to provide such an alloy which has substantially higher electrical conductivity for a given hardness than is attainable in prior copper base alloys.

Another object is to provide such an alloy that has greater fluidity when molten and which has a lower pouring temperature.

Another object is to provide such an alloy containing chromium as one of the major alloying ingredients and in which the chromium recovery is higher than in former copper chromium alloys.

The alloy, in general, is of the copper-chromium-beryllium type with copper ordinarily in excess of 95% and preferably as high as 99%.

The features of higher electrical conductivity and also of higher recrystallization temperature and fluidity are obtained by the addition to such an alloy of from .01 to 1.0% of silver, preferably about .05%. When silver is employed, it is well also to have present about .05% of iron to increase the hardness upon precipitation and cold working.

The features of higher fluidity and high chromium recovery are obtained by adding from .01 to 1.0% of silicon prior to the adding of the chromium to the bath. The silicon is believed to prevent oxidation of the chromium and its resulting loss. The silicon also greatly improves the handling of the alloy and increases its fluidity so that it may be poured at lower temperatures.

A combination of the above features are obtainable by adding both silver and silicon as alloying constituents, and the resulting alloy has properties not heretofore attainable in copper base alloys.

A preferred composition is as follows:

| | Percent |
|---|---|
| Chromium | .35 |
| Beryllium | .05 |
| Silver | .05 |
| Silicon | .05 |
| Iron | .05 |
| Copper, balance | |

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An alloy of the above composition may be heat-treated by heating to between 1500 and 1800° F., water quenching and then aging by heating to between 700 and 1000° F. for less than two hours.

The resulting alloy, after cold working, has a hardness between 75 to 90 Rockwell B and an electrical conductivity between 75 and 95% of that of pure copper. The tensile strength is around 80,000 lb. per square inch with about a 15% elongation.

For resistance welding electrodes where higher hardness is desired, the alloy should be age-hardened and cold worked and should have a composition preferably as follows:

| | Percent |
|---|---|
| Chromium | .75 |
| Beryllium | .10 |
| Silver | .05 |
| Silicon | .08 |
| Iron | .10 |
| Copper, balance | |

Depending upon the use for the alloy and the characteristics desired, the composition may be varied within the following range:

| | Percent |
|---|---|
| Chromium | .10 to 1.0 |
| Beryllium | .01 to 1.0 |
| Silver | .01 to 1.0 |
| Silicon | .01 to 1.0 |
| Iron | .01 to 1.0 |
| Copper, balance | |

The iron should be kept low as it has a tendency to decrease the electrical conductivity of the alloy. Its advantage lies in increased hardness. The silver, which does not adversely effect hardness, will compensate for the iron and tend to effect high conductivity in the alloy.

The alloy has high hardness up to temperatures as high as 500° C.

The silicon present makes it possible to save nearly all of the chromium addition so that for a given amount of chromium desired in the final alloy it is only necessary to add about .10% extra of chromium to compensate for the chromium loss through oxidation. Without the silicon it would be necessary to add double the amount of chromium required in the final alloy, the loss being about 50%.

The chromium should bear a definite relation to the other alloys. In general the quantity of chromium should range between from about seven to ten times the amount of each of the other additions in order to obtain the best results,

although a lower ratio is possible within the ranges specified.

The alloy may have various compositions and uses within the scope of the accompanying claim.

I claim:

An age-hardened cold-worked alloy suitable for resistance welding electrodes and consisting essentially of about .75% chromium, .10% beryllium, .05% silver, .08% silicon, .10% iron, and the balance essentially copper.

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