

1

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PROCESS FOR MAKING HARDENABLE COPPER ALLOY PRODUCTS

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1 Claim

ABSTRACT OF THE DISCLOSURE

A method of improving the properties of heat hardenable copper alloys by heating the alloy in its original cast form to its solution annealing temperature, working the heated alloy to a selected semi-finished cross section and immediately thereafter quenching the alloy in its worked form to thereby obtain a fine grain structure giving rise to improved mechanical and electrical properties.

BACKGROUND OF THE INVENTION

Copper alloys having a small zirconium content of the order of 0.1 to 5.0% have been heated to temperatures in the range of from 700 to 1000° C., at which temperature the alloy is solution annealed, the heated alloy then being quenched.

Also, it has been suggested that copper-zirconium alloys having a zirconium content of the order of 0.01 to 0.15% be quenched after solution annealing, followed by cold working to reduce the cross sectional area thereof. Such alloys are suitable as conducting elements such as commutator segments in electric motors where optimum mechanical strength of the material perpendicular to the direction of forming the material is important. However, for semi-finished materials such as rods, wires, etc., such a procedure is without advantage, since the ordinate of the perpendicular direction cannot be clearly defined.

Accordingly, an object of this invention is to provide an improved procedure for making semi-finished materials from hardenable copper alloys wherein the cast alloy in its heated condition is brought to its solution annealing temperature and at such temperature the alloy is worked to reduce the cross sectional area thereof to a desired form and immediately thereafter is quenched.

Another object of this invention is to provide a procedure of the character described wherein the heating of the alloy to effect solution of the alloying constituents is also used in the working of forming operation, to thereby reduce manufacturing costs and to improve the quality of the product as by producing a fine grain structure, rather than the coarse grain structure produced when hot pre-formed material is separately solution-annealed.

A further object of this invention is to provide a procedure of the character described wherein the immediate quenching of the hot material after it has been worked in the hot state, is effective to eliminate oxygen absorption along the surface of the metal. Such oxygen absorption leads to embrittlement of the skin surface when exposed to hydrogen at elevated temperatures, as in a brazing operation, unless the outer layer is later removed in a separate machining operation.

2

Still another object of this invention is to provide a procedure of the character described whereinafter the quenching step, to further treat the alloy product in successive heat hardening, cold-forming and additional heat hardening steps. Thus, with such procedures, one may achieve maximum electrical conductivity with maximum tensile strength and hardness.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

The process of the instant invention is useful for making roller electrodes used for electric resistance welding. An alloy for such purpose consists of 0.6% chromium with the balance copper. The rollers are made from cast billets or compressed rod material and are hot compressed when the material has been heated to its solution-annealing temperature. The resultant discs are quenched immediately after hot compression. The rollers show a constant fine grain structure across the entire cross-section of the material with grain sizes of 25–60 microns. The article also exhibits a substantial increase in hardness.

In the manufacture of semi-conductor systems and particularly in the case of base members for carrying the semi-conductors which must show good mechanical strength, good conductivity and non-porosity; it is advantageous to utilize a billet of a well known copper-zirconium alloy. Such billet is brought by inductive heating to its solution-annealing temperature and is then isothermally extruded to form rods which are immediately thereafter quenched in water.

Thus, the individual steps of solution-annealing and quenching are combined with the hot forming of the cast metal to obtain the desired properties. Such procedure avoids coarse grain structure and a reduction in quality.

Typical heat hardenable copper alloys which may be used with the process of the instant invention, include:

(1) a copper-chromium-zirconium alloy having a content of 0.6% chromium; 0.1% zirconium, with the balance copper. The solution annealing temperature is above 950° C.

(2) a copper-zirconium alloy having a content of 0.15% zirconium, balance copper. The solution annealing temperature is above 800° C.

(3) a copper-nickel-silicon alloy having a content of 1.3% nickel; 0.5% silicon, balance copper. The solution annealing temperature is above 750° C.

(4) a copper-cobalt-beryllium alloy having a content of 2.5% cobalt; 0.6% beryllium, balance copper. The solution annealing temperature is above 880° C.

It is understood that the essential steps of the process of the instant invention, as set forth above, may be followed successively by heat hardening, cold forming, and a second heat hardening step. Also, such steps may be followed by a cold hardening step.

I claim:

1. A method of converting a heat hardenable copper alloy to a semi-finished form, said alloy consisting of copper and a metal additive, said additive being zirconium in the amount of 0.1% to 5.0% by weight, comprising heating said alloy in its cast state to its solution-annealing temperature, immediately working the heated alloy to a predetermined semi-finished form of reduced cross sectional area, and immediately thereafter quenching the same.

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3,717,511

3

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4

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5

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