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METHOD FOR PREVENTING INTERGRANULAR OXIDATION IN TERNARY BERYLLIUM ALLOYS

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2 Claims. (Cl. 148—13.2)

This application is a continuation in part of my copending application Serial No. 221,976, filed July 29, 1938, now Patent 2,226,284.

The present invention relates to ternary alloys containing copper, beryllium and metal from the group cobalt and chromium but more particularly to a method for producing such alloys in the form of wire or strip. Alloys of this composition are disclosed in Dahl Patent 1,847,929 and in Horstkotte Patent 1,957,214 and heretofore have been employed to a considerable extent as forged material and castings and in the form of welding electrodes and current conducting bearings. In fabricating the alloys a heat treatment is employed to effect precipitation hardening. This treatment consists in heating the alloys to a temperature of about 900° C. to effect a solid solution condition in the alloy, quenching and thereafter reheating or drawing the alloy at 450° C. to 550° C. to effect a condition of precipitation in the alloy.

In heating these alloys at temperatures about 500° C. and above in air or any oxidizing atmosphere intergranular oxidation takes place beneath the normally oxidized or scaled surface. These alloys are extremely sensitive to oxidation along grain boundaries, even in standard bright annealing atmospheres. Such oxidation generally is not detrimental in castings, rod or plate stock since they usually are not subjected to permanent bending and when that is necessary they may be machined before bending to thereby remove the layer containing intergranular oxidation beneath the oxidized surface. The intergranular oxidation condition however is particularly undesirable when these alloys are in the form of strip or wire since the depth of material affected is a large percentage of the cross section area of the strip or wire. When such a condition exists in wire or strip forms of these alloys they crack severely when bent, thereby rendering the material useless for purposes such as springs and the like.

One of the objects of the present invention is to provide a process for preventing intergranular oxidation in strip or wire form of alloys which consist of copper, cobalt, beryllium, or copper, chromium, beryllium which contain percentages of ingredients such as set forth in the above-noted Dahl and Horstkotte patents.

In carrying out the present invention the wire and strip of these alloys are heated at an elevated temperature of about 900° C. and for a period of time sufficient to effect a solid solution condition in the alloys but the heating, contrary to the former practice, is carried out in a protective atmosphere free from oxygen, carbon dioxide and water vapor.

If more than a minute trace of oxygen, carbon dioxide or water vapor is present in the furnace atmosphere intergranular oxidation of the alloy wire or strip will take place. Any gaseous medium, for example: partly combusted city gas, cracked ammonia, hydrogen, nitrogen, argon, helium, etc., from which oxygen, carbon dioxide and water vapor have been removed, may be employed as the furnace atmosphere.

The alloy strip or wire is quenched from the solution temperature. For best physical properties the quenching medium must be one which will break up any vapor film which otherwise would form on the metal surface in the quenching operation. It may be a non-oxidizing oil but more satisfactory results are obtained by quenching in a 10% solution of sodium chloride, potassium chloride, sodium nitrate, potassium nitrate, sodium sulphate, potassium sulphate, potassium or sodium hydroxide. However, any solution may be employed which, in contact with the hot surface of the metal, will break up any vapor film which otherwise would form on the metal surface in the quenching operation.

When the wire or strip which has been heated in the protective atmosphere is quenched in non-oxidizing oil the freedom from intergranular oxidation is maintained. However, the physical properties of the alloy quenched in oil are inferior to the properties which are obtained when the wire or strip alloy is quenched in salt water or an equivalent solution. When the alloy wire or strip is quenched in ordinary standing water, in a quenching tank, sufficient intergranular oxidation results to damage the alloy irreparably in a commercial sense. However, if the alloy is quenched in a salt solution or equivalent cooling medium such as indicated hereinbefore, such solutions will break up any vapor film which otherwise would form on the surface of the hot metal and thereby prevent any intergranular oxidation during quenching.

After quenching from the solution temperature the wire or strip alloy may be precipitation hardened by reheating or drawing at the usual elevated temperatures but not materially higher than 500° C. and for the usual periods of time necessary to effect precipitation in such alloys. The reheat or draw preferably should be carried out in a protective atmosphere as indicated above, since 500° C. is the lower limit for temperatures which cause intergranular oxidation

when CO_2, O_2 and water vapor are present in the furnace atmosphere. If the draw or reheat is carried out in air and at temperatures below 500° C. the alloy strip or wire should be pickled thereafter to remove any scale formed during the draw or reheat. The alloys may be cooled from the reheat temperature in air or in gaseous atmospheres which ordinarily prevent scaling at 500° C. When the reheat or draw is carried out at temperatures below 500° C. any scale which may be formed during such draw is not accompanied by intergranular oxidation since the latter occurs only at temperatures at and above 500° C.

What I claim as new and desire to secure by Letters Patent of the United States, is:

1. The method of preventing intergranular oxidation in wire or strip form of ternary alloys consisting of copper, beryllium and metal from the group cobalt and chromium which comprises heating said wire or strip to an elevated temperature in an atmosphere free from oxygen, water vapor and carbon dioxide to thereby effect a solid solution condition in the alloy, and quenching said strip or wire from said temperature in a solution of sodium hydroxide.

2. The method of preventing intergranular oxidation in wire or strip form of ternary alloys consisting of copper, beryllium and metal from the group cobalt and chromium which comprises heating said alloys to an elevated temperature in a gaseous atmosphere free from oxygen, water vapor, and carbon dioxide to thereby effect a solid solution condition in the alloy, quenching said wire or strip from said temperature in a solution of sodium hydroxide which in contact with the hot metal breaks up any vapor film which otherwise would form on the hot surface of said wire or strip, and thereafter reheating said wire or strip at an elevated temperature to thereby effect a condition of precipitation in said alloy wire or strip.

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