Patented Feb. 19, 1935

1,992,118

UNITED STATES PATENT OFFICE

1,992,118

MANUFACTURE OF ALLOYS CONTAINING COPPER AND ZINC

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No Drawing. Application March 24, 1933, Serial No. 662,640. In Great Britain March 24, 1932

4 Claims. (Cl. 148—21.2)

This invention relates to the manufacture of alloys containing copper as the primary component and zinc as a subsidiary component.

The object of the invention is to alloy these copper-zinc alloys with other metals to obtain a material having properties which permit of its use for any purpose for which copper-zinc alloy is used at the present time and which in addition is, by suitable heat treatment, modified such that its hardness and strength are increased far in excess of present known copper-zinc alloys or modifications thereof.

This improvement in the properties of the material is brought about by heating the alloy to pre-determined high temperatures, cooling at a suitable rate and subsequently heating to predetermined lower temperatures and is known in a number of alloys, such as duralumin and copper-nickel-aluminium alloys, and is generally attributed to the presence of constituents which go into solution at high temperatures, which are kept in solution by rapid cooling, and which are precipitated from solution on reheating to a suitable temperature.

We have found that the alpha copper-zinc alloys containing up to 37 per cent. of zinc are capable of being hardened and strengthened by heat treatment if suitable proportions of nickel together with aluminium are added. The proportion of nickel must be at least 2 per cent. and the proportion of aluminium at least 0.5 per cent. and preferably 1–3 per cent. The nickel content is preferably at least three times the aluminium content.

The essence of our invention resides in the correct proportioning of the nickel and aluminium contents of copper-zinc alloys and the heat treatment to which such alloys are subjected. The addition of nickel and aluminium to copper-zinc alloys for the purpose of producing alloys capable of being hardened by heat treatment in accordance with our invention, leads to alloys of the nickel silver type.

As an example of carrying our invention into effect we make an alloy containing 72% copper, 21% zinc, 5.2% nickel, and 1.8% aluminium, which may be considered to be an alpha brass in which some of the zinc content has been substituted by nickel and aluminium. If this alloy having in the work hardened condition a diamond pyramid hardness of 210 is heated to a temperature of 900° C. it will be found that its hardness is considerably influenced by the rate of cooling to room temperature. When quenched in water its hardness is reduced to about 80, if rapidly cooled in air to about 90, and if very slowly cooled in a furnace its hardness will be about 120. Now if this alloy is reheated for a period of about two hours at a temperature below 300° C., the hardness factor will only be changed slightly, but if the temperature is further increased the alloy commences to harden. For instance, a hardness of about 180 is obtained on reheating a water quenched alloy to a temperature of 500° C. If the temperature is raised substantially more than 500° C. the alloy is softened by the annealing that takes place.

A further increase of hardness and strength can be obtained if the soft water quenched alloy is hardened by cold work and afterwards reheated for a prolonged period at a temperature below the softening temperature. As an example of this change we increase the hardness of the aforementioned water quenched alloy from 80 to 212 by cold working such as rolling, and we further increase the hardness to 258 by reheating for twenty hours at 300° C.

The following examples of some typical alloys amenable to hardening by heat treatment will serve to illustrate the scope of our invention. Table 1 gives the compositions of five different alloys and Table 2 gives the corresponding hardness figures at various stages of the manufacture.

Table 1

[Composition in percent by weight]

Alloy	Cu	Zn	Ni	Al
No. 1	72	21	5.2	1.8
No. 2	66	22	10	2
No. 3	60	18	20	2
No. 4	78	10	9	3
No. 5	80	10	8	2

Table 2

[Diamond pyramid hardness]

Alloy	After quenching the cold worked alloy from 900° C.	Heat treatment after quenching	Cold worked after quenching	Heat treatment after cold working
No. 1	82	177 (500° C.)	212	258 (300° C.)
No. 2	62	195 (550° C.)	227	290 (300° C.)
No. 3	82	150 (600° C.)	209	252 (500° C.)
No. 4	68	193 (550° C.)	197	250 (550° C.)
No. 5	72	193 (550° C.)	178	266 (550° C.)

The temperatures in Table 2 are only given as illustrative of the effects of heat treatment and

are not necessarily those which must be used for obtaining the hardening phenomena, for the time of heating is also of considerable importance and lower temperatures for longer times may in certain cases be employed with advantage. Further, the heat treatment conditions necessary for obtaining the maximum hardening effects will be different for different alloys.

We claim:

1. A manufacture of hard copper-zinc alloys which comprises subjecting an alloy containing 10 to 37 per cent of zinc, 3–12 per cent. of nickel and 1–3 per cent of aluminum, the balance of the allow consisting of copper and the nickel content being about 3–4 times the aluminum content, to heat treatment involving heating the alloy to a temperature of the order of 900° C. followed by rapid cooling and reheating to a temperature of about 300–600° C.

2. A manufacture as set forth in claim 1, in which the alloy, after the rapid cooling from the temperature of the order of 900° C. is subjected to cold working prior to reheating.

3. A manufacture of hard copper zinc alloys which comprises subjecting an alloy containing 10–37 per cent. of zinc, 2–20 per cent. of nickel and 0.5–3 per cent. of aluminium, the balance of the alloy consisting of copper and the nickel content being at least three times the aluminium content, to heat treatment involving heating the alloy to a temperature of the order of 900° C. followed by rapid cooling and reheating to a temperature of about 300–600° C.

4. A manufacture as set forth in claim 3, in which the alloy, after the rapid cooling from the temperature of the order of 900° C., is subjected to cold working prior to reheating.

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