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UNITED STATES PATENT OFFICE

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ALLOY

No Drawing. Application filed June 12, 1931. Serial No. 544,037.

My invention relates to improvements in alloys of the kind disclosed in my United States Patent No. 1,442,742, issued to me January 16, 1923. The present application is a continuation in part of my pending application Serial No. 450,593, filed May 7, 1930.

The present invention has among its objects the provision of a homogeneous, malleable and ductile, acid-resistant alloy which may be readily and economically attenuated by a mill process of drawing or rolling.

The alloy according to the present invention consists essentially of copper and nickel with other materials, preferably tin and lead, to impart the desired chemical and physical properties. As a typical alloy according to the invention the same may consist of by weight about 70% copper, 28% nickel, 1.5% tin, and 0.5% lead.

In the practice of the invention the tin and lead may be first alloyed in the proportions mentioned, and this intermediate alloy then alloyed with copper and nickel, say by use of a suitable electric furnace or placing the substances in a graphite crucible lined with refractory clay and bringing them to the melting point of the most refractory metal. Preferably, the crucible will be first raised to a white heat and the metals then be placed therein in the order of their specific gravities, that is to say, the tin-lead intermediate alloy in the bottom of the crucible and the copper and nickel above it in the order named, after which the contents of the crucible may be brought to about 2650° F., causing the substances to melt and alloy. Conveniently, in making the alloy about 0.5% of manganese may be added, say in the form of a 30% manganese copper alloy to serve as an anti-oxidant, which manganese will be substantially entirely dissipated during the alloying operation.

Preferably, the alloy is free from carbon if it is intended that the alloy shall be worked. Carbon is not particularly objectionable when the alloy is to be employed merely for castings, but when it is to be worked best results will be secured when the carbon content is below 0.08% of the alloy. Conveniently, the melt may be superheated by raising its temperature to burn out the carbon, say, for example, when the constituents are melted in a crucible as above described, by increasing the draft to raise the temperature of the melt to say about 3000° F. and maintaining it at that temperature for one or two minutes before pouring. The presence of certain other metals and metaloids such as, for example, phosphorous, is to be avoided if best results are to be secured. Phosphorous, for example, will render the alloy unhomogeneous after annealing, and will destroy materially its acid resisting properties.

Preferably, the ingot is cast in a so-called "snap" mold, that is to say, a mold which has all corners rounded and is split, for example, along a plane which includes its axis, so as to prevent the effects of cooling the liquid metal at sharp corners, which latter would act to cause a non-uniform structure of the ingot resulting in checks in the sheets, wires, tubes, or the like formed therefrom. Preferably the metal is poured from the crucible into the mold at a slightly lower temperature than the alloying temperature, for example, it may be poured at about 2350° F., which lower temperature may be secured by pouring the metal in a thin stream into the mold.

I have found that ingots prepared as above may be cold rolled or drawn by the usual mill processes without annealing between the successive drawing or rolling operations. Preferably in attenuating the ingot it is first reduced a material amount, say at least 30%. and then rolled or drawn by successive steps to the desired thickness. The resulting product is soft and ductile. For example. following the above practice I have reduced ingots 1.5 inches thick to form plates 0.046 inches thick without annealing. This product may be readily annealed, say by heating it to about 1500° F. and permitting it to cool at room temperature, to produce a product which has a hardness of only about B 32 Rockwell, that is to say, a metal about as soft as tin.

I have found that the alloy, the tubes, plates, wires, and the like formed of the alloy, above described may be worked either cold or hot, and can be readily welded, the alloy also having the desired property that it may be hardened by heating it and then allowing it to cool, as for example, the material above described may be raised from about B 32 Rockwell to about B 90 Rockwell by heating it to 1500° F. and allowing it to cool slowly, say by packing it in line. The temperature to which the material is heated is however somewhat critical, and conveniently may be any temperature from 1300° F. to 1350° F.

The property of the alloy just mentioned makes it particularly useful for fabricating plates for supporting false teeth. For example, a sheet of the soft alloy may be readily pressed to conform with the hardened cast impressions of the mouth so as to form the plate for supporting the false teeth. This plate, then, according to the common practice in dentistry, will be coated with rubber compound which may be raised to the vulcanizing temperature of say 1380° F. and slowly allowed to cool, and at the end of the cooling operation the plates, for example, will have a hardness of about B 90 Rockwell, which in common parlance is "glass hard."

As explaining some of the properties imparted to the metal, applicant has found that when the alloy is prepared as above described the lead is not in solution in the basic alloy of copper, nickel and tin. This, it is believed, acts to render the alloy readily workable, the lead in effect serving as a lubricant between the particles of the basic alloy.

As explaining the acid resisting property of the alloy, it is known that in the electromotive series of elements the four essential metals entering into the alloy have potential values as follows:

Cu+42
Ni−20
Sn−10
Pb−12

The relation of these potential values is such that the copper balances the remaining constituents, producing in effect what would be zero valence in an element rendering it acid resistant.

Applicant has found, however, that the above result will not be secured, or a homogeneous alloy produced, with the lead not in solution, unless there are present at least about 0.5% tin, at least about 0.04% lead, and at least about 2.5% nickel, and unless the amount of lead present is more than 1/12 the amount of tin. Applicant has also found, that with the nickel content of the alloy between 17 and 35%, if the tin content does not exceed about 2% and the lead content does not exceed about 1.5%, the alloy, when the balance is substantially all copper, will be malleable and ductile, can be cold rolled or drawn by usual mill processes without annealing between the rolling or drawing steps, is age hardening, and will not exhibit so-called "crocking," that is to say, soil articles in contact with it, provided in each given case the lead content does not exceed the tin content. It will therefore be observed, that with the range of copper and nickel defined, to secure all the desired properties of the improved alloy the range of tin is about 0.5 to 2%, the range of lead about 0.04 to 1.5%, and the range of the ratio of tin to lead about 12:1 to 1:1.

If desired, small percentages of materials other than those above mentioned may be incorporated into the alloy for imparting desired special characteristics without altering the characteristic properties of the alloy.

Claims:

1. Alloys containing by weight approximately from 17 to 35% nickel, 0.5 to 2% tin, 0.04 to 1.5% lead, with the balance approximately all copper, the amount of lead in each particular instance not exceeding the amount of tin.

2. Alloys containing by weight approximately from 17 to 35% nickel, 0.5 to 2% tin, 0.04 to 1.5% lead, with the balance approximately all copper, the amount of lead in each particular instance being at least 1/12 the amount of tin.

3. Alloys containing by weight approximately from 17 to 35% nickel, 0.5 to 2% tin, 0.04 to 1.5% lead, with the balance approximately all copper, the amount of lead in each particular instance being at least 1/12 the amount of tin but not exceeding the amount of tin.

4. An alloy containing by weight approximately 70% copper, 28% nickel, 1½% tin, and ½% lead.

In testimony whereof, I have signed my name to this specification.

JOSEPH C. R. STONE.

CERTIFICATE OF CORRECTION.

Patent No. 1,851,218. Granted March 29, 1932, to

JOSEPH C. R. STONE.

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows: Page 2, line 7, for the word "line" read lime; and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 3rd day of May, A. D. 1932.

M. J. Moore,
Acting Commissioner of Patents.

(Seal)