Patented Apr. 12, 1949

2,466,700

UNITED STATES PATENT OFFICE

2,466,700

COPPER BASE ALLOY

Vladimir A. Grodsky, Washington, D. C.

No Drawing. Application December 4, 1944, Serial No. 566,630

1 Claim. (Cl. 75—159)

(Granted under the act of March 3, 1883, as amended April 30, 1928; 370 O. G. 757)

1

This invention relates to copper base alloys and has particular relation to alloys which are adopted for use as a casting metal, as a bearing metal or as a welding metal.

A principal object of the invention is to provide a new and improved copper base alloy which has good casting properties and has among other advantageous characteristics a high resistance to corrosion, a low porosity and a corresponding high density.

Another object of the invention is to provide a copper base alloy which is adapted for use as a high pressure casting alloy, bearing alloy and welding alloy.

A further object of the invention is to provide a copper base alloy which may be cast and may be welded either electrically or by a gas weld with a welding rod composed of the same alloy as the casting.

A still further object is to provide a copper base alloy having improved physical properties as a cast metal such as good machineability, high resistance to shock, low melting temperature, low casting temperature and short melting time.

Another object of the invention is to provide a copper base alloy which has improved physical properties for welding purposes such as smooth, free flow during welding, the ability to be electrically welded as well as gas welded, and the ability to weld satisfactorily with a minimum number of fillets required for the weldment thereby eliminating the need for chipping and rewelding.

Still another object is to provide a copper base alloy which is economical to manufacture, due in part to the large percentage of lead contained therein and the absence of any appreciable amount of tin, or tin and zinc.

Still another object is to provide a copper base alloy containing no appreciable percentage of tin, which is suitable for use as a bearing bronze casting and the physical properties of which generally conform to high grade bearing bronze such as specified in Navy Department Specification 46B22e, issued February 1, 1944.

These and other objects of the invention will be better understood from the following description.

The majority of copper base alloys form solid solutions in which the amount of components is close to the saturation point, and the copper base alloys of the present invention belong to this group. Present bronze alloys comprise essentially a copper base and tin, or tin and zinc. Phosphorus has heretofore been used in a small

2

amount in the preparation of bronze alloys as a deoxidizing agent, with a negligible trace thereof remaining in the final alloy product. The alloy of the present invention is distinguished from prior copper base alloys in one respect in that it contains a substantial phosphorus content in the final alloy product. Contrary to all expectations, it has been found that a strong copper-lead bronze alloy, which is well suited for high pressure castings and bearings, can be produced by the inclusion of phosphorus in a proportion which makes it a substantial constituent of the final alloy.

In accordance with the present invention, the desirable physical properties of known copper base alloys are markedly improved by preparing a final product alloy containing approximately 5 to 20% lead, 2½ to 10% phosphorus, 0.5% to 3% of a lead dispersing agent such as nickel and the balance copper, the amount of impurities present being insufficient to alter the essential properties of the alloy. Within the above ranges it has been found that for general purposes among the optimum proportions are approximately 8 to 12% lead, 3 to 4% phosphorus, 0.75% to 1.5% lead dispersing agent and the remainder copper.

Small amounts of other components, such as modifiers, may be added to mixes of the above basic components taken as 100% in order to improve particular properties of the present alloy. Thus, the inclusion of from 0.2% to 0.5% antimony refines the structure, affords a smaller and more uniform grain and also increases the tensile strength and ductility of the present alloy. Antimony also acts as a lead disperser and when used as such, in place of nickel or other disperser, its total amount should preferably not be substantially in excess of 3% in order to avoid brittleness. The addition of up to 0.03% lithium acts as an excellent scavenging agent inasmuch as lithium has a high affinity for practically all elements which occur as non-metallic impurities. A small amount of tellurium, up to 0.1%, serves to harden the lead component of the alloy and increases the tensile strength and elongation of the alloy. Tin or zinc, or both, may be encountered when, for example, scrap is used but the presence of small amounts of these metals is not objectionable. Modifiers such as calcium, titanium, indium, etc. may also be added in small amounts.

In producing the new alloy, the phosphorus content may be conveniently introduced as a part of a conventional phosphor-copper alloy which

is a commercially available product usually comprising from about 10% to 15% phosphorus and 85% to 90% copper. The copper, disperser and part (for example 75%), of the above-mentioned phosphor-copper alloy are melted in a crucible at high furnace temperature such as 3000° F. When the charge is melted, the rest of the phosphor-copper alloy is added, thereby resulting in the removal of oxides which may have been formed. When the temperature reaches about 1800° F., the lead is added and the whole melt is stirred to obtain an intimate intermixture. Melting is preferably accomplished as quickly as possible in an oxidizing atmosphere to prevent the absorption of gases. The molten charge, after skimming, is poured into molds or injected as soon as it reaches the required pouring temperature, or, as is preferred, the molten charge is cast into stock pigs which are remelted for use. If desired, the phosphorus may be introduced into the molten copper, together with the disperser, and the lead may be added to the molten mass.

The following are examples of copper base alloys made in accordance with the present invention.

EXAMPLE 1

Components:	Percent
Lead	9.30
Phosphorus	3.27
Nickel	0.98
Copper	86.43

Incidental components

Impurities:	
Tin	0.01
Iron	0.01

The above alloy was cast into a number of test ingots which exhibited the following average physical properties: tensile strength, 38,000 p. s. i.; yield strength (.01 inch extension in 2 inches under load, 15,000 p. s. i.; elongation in 2 inches, 9.2%; reduction in area, 8.1%; modulus of elasticity (tension), approximately 10,000,000 p. s. i.

The above alloy was also cast in the form of optical instrument bodies, i. e., rangefinder tubes and gun turret telescopes which were successfully subjected to a 2000 lb. shock test. This shock test consisted in applying three horizontal and three vertical strokes of 2000 lbs. each to the casting.

The same cast alloy was also subjected to a synthetic sea water spray test for 70 hours in the form of discs 1.5 in. diameter, ⅛ in. thickness and having a total area of 4.2 in.^{2}. Steel discs of similar dimensions, included for purposes of comparison, were snugly sandwiched on both sides of the alloy discs. The alloy discs made in accordance with the present invention exhibited a corrosion loss of 1.6 mgr./in.^{2} as compared to a corrosion loss of 7.0 mgr./in.^{2} for the steel discs.

EXAMPLE 2

Components:	Percent
Lead	8.65
Phosphorus	3.15
Nickel	1.12
Copper	Balance

The above alloy was cast in the form of bearing bronze castings which were tested for their physical properties in accordance with Navy Department Specification 46B22e issued Feb. 1, 1944, and the bearing castings were found to meet the specification with respect to all physical requirements.

EXAMPLE 3

Components:	Percent
Lead	14.95
Phosphorus	5.95
Nickel	1.0
Copper	78.1

The above alloy was formed into standard electric welding rods of $\frac{3}{16}$ inch diameter which exhibited a Rockwell B hardness of 80 before welding and 34 after welding. The weldment had a tensile strength of 39,000 lbs./in.^{2} and an elongation between 0.5 and 1.0%.

The welding rods were exposed to a synthetic sea water corrosion test for three months after which they exhibited a loss in weight of only 0.376%.

For use as a welding rod it has been found preferable to keep the phosphorus content at not less than 5%. Thus, a welding rod alloy which has been found advantageous is constituted substantially of approximately 6 to 12% lead, 5 to 7% phosphorus, 1 to 2% disperser (preferably nickel), and the remainder copper, the amount of impurities and modifying agents present being insufficient to alter the essential properties of the alloy.

The alloys of the present invention have a low melting point, around 1400° F., thereby resulting in a saving of fuel and melting time and minimizing the opportunity for the absorption of injurious gases. Another advantageous feature is the low pouring temperature of the present alloys, which is in the neighborhood of 1700° to 1800° F.

The invention herein described may be manufactured and used by or for the Government of the United States of America for governmental purposes without the payment of any royalties thereon or therefor.

I claim:

A copper base alloy consisting of essentially 8 to 12% lead, 3 to 4% phosphorus, 0.75 to 1.5% nickel as a dispersing agent for the lead and the balance copper, except for minute proportions of impurities.

VLADIMIR A. GRODSKY.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
217,946	Jackson	July 29, 1879
646,118	Clamer	Mar. 26, 1900
646,119	Clamer	Mar. 27, 1900
1,286,921	Berry	Dec. 10, 1918
1,652,107	Eschholz	Dec. 6, 1927
2,018,417	Peyinghaus	Oct. 22, 1935
2,040,055	Lytle	May 5, 1936
2,079,481	Bennett	May 4, 1937
2,229,117	Ness	Jan. 21, 1941

FOREIGN PATENTS

Number	Country	Date
5,218	Great Britain	Dec. 13, 1880

OTHER REFERENCES

Metals and Alloys, Dec. 1942, page 1074.