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UNITED STATES PATENT OFFICE

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METHOD OF DECREASING SHRINKAGE IN ALUMINUM BRONZE CASTINGS

No Drawing. Application filed November 3, 1928, Serial No. 317,114, and in Germany December 3, 1927.

This invention relates to alloys and has for its object the provision of a new metallic composition which shall combine in itself the ready casting properties of red brass, together with a less expensive composition and a substantially increased mechanical strength and corrosion resistance. My discoveries envisage both the composition of matter and the method of incorporating the ingredients together.

My improvements relate to alloys which contain copper as a chief constituent and especially copper and aluminum alloyed together. A binary alloy of these metals under the name of aluminum bronze has been known for a great many years, but has exhibited the defect of a substantial casting difficulty, due in large part to excessive shrinkage which has produced flaws and unexpected failures so that the material was untrustworthy. From one point of view my invention can be considered as a method of decreasing shrinkage in such aluminum bronze castings whereby such alloys are rendered commercially valuable. I have discovered that such a copper-aluminum alloy exhibits especially valuable properties when silicon and iron in proper quantities are both incorporated therein, producing a quaternary alloy. The quantity of these components can be varied within certain limits according to the desired character of the alloy. The following table illustrates the best proportions:

Ingredient	Limits	Preferable range
Copper	87 -93 %	88 -92 %
Aluminum	3 - 9 %	6 - 7 %
Silicon	1½- 2½%	1½- 2½%
Iron	1 - 3 %	1½- 2 %

In addition to the above substances manganese in small amounts is desirable although it should generally be employed to an amount not above about 0.2 of 1% of the alloy, for example from .05 to .10%.

The alloy of my invention can for example satisfactorily exhibit the following composition:

	Per cent
Copper	90.1
Aluminum	6.14
Silicon	1.76
Iron	1.64
Manganese	0.05

The iron can be employed in any available granular or powdered form or in the form of some cheap, iron-containing, by-product. I prefer to use an iron powder made from common cast-iron borings. As an iron-containing alloy one can employ ferro-silicon or ferro-manganese, and thereby obtain at the same time the advantage of these other valuable constituents, namely: silicon or manganese, in the alloy. Other iron alloys such for example as ferro-titanium, ferro-boron, ferro-silicon-zirconium, and the like can be employed in case the peculiar effects due to these other alloying constituents are desired.

In the preparation of this alloy I prefer first to melt the copper, then to add the necessary quantity of silicon thereto, and afterwards the aluminum, either in the metal form or in the form of some specific alloy such as aluminum-silicon, copper-aluminum or the like. Last of all the iron is added either in the form of iron-powder or pulverized iron alloy as heretofore described. I have found it to be important that the iron or the iron-containing alloy should be added only at the end, that is to say after the addition of the other substances, especially after the addition of the aluminum.

I have further found it of special advantage to the introduction of the iron into the alloy to accomplish the same with the assistance of certain decomposable fluxing constituents of a type to become dissociated under the conditions of the operation with the production of an alkali metal and an evolved gaseous substance. A simple example of this is sodium fluoride, which is stirred into the

molten alloy at the time the iron powder is added thereto. An even better incorporation is obtained by the use of certain double fluorides, such as sodium-silica-fluoride or sodium-aluminum-fluoride in company with aluminum powder which gives rise to the decomposition of the double fluoride throughout the mass as described in my Patents Nos. 1,464,625, 1,518,872, and 1,562,654 and the resulting sodium fluoride becomes still further broken up as described in my patents. The resulting action exhibits the two-fold advantage of favoring on the one hand to a considerable degree the alloying of the iron with the other constituents of the melt which is itself a difficult thing to accomplish and also of producing evolved substances throughout the mass of alloy which affect a peculiarly efficacious fluxing action by combining with the aluminum oxide and other non-metallic impurities. The amount of such fluxing constituents to be used can vary widely according to the conditions encountered. In any given case good results are obtained from the employment of relatively small quantities, while the use of a total of several percent of the weight of the alloy exhibits no disadvantage.

As an example, I take 100 parts of iron with 25 to 50 parts of sodium-silico-fluoride intimately mixed with a smaller proportion of aluminum powder, for example 5 to 10 parts.

This mixture may be incorporated with the iron which is to be introduced into the copper-aluminum-silicon-alloy and the whole stirred into the molten mass at one time or the iron constituent can be added separately and the fluoride-aluminum mixture either before or after.

Besides the previously mentioned alloying constituents it is possible in any given case to add still other metallic modifying substances to the alloy and thereby change the character of the alloy in any desired manner.

The alloys produced according to my invention are very fine grained, and exhibit extraordinary strength, ductility, heat resistance, and resistance to corroding influences of various sorts especially against chemical corrosion. The alloy exhibits peculiarly advantageous casting properties, being easy to melt, showing little tendency towards segregation of the constituents, flows readily at low temperatures, copies the mold faithfully, and exhibits a very small degree of shrinkage, thereby enabling the production of successful castings whose different parts vary substantially in thickness. The castings can be worked according to any of the usual procedures, both hot and cold, as by forging, pressing, drawing, turning, cold-rolling and the like. By the use of proper heat-treatment and crystal-control-methods the characteristics of the alloy can be changed as regards its ductility, tensile strength, and rigidity.

It is a particular advantage of my invention that I produce an alloy equal in casting qualities to the best red brass, without the employment of any expensive ingredients such as tin, or any weakening ingredients such as lead, and this by the employment of such cheap and readily available materials as cast iron, and at the same time produce a product which is improved in its qualities of strength, ductility, and corrosion resistance.

Having thus described my invention what I claim is:

1. Method of preparing an alloy containing copper 87% to 93%, aluminum 3% to 9%, silicon 1½% to 2½% and iron 1% to 3% characterized by first melting together the copper, aluminum and silicon, and finally adding the iron after the copper and aluminum have become melted together.

2. Method of preparing an alloy containing copper above 80%, aluminum above 6%, and between 1.5 and 2% of iron together with small amounts of one or more of the substances silicon, manganese, titanium, boron, zirconium, characterized by the incorporation of iron in the form of such an alloy that some of the components other than aluminum or copper shall be introduced thereby.

3. Method of preparing an alloy containing above 80% of copper together with a small amount of aluminum but greater than 6%, and a still smaller amount of iron but greater than 1%, characterized by the addition of the iron after the aluminum.

4. The method of preparing an alloy containing copper 87% to 93%, aluminum 3% to 9%, and iron 1% to 3% which contains the steps of first preparing an alloy of copper and aluminum and afterward adding iron thereto.

5. The method of preparing an alloy containing copper 87% to 93%, aluminum 3% to 9%, and iron 1% to 3% which contains the steps of adding the iron to the other molten metals only after the aluminum has been incorporated therewith and incorporating such iron in company with a fluxing material containing fluorine and an alkali metal.

6. Method of preparing an alloy containing copper 87% to 93%, aluminum 3% to 9%, silicon 1½ to 2% and iron 1% to 3% characterized by first melting together the copper and aluminum and finally adding the iron in the form of an alloy with silicon.

7. Method of preparing an alloy containing copper 87% to 93%, aluminum 3% to 9%, silicon 1½% to 2½% and iron 1% to 3% and manganese which contains the steps of first melting together the copper and aluminum, and finally adding the iron in the form of such an alloy that some of the other ingredients such as silicon or manganese shall be introduced thereby.

In testimony whereof I hereunto affix my signature.

ALADAR PACZ.

CERTIFICATE OF CORRECTION.

Patent No. 1,838,632. Granted December 29, 1931, to

ALADAR PACZ.

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows: Page 2, line 115, claim 6, for "2%" read 2½%; 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 16th day of February, A. D. 1932.

M. J. Moore,
Acting Commissioner of Patents.

(Seal)