

UNITED STATES PATENT OFFICE

ARTHUR FRITSCHLE, OF ST. LOUIS, MISSOURI, ASSIGNOR TO OWENS-ILLINOIS GLASS COMPANY, A CORPORATION OF OHIO

METAL ALLOY

No Drawing.

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My invention relates to metal alloys and particularly to an alloy in which the major ingredients are copper, nickel, zinc, and aluminum, and which also contains minor quantities of other metals, as iron, lead, manganese, and silicon.

An object of the invention is to provide an improved metal alloy having a high resistance to corrosion and having great tensile strength without the excessive hardness which is characteristic generally of this and similar types of alloys. Such excessive hardness is objectionable, particularly as it makes it difficult to machine castings made therefrom.

A further object of the invention is to provide a highly refined alloy of the character indicated in the form of ingots for delivery to brass foundries where, under approved foundry practice, they can be remelted to produce castings of great density and the utmost freedom from porosity caused by air and gas holes. The present invention deals with the production of such alloy and not with the remelting and recasting of the ingots in the manufacture of the final products of such alloy.

A further important aim of the invention is to provide a thoroughly homogeneous alloy rather than a raw mechanical mixture consisting of numerous elements held in suspension.

A further feature of the invention relates to a novel method of manufacturing the alloy in a manner to reduce oxidation to a minimum, particularly as regards the more volatile ingredients which constitute a part of the final alloy. In accordance with this method, a plurality of preliminary alloys are first produced independently of each other, permitting the more volatile elements to be melted and united at comparatively low temperatures, thus reducing oxidation. The several preliminary alloys are then combined and melted together to form the final alloy which is cast into ingots. The ingots are designed for remelting and making castings adapted to be machined for producing various objects in their final form, as, for example,

molds and plungers of glass forming machines and numerous other articles.

Other objects of the invention will appear hereinafter.

The following formula of an alloy made in accordance with my invention, containing the following, or approximately the following, percentages by weight of the several elements, has been found to give very satisfactory results, namely:

	Percent
Copper	60.25
Nickel	19.25
Zinc	10.00
Aluminum	8.65
Iron	.75
Lead	.75
Manganese	.25
Silicon	.10

It is to be understood, however, that variations in the percentages of the several ingredients is permissible within certain limits. I have found that variations are permissible between the following approximate maximum and minimum percentages by weight, namely:

	Per cent
Copper	58.50 to 63.50
Nickel	17.50 to 21.50
Zinc	8.00 to 11.00
Aluminum	7.00 to 9.50
Iron	0.50 to 0.75
Lead	0.50 to 1.00
Manganese	0.15 to 0.25
Silicon	0.03 to 0.10

The above formulæ do not represent the exact percentages of all the elements entering into the final products made from the alloy because allowance is made in the ingots to cover the normal melting loss of aluminum and zinc due to volatilization in remelting the ingots under average good foundry manipulation and melting control. Certain amounts of zinc and aluminum are invariably volatilized in the operation of remelting the ingot in the brass foundry. Accordingly, the nickel and copper ingredients in the remelted metal which actually goes into the sand molds, are correspondingly raised in

about the proportion of their percentages given in the above formulæ.

In accordance with the present invention, the method of manufacturing the alloy comprises making three separate alloys, each containing certain of the elements entering into the final product, then melting the three alloys together to produce the complete alloy, and casting the latter into ingots. The alloy thus produced may be rightfully termed a genuinely homogeneous alloy of the several elements in the proportions above indicated, and not a raw mechanical mixture such as would result if the various ingredients were combined in a conventional manner.

First Alloy.—As it requires considerably more heat to liquefy nickel than any other major element entering the alloy, I first melt together in a special furnace and alloy high grade refined nickel with an equivalent amount of pure electrolytic copper and a very small percentage of silicon for deoxidizing and promoting fluidity. In this manner, I am able to thoroughly and completely fuse the nickel and the copper without encountering the influence of the oxidation of the more volatile ingredients which constitute a part of the final alloy, particularly aluminum and zinc. The alloy of copper and nickel is then run into slabs and solidified for subsequent use in making the final alloy, as hereinafter explained.

Second Alloy.—In like manner, I alloy ferromanganese with electrolytic copper in a special furnace and produce a cuprous-manganese containing substantially 25% of manganese. This also usually carries about 1% of iron, but as only about 1% of the cuprous-manganese alloy is required in the final ingot alloy, it will be observed that the amount of iron obtained from the cuprous-manganese is practically negligible.

Third Alloy.—A third alloy is prepared which contains copper, aluminum, zinc, and preferably a small amount of lead. The copper, aluminum, and zinc are melted together. The lead is added to the molten bath of this particular alloy after the bath is thoroughly liquid, so that the lead will be more readily absorbed. Silicon is used for deoxidizing this alloy. The purpose of separately preparing this third alloy is to raise the melting point thereof as compared with the melting or fusing point of the individual ingredients, aluminum, zinc, and lead, and thus more nearly approach the melting point of the copper-nickel alloy (which latter obviously is to constitute the basic metallic bath for the final amalgamation of all the component parts of the alloy). Also, in the production of this third alloy, volatilization and the resulting excessive oxidation of the volatile ingredients are greatly reduced because the individual volatile elements are not exposed separately in the raw state to the high temperatures. In

the raw or unamalgamated state, they are much more susceptible to volatilization and oxidation.

Combining the three alloys. The final complete alloy is produced by amalgamating the three alloys above described. The two primary alloys, namely, the copper-nickel alloy and the copper-aluminum-zinc-lead alloy are remelted in the proper proportions and when the metal bath thus produced has become thoroughly liquid, the cuprous-manganese alloy is added for the purpose of deoxidation. The manganese thus introduced also adds material strength and malleability to the finished product.

Through the preliminary operations of first producing copper-nickel and copper-manganese alloys, the fusing points of the more refractory metals are greatly reduced. This is highly desirable because it permits the introduction of the more volatile elements at a comparatively low temperature which results in greatly reduced oxidation and also reduces the possible ill effects resulting from the distribution of oxide particles thus produced.

As a final stage of super-refinement in reducing the dissolved gases which may possibly exist, and to reduce the oxides to the lowest possible degree, I introduce a quantity of boronic copper alloy.

As a means of protecting the molten bath from absorption of furnace gases and also from oxidation during the entire process of fusing the alloys in the final melting operations, I use a liquid slag covering for the bath, consisting of substantially 50% silica sand and 50% lime, which fuses well in advance of any portion of the metal charge. Upon completion of the final alloy in the manner above described, the molten metal is drawn from the furnace and cast in molds, producing ingots of a convenient size for delivery to the foundry where they are recast in the manufacture of the final products.

The ingots are chill cast and are dumped into water immediately upon solidification of the metal. This insures rapid cooling which in itself prevents separation or segregation of the individual elements which otherwise might occur during the process of solidification of the alloyed metal after pouring into the ingot or pig molds.

It will be seen that the method above described is in reality a "duplex smelting" method, by means of which an alloy is obtained which is converted into an improved finished product, namely, the finished castings made from the ingots of said alloy, as above pointed out.

Although the iron, lead and manganese comprise only small percentages of the alloy as given in the above formulæ, they are not without importance.

The iron is obtained principally from the

nickel and aluminum, so that in one sense it is incidental, but I find it is beneficial to the particular type of alloy forming the subject of the present invention, so that in selecting the raw materials the iron content is considered the same as any of the other ingredients.

The lead is found to be of value particularly as it materially improves the machining qualities of the alloy without sacrificing tensile strength. It reduces to a moderate extent the hardness of the alloy which is a desirable feature.

The manganese serves as a deoxidizer in the manufacture of the alloy and also serves to toughen the mixture and render the alloy less brittle.

The silicon is incorporated mainly as a deoxidizing agency, but its presence in the ingot or alloy herein described is desirable because it prevents to some extent or reduces the amount of oxidation which takes place in the remelting of the ingot metal preparatory to casting. It is not necessary to retain any of the silicon in the finished sand casting, but it is important to retain a small percentage of the silicon in the ingots which are supplied for conversion into castings.

What I claim is:

1. A metal alloy comprising the following elements in substantially the following proportions by weight, namely,

	Per cent
Copper -----	60.25
Nickel -----	19.25
Zinc -----	10.00
Aluminum -----	8.65
Iron -----	.75
Lead -----	.75
Manganese -----	.25
Silicon -----	.10

2. A metal alloy comprising the following elements in substantially the following proportions by weight, namely,

Copper not less than 58.50% and not more than 63.50%.
 Nickel not less than 17.50% and not more than 21.50%.
 Zinc not less than 8.00% and not more than 11.00%.
 Aluminum not less than 7.00% and not more than 9.50%.
 Iron not less than 0.50% and not more than 0.75%.
 Lead not less than 0.50% and not more than 1.00%.
 Manganese not less than 0.15% and not more than 0.25%.
 Silicon not less than 0.05% and not more than 0.10%.

3. A metal alloy comprising the following elements in substantially the following proportions by weight, namely,

Copper not less than 58.50% and not more than 63.50%.
 Nickel not less than 17.50% and not more than 21.50%.
 Zinc not less than 8.00% and not more than 11.00%.
 Aluminum not less than 7.00% and not more than 9.50%.
 Lead not less than 0.50% and not more than 1.00%.
 Manganese not less than 0.15% and not more than 0.25%.

Signed at St. Louis, Missouri, this 12th day of October, 1931.

ARTHUR FRITSCHLE.