

# UNITED STATES PATENT OFFICE.

EDWARD C. KIRK, OF PHILADELPHIA, PENNSYLVANIA.

## IMPROVEMENT IN BRONZE ALLOYS.

Specification forming part of Letters Patent No. **201,536**, dated March 19, 1878; application filed November 6, 1877.

*To all whom it may concern:*

Be it known that I, EDWARD CAMERON KIRK, of the city of Philadelphia, in the State of Pennsylvania, have invented or discovered a new and Improved Alloy or Bronze; and I do hereby declare that the following is a full, clear, and exact description thereof, sufficient to enable others skilled in the art to which it appertains to make, compound, and use my invention.

I have discovered that when arsenic or arsenical compounds or substances are made to unite with alloys of copper and tin, known variously as red brass, gun-metal, bronze, &c., under suitable conditions, it imparts to them several remarkable, and, for many purposes in the arts, desirable properties, among others, and principal of which, are homogeneity, hardness, elasticity, greatly increased tensile strength and toughness, and an unctuousness or smoothness, rendering it a valuable anti-friction metal for journal-bearings, &c. The arsenical compounds or alloys of copper and tin are also more fluid when molten than are other known alloys of copper and tin, this property rendering them capable of filling out sharply and without flaws the most intricate molds.

Metallic oxides are invariably present in the body of castings made of ordinary alloys of copper and tin, and these oxides are highly detrimental, rendering the alloy weak, more or less flawy, and less capable of bearing great strain. In my alloy the arsenic completely deoxidizes or eliminates the metallic oxides, and the resulting metal is therefore free from these defects.

It is the manufacture and production of an alloy having these many desirable qualities, by the addition to copper and tin, whether with or without the addition of other metals, of arsenic or arsenical compounds, in the manner and in or about the proportions hereinafter more particularly mentioned, that is the nature, object, and result of my invention or discovery.

In making my alloy I find that it is preferable to add the arsenic to the molten copper and tin in the form of arsenide of copper or arsenide of tin, the proportion of arsenic in which is known, or previously ascertained by

chemical analysis or test, though metallic arsenic can be used with excellent results in any case, or even any arsenical substance in which the quantity of metallic arsenic actually present is known or previously ascertained, and which is separable in the furnace.

The copper and tin in the crucible, in the process of melting, should be covered with a layer of charcoal, to exclude it from the action of the atmosphere, and as soon as the melting point is reached the arsenic is to be added, and the whole then thoroughly stirred in the crucible for a period of time ranging from one to three minutes, according to the quantity of metal acted upon, until a chemical unity is established; the molten metal may then be run directly into the molds in the usual manner; but to insure a perfect cast where chill-molds are used, the inner surface of the mold should be first lightly greased or oiled.

A fracture of the new alloy produced will show it to be of great strength and toughness, free from flaws, finely granular in appearance, and more homogeneous.

The number of uses and variety of objects to which my new alloy may be applied is almost unlimited, for it may be used in any case in which metal having the peculiar properties of tenacity, hardness, elasticity, homogeneity, anti-friction properties, and absolute freedom from oxides or rust, and its property of running sharp and true castings without flaws, is desired. The addition to the copper and tin of other metals than the arsenic is not desirable, except for minor considerations, such as the production of a peculiar sound, color, &c.

The strength, toughness, and elasticity of this alloy can be regulated with the nicest accuracy by varying the quantity of arsenic used in proportion to the tin and copper employed; thus, if to an alloy of ninety parts (by weight) of copper and ten parts (by weight) of tin, as small a quantity as from one-fifth of one per cent. to one per cent. (of the total weight of copper and tin) of arsenic is added, the result will be a considerable increase in strength and toughness, and a more homogeneous appearance of the fracture of the metal.

I have made alloys containing as high as five, eight, and ten per cent. of arsenic, but when quantities of more than five per cent. of

arsenic are added, the resulting alloy is too hard and brittle for most purposes. An alloy of copper ninety parts, tin ten parts, with five per cent. of arsenic, is almost as hard as cast-iron, and shows a fracture resembling cast-steel in structure.

Alloys of copper and tin in the proportions above named, of nine of the former to one of the latter, with the addition of two to four per cent. of arsenic, possess all the desirable qualities hereinbefore mentioned to a remarkable degree.

The endless variety of uses to which my new alloy-metal may be applied render it impossible within reasonable limits to state them all, or to give the percentage of arsenic, within the limits mentioned, applicable to each case; but, as before mentioned, the qualities of strength, hardness, and toughness can be increased or diminished by varying the proportions of arsenic with respect to the different quantities of tin and copper used, so that any intelligent melter or founder, from the directions already given, will be able to produce an alloy suitable to the purpose or use to which it is to be applied.

As it is my design to produce a bronze metal only, the proportion of tin used must never exceed twenty-five per cent. of the total weight

of copper employed, and to secure in the resultant compound all the desirable qualities hereinbefore described, the proportion of arsenic in the alloy should not exceed ten per cent. of the total weight of the finished metal.

I am aware that Letters Patent of the United States were granted to A. A. Randall, dated December 21, 1869, for a metal alloy "brilliant like silver," for harness-trimmings, &c., composed of the same ingredients, but united in different proportions, for a different purpose, and having different properties, from mine; and I do not claim the invention therein described, my invention relating to bronze alloys only.

Having thus described my invention or discovery, what I claim, and desire to secure by Letters Patent, is—

The bronze-metal alloy herein described, composed of copper, tin, and arsenic, in the proportions of seventy-five to ninety parts of copper, ten to twenty-five parts of tin, and of one-fifth of one per cent. to ten per cent. of arsenic, substantially as and for the purpose set forth.

EDWARD CAMERON KIRK.

Witnesses:

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