UNITED STATES PATENT OFFICE.

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IMPROVEMENT IN BRONZE ALLOYS.

Specification forming part of Letters Patent No. 120,984, dated November 14, 1871.

To all whom it may concern:

Be it known that we, GEORGE MONTEFIORE LEVI, of Brussels, and CHARLES MAURICE KÜNZEL, of Liege, in the Kingdom of Belgium, have invented an Improvement in the Preparation of Alloys and in the Casting thereof, of which the following is a specification:

Our invention consists in the employment and the mode of employment, substantially as described, of phosphuret of copper or phosphuret of tin in the production of the alloy described hereafter, and in general of phosphorized alloys of copper and tin, with or without other metals. Our invention further consists in the employment in the molds into which phosphorized alloys of copper and tin, with or without other metals, are run, of oil, petroleum, or such other matter or substances as will evolve gases of a non-oxidizing character, substantially as and for the purpose hereafter referred to. The object of our invention is to accurately regulate the degree of phosphorization of the alloy described hereafter, and of phosphorized alloys of copper and tin, with or without other metals, in general, and to obtain castings from such alloy having true surfaces and edges.

We have discovered that in treating with phosphorus or phosphoric substances alloys of copper and tin they acquire many advantageous properties, fully alluded to hereafter, and are thereby rendered available for the manufacture of a great variety of industrial and ornamental objects, provided that the quantity of phosphorus contained in the perfected alloy does not exceed two and a half per cent. of the total weight thereof; and furthermore, that when the maximum quantity of phosphorus is used the total component quantity of tin shall not exceed ten per cent. of the total weight of the perfected alloy.

On applying phosphorus or phosphoric substances to an alloy of copper and tin they will be found to eliminate or neutralize the effect of the oxides, if any are therein contained, and the proper quantity for this purpose should be ascertained by preliminary tests or analyses, as the oxides may vary in quantity in accordance with the character of the metal employed. The absolute resistance of the alloy thus treated is considerably augmented, the fused alloy is rendered more fluid, and the process of running it off into molds facilitated, so that the largest and smallest objects of the most complicated and intricate character may be cast without any material flaw; but an additional quantity of phosphorus over and above that required for the deoxidizing process must be added to bring the alloy to the desired high standard, and this additional quantity we have found by repeated tests should not exceed the limits above referred to. By varying the quantity of phosphorus within these limits, at the same time having a due regard for the quantity of tin used, as indicated above and by the examples given hereafter, the hardness, elasticity, and toughness of the alloy may be regulated with the greatest accuracy, in accordance with the character of the object into which the alloy has to be converted. In order to more accurately regulate the component quantity of phosphorus we first by any suitable means phosphorize copper or tin to a higher degree than is required in the perfected alloy, and having ascertained the component proportions of these phosphurets we reduce their degree of phosphorization by adding thereto copper and tin in the proper quantities. Phosphorized copper being fusible at a lower degree than copper, we prefer to melt this additional quantity of copper or copper and tin, and then to introduce the phosphurets above named, the molten copper or alloy being covered with a layer of carbon or otherwise excluded from the air. The alloy, with its supply of phosphorus, is then well stirred in the furnace or crucible, and may be run directly from the latter into the molds. If cast into chill-molds we have found that the quality of the metal is improved as regards its homogeneity, elasticity, and tensile strength. The inner surfaces of the molds should be slightly coated with oil, petroleum, or such matter or substances other than those named as will evolve gases of a non-oxidizing character, in order to prevent the oxidization of the phosphorus contained in the molten alloy as the same is being run into the molds, the castings thereby being rendered more accurate and perfect. Small quantities of other metals, such as zinc, nickel, &c., may be added to the main ingredients; but as the most important features of the alloy can be completely controlled by varying the proportions of phosphorus and tin used, the addition of other metals, except in

special cases, or for minor considerations—such, for instance, as the attainment of a particular color, sound, &c.—had better be discarded.

The application of our improved alloy is so extensive that a full account of the different proportions for different uses would be voluminous and unnecessary. We will, however, give a few examples, which, with the foregoing explanation, will afford a sufficient guide for those skilled in metallurgy to carry our invention into effect. For fine ornamental objects, an alloy very fluid when melted and very tenacious may be composed of 0.5 per cent. phosphorus, 7 per cent. tin, and 92.5 per cent. copper. For ordnance, parts of machinery, and such objects as require a great amount of elastic resistance and toughness, we use 1.6 per cent. phosphorus, 8.5 per cent. tin, and 89.9 per cent. copper. The addition to ordinary gun-metal (composed of nine parts of copper and one part of tin) of 2.3 per cent. of phosphorus imparts to the alloy the hardness of steel. For industrial purposes in general we use phosphorus up to one per cent. of the total weight of the alloy, varying the component quantity of tin; and qualities may thus be produced which are either ductile and malleable and can be rolled into sheets or drawn into wire, or such having greater hardness and resistance; but when using one per cent. of phosphorus the component quantity of tin should not exceed fifteen per cent. of the total weight of the alloy, as the same otherwise becomes too brittle.

As will be seen from the above examples, the toughness, elasticity, and hardness of the alloy can be regulated by varying the proportions of tin and phosphorus.

The almost endless variety of objects and purposes for which the alloy may be used to advantage makes their enumeration endless, for they would embrace the boat-nail and the siege-gun, the cog-wheel and the finest work of art; in fact, the new alloy is applicable to and may be used for the manufacture of all objects in which tenacity, elasticity, homogeneity, hardness, and freedom from rust on the one side, and on the other hand perfectly fine and true surfaces and edges, are desirable qualities.

We do not here desire to claim an alloy of copper and tin when treated with phosphorus, as this formed the subject of another application for which Letters Patent have been allowed us; but

We claim—

1. The within-described process of producing the alloy specified—that is, by combining with the metal a prepared alloy of phosphorus and tin or copper when the said prepared alloy is so proportioned to the metal, and when the ingredients of said alloy are so proportioned to each other, that the product shall not contain more than 2.5 per cent of phosphorus and fifteen per cent. of tin.

2. The process of casting the alloys specified in molds prepared by the application of petroleum or its equivalent, substantially as set forth.

In testimony whereof we have signed our names to this specification in the presence of two subscribing witnesses.

GEORGE MONTEFIORE LEVI.
CHARLES MAURICE KÜNZEL.

Witnesses:
TUYENDHOLS,
V. HARSSUN.

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