No. 778,398. Patented December 27, 1904.

UNITED STATES PATENT OFFICE.

CHRISTOPHER H. BIERBAUM, OF BUFFALO, NEW YORK.

ALLOY.

SPECIFICATION forming part of Letters Patent No. 778,398, dated December 27, 1904.

Application filed May 7, 1904. Serial No. 206,848.

To all whom it may concern:

Be it known that I, CHRISTOPHER H. BIERBAUM, a citizen of the United States, residing in Buffalo, in the county of Erie, in the State of New York, have invented new and useful Improvements in Metal Alloys, of which the following is a complete specification.

My invention relates to that class of alloys known as "white bronzes," and it is especially adapted to be used in the construction of bearings and wearing parts in machines.

The alloy is composed of four metals—zinc, copper, aluminium, and magnesium. The zinc is always the preponderant ingredient. The next metal in importance as to quantity is copper. It is essential that by weight the copper be in excess of the aluminium. The magnesium is always less than either the copper or the aluminium. All proportions are considered by weight. The preferred composition is: zinc, eight-six per cent.; copper, nine and nine-tenths per cent.; aluminium, four per cent., and magnesium one-tenth per cent.

Magnesium when in a molten or heated condition has an extremely-high affinity for oxygen, and by virtue of this affinity when an alloy containing magnesium is in a molten state the magnesium oxidizes in preference to the other constituents, and here the oxid of magnesium has a special virtue in that it is light and flocculent, floats on the surface of the metal, is easily skimmed off, and has in itself no tendency of being entrained and held in suspension after the metal is poured. In addition to this the oxid of magnesium is perhaps the least cutting or abrasive metallic oxid known, unlike the oxid of aluminium, which is emery or corundum and the most abrasive metallic oxid known. From the foregoing the beneficial effect of magnesium in an aluminium alloy is very apparent, especially so in an antifriction or bearing metal. Even though magnesium exists in an extremely-minute quantity its presence is beneficial. Owing to the readily oxidizing and corroding properties of magnesium, this constituent should never be excessive in a composition largely composed of zinc, since zinc has a less protecting effect on magnesium than perhaps any other metal with which magnesium alloys. The special purposes served by the magnesium in this alloy are primarily its deoxidizing effect. Secondly, it tends to prevent formation of excessively-large crystals of zinc. In other words, it tends to prevent the zinc from "crystallizing out," and in consequence of its presence tends to produce a grain resembling that of tool-steel. Thirdly, it makes a most desirable alloy for casting in metal molds.

The best method of making this alloy is the one most naturally pursued by any one versed in the art of alloying metals—namely, that of alloying them in the inverse order of their fusibility. The copper is first melted and the aluminium is then added, the zinc is then added to the molten alloy of copper and aluminium, and finally the magnesium. When the aluminium is added to the copper, great care should be exercised in getting a perfect and uniform alloy of these two metals. Their natural affinity for each other is such that they alloy very readily; but owing to the great difference in their specific gravities care must be exercised in thoroughly mixing them. When aluminium is introduced into molten copper, a portion of the two metals combine chemically—that is, form copper-aluminid. In order to get the best results in practicing this invention, one object must be kept in view—that is, to retain the greatest possible percentage of this chemically-united copper-aluminid from being broken up during the subsequent alloying with the other metals by gradually decreasing the temperature while alloying. With the introduction of the first aluminium into the molten copper a rise of temperature occurs, owing to the chemical exothermic reaction taking place between the two metals. Upon the further introduction of aluminium and with the further satisfying of the affinity between the two metals this intensity of reaction decreases as the fusing-point of the alloy gradually decreases, owing to the increased amount of aluminium in its composition. The last portion of the aluminium is therefore alloyed with the copper at a much lower temperature than the first. The

alloying of the first zinc is essentially a physical reaction, with perhaps only a very slight chemical reaction, and is endothermic in its nature. Upon the continued further introduction of zinc, the melting-point of the alloy is gradually decreased with the further increase of zinc in its composition. After the requisite amount of zinc has been added the magnesium is then added. A convenient way of adding magnesium is that of having a zinc and magnesium alloy and from its known composition compute the amount of alloy necessary and then introducing this requisite amount.

Within the scope of the broadest claim this composition may vary considerably, though the best and most economic proportions are those approximating the preferred composition.

What I claim as new, and desire to secure by United States Letters Patent, is—

1. An alloy composed of zinc, copper, aluminium and magnesium, the zinc being in excess of the other metals and the copper being in excess of the aluminium and the aluminium being in excess of the magnesium.

2. An alloy containing zinc eighty-six per cent., copper nine and nine-tenths per cent., aluminium four per cent. and magnesium one-tenth per cent.

CHRISTOPHER H. BIERBAUM.

Witnesses:

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EUGENE WARNER.