UNITED STATES PATENT OFFICE.

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METALLIC ALLOY OR COMPOUND.

No. 864,140. Specification of Letters Patent. Patented Aug. 20, 1907.

Application filed April 22, 1904. Serial No. 204,365.

To all whom it may concern:

Be it known that WALTER RÜBEL, a subject of the Emperor of Germany, residing at 26 Neuer Wall, Hamburg, in the Empire of Germany, engineer, has invented certain new and useful Improvements Relating to Metallic Alloys or Compounds, of which the following is a specification.

It is well known that there is a large industrial demand for metallic alloys, and that more particularly for shipbuilding purposes new metallic alloys are required which present very great strength. It is, however, absolutely necessary that the cost of production of such alloys should not exceed a certain limit, as otherwise they would be too costly for practical purposes. The copper alloys hitherto produced, such for example as brass (60 copper, 40 zinc), tombac (80 copper, 18 tin and 2 lead) and phosphor bronze (80 copper, 19 tin and 1 phosphorus) are readily worked and present sufficient strength for some purposes. The proportions of the alloy are arbitrary and are the result of experiments. There are also alloys, although for other purposes, consisting of copper, zinc, aluminium with small additions of tin, also of copper and zinc, aluminium and nickel. In manufacturing all these alloys, however, unless great care be taken, and the mass be constantly agitated, separation of the metals, the melting points and specific weights of which are so different, may easily take place so that in many cases castings which are rough and wanting in uniformity are produced. This is more particularly liable to happen in the case of alloys which contain zinc or phosphorus, as these substances are readily capable of volatilization and oxidation, their non-fusible oxids in the form of scoria rendering the final product impure. It is true that various attempts have been made to remove such scoria from the metal but these attempts have met with no real success.

As regards the alloy consisting of 90 copper and 10 aluminium, which it was at first thought was free from all the defects enumerated above, it has not been successful in practice because with a strength of 48 kilograms per square centimeter, it is far less readily worked than brass, can only be cast with difficulty and is so costly that only in exceptional cases can it be employed instead of brass.

All the defects pointed out above are obviated by means of the present invention by means of which an alloy is produced which fulfils all possible requirements. This is brought about owing to the fact that in the first place chemical combinations of copper, zinc, aluminium and silicium are produced, this alloy then serving as an addition to alloys of copper and aluminium and imparting very valuable properties thereto, metallic alloys being thereby produced presenting a tensile strength of as much as 100 kilograms and which are considerably less expensive than the bronzes hitherto manufactured. Practical experiments have demonstrated that the metallic alloys so produced are extremely hard and they also present great resistance to chemical influences, while in spite of their hardness, which is equal to that of tool steel, at a red heat they may be forged and rolled like iron.

It is true that attempts have already been made to employ silicium as an addition to copper or copper bronze, it is, however, new and has not been described in any publication, to produce a compound consisting of copper, aluminium, zinc and silicium in proportion to their atomic weights and to then employ this compound as an addition to copper-aluminium alloys. It is capable of proof that by alteration in the quantity of this added alloy to like parts of copper and aluminium, very considerable alteration in the quantity of this added alloy to like parts of copper and aluminium, very considerable alterations in the properties of the resulting products may be obtained, and it is shown that in the manufacture of the novel alloy there is in fact a chemical combination of the constituents because the combination takes place with generation of heat. The novel compound is produced in the following manner: 65.4 parts of zinc are melted and 27.1 parts of aluminium are added to the mass. These two metals readily alloy, and when this has taken place, 28.4 parts of silicium are added to the composition. The compound so obtained, consisting of aluminium, zinc and silicium is then poured into 63.6 parts of molten copper. The silicium may be employed in crystalline form. The most ready and inexpensive manner of arriving at the proper proportion of silicium is to melt together with aluminium the suitable quantity of pure silica and to then add the zinc. It may be assumed that the silicium acts in the present case in the same manner as carbon in iron. If this copper-aluminium-zinc alloy be added to compounds of copper aluminium, and we may take by way of example 8 kilograms of copper, 769.2 aluminium and 238 grams of the above alloy, a bronze is produced presenting 99.2 kilograms tensile strength, which is steel hard but which is nevertheless readily adapted for forging and rolling. If with the same quantities of copper and aluminium 250 grams of the atomic weight alloy be taken, a bronze presenting only 67 kilograms tensile strength is obtained, and if 350 grams of the atomic weight alloy are used the tensile strength is only 38.8 kilograms. Experiments have demonstrated, that by omitting the silicium and adding pure nickel to the atomic weight alloy, which in this case would consist of 63.12 kilograms copper, 64.91 zinc, 26.91 aluminium and 58.3 nickel, if up to 750 grams of this atomic weight alloy be added, the bronze produced retains the strength of about 100 kilograms per square m/m,

but the hardness has still further considerably increased. The property of being readily forgeable is not lost.

Bronzes presenting a tensile strength of 99.2 kilograms have not hitherto been known. These bronzes also present very considerable resistance to chemical influences; thus for example they offer eighty times more resistance to the influence of seawater and thirty times more resistance to the attacks of acetic acid than ordinary phosphor bronzes. Although exceedingly hard and apparently brittle when cold, at a red heat these bronzes, as already mentioned, may be readily forged and rolled. The substance is absolutely free from pores and does not exhibit any separation of the different constituents under the microscope. Unmelted test bars present no diminution whatever of these good properties.

The bronze is particularly well adapted for shipbuilding purposes and for gun barrels. The limit of elasticity lies only 12% below the rupture strength.

The term, "hardening ingredient", as used in the claims which follow hereinafter is a generic term by which the applicant intends to include both silicium and nickel, the effect of both of which in imparting hardness to the alloy has been set forth fully hereinbefore.

What I claim and desire to secure by Letters Patent of the United States is:—

1. The herein described process which consists in first mixing molten zinc and aluminium together; second, adding silicium to the mixture so obtained; and third, in pouring the mixture of zinc, aluminium and silicium into molten copper; the zinc, aluminium, silicium and copper entering in proportion to their respective atomic weights.

2. An alloy made up of zinc, aluminium, silicium and copper in the proportion of the respective atomic weights of the said ingredients.

3. An alloy made up of zinc, aluminium, copper and a hardening ingredient, said ingredients entering into the alloy in the proportion of their respective atomic weights.

In testimony whereof I have hereunto set my hand in presence of two subscribing witnesses this 18" day of March 1904.

WALTER RÜBEL.

Witnesses:
E. H. L. MUMMENHOFF,
OTTO W. HELLMRICH.