UNITED STATES PATENT OFFICE.

JOHN W. LANGLEY, OF EDGEWOODVILLE, ASSIGNOR OF ONE-HALF TO HUNT & CLAPP, OF PITTSBURG, PENNSYLVANIA.

PROCESS OF MANUFACTURING ALLOYS OF ALUMINIUM.

SPECIFICATION forming part of Letters Patent No. 451,404, dated April 28, 1891.

Application filed September 20, 1890. Serial No. 365,657. (No specimens.)

To all whom it may concern:

Be it known that I, JOHN W. LANGLEY, of Edgewoodville, in the county of Allegheny and State of Pennsylvania, have invented a new and useful Improvement in Processes of Manufacturing Alloys of Aluminium, of which the following is a full, clear, and exact description.

My invention has for its object to provide means whereby aluminium can be alloyed economically with such metals as titanium, tungsten, boron, chromium, &c., which are difficult and costly to obtain in a metallic state. I have discovered that of such metals the metal titanium especially produces definitely beneficial results when alloyed with aluminium and improves the properties of the latter in many ways. Thus I have found that when titanium in small proportion is alloyed with aluminium it produces a metal which is of low specific gravity and easily malleable, but is intrinsically harder than pure aluminium, and is adapted to acquire, by hammering or rolling, a degree of elasticity comparable to that of spring-brass. The obviously undue cost of alloying such rare metals as titanium, &c., with aluminium by simple fusion of the metallic elements has led to attempts to make the alloy by the reduction of their oxides in the presence of aluminium; but hitherto such attempts have not risen above the category of mere unsatisfactory laboratory experiments, and have not demonstrated the feasibility of producing such alloy as a useful article of commerce. I have succeeded in solving the problem thus presented, and for the first time have made it possible to produce a useful alloy of the kind above described in a cheap and ready manner.

In the course of the following description I shall explain the application of my invention to the alloying of aluminium with titanium, since it is this alloy that I deem to be the most useful, premising, however, that by substituting for the titanic oxide or salt the oxides or salts of other metals more electro-negative than aluminium the metallic bases of such oxides or salts may be alloyed with aluminium in like manner. Metals which can be alloyed thus with aluminium are bismuth, cadmium, cæsium, cerium, chromium, cobalt, copper, gold, iron, lead, manganese, molybdenum, nickel, osmium, palladium, platinum, silver, tin, titanium, tungsten, uranium, and zinc.

In carrying my invention into practice I proceed as follows: I make by fusion a bath of fluorides of aluminium and sodium, or of fluoride of sodium, or of fluorides of aluminium, sodium, and calcium, or, generally, a fluoride or fluorides of a metal or metals more electro-positive than aluminium. I may add to these fluorides chlorides of the alkalies or alkaline earths; but these are unnecessary. Cryolite of commerce may be used as the fluoride constituent of the bath; but, although I do not exclude its use from the scope of the broad claim of this application, it is in some respects disadvantageous because of its iron, which in the alloying process hereinafter described is reduced, and by mingling with the alloy impairs its quality. For this reason I prefer to employ the above-mentioned fluoride in as pure state as possible. Either before or after the fusion of this fluoride bath I add to it a reducible oxide or salt of the rare metal to be alloyed. In making an alloy of aluminium and titanium titanic oxide is preferably used, and after thorough admixture of these substances, the oxide or salt being dissolved by the fluoride, I introduce the aluminium, which may be introduced either in a molten state or in a solid state. When introduced in solid state, it is fused by the heat of the bath, and when fused a reaction between the aluminium and said oxide or salt at once takes places, the oxide or salt is reduced, its oxygen or acid radical combines with a part of the aluminum, and the freed metallic base immediately alloys with the remainder of the aluminium. In practice I prefer to use as the fluoride bath fluorides of aluminium and sodium, which may be employed in amount ranging from one hundred to four hundred per cent. of the weight of the aluminium intended to be added. This bath I melt in a carbon crucible, and add thereto the oxide or salt of the metal to be alloyed. When the whole mass is incorporated and as nearly fluid as possible, I charge metallic aluminium into the crucible, the relative proportions of

the aluminium and oxide or salt being such that the percentage of oxide or salt shall be about twice the percentage in which its metallic base is desired to be present in the alloy. Immediately on the introduction of the aluminium the reaction above noted takes place between the aluminium and the oxide or salt and is accompanied by a rapid elevation of temperature of the bath. After waiting until further reaction ceases, which is indicated by cessation of rise of the temperature, the contents of the crucible are poured into a suitable receptacle, and after cooling somewhat the melted fluoride can be separated as a supernatant slag from the metallic alloy at the bottom of the vessel. The alloy is then collected, and is preferably remelted to cleanse it thoroughly from slag and otherwise to improve its properties.

It is important that the reduction of the oxide or salt of titanium and its alloying with the aluminium should be conducted in a non-silicious crucible, (preferably a carbon crucible,) since if the vessel be silicious in its composition a considerable portion of silicon will be alloyed with the aluminium and titanium, producing a compound of inferior quality.

In the foregoing specification I have recited particularly the order in which I prefer to conduct the steps of my process, and as this succession of steps enables me to obtain uniformity and certainty in the product by making it easier to regulate the reactions I intend to claim it specifically, but do not limit thereto those claims in which such order is not expressed.

I claim—

1. In the art of alloying aluminium with more electro-negative metals whose oxides or salts are difficult of reduction, the method hereinbefore described, which consists in incorporating such oxide or salt with a molten fluoride bath and then adding aluminium thereto, substantially as described.

2. In the art of alloying aluminium with more electro-negative metals whose oxides or salts are difficult of reduction, the method hereinbefore described, which consists in treating such oxide or salt with molten aluminium in a molten fluoride bath contained in a non-silicious vessel, whereby the metallic base of the oxide or salt is reduced and alloyed, substantially as described.

In testimony whereof I have hereunto set my hand this 18th day of September, A. D. 1890.

JOHN W. LANGLEY.

Witnesses:
THOMAS W. BAKEWELL,
W. B. CORWIN.