UNITED STATES PATENT OFFICE.

AUGUSTE J. ROSSI, OF NIAGARA FALLS, NEW YORK, ASSIGNOR TO THE TITANIUM ALLOY MANUFACTURING COMPANY, OF NEW YORK, N. Y., A CORPORATION OF MAINE.

PROCESS FOR PRODUCING THE ALLOY OF TITANIUM WITH ZINC.

1,019,527. Specification of Letters Patent. Patented Mar. 5, 1912.

No Drawing. Original application filed May 6, 1910, Serial No. 559,657. Divided and this application filed February 4, 1911. Serial No. 606,449.

To all whom it may concern:

Be it known that I, AUGUSTE J. ROSSI, a citizen of the United States, and a resident of Niagara Falls, in the county of Niagara and State of New York, have invented certain new and useful Improvements in Processes for Producing the Alloy of Titanium with Zinc, of which the following is a specification.

My present application is a division of my pending application for Letters Patent, Serial No. 559,657, filed May 6, 1910, allowed Dec. 23, 1910, and my present invention relates to a novel method for producing the alloy of titanium with zinc, and has for its object the prevention, more efficiently and economically than heretofore, of oxidation, volatilization, or other undesired alterations, of the zinc so alloyed or combined, and also of the said titanium, during the production of said alloy. In producing the said alloy, more or less difficulty has been encountered, due to such oxidation, volatilization, etc., resulting not only in undesired losses of the metals themselves, but also, in some instances, production of fumes deleterious to the operator. The losses and other undesirable incidents referred to are to be expected particularly when the said alloy is produced, as is otherwise desirable, in an electric furnace of the type known as an "open furnace", but may also be expected undesirably during the formation of the alloy in any other electrical or other apparatus in which sufficient or equivalent requisite temperature may be developed. It will be understood that in the formation of said alloy the titanium is usually supplied to the charge in the form of its oxid, and that the chemical combinations resulting in the volatilizations, losses, etc., above referred to are usually between constituents of the forming alloy and of the atmosphere, and therefore require, for the prevention of such combinations, interposition between said alloy and atmosphere of a coating of molten material normally impervious by the atmosphere.

My present invention may be practiced as follows: Into one of the now well known forms of so-called electric furnaces, such for example as illustrated and described in Letters Patent No. 802,941, granted to me October 24, 1905, I charge a predetermined quantity of zinc intended to be alloyed with the titanium. Such zinc has been previously melted, or is melted, in the said furnace, so as to produce a bath of molten zinc. It is obvious that the said bath might be produced by reducing directly in the said furnace an oxid of zinc. Onto the surface of said bath is then charged a chemical compound of calcium, preferably the oxid CaO, the said charge so added being in quantity sufficient to constitute when melted a complete covering or coating for the exposed surface of the underlying molten zinc bath. After the lime has melted, or while it is melting, there is next superimposed thereon a charge of a mixture of titanium oxid and carbon, preferably comminuted or agglomerated in briquets, the carbon of the said last mentioned mixture being so proportioned as to be in sufficient quantity to reduce both the said titanium oxid and the lime. As equivalent for, and in lieu of, titanium oxid, or of oxid of calcium, a titanate of lime (CaO,TiO_2) might, to such extent as desired, be employed, the titanium content of which may be such as to impart to the resulting alloy the desired content of titanium. In such cases the said titanate comprising titanium in a chemical combination reducible by carbon, and also calcium in a chemical combination reducible by carbon, is similarly mixed with carbon, the proportion of the latter being sufficient to insure reduction of the lime, if any, present, also formation of calcium carbid, and also liberation of metallic titanium, or, in certain cases, it may be found desirable to substitute completely for both the said lime and the said titanium oxid, said titanate of lime, from which may be derived the required amount of titanium, and also the required amount of lime for combination with the carbon.

The temperature of the charge being raised sufficiently to insure reduction of the titanium compound under the conditions mentioned, there is formed alike in all the cases mentioned, and by the resulting reactions metallic titanium, which, passing through the lime, dissolves in the bath of molten zinc below to produce the desired alloy of titanium and zinc, and there is also

formed, superimposed and maintained above the said alloy during its formation a coating of calcium carbid, which, possessing reductive properties, promotes reduction of said compound of titanium and simultaneously effectually protects the said metals constituting the bath of said molten alloy from substantially all alterations by oxidation, volatilization, or otherwise. It is preferable to add on the surface of the said melted carbid of calcium, toward the close of the operation, an additional covering or blanket of carbon in order to insure a reducing atmosphere throughout the furnace. Reactions so occurring in cases in which oxid of calcium and oxid of titanium are employed may be illustrated by the following formulæ:

$$CaO+C_3=CaC_2+CO.$$
$$TiO_2+C_2=Ti+2CO.$$

The resulting alloy may be tapped, in any approved manner, into any desired receptacle, the supernatent molten carbid of calcium running out simultaneously therewith and forming on the alloy, while the latter is cooling, a protective coating.

When, as above noted, a mixture of carbon and of a titanate of lime is employed, the final reactions will be similar and the results the same as when lime and titanium oxid are employed, *i. e.* as per the formula

$$CaO,TiO_2+5C=CaC_2+3CO+Ti.$$

I regard it as advisable in some cases to add carbon in excess of the quantity strictly required by the said formulæ, said surplus of carbon being not only to guard against possible contingencies, but also in order to insure, in cases in which lime is used for the covering, decomposition of any accidentally formed titanate of lime, which compound, however, would nevertheless, even were it to remain intact until the end of the operation, be evacuated with the carbid of calcium, with no greater detriment to the success of the operation, or to the qualities of the resulting alloy, than a possibly small, though undesired, loss of titanic acid. It is obvious that the amount of said excess of carbon will be readily determined according to the requirements of each case by those skilled in the metallurgical art. It will also be appreciated that in the production of said alloy of titanium and zinc a concentrate of titanium oxid and oxid of zinc may be employed instead of titanium oxid pure and simple and with equivalent results, a proper amount of carbon being, in such cases, however, added, sufficient to reduce also the oxid of zinc and the resulting zinc passing into the original bath of molten metal together with the titanium.

The foregoing formulæ should enable those skilled in the metallurgical art to calculate the proportions of carbon required to secure the reduction of the compound of lime and of the titanium oxid or other titanium compound and of the other oxids employed as the case may be; also the amount of carbon required in cases in which, instead of titanium oxid alone, titanium oxid and the oxid of zinc are employed. Furthermore, those so skilled will readily understand the various proportionings of titanium oxid or other titanic material employed to furnish to the metallic bath the required percentage of titanium.

What I claim as new and desire to secure by Letters Patent is the following, viz:—

1. The method of producing an alloy comprising titanium and zinc which comprises producing over a bath containing molten zinc a covering comprising carbon, titanium in chemical combination reducible by carbon, and calcium in chemical combination reducible by carbon, and imparting to the whole a temperature sufficient to insure liberation of metallic titanium by carbon reduction.

2. The method of producing an alloy comprising titanium and zinc which comprises superimposing over a bath containing molten zinc a covering comprising carbon, oxid of titanium, and a compound of calcium and imparting to the whole a temperature sufficient to insure reduction of said oxid of titanium under the conditions specified.

3. The method of producing an alloy or compound of titanium with zinc which comprises superimposing over a bath of molten zinc a covering of molten oxid of calcium, superimposing above said oxid of calcium oxid of titanium and carbon and imparting to the whole a temperature sufficient to insure reduction of said oxids under the conditions specified.

4. The method of producing an alloy or compound of titanium with zinc which comprises superimposing over a bath containing molten zinc a covering comprising carbon, a compound of titanium reducible by carbon, and oxid of calcium, and imparting to the whole a temperature sufficient to insure liberation of metallic titanium by carbon reduction.

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