

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 ALLOYS OF TITANIUM WITH FERROMETAL.

1,019,528.

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. 606,450.

To all whom it may concern:

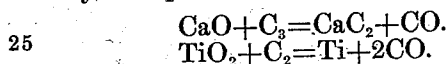
Be it known that I, AUGUSTE J. ROSSI, a citizen of the United States, and a resident of Niagara Falls, in the county of Niagara and State of New York, have invented certain new and useful Improvements in Processes for Producing Alloys of Titanium with Ferrometal, of which the following is a specification.

My present application is a division of my pending application for Letters Patent Serial No. 559,657, filed May 6, 1910, allowed December 23, 1910, and my present invention relates to a novel method of producing the alloy of titanium with iron in its various forms including steel, and has for its object the prevention, more efficiently and economically than heretofore, of oxidation, volatilization, or other undesired alterations of the elemental ferro-metal, including steel, so alloyed or combined and also of the said titanium during the production of said alloy. In producing the said alloy, some difficulty may sometimes be encountered, due to such oxidation, volatilization, etc., resulting not only in undesired losses of the metals themselves, but also, in some instances, in production of undesirable fumes. The losses and other undesirable incidents referred to are to be expected particularly when the said alloy is produced, as is usual, in an electric furnace of the type known as an "open furnace." 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, as for instance per the method described in my Letters Patent No. 609,463, granted August 23, 1898, and that the chemical reactions 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: Taking for example the production in an electric furnace of an alloy of iron and titanium known as ferro-titanium, there is charged into said furnace a predetermined quantity of iron intended to be alloyed with the titanium. Such iron has been previously melted, or is melted, in the said furnace so as to produce a bath of molten iron. Onto the surface of said bath is then charged preferably lime, 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 iron bath. After the lime has melted, or while it is melting, there is next superimposed thereon a charge of a mixture of titanitic acid 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 titanitic acid and the lime. As equivalent for and in lieu of titanitic acid 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 case 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 carbide, and also liberation of metallic titanium, or, in certain cases, it may be found desirable to substitute completely for both the lime and the titanitic acid the 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.

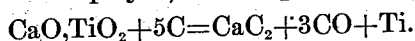
The temperature of the charge being raised sufficiently to secure reduction of the titanium compound under the conditions

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 iron to produce the desired alloy of titanium and iron, 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 expressed by the following formulæ:



The resulting alloy may be tapped in any approved manner into any desired receptacle, the supernatant 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 titanic acid are employed, *i. e.* as per the formula



I have also found it advisable in many 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 qualities of the resulting alloy than a possible small, though undesired, loss of titanic acid. It is obvious that the amount of such 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 ferro-titanium, as well as alloys of any other metal to be alloyed with titanium, a concentrate of titanic acid and oxid of iron, or of titanic acid and the oxid of the other metal may be employed instead of titanic acid

pure and simple and with equivalent results, a proper amount of carbon being, in such case, however added sufficient to reduce also the oxid of iron, or of the other metal present, and the resulting iron, or other metal, 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 lime, titanic acid or other oxids employed as the case may be; also the amount of carbon required in cases in which instead of titanic acid alone titanic acid and the oxid of the other metal to be alloyed with the titanium are employed. Furthermore those so skilled will readily understand the various proportions of titanic acid, or other titanic material, employed to furnish to the metallic bath the required percentage of titanium.

It will be observed that in cases in which metals, or metalloids, other than iron, are desired to be alloyed or combined with titanium, my process is substantially the same as above applied to production of ferro-titanium, in such case such other metal, or metalloid, being substituted for the iron and the oxid of such other metal, if employed, for the oxid of iron.

By means of my said process, metals heretofore alloyed with titanium with difficulty, loss, and danger, as for instance copper, are, as likewise the titanium, retained substantially intact without loss or other undesired alteration and without production of undesirable fumes.

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

1. The method of producing an alloy or compound of titanium with other metal which comprises superimposing over a molten bath of said other metal a coating 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 of titanium and a ferro-metal which comprises superimposing over a molten bath containing such ferro-metal a covering comprising a compound of titanium, carbon, and a compound of calcium, and imparting to the whole a temperature sufficient to insure reduction of said compound of titanium under the conditions specified.

3. The method of producing an alloy of titanium and iron which comprises superimposing over a molten bath containing such iron a covering comprising a compound of titanium reducible by carbon, carbon and a compound of calcium, and imparting to the

whole a temperature sufficient to insure reduction of said compound of titanium under the conditions specified.

4. The method of producing an alloy or
5 compound of titanium and a ferro-metal which comprises superimposing over a molten bath containing such ferro-metal 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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Witnesses:

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