

UNITED STATES PATENT OFFICE.

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PROCESS FOR PRODUCING ZIRCONIUM STEEL.

1,374,038.

Specification of Letters Patent.

Patented Apr. 5, 1921.

No Drawing.

Application filed July 23, 1920. Serial No. 398,513.

To all whom it may concern:

Be it known that I, HUGH C. SICARD, a citizen of the United States of America, and a resident of the city of Buffalo, county of Erie, and State of New York, have invented a new and useful Process for Producing Zirconium Steel, of which the following is a full, clear, and exact description.

This invention relates generally to the manufacture of zirconium steel and more particularly to a process of making such steel in such a way that the physical qualities of the product will be substantially preserved throughout the process.

On April 6th, 1920, I was granted U. S. Letters Patent No. 1,335,992 for a process for producing zirconium steel. In carrying out the process described in the said patent, I used a ferro-zirconium-titanium alloy and I found that if a small quantity of the zirconium of such alloy is oxidized, it is left in the steel in a divided form thereby affecting somewhat the physical qualities of the zirconium steel. This invention overcomes the difficulties just set forth and the practice of the invention herein described will produce a product in which the zirconium is substantially protected from oxidation during the process and thereby a product of a predetermined composition can be secured and substantially none of the zirconium will be found in the resulting steel in a divided form.

I have discovered that by using an alloy of zirconium and silicon, with or without a carbon content, in which the zirconium exists mostly as zirconium silicids, such combination is broken up when the alloy is added to the molten steel. The silicon then oxidizes rapidly and thereby substantially prevents the oxidation of the zirconium and at the same time combines with whatever zirconium has been oxidized and gives a complex silicate and zirconiate of lime and alumina. The zirconiate of lime is always found in the slag and in particular in the basic processes, or with the alumina which is formed by the oxidation of aluminum which has been added as such to the molten bath as a deoxidizing agent or still found as an impurity in the ferro-zirconium, if

such alloy has been made by the aluminothermic process. Therefore, in carrying out my invention I use an alloy of zirconium and silicon with or without a carbon content in which the zirconium is found mostly as zirconium silicids. This alloy is then added to the molten steel and the reactions above set forth occur. Thereby, the zirconium is protected and the resulting steel product is free from the objections hereinbefore noted.

I have found that the best results have been secured by using an alloy in which the silicon content, is from 5% to 30% of the zirconium content. I have also found that an excess of silicon in the ferro-zirconium alloy is an objection, as, if it does not oxidize it goes in solution in the ferrite as a complex silicid, and in all such grades of zirconium steel a certain amount of silicon is always specified.

Having thus described my invention what I claim is:

1. An improved process of making zirconium steel which consists in adding to molten steel an alloy of zirconium and silicon.

2. An improved process of making zirconium steel which consists in adding to molten steel an alloy of zirconium and silicon having a carbon content.

3. An improved process of making zirconium steel which consists in adding to molten steel an alloy of zirconium and silicon in which the silicon content is from 5% to 30% of the zirconium content.

4. An improved process of making zirconium steel which consists in adding to molten steel an alloy of zirconium and silicon in which the silicon content is sufficiently great to react with all of the oxides contained in the steel, thereby protecting the zirconium content of the steel.

5. An improved process of adding zirconium to steel which consists in adding to molten steel a carbid of zirconium and silicon.

In testimony whereof I have hereunto signed my name.

HUGH C. SICARD.