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ALLOYS FOR ADDITION TO IRON AND STEEL

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This invention relates to an alloy containing silicon, titanium, zirconium, aluminum and iron, and especially to an alloy suitable for additions to molten iron and steel for the purpose of obtaining a more sound, dense and clean metal when such steel or iron solidifies.

The present application is a continuation-in-part of my copending application, Ser. No. 128,231, filed February 27, 1937.

The use of ferro-silicon, ferro-titanium, ferro-zirconium, aluminum, ferro-aluminum, iron-silicon-zirconium, and iron-silicon-titanium for the purpose of scavenging molten steel and iron is very well-known and these alloys are more or less generally employed in iron and steel manufacturing practice. Their use, however, is accompanied by very marked deficiencies so that, while they free the molten metal of impurities, such as iron oxide and iron nitride by chemically reacting with these compounds, the products: iron-silicate, alumina, titanium cyanonitrides, and zirconium cyanonitrides, remain entrapped in the metal, thereby imparting to it several objectionable qualities. The amount of non-metallics remaining entrapped in the metal is not always the same. Therefore, iron and steel alloys are obtained which have varying physical qualities, such as ductility, although of the same chemical composition.

I have discovered that the combination of all four elements—silicon, titanium, zirconium and aluminum—with iron, in proper proportions, produces an alloy which when added to molten iron and steel reacts with gaseous, and other impurities in the molten metals to form reaction products which more readily coagulate and separate from the molten iron or steel. My alloy is readily soluble in molten iron or steel and is more effective and economical than alloys containing one or two of the elements silicon, titanium, zirconium, aluminum alone or in combination with iron.

My alloy not only acts as a scavenger in molten iron and steel, i. e., removes the various impurities in the molten metal, but also serves to control the grain size of the treated product.

While my alloy is composed of silicon, titanium, zirconium, aluminum, and iron and is substantially free from carbon, there may be present small percentages of other elements incidental to the method of production or in the raw materials

used. For example, the chemical composition of one melt of this alloy which may be considered typical in respect to the presence of the other metals, is:

	Per cent
Silicon -----	31.20
Titanium -----	11.78
Zirconium -----	9.75
Aluminum -----	8.50
Manganese -----	0.87
Carbon -----	0.06
Iron -----	Balance

This alloy is substantially free from carbon, but the carbon content may vary up to a maximum of about 2.0% or even up to 10.0%, depending upon the method of manufacture and intended use. In many cases, I prefer to have the carbon below 0.15%.

The improved composition of my present invention consists of an alloy with a minimum amount of carbon so as to be substantially free from carbon and contains about 10% to 50% silicon, preferably about 10% to 45% silicon, about 5% to 15% or 25% titanium, about 5% to 15% or 25% zirconium, and about 5% to 15% or 25% aluminum. In no case, however, does the sum of the silicon, titanium, zirconium and aluminum exceed 90%. The percentage of silicon is at least equal to or greater than the percentage of either the titanium, the zirconium or the aluminum. The remainder of the alloy is principally iron, although usual impurities or small amounts of other alloying elements may be present.

While I have described my alloy in its preferred composition, it is to be understood that the invention is not so limited, but may be otherwise embodied within the scope of the following claims.

I claim:

1. An alloy for addition to iron and steel, containing about 10% to 50% silicon, about 5% to 25% titanium, about 5% to 25% zirconium, about 5% to 25% aluminum, the sum of the silicon, titanium, zirconium and aluminum not exceeding 90%, and not over about 10.0% carbon, the remainder being principally iron.

2. An alloy for addition to iron and steel, containing about 10% to 50% silicon, about 5% to 25% titanium, about 5% to 25% zirconium, about

5% to 25% aluminum, the sum of the silicon, titanium, zirconium and aluminum not exceeding 90%, and not over about 2.0% carbon, the remainder being principally iron.

- 5 3. An alloy for addition to iron and steel, containing about 10% to 50% silicon, about 5% to 25% titanium, about 5% to 25% zirconium, about 5% to 25% aluminum, the sum of the silicon, titanium, zirconium and aluminum not exceeding
10 90%, the percentage of silicon being not less than

the percentage of either the titanium, the zirconium, or the aluminum, and not over about 10.0% carbon, the remainder being principally iron.

4. An alloy for addition to iron and steel, containing about 10% to 45% silicon, about 5% to 15% titanium, about 5% to 15% zirconium, about 5% to 15% aluminum, and not over about 0.15% carbon, the remainder being principally iron.

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