TREATMENT OF CAST IRON

Harry B. Kinnear, Columbus, Ohio, assignor, by mesne assignments, to Chromium Mining & Smelting Corporation, Limited, Sault Ste. Marie, Ontario, Canada, a corporation of Canada

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1. This invention relates to metallurgy and has for an object the provision of certain improvements in metallurgical methods or processes. More particularly, the invention contemplates the provision of certain improvements in methods or processes suitable for use in the production of cast iron. A particular object of the invention is to provide an improved method or process for improving the mechanical or physical properties of cast iron. A specific object of the invention is to provide an improved process for utilizing exothermic reaction mixtures in the production of high-strength cast iron.

The invention is based on my discovery that cast iron can be treated while in the molten state with an exothermic reaction mixture comprising silicon, strontium and a nitrate radical to produce cast iron products having improved mechanical or physical properties. Thus, for example, I have found that by reacting with such a reaction mixture molten cast iron, such as cupola iron and blast furnace iron, containing about two and seventy-five hundredths percent (2.75%) to three and twenty-five hundredths percent (3.25%) of carbon and silicon in amount less than that required for high-strength cast iron, cast iron products having improved tendence, tensile, deflection, impact, hardness and other properties can be produced. Thus, for example, exothermic reaction mixtures may be employed in accordance with the method or process of invention to convert cast iron products of the above-indicated compositions with respect to carbon and silicon and having tensile strengths ranging from about 30,000 to 35,000 pounds per square inch to cast iron products having tensile strengths in the range, 40,000 to 55,000 pounds per square inch. The method or process of the invention is particularly useful for producing gray cast iron.

The depth of chill of cast iron treated with exothermic reaction mixtures in accordance with the invention is not materially different from that of an untreated cast iron of equivalent silicon and carbon contents.

In carrying out a method or process of the invention, molten cast iron from any suitable source is reacted in a ladle, for example, with an exothermic reaction mixture in amount sufficient to modify the mechanical or physical properties or characteristics of the cast iron by increasing the silicon content without altering substantially the composition of the cast iron with respect to total carbon.

In carrying out a method or process of the invention, I may employ an exothermic reaction mixture comprising a nitrate of any metal of the group consisting of strontium, barium, calcium and magnesium, or I may employ an exothermic reaction mixture comprising a compound of strontium, a nitrate of another metal and silicon. Two or more nitrates may be employed in a reaction mixture if desired. Sodium nitrate may be employed in conjunction with any one or more of the nitrates of strontium, barium, calcium and magnesium.

Exothermic reaction mixtures employed in carrying out a method or process of the invention preferably contain ferrosilicon as the source of silicon, and they preferably are formed by grinding together the components to form mixtures of particles most or all of which are small enough to pass a 100-mesh screen. Grinding together of the components results in thorough and intimate mixing which is conducive to effective and complete reaction. The reaction mixtures may be employed in the form of loose powders or in the form of agglomerates or briquets. Any suitable bonding agent may be employed in forming the agglomerates or briquets. When sodium nitrate is employed, it may function as the bonding agent. Thus, for example, a finely divided mixture comprising sodium nitrate may be moistened with water in amount by weight equal to about two to three percent (2 to 3%) of the weight of the mixture, molded, heated to drive off water and melt the sodium nitrate and cooled to permit solidification of the sodium nitrate in place. The solidified sodium nitrate is intimately associated with the other components and functions as the bonding agent.

The components of a reaction mixture employed in carrying out a method or process of the invention are so proportioned as to provide silicon in excess of the amount which can be oxidized by all of the nitrate and any other reducible compound which may be present. The excess silicon enters the molten cast iron, increasing the silicon concentration and causing a graphitizing effect on the carbon contained therein. Nitrates and silicon for oxidation by the nitrate preferably are employed in amounts such that, by reaction, sufficient heat is generated to melt the excess silicon, so that the excess silicon enters the molten cast iron in the molten state and becomes quickly and thoroughly dispersed therein.

The following examples illustrate reaction mixtures which may be employed in carrying out a method or process of the invention:

(In the various examples illustrating the reaction mixtures, the proportions of the components are set forth in parts by weight.)
The base iron used was similar to that employed in the tests for which results are set forth in Example XII above.

1. The method of producing high-strength cast iron which comprises contacting molten cast iron containing silicon in an amount less than that required for high-strength cast iron with an exothermic reaction mixture comprising silicon, strontium and a nitrate radical, the components of the reaction mixture being of such compositions and being present in such proportions as to be capable of reacting exothermically upon contact with the molten cast iron to decompose the nitrate radical, oxidize a portion only of the silicon and melt and incorporate in the molten cast iron the remainder of the silicon.

2. The method of producing high-strength cast iron which comprises contacting molten cast iron containing silicon in an amount less than that required for high-strength cast iron with an exothermic reaction mixture comprising silicon, strontium and one or more nitrates of the group consisting of calcium, strontium, barium and magnesium, the components of the reaction mixture being of such compositions and being present in such proportions as to be capable of reacting exothermically upon contact with the molten cast iron to decompose the one or more nitrates, oxidize a portion only of the silicon and melt and incorporate in the molten cast iron the remainder of the silicon.

3. The method of producing high-strength cast iron which comprises contacting molten cast iron containing silicon in an amount less than that required for high-strength cast iron with an exothermic reaction mixture comprising ferrosilicon, sodium nitrate and strontium nitrate, the components of the reaction mixture being of such compositions and being present in such proportions as to be capable of reacting exothermically upon contact with the molten cast iron to decompose the sodium nitrate, oxidize a portion only of the ferrosilicon and melt and incorporate in the molten cast iron the remainder of the ferrosilicon.

4. The method of producing high-strength cast iron which comprises contacting molten cast iron containing silicon in an amount less than that required for high-strength cast iron with an exothermic reaction mixture comprising ferrosilicon, sodium nitrate and strontium nitrate, the components of the reaction mixture being of such compositions and being present in such proportions as to be capable of reacting exothermically upon contact with the molten cast iron to decompose the sodium and strontium nitrates, oxidize a portion only of the ferrosilicon and melt and incorporate in the molten cast iron the remainder of the ferrosilicon.

5. The method of producing high-strength cast
iron which comprises contacting molten cast iron containing carbon in the range two and seventy-five one-hundredths percent (2.75%) to three and twenty-five one-hundredths percent (3.25%) by weight and containing silicon in an amount less than that required for high-strength cast iron with an exothermic reaction mixture comprising silicon, strontium and a nitrate radical, the components of the reaction mixture being of such compositions and being present in such proportions as to be capable of reacting exothermically upon contact with the molten cast iron to decompose the strontium nitrate, oxidize a portion only of the silicon and melt and incorporate in the molten cast iron the remainder of the silicon.

The method of producing high-strength cast iron which comprises contacting molten cast iron containing carbon in the range two and seventy-five one-hundredths percent (2.75%) to three and twenty-five one-hundredths percent (3.25%) by weight and containing silicon in an amount less than that required for high-strength cast iron with an exothermic reaction mixture comprising silicon and strontium nitrate, the components of the reaction mixture being of such compositions and being present in such proportions as to be capable of reacting exothermically upon contact with the molten cast iron to decompose the strontium nitrate, oxidize a portion only of the silicon and melt and incorporate in the molten cast iron the remainder of the silicon.

HARRY B. KINNEAR.

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