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WINFIELD C. HAMILTON, OF EAST CHICAGO, INDIANA, ASSIGNOR TO AMERICAN STEEL FOUNDRIES, OF CHICAGO, ILLINOIS, A CORPORATION OF NEW JERSEY

HIGH SILICON AND HIGH MANGANESE STEEL

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My invention relates to an improved steel and more particularly to a high manganese pearlitic steel and the method of producing said steel.

One of the objects of my invention is to increase the tensile strength and hardness of high maganese pearlitic steel without materially affecting the ductility or to permit the reduction of the carbon and manganese content of the steel, but providing the same tensile strength and hardness with an increased ductility.

Another object of my invention is to provide for the elimination of impurities during the process of manufacturing the steel whereby a more thoroughly cleansed steel will be produced.

Another object of my invention is to improve the grain refinement of the steel as seen under a microscope.

My invention accordingly proceeds upon the principle of adding to a high manganese pearlitic steel, silicon in a quantity sufficient to provide for a silicon content in the final product of between .50 per cent and 1.50 per cent. The desirable qualities of my invention are realized in providing the above specified quantity of silicon in the final product in combination with the quantities of manganese and carbon which will produce, considering all of the constituents, a pearlitic steel, the manganese being present in a quantity sufficient to produce what is known in the art as a high manganese steel.

Inasmuch as the silicon acts in the capacity of a deoxidizer during the process of formation, it is necessary to add a quantity in excess of the above specified amount, due to the fact that silica is formed and passes out carrying the impurities into the slag. The specific amount in excess of the above specified quantities will depend largely upon the particular conditions of manufacture and will vary in different instances, the primary feature being to provide a sufficient amount to assure a content in the final product within the desired range.

It is well known in the art that pearlitic steel will be formed under certain specified conditions depending upon the per cent of the carbon content, and the content of the other ingredient which ingredient will be manganese in the case of manganese steel, and that these quantities are limited in the formation of pearlitic steel, and that also the various heat treatments to which the steel is subsequently subjected must be considered in determining the proportions, bearing in mind the particular kind of steel desired.

It is my intention to include as my invention, a high manganese pearlitic steel having a silicon content of from .50 per cent to 1.50 per cent and also, the process of forming said steel which consists in introducing silicon in sufficient quantities to assure a final content of this amount.

Although there are various proportions of the various ingredients which will produce high manganese pearlitic steel by way of example, I find it preferable to provide the carbon content of between .2 per cent and .6 per cent and a manganese content of between 1 and 2.25 per cent and a silicon content in the final product of between .5 per cent and 1.5 per cent. The presence of the specified amount of silicon in the final product affects the composition of the constituents which are formed as the steel is cooling through the critical temperature, these constituents being detected under the microscope. Steel when heated to a temperature above its critical temperature exists as Austenite in which form the different constituents exist in solid solution in gamma iron. In cooling from this condition through the critical temperatures, a crystallization of the different constituents takes place and according to theory, the ferrite or iron free of carbon separates before manganese leaving the solution richer in manganese. On the other hand, silicon separates from the solid solution more quickly than will iron, and when present in sufficient quantities, the silicon forms a compound with the iron separating out first giving a ferrite containing silicon, which combination results in a change in the physical properties of the steel.

This same action in which the silicon acts contrary to the manganese in the crystallization results in a change of the naturally

coarse structure of high manganese steel which coarse structure is broken up into structures of smaller grain sizes and therefore gives a more homogeneous mixture of the different constituents. While the addition of small amounts of silicon to steel increases the inclusions in the steel due to the formation of silica, it has been demonstrated that the use of the higher amounts of silicon results in the elimination of other impurities due to the fact that the silica which is formed unites with them and carries them out of the steel into the slag.

Although, it is my intention to include as part of my invention the addition of the necessary quantities of silicon in any desired manner, it is proposed by way of example as one desirable method that the silicon addition be made in the furnace, whereby the silicon content of the steel is sufficient to act as a deoxidizer according to ordinary practice and that the additional amount of silicon be added to the ladle.

The applicant is aware of the fact that the addition of silicon in steel is old and well known, and that in some instances silicon in the large quantities called for in this invention has been added to steel but what the applicant claims as new is the addition of the quantity of silicon specified, in a high manganese pearlitic steel and also, as a product, a high manganese pearlitic steel containing from .5 per cent to 1.5 per cent of silicon. The high manganese pearlitic steel made in accordance with my invention is found to possess a higher tensile strength than other known steels of its kind, while having the same degree of ductility, and also, according to my invention, by the increased percentage of silicon it is found that the carbon and manganese content can be reduced while maintaining the same tensile strength and providing an increased ductility.

Further, I have provided a steel which is more thoroughly cleansed and one which has an improved grain refinement. The points of novelty, and the scope of my invention are set forth in the appended claim.

I claim:

A high manganese pearlitic steel consisting of carbon, of from .20 to .60 per cent, manganese of from 1 to 2.25 per cent and silicon of from 0.5 to 1.5 per cent and the balance principally iron.

Signed at Chicago, Illinois, this 18th day of April, 1927.

WINFIELD C. HAMILTON.