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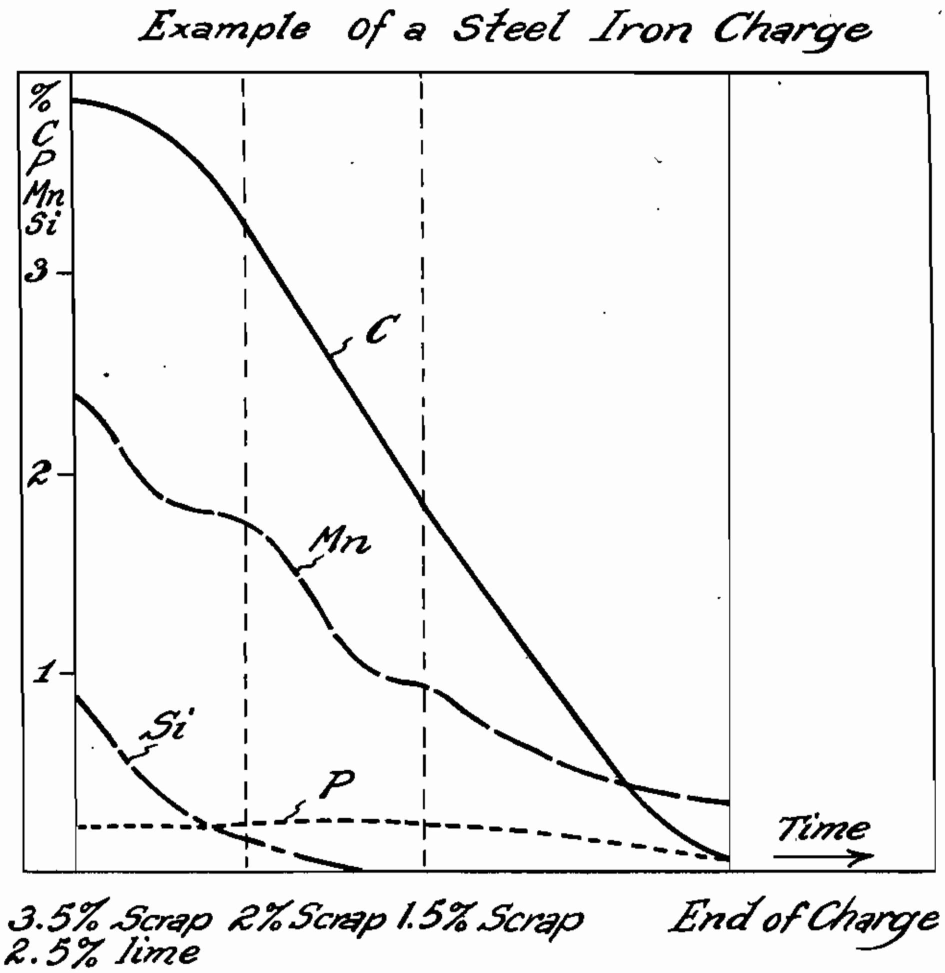

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ALIEN PROPERTY CUSTODIAN

PROCESS FOR THE PRODUCTION OF STEEL FROM PIG IRON

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For the conversion of pig iron into steel, it is known to use the blast converting process or the open hearth refining process or a combination of the blast converting process and of the open hearth refining process. The simplest, most efficient and most economical process for converting pig iron into steel is the blast converting process. In the case of the blast converting process it is possible to carry out the process either as an acid process (Bessemer process) or as a basic process (Thomas process) according to the composition of the pig iron. In the case of the acid process, which is still used on a large scale in the United States of America, the silicon is the main heat carrier. The pig iron contains about 1 to 2% Si and about 0.5% Mn. The phosphorus content must be low (considerably less than 0.1%) as a dephosphorization does not take place on the acid lining. The manganese content must also be low, as the manganese attacks the acid lining very actively and is besides lost on being converted into the acid slag. Occasionally higher percentages of manganese have been treated on acid lining. However, this is only in the case of emergency on account of the above reasons. In view of the present day position of raw materials it would be entirely wrong to blast on an acid lining pig iron with a high percentage of manganese.

The blast converting process on acid lining can supply only a small portion of the steel production, as $\frac{9}{10}$th of the whole of the existing iron ores contain phosphorus. Consequently, when working on acid lining, there usually only remains the expediency of preliminarily converting in the converter and finishing (dephosphorizing) in the open hearth furnace. The blast conversion on basic lining allows of direct blasting to steel even in the case of ores rich in phosphorus. The phosphorus content in the case of the basic process, is the main producer of the quantities of heat necessary for the production of steel. In view of the use of the slag as fertilizer a phosphorus content of at least 1.8% is necessary. The pig iron generally available today for the basic blast conversion mostly has approximately the following composition:

P 1.8—2%, Mn 0.6—1.2%, Si 0.2—0.5%

Occasionally, Thomas pig iron with a higher percentage of Si has been blasted to-day by way of experiment. In view of the saving in manganese the manganese content has recently been reduced in Germany to 0.6–0.8% as compared with the former content of 1.0–1.2%. The quantity of manganese necessary for the production of Thomas steel and introduced into the Thomas pig iron mixture is almost completely lost. For this reason iron with a higher percentage of manganese has never been blown in Thomas converters, except in works where the earth base naturally brought a higher percentage of manganese into the Thomas pig iron, for example in the Thomas Works at Peine. Moreover, this higher percentage of manganese represents another disadvantage for the Thomas process in losses of iron and manganese, as iron slagging occurs and consequently the waste becomes greater as the manganese content increases.

The present day position of raw materials compels exceptionally high steel charges in the Siemens Martin furnaces, which leads to exceptionally great difficulties in the running, because higher percentages of manganese in the charge have an extraordinarily great disturbing effect on the course of the reactions in the case of the open hearth refining process. At a corresponding state of the raw material conditions it is often necessary to treat 80 to 100% steel iron with a higher percentage of manganese and normal or higher percentage of silicon. The exceptionally great difficulties of a metallurgical kind, and the abnormally high expenses incurred by this method of treatment are known in the industry. It has been endeavoured, with the aid of open hearth refining mixers, to remove a small portion of the carbon and the greatest part of the manganese and of the silicon and to finish the melting in a second hearth furnace. In the case of manganese percentages far exceeding 1.8%, considerable difficulties arise also in the preliminary converter combined with high expenses. Moreover, the treatment with preliminary refining mixers is much more expensive than the ordinary basic S. M. process and the waste is much greater because the preliminary refiner converts 20% and more iron into slag.

Hitherto it was considered as not practical to blow to steel in the basic converter a steel iron with higher manganese content in the order of 1.5 to 5% manganese, 0.5 to 2% Si, 0.1 to about 0.4% P and 0.07% S or a Bessemer pig iron of similar nature with phosphorus amounting to 0.1% and more. The invention does away with this prejudice and proposes to work such a pig iron into steel also in the basic converter. At the same time it is particularly advantageous to ensure an undisturbed blowing process and to attain the desired final analysis with the greatest possible degree of accuracy by following certain measures. In putting the invention into practice it has been found particularly advantageous to allow the burning of the associated elements with the iron, particularly the manganese and carbon, to take place as uniformly as possible so as to attain the desired final steel product with the greatest degree of accuracy as regards temperature and also the analysis, and also as regards the waste.

An example of this method of working is illustrated in the accompanying diagram. The melting therein illustrated has been regulated in such a manner that the carbon and manganese burn uniformly and after the burning of the carbon the dephosphorisation sets in satisfactorily.

According to the invention this course of the reactions is attained by adding, according to the quantities of Si, Mn and P in the pig iron, a cooling medium (scrap, ore or lime) the quantity of which is determined merely by experiment. The time when the addition has to be made depends upon the behaviour of the melting during the blasting. With the same analysis the course of the reactions very often varies within wide limits during the blasting, owing to the different temperature of the pig iron in state of delivery and to its other properties, in a similar manner to that also known in the Thomas process. It is then necessary, when watching the blasting process, to add the cooling medium at the suitable moment. The correct time is recognized by the phenomena of the discharge and the nose flame also known in the Thomas process. For example it has been found to be correct, in the case of a steel pig iron containing 2.5% Mn, 0.55% Si and 0.15% P, to add a quantity of lime equal to 3% of the weight of the charge at the beginning of the blowing, 2% cooling scrap after 3 to 6 minutes blowing and an additional 1½% of cooling scrap after 6 to 10 minutes blowing.

By this method it is possible to reduce the Si content to traces, the carbon content to about 0.02% the phosphorus content to about 0.05% and the manganese content to 0.3 to 0.4% and at the same time to attain a temperature which is necessary for the casting of steel. The advantage of this method consists in that a slag is now obtained which is suitable for producing specular iron with for example max. 10% Fe, 18 to 20% Mn, about 20% SiO_2 and about 30% CaO, with a yield of 90% related to the metallic charge.

The new process allows a small quantity of slag with high percentage of manganese to be obtained, in that as little lime as possible is added beyond the theoretical quantity necessary for binding silicon and phosphorus. Moreover, the manganese content in the final product can in this manner remain so high that no manganese carriers need be used for the deoxidaton, at the most some phosphorus free steel iron for increasing the carbon. This means a considerable saving in manganese as compared with the ordinary blast conversion.

It is evident that in this manner a preliminary metal can be blown which is finished in known manner in the S. M. furnace. The above mentioned facts also apply for the production of this preliminary metal. It is possible by the same method to bring the carbon content of the preliminary metal, as in the case of the steel described, to within the limits of 0.5 and 1% and more, and at the same time the manganese content to about 0.80 to 1.5% and the silicon content to traces, according to the composition of the desired final product in the finishing furnace. The phosphorus content, however, remains then entirely in the preliminary metal.

By working according to the invention it is possible to produce a slag which can be worked to ferro manganese in that the slag after practically terminated decarbonisation is tapped before the burning of the phosphorus commences. In this case,, however, it is advantageous to tap the slag rich in silicon when the silicon burning is practically terminated, but before the decarbonization sets in, in order to prevent to a great extent a dilution of the slag rich in manganese to be tapped after the decarbonization.

An extremely great advantage of the blowing of steel iron in the basic blast refining converter is therefore the saving of manganese unsurpassed by any other process and the reduction of the waste. The necessary changing over to German ores allows occasionally conditions of production in which normal kinds of pig iron rich in phosphorus are obtained besides kinds of pig iron poor in phosphorus and rich in manganese. The basic blast converting process allows alternately an immediate changing over from the ordinary Thomas pig iron process to the blowing of steel iron rich in manganese.

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