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PROCESS FOR THE PRODUCTION OF PURE IRON OR IRON ALLOYS WITH STARTING FERROUS MATERIALS, ETC.

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The present invention relates to a process for the production of pure iron or iron alloys (that is a product containing impurities (S, Ph, Mn, Si, C) in a quantity not superior totally to 0,10%) starting from ferrous materials, above all finely subdivided particularly of ferric sands, residual muds from the extraction of aluminium, pyrite's ashes and similar natural or artificial substances containing not less than 20% of the metals to be extracted and the relative product.

It is well known that the immediate utilisation of ferric sands or of small iron ore bearing beds is impossible with the normal systems of production of iron cast out of a high furnace owing to the dustlike state in which the material is found or the great distance of the beds from the places where the working is done, this meaning too high expenses of forwarding, compared to the cost of production. On the other hand, owing to the insufficient consistency of said ore bearing beds and above all to their excessive extension it is not possible to construct important works not far from them because they would be exhausted before the cost of construction could be amortised.

Further on for these dustlike minerals a preliminary agglomeration is necessary to acquire the possibility of using them in the high furnace.

The process according to the present invention allows to utilise said ore bearing beds of ferrous material and to obtain pure iron or iron alloys. In order to reach this object the material is utilised in the same physical state in which it is extracted, such material then being treated in the electric furnace and iron instead of pig iron, extremely pure, is obtained, thus the further treatment being avoided which is required by cast iron for the transformation into common iron or steel.

The establishment comprises an electric furnace even of a small efficiency and relatively cheap and may be, above all, displaced from a bed to another with a moderate expense so that it is possible to utilise beds even of a limited efficiency and to produce blocks to be sent afterwards to the centers of utilisation.

On the other side the pure iron obtained has such mechanical properties that this iron can fully replace copper and brass for instance in the production of artillery cases and projectiles in general, of objects requiring a good resistance against corrosion and rust and possessing at the same time a great capacity of being pressed.

Owing to its very low contents of carbon the iron obtained according to the process of the present invention may be alloyed with special metals for the production of unoxidisable steel much cheaper than it is usually obtained; special steel sorts for very peculiar applications characterised by a great number of desirable properties as a great resistance to considerable strains. The iron may have further important applications which may be perhaps foreseen but not singularly specified.

In general the process forming the subject matter of the present invention consists in the introduction in a convenient electric furnace of a mixture of ferrous material of a convenient reducing means of an acid or alcaline basic addition, according to the nature of the reduction material, finely subdivided and intimately mixed. Said mixture is then progressively charged in order to be entirely melted. From this point forward great care is required to prevent the furnace's walls from being corroded by the slag. To this effect it is convenient to charge the mixture always towards the walls in order to cool the periphery of the bath. Eventually large pieces of the alcaline or acid basic material may be thrown against the walls. This first phase of the process serves to effect the reduction of the iron ore and may be prolonged till the bath contains but 2% of silicum or of the reduction means employed. The slag may be then removed. Should on the contrary it not be possible to keep the slag so long in the furnace this first slag is flown off and more iron ore is charged in the furnace with as much alcaline or acid basic material. Atfer the complete fusion of the bath the casting may take place. Should iron still contain a positive quantity of silicium or of another reduction means or other impurity, the operation may be repeated by conveniently adding a suitable flux.

In order to better illustrate the invention the following example of a particular application is given:

A mixture comprising

	Kg
Ferric sand (65% iron)	200
Silicium iron at 45%	120
Dried calcium oxyde	20

is placed in a convenient electric furnace for instance in a Three-Phase Heroult Furnace of 1 ton charge with a not carburising lining in the case a product deprived or nearly deprived of carbon is wanted. Care should be taken that arc heating occurs in precedence accurately avoiding any fall of coal from the electrodes of the furnace as

also any coal impurities whatever may be their cause. The mixture is charged progressively according to foundry practice and to the type of the furnace with the object to avoid a stoppage of the furnace and a bubbling around the electrodes.

After about two hours the mixture is completely melted. From the moment the melting has taken place, the walls of the furnace must be the object of great care and attention since they are subjected to be rapidly corroded by the slag, which in this case is very acid and fluid. In this connection care is to be taken that the mixture successively charged is always arranged near the walls of the furnace so that there is in contact with said walls always a cold mixture while the mixture under the electrodes is warm and fluid. When the whole mixture is melted, should any sign of bubbling or ebullition towards the walls or any other symptom of corrosion be perceived, it is necessary to throw against the walls on such points large pieces of dried oxide of calcium.

This phase of the process being a phase of reduction serves to have the greatest possible quantity of silicium passed from the metallic state to the one of oxide, while the passage in a contrary sense is at the same time obtained of as much iron. Said phase may be prolonged advantageously till the metal contains but about the 2% of silicium, after which such a slag is removed. Should the furnace not keep so long the slag, this slag is flown off before reaching the percentage of 2% of silicium. After removing this first slag there is charged

	Kg
Ferric sand	25
Oxide of calcium	25

taking care that a part at least of such calcium is arranged around the furnaee, against the walls, under the shape of large clods.

Also this mineral in about an hour and a half is completely melted and kept in the furnace till the metal which is on the bottom has lost the whole silicium after which the metal is flown off, taking care to choose the exact instant in which the metal has lost the silicium and has not been too much oxidised. An eventual oxidation may in any case be remedied as set off further-on.

In the case that after the removal of the first slag a too high percentage of silicium is remained in the metal, for instance the 10%, it certainly happens that the mineral recharged cannot be freed from said percentage. The second slag may then be removed and new material may be charged again for instance 25 kg more. Then the operation may go along similarly, attention being always made to the walls of the furnace, regulating the charge of the three electrodes, or displacing them possibly removing them to a certain distance from the dangerous point on which there is to be placed clods of calcium oxide.

Should the favourable point be surpassed and the metal is oxidised it is then necessary to remove all the slag containing iron oxide and charge oxide of calcium with some flux, for instance fluor-spar capable of keeping the new slag sufficiently liquid notwithstanding the absence of iron oxide together with deoxidising substances.

In order to obtain a good deoxidation it is necessary that the metal remains in the furnace at a temperature of about 1600° C for at least an hour and a half taking care during this period to supply the current but sufficient to keep said temperature so that all the little bubbles being formed in the mass of the metal owing to the deoxidising substances have time enough to ascend and float again, leaving the metal deprived of oxides and inclusions.

The deoxidising substances above mentioned may be aluminium, calcium, magnesium, boron, possibly in alloy even with iron, as also titanium, vanadium and the like. Of course they must not contain impurities especially carbon.

The starting mixture above mentioned is not essential and its composition may vary both according to the concentration of the principal elements contained in the different substances and to the object to be obtained. Also other substances may be added with the object of compensating eventual deficiencies of the substances employed. Instead of silicium iron for instance there may be used aluminium, sodium, magnesium, calcium, carbon, calciumcarbid, calciumsilicid, potassium and so on, mixed or eventually alloyed. There may be also employed a mineral containing other elements besides iron in order to obtain a product containing them in any concentration whatever. This may be particularly applied to the production of alloy steels.

The present invention has been illustrated and described in a preferred form of realisation, but it is clear that constructive changes may be introduced therein practically without surpassing the limits of protection of the present industrial patent.

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