UNITED STATES PATENT OFFICE.

MARCUS RUTHENBURG, OF PHILADELPHIA, PENNSYLVANIA.

PROCESS OF SMELTING IRON.

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To all whom it may concern:

Be it known that I, MARCUS RUTHENBURG, of Philadelphia, in the State of Pennsylvania, have invented certain new and useful Improvements in Processes of Smelting Iron, whereof the following is a specification.

My improvements comprise a smelting and refining process employing pig iron and iron ore in an ordinary foundry cupola or vertical stack furnace, as hereinafter described, and characterized by the production of a quantity of iron, approximating that originally contained in the entire charge of pig and ore, and of a quality superior to the original pig and ore in that it contains less sulfur and phosphorus, and is of finer grain, and of greater strength than the original pig.

The process consists in mixing ordinary pig iron and iron ore in definite proportions; charging the same in a vertical stack furnace; subjecting the mass to a fusing temperature, and, thereby producing two products; first iron containing less sulfur and phosphorus than the original pig iron or ore and second, ferruginous cinder containing the greater portion of the sulfur and phosphorus before embodied in the original pig iron and ore.

The following is cited as an example of the aforesaid process:—Taking a definite weight of an ordinary pig iron, known to the trade as #2 X Buffalo, an analysis of which showed .75 P., .15 S., and 3.25 C.; I mixed said iron with an equal weight of an ordinary iron ore in lumps, an analysis of which latter showed 62.7 Fe., .6 P., and .12 S., and charged said mixture in an ordinary foundry cupola furnace. Upon subjecting the mass to heat, by combustion of an amount of coke in said furnace, equal in weight to approximately 15 per cent. of the weight of the charge of pig iron and ore; an iron product was formed which amounted in weight to 80.75 per cent. of the aggregate weight of said original pig iron and ore. An analysis of said iron product showed .50 P., .095 S., and 2.00 C., and, the production of said iron was accompanied by the formation of a cinder which was highly ferruginous, showing upon analysis 51.51 Fe., 26.00 SiO_2, .775 P., and .25 S. Said iron product when cast in pigs was found to be of 50 per cent. greater tensile strength than the original pig iron, and superior thereto in every respect, its fracture being fine grained and silky.

It may be noted that if the original ore aforesaid had been melted by itself, (the stack being low and the melting rapid,) no reduction would have taken place. Of course, the 1.5 of carbon taken from the pig iron would not satisfy the oxygen of the ore, and, therefore, it may be assumed that the reaction occurred with the mass in a fused state, the ore robbing the metal of carbon and the metal being replenished with carbon from the coke; the metal in the mixture acting thus as a carrier of carbon to the ore.

In view of the fact that ordinary practice of iron melting in a cupola does not permit the admixture of any ore with the pig iron which is to be melted; and, that ordinary iron refining requires the employment of an open hearth furnace; it is to be observed that my present process is advantageous, first, in that approximately an equal quantity of ore may be mixed with the pig iron, thus, with a minimum amount of fuel; winning the iron direct from the ore and refining the pig used; and second, that an ordinary foundry cupola furnace may be employed instead of an open hearth furnace, or an expensive blast furnace for reducing the ore. Both of the aforesaid features of my process tending to economy of labor, time and fuel in the production of the iron, it is obvious that, by the employment of my process, a given quantity and quality of iron may be produced at less cost than hitherto possible.

For economical reasons, it is desirable to employ as large a proportion of ore as is possible in mixture with the particular pig iron to be used, and I find that the definite proportions may be advantageously varied in accordance with the grade of pig iron and ore employed, without departing from the essential features of my invention. Therefore, I do not desire to limit myself to the precise proportions stated.

I do not desire to broadly claim the feature of mixing iron and ore, for such mixtures are employed in the well known "pig and ore" processes of manufacturing steel and wrought iron. However, such known processes are of course distinguished from my present process by the different character of product obtained, and by the fact that open hearth, puddling or boiling furnaces are required for them. Moreover, said old processes are characterized by the agitation of the mixture during the process, by rabbling, boiling etc., and

are thus further distinguished from my present process, wherein the mixture is not agitated.

I claim:—

1. The herein described process which consists in mixing unburned pig iron and non-manganic iron oxid ore, in definite proportions; charging the same in a vertical stack furnace; preventing agitation of said mass while subjecting it to fusing temperature in said furnace, and, thereby producing two products; first, iron containing less sulfur and phosphorus than said pig iron; and, second, cinder containing sulfur and phosphorus derived from said pig iron.

2. The hereinbefore described process which consists in mixing ordinary pig iron and non-manganic iron oxid ore in approximately equal parts by weight; charging the same in a vertical stack furnace; preventing agitation of said mass while subjecting it to fusing temperature in said furnace, and, thereby producing two products; first, iron representing the amount in said pig plus the greater part of that in said ore, and containing less sulfur and phosphorus than the original pig iron; and, second, ferruginous cinder containing the greater portion of the sulfur and phosphorus before embodied in the original pig iron and ore, substantially as and for the purpose set forth.

3. The hereinbefore described process which consists in mixing ordinary pig iron and non-manganic iron oxid ore in definite proportions; charging the same in a vertical stack furnace upon a separate and distinct mass of fuel; preventing agitation of said mass while subjecting it to fusing temperature in said furnace, and, thereby producing two products; first, iron representing the amount in said pig plus the greater part of that in said ore, and containing less sulfur and phosphorus than the original pig iron: and, second, ferruginous cinder containing the greater portion of the sulfur and phosphorus before embodied in the original pig iron and ore, substantially as and for the purpose set forth.

4. The hereinbefore described process which consists in mixing unburned pig iron and iron ore, in definite proportions; charging the same in a cupola furnace; continuously preventing agitation of said mass while subjecting it to fusing temperature, and, thereby producing two products; first, iron representing the amount in said pig plus the greater part of that in said ore, and containing less sulfur and phosphorus than the original pig iron; and, second, ferruginous cinder containing the greater portion of the sulfur and phosphorus before embodied in the original pig iron and ore, substantially as and for the purpose set forth.

In testimony whereof, I have hereunto signed my name, at Philadelphia, Pennsylvania, this twelfth day of February, 1903.

MARCUS RUTHENBURG

Witnesses:

ARTHUR E. PAIGE,

E. L. FULLERTON.