

UNITED STATES PATENT OFFICE.

GEORGE HAND SMITH, OF ROCHESTER, NEW YORK.

IMPROVED PROCESS FOR MAKING STEEL DIRECT FROM THE ORE.

Specification forming part of Letters Patent No. **11,338**, dated July 18, 1854.

To all whom it may concern:

Be it known that I, GEORGE HAND SMITH, M. D., of Rochester, New York, have invented a new Process for the Manufacture of Steel Direct from the Ore, of which the following is a full, clear, and exact description.

My invention relates to a process for deoxidizing and carbonizing iron ores and producing therefrom either spring or cast steel; and my said invention consists in treating the ore in a comminuted state and mixed with charcoal or other carbonaceous matter, and with or without other flux, depending on the nature of the ore, in a close cementing oven, retort, or other suitable close vessel, at a high degree of heat—say about a white heat—and after it has been deoxidized, if an oxide, and the carbonic acid expelled, if a carbonate, and then carbonized, separating the metallic particles of steel from the remaining impurities, and then, for making spring-steel, welding the particles in a reheating furnace and rolling or hammering it into bars; and for cast-steel, melting the particles of carbonized metal in crucibles, in the usual manner of making cast from blistered steel.

The mode of procedure which I have practiced with success is as follows, viz: By any of the known and suitable means the ore is crushed or ground to lumps of about the size of forty to the inch (more or less) and then, as far as possible, mechanically separated from the earthy and other impurities, the object being twofold. First, the better to effect the separation of the earthy impurities; and, second, to present the metallic particles in such a state that they will be readily and uniformly charged with carbon. And thus prepared it is charged in a cementing-oven, such as is used for making blistered steel, or in a retort or other suitable vessel with pounded or ground charcoal or other carbonaceous matter.

The charge should be in alternate layers of ore and coal, and each layer from about one inch to one inch and a half in thickness.

When the ore is of such a composition as to require other flux than carbon such other flux is to be mixed with the ore in the charge. When the charge is completed the oven is closed and heated in the usual manner of cementing-ovens, and after the ore in the charge has reached what is termed a "white" heat, it is

to be kept at that temperature for about forty-eight hours, the length of time depending somewhat on the nature of the ore and the degree of temper (carbonization) required. The temperature required and expressed by white heat is just short of fluidity, as the object is to effect the change without melting the particles of iron, which would thereby be overcharged. For a large oven containing a charge of about twenty tons of ore the heat should be applied about six days, the greater portion of which time will be consumed in heating the oven and bringing up the charge to the required temperature.

The mode of testing the degree of carbonization is by the color of the surface of the ore. When properly charged with carbon the ore assumes (in cooling) a blue and yellow color and combinations of these colors, and then passes to a brown, and finally, when overcharged, to a gray color. By taking out portions of the ore the operator can tell by the colors when the required temper is reached, and then the fire is to be discontinued and the charge permitted to cool down in the oven. During the converting process the particles of ore become united by the earthy impurities and the flux, if any be used in addition to the carbon, and each layer forms a sheet. When cooled and taken out of the oven the mass is to be re-broken or crushed, and the metallic particles separated from the impurities by magnets, or by blowing or other suitable means, and if it is to be made into cast-steel it must be melted in crucibles and cast into ingots precisely as in the well-known process of making cast-steel from blistered steel; but if to be converted into spring-steel, the articles are to be worked in a furnace such as is used for balling scrap-iron, and there heated to a welding heat, but not so long as to burn out the carbon, and balled and either rolled or hammered into bars, as may be required.

When, by the neglect of the operator or from any other cause, it is found that the metallic particles have been overcharged with carbon, the mass is to be treated in a reheating-furnace such as is used for balling scrap-iron, and there puddled to expel the surplus of carbon, and then balled and hammered and rolled into spring-steel, or broken up and treated in the crucible to be made into cast-steel.

It is not deemed necessary to describe the various kinds of flux which may be used in addition to the carbon, as the necessity for and the kind to be used will depend upon the constituents of the ore and the properties other than the temperature required to be imparted to the steel, and as these are all matters well-known to iron-masters and foreign to my invention, which relates simply to the process of converting iron ore directly into steel, it is deemed unnecessary to specify the kinds of flux to be used other than carbon.

This process is as equally applicable to the ores known as "carbonates" as to the oxides, for in the carbonates the carbon is not mixed with the iron alone, as in the case of steel, but it is united with the iron in the form of carbonic acid, which must be expelled before the union is formed between the iron and carbon without oxygen to produce good steel.

What I claim as my invention, and desire to secure by Letters Patent, is—

The process of converting the iron ores known as the "oxides" and "carbonates" directly into steel by subjecting the ore in the comminuted state with carbon, and with or without other flux, in a close oven, retort, or other vessel to a high degree of heat—say about the temperature of what is known as "white heat"—and then separating the metallic particles from the impurities, and either melting them in crucibles to produce cast-steel or welding and balling them in a reheating-furnace and subjecting the mass to pressure by rolling or hammering to produce spring-steel, all substantially as specified.

GEORGE HAND SMITH.

Witnesses:

WM. H. BISHOP,
CHAS. W. BAMBURGH.