

# UNITED STATES PATENT OFFICE.

JAMES HENDERSON, OF BELLEFONTE, PENNSYLVANIA.

## BASIC PROCESS OF MANUFACTURING IRON AND STEEL.

SPECIFICATION forming part of Letters Patent No. 284,553, dated September 4, 1883.

Application filed August 10, 1883. (No specimens.)

*To all whom it may concern:*

Be it known that I, JAMES HENDERSON, of Bellefonte, in the county of Centre and State of Pennsylvania, (formerly of New York city,) have invented a certain new and useful Improvement in Basic Processes of Manufacturing Iron and Steel; and I hereby declare that the following is a full, clear, and exact description of the same.

10 The invention has for its object the removal of phosphorus from liquid cast-iron; and it consists in subjecting the metal in a basic-lined converter to the action of fluor-spar, and of air and hydrogen, and, under some circumstances, 15 to the action of a hydrocarbon, as more fully hereinafter set forth.

In carrying out this invention I make use of a Bessemer converter or similar vessel, lining the same with some suitable basic or non-silicious material, which may be lime, magnesia, 20 or magnesian lime, applied preferably in the form of burned brick; but other modes of applying these substances, for which Letters Patent have been granted to me, may be used.

25 The iron to be treated may be the iron rich in carbon and silicon—such as is generally used in the “acid process”—say containing two to three per cent. of silicon, three and one-half to four per cent. of carbon, and too much phosphorus to make useful steel by that process; 30 but I do not purpose to limit myself to the use of this iron. It is preferred, also, that the metal contain enough manganese—say from three to five per cent.—to effect the production of steel without the use of spiegeleisen at the end of the blowing. The iron may be taken 35 direct from the blast-furnace to the converter, or melted in a cupola and poured into the converter, and blown in the usual way with air during the “first period,” or that portion of 40 the operation which is known as the “desilicization period,” or until the silicon is reduced to about or below five-tenths per cent. At the end of this period the converter, preferably, may be turned down and the slags 45 poured from it, after which the fluor-spar is charged upon or into the metal in any convenient way, as by blowing it in with the air, the converter being raised to its usual position 50 when at work. The blowing is then continued, steam being admitted into the blast-pipe with the air, and thus forced into the metal.

The steam is decomposed by the heat into its constituents. The fluor-spar also is melted and decomposed, the fluorine and lime combining with the greater portion of the phosphorus and removing it partially as a vapor, 55 but a portion of it also going into the slag. The hydrogen of the steam facilitates the operation by also combining with a portion of 60 the phosphorus. After the metal has been blown until the carbon is reduced to approximately one per cent. petroleum or some equivalent hydrocarbon may be introduced with advantage for a period of two or three minutes, 65 (its introduction into the blast-pipe being conveniently effected by means of an Archimedean screw.) The hydrogen of the petroleum contributes toward the removal of the phosphorus, while the carbon serves to increase the 70 temperature of the metal, thus making it easier to pour from the converter. From two to three gallons of petroleum to each ton of metal may be used with advantage.

While it is preferred to introduce the fluor-spar after the removal of the silicious slags that 75 are formed during the process of desilicization, the fluor-spar may be introduced before the blowing begins. In such case, however, a much larger quantity will be required, and 80 there will not be the same advantage in pouring off the slags prior to the introduction of the steam. If, however, the fluor-spar be introduced into the vessel with the charge and before the blowing begins, it will be found necessary to use petroleum or some equivalent 85 hydrocarbon at a later stage in the process. The reason for this is that the silicon, instead of burning, as would be the case if the fluor-spar were not introduced at the beginning, 90 will largely be removed by the fluorine without combustion, and this will tend to cool the metal to such a point that it will be exceedingly difficult to pour it. The subsequent use of petroleum will restore the heat thus lost 95 and render the metal sufficiently fluid to pour with ease.

By using the petroleum in sufficient amount the use of steam may be dispensed with, since the hydrocarbon will supply the requisite 100 quantity of hydrogen to effect the purification of the metal.

For the purpose of preventing redshortness and giving steely properties to the metal, it



may, after the desiliconization or the decarbonization, be treated with ferro-manganese or with spiegeleisen in the usual manner, as practiced in the Bessemer process.

5 I do not herein broadly claim the use of fluor-spar and air to remove the phosphorus from cast-iron when applied in the Bessemer process, as this is described in Patent No. 274,889, dated March 27, 1883, granted me.

10 My present invention is an improvement on said process, as it enables the purification of the metal with less fluor-spar, and the metal is hotter at the end of the operation, and may be more readily poured from the converter.

15 I do not claim, broadly, the use of hydrocarbon in the Bessemer process for keeping up the heat.

What is claimed as new is—

1. The improvement in the art of manufacturing iron and steel, which consists in sub-

jecting the molten iron in a converting-chamber lined with a basic or non-silicious material to jets of air to desiliconize it, and subsequently treating it with fluor-spar, and with air and the vapor of water, substantially as and for 25 the purpose set forth.

2. The improvement in the art of manufacturing iron and steel, which consists in subjecting the molten iron in a converting-chamber lined with a basic or non-silicious material 30 to jets of air to desiliconize it, and subsequently treating it with fluor-spar, and with air and the vapor of water, and with petroleum or some equivalent hydrocarbon, substantially as and for the purpose described.

JAMES HENDERSON.

Witnesses:

ROBT. H. DUNCAN,  
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