

UNITED STATES PATENT OFFICE.

GEORGE ARCHBOLD, OF NEW YORK, N. Y., ASSIGNOR TO HIRAM GILBERT
BOND, OF SAME PLACE.

PROCESS OF DEPHOSPHORIZING IRON AND STEEL.

SPECIFICATION forming part of Letters Patent No. 412,448, dated October 8, 1889.

Application filed August 23, 1889. Serial No. 321,770. (Specimens.)

To all whom it may concern:

Be it known that I, GEORGE ARCHBOLD, a subject of the Queen of Great Britain, and a resident of the city of New York, New York county, and State of New York, have invented certain new and useful Improvements in the Dephosphorizing of Iron and Steel, of which the following is a specification.

In the process of refining crude and pig iron and converting it into malleable iron or steel, either in the cupola, ladle, crucible, or in the converter used in what is generally known as the "Bessemer" process of conversion, it has been found difficult to use iron containing large proportions of phosphorus or phosphorus and sulphur. Many attempts have been made to overcome these objections, and what is known in the art as the "basic" method of conversion has been found perhaps the most practicable way of treating such iron in carrying out the Bessemer process. This method, while successful to a certain extent, is expensive, owing to many reasons which need not be specifically set forth, but principally owing to the rapid destruction of the so-called "basic lining" of the converters, and to the additional manipulations necessary in the treatment of the metal. By my invention I am enabled to overcome these objections, to eliminate the phosphorus and sulphur, and this without the use of any special basic lining to the converter, nor other lining than the ordinary ganister or other equivalent material, and without the additional manipulation required in the basic process.

My invention consists in treating or subjecting the molten metal while being reduced to the action of the salts of barium, and while this may be accomplished in different ways I have found it most convenient and practicable to add the salts of barium to the molten metal in the form of a powder, which may be supplied to the cupola, ladle, crucible, or converter in any convenient manner, though it may be supplied in the form of lumps, or in any other equivalent manner. The salts of barium are added in amount shown by the analysis of the iron to be sufficient at least to completely combine with all the phosphorus and sulphur; or, if it is desired to re-

tain some of the phosphorus, the desired proportion of phosphorus can be eliminated by adding the proper amount of the salts of barium to combine with that proportion of phosphorus. The salts of barium combines with the phosphorus and with any sulphur contained in the molten mass and passes off as a volatile product and as slag, which may be removed in the usual way.

While I can make use of different salts of barium—as the oxides and nitrate and other oxysalts of barium—I have found, for many reasons, that the carbonate of barium is the best. This substance, which is found in nature in the form termed "witherite," is cheap and easily attainable, and, moreover, its chemical properties are such that it is peculiarly adapted to accomplish the desired result. At the melting-point of iron the carbonate of barium unites with the phosphor compound and sulphur compound in the iron, forming waste products.

I have experimented with other substances than the salts of barium; and while I have found the most satisfactory results from the use of these salts I have found the salts of strontium to possess these properties in some degree, although not to the extent of the salts of barium.

By the use of my invention I am therefore enabled to refine what is known as iron high in phosphorus and convert it into malleable iron and steel, which products have the qualities of iron and steel made from iron low in phosphorus, and this I accomplish without a basic lining of the vessel used.

I am aware that it has been suggested to use a small proportion of chloride of barium and fluoride of calcium in connection with chloride of calcium for the purpose of dephosphorizing molten iron, the air being excluded from the iron during the process. I am also aware that the use of fusible mixtures containing barium has been suggested; but my invention is distinguished from these in that I make use of the reaction that when barium carbonate is heated in contact with carbon and atmospheric or equivalent nitrogen at a temperature of at least 2,200° Fahrenheit, forty per cent. of the barium is con-

verted into cyanide of barium, which immediately reacts upon the phosphide of iron, eliminating the phosphorus, which unites with the resulting baryta as phosphide of barium, while in this reaction ferro-cyanide of iron is produced, and is immediately converted into a refractory carbide of iron, which mixes with the slag. Fusible mixtures of alkaline carbonates, fluorides, &c., will retard such action, while under these conditions barium carbonate alone is eminently fitted not only as a dephosphorizer but desulphurizer at the same time, while when fusible mixtures with other alkaline carbonates are used I have found by direct experiment that only the sulphur is acted upon, and that partially. I find that fifty per cent. of the original carbon in the iron is consumed in this reaction.

I do not herein claim the method of smelting iron ores in the presence of salts of barium, as set forth in my application No. 321,769, filed simultaneously herewith. 20

What I claim is—

The process of refining crude or pig iron and converting the same into malleable iron and steel, which consists in subjecting the crude molten metal to the action of the oxy-salts of barium, substantially as described. 25

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses. 30

GEORGE ARCHBOLD.

Witnesses:

J. S. BARKER,
FRANK H. PLATT.