

# UNITED STATES PATENT OFFICE.

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AND TENER ASSIGNORS TO SAID OLIVER AND WITHEROW.

## INGOT IRON AND STEEL.

SPECIFICATION forming part of Letters Patent No. 314,505, dated March 24, 1885.

Application filed February 4, 1885. (Specimens.)

*To all whom it may concern:*

Be it known that we, JAMES P. WITHEROW, HENRY W. OLIVER, Jr., JOHN F. WILCOX, and GEORGE E. TENER, all of Pittsburg, in the county of Allegheny and State of Pennsylvania, have invented a new and useful Improvement in Ingot Iron and Steel; and we do hereby declare the following to be a full, clear, and exact description thereof.

Much difficulty has heretofore been experienced in the manufacture of Bessemer steel because of the presence in the pig metal of various impurities, such as silicon, phosphorus, and sulphur. The amount of phosphorus present is relatively much greater than that of sulphur, and the defects in the product have usually been attributed to the phosphorus. When the ore contains over .06 per cent. of phosphorus, it is regarded as unfit for use in the manufacture of Bessemer pig, and this is the case with fully four-fifths of the ore now in use, so that with the constantly-extended uses to which Bessemer steel is being put the tendency is to an increased price for suitable ores. The basic dephosphorizing and other processes were devised for the purpose of utilizing for Bessemer purposes the phosphoric metal made from such ores; but the increased cost of manufacture is so great as to neutralize the saving effected by using the cheaper ores. There remains, therefore, a vast quantity of cheap ore which cannot be used for ordinary Bessemer purposes, because the metal made therefrom can be brought into malleable shape only by the basic dephosphorizing or other process, or by puddling, all of which are expensive operations. Furthermore, there are enormous deposits of iron ore on this continent and elsewhere which have heretofore been considered entirely worthless on account of the high proportion therein of such impurities as phosphorus, sulphur, &c., which rendered it impossible to produce marketable iron therefrom by any of the processes mentioned or known.

In making our improved product we utilize in the pneumatic or other form of oxidizing process phosphoric pig metal containing a percentage of phosphorus which has hereto-

fore entirely unfitted it for Bessemer or like purposes, and thereby make it possible to use for such purposes many varieties of ore which have heretofore been entirely inapplicable and worthless in the arts.

The invention consists of ingot iron or steel which is practically free from silicon, low in carbon, and high in phosphorus.

One process by which we can obtain our improved product is as follows, viz: We use a stationary converter having the requisite number of tuyeres extending horizontally through its sides, preferably at or about midway of the height of the column of metal in the converter, and a cinder-notch placed about eighteen to twenty inches above the metal-line. A charge of molten metal—say three thousand four hundred pounds—containing 1.8 per cent. of silicon and .55 of phosphorus is placed in the converter, and is blown with a low-pressure blast, beginning, say, at seven pounds, and then slowly reduced to about five pounds as the metal becomes more fluid. In five or six minutes the cinder will begin to flow from the cinder-notch, and this flow usually continues for one or two minutes. The blow is continued, and then the metal is tapped off in a ladle and recarburized, if desired, by the addition of ferro-manganese or other recarburizer, in the usual way. In this operation the charge is practically desiliconized, the silicon going into the slag and passing off at the cinder-notch in the form of silicate of iron. The phosphorus remains in the metal. The percentage of phosphorus in the product is usually proportionately higher than in the charge, owing to the reduction of the total weight due to the waste of conversion.

We have discovered that the phosphorus may be used as a steelifying agent for iron in place of silicon or carbon, which have heretofore been considered essential to the production of steel, and in proportion as the other metalloids are reduced or eliminated this property of the phosphorus is utilized, so that the necessity of the final additions of carbon and manganese heretofore used in the basic or other oxidizing processes is more or less obviated. If it is desired, carbon and



manganese may be added in quantities to suit the particular grade of metal required, as will be understood.

Bessemer steel is considered to be high in phosphorus when it contains .12 per cent., and usually it is unfit for use if this limit is exceeded, while our improved product runs from .15 upward in phosphorus, usually containing from .40 to .60 per cent.

By "phosphor ingot iron or steel" we mean a product of the pneumatic process practically free from silicon, low in carbon, and containing from .15 per cent. and upward of phosphorus.

The presence of the phosphorus assists in keeping up the heat of the bath after the elimination of the silicon and carbon, and also imparts to the resultant product hardness, stiffness, and rigidity—properties of value for many uses in the arts—while it has been found by us that it does not detract from the working or malleable qualities of the metal.

By "low in carbon" we mean one-tenth of one per cent. or under.

While we have described the operation of producing our improved metal as being carried on in a stationary converter, we do not wish to be understood as limiting it thereto, but desire to include all forms of pneumatic apparatus capable of use for the purpose described.

We do not herein claim the process, as such process forms the subject of another application of even date herewith.

The characteristics of our improved product are high tensile strength, with .5 per cent. of phosphorus, being from seventy thousand to eighty thousand pounds; elastic limit, about fifty thousand pounds; percentage of elongation, about twenty per cent.; reduction of area, thirty-five per cent.; perfect ease of welding, extreme ductility, spreading freely, and absence of tempering properties.

It is particularly applicable for use in the manufacture of nails, tacks, spikes, rivets, bolts, chains, shovels, spades, and all kinds of stamping ware, wire, rails, crow-bars, harrow-teeth, wood-choppers' wedges, picks, mattocks, &c., pipes, tubes, and flues, tin plates and sheets, tank and boiler iron, and all kinds of blacksmithing and merchant iron.

What we claim as our invention, and desire to secure by Letters Patent, is—

Phosphor ingot iron or steel practically free from silicon and low in carbon, substantially as described.

In testimony whereof we have hereunto set our hands this 30th day of January, A. D. 1885.

JAMES P. WITHEROW.  
HENRY W. OLIVER, JR.  
JOHN F. WILCOX.  
GEORGE E. TENER.

Witnesses:

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