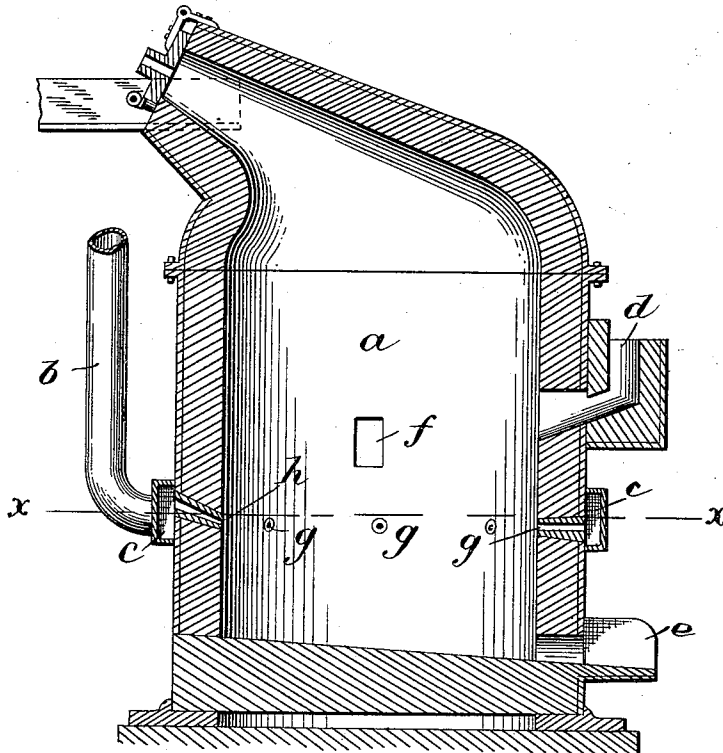


(No Model.)

J. P. WITHEROW.
MANUFACTURE OF IRON AND STEEL.

No. 481,881.

Patented Aug. 30, 1892.



Witnesses:
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UNITED STATES PATENT OFFICE.

JAMES P. WITHEROW, OF ALLEGHENY, PENNSYLVANIA.

MANUFACTURE OF IRON AND STEEL.

SPECIFICATION forming part of Letters Patent No. 481,881, dated August 30, 1892.

Application filed January 2, 1889. Serial No. 295,171. (No specimens.)

To all whom it may concern:

Be it known that I, JAMES PORTER WITHEROW, of Allegheny, in the county of Allegheny and State of Pennsylvania, have invented a new and useful Improvement in the Manufacture of Iron and Steel, of which the following is a full, clear, and exact description.

It has been customary in the treatment of molten metal by what is known as the "Bessemer process" to subject a large quantity of metal to the action of a high-pressure blast of air entering the converter through tuyeres placed at or near the bottom for the purpose of blowing through the entire charge. The weight of the metal upon the mouths of the tuyeres is so great that it is necessary to have a strong blast-pressure to keep the tuyeres clear. In addition to this the tendency of the Bessemer practice is to increase the pressure of the blast, on account of its more rapid action on the crude metal. As the blast cannot be stopped until the converter is tipped or the metal falls below the nozzles of the tuyeres, it follows that the portion of the charge which is last to leave the converter in tapping is subjected to the action of the blast for a longer period than the first portion of the metal. The result is that the ingots vary in character and are not homogeneous in structure. Various expedients have been adopted to obviate this evil. It was for this purpose that the tipping converter was devised. This, however, does not entirely obviate the trouble, because the tuyeres do not all leave the metal at the same time while the converter is turning over. Another expedient is found in the Clapp & Griffiths stoppers, by means of which the blast may be shut off at pleasure without danger to the tuyeres.

It is desirable in the manufacture of ingot iron and steel to treat the metal to a low pressure or to so apply the blast that it operates upon but a portion of the metal at a time. To accomplish this and at the same time to avoid the necessity of using stoppers without to any considerable extent destroying the uniformity of the product, I have devised my present improvement, in practicing which the tuyeres are arranged either horizontally or with a downward projection at or near the surface

of the metal in the converter, so as to blow on or near the surface of the charge. When thus arranged, there being but a small portion of metal above the nozzles of the tuyeres at any time, only a very mild or low-pressure blast is necessary to keep the mouths of the tuyeres clear and but a small portion of the metal is treated at a time. The effect of the blast, however, is to cause an upward circulation of the molten metal, which will bring all portions of the entire charge successively under the oxidizing influence of the blast, so that it is thoroughly decarbonized and purified during the operation. When the charge is tapped off, the tuyeres being at or near the surface, the molten metal soon falls below them, so that but little harm is done by keeping on the mild blast which is used and there is no want of uniformity in the product.

To enable others skilled in the art to make and use my invention, I will now describe it by reference to the accompanying drawing, which is a vertical section of a converter constructed in accordance with my improvement.

The converter *a* is of the usual form known as a "fixed converter" and is provided with a blast-main *b*, blast-box *c*, charging-hole *d*, metal-tap *e*, slag-hole *f*, and tuyeres *g*, the latter, however, being arranged near the metal-line *x x* instead of, as heretofore, at or near the bottom of the converter.

At *h* I show an inclined tuyere, the nozzle of which dips into the metal in such a way that if the blast should be stopped before the molten metal falls below the level of the nozzle any portion which may enter therein will fall out by its own gravity. The tuyeres being arranged at or near the metal-line and below the slag-hole *f* the blast acts only on the upper portion of the charge; but it causes or creates an upward circulation of the metal, which brings every portion of the charge successively under its oxidizing influence, portions of the metal being in and by such circulation successively agitated and atomized or broken up into small particles. The slag being formed at the surface of the bath is more perfectly separated therefrom than where the tuyeres are arranged below and more easily removed after separation by skimming off or by flushing it through the slag-

hole when it boils up during the operation. It will be evident to those skilled in the art that this operation is not necessarily conducted in the particular construction of fixed converter described, and I propose to apply the oxidizing process set forth to any form of converter or converting-vessel known in the art. For example, the air-blast when applied in the manner above described to the molten metal while being held in a ladle or receiving-reservoir will keep the metal from chilling and partially purify the charge, or if the blast and agitation be continued for a sufficient time the crude metal may be completely refined in the ladle or receiving-chamber, suitable means being provided for the removal of the slag. The upward circulation or agitation of the charge of metal in the manner described, whereby each portion of the bath is brought successively in contact with the air of the blast, may be assisted by mechanical means. For example, an agitator inserted into the bath or the metal may be thus treated in a revolving hearth, mechanical puddler, or oscillating converter.

By "upward circulation" I mean that movement in the bath caused by the action of the blast on or at the upper surface whereby the lower parts of the charge rise and pass in procession in front of the tuyeres and then sink to the bottom to give place to other rising portions, establishing an upward circulation, which continues as long as the blast is on. This result is not obtained in a horizontal circulation, because in such case the metal in the plane of the tuyeres only would be exposed to the direct action of the blast, the other parts of the charge not passing in front of the tuyeres.

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

1. The method of refining molten iron in the pneumatic process, which consists in simultaneously agitating and subjecting the charge of metal to a blast of air on or near the surface in such manner as to produce an upward circulation of the metal and bring every portion of the charge successively under the oxidizing influence of the blast, substantially as and for the purposes described.

2. The within-described improvement in converting crude iron into malleable iron or steel, consisting in imparting to limited portions in succession of a bath of molten metal violent agitation in the presence of a converting agent, separating the impurities and the metal, returning the latter to the body of the metal in the bath and back from the body of metal in the bath to the area of agitation, and repeating these operations until all the metal has been acted on, the impurities are separated therefrom, and the conversion is complete, substantially as set forth.

3. The process of converting crude iron into malleable iron or steel, which consists in imparting to successive limited portions of a bath of molten metal a violent atomic agitation and separating the metal and the impurities, returning the metal to the body of the bath and maintaining the eliminated impurities in their separated state, and repeating these operations until the entire body has been repeatedly operated upon, substantially as set forth.

In testimony whereof I have hereunto set my hand this 29th day of December, A. D. 1888.

JAMES P. WITHEROW.

Witnesses:

THOMAS DUGAN,
JNO. F. WILCOX.