(No Model.)

G. L. ROBERT.

PROCESS OF CONVERTING CRUDE IRON INTO MALLEABLE IRON OR STEEL.

No. 400,010. Patented Mar. 19, 1889.

Fig. 1.

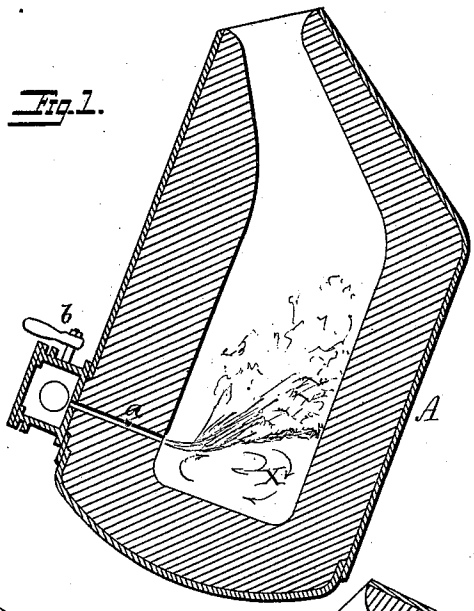


Fig. 2.

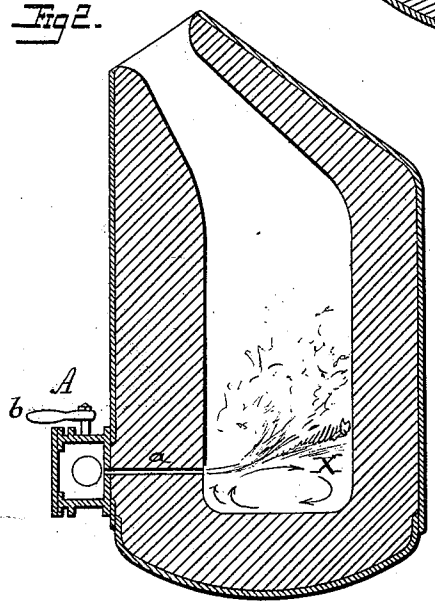
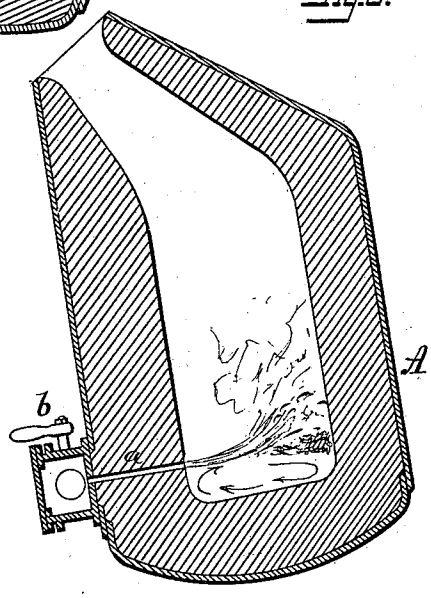


Fig. 3.



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UNITED STATES PATENT OFFICE.

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PROCESS OF CONVERTING CRUDE IRON INTO MALLEABLE IRON OR STEEL.

SPECIFICATION forming part of Letters Patent No. 400,010, dated March 19, 1889.

Application filed November 19, 1888. Serial No. 291,189. (No model.)

To all whom it may concern:

Be it known that I, GUSTAVE LOUIS ROBERT, a citizen of the Republic of France, residing at Stenay, Department of the Meuse, Republic of France, have invented a new and useful Improvement in the Process of Converting Crude Iron into Malleable Iron or Steel, of which the following is a full, clear, and exact specification.

In the use of the rapid method of converting crude iron into malleable iron or steel a converting-blast of aeriform oxidizing agent, as air, has been projected upon a portion of a body of molten metal in such manner as to contact at one time with a limited part only of said body to impart a violent agitation to such part only, and also to impart to the main body of the metal a flow or gyration which repeatedly brings every portion within the area of violent agitation without creating currents or movements that would tend to carry into the body of the metal any eliminated particles that are upon the surface thereof. The violent agitation results in separating the metal and the impurities, and the latter, once freed from their adhesion to the metal, remain upon the surface of the bath, owing to their lighter specific gravity, while the contact of the converting agent with the extended surfaces of metal resulting from stripping off and breaking up successively small bodies of metal by the action of the blast causes a rapid oridizing action and the formation of impurities which are separated from the metal carried with the blast and deposited and retained collected together upon the surface of the bath. In this mode of conversion there are certain variable conditions inherent in the nature of the process, which, if not fully met and provided for, affect in varying degrees the ultimate result produced. First, the metal when first put into the converter is lower in temperature than later in the process of conversion, and is therefore more viscid and immobile, and it will be evident that a large mass of metal in such viscid condition, and weighing in some cases several tons, cannot at once be set in rapid gyration by the action of a propelling-blast directed upon a small area of one of the faces of the mass unless such blast is strong and powerful, so as to overcome the inertia of the mass, and that even in such case the initial movements are necessarily slow. There is a greater tendency to overoxidation when the mass is in a stationary or comparatively stationary state than when it is gyrating, so that as a result of the slow gyration of the mass at the beginning of the operation there is relatively less metal presented to the oxidizing agent, and the combustible elements of the bath are not exposed with such rapidity as to take up all of the oxidizing agent, and as some considerable time necessarily elapses before the inertia of the mass is fully overcome and the requisite gyratory motions secured there is a tendency of the surplus oxygen to attack and act with destructive effect upon the metal. Thus while the oxygen may quickly burn out the carbon and silicon and other combustible elements held by the iron, the surplus of oxygen in the blast, owing to the limited amount of metal presented to its action, seizes upon the iron itself in the absence of other combustible elements to take it up and rapidly forms therewith an oxide of iron, resulting not only in a great waste of metal, but in the production of impurities which deteriorate the quality of the product. As the process continues and the metal is presented more rapidly to the blast, presenting increased quantities of the elements to the oxygen, there is an increased combustion and heat, which results in rendering the metal more fluid and therefore more mobile, so that the blast will impart a more rapid gyration thereto, and this may increase until the movement is too rapid, tending to cause the impurities generated in the process of conversion to be returned to and remixed with the body of the metal in the bath. As the combustible elements contained in the iron are gradually reduced in amount as the process is continued, and the proportion of combustible matter subjected to the action of the blast and capable of combining with the oxygen becomes gradually less and less, the amount of oxygen in the blast presented to the metal becomes relatively greater toward the termination of the process, and this results in a further excess

of oxidizing agent, which, in the absence of any material with which to combine, seizes upon the iron, forming an oxide with the detrimental effects before referred to.

It is the object of this invention to overcome the defects in the rapid mode of conversion, as above set forth, and to provide means for maintaining more constant and fixed relations throughout the whole period of the act of conversion, and this object is effected by varying the position and volume of the blast, so that its mechanical and converting action will each vary with the varying conditions of the metal.

For the purpose of illustrating the invention and one means of carrying it into effect, I have shown in the accompanying drawings sectional elevations of an ordinary converter, three Figs. 1, 2, and 3 illustrating the operations and conditions at three different stages in the process.

The mass of metal constituting the bath X is passed in a molten form into the converter A, as usual. The latter is tilted so as to carry the surface of the metal to the tuyeres *a*, as shown in Fig. 1, that the converting-blast may be thrown upon the surface of the metal.

In order to vary the volume and pressure of the blast for the purpose described, I throttle the passage through which the air is conducted to the tuyeres in any suitable manner—as, for instance, by an ordinary valve controlled in its position by a handle, *b*—and while different means may be employed for varying the height of the blast in respect to the normal surface of the metal, I prefer to effect this result by tilting the converter to different positions during different stages of the operations. Thus, at the beginning of the operation the converter is tilted so that the blast, which is then at its maximum pressure, is applied upon the surface in such manner as will overcome as speedily as possible the inertia of the metal and quickly impart to it the desired speed of gyration.

In applying the blast in the beginning of the operation it is projected at such an angle as to come into contact with a more extended surface of the metal than at subsequent stages of the operation for the purpose of avoiding the overoxidation that would result from applying the blast violently and in large volume upon a limited area of the metal. After the metal has acquired the desired speed of gyratory motion, the converter is tilted to lower the bath to its position, (shown in Fig. 2,) so as to act upon a more limited area of the metal at one time, but with a greater atomizing or dividing effect, bringing the particles of iron into more intimate contact with the air and increasing the combustion and heat and the fluidity of the metal, and with this change in the position of the blast I begin to reduce the volume and the pressure, proportioning such reduction to the effect desired to be produced, as may be determined by indications easily recognized by any one skilled in the operation of conversion. As the process continues, the converter is further tilted toward the position shown in Fig. 3, and from this on the pressure and position of the blast are so varied or maintained as may be necessary to secure the desired result.

By the operation above described I can readily avoid the tendency to overoxidation that results at the beginning of the rapid process of conversion from the inertia of the metal, the sluggishness of its movements, and from the difficulty of imparting to it the desired speed of gyration by a blast applied locally at the surface, without also supplying an excess of the oxidizing agent.

I claim—

1. The within-described improvement in the conversion of crude iron into malleable iron or steel, consisting in applying a blast of air to the surface portion of a body of molten metal at a maximum pressure at the beginning of the operation for the purpose of overcoming the inertia of the metal and imparting thereto the proper speed of gyratory motion, lowering the level of the blast as the process continues without carrying it into the body of the metal, and varying the pressure and volume of the blast to meet the requirements of the reduction in the combustible elements of the iron and the increased fluidity of the metal, substantially as set forth.

2. In the process of converting crude iron into malleable iron or steel by the action of a blast applied locally upon the surface of the mass of molten metal, varying the level of the blast and the volume and pressure thereof in proportion as the metal increases in speed of gyration and fluidity and as the combustible elements are eliminated, substantially as set forth.

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

GUSTAVE L. ROBERT.

Witnesses:
GEO. H. GRAHAM,
F. L. FREEMAN.