

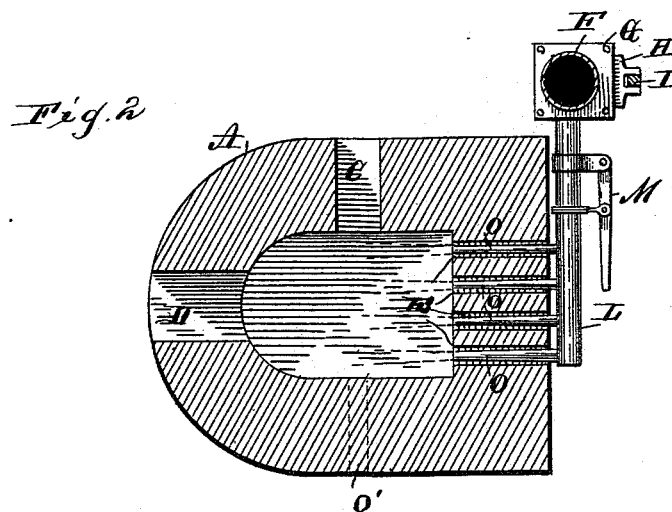
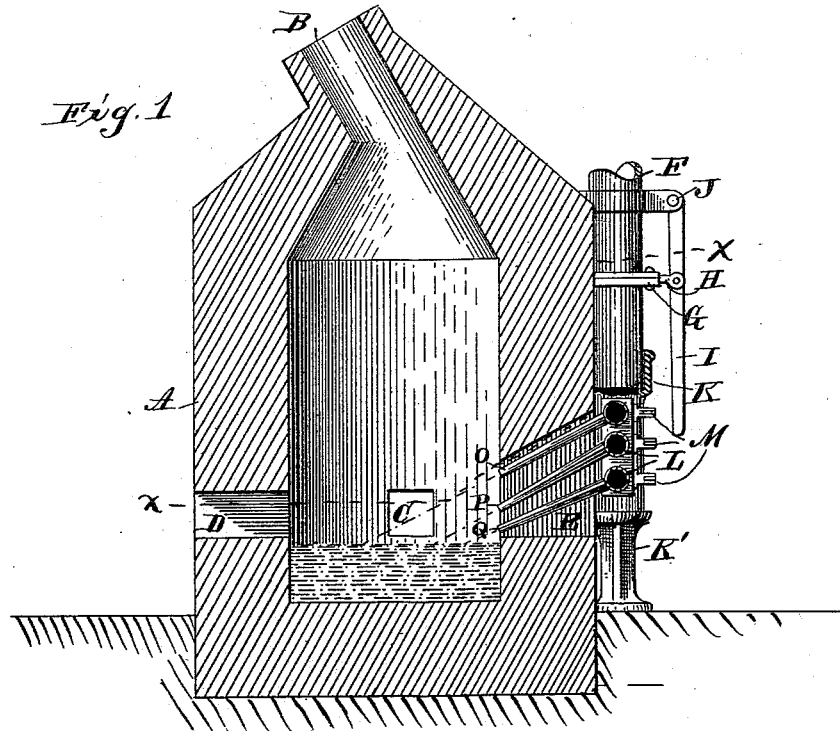
(No Model.)

R. F. LUDLOW.

APPARATUS FOR DECARBONIZING AND PURIFYING IRON.

No. 420,078.

Patented Jan. 28, 1890.



WITNESSES

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# UNITED STATES PATENT OFFICE.

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## APPARATUS FOR DECARBONIZING AND PURIFYING IRON.

SPECIFICATION forming part of Letters Patent No. 420,078, dated January 28, 1890.

Application filed December 18, 1888. Serial No. 293,982. (No model.)

*To all whom it may concern:*

Be it known that I, RODNEY F. LUDLOW, a citizen of the United States, residing at Springfield, in the county of Clark and State of Ohio, have invented certain new and useful Improvements in Apparatus for Decar-

bonizing and Purifying Iron, of which the following is a specification, reference being had therein to the accompanying drawings.

This invention relates to the decarboniza-

tion of iron and the removal or liberation of the impurities contained therein while in a molten state by the action of atmospheric-air blasts or currents for the purpose of converting the same into higher and different grades of iron or into different grades of steel, as may be desired.

The invention consists of a converter-vessel and separate tuyere-sections adjustable to and from the converter upon a vertical axis, and carrying, respectively, one or more tuyeres proper, the tuyere or tuyeres of one section running at an angle to the tuyeres carried by the other sections, and suitable cut-offs to control the respective tuyere-sections, so that by the several directions of the tuyeres proper and the said adjustment the air may be directed upon the molten metal contained in the converter-vessel at different places over essentially the entire surface thereof, the said air-currents having the ability to so disturb the mass as to cause it to expose practically its entire body to the air-currents, whereby essentially every part of the mass is exposed to the effect or combustion which this action creates, to the end that the contained impurities may be consumed or liberated and decarbonization effected, rendering the mass in condition to be recarbonized by fluxing therewith some carbonizing agent to convert it into any high desired grades of iron or to convert it into steel.

In the accompanying drawings, forming a part of this specification, and on which like reference-letters indicate corresponding parts, Figure 1 represents a vertical sectional view of a converter and an elevation of the air-blast pipes and tuyeres, and Fig. 2 a horizontal section of the same parts on the line *xx* of Fig. 1.

The letter A designates the vessel, which I term the "converter," built or lined with refractory material, and conveniently located with respect to the surface of the ground or floor about the apparatus, on which the workmen stand. It is, by preference, of the type illustrated in the figures, being rectangular in three sides, substantially semicircular in the fourth side, and terminating in an inclined neck or exit B, and provided with openings C and D for the introduction of the molten mass, for inspecting the same after the blast is cut off, and for introducing the carbonizing agent, concerning which more will hereinafter be stated. The openings C and D may be interchangeably used for these purposes. One of the vertical walls of the converter is constructed with a series of slots or passages E for the reception of the tuyeres, and of such shape as to permit the tuyeres to be adjusted to different lateral directions relative to the converter.

The letter F refers to a blast-pipe, provided with a cut-off G, preferably in the form of a slide H, operated by a lever I, fulcrumed to the pipe through a band and pin J. This pipe has rotatably fitted over its lower end a section K, supported upon a pedestal K', and to this section are connected several tuyere-sections L—three in the present instance. This connection between the section K and the pipe F admits of the tuyere-sections being adjusted to and from the converter, so as to change the lateral direction of the tuyeres proper to cause the air issuing therefrom to reach to different places across the surface of the molten metal, as suggested by the dotted lines in Fig. 2.

The letter M refers to the cut-offs entire of the respective tuyere-sections L, these cut-offs being preferably of the type shown in connection with the pipe F. As each tuyere-section has its independent cut-off, it will be seen that the air may be allowed to issue from either or all of the respective sets of tuyeres. These tuyeres are designated O, P, and Q, and extend from the respective tuyere-sections through the slots E in the wall of the converter, and are disposed at angles to each other, as seen in Fig. 1. These angles are such that the air is directed against the

proper places of the surface of the molten mass, which they act upon to impart thereto a regular, constant, and tumbling motion, which results in the exposure to the air-currents of the entire mass. The high degree of heat of the mass of metal and the violent projection of the air-currents against the various parts of the surface produce the combustion or effect which takes up or consumes the contained carbon and impurities, effecting decarbonization and the liberation of foreign substance. When these results have been secured, an indication of which is the withdrawal or absence of escaping flames from the neck or exit B of the converter, I recarbonize the molten mass of pure iron with any of the known carbons, as spiegeleisen, in varying quantities, according to the grade of commercial iron or grade or hardness of steel desired. After a lapse of about three minutes the molten mass will be found to have thoroughly fused with the introduced carbon and to be ready for withdrawal. The converter is then tapped, as by removing an obstruction from an opening designated at O' in Fig. 2. The converting process occupies from eight to eleven minutes when a ton is contained in the converter.

I desire to have it understood that I am aware that prior to my invention it was well known to introduce air-currents upon the surface of molten iron; but in such instance the direction of the currents was not varied and the place of contact of the air with the metal was essentially in one place. This failed of the result attained by me in the practice of this invention, as I have ascertained by repeated trials on a large and practical scale. I am also aware that prior to my invention it had been proposed to manipulate the converter on trunnions practically in this regard after the fashion of the well-known tipping of the Bessemer converter during the introduction of air-currents through tuyeres fixed in the wall of this tipping converter; but this involved a manipulation of the converter itself—a structure necessarily heavy and correspondingly unwieldy—and also involved, as is apparent, a mode of operation differing from mine and opposed to the change of relative position between the tuyeres and the converter, and devoid of the various angles of the tuyeres, which change and angles lead to the change and various places of contact between the air and the metal. I have shown one manner of adjusting the tuyere-sections to and from the converter; but others may be employed.

It will of course be understood, in referring hereinbefore to the use of the openings C and D for the admission of the molten metal, that it is drawn from a furnace or other melting apparatus. A cupola—that is to say, a vessel constructed after the manner of a cupola—

when provided with my improvements, will be understood as included within the term "converter" or "converter-vessel."

While I have referred to air as being forced into the converter, I wish to be understood as contemplating the use of any vapor or gaseous substance capable of desired results.

The openings C and D may also be used, besides for the purposes hereinbefore mentioned, for skimming the dross or other impurities which accumulate on the surface of the iron. I also take out of the converter through either of these openings some of the metal to more closely inspect its condition, should occasion require. These openings C and D are closed by suitable means, as by filling them with fire-clay during the operation of converting.

Having thus fully described my invention, what I claim as new, and desire to secure by Letters Patent, is—

1. In an apparatus for decarbonizing iron and liberating the impurities contained therein, the combination, with a converter-vessel, of an air-supply pipe in proximity thereto, a series of distinct tuyere-sections connected to said pipe one above the other and extending across one side of said converter, and one or more tuyeres connected to each of said sections and extending into the converter, the tuyeres of each section discharging at different places upon the surface of the contained bath from the tuyeres of the other section and running at an angle to the tuyeres of the other sections.

2. In an apparatus for decarbonizing iron and liberating the impurities contained therein, the combination, with a converter-vessel, of an air-supply pipe in proximity thereto, several distinct tuyere-sections connected to said air-pipes and adjustable on a vertical axis to and from the converter, suitable cut-offs, and one or more tuyeres connected to said section, and each tuyere separately discharging into the converter at a different place on the surface of the contained bath from the tuyeres of the other sections.

3. In an apparatus for decarbonizing iron and liberating the impurities contained therein, the combination, with a converter-vessel, of an air-blast pipe, a pipe-section rotatably connected thereto, a plurality of tuyere-sections extending from said pipe-section, a cut-off in the air-blast pipe and a cut-off for each tuyere-section, and a series of tuyeres proper connected to each tuyere-section, the tuyeres of one section running at an angle to those of the others.

In testimony whereof I affix my signature in presence of two witnesses.

RODNEY F. LUDLOW.

Witnesses:

E. S. WALLACE,  
WARREN HULL.