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A. B. KITTSON & A. B. BROWNE.

APPARATUS FOR DEOXIDIZING OR OXIDIZING.

No. 522,422. Patented July 3, 1894.

Fig. 1.

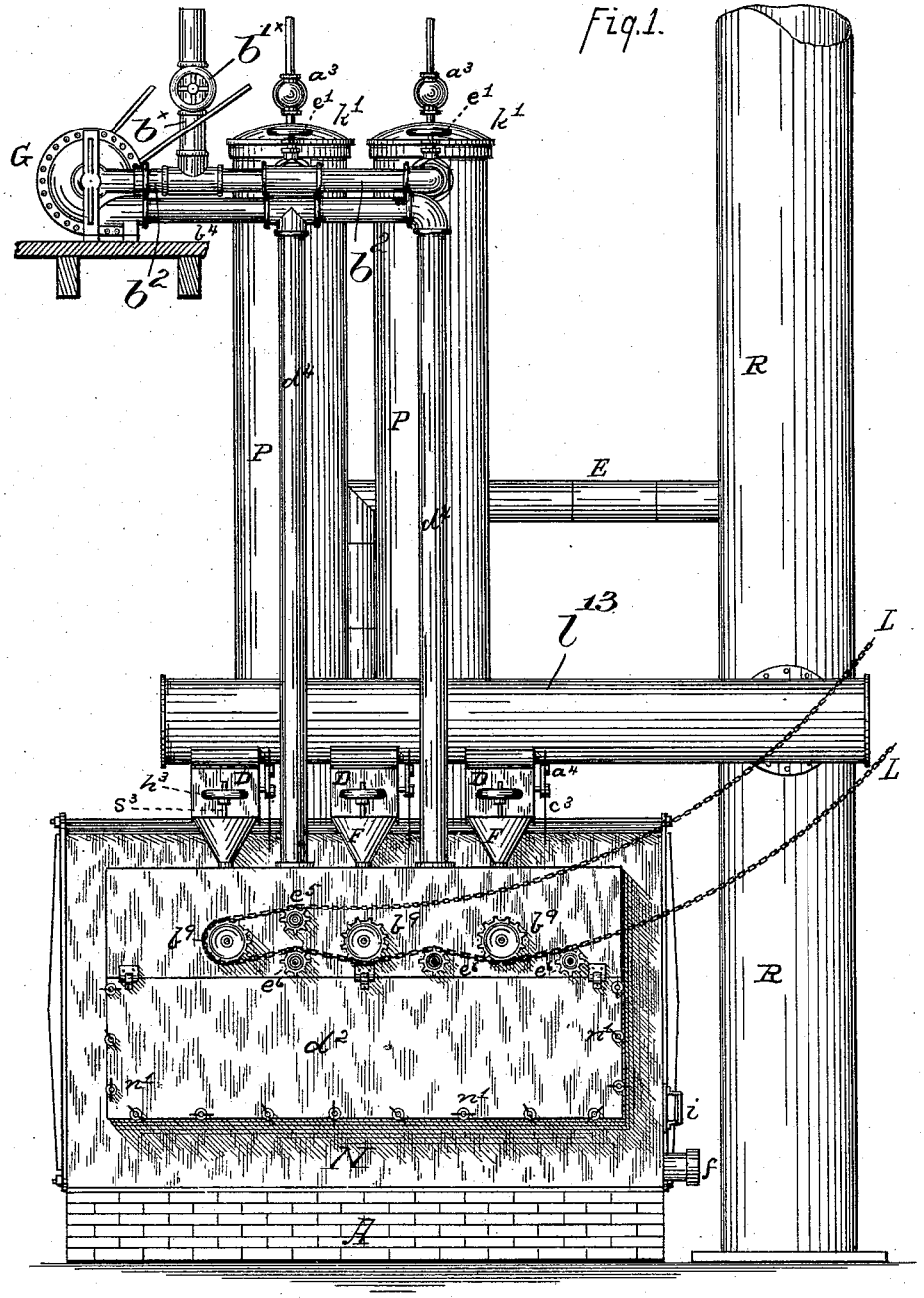

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Fig. 2.

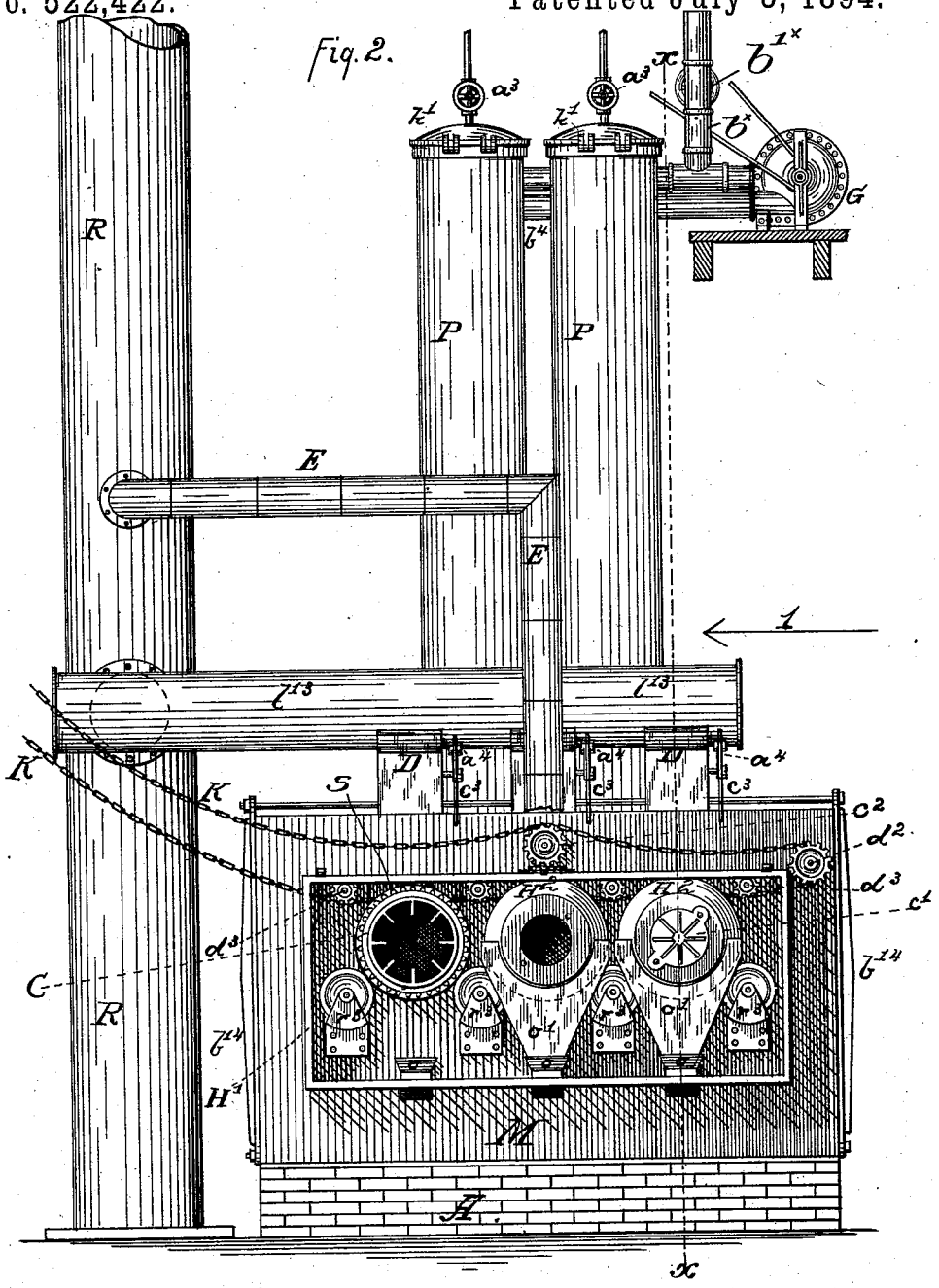

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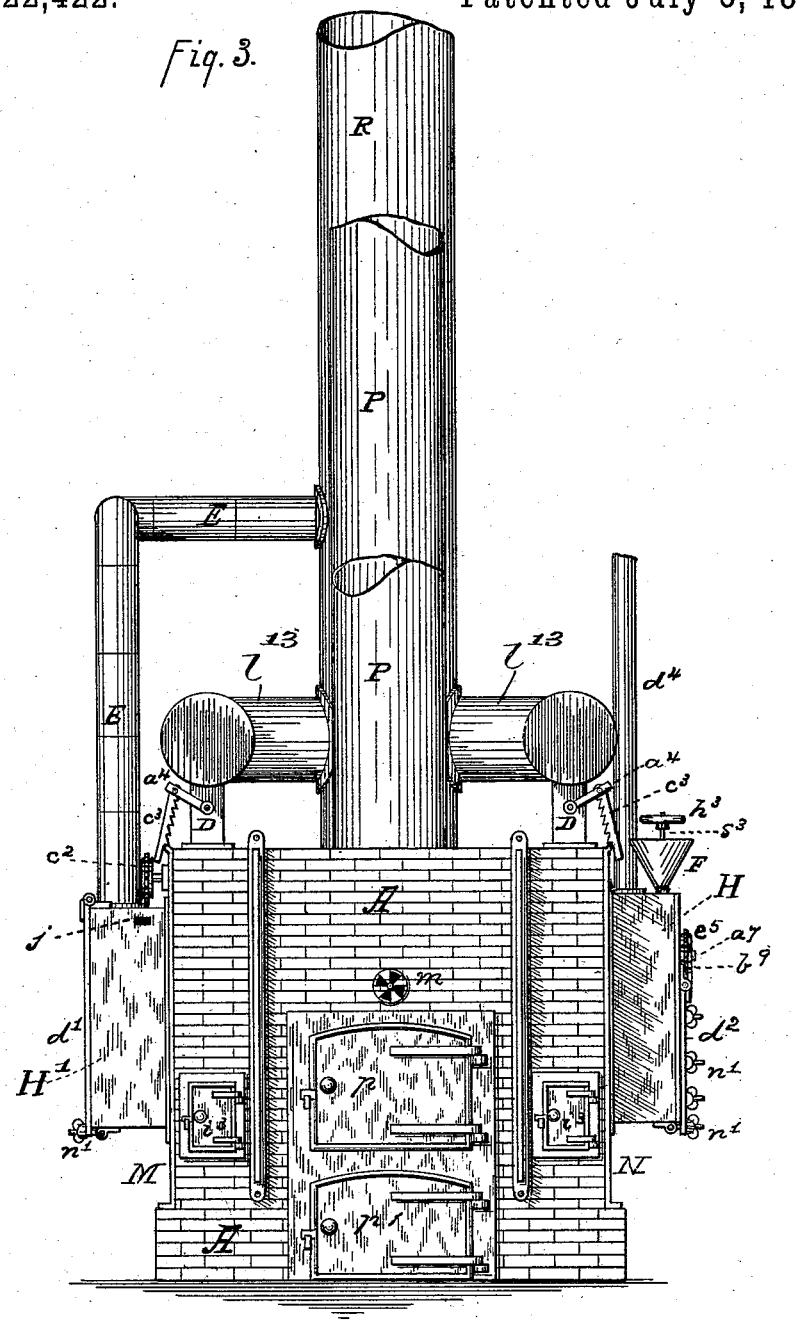
Fig. 3.



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APPARATUS FOR DEOXIDIZING OR OXIDIZING.

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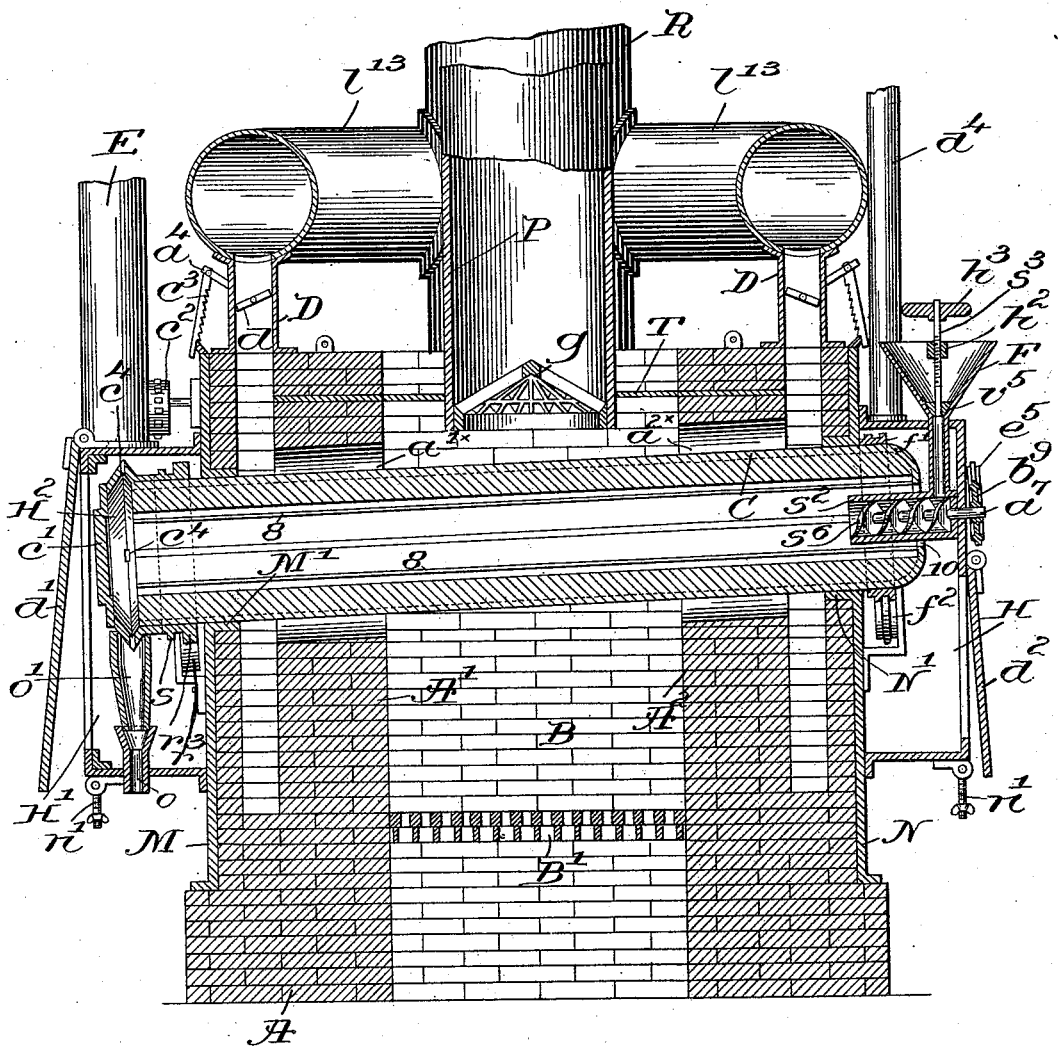
Fig. 4.



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UNITED STATES PATENT OFFICE.

ALFRED B. KITTSON, OF BOSTON, AND ARTHUR BENJ. BROWNE, OF CAMBRIDGE, MASSACHUSETTS.

APPARATUS FOR DEOXIDIZING OR OXIDIZING.

SPECIFICATION forming part of Letters Patent No. 522,422, dated July 3, 1894.

Application filed August 18, 1893. Serial No. 483,449. (No model.)

To all whom it may concern:

Be it known that we, ALFRED B. KITTSON, of Dorchester, Boston, county of Suffolk, State of Massachusetts, and ARTHUR BENJAMIN BROWNE, of Cambridge, county of Middlesex, State of Massachusetts, have invented an Improvement in Apparatus for Deoxidizing or Oxidizing, of which the following description, in connection with the accompanying drawings, is a specification, like letters and figures on the drawings representing like parts.

This invention has for its object the production of an apparatus for deoxidizing or oxidizing material, such as ore, &c., in a rapid, cheap and convenient manner, our invention consisting in various details of construction to be hereinafter described and claimed.

Figure 1 is an elevation, taken at the feed end, of an apparatus embodying our invention. Fig. 2 is a similar view of the apparatus taken at the delivery end, with the door of one of the hoods removed. Fig. 3 is a side elevation thereof, showing the fire and ash doors, and Fig. 4 is a vertical longitudinal section enlarged, and partly broken out, taken on the line x—x, Fig. 2.

A brick or masonry furnace A, provided at its ends, as herein shown, with metallic casings M and N, has a combustion chamber B extending across the same, with a grate B′ therein of usual construction, access being had to the combustion chamber and ash pit by suitable doors p and p' respectively, see Fig. 3, a damper m opening into said chamber. Bridge walls A′ and A^2, see Fig. 4, are located at each end of the combustion chamber, provided with openings $a'^{\times}$ and $a^{2\times}$ respectively, for the passage of the products of combustion, and as herein shown the openings are at different heights, the opening $a'^{\times}$ being the lower. These openings communicate with flues D which lead to collecting flues or pipes l^{13}, opening into the stack or chimney R.

As shown in Figs. 1 and 2 there are three flues D, at each end of the apparatus, and preferably each bridge wall has three openings therein, similar to $a'^{\times}$ and $a^{2\times}$ respectively, communicating each with a flue, and for a purpose hereinafter described.

A crown sheet T closes the top of the combustion chamber, and is supported by the sides and bridge walls of the furnace, as clearly shown in Fig. 4, said crown sheet being pierced preferably above the center of the grate to receive the ends of one or more carburetors P, two being herein shown, see Figs. 1, 2, and 3, said carburetors being closed at their upper ends by movable caps or covers k', and provided with test valves a^3.

The lower ends of the carburetors open into or communicate with the combustion chamber, see Fig. 4, and are provided with grates g, herein shown as conical, to sustain the charcoal or other carbonaceous material with which the carburetors are to be filled, for a purpose to be described.

A pipe b^2 connects the carburetors with the exhaust side of a suitable fan or blower G, valves e' controlling the connection between said pipe and each carburetor, and a suitable pipe or passage d^4 connects the pressure side of the fan or blower G with a hood H located at the feed end of the apparatus and secured to or forming a part of the casing N, the hood having a door d^2 whereby access may be had to its interior, suitable catches, shown herein as thumb nuts n', serving to retain the door tightly shut when the apparatus is in operation.

From the foregoing description it will be seen that a portion of the products of combustion traverse the carburetors P, are drawn thence by the fan or blower G and conveyed to the closed hood.

A series of cylinders, one of which as C is shown in section in Fig. 4, are supported in suitable bearings M′, N′, in the casings M and N respectively, said cylinders extending through the openings $a'^{\times}$ and $a^{2\times}$ in the bridge walls heretofore described, in an inclined position with relation to the horizon, the ends of the cylinders projecting beyond the ends of the furnace, as clearly shown in Fig. 4. Said cylinders are made of metal and provided on the inside with a series of longitudinal bars or projections 8, dividing said cylinders into a series of longitudinal grooves or channels extending from one to the other end thereof, the upper or feed ends of the cylinders or chambers being open, as at 10, Fig. 4, and into each cylinder through said opening is extended a feed duct s^2 communicating

with the outlet of a hopper F, into which the ore or other material to be deoxidized or oxidized is fed, the same having preferably been previously pulverized.

The outlet of the hopper is provided with a suitable controlling valve v^5 secured to the valve stem s^3 extended through the support h^2 and controlled by a suitable hand wheel h^3, rotation of the latter in one or the other direction raising or lowering the stem, and thereby the valve v^5, to regulate the flow of the material to the feed duct. The feed ducts are each provided with a worm or screw s^6 secured on a shaft a^7 extended through the outer wall of the hood H, and provided with a sprocket or other wheel b^9, whereby the shaft may be rotated to feed the material forward through the feed duct and into the upper end of cylinder C, as best shown in Fig. 1.

The sprocket wheels b^9 are rotated by a chain L driven in any suitable manner, not herein shown, said chain being supported by idlers e^5 and e^6, as shown, whereby the feed of the material into each of the cylinders is uniform, the rate of feed being regulated by the rapidity of travel of the sprocket chain L. It is obvious that belt pulleys and a belt might be substituted for the sprocket wheel and chain to accomplish the same purpose.

The cylinders are preferably provided at their upper ends and outside of the casing N with flanged guide wheels f' which rest upon friction or other rolls f^2, serving to keep the cylinders in position and also to reduce friction.

As shown in Figs. 2 and 4, the lower ends of the cylinders are closed by caps H^2 formed to present a friction bearing r adapted to rest upon a series of friction rolls r^3, the projecting ends of the cylinders and the caps thereon being inclosed by the hood H', provided with a door d' adapted to be tightly closed during the operation of the apparatus.

The caps H^2 are provided with a series of peripheral openings c^4 through which the ore and the gas escape after passing through the cylinder, removable ends c' being secured to the cap whereby access may be had to the interior of the cylinder if desired, and, as shown in Fig. 2 the cap is removed entirely from the left hand piece, and the end piece from the center cylinder.

The gear s is formed on or secured to the cap, as shown in Figs. 2 and 4, to be engaged by a sprocket or other chain K, see Fig. 2, said chain being guided and supported by idlers c^2, d^2 and d^3, whereby the cylinders C are rotated in the same direction and at the same rate of speed, the weight of the cylinder largely being taken up by the friction bearings at its projecting ends, as described.

Referring to Fig. 4 it will be seen that the central portion of each cylinder is located immediately over the combustion chamber and consequently is most highly heated at its central portion, the heat gradually diminishing toward the ends as the products of combustion pass through the openings in the bridge walls and out through the flues D, so that the heat gradually increases from the feed end of the cylinder to the center thereof, thence gradually diminishing to the delivery or outlet.

The hood H' is provided with a series of discharge ducts o, and preferably between each discharge and the corresponding cap H^2 we interpose trunks o', best shown in Fig. 2, which fit snugly around a portion of the cap and open into said discharge ducts.

In Fig. 2 one of the trunks o' has been omitted to show the cylinder end from which the cap has been removed.

The flues D are provided with suitable dampers d actuated by external levers a^4 to which are pivoted adjusting rack-bars c^3.

A flue E leads from the hood H' and communicates with the stack or chimney R for the purpose of carrying off the gases escaping from the cylinders or chambers.

The operation of the apparatus described when used to deoxidize is as follows—The carburetor P having been filled, by means of the movable covers k', with some carbonaceous material, preferably coke or charcoal, a fire is built upon the grate of the combustion chamber B and the fan or blower G is set in motion, whereby the gaseous products of combustion, consisting principally of carbon-dioxide, are drawn from the combustion chamber and through the carburetors, highly heating the same and causing the carbon-dioxide to part with one atom of oxygen, thereby becoming carbon-monoxide. This carbon-monoxide is forced through the pipe d^4 into the hood H, and thence into the cylinders C through the openings 10 in their upper end, where it comes in contact with the pulverized ore which is fed in gradually by the feeding mechanism hereinbefore described, the ore, as heretofore stated, being gradually heated until it reaches the center of the cylinders. The cylinders are revolved by the mechanism described, and owing to the inclinations of the cylinders and the projections or bars 8 the ore is made to slowly traverse the entire length of the cylinders in constant contact with the highly heated carbon-monoxide with which the cylinder is filled, finally dropping out of the lower end of the cylinder through the apertures c^4, provided for that purpose, into the trunks o' and out through the discharge ducts o. The projections or bars in the rotation of the cylinders carry a portion of the ore up along the side and then drop it into the bottom of the cylinders to thoroughly expose it to the action of and bring it in contact with the carbon-monoxide which constantly fills the cylinders, due to the pressure exerted by the fan or blower G, and inasmuch as the inclination of each cylinder is known, and the number of revolutions made thereby per minute, the length of time required for the ore to pass from one to the other end of the cylinder can be calculated readily. By the action of the carbon-monoxide upon the ore metallic oxides

therein are reduced and are discharged from the hood H′, the carbon-monoxide combining with the oxygen of the material and being thereby converted to carbon-dioxide, escaping through the apertures c^4, which are uppermost in the rotation of the cylinders, into the hood H′ and thence by pipe E to the stack or chimney.

In Fig. 1 it will be seen that the pipe b^2 has a branch $b^\times$ located between the fan or blower and the valves e', said branch having a valve $b'^\times$ therein, to normally close said branch when the apparatus is used as a deoxidizing apparatus. When, however, it is desired to use the apparatus for the purpose of oxidizing the valves e' are closed, to thereby cut off the carburetor P from the fan or blower, and the valve $b'^\times$ in the branch $b^\times$ is opened, to thereby open the inlet side of the fan to the air, whereby air is forced through the fan d^4 to hood H′, and thence into the cylinder C, to supply a superabundance of oxygen thereto to act upon and oxidize the materials passed therethrough.

Our apparatus is particularly adapted to the production of iron from hematite and other ores, and in the manufacture of metallic paint, which is composed of peroxide of iron, we have found our apparatus to be well adapted to carry out the successive steps in such process, which is described and claimed in another application pending concurrently herewith, Serial No. 482,857, filed August 10, 1893.

Hydrogen or any other reducing gas which is capable of uniting with the oxygen in the material treated may be used instead of carbon-monoxide in the hereinbefore described apparatus when used for deoxidizing, although we have found that the carbon-monoxide is preferable for many reasons and is as effective as any other of the reducing gases which we have tried. The material in the reducing chamber is gradully heated until it reaches the central portion of said chambers, as described where the temperature is highest, and where the reduction of the metallic oxides is practically completed. From such point to the discharge or delivery end of the chambers the heat gradually diminishes, and the reduced oxides pass through the trunks o' to the open air so cooled that they will not return to their former condition when brought into contact therewith.

It will be noticed that from the entrance of the material into the reducing chambers until its discharge therefrom it is in an atmosphere of substantially pure carbon-monoxide gas, so that the metallic oxides are exposed to its action throughout their passage.

The apertures in the caps of the cylindrical chambers serve to discharge the material when they are downturned in the revolution of the chambers, and permit the escape of the converting gas when they are uppermost, and hence uncovered by the material.

The size of the opening at the feed end of the chamber is so great compared with the apertures at the other end that the chamber is maintained full of the converting gas by the back pressure thus made with very slight pressure exerted by the fan or blower.

Our invention is not limited to the specific construction and arrangement of parts as herein shown and described, as it is evident that the same may be modified and altered without departing from the spirit and scope of our invention, the gist of which consists in an apparatus for continuously and automatically subjecting material in an externally heated chamber to the action of a reducing gas to deoxidize the metallic oxides in said material and deliver them at the delivery or discharge end of the apparatus, the heat of the said chamber decreasing from its center to its ends, or to subject the material in the chamber to oxygen, to oxidize the same.

We claim—

1. In an apparatus for continuously deoxidizing or oxidizing, a rotatable externally heated inclined cylinder having a series of longitudinal channels therein, and means to rotate it, a feed duct leading into the upper end of the cylinder, and a movable feeding device to positively and continuously force the material through the feed duct into the cylinder, combined with means to force a converting gas into and to fill the cylinder, whereby the material received from the feed duct is agitated and moved forward in the cylinder by means of the channels therein, in the presence of and to be acted upon by said gas, and delivered automatically at the lower end of the cylinder, substantially as described.

2. In an apparatus for deoxidizing and oxidizing, a rotatable inclined cylinder having a series of longitudinal channels therein, and means to heat the cylinder gradually from the ends to the center, combined with a feed duct for the material to be treated at the upper open end of the cylinder, a feeding device movable in and to positively and continuously force a regulated quantity of the material through the duct and into the cylinder, contracted outlets at the other end of the cylinder for the material and for the converting gas, means to force a converting gas into the cylinder to act upon the material therein, the contracted outlets exerting a back pressure upon the gas and maintaining the cylinder full, and mechanism to rotate the cylinder, whereby the material is agitated and moved through the cylinder in the presence of the gas, substantially as described.

3. In an apparatus for deoxidizing and oxidizing, a rotatable cylindrical chamber, means to heat the exterior thereof, and a cap provided with discharge apertures, and adapted to close one end of the chamber, combined with a closed hood surrounding the other open end of the chamber, a feed duct leading through the hood and into the chamber, and a gas inlet opening into said

hood, through which a converting gas is introduced and forced into the chamber, substantially as described.

4. In an apparatus for deoxidizing and oxidizing, a combustion chamber, a series of rotatable inclined cylinders extended across said combustion chamber and projecting beyond the same, and closed hoods surrounding the projecting ends, combined with caps to cover the discharge ends of said cylinders, and provided with apertures, outlets communicating therewith to conduct the converted material from the chambers out of said hood, an inlet for the converting gas in the other hood, and a gas outlet in the cap inclosing hood, substantially as described.

5. In a deoxidizing apparatus, a combustion chamber, a rotatable cylinder adapted to be heated thereby, and a carburetor communicating with said chamber and cylinder, combined with means to draw the gaseous products of combustion through the carburetor and into the cylinder to act upon the material therein and deoxidize the same, substantially as described.

6. In a deoxidizing apparatus, a combustion chamber, having an apertured bridge wall at each end thereof, a rotatable inclined cylinder extended through said apertures and across the combustion chamber, whereby the heat gradually decreases from its center to the ends of said cylinder, and means to feed the material into the upper end of the said cylinder, combined with a carburetor to receive carbonaceous material, connections between said carburetor and said combustion chamber and cylinder, and means to force the gas from the carburetor into the cylinder, substantially as described.

7. In an apparatus for deoxidizing metallic oxides, a heat generator, a rotatable cylinder externally heated thereby gradually from its center to its ends, and friction bearings for said cylinder, combined with means to rotate the cylinder, a carburetor to contain carbonaceous material, and connections between it and said heat generator and cylinder, whereby carbon-dioxide gas in its passage from the generator through the carburetor is changed to carbon-monoxide gas, to reduce the metalic oxides in the cylinder, substantially as described.

In testimony whereof we have signed our names to this specification in the presence of two subscribing witnesses.

ALFRED B. KITTSON.
ARTHUR BENJ. BROWNE.

Witnesses:
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