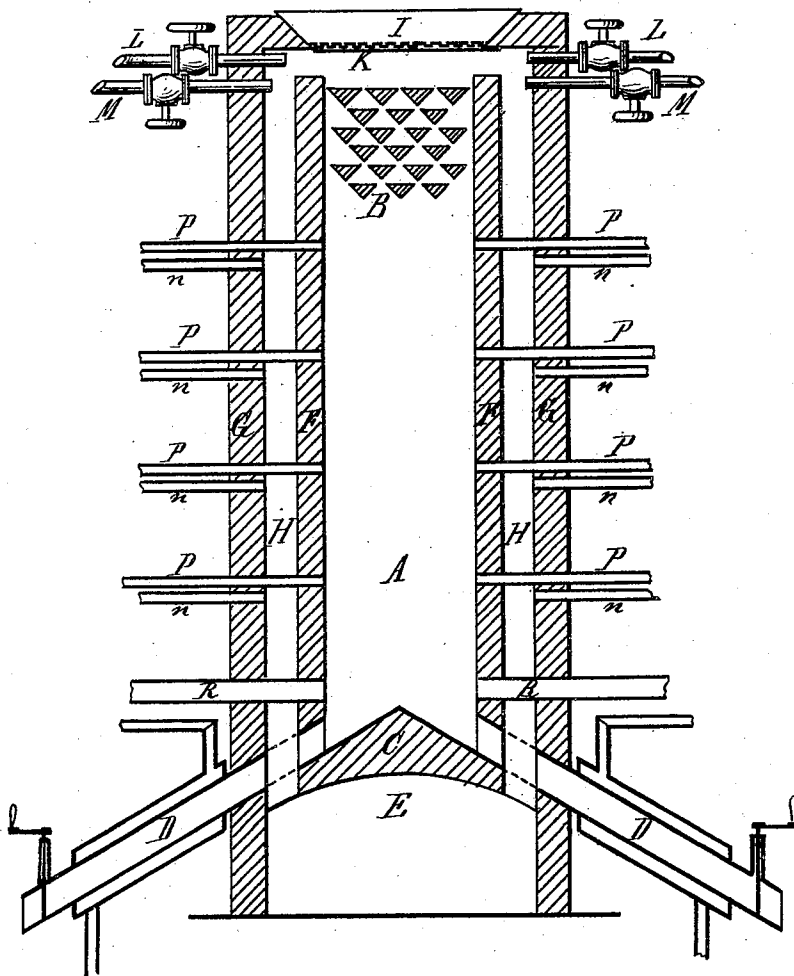


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APPARATUS FOR DEOXIDIZING IRON ORE.

No. 171,812.

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ANDREW GEORGE HUNTER, OF DETROIT, MICHIGAN.

IMPROVEMENT IN APPARATUS FOR DEOXIDIZING IRON ORES.

Specification forming part of Letters Patent No. **171,812**, dated January 4, 1876; application filed August 28, 1874.

To all whom it may concern:

Be it known that I, ANDREW GEORGE HUNTER, of Detroit, in the county of Wayne and State of Michigan, have invented an Improvement in Process and Apparatus for Deoxidizing Iron Ores, of which the following is a specification:

The nature of this invention relates to certain improvements in apparatus for deoxidizing, or deoxidizing and carburizing, iron ores, and converting them into an iron sponge preparatory to being made into blooms or conversion into steel. The object of the invention is to render the process, as heretofore practiced or attempted to be practiced, more effective, more certain, and less expensive in reducing ores by means of carburized hydrogen or carbonic oxide, or other gases resultant.

A suitable apparatus is shown in vertical section in the annexed drawings, in which A represents a rectangular tower or chamber, which may be of any other form, if preferred, which may be entirely unobstructed in its interior space, or provided with shelves B throughout a part or all of its height. The bottom of this tower, chamber, or shaft is provided with a floor, C, inclining from the center toward the outlets D, which latter may be surrounded with suitable water-jackets, with water inlet and outlet pipes, and may be also provided with proper gates or valves to close the outlets when desired. E is a flue and ore-dust chamber beneath the floor C, and from this chamber there should be openings for removal of ore-dust and a flue leading to a proper smoke-stack or chimney. (Not shown.) This shaft or tower or chamber may or not, as desired, be provided with inner walls F and outer walls G, and between these walls there may be arranged, on each side, flues H, extending from the open space above the top of the inner wall F, through the floor C, into the chamber E beneath the floor. Into the top of the tower or shaft, and filling an appropriate opening therein, is placed a hopper, I, the lower or discharge end of which is provided with a suitable screen, K, so arranged that there may be a nearly-continuous flow of finely-pulverized ore from the hopper through said screen, which preferably should be pro-

vided with proper devices to close the discharge end of the hopper when and as desired. The form of the shelves B, where such are employed, is shown in cross-section in the drawings, but any other suitable form, combining sufficient strength, may be employed, and they should be arranged in tiers, so that a shelf on the lower tier should be placed immediately below the space between two adjoining shelves in the higher tier, so that the finely-powdered ore which may fall off from the higher will be caught upon the lower tier of shelves, and so retarded in its passage downward through the shaft. L M are air and gas inlet pipes, respectively, communicating with the upper part of the interior of the shaft. N are a series of air-inlet pipes, communicating with the interior of the flues H; and P are another series of similar pipes, communicating with the interior of the shaft, tower, or chamber. R are inlet-pipes, for the admission of carburized hydrogen or carbonic oxide, or both, into the lower end of the shaft, just above the highest part of the floor thereof.

The process of reducing the iron ores may be thus described: The iron ore, in a crushed, or preferably finely ground or stamped, and in a heated, state, is fed into the top of the tower, and in falling is met by an ascending current of highly-heated carburized hydrogen, either pure or containing carbonic oxide or other deoxidizing gases, and, by preference, free from sulphur compounds. The carburized hydrogen or carbonic oxide enters through the pipes R, having been previously heated to the proper temperature in any convenient way. The ore, meeting the ascending currents of highly-heated gases, is deoxidized in its descent, and is removed from time to time through the outlets D. The walls F of the tower or shaft may be heated externally, and for this purpose the gases leaving the top of the shaft may advantageously be employed, their perfect combustion being effected by the admission of air to the flues H, through the air-inlets L and N, at suitable and desired points. The iron ore, previously to being fed into the shaft, may or not be mixed with carbonaceous matter, and may be fed into the top of the tower in a heated state.

A convenient mode of heating the ore is by passing it down through a plain unobstructed tower, or through a tower provided with shelves, being met in its descent by an ascending current of highly-heated gas or flame, and for this purpose the gases evolved from the deoxidizing-tower, when mixed with air, are suitable. A convenient arrangement is to make the heating-tower an upward continuation or part of the deoxidizing-tower, the respective limits of each being defined by the point at which air is admitted to the interior of the tower through the pipes P, or any of them, to burn the carburated hydrogen and other gases, and these limits may be readily varied by having the air pipes P at different levels, as shown, provided with suitable valves or cocks by which air can be admitted at the point desired; or the heating-towers may be arranged side by side, or in any other convenient position, with reference to the deoxidizing-tower, the heated ore being delivered at the top of the deoxidizing-tower by suitable elevators. The heating-tower may have external heating-flues, down which the gases evolved from the top of the said tower may be passed, together with such other heating-gases or waste heat as may be necessary or convenient. The carburated-hydrogen and other deoxidizing gases may be heated by passing them through a system of heating-pipes or through heated chambers of brick-work or other convenient and efficient apparatus for heating gases, and as a source of heat for this purpose the gases or part of them evolved from the deoxidizing-tower may, when mixed with air, be employed. The flues leading from the deoxidizing and heating towers should be provided with dust-chambers for the deposition therein of the iron-ore dust mechanically carried off by the currents of gases, and also with dampers or valves to regulate the heat and currents of gases. When it is desired not only to deoxidize the iron ore, but also to partially carburize the resulting iron sponge it is well to mix with the iron ore, previously to passing it down the tower, a quantity of carbonaceous matter, and to permit the ore and carbonaceous matter to remain at the bottom of the shaft for some time exposed to the heat of the incoming current of highly-heated carburated hydrogen or carbonic oxide, thereby affording time for the carbon to soak into and carburize the iron sponge. The time necessary for this depends not only on the degree of carburization desired, but also on the fineness of the iron sponge, the heat to which it is exposed, and the refractory or other nature of the ore under treatment. A tower fifty feet high inside, the lower half being devoted to deoxidizing

and the upper half to heating, is a convenient size, the deoxidation in the lower half being produced by the highly-heated current of gas or gases entering through the pipes R, and the heating in the upper half being produced by consuming the gas or gases by the admission of air at any desired point through the pipes P. The gases resultant from the ore under treatment are employed partly in the tower A, and partly in the flues H, for heating, and are ignited and burned by the admission of air at any desired point through the pipes N, L, and P.

When the ore has been treated as described, and it is desired to remove the resultant iron sponge in a hot state, it should be withdrawn into air-tight boxes or wagons, in which a little tar, pitch, grease, or other cheap inflammable substance may have been previously placed, in order, by its flame and smoke, to expel the oxygen from the interior of the box or wagon, and thereby prevent the oxidation of the iron sponge; or the iron sponge may be allowed to cool before removal from the deoxidizing apparatus. The sponge, whether removed hot or cold, may be, in a suitable press, reduced to blooms of convenient size for further uses.

It will be noticed that the salient point in this invention is so constructing the reducing apparatus that one portion thereof may be employed for the purpose of deoxidation, or for deoxidation and carburization, while the other portion is employed for heating the ore previous to its being subjected to the deoxidizing process by means of the current of highly-heated carburated-hydrogen and other gases ascending through the descending mass of ore.

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

1. In combination with the chamber, shaft, or tower, the flues H, provided with air-inlets L N, substantially as described, by means of which the gases resultant may be ignited and consumed at the point desired.

2. A shaft, tower, or chamber, for deoxidizing iron ores, wherein the chamber A, floor C, outlets D, flue and ore-dust chamber E, flues H, hopper I, hopper-valve K, air-inlet pipes L N P, and gas-inlet pipes M R, are constructed and combined to operate substantially as and for the purposes set forth, whether combined with the shelves B or not.

ANDREW GEORGE HUNTER.

Witnesses:

C. E. HUESTIS,
H. S. SPRAGUE.