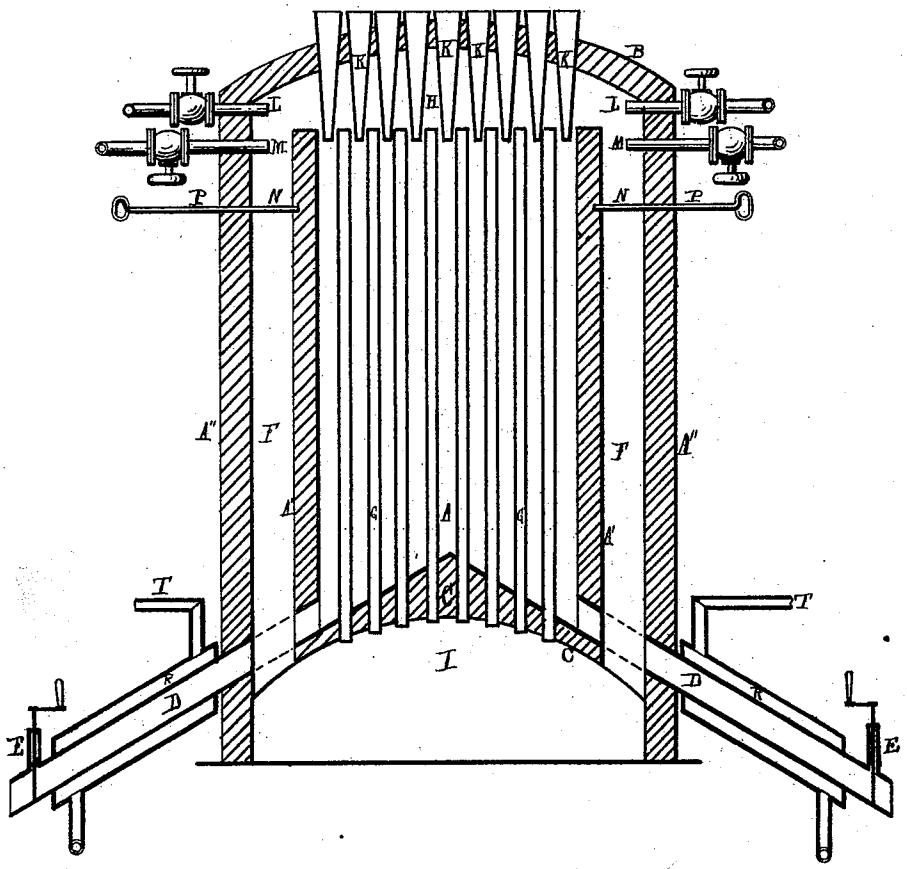
A. G. HUNTER.

APPARATUS FOR DEOXIDIZING IRON ORE.

No. 171,811. Patented Jan. 4, 1876.



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IMPROVEMENT IN APPARATUS FOR DEOXIDIZING IRON ORES.

Specification forming part of Letters Patent No. **171,811**, dated January 4, 1876; application filed August 28, 1874.

To all whom it may concern:

Be it known that I, ANDREW G. HUNTER, of Detroit and State of Michigan, have invented an Improvement in Apparatus for the Manufacture of Iron, of which the following is a specification:

The nature of this invention relates to certain improvements in the necessary apparatus for deoxidizing iron ores, and treating the deoxidized products for the purpose of obtaining iron or steel; and its object is to provide an apparatus in which better results can be obtained at a less expense than by the known appliances for the purpose; an apparatus in which deoxidation is effected by means of carbureted hydrogen or carbonic oxide, either alone or mixed with each other, or other deoxidizing gases, derived from and with the aid of carbonaceous matter, mixed with the iron ore, which, when being treated, is maintained at a red or higher heat.

In the drawings, in which my apparatus is shown in vertical section, a suitable apparatus is shown for reducing iron ores. It consists of a chamber, A, of any desired size or form, closed at the top by the cover B, and at bottom by the floor C, the latter preferably being inclined from the center to the outlet-pipes D, which may be provided with proper valves or gates E. Flues F, as many as may be desired, are placed between the inner walls A′ and the outer walls A″ of the chamber, and G are other flues within the chamber A, and all the flues open into the open space H, beneath the roof or cover B, and terminate, their lower ends being open, in the chamber I, beneath the floor, said chamber being a flue and ore-dust chamber, from which there should be openings for removal of ore-dust, and a suitable draft-flue (not shown) connects with a suitable smoke-stack. K are hoppers through the cover or roof, and extending preferably downward, so that their lower open ends terminate upon a plane just below the top of the flues hereinbefore described. L are suitable air-pipes, and M suitable gas-pipes, each provided with a proper stop-cock, as shown, and communicating with the interior of the chamber or open space H, above the top of the flues. N are dampers, operated from without the walls of the chamber by means of the rods P, and may be placed in any part of, and are employed for closing, the flues F when and as desired. The flues should all preferably be made of some fire-resisting material. The walls of the chamber may be constructed of brick-work, securely bound together, and the flues G, as before remarked, of fire-clay, or their upper portions of that material, with the lower part of cast-iron, or they may be entirely constructed of cast-iron, with or without stiffening-ribs running lengthwise of the pipes, and should be provided with suitable dampers to regulate the passage of the gases. Various sizes of chamber and pipes may be used. A convenient size is about twelve feet internal diameter of chamber, and thirty feet high, inside—the pipes four inches in diameter, placed about four inches apart. At least six feet of the upper end of the pipes or flues should be fire-clay, and the rest cast-iron.

The method of operating is as follows: The iron ore, in a crushed or powdered state, is mixed with carbonaceous matter, which should preferably be free from sulphur and phosphorus, in proportions rather in excess of the quantity requisite to form carbonic oxide with the oxygen present as oxide of iron in the ore, and charged into the closed chamber, care being taken that none enters the pipes or flues, either the internal or external ones. Combustible gas and air are passed, in a state of ignition and, by preference, downward, through the internal and external flues, thus heating the mixture of iron ore and carbonaceous matter, which, according to its composition, evolves carbonic oxide and carbureted hydrogen in varying proportions. Their gases rise through the mass of iron ore and carbon, and, on reaching the surface, find an exit downward through the pipes or flues, or through both external and internal flues or pipes, and aid in maintaining the heat, when ignited, on meeting the air at the top of said flues. When the mixture of iron ore and carbon has been maintained at a red heat for some time a portion is withdrawn through the outlets at the bottom, the whole mass sinks downward, and the vacant space at top is then supplied by a new charge of ore and carbonaceous matter.

By a repetition of withdrawals and remov-

als the process goes on continuously, care being taken to so regulate the admission of combustible gas and air as to maintain the mass in a red-hot state.

The length of time necessary to deoxidize a given quantity of iron ore depends partly on the fineness to which it is crushed or powdered, and the consequent more or less intimate mixture with carbonaceous matter, and partly on the uniform maintenance of the heat, and also upon the refractory or other nature of the ore under treatment. When it is desired not only to deoxidize the iron ore, but also to partially carburize the resulting iron sponge, it is necessary to use a greater excess of carbon, to employ a higher heat, and to permit the mass to remain exposed to the heat for a longer time than when simple deoxidation is only required. The quantity of carbon, the degree of heat, and the length of exposure to heat requisite, depend not only on the degree of carburation desired, but also on the fineness with which the ore is crushed or powdered, and upon its refractory or other nature, this being largely influenced by the nature and amount of the gangue or impurities associated in the ore.

By the term "combustible gas" is meant not only gas specially prepared for use, but also that resulting from any other available source of waste or other heat.

After the ore has been treated substantially as hereinbefore described, and deoxidized, and, if desired, carburized, if removed in a hot state, it should be placed in 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 free oxygen from the interior of the box or wagon, and thereby prevent oxidation of the iron sponge. This sponge may be allowed to cool before removal from the deoxidizing apparatus. A convenient mode of cooling is by prolonging the outlet-pipes D, and inclosing them within a suitable water-jacket, R, so arranged that it may be continuously supplied with cold water, and provided with an outlet, T, for the heated water. If the iron sponge is cooled before removal from the deoxidizing apparatus, the use of air-tight boxes or wagons is unnecessary; or it may be allowed to cool in said boxes or wagons, or it may be taken directly to a press in a hot state; but whether allowed to cool or treated hot, it should be placed in a press and subjected to pressure, and thereby consolidated into blooms, thus facilitating subsequent handling, and reducing the amount of surface liable to be exposed to oxidation. A hydraulic press capable of exerting a pressure of from four hundred to six hundred tons, or upward, will force the deoxidized ore or resultant iron sponge into a compact bloom, say six inches in diameter, and from one to a foot and a half in length, according to the length of the chamber of the press. A less powerful press will produce a less compact bloom, or one of a smaller size. These pressed blooms may then be reheated, repressed, shingled, rolled, hammered, or squeezed, and treated as muck bars, or, by preference, used for conversion into steel by fusion with cast or pig iron, or, if sufficiently carbureted, without any pig-iron in an open-hearth steel furnace, with the addition of spiegeleisen or ferro-manganese, for which purpose they are well adapted.

It will be noticed that the salient point of the above-described invention is the deoxidation of iron ores by means of carbonaceous matter in intimate contact with the iron ore at a red heat, and in utilizing the carbonic oxide and carbureted hydrogen evolved in the process of reduction for fuel to furnish heat, and in the apparatus described for these purposes.

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

1. A chamber for deoxidizing or deoxidizing and carbureting iron ores, having within it flues or pipes extending from a space above the mass of ore under treatment down through said mass, and opening into and terminating in a space beneath the floor of the reduction-chamber, substantially as and for the purposes described.

2. The chamber A, provided with roof B, floor C, and flues G, outlet-pipes D, and hoppers K, the parts being constructed to operate in combination, substantially as and for the purposes set forth.

3. In combination, the roof B and the flues G F, the air and gas inlet-pipes L M, provided with suitable stop cocks, and the hopper K, substantially as and for the purposes specified.

ANDREW GEORGE HUNTER.

Witnesses:
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THEO. S. DAY.