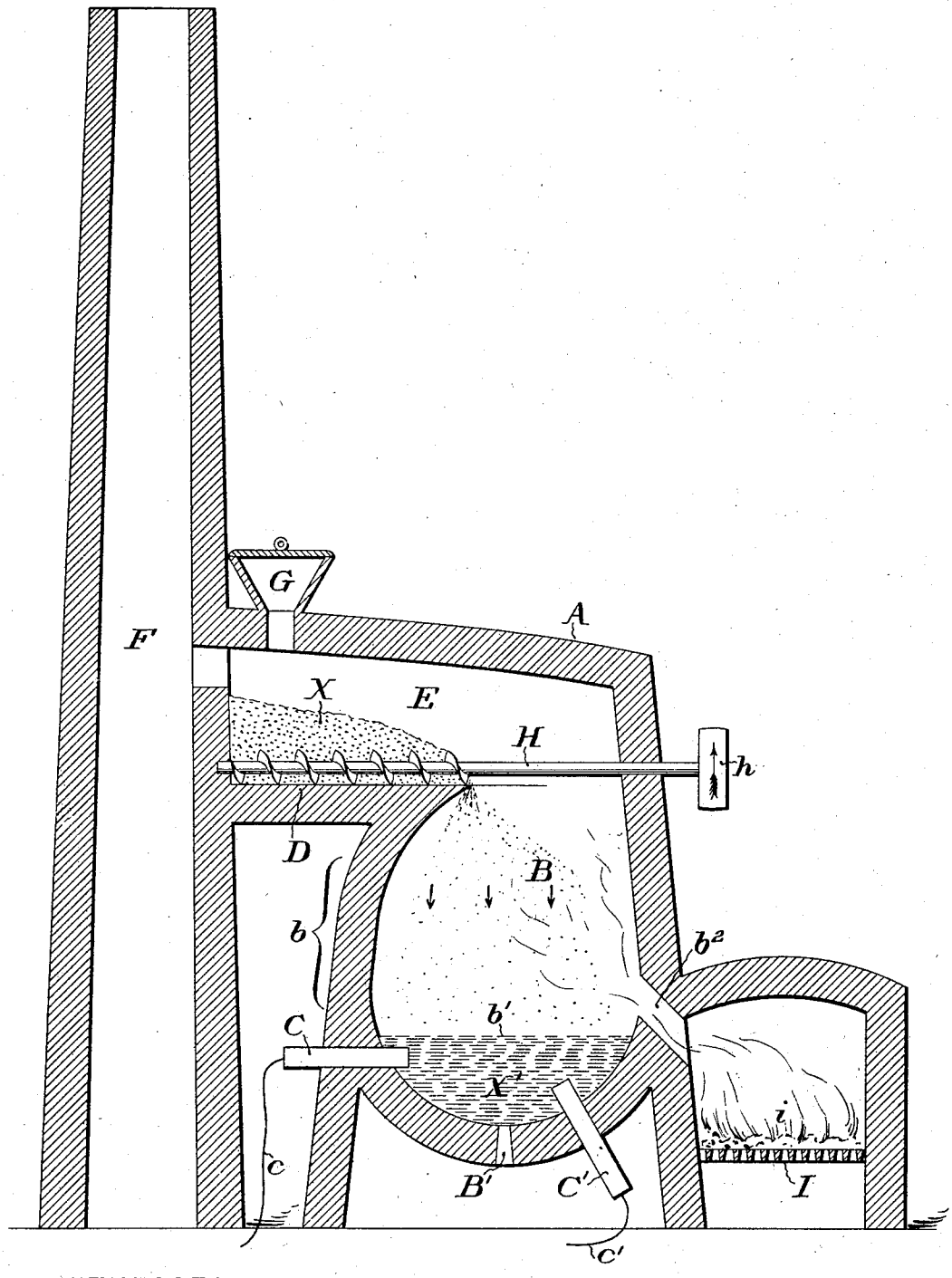
No. 722,253. PATENTED MAR. 10, 1903.

M. RUTHENBURG.

PROCESS OF REDUCING IRON FROM ITS ORE.

APPLICATION FILED JULY 10, 1900.

NO MODEL.



WITNESSES:

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UNITED STATES PATENT OFFICE.

MARCUS RUTHENBURG, OF PHILADELPHIA, PENNSYLVANIA.

PROCESS OF REDUCING IRON FROM ITS ORE.

SPECIFICATION forming part of Letters Patent No. 722,253, dated March 10, 1903.

Application filed July 10, 1900. Serial No. 23,130. (No specimens.)

To all whom it may concern:

Be it known that I, MARCUS RUTHENBURG, of Philadelphia, Pennsylvania, have invented certain new and useful Improvements in Processes of Reducing Iron from its Ore, whereof the following is a specification, reference being had to the accompanying drawing.

The object of my invention is to provide a process whereby malleable iron or steel may be directly manufactured from comminuted ore, particularly magnetite.

My process consists in preheating a mass of comminuted ore, introducing the heated ore to an atmosphere of deoxidizing-gas, such as hydrogen or hydrocarbon gas, arranged to reduce the particles of ore to the metallic state in their passage therethrough without fusing them, and, finally, fusing the metallic residue.

As an example of the operation of my invention I will describe the treatment of a mass of magnetite in an electric furnace such as is shown in the accompanying drawing.

In said drawing, A is the furnace, comprising the crucible B, in which are opposed electrodes C C′ of the heating-circuit *c c′*. Above said crucible B and in communication therewith is the hearth D, inclosed by the flue E, leading from the crucible B to the stack F. The hopper G is arranged to deliver material upon said hearth D, and the screw-shaft H is so constructed as to deliver the material from said hearth D to the crucible B when rotated in the direction of the arrow marked upon the driving-wheel *h*. A mass of comminuted ore X, being delivered upon the hearth D of the furnace through the hopper G, is preheated upon said hearth to such a degree that a deoxidizing-gas will immediately reduce it in its comminuted state, and in such preheated condition said comminuted ore is gradually introduced to the crucible B, which contains the atmosphere of heated deoxidizing-gas. It is to be understood that the furnace A is so proportioned and arranged that the particles of comminuted ore are reduced in passing from the top to the bottom of the crucible B through the heated deoxidizing atmosphere maintained in the zone *b* thereof without being fused. Below said zone *b* the heat causes fusion of the reduced particles into the molten metallic residue X′, which during the conduct of the process is limited to about the height indicated by the line *b′* by discharge through the tap-hole B′.

The atmosphere of heated deoxidizing and carbonizing gases is conveniently maintained in the crucible B by combustion of fuel *i* in the fire-box I, the products of such combustion being delivered to said crucible through the flue b^2. However, it is to be understood that the principal source of heat in the furnace above described is the electric current which passes between the electrodes C C′ and fuses the interposed mass X′, which forms a conductor for it, and that the heat to effect the reduction of the particles in the zone *b* is derived from said current, from the combustion of the gases which are liberated during the reduction, and from the combustion of the fuel *i*.

I prefer to use an electric current as a source of heat in the conduct of my process, for the reason that it may be precisely varied at the will of the operator with consequent variance in the product. For instance, the oxid may be reduced at a temperature less than that which the carbon will combine therewith in the production of carbid, and thus malleable iron may be directly produced, or by elevating the temperature various grades of steel may be directly produced, the percentage of iron introduced to the product being, of course, predetermined by the temperature at which reduction is effected.

Although for the reason stated I prefer to employ apparatus of the form hereinbefore described, I do not desire to limit myself thereto, as it is obvious that various modifications may be made in the apparatus employed without departing from the essential features of my process.

I claim—

1. The herein-described process of reducing iron ores to the metallic state, which is continuous and which consists in detaining each particle of a mass of comminuted ore for a definite time in a region heated to a determined degree less than reducing temperature, but a temperature at which it is capable of being immediately deoxidized; then progressing the particles of ore in granular form, and at a determined rate through an atmosphere of deoxidizing-gas heated to such a degree as

to effect the reduction of the particles during their movement therethrough, without fusing said particles; progressing the reduced metal in granular form, at reducing temperature, into a region of fusing temperature; and fusing the reduced metal, substantially as set forth.

2. The herein-described process of reducing iron ores to the metallic state, which is continuous and which consists in detaining each particle of a mass of comminuted ore for a definite time in a region heated to a determined degree less than reducing temperature, but a temperature at which it is capable of being immediately deoxidized; then progressing the particles of ore in granular form, and at a determined rate through an atmosphere of deoxidizing-gas heated to such a degree as to effect the reduction of the particles during their movement therethrough, without fusing said particles; in assembling the reduced particles to form a path for an electric current, and fusing the reduced metal by an electric current passed therethrough, substantially as set forth.

In testimony whereof I have hereunto set my hand this 16th day of April, A. D. 1900.

MARCUS RUTHENBURG.

Witnesses:
LILIAN V. MERK,
W. G. HAVENS.