

# UNITED STATES PATENT OFFICE.

CHARLES J. EAMES, OF NEW YORK, N. Y., ASSIGNOR TO THE CARBON IRON COMPANY, OF SAME PLACE.

PROCESS OF MANUFACTURING IRON SPONGE, WROUGHT AND STEELY IRONS DIRECTLY FROM THE ORE.

SPECIFICATION forming part of Letters Patent No. 318,552, dated May 26, 1885.

Application filed December 6, 1884. (No specimens.)

*To all whom it may concern:*

Be it known that I, CHARLES J. EAMES, a citizen of the United States, residing at New York city, in the State of New York, have invented certain new and useful Improvements in Processes of Manufacturing Iron Sponge, Wrought and Steely Irons Directly from the Ore; and I hereby declare the following to be a full, clear, and exact description of the same, such as will enable others to apply the invention.

The invention, generally stated, may be said to consist in intermingling with the ore lumps of graphitic carbon, covering the charge with a layer of lumps of graphitic carbon, and subjecting the charge contained in a furnace having a friable graphitic lining first to a sustained dull-red heat, and finally to a higher and sustained temperature.

Heretofore in the manufacture of iron sponge and malleable iron directly from the ore carbon in various forms—such as charcoal, plumbago, &c.—together with various fluxes, protective coverings of slag, &c., have been used; and where steel or steely iron was desired scrap-iron, wrought-iron, iron shavings, &c., have been added to the charge. Plumbago has been also employed as a material for crucibles or containing-vessels, or in conjunction with fire-clays to form furnace-linings to avoid silicious linings, which are often detrimental.

The main objections to the methods commonly practiced may be briefly stated to be, first, plumbago linings and crucibles as heretofore employed do not yield up the carbon with sufficient readiness, and thus retard the process, to the detriment of the product; secondly, where used in the ordinary condition—viz., as a powdered mass admixed with the ore—it cannot be uniformly distributed, is drifted out and carried off by the blasts, producing irregularity in the results obtained; and, thirdly, where used in conjunction with a fusible slag-covering for the ore, it rises into fusible slag and the greater portion is lost without obtaining any results. To these objections must be added the material one of the high price of plumbago and the large amount of charcoal and other forms of soft carbons required, which add materially to the expense

of producing wrought iron or steel from the ore by the methods now commonly practiced.

Having acknowledged and reviewed the prior state of the art, it will clearly appear from the following description wherein my invention lies.

In carrying out my invention I make use of a reverberatory furnace or similar chamber in which a moderate and controllable temperature can be maintained. This furnace has a sole or hearth of friable graphitic material, preferably composed of sixty (60) per cent. of graphite and forty (40) per cent. of fire-brick, intermingled thoroughly, and rendered plastic by a carbonaceous adhesive binder—such as a minimum quantity of coal or wood tar, molasses, or the like. When this mass has been applied to the furnace and permitted to dry out, a friable highly graphitic hearth will be obtained. Upon such a hearth the ore, as taken from the mines, intermingled with lumps of “graphitic carbon,” (preferably without flux,) said carbon constituting such a per cent. of the charge as shall approximate the quantity required to deoxidize the ore, (which can readily be ascertained by analysis,) say about thirty to fifty per cent., is charged and then covered with a layer of graphitic carbon in lumps, said layer being preferably about one or two inches thick. The layer of intermingled ore and graphitic lumps composing the charge may vary from four (4) to eight (8) inches. The graphitic carbon referred to is an impure graphite containing considerable earthy matters, iron, &c., of a character, such as is found at Cranston, Rhode Island, and elsewhere, and distinguished in the trade as “graphitic carbon,” being much cheaper and more readily obtained than “plumbago,” so called and employed in the arts.

The furnace-hearth being of the character described, and the charge of the nature before specified, the furnace is raised and maintained at a dull red-heat—say 1500° Fahrenheit to 2000° Fahrenheit—(varied to meet the nature of more or less refractory ores) where deoxidation of the ore will take place without danger of fusion. This temperature is sustained for from five (5) to seven (7) hours, by which time deoxidation will have been completed, and



an iron sponge containing the free metal inclosed in its earthy matrix will have been obtained. The heat is then raised sufficiently to cause an agglomeration of the mass or the agglutination of the contained metal—say from 2000° Fahrenheit to 2500° Fahrenheit or more—but not sufficiently high to fuse the mass. When this temperature has been maintained for from one (1) to two (2) hours, the mass can be balled and removed to the blooming apparatus for reduction to wrought-iron; but if a steel or steely iron is preferred, this stage of the process must be prolonged some six (6) or seven (7) hours, which can be readily determined by the operator, and necessarily varies according to the more or less refractory character of the ore, as before specified. Finally, the steelified mass will be balled and removed to the blooming apparatus, as before specified. During this second stage of the process care should be had to avoid excessive temperature, as fusion of the metal would insure the formation of slaggy sponge of deteriorated character.

Owing to the fact that the presence of the graphitic lumps intermingled with the lumps of ore lightens up the mass and renders it permeable to the heated gases, &c., it is not absolutely necessary to employ a covering of graphitic lumps, though such a covering is highly desirable.

The advantages of my process are, first, the friable bed readily yields its carbon to the superimposed ore; secondly, the lumps of graphitic carbon interposed between the lumps of ore lighten up the mass and permit the circulation of the heat-bearing gases therethrough, while the carbon is immediately presented to the ore to be deoxidized, and in such form that it can not be drifted or swept off by the blasts of gas, &c.; and, thirdly, the covering of the ore, while it is of a character to protect it from the direct and injurious action of the flame, is also of such character as to obviate in a great measure the evils attendant on the use of fusible slag, as well as the common loss of graphite carried off in the slag.

I do not herein claim the friable graphitic hearth, as the same forms the subject-matter of applications filed September 27, 1884, Serial No. 144,152, and Serial No. 149,823, filed December 9, 1884; neither do I herein claim a process wherein the ore without admixture of lumps or graphitic carbon is treated on a friable graphitic bed while covered with a layer of graphitic lumps, as that forms the subject-matter of application Serial No. 149,684, filed December 6, 1884. Further, I do not herein claim charging the ore on a fri-

able graphitic hearth, covering the charge with a layer of lump-graphite, and subjecting the charge to a dull-red sustained heat until deoxidation, and then to a higher heat until agglomeration takes place in the manufacture of wrought-iron, as the same forms the subject-matter of my application, Serial No. 157,226, filed February 27, 1885.

In lieu of the friable hearth-covering herebefore specified, good results will be obtained by covering the sole of the furnace with a layer of some six (6) to twelve (12) inches of graphitic lumps arranged to protect the bridge-wall and flue-bridge.

Such a mass in its natural condition will be sufficiently friable, and has the advantage that it can be more easily applied without cooling off the furnace, and can be repaired from time to time by a top-dressing.

Having thus described the nature, advantages, and characteristics of my invention, what I claim, and desire to secure by Letters Patent, is—

1. The method herein described for the production of iron sponge direct from the ore, which consists in charging the ore intermingled with lumps of graphitic carbon on a friable graphitic hearth, and subjecting the charge to a dull-red sustained heat until deoxidation of the ore is accomplished, substantially as and for the purposes specified.

2. The method herein described for the production of iron sponge direct from the ore intermingled with lumps of graphitic carbon on a friable graphitic hearth, covering the charge with a layer of graphitic carbon in lumps, and finally subjecting the charge to a dull-red sustained heat until deoxidation of the ore is accomplished, substantially as and for the purposes specified.

3. The method herein described for producing steelified iron direct from the ore, which consists in charging the ore mingled with lumps of graphitic carbon on a friable graphitic hearth, covering the charge with a layer of graphitic lumps, subjecting the charge thus formed first to the action of a dull-red sustained heat until deoxidation is accomplished, and then to a higher sustained heat short of the fusing-point of the metal for a further period of six (6) or more hours, substantially as and for the purposes specified.

In testimony whereof I affix my signature, in presence of two witnesses, this 6th day of December, 1884.

CHARLES J. EAMES.

Witnesses:

F. W. RITTER, Jr.,  
H. B. MOULTON.