

W. A. STEPHENS.

PROCESS AND APPARATUS FOR REDUCING IRON ORE.

No. 177,029.

Patented May 2, 1876.

Fig. 1.

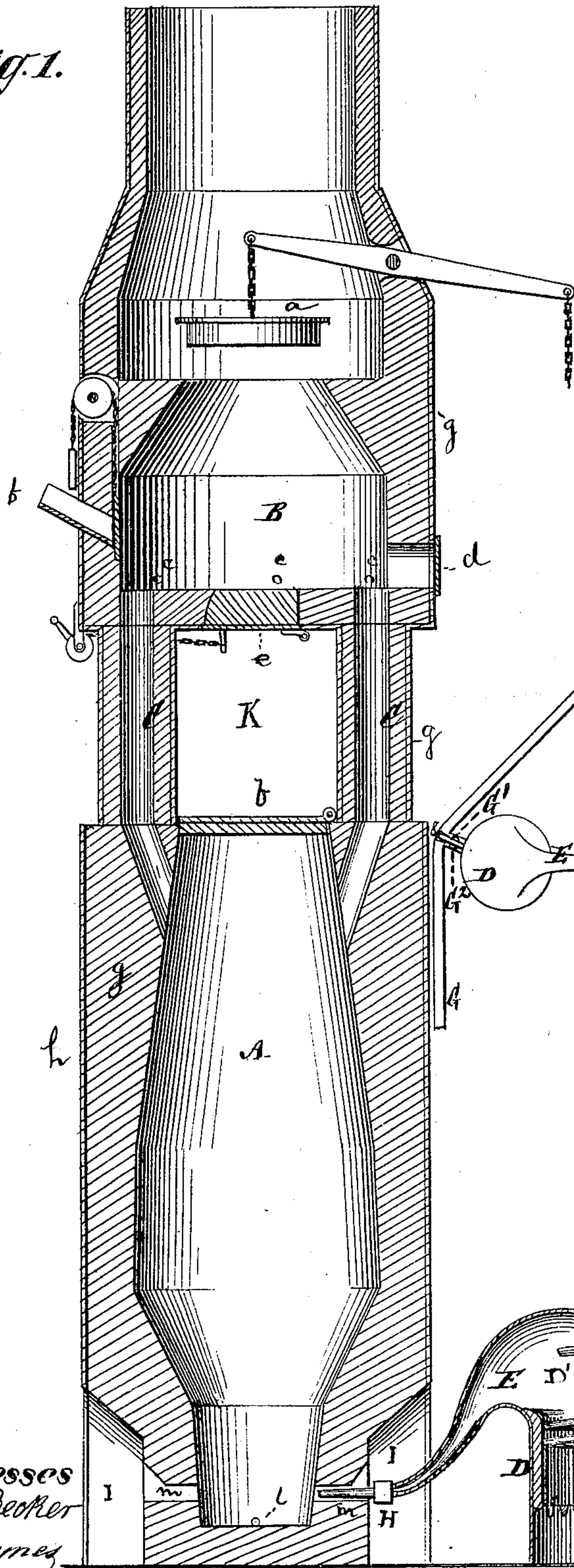
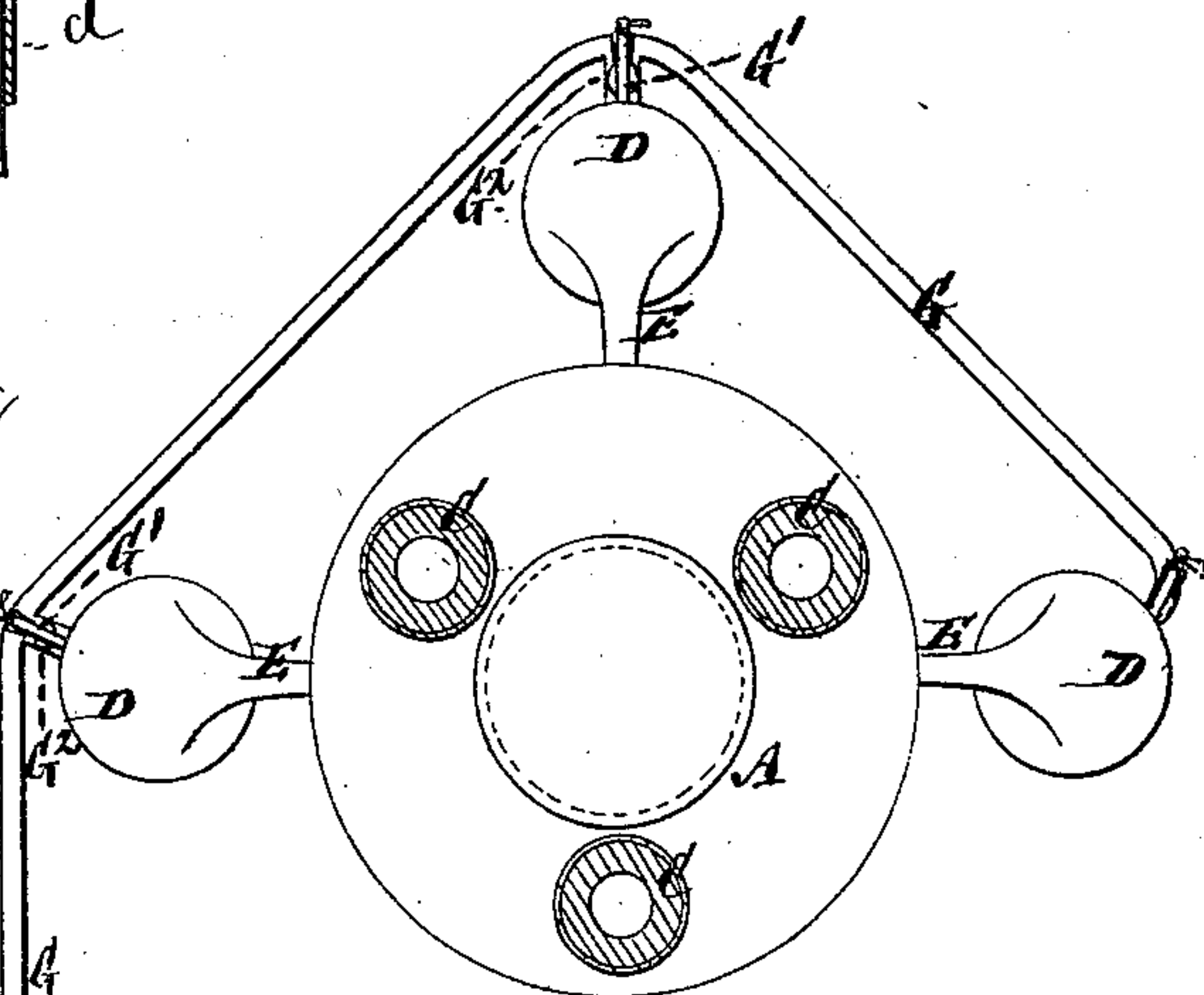
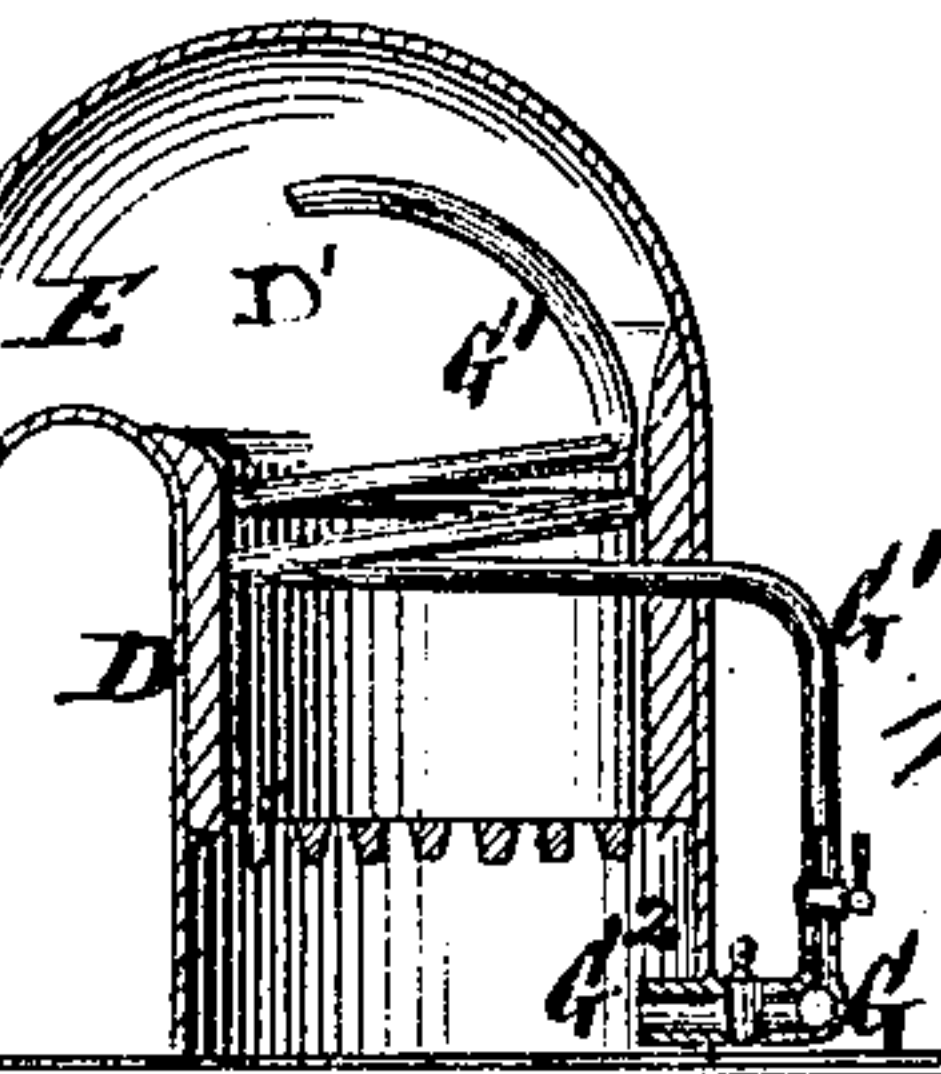


Fig. 2.



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IMPROVEMENT IN PROCESSES AND APPARATUS FOR REDUCING IRON ORES.

Specification forming part of Letters Patent No. 177,029, dated May 2, 1876; application filed
March 4, 1875.

To all whom it may concern:

Be it known that I, WILLIAM ALEXANDRE STEPHENS, of Suckasunny Plains, in the county of Morris and State of New Jersey, have invented certain new and useful Improvements in Blast-Furnaces and their Appurtenances for Smelting Iron and other Ore; and I do hereby declare that the following is a full, clear, and exact description of the same, reference being had to the accompanying drawing, which forms part of this specification.

My invention relates to furnaces adapted for anthracite coal, and for hot-air blasts, and confined to the use of such sort of coal and such a kind of blast, and no other sort or kind whatever; and it consists, first, in the construction of a peculiar roasting-oven and its connections with the furnace proper, whereby gases evolved in the combustion taking place in the furnace proper are forced by air-pressure into the roasting oven; secondly, in the means employed to produce a hot-air blast in said furnace proper; and thirdly, in the combination of the principal operative parts, all as more fully hereinafter described; also, in the process connected therewith.

In the drawings, Figure 1 is a vertical section of my entire device, and Fig. 2 a diagram or sectional plan upon a reduced scale of the same.

A represents the furnace proper, in which the ore is melted, of which a convenient form is shown in Fig. 1. Above this furnace is placed the roasting-oven B, which is supported by hollow supports C C, usually of cast-iron, and lined with fire-brick, leading from near the upper outside portion of the furnace A into the bottom of the roasting-oven B, and affording a communication for the gases of combustion from said furnace A into said roasting-oven. A valve, *a*, operated by a lever regulates the intensity of heat in the roasting-oven, and chutes *b* enable the charge to be placed in the same. Air-passages *c c c*, regulated by valves arranged about the periphery of the bottom of the roasting-oven, admit air therein to aid in combustion. A passage, *d*, covered with a door, serves to give access to the interior of the roasting-oven, to stir up the contents and to clean out the débris which

may collect there. In the central bottom of the said oven a hinged door, *e*, with any convenient means of opening or closing the same, permits the charge in said oven to fall out of the same, and a similar door, *f*, but of larger dimensions in the top of the furnace, permits the falling charge to pass at once into the top of the furnace proper.

The parts above described—namely, the furnace proper, the roasting-oven, and the hollow supports connecting the two—are inclosed in suitable brick-work *g*, which in turn is inclosed by a suitable shell, preferably of boiler-iron, and said brick work extended above the roasting-oven, as at *j*, forms the stack or main exit for the furnace.

Between the bottom of the roasting-oven and the top of the furnace proper is a free open space, *k*, by means of which access is had from the platform at the top of the furnace to the door *f*, for the purpose of charging said furnace. A tap-hole, *l*, at the bottom of the furnace, allows the metal to run off, and also gives access for kindling the fire in the same, and said furnace is also furnished with suitable means for removing cinders.

The blast-heating apparatus is composed of several heaters, D, arranged about the base of the furnace proper, each furnished with suitable means for burning anthracite coal, and each having a combustion-chamber, D', arched at the top, so as to reverberate the heat. Leading out of this is a duct, E, curved downward and gradually contracted to its end, where it enters the tuyere H, which reaches into the bottom of the furnace proper, passing through a proper channel, *m*, the brick wall at that point being reduced in thickness, as shown at I.

A blast-pipe, G, having communication with a suitable blower, has branches G¹ and G², the latter being let into the heater below the fire-bed to furnish air for the combustion of the coals, and the former entering directly into the combustion-chamber, and there coiled about the interior of the same; then, passing up and bending around below the arched top of the same, terminates near the larger end of the duct E.

In the operation of my furnace, a fire is first

started in the heater D, and the blast is set in motion. Then the furnace proper is partly filled from the top with wood and charcoal, and the same kindled. Then anthracite coal is poured in upon the kindled wood and charcoal, and allowed to burn until the furnace and roasting-chamber are thoroughly heated. The chamber B is then charged with ore alone sufficiently to cover the floor of the chamber to the bottom of the chutes, and also to fill the chutes.

The gases arising from the combustion within the furnace proper are forced by the blast through the hollow supports C into the roasting-chamber B, and there, receiving a fresh supply of air through the openings *c* in the bottom of said chamber, burn in said chamber, and roast and desulphurize the ore contained therein.

After a sufficient roasting, commonly about two hours at the first, about one-fourth part of the charge is suffered to fall into the furnace proper through the doors *e* and *f*, and a fresh charge supplied at the chutes. After the first withdrawal of the ore, as described, the subsequent withdrawals and fresh supplies are more frequent, the ore in the roasting-chamber and also in the chute being at all times under treatment.

After the charge named has been received from the roasting-chamber into the furnace proper, where it has fallen upon the incandescent coal, it is followed by a sufficient charge of limestone and another charge of anthracite coal, and the door *f* is closed. Then after an interval of half or three-quarters of an hour another charge of ore is received from the roasting-chamber, followed by charges of limestone and anthracite coal, as before, and the same course is continued until the furnace proper is filled. After a suitable time the melted contents of the furnace are drawn off in the usual manner.

It is to be understood that during the whole time consumed in the proceedings above described, the hot-blast is in operation.

The volume of air blown in at the branch *G*² is regulated by suitable valves, and must be sufficient to keep up a lively combustion of the coal in the heater. The air blown in at the branch *G*¹, the volume of which is also regulated by proper valves, in passing in coils

around the combustion-chamber and through the arched top of the same is intensely heated, and delivered in such intensely-heated condition at the mouth of the duct E, where, coming in contact with the gases arising from the consumption of the coal, there is an instantaneous combustion of gases at this point, which are forced forward continually, compressed by the narrowing size of the duct violently through the tuyere into the furnace proper, forming thereby a hot-blast of great power.

The advantage, therefore, of the peculiar form of the duct in giving force to the blast is obvious from the above recital.

By means of the apparatus and process above described I am enabled to make out of magnetic iron-ore, with anthracite coal alone, a high quality of pig-iron at a very cheap rate.

Having thus described my invention, what I claim as new therein is—

1. In combination, a furnace proper, a roasting-oven directly above the same, hollow supports connecting both, leaving an open space between the oven and the furnace proper, whereby a charge of roasted ore may be dropped directly from said oven into said furnace, substantially as described.

2. In combination with the furnace A, the heater D, with a reverberating combustion-chamber, a coiled blast-pipe, *G*¹, and the duct E, terminating in the tuyere H, substantially as and for the purposes set forth.

3. In combination, the roasting-oven B, connecting hollow supports C C, furnace A, the heaters D D', provided with the coiled blast-pipe *G*¹, and the duct E, substantially as and for the purposes set forth.

4. In reducing iron ores with anthracite coal and a hot-blast, the process, substantially as described, consisting in first roasting the ore in successive charges in an oven, and then filling the furnace by dropping a charge of the same upon incandescent coal in the furnace, then supplying charges of limestone and coal in the furnace, then at intervals, as described, dropping new charges of roasted ore and supplying charges of limestone until the furnace is filled.

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