

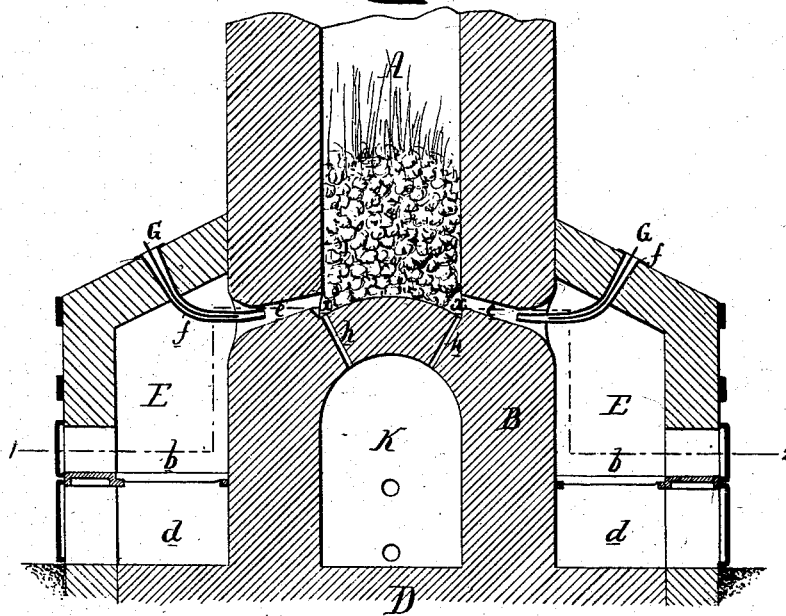
—R.D. & W.F. Cox,—

—Process of Smelting Ores and Appliances for Conducting—  
—the process.—

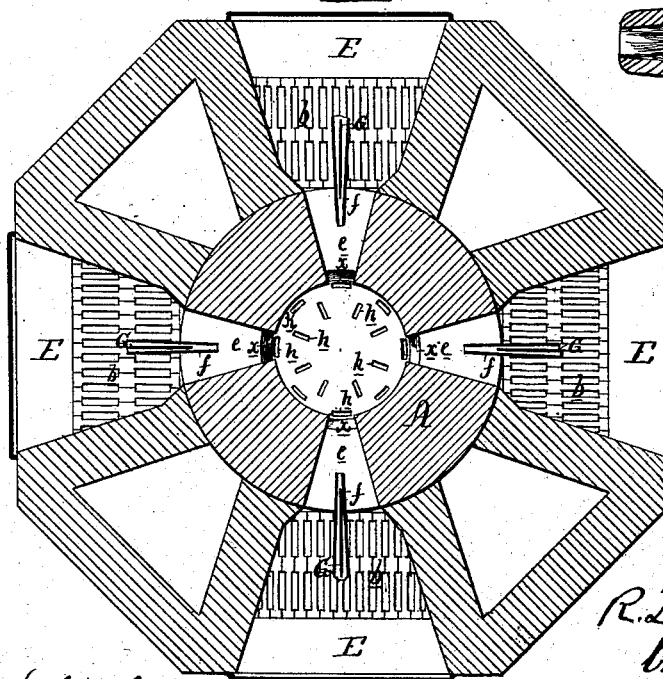
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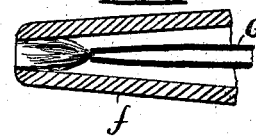
—FIG. 1.—



—FIG. 2.—



—FIG. 3.—



Witnesses { *Wm. B. Harding*  
*Thomas C. Brown*

*R.D. & W.F. Cox*  
*by their atty*  
*Howard and Co.*

# United States Patent Office.

RICHARD DARNEL COX AND WILLIAM FRANKLIN COX, OF PHILADELPHIA, PENNSYLVANIA.

Letters Patent No. 113,401, dated April 4, 1871.

## IMPROVEMENT IN SMELTING IRON AND OTHER ORES.

The Schedule referred to in these Letters Patent and making part of the same.

We, RICHARD DARNEL COX and WILLIAM FRANKLIN COX, both of Philadelphia, county of Philadelphia, State of Pennsylvania, have invented a Process of Smelting Ores, and Appliances for conducting the process, of which the following is a specification.

### *Nature and Object of the Invention.*

Our invention consists of a process, too fully explained hereafter to need preliminary description, of smelting ores without bringing them into contact with the fuel, which in many cases is of such a character as to interfere with the process of reduction.

Our invention further consists of a furnace and appliances, described hereafter, for carrying the process into effect.

### *Description of the Accompanying Drawing.*

Figure 1 is a vertical section of our improved smelting-furnace;

Figure 2, a sectional plan on the line 1-2, fig. 1; and

Figure 3, an enlarged sectional view of one of the tuyeres.

### *General Description.*

It is well known that in many localities in the West where iron-ore is abundant, the neighboring coal is of a quality which precludes its use for smelting purposes; hence it becomes necessary to transport the ore to the neighborhood of available coal-fields, or to convey the desired coal to the point where the ore is abundant.

Our invention has been designed with the view of utilizing this hitherto objectionable coal by rendering it available for smelting purposes, thereby avoiding the expensive system of transportation which has hitherto been practiced.

The difficulty in using coal of the character referred to for smelting purposes has arisen from what has hitherto been considered the necessity of bringing the ore into immediate contact with the burning coal, which, although available for generating heat, gives out such an amount of slag and refuse as to interfere with the process of smelting.

We overcome this difficulty by maintaining the ore free from the fuel, and directing the products of combustion only to the ore in the manner we will now proceed to describe.

In the present instance, the reducing-chamber consists of a simple circular flue, A, formed within an annular structure similar to an ordinary chimney, and this structure is supported on a base, B, resting on a suitable foundation, D.

Adjacent to this structure are built any desired number of fire-places E, there being in the present instance four, each fire-place having a grate, b, and ash-pit d furnished with suitable doors, and each fire-place being roofed over, so that there is no escape for the products of combustion excepting through openings e into the reducing-chamber A. These openings are inclined upward from the fire-places, and are of such dimensions that the ore in the chamber cannot escape through them.

In the roof or wall of each fire-place is built or fitted a tuyere, f, the tapering end of which is directed into one of the openings e, and into each tuyere projects a nozzle, G, communicating with a steam-pipe from a boiler in which the steam is maintained at a high pressure.

The fuel in the fire-place having been properly kindled, steam is admitted to the nozzles, from which it escapes with great force, and in a superheated condition passes through the tuyere, into which, also, a volume of air is necessarily drawn.

These violent jets of steam induce the forcible passage of the products of combustion of fuel in the fire-places into the openings e, where they unite with the combined superheated steam and air and form a flame of such intense heat and force as to rapidly reduce the ore, which rests on the bottom of the chamber, and which is slightly elevated in the middle and has an annular recess, x, so that the molten metal and slag are directed downward and flow through passages h into the general receiving-chamber K, formed in the foundation B, from which the slag and metal may be separately drawn, as in ordinary reducing-furnaces. The molten metal is prevented from escaping through the openings e by the said recess.

The reducing-chamber may be of comparatively small dimensions, as the reduction of the ore is rapid and continuous, and the entire structure may be of a simple and inexpensive character compared with ordinary blast-furnaces.

It is not essential in carrying out my invention to adhere in every particular to the structure illustrated and described. The number of fire-places, for instance, may be increased or diminished according to the size of the furnace, and may be arranged in respect to the reducing-chamber in a manner differing from that described—in any manner, in fact, which will insure the direction of the products of combustion or gases by the steam-jets to the openings e.

The number of jets of steam may be increased according to the size of the apertures e, and provision should be made to regulate the supply of steam and the quantity of air admitted with the steam.

Instead of directing the molten metal and slag to a central reservoir, they may pass to any suitable receptacles outside the structure.

We prefer, however, to build the furnace in the simple manner described, the fire-places being independent structures, which can be removed and rebuilt without disturbing the furnace.

The reservoir K should be of sufficient dimensions to admit an operative after the cooling of the furnace, for the purpose of relining the interior with refractory material, or for the purpose of clearing the passages to the reducing-chamber.

As the usual air-blast is dispensed with, the only necessary adjunct to the furnace is an adjacent steam-boiler for supplying the nozzles, and this boiler may be heated by the gases which pass from the furnace.

Wood or other fuel may be used in place of coal, as circumstances may suggest, and the process may be applied to the reduction of any ores.

#### *Claims.*

1. The reduction of a mass of ore in a chamber, by causing jets of steam to direct to the ore the products of combustion or gases united with the said steam, all substantially as set forth.

2. A furnace in which the products of combustion, with air, and a jet or jets of steam are united at the tuyere-openings, as set forth.

3. A smelting-furnace in which a reducing-chamber for containing the ore, a fire-place or fire-places, and a steam-nozzle or nozzles are combined and arranged substantially in the manner described.

4. The combination, substantially as described, of the air-pipe G and its internal steam-nozzle H, with a fire-place and with a tuyere-opening, *e*, of a reducing-furnace.

5. The combination of the reducing-chamber A, recessed bed *x*, tuyere-openings *e*, and passages *h*, for the escape of the molten metal.

6. The central reservoir K, arranged below the reducing-chamber A, and communicating with the same through openings *h*, as set forth.

In testimony whereof we have signed our names to this specification in the presence of two subscribing witnesses.

RICHARD D. COX.  
WILLIAM F. COX.

Witnesses:

WM. A. STEEL,  
FRANKLIN B. RICHARDS.