Aug. 22, 1933. A. FOLLIET ET AL 1,924,034

PROCESS FOR THE CONTINUOUS CONVERSION OF FERRUGINOUS MATERIALS INTO SPONGY METALLIC AGGLOMERATES

Filed Aug. 10, 1932

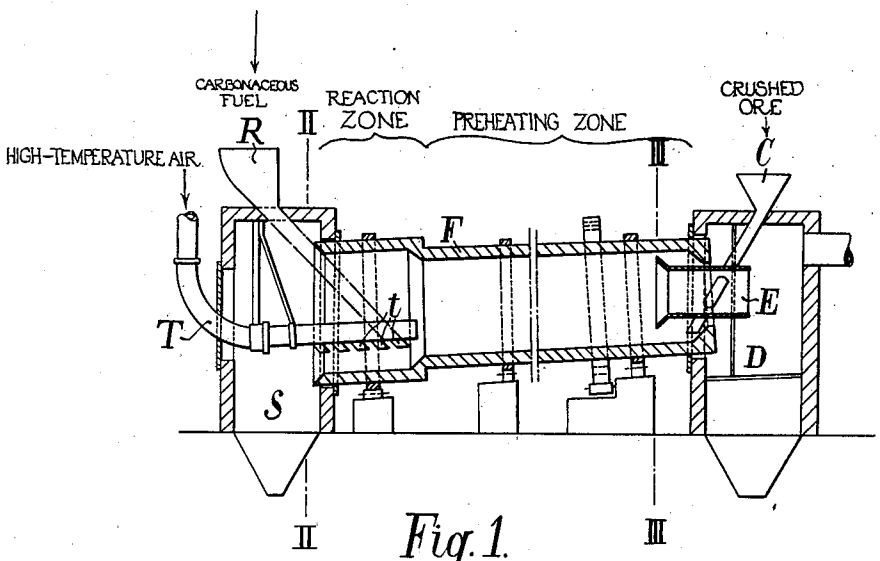


Fig. 1.

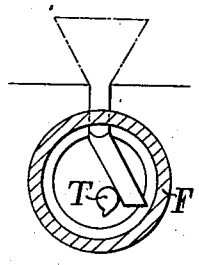


Fig. 2.

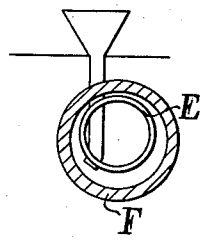


Fig. 3.

A. Folliet & N. Sainderichin
INVENTORS

By: Marks & Clerk
Attys.

Patented Aug. 22, 1933

1,924,034

UNITED STATES PATENT OFFICE

1,924,034

PROCESS FOR THE CONTINUOUS CONVERSION OF FERRUGINOUS MATERIALS INTO SPONGY METALLIC AGGLOMERATES

Alexandre Folliet and Nicolas Saindérichin, Paris, France

Application August 10, 1932, Serial No. 628,544, and in France August 10, 1931

2 Claims. (Cl. 75—14)

In French Patents Nos. 684,174 and 697,006 has been set forth the action of the air, previously raised to high temperatures acting upon a mixture of ores and reducing carbon, advancing progressively in a refractory enclosure. The penetrating insufflation, by the jets of a special twyer, taking place in the final reaction zone, in proximity to the discharge, occasion by the calorific energy developed the continuous agglomeration of the residues, in which the iron is found in the form of magnetic oxide and a little in the state of metal.

This formation of magnetic oxide (Fe_3O_4), as experience has shown, occurs progressively during the travel of the material until its arrival at the final zone of insufflation of air at high temperatures.

In pursuing these applications by utilizing air raised to from 750 to 850° C., with suitable discharge volume and pressure, with a suitable combustible previously added, it has been possible to carry on, practically and with continuous operation, the manufacture of spongy metallic agglomerates, veritable "iron sponge" which is directly utilizable for the manufacture of steel.

This "iron sponge" is moreover of remarkable softness.

This practical operation forms the subject of the present patent.

The raw material, in a suitable state of division, either in the state of fines, like blast-furnace dust, or, for ores and ferruginous materials, crushed from 0 to 8 millimetres; this material should be very uniformly moistened, according to its nature, with a proportion of 5 to 10 per cent. of water.

The material thus moistened is supplemented by a variable percentage of small oven coke or lean anthracite coals, etc., of a screening of 0 to 8 millimetres. According to the iron content the proportion may vary from 10 to 15 per cent. in relation to the fixed carbon contained. The mixture should be intimate.

By its progressive travelling in the oven the mixture is subjected to progressive dessication and progressive heating, likewise in approaching the reaction zone, as the conversion of Fe_2O_3 into Fe_3O_4 progresses to a maximum.

The mixture, arriving thus at a dull red heat in the reaction zone, under a reduced thickness, is subjected to the penetrating jets of air, raised to from 750 to 850° C., blown in through the special twyer. The fixed carbon of the mixture is burnt, in the mass, in the form of CO, with a considerable evolution of calorific energy. This nascent carbon monoxide at high temperatures reacts instantaneously upon the Fe_3O_4, causing the formation of pasty metallic iron. The porosity of this "iron sponge" arises from the immediate escape, at this prevailing temperature resulting from the calorific energy evolved, of the gaseous carbonic acid resulting from the reaction:

$$Fe_3O_4 + 4CO \text{ (nascent)} = 3Fe + 4CO_2$$

An example of a suitable form of apparatus for carrying out the process described above is shown in the accompanying diagrammatic drawing, in which:—

Figure 1 shows a longitudinal section of the furnace,

Figure 2 a cross-section on the line II—II of Figure 1, and

Figure 3 a cross-section on the line III—III of Figure 1.

In the drawing, crushed ore from the hopper, C, passes in a thin layer through the rotary chamber, F, being preheated during the first part of such passage by products of combustion from the final zone. The preheated products after such treatment enter a cylindrical chamber of increased cross-section where they receive the necessary excess of reducing carbon from the piping and hopper R.

The intimate mixture of the products of the preheating and carbon then pass under jets *t*, of air at a high temperature from the main twyer T. Any metals volatilized by this reaction are led back along the chamber F, together with products of combustion into a chamber D, after passing through a flared pipe E, which is stationary and traversed by the feed pipe C, this backward lead effecting preliminary heating of the layer of material moving forward.

The resulting spongy iron in the form of substantially spherical lumps is automatically discharged into a chamber S.

Having now described our invention what we claim as new and desire to secure by Letters Patent is:—

1. A continuous process for reducing iron oxide

in ferruginous material to metallic iron in spongy form which consists in moistening said material, feeding forward said moistened material in a thin layer, mixing carbonaceous fuel with said material prior to said layer entering the final zone of its forward feed, and subjecting said mixture to the action of penetrating blasts of air heated to temperatures of the order of 750° to 800° C., the gases formed within the mixture due to the action of said penetrating blasts serving as they escape therefrom to give a spongy form to the metallic iron produced by the reaction, said carbon in said fuel being in sufficient quantity to prevent re-oxidizing of said reduced iron.

2. A process as claimed in claim 1, in which the carbon added is equivalent to that in a quantity of coal weighing not less than about 10 to 15 per cent. of the weight of the ferruginous material.

ALEXANDRE FOLLIET.
NICOLAS SAINDERICHIN.