No. 652,076. Patented June 19, 1900.

W. BORCHERS.

HIGH TEMPERATURE SMELTING FURNACE.

(Application filed Apr. 25, 1899.)

(No Model.)

Fig. 1.

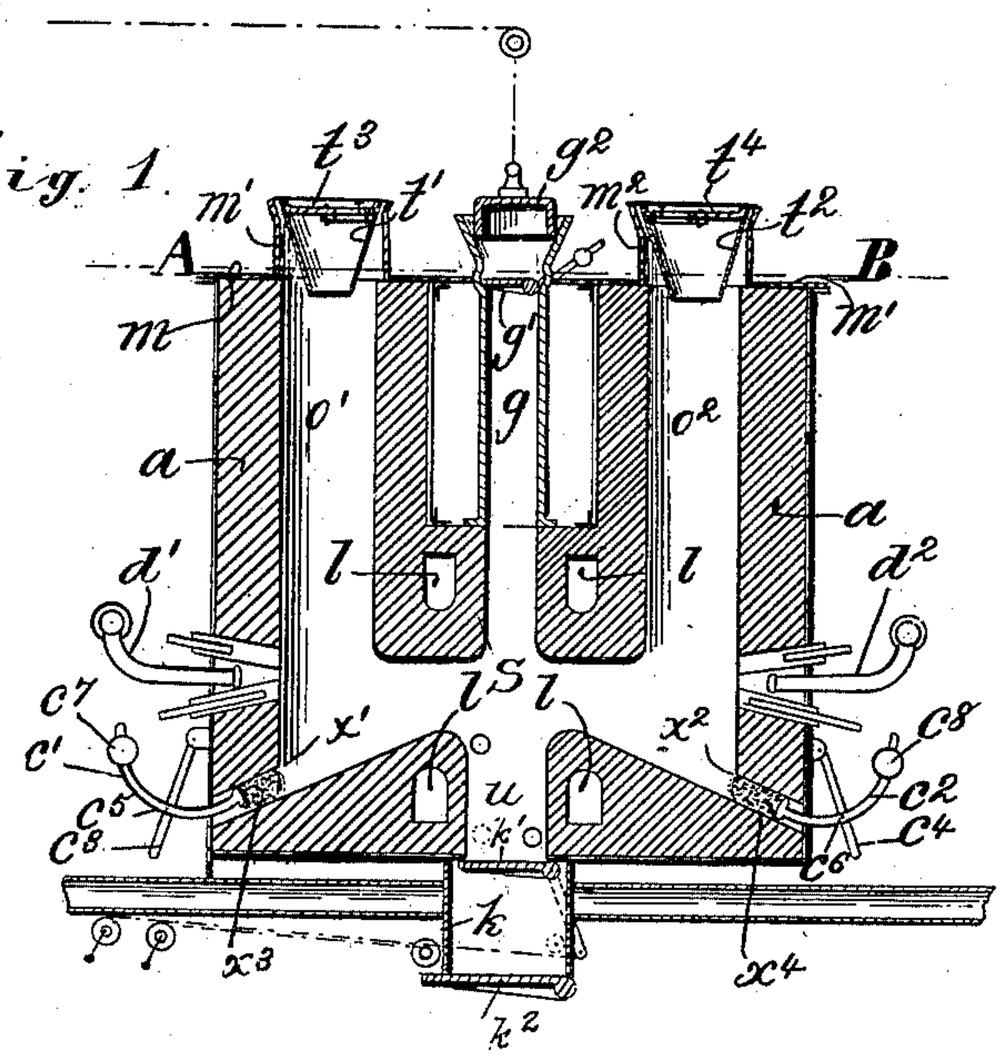


Fig. 4

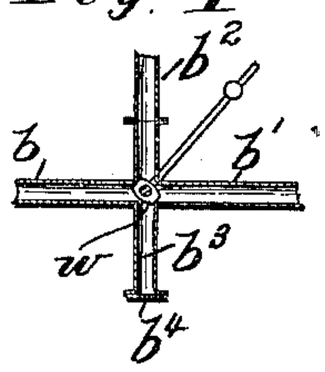


Fig. 2.

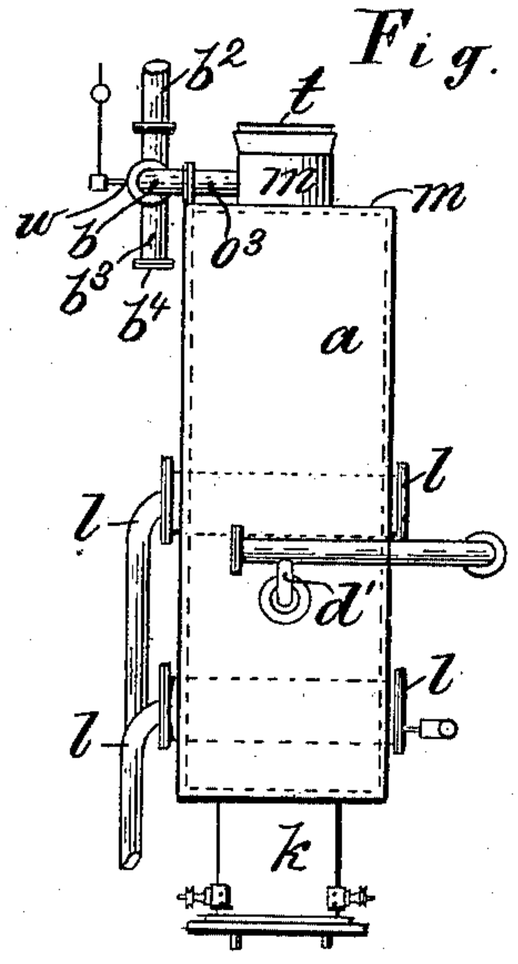


Fig. 5.

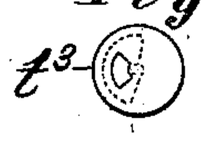
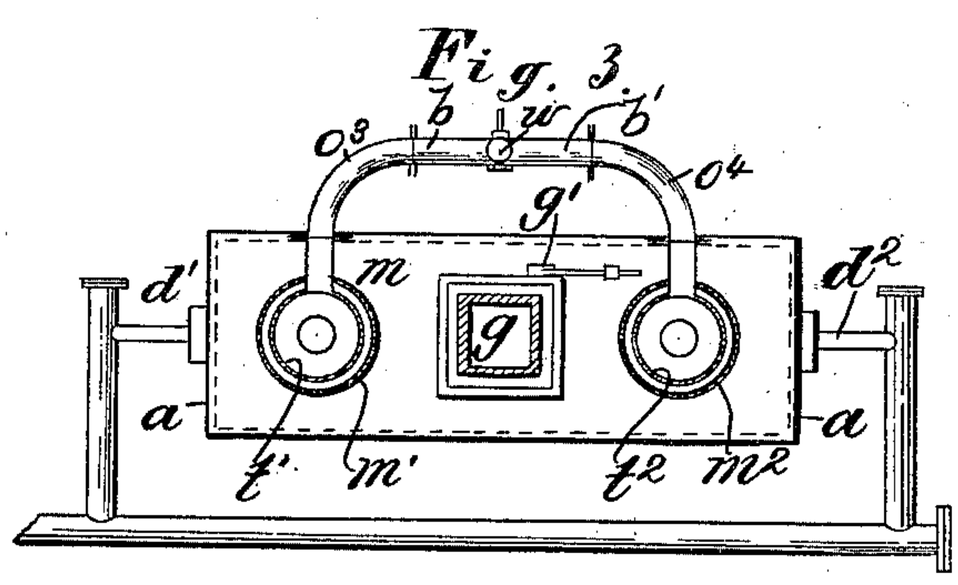


Fig. 3.



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UNITED STATES PATENT OFFICE.

WILHELM BORCHERS, OF AIX-LA-CHAPELLE, GERMANY.

HIGH-TEMPERATURE SMELTING-FURNACE.

SPECIFICATION forming part of Letters Patent No. 652,076, dated June 19, 1900.

Application filed April 25, 1899. Serial No. 714,384. (No model.)

To all whom it may concern:

Be it known that I, WILHELM BORCHERS, residing at Aix-la-Chapelle, in the German Empire, have invented certain new and useful Improvements in High-Temperature Smelting-Furnaces; and I do hereby declare that the following is a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

This invention relates to furnaces for obtaining high temperatures for smelting metals and other like purposes.

Attempts have been made to obtain very high temperatures by combustion by the employment of gas heating apparatus in connection with heat-generators, but for well-known reasons such apparatus rarely permitted of a temperature of 2,000° centigrade being exceeded. Higher temperatures can in a reliable manner only be obtained by the combustion of solid carbon in such a manner as to to directly form carbonic oxid. Moreover, for raising natural temperatures of combustion preliminary heating of the fuels and of the air has been employed, while it is known that by the aid of oxygen or of gas mixtures rich in oxygen a similar object may be attained. Lastly, an increased rate of combustion by the use of compressed air is another means for attaining the desired result.

The furnace hereinafter described is intended to serve for the practical carrying out of all three means above referred to, but is more especially intended for the indispensable preliminary heating of the solid fuel, coke, or charcoal, which operation, as is known, has heretofore been a matter of difficulty. For this purpose the fuel employed is caused to serve at the same time as the heat-accumulating material.

Reference being had to the accompanying drawings, Figure 1 is a vertical longitudinal section of my improved furnace. Fig. 2 is a side elevation of the same. Fig. 3 is a horizontal section on the line A B of Fig. 1. Fig. 4 is a detail section taken through the draft-regulating valve shown in Fig. 2. Fig. 5 shows one form of damper, which may be of any known construction, for closing the feed-hopper.

In order to enable those skilled in the art to make and use my invention, I will now describe the same in detail, referring to the drawings, wherein—

The letter a indicates the furnace structure, built of brickwork or other fireproof material and constructed in its opposite side portions with vertical cylindrical shafts o' o^2, which may be jacketed with iron. The top of the furnace structure is provided with an iron cover-plate m, having vertical tubular necks m' m^2, supporting two feed-hoppers t' t^2 for feeding solid fuel to the shafts. Between the hoppers and the cover-plate a free space is left, through which the waste gases from the furnace can be carried off. For the admission of air or oxygen nozzles d' d^2, worked alternately and protected by water-jackets or cooled mountings, are provided. Between the two chambers is a shaft or passage g, (seen in the drawings,) which is provided with two suitable closing devices g' g^2 for preventing the escape of gas therethrough. The hoppers t are also kept closed by suitable dampers or register-plates t^3 t^4, one of which is shown in plan view, Fig. 5.

k is a collecting box or receptacle for the solidified products, which are to cool therein and from which the air is excluded.

l indicates cooling-passages for protecting the masonry at the hottest places of the furnace.

The tubular necks m' m^2 of the cover-plate m communicate with two gas-discharge pipes o^3 o^4, connected to the horizontal members b b' of a vertical escape-pipe b^2, said pipe thus being T-shaped at its lower end. A suitable valve w is properly arranged at the junction of the vertical escape-pipe b^2 with its horizontal members b b', so that either vertical fuel-shaft o' o^2 can be made to communicate with the vertical escape-pipe through its appropriate tubular neck and discharge-pipe, while the other fuel-shaft is cut off from said escape-pipe.

The operation is as follows: According as the fuel is coarse or fine, the shafts o' o^2 are filled either partially or entirely. The fuel is lighted through the holes x' x^2 and is at first allowed to burn undisturbed with the hoppers t open. The holes x' x^2 are adapted to be closed, as hereinafter explained, and when open they serve for lighting the fuel and for

the discharging ashes from the opposite upright fuel-shafts o' o^2. After the furnace has thus been preliminarily heated to a sufficient degree and the lower layers of the fuel have become sufficiently incandescent both shafts are then charged with fuel to the desired height and the feed-hoppers are closed. The charge to be smelted is then admitted through the central shaft g, and air or oxygen is blown into one of the outer shafts—for instance, by nozzle d' into shaft o'—the air or oxygen being delivered to the nozzle to a suitable pipe or conduit. The other shaft o^2 is arranged to simultaneously communicate with the gas-discharge pipe by the three-way valve w. After the holes x' x^2 have been closed (say by clay plugs x^3 x^4) the hot gases of combustion pass through a transverse chamber or passage s from the chamber o' to the chamber o^2, and while the combustion and the generation of heat take place in the chamber o' the heat that has not been consumed in the chamber accumulates in the fuel in the other chamber o^2, as the gases of combustion are compelled to pass off through the latter. After a short time the valve w is reversed and the air or oxygen, as the case may be, is blown in at d^2, whereby the gases of combustion are compelled to pass off through the fuel accumulated in o', thereby heating the said fuel. It is evident that in this manner the temperature in the furnace will soon attain the highest possible limit. It is clear, moreover, that this temperature will be higher than in the case of furnaces heated by gaseous fuels, for in the latter on account of the low temperature at which the products of combustion, CO_2 and H_2O, become dissociated it is not possible to greatly exceed a temperature limit of 2,000° centigrade. On the other hand, there is nothing in the way to prevent the combustion of the carbon being effected, as is intended in this furnace, partly by a suitable preliminary heating of the carbon, partly by enriching the air with oxygen, and partly by the possibility of operating under pressure. In fact, carbon is still consumed at temperatures beyond 3,500°, and although it only forms carbonic oxid there is still a sufficient development of heat for the purposes for which the furnace is designed.

In order to remove the molten products from the horizontal chamber or passage s, the upper closing-lid of the box k is opened, wooden or carbon rods being inserted through each of the openings u to prevent undecomposed portions of the charge from slipping out after the said products. The openings u also enable the smelting process to be watched. The finished product first descends into the box k, the upper lid of which is at once reclosed, and after it has cooled down the contents of said box k are discharged through the bottom door or flap. As in these high temperatures the ashes of the fuel will accumulate in a molten state in the chambers o' o^2, the holes x' x^2, already referred to, are provided, through which the ashes can be discharged after the clay plugs have been removed. To prevent the clay plugs x^3 x^4 from being blown out if compressed air is delivered through the air-injecting nozzles d' d^2, the plugs are held in place through the medium of curved presser-rods c' c^2, having weights c^7 c^8 at their outer ends and pivoted at c^5 c^6 to pivotally-suspended bails or supports c^3 c^4, so that the inner ends of the rods are caused by gravity to press against the plugs and hold them in place. The horizontal members b b' of the gas-escape pipe b^2 are preferably provided with a pendent branch b^3, closed at its lower end by a removable cap b^4 for enabling access to be had to the valve w for cleaning the same, if occasion demands.

The process as well as the apparatus are applicable, first, for heating all substances which in order to be reduced require a higher temperature than could be obtained by former methods of heating, and, secondly, in cases where the products of combustion, such as carbonic acid (CO_2) and wet steam (H_2O), have an injurious effect upon the smelting products.

Obviously under the working conditions above described and by utilizing carbon alone as fuel the gases of combustion will be obtained in a form approximately free from carbonic acid.

I do not limit myself to the use of two vertical fuel-shafts in the furnace structure; but at least two are essential for the purposes hereinbefore stated.

Having now particularly described and ascertained the nature of my invention and in what manner the same is to be performed, I declare that what I claim is—

1. A high-temperature smelting-furnace having two opposite fuel-shafts o', o^2, alternately serving as combustion and heat-accumulator chambers, the horizontal passage s connecting the lower end portions of the fuel-shafts, a smelting chamber or shaft g, arranged centrally between the fuel-shafts and opening at its lower end into said horizontal passage, means for feeding fuel to and for closing the upper ends of said fuel-shafts, nozzles at the lower ends of said fuel-shafts opposite said passage s for delivering air or oxygen into the lower part only of the fuel in said shafts, a gas-escape pipe b^2 independent of the air-supply nozzles, having branches b, b', communicating respectively with the upper ends of said fuel-shafts for carrying off the gases therefrom, a valve at the intersection of said pipes for closing either branch discharge-pipe while the other remains open to discharge the gases from its fuel-shaft, and a collecting-box k located below said smelting-shaft and having opening and closing devices, substantially as described.

2. A high-temperature smelting-furnace having two opposite, vertical fuel-shafts serving alternately as combustion and heat-accumulator chambers, the horizontal passage

connecting the lower ends of the fuel-shafts, holes at the bases of the fuel-shafts for lighting the fuel therein and discharging the ashes therefrom, devices for closing said holes after the fuel is lighted, nozzles arranged to deliver air or oxygen into the lower portions of said fuel-shafts opposite said horizontal passage, a smelting-shaft arranged centrally between the fuel-shafts, opening at its lower end into said horizontal passage and provided with devices for closing its upper end, opening and closing devices for feeding fuel into and for closing the upper ends of said fuel-shafts, a collecting-box arranged below and adapted to communicate with the central smelting-shaft through said horizontal passage and having opening and closing valves, a gas-escape pipe independent of said nozzles arranged at the rear of the fuel-shafts and having branch pipes communicating respectively with the upper portions of said fuel-shafts, and a valve controlling the communication between said branch pipes and the gas-escape pipe, for closing either branch pipe and leaving the other in communication with the gas-escape pipe and its fuel-shaft, substantially as described.

3. A high-temperature smelting-furnace having two opposite, vertical fuel-shafts serving alternately as combustion and heat-accumulator chambers, a horizontal passage connecting the lower ends of said fuel-shafts, a vertical smelting-shaft arranged centrally between the fuel-shafts and opening at its lower end into said horizontal connecting-passage, holes in the sides of the fuel-shafts for lighting the fuel therein and discharging the ashes therefrom, plugs for closing said openings, pivotally-mounted bails, presser-rods pivoted to said bails for holding said plugs in position, air-injector nozzles entering the lower portions of the fuel-shafts opposite said horizontal passage, valved devices for feeding fuel into, and for closing the upper ends of said fuel-shafts, a gas-escape pipe independent of said nozzles arranged in rear of the fuel-shafts and having branch pipes connected respectively with the top portions of said fuel-shafts, and a valve for controlling communication of either branch pipe with the gas-escape pipe, substantially as described.

4. A high-temperature smelting-furnace having two opposite vertically-arranged fuel-shafts serving alternately as combustion and heat-accumulator chambers, a horizontal passage connecting the lower ends of the fuel-shafts, a smelting-shaft located vertically between the latter and at its lower end communicating with said horizontal passage, a cover-plate over all of said shafts constructed with fuel-hoppers communicating with the shafts, register-plates for closing said hoppers, a collecting-box located below and constructed to communicate with the smelting-shaft through said horizontal passage to receive the finished product therefrom, openings in the sides of the fuel-shafts for igniting the fuel therein and discharging the ashes therefrom, closing-plugs for said openings, pivotally-mounted bails, presser-rods pivoted to said bails for holding said plugs in position, injectors for supplying air to either fuel-shaft entering the lower end of said fuel-shafts opposite said horizontal passage, gas-discharge branch pipes communicating, respectively, with the upper ends of said fuel-shafts, a gas-escape pipe, and a valve for controlling communication between either gas-discharge pipe, and the escape-pipe, substantially as described.

In witness whereof I have hereunto set my hand in presence of two witnesses.

WILHELM BORCHERS.

Witnesses:
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CH. WARDELL STILES.