(No Model.) 2 Sheets—Sheet 1.

C. J. FAUVEL.

FURNACE FOR THE TREATMENT OF REFRACTORY ORES.

No. 493,076. Patented Mar. 7, 1893.

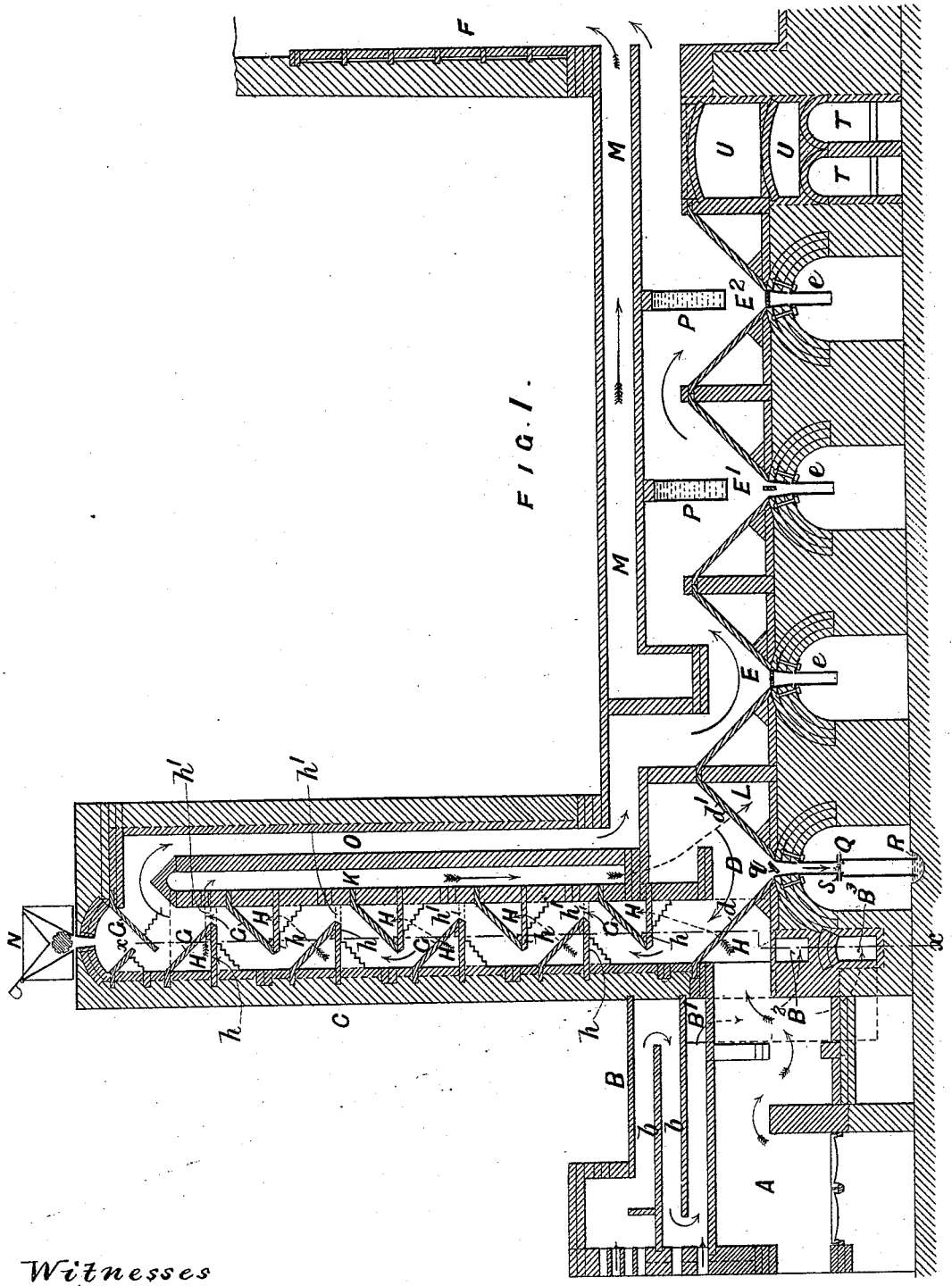

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FIG. 2.

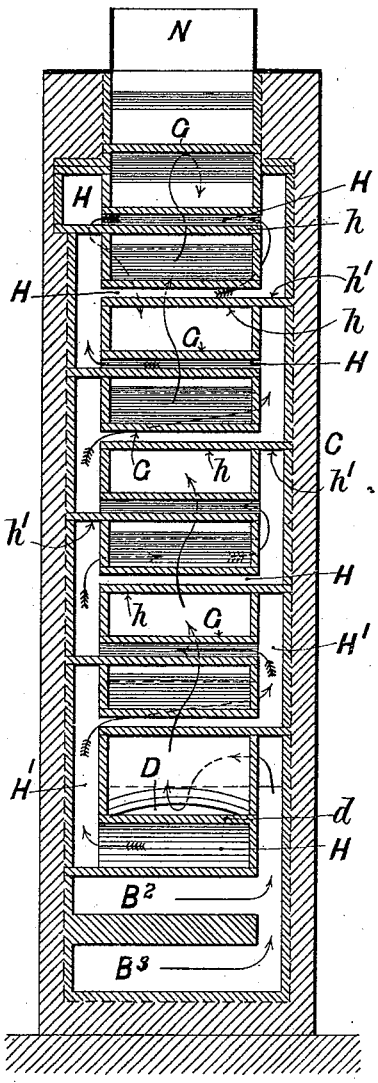
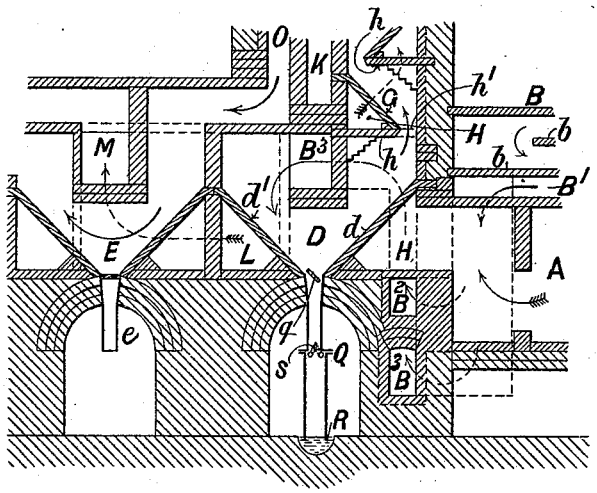


FIG. 3.



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UNITED STATES PATENT OFFICE.

CHARLES JAMES FAUVEL, OF LONDON, ENGLAND.

FURNACE FOR THE TREATMENT OF REFRACTORY ORES.

SPECIFICATION forming part of Letters Patent No. 493,076, dated March 7, 1893.

Application filed April 25, 1892. Serial No. 430,497. (No model.)

To all whom it may concern:

Be it known that I, CHARLES JAMES FAUVEL, assayer and mining engineer, of 15 George Street, Mansion House, in the city of London, England, have invented an Improved Furnace for the Treatment of Refractory Ores; and I do hereby declare the following to be a full, clear, and exact description of the same.

This invention relates to the treatment of refractory ores containing precious and other metals, and it consists essentially of an improved furnace whereby the operation of oxidizing the impurities associated with or forming part of the ore may be effected by a current of hot air entirely out of contact with the furnace gases so that the ore will not be exposed to the chemical action of the said gases or be contaminated by the formation of any carbonaceous deposit therefrom, but, after undergoing the process of oxidizing, will be delivered in what is technically known as a "sweet" condition. To accomplish this oxidizement and sweetening it is essential that the current of air which is to effect the oxidation should not be robbed of its oxygen to support the combustion of the fire and accordingly the oxidizing current is separately heated and the passages are so arranged that neither the ore nor the oxidizing current can at any time come in contact with the products of combustion of the fuel, while the flues for the latter are so arranged as to insure the utilization in a rational manner and to the utmost possible extent of the available heat.

The furnace is also applicable for chloridizing the silver contained in the ore for which purpose it is only necessary to add the requisite amount of chlorinating medium to the ore.

This improved oxidizing and ore "sweetening" furnace is illustrated in the accompanying drawings, forming part of this specification, and will be described with reference thereto.

Figure 1 is a longitudinal sectional elevation of the entire furnace. Fig. 2 is a vertical section on line x—x Fig. 1. Fig. 3 is a central detail section looking in the reverse direction to Fig. 1.

It comprises a fireplace A of suitable construction, an air-heating chamber B, an oxidizing tower C, settling chambers D, E, E′, E², and a chimney F, with their various flues, chutes and other adjuncts constructed and arranged for effecting the oxidizing operation as hereinafter described with reference to the drawings in which the feathered arrows indicate the course followed by the products of combustion while the featherless arrows indicate the course of the oxidizing current.

The fireplace A is so constructed as to burn any fuel, air holes being provided in the side walls to admit air and insure perfect combustion. It is preferably built in duplicate to give a greater command of heat at starting or whenever required.

The oxidizing tower C in which the oxidation of the sulphides &c., is accomplished is a rectangular brick structure about forty feet high, fitted internally with a series of inclined fireclay slabs G each slab extending the full width of the oxidizing chamber and projecting alternately from the opposite walls by which they are supported as shown in Fig. 1 so that the pulverized ore supplied at the top of the tower must slide down these slabs in succession, the slabs being so arranged with regard to each other that the ore will be delivered by each slab on to the highest part of the next below and so on from one to another throughout the whole series so that the whole superficial area of the slabs is utilized as heating surface for the ore which is finally received in the first settling chamber D at the bottom of the tower. It is beneath the inclined slab d forming one side of this settling chamber that the greatest heat is developed, this being the point at which the gases from the furnace enter the flues H, H′ of the oxidizing tower. These flues H extend beneath each of the inclined slabs G and communicate with vertical flues H′ in the end walls of the tower which are so interrupted by cross-partitions h' that the furnace gases will be caused to follow a zig-zag course such as indicated by the feathered arrows so as to pass through all the flues H in succession from the lowest upward, the highest flue H finally leading into the upper end of a central downcast

flue K leading into a cross-flue L situated beneath the other inclined slab d' of the settling chamber D and communicating by a side passage at the opposite end with a flue M leading direct to the chimney F. None of these flues has any connection with the interior of the oxidizing tower so that the furnace gases cannot come in contact with the ore or the oxidizing current, while the course of the furnace gases as well as that of the oxidizing current being upward, and inverse to that of the falling ore, the latter is subjected to a gradually increasing temperature, the maximum degree of heat being attained at the completion of the operation. In this way the heat is developed and utilized in the most rational manner for progressively effecting and finally completing the oxidation of the ore. Each flue H is inclosed at the underside by a fireclay slab h which is also available as heating surface for the oxidizing current which, in ascending through the oxidizing tower, strikes against these underside slabs and takes up heat therefrom.

The pulverized ore is supplied at the top of the oxidizing tower, by an automatic feeder (preferably consisting of a fluted cylinder working in a hopper N) which distributes the ore in the form of a thin stream extending across the whole width of the tower and falls upon the hot sloping surfaces G rolling down them in a constant stream, the particles being raised to a state of incandescence by contact with the slabs. During their passage down the inclined slabs, and in falling from one to the next, the ore particles encounter an abundant upward stream of hot air supplied from the air heater B. The air heater is situated above the fire place A and is divided by baffles b and provided with air inlets furnished with dampers to regulate the air supply to suit the ore under treatment. The air having been heated to the proper temperature passes out of the heater through lateral and cross flues B' B^2 B^3, as indicated by the featherless arrows, into the upper part of the first settling chamber D and flows up through the oxidizing tower meeting the incandescent particles of falling ore, checking their descent and scattering them in such a way that no particle can escape the complete oxidation and removal of its associated sulphur, arsenic, antimony or tellurium compounds. Moreover, the stream of heated air on entering the first settling chamber D not only helps by its own temperature, and by perfecting the oxidation at that point, to raise the temperature of the ore to the highest degree just where the greatest heating effect is needed but the air is in the purest possible condition on meeting the ore at the moment when it approaches the completion of its oxidation, so that the culminating points of the heating and oxidation coincide. The oxidizing current carries off the fumes and passes off at the top of the tower into a downcast flue O leading to the series of settling and condensing chambers E E' E^2 wherein any solid particles that may be carried off along with the oxidizing current are caught and wherein the sulphurous and other fumes are condensed by contact with the cooled surfaces of metal tanks P, through which a constant circulation of cold water is maintained, the air and vapors passing on into the chimney F and being thus freed of noxious properties, before being allowed to escape.

Reverting now to the product of the oxidizing process, the oxidized and "sweetened" ore is discharged from the settling chamber D through a discharge pipe Q (provided with a regulating valve q) into a quick running stream R of cold water contained in a trough into which the pipe Q dips whereby the pipe is sealed against the admission of cold air. It is necessary to keep the water in a turbulent state otherwise the bubbles of steam may cause the particles to float on the surface of the water, instead of being immediately immersed. The constant agitation of the water and the complete immersion of the glowing particles may be conveniently effected by the introduction in the pipe Q of jets of cold water at S which meet the falling stream of particles and increase the force with which they descend into the trough. The sudden cooling of the glowing particles of ore thereby effected, and the disruptive effect produced by the flashing of the water into steam cause the breaking up of the particles and of any glaze-like coating or adherent oxides of the base metals, which are carried off by the running water, thus freeing the noble metals of impurities which would be detrimental to the subsequent amalgamating or other metal saving operation. The particles are transported by the running stream to a series of settlers, amalgamators or other means of arresting and collecting the heavier and valuable metals contained in the ore. As by this quenching operation the ore is reduced to an almost impalpable powder very fine crushing is not necessary and therefore the output of the crushing mill can be increased. Moreover, the particles are so minute that there is no longer any room for atoms of gold or other metal to be locked up in them and the skin of oxide having been removed, as above mentioned, the gold is clean and in a condition specially adapted for amalgamation.

The settling chambers E E' E^2 are provided with discharge spouts e closed by valves, at which the particles intercepted and the sulphurous and other vapors which have been condensed may be periodically discharged into trucks below.

In order to insure a sufficient draft in the chimney to draw the air through the air heater and through the oxidizing tower and condensing chambers, and likewise to draw the furnace gases through the flues above described,

special draft furnaces T would be provided, communicating directly with the chimney, and over them, air-heating chambers V, connected by a flue with chamber D, for the supply of hot air thereto, should the supply from the air heater B before described be insufficient. Retorts for the generation of oxygen or chlorine gas, may be arranged in or above the furnaces T for supplementing or replacing as the case may be the oxygen of the hot-air supply when required.

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

1. In a furnace for the treatment of refractory ores, an oxidizing tower or shaft having a series of inclined shelves projecting within the shaft alternately from opposite sides thereof, in combination with horizontal transverse flues formed beneath such shelves and connected with each other in zig zag order by vertical end flues, the lower end of the series being connected with a furnace adjacent to the tower so as to receive the furnace gases therefrom, whereby the shelves will be heated by the furnace gases passing through the said horizontal flues, substantially as specified.

2. In a furnace for the treatment of refractory ores, an oxidizing tower or shaft having a series of inclined shelves projecting within the shaft alternately from opposite sides thereof, in combination with horizontal transverse flues formed beneath such shelves and connected with each other in zig zag order by vertical end flues, the lower end of the series being connected with a furnace adjacent to the tower, so as to receive the furnace gases therefrom and at top to a down flue leading beneath the settling chamber at the foot of the tower and thence to the chimney, substantially as specified.

3. In a furnace for the treatment of refractory ores, an oxidizing tower or shaft provided with a series of inclined shelves projecting within the shaft alternately from opposite sides thereof and with transverse flues formed beneath said shelves connected together in zig zag order by end flues and connected with a furnace so as to receive the furnace gases therefrom, in combination with an air heater situated above but having no communication with the furnace and connected with the lower end of the shaft or tower so as to supply a current of heated air thereto which flowing upward through the shaft or tower meets the stream of falling ore passing over the shelves, as described.

4. In a furnace for the treatment of refractory ores, an oxidizing tower or shaft provided with alternating inclined shelves having flues beneath them connected together in zig zag order and connected with a furnace so as to receive the furnace gases therefrom, an air heater above the furnace connected with and for supplying hot air to the interior of the tower and a hopper shaped settling chamber at the foot of the tower for receiving the particles of ore after being subjected to the oxidizing action of the air current, the inclined sides of the said settling chamber having transverse flues beneath them through which the furnace gases pass on their way to and from the shelf flues of the tower, substantially as specified.

5. In a furnace for the treatment of refractory ores, comprising an oxidizing tower or shaft having a series of internally-projecting alternating inclined shelves heated by flues beneath coupled in zig zag order and connected with a furnace as described, and an air heater for supplying an upwardly flowing current of hot air to the interior of the tower or shaft, the combination with the receiving and settling hopper at the foot of the tower, of a vertical spout arranged to be sealed by dipping into running water and containing perforated jet pipes at which jets of cold water are projected across said spout so as to meet and quench the freely-falling stream of ore particles, substantially as specified.

6. In a furnace for the treatment of refractory ores, comprising an oxidizing tower or shaft having a series of internally-projecting alternating inclined shelves heated by flues beneath coupled in zig zag order and connected with a furnace as described, the interior of the tower or shaft being connected at bottom with an air heater as described, for supplying an upwardly flowing current of hot air through said tower, the combination with said tower, of a series of settling chambers for intercepting particles carried over by the air current, the chambers being connected on the one hand with the upper end of the tower or shaft by a down flue and on the other hand with the chimney, as described.

7. In a furnace for the treatment of refractory ores comprising an oxidizing tower or shaft having a series of internally-projecting alternating inclined shelves heated by flues beneath connected in zig zag order and connected with a furnace as described, the interior of the tower or shaft being connected at bottom with an air heater, as described for supplying an upwardly flowing current of hot air through said tower, the combination with said tower, of a series of settling and condensing chambers for intercepting the particles carried over by the air current, said chambers being connected on the one hand with a down flue leading from the top of the tower or shaft and on the other hand with the chimney, and containing hanging water bridges or tanks through which cold water may circulate for providing cold surfaces within the chambers for condensing the fumes, substantially as specified.

8. A furnace for the treating of refractory

ores, comprising a tower having internally-projecting alternating inclined shelves with flues beneath them connected together in zig zag order and connected with a furnace as described, and having a down flue for the furnace gases connected with the uppermost shelf flue and a down flue for the oxidizing current and fumes, the down flue for the furnace gases being situated between the oxidizing shaft and the down flue for the oxidizing current and fumes so as to avoid loss of heat, substantially as specified.

Dated this 8th day of April, 1892.

CHARLES JAMES FAUVEL.

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