

R. F. KNOX & J. OSBORN.

Process of and Apparatus for Reducing Mercury Ores.

No. 233,520.

Patented Oct. 19, 1880.

Fig. 2.

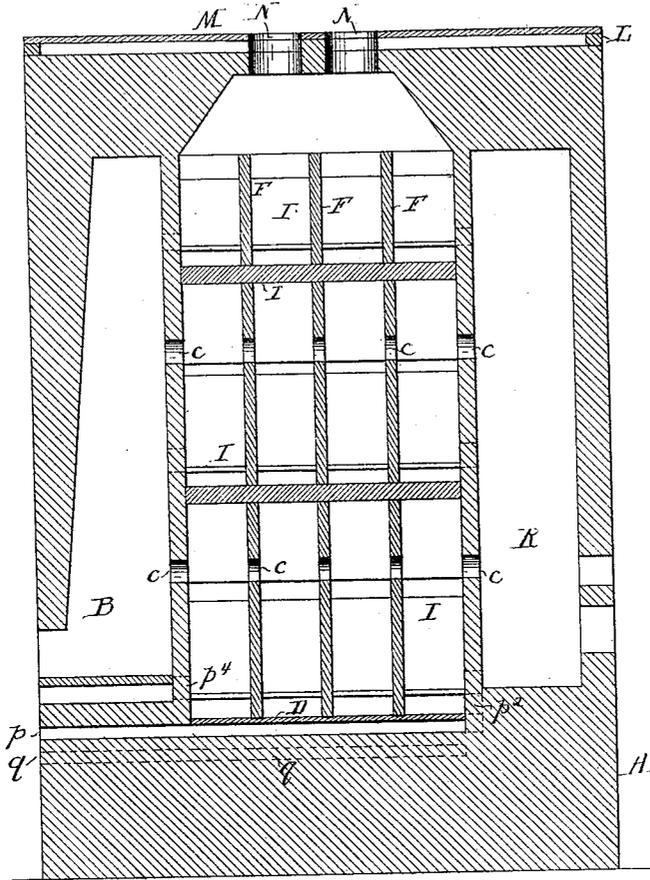
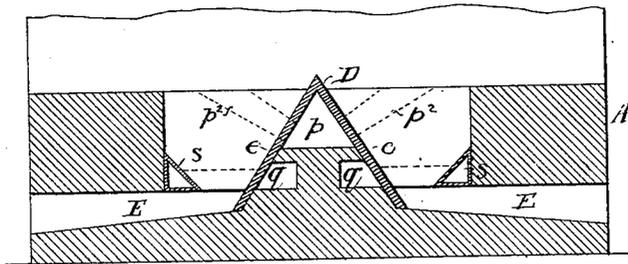


Fig. 3.



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PROCESS OF AND APPARATUS FOR REDUCING MERCURY ORES.

SPECIFICATION forming part of Letters Patent No. 233,520, dated October 19, 1880.

Application filed April 2, 1875.

To all whom it may concern:

Be it known that we, RICHARD F. KNOX and JOSEPH OSBORN, of San Francisco city and county, State of California, have invented Improvements in Furnaces for Roasting Ores; and we do hereby declare the following description and accompanying drawings are sufficient to enable any person skilled in the art or science to which it most nearly appertains to make and use our said invention or improvement without further invention or experiment.

Our invention relates to the reduction of mercury ores; and it consists in certain improvements in processes and apparatus, the nature of which will be hereinafter more fully explained.

On reference to the accompanying drawings, forming part of this specification, Figure 1 is a perspective view of our improved furnace, used in carrying out the process. Fig. 2 is a longitudinal sectional elevation, and Fig. 3 is a partial section of the bottom portion of the furnace.

A is the stack or body of the furnace, into which the ore is to be fed by dropping it through openings in its top. The fire-place B is located near the bottom of the furnace and at one side—say at two-fifths the distance from the bottom to the top—and at the opposite side is a chamber, R, communicating with the condensers, and openings C are made in transverse vertical walls of the furnace, so that the heat and products of combustion are compelled to pass across the ore-chamber on their way from the fire-place to the condenser.

Directly across the lower end of the ore-chamber, and in line with the middle of the fire-place, we construct an inverted-V-shaped ridge, D, the apex of which is almost upon a level with the fire-place, and this ridge serves to divide the roasted ore, when it has passed below the level of the fire-place, and direct it to the discharge or draw openings E, one set of which is located on each side of the furnace. This ridge or double incline we construct of two inclined sides, tiles, or plates, *e e*, and strengthen it by an inner supporting-wall, in which we make three passages, *p q q*, one at the top, and one lower down, at each side, for the purpose hereinafter explained. The ore-chamber or interior of the furnace we may then

divide into a number of peculiarly-constructed chambers in the following manner: Across the chamber we construct a number of upright transverse partitions, F F F, at a short distance from each other, so as to divide the chamber into any desired number of narrow upright chambers X, which extend from the top of the inverted-V-shaped ridge to the top of the ore-chamber. While constructing these upright partitions we build across the chamber, transversely to the partitions, shelves I I, of refractory material, which extend from the wall upon one side of the chamber to the wall of the opposite side. (See Fig. 1.) These shelves are made in the shape of an inverted V, so as to form double inclined planes or shelves, sloping in opposite directions, and openings C permit the gas to traverse beneath the shelves through the partitions. These inverted-V-shaped shelves are so disposed that the shelves of each horizontal series will alternate with the shelves in the series directly above and below it, while a narrow space, *j*, is left between the lower edge of the inclined side of each shelf, and the upper edge or apex of the shelves below.

The spaces between the upright partitions F F F are thus converted into a number of diamond-shaped chambers, into the lower portion of each of which the ore will enter through the side spaces, *j*, and pass out through the space *j* at the bottom into the chamber below. By this arrangement the ore which descends from either chamber will be distributed equally between the two chambers below by the dividing apex.

In practice we have found it advantageous to make the angle of inclination of the shelves about sixty degrees, and to arrange the latter as shown, so that the passages will be on diagonal lines, thus permitting the introduction, through such chambers, of rods to break up any matter which may become clogged, and clear the passages.

The top of the furnace is made flat, and has a ledge, L, extending entirely around its upper edge, and upon this ledge we secure a sheet-iron or other suitable cover, M, so as to leave a space between it and the top of the furnace, into which heated air is introduced, as hereinafter described, for the purpose of drying

the ore previous to introducing it into the furnace by spreading it upon the cover M.

N N are the feed-openings, through which the ore is fed into the furnace, and these openings are walled up to the cover M, to prevent the heated air from escaping from between the cover and the roof. Between the roof and cover we also construct semi-partitions O, which are so arranged as to cause the heated air to pass in a tortuous course over the entire top of the furnace before permitting it to escape into the open air.

An opening, p' , directly under the fire-place, communicates with the upper passage, p , in the ridge D, and with the latter connect openings p^2 , (shown in dotted lines, Figs. 2 and 3,) so that the air entering at p' is led into the back part of the ore-chamber, and then passes forward through the lower diamond-shaped chambers and through openings p^1 , (dotted lines, Fig. 2,) to the fire-place below the grate, where it serves to supply oxygen to the fire. In its passage through the heated chambers and through the lower calcined portion of ore or waste the air is heated, and any remaining fumes in the ore are swept off and carried to a higher point, from which they can pass back through the ore, and finally to the condensers. The ore is also somewhat cooled, while the heated air supplied to the fire facilitates combustion.

Two other openings, q' q' , communicate with the side passages, q q , in the ridge D, and connect to return-tubes S, secured to the outer walls of the discharge-passages, and thence vertical passages T in the masonry of the furnace lead to the space between the top of the furnace and the cover M on opposite sides.

The air is heated in passing through the various channels, and at the top of the furnace serves to supply the heat necessary to dry the pulverized ore before it is fed into the furnace.

The operation of reducing is as follows: The naturally fine or mechanically-pulverized ore is first spread upon the drying-roof, and when properly dried is fed through the openings N N into the ore-chambers.

As many feed-openings may be used as desired, and we shall probably employ as many as there are vertical chambers X in the body of the furnace. As the falling ore strikes the inclined shelves it is directed from one to another until each diamond-shaped chamber contains all that will flow into it through the side openings, j .

It is evident that the ore will only flow into the lower half of each diamond-shaped chamber, and cannot possibly cover the draft-openings c c in the partitions F F and walls of the ore-chamber.

The heated gases which traverse the ore in the chambers and in contact with the shelves above each subdivided body of ore will readily heat the ore and shelves upon which the ore rests sufficiently to expel the sulphur and volatilize the mercury, and the current of

heated gases will carry the vapors through the openings C C directly and as rapidly as formed to the chamber R, the outlet from which, near the bottom, forms an exit through which the vapors and gases may pass to the usual condensers to be separated in the ordinary manner. Thus, by the direct and indirect action of reducing gases carried transversely across the body of ore in subdivided masses, we have succeeded in reducing directly those fine ores that have heretofore been reduced only by admixture with other materials.

Owing to the finely-divided condition of the ore the mercury is more thoroughly extracted and by the application of less heat than is required when the ore is in large pieces.

The spent ore is drawn out at intervals through either or both discharge-openings, E, at the bottom of the furnace, and in proportion as the spent ore is withdrawn the entire quantity of ore contained in the chambers will settle downward, thus rendering the operation continuous and stirring up and changing the position of the masses of ores in the chambers at intervals, so as to present new surfaces to the action of heated gases, the feeding being continuous as fast as the ore is drawn, so as to keep the chambers full.

As the openings C in the rear wall communicate directly with the fume-collecting chamber, it will be seen that all the quicksilver-vapor produced at any point in the furnace is withdrawn as fast as generated, without being caused to travel upward through a body of ore cooler than that from which it was produced, and we thus avoid all danger of condensing any of the vapors in the furnace, which would necessitate the revaporizing of the same or result in carrying them out with the spent ore as waste.

We thus provide a furnace for reducing fine and pulverized ore which will not choke up, and in which the ore is moved and stirred by gravity, while at the same time it is retained, the whole mass is divided into thin bodies, and is in a favorable condition to be effectively operated on by the heat.

We claim—

1. The process of obtaining volatile metals from their ores, which consists in subjecting a body of pulverized ore in divided masses to the direct and indirect action of reducing-gases at a high temperature, passing to and from said masses, whereby the reduction of ore and the distillation of the resultant metal are simultaneously effected and the evolved vapors conveyed directly away and separated, as specified.

2. In the reduction of mercury ore, the mode described of extracting the fumes from the spent ore and preheating the air, by conveying the latter through the spent ore and then to the ore-chamber, substantially as set forth.

3. The process herein described of treating fine ore to extract the volatile matter—that is to say, subdividing the ore into small masses,

passing heated gases transversely across, above, and beneath said masses, conducting said gases, with the evolved vapors, as soon as formed, directly away, and then condensing and separating the vapors, substantially as set forth.

4. The combination, in a quicksilver-reducing furnace, of a chamber for containing a body of ore and passages arranged to permit currents of air to flow through the lower or calcined portion of ore to the fire-place, and thence into the main ore-chamber, substantially as set forth.

5. In combination with a furnace for reducing fine ore, a plate and heating-passages beneath said plate, whereby the ore may be dried before being introduced into the ore-chamber, substantially as set forth.

6. The combination, with the outlet for spent

ore, of air-passages leading to the fire-place, arranged to be heated by the ore, substantially as set forth.

7. The combination of the ore-reducing chamber, containing refractory shelves arranged to subdivide the ore, a fire-place at one side of said chamber, a chamber at the other having an outlet for communication with the condensers, and passages whereby the products of combustion may flow directly from the fire-place across the ore-chamber and to the said chamber, substantially as set forth.

In witness whereof we hereunto set our hands and seals.

RICHARD F. KNOX. [L. S.]
JOSEPH OSBORN. [L. S.]

Witnesses:

GEO. H. STRONG,
JNO. L. BOONE.