2 Sheets—Sheet 1.

R. F. KNOX.

Quicksilver Furnace.

No. 202,274. Patented April 9, 1878.

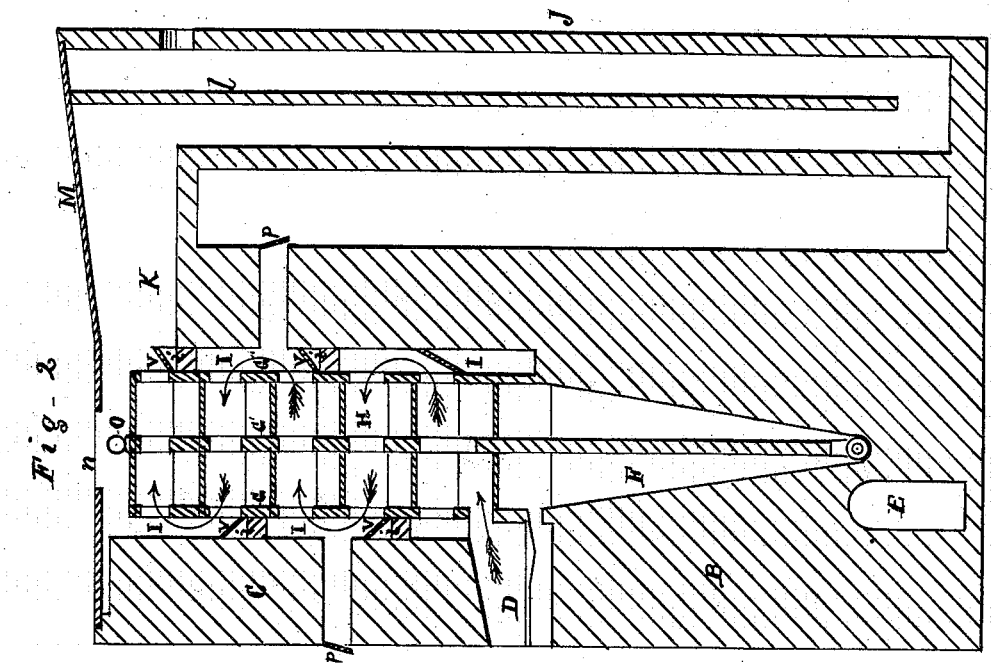

Fig. 2

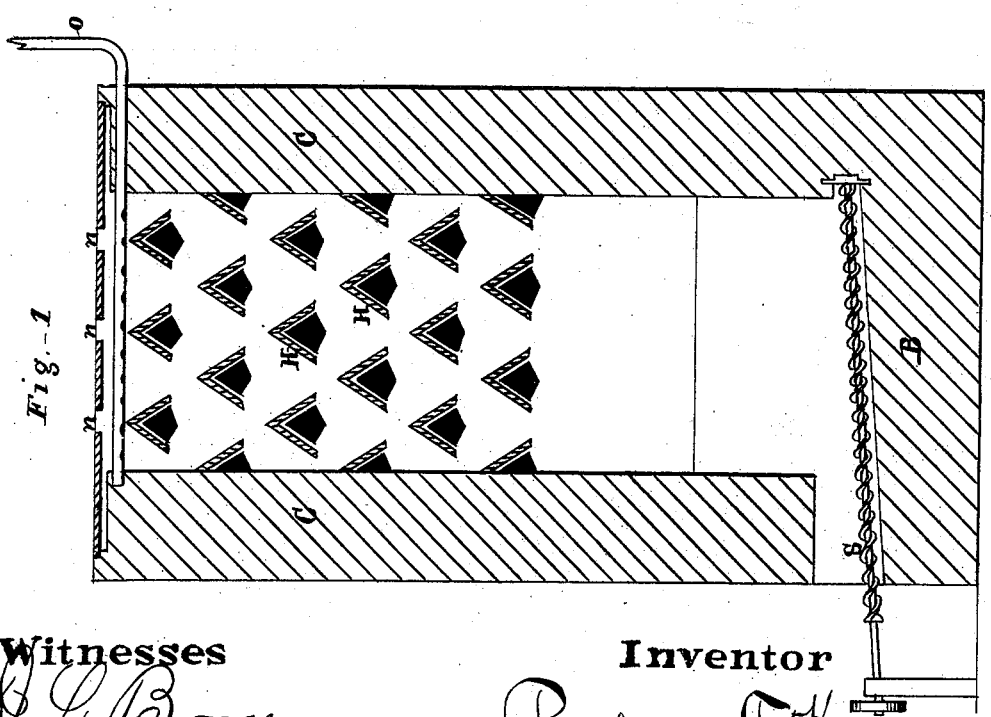

Fig. 1

Witnesses

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2 Sheets—Sheet 2.

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Fig. 4

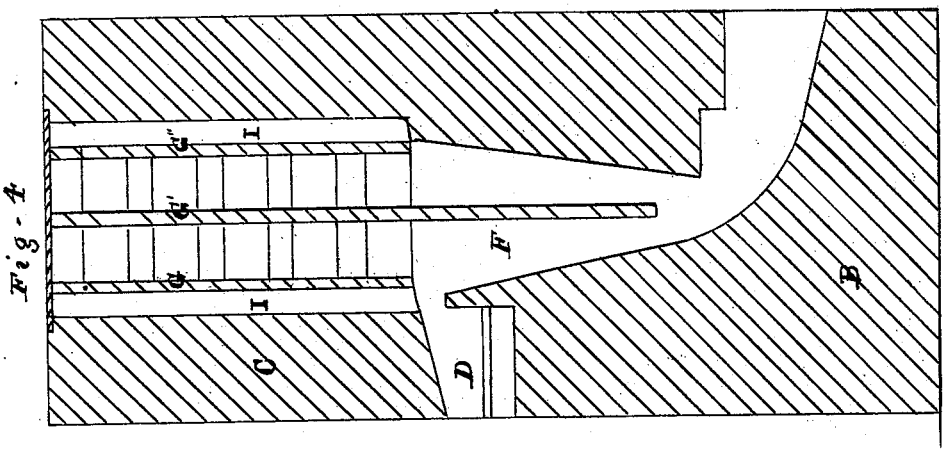
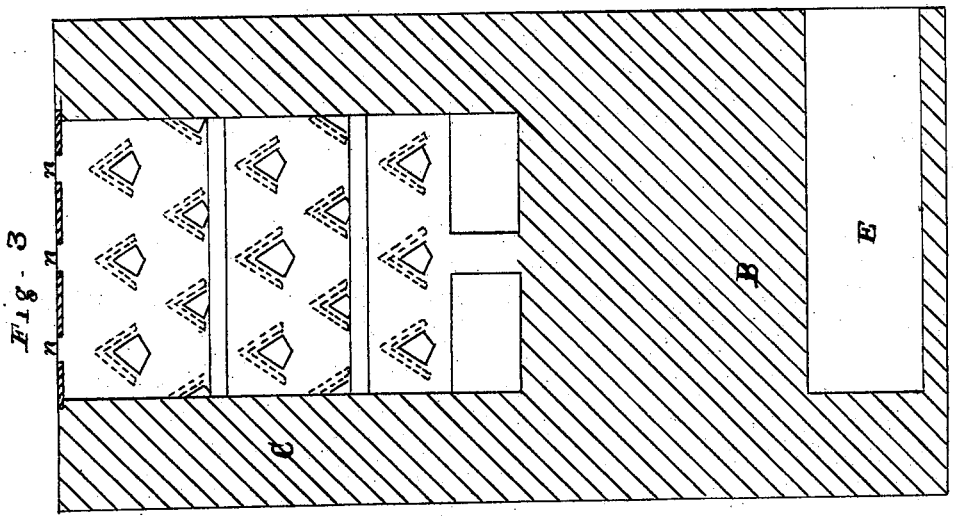


Fig. 3



Witnesses

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UNITED STATES PATENT OFFICE.

RICHARD F. KNOX, OF SAN FRANCISCO, CALIFORNIA.

IMPROVEMENT IN QUICKSILVER-FURNACES.

Specification forming part of Letters Patent No. **202,274**, dated April 9, 1878; application filed September 9, 1876.

To all whom it may concern:

Be it known that I, RICHARD F. KNOX, of the city and county of San Francisco, and State of California, have invented an Improved Fine-Ore Furnace; and I do hereby declare the following to be a full, clear, and exact description thereof, reference being had to the accompanying drawings.

My invention relates to certain improvements in that class of furnaces for roasting fine or pulverized ores in which the downward flow of the ore as it passes through the furnace is delayed, sustained, and directed by inclined shelves or other obstructions, which are arranged to serve the double purpose of providing a means for retaining the ore during its descent in a comparatively thin layer, even when the furnace is filled to its utmost capacity, and at the same time providing suitable channels, passages, or flues for conducting the heat from the fire-place or fire-places and the gases generated in the furnace into, around, and through the ore thus disposed.

Certain difficulties are encountered in the practical roasting of fine or pulverized ores, even in the above-described class of furnaces, and these difficulties I have made the special subject of investigation. My invention therefore consists in certain changes, modifications, and improvements, by which I remedy these difficulties, and provide for practically roasting and handling the ores.

Referring to the accompanying drawings, Figures 1, 2, 3, and 4 are vertical sections of my furnace.

In describing my improved furnace I will characterize that portion which is below the fire-place as the "base" B, and that portion which is above the fire-place D as the "top" C, of the furnace. This is rendered necessary because, instead of placing the fire-place D in or at the base of the furnace structure, I have discovered a special advantage in placing it at a considerable height above its bottom, as will be more fully explained as I progress with the description.

In constructing the bottom or base of the furnace I leave a ground tunnel or passage, E, extending directly through it transversely to the length of the fire-place, as represented, and in the upper portion of this base I make a chamber, F, the sides of which converge toward its bottom in a hopper form, so that the lower end of the chamber will be in close proximity to the arched top of the tunnel E. This chamber F is a continuation of the main chamber of the furnace, which is above the fire-place, and forms a hopper or receiving-chamber directly below the main chamber, in which the ore will be received after it passes the fire-place.

That side of the lower chamber which is next to the fire-place I carry upward above the fire-grates, so that its upper end forms the rear end of the ash-pit and fire-place, leaving a sufficient space between its upper end and the lower edge of the upper chamber for a draft and heat passage, through which the heat and products of combustion can pass from the fire-place into the upper chamber.

The upper chamber of the furnace I divide into two or more compartments by means of upright parallel partitions G G′ G, which can be made of tiling or other suitable fire and acid resisting material. The central partition G′, I prefer to extend down into, and preferably entirely to the bottom of, the lower or hopper chamber F; but this is necessary only so far as it serves as a convenient means of supporting the partitions and shelves in the upper chamber. The partitions G G′ G, I then connect together by means of, the inverted-**V**-shaped or double-inclined shelves H H H, which are fitted in triangular openings in the partitions, so as to leave a triangular opening through each partition directly below the diverging or inclined shelves. These shelves I arrange in rows, so that the shelves in each row will alternate with the shelves in the rows above and below it, as described in a former application for a patent filed by me.

The side partitions G G″, I place at a short distance from the walls of the chamber, so as to leave a space, I, between the partitions and walls, the inclined shelves H being extended only to the outside of these partitions, without passing across the space between the partitions and walls. I then employ horizontal partition-strips *i i* for dividing off these side spaces between each two rows of openings, so that only two contiguous rows of openings will communicate with each other on each side.

These separating-strips are alternated on opposite sides of the chamber, so that the heat and products of combustion from the fire-place and the gases generated in the body of the chamber will be compelled to pass horizontally through the openings below the shelves into the side spaces, and then back horizontally to the opposite side space through the openings above, as indicated by the arrows in Fig. 2. I thus direct the course of the heat and generated gases, and compel them to travel in a zigzag course from the bottom to the top of the ore-chamber, thus more completely utilizing the heat, and subjecting the ore to a more thorough and prolonged contact with the gases.

Upon each horizontal partition thus formed I construct an inclined shelf, V, extending from the edge of the openings upward against the outside wall, to prevent the lodgment of particles of dust, an accumulation of which would choke the opening.

J is a large chamber or additional structure, which I construct alongside of the furnace B C, and connect it with the upper end of the roasting-chamber by an opening or passage, K. When the furnace B C is used for roasting gold or silver ores, this outside chamber or structure will be used as a dust-chamber, to collect any fine particles and to condense any metals that may be carried over by the draft; but when the furnace is used for roasting quicksilver or other ores from which it may be desired to extract the volatile part only, the chamber will be used as a fume-chamber or preliminary condensing-chamber; and to better adapt it for both of the purposes above mentioned, I separate it into two chambers by means of an upright partition, *l*, leaving communication below this partition only between the two chambers.

In my former application for a patent on a fine-ore furnace I described a drying-floor constructed upon the top of the furnace structure, upon which the ore was to be placed and dried preparatory to introducing it into the roasting-chamber. This drying-floor I retain in my present arrangement, and, in addition, I increase its capacity by constructing an extension-floor, M, out over the supplementary structure or chamber J. The upper end of the structure J, I make inclining toward the furnace B C, so that the drying-floor M, which extends over it, will slope or incline toward the drying-floor of the furnace, and thus facilitate the moving of the dried ore toward the feed-openings *n n*.

I thus obtain the additional advantage of being able to utilize the heat which radiates from the chamber J for assisting in drying the ore on its top, thus increasing the capacity of the drying-floor without additional cost.

I have found, however, that this preliminary drying operation does not entirely remove the moisture, but that when the ore is introduced into the furnace-chamber a considerable quantity of steam is generated, which rises to the upper part of the chamber and saturates the freshly-introduced ore, so that after the furnace has been in operation for several days the ore will often arch and clog the furnace, in which case it was necessary to introduce rods and break down the arches thus formed, and in one instance that I know of the sudden introduction of a large quantity of this moist ore into the heat of the furnace caused the generation of such a quantity of steam that the resulting steam-pressure disrupted a portion of the furnace.

To obviate this difficulty I lay a pipe or tube, O, across the furnace before completing the top, so that it will extend across through the upper part of the chamber, while one end passes through the wall and communicates with the outside air.

Inside of the chamber I perforate the pipe O, so that any steam which may be generated in the chamber will enter the pipe, and be conveyed away and discharged into the air at some place where it will not interfere with the workmen; and in order to prevent any damage which would result in case a pressure of steam should be created inside of the furnace by accident or otherwise, I construct a safety-valve, *p*, in the wall of the furnace, which will open when a stated pressure is reached, and thus release sufficient steam to reduce the pressure.

The ore, which is dropped through the feed-openings in the top of the roof, falls upon the inclined shelves, and is supported in a thin layer over all the shelf-surfaces from the top to the bottom of the furnace, while the heat, products of combustion, and gases from the fire-place pass through the openings beneath the shelves and ore. As the roasted or spent ore is withdrawn from the lower or hopper chamber the ore above slides downward to occupy its place, thus shifting the entire body of ore, and presenting new surfaces to be acted upon by the heat and gases. When the ore passes the fire-place and enters the hopper-chamber it is in a highly-heated condition, and as it is compelled to remain in the hopper in a body until it is finally discharged, it retains a large proportion of the heat, and undergoes a final heating process that completes the roasting.

This feature of my invention is of great importance, as the process of retaining heated ore in a compact body after it leaves the furnace has long been recognized as a necessity; but as ordinarily practiced the ore is raked out into a pile in the open air, where it soon parts with its heat; but by my process it is retained in a close chamber and in a compact body without being disturbed or exposed to the air after leaving the furnace or ore-chamber.

If desired, the lower or hopper chamber can be provided with an inclined draw in the ordinary way, as represented at Fig. 4, in which case the spent ore must be removed therefrom by raking by hand; but I prefer to mount a conveyer-screw, S, in the bottom of the lower

chamber and drive the screw by power, all as represented at Fig. 1. In this case the screw will remove the spent ore, and the whole can be accomplished with but little manual labor. Covered hand-holes may be constructed leading from the tunnel or passage E to the bottom of the hopper-chamber, so that in case anything should get out of order with the screw it can be easily repaired.

I am aware that perforated escape-pipes for carrying off generated steam are old in grain-driers, and therefore I do not claim such pipes, broadly.

Having thus described my invention, what I claim, and desire to secure by Letters Patent, is—

1. A quicksilver-reducing furnace consisting, essentially, of the central ore-chambers provided with a series of inverted-V-shaped shelves alternately spaced, side flues or chambers separated by alternating partition-strips, and a fire-grate, D, the several parts being relatively located as described, whereby the hot combustion products from the fire pass to and fro across the furnace, and upward through the body of the contained ore, substantially as set forth.

2. In a quicksilver-reducing furnace, and in combination with the central ore-chamber, the perforated escape-pipe O, located at the top of and across the said chamber, whereby the generated steam is withdrawn and the clogging of the ore prevented, as set forth.

In witness whereof I have hereunto set my hand and seal.

RICHARD F. KNOX. [L. S.]

Witnesses:
J. L. BOONE,
OLWYN T. STACY.

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Mar. do.