W. T. RICKARD.
Oxidizing and Chloridizing Furnace.

No. 214,525. Patented April 22, 1879.

Fig. 1.

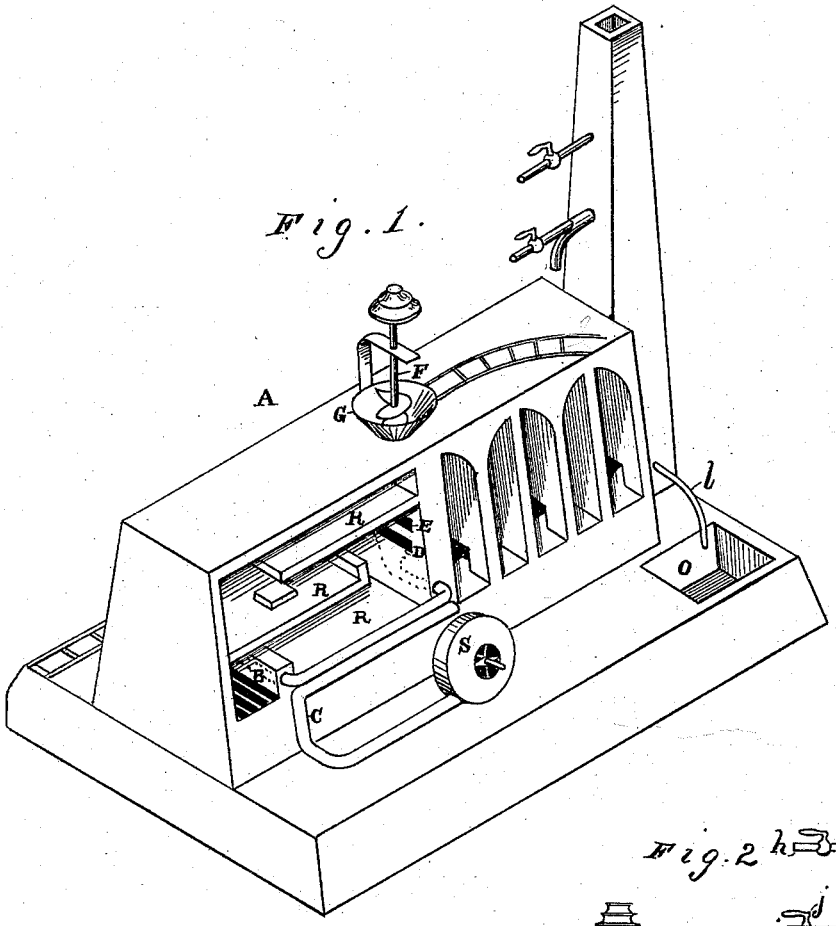
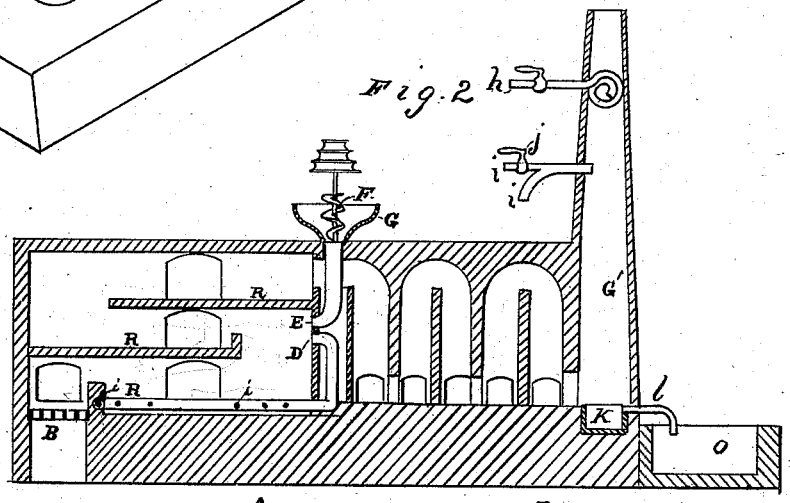


Fig. 2



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UNITED STATES PATENT OFFICE.

WILLIAM T. RICKARD, OF SAN FRANCISCO, CALIFORNIA.

IMPROVEMENT IN OXIDIZING AND CHLORIDIZING FURNACES.

Specification forming part of Letters Patent No. **214,525**, dated April 22, 1879; application filed November 6, 1877; patented in England, December 22, 1876.

To all whom it may concern:

Be it known that I, WILLIAM T. RICKARD, of the city and county of San Francisco, in the State of California, have invented an Improved Oxidizing and Chloridizing Furnace; and 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 my said invention without further invention or experiment.

My invention relates to an improved furnace and method for oxidizing and chloridizing finely divided or pulverized ores.

My furnace is constructed on a simple and inexpensive plan, which retains all the well-known advantages of the old reverberatory combined with some novel applications of chemical and mechanical forces, which greatly expedite its oxidizing, sulphating, or chloridizing action, without entailing any additional expensive machinery or special technical skill in the arrangement.

It consists of an ordinary reverberatory furnace, A, provided with three shelves, R R R, and fitted with the usual fire-place B, discharge-holes, and working-doors. Round the lower hearth I place iron pipes C, or other similar flues, which pass through the fire-bridge, and communicate with the furnace through openings *i i*, and terminate in a horizontal orifice, D, in the throat or gorge of the furnace.

The ore passes into the furnace in a constant stream through opening E, and at the moment of its entry, when it falls across opening D, and before it is affected by the products of combustion from fire-place B, it is struck by the blast of highly-heated air from the orifice D, also unaffected by the products of combustion as it passes directly from fan S to orifice D, around the fire-place in pipe C. The blast from D oxidizes the ore as a chemical result, and scatters it over the shelves as a mechanical result, the lighter particles passing to the upper shelves and the heavier ones to the lower shelf.

Through these pipes or flues I direct a powerful blast of air by means of a fan, S, or other blower, which, or a portion of which, being raised to a red heat during its passage through the pipes C, strikes with considerable mechanical force a shower of pulverized ore which enters the furnace from another horizontally-elongated orifice, E, placed two inches above this hot-air blast, the supply of ore being regulated by a screw, F, with a conical pulley, working in a hopper, G, which conveys it into the vertical passage terminating in the elongated ejection-orifice E. The screw is worked faster or slower, according to the character of the ore being operated upon, or, in other words, the quantity of sulphur, arsenic, or metal which has to be oxidized or burned off. For instance, ores containing fifteen to twenty per cent. of sulphides or arsenical metal may be introduced at the rate of a ton an hour into a medium-sized furnace of, say, ten by five feet hearths; while those carrying higher percentages of pyritous or other oxidizable matters must be fed more slowly till the maximum quantity shall have been determined by the operator.

The mechanical effect of the hot-air blast from orifice D is to scatter the ore all over the three hearths of the furnace, previously brought to a bright-red heat, but not beyond, by the ordinary firing, the heavier (larger) particles falling on the bottom, while the lighter (finer) portion is carried by the blast onto the two upper floors, and finally into the extensive dust-chambers attached, where the continuous force of the blast keeps it in motion, scattering it through the atmosphere, and exposing fresh surfaces on the floors, much more effectually than can be accomplished by any raking motion, either by hand or by any system of machinery, both of which involve a serious outlay, fatal in low-grade ores; while this simple arrangement performs the mechanical work at no cost beyond the insignificant item of power to keep the blower in motion. The coarse ore, falling on the bottom hearth, is acted on by special hot-air jets *i*, proceeding from the fire-bridge and sides of the furnace.

Its chemical effect is produced by the introduction of the largest possible amount of oxygen in the form of atmospheric air at a high temperature, which will not cool the furnace, uncontaminated by the products of combustion, as is not the case with all other roasting-furnaces hitherto in use. The oxygen is consequently in the best possible condition for combining with the sulphur and the matters in the ore to be oxidized, which, being, by the force of the blast, simultaneously spread in a finely-divided state over a large and ever-changing

heated surface, is almost instantaneously attacked by the oxygen, and either thrown off as a gaseous product of combustion, &c., (SO_2,) or retained in the furnace as a metallic oxide. Another very economic and valuable effect produced by this introduction of large volumes of hot air is the complete combustion of all the fuel used, not a particle of which can escape in an unconsumed condition—as soot—the result being a maximum roasting effect with a minimum supply of fuel.

By the time the hot blast has passed through all the dust-chambers and reached the chimney G′ it has become charged more or less with fumes of sulphurous acids, which, being brought into contact with steam introduced through the pipe *h*, and with air and water, which are introduced by suitable pipes *i i* and taps *j* into the tower, aided by nitrous fumes evolved in the dust-chambers, are converted wholly into sulphuric acid, (as in an ordinary vitriol-chamber,) which is collected in a lead vessel, K, at the bottom of the shaft, furnished with an overflow-pipe, *l*, which communicates with another larger vessel, O, of the same kind, sunk in the ground in any convenient part of the premises, from whence the acid may be pumped up from time to time and used for washing tailings where copper ore has been operated on by the Hunt & Douglas or other lixiviating process, blue-stone making, or other purposes.

By a careful attention to the requisite temperature and other essential conditions, copper ores may be desulphurized to a higher percentage in this furnace than has hitherto been attained by any other system of roasting.

When used for chloridizing silver ores, the highest practicable results are obtained with from one-third to one-half less salt than is now being consumed by the very wasteful and unnecessary custom of introducing it into the furnace with the raw ore, by which the greater portion of it is converted into sulphates of soda, lime, alumina, and other useless and valueless products before its chlorine commences to act on the silver contained in the ore. By simply mixing the actual quantity of salt requisite to accomplish the chloridization of the silver with the roasted ore on the bottom hearth of the furnace, (after adding the ore from the two upper hearths for the purpose for about a quarter of an hour before withdrawing the charge,) a most perfect chloridizing effect will be produced, enabling the ore to be worked up to ninety or ninety-five per cent. of its assay value.

In addition to the advantages already stated regarding its power for rapid and cheap oxidation, chloridization, &c., it can be worked at a very small expense; only two men—viz., one to feed, with another to fire and discharge—being required on a shift, or four to the day of twenty-four hours, during which time, while roasting twenty tons of ore, its consumption of wood will not exceed three cords, (usually not over two and a half,) in consequence of a suitable moderate temperature being steadily maintained, (overheating being carefully avoided,) and the complete combustion obtained by the introduction of heated air, thereby avoiding the customary loss of fuel (thirty to fifty per cent.) entailed through the habitual and almost universal neglect in providing a proper combustion-chamber in roasting and other furnaces.

There being no complicated or expensive machinery in connection with this furnace, its construction is of the cheapest possible kind, involving very little outlay beyond bricks and labor.

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

The reverberatory furnace A, with its shelves R R R and feed-orifice E, opening to hopper G, provided with feed-screw F, in combination with the air-pipe C, passing around the hearth and opening into the furnace through orifice D, below orifice E, and blower S, substantially as and for the purpose described.

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

WM. T. RICKARD. [L. S.]

Witnesses:
FRANK A. BROOKS,
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