(No Model.) 2 Sheets—Sheet 1.

J. J. STORER.

ORE ROASTING AND SMELTING FURNACE.

No. 516,662. Patented Mar. 20, 1894.

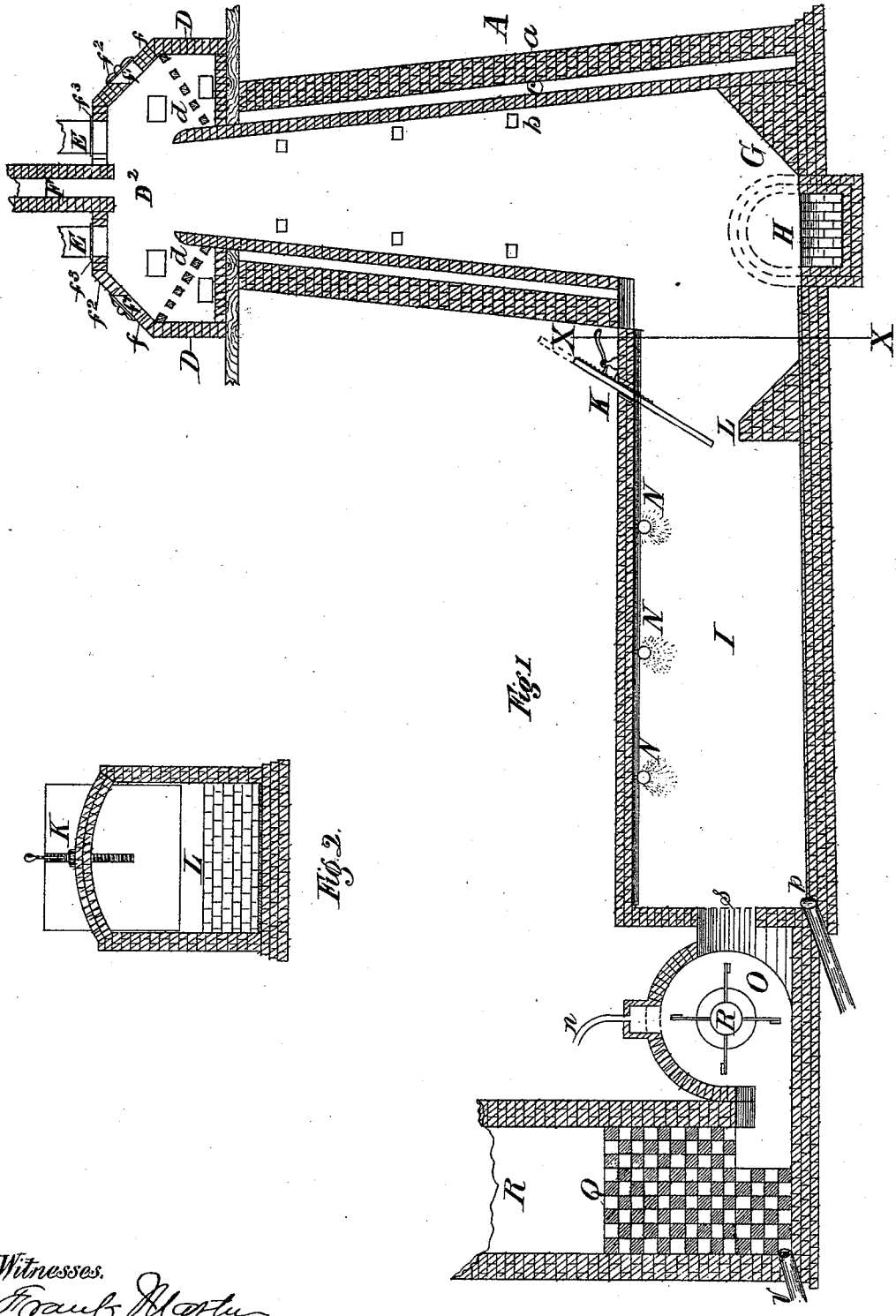

Fig. 1.

Fig. 2.

Witnesses.
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John A. Farmer

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(No Model.) 2 Sheets—Sheet 2.

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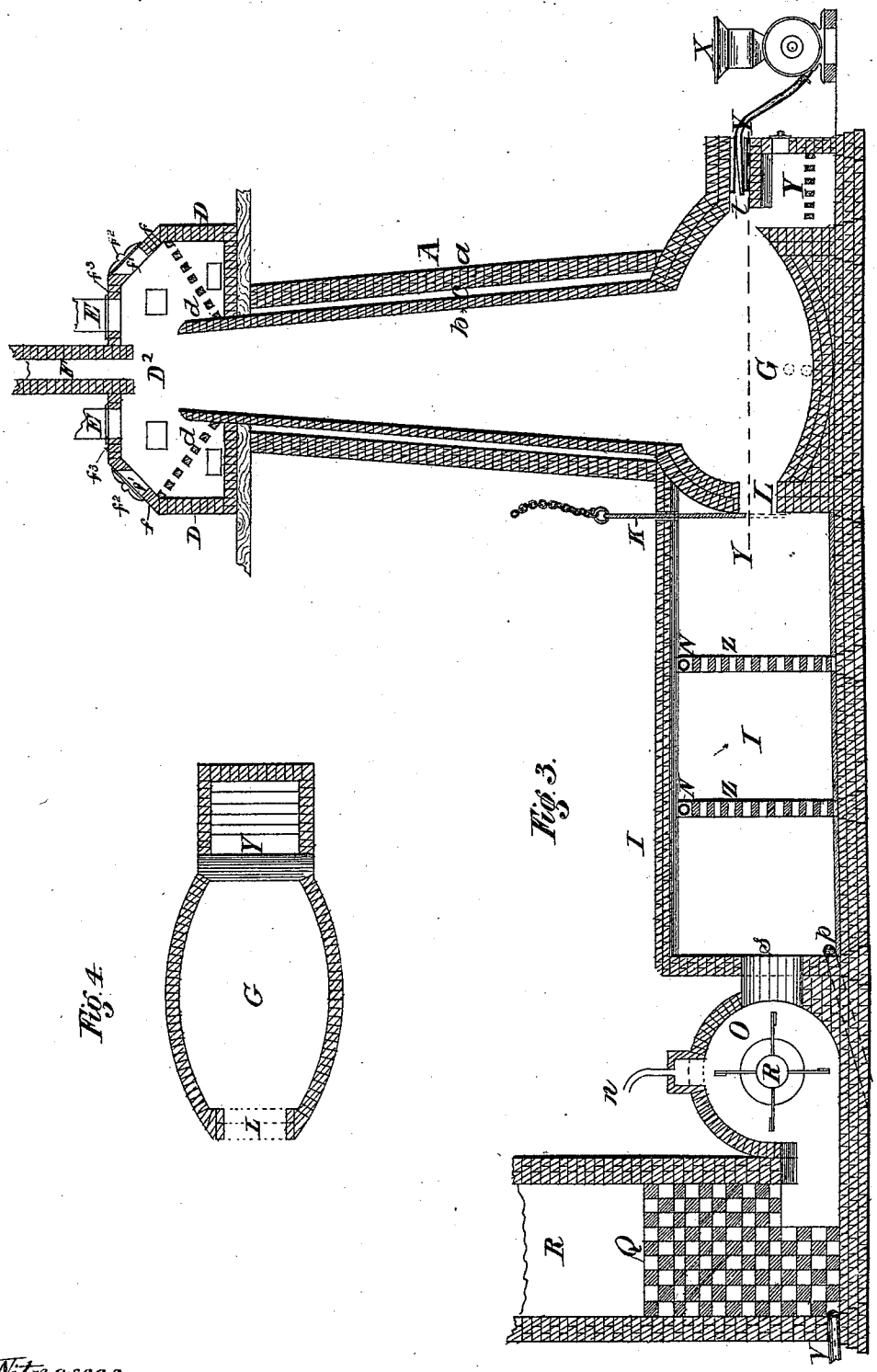

Fig. 3.

Fig. 4.

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UNITED STATES PATENT OFFICE.

JACOB J. STORER, OF HELENA, MONTANA, ASSIGNOR TO THE UNITED MILL AND FURNACE COMPANY, OF MONTANA.

ORE ROASTING AND SMELTING FURNACE.

SPECIFICATION forming part of Letters Patent No. 516,662, dated March 20, 1894.

Application filed March 8, 1893. Serial No. 465,216. (No model.)

To all whom it may concern:

Be it known that I, JACOB J. STORER, of Helena, county of Lewis and Clarke, and State of Montana, have invented certain new and useful Improvements in Ore Roasting and Smelting Furnaces, of which the following is a full, clear, and exact description, reference being had to the accompanying drawings, and to the letters of reference marked thereon.

This invention is designed as an improvement on those so-called dry hearth ore-roasting or smelting furnaces, in which the raw ore is introduced in a pulverized condition from above.

Its object is to provide an improved furnace for the complete reduction, by the dry method, of gold, silver, and other metallic ores; or for their preparation for subsequent treatment by amalgamation, chlorination, lixiviation, leaching, and other processes.

For the most thorough and economical treatment of ores in this furnace, they are first reduced to an exceedingly fine powder, about nine-tenths of which will pass through a hundred mesh screen, and the balance through an eighty mesh. In its brief passage down the heated shaft each minute ore particle will be affected as desired by the combined action of heat, oxygen, carbon and other chemical reagents that may be introduced with them: the completeness of the operation,—the desulphurization, chlorination, the reduction of the oxides and the volatilization of the volatile elements of the ore in the shaft,—being best assured by the fineness to which the ore and said re-agents are reduced.

To these ends the invention consists mainly of a dry hearth, reservoir or furnace of novel construction, set directly beneath and communicating at its top with an upright, cylindrical, ore-feeding and desulphurizing shaft, which expands from above downward, and has about its top opposite fire places, between which is a space forming a gas-expansion chamber; said shaft, its fireplaces and expansion chamber being designed for the treatment of air-borne particles of ore introduced at its top, so that they shall fall hot and oxidized upon or into the receiving hearth or furnace; all of which will be hereinafter fully set forth, and then definitely claimed.

Reference is to be had to the accompanying drawings, forming part of this specification, in which similar letters of reference indicate corresponding parts.

Figure 1 represents a longitudinal, sectional elevation of my improved device, showing one form of the receiving hearth, reservoir or furnace. Fig. 2 represents a vertical section on line X X Fig. 1, as indicated by an arrow. Fig. 3 represents a longitudinal, sectional elevation, showing another form of the receiving hearth, reservoir or furnace. Fig. 4 represents a horizontal section on line Y Y Fig. 3.

In the drawings A represents the ore-feeding shaft, preferably of cylindrical cross section, and expanding from above downward. This shaft, which extends downward from the roofs of the fire places, consists of an exterior wall *a*, and an interior wall *b*, between which is an annular air space *c*, which is, preferably, closed at both top and bottom. About the top of this shaft, and constructed so as to internally communicate with it, are one or more fire places D (four herein shown), directly opposite each other, so constructed with sloping grates *d*, and slooping roofs *f*, that the heat therefrom shall be radiated through their throats, as indicated by arrows, directly into the vertical axis of the shaft, or rather into the axis of the gas-expansion chamber D^2 which is formed in the top of the shaft by the wide open throats of the fire places. Openings f', that may be closed by stoppers or doors f^2, are for feeding fuel into these fire places.

In the roofs of the fire places are fixed stove pipes E, provided with dampers f^3, which pipes serve to carry off the smoke and gases, and furnish temporary draft, when the fires are first lighted. A cylindrical pipe or conductor F, preferably of brick, is fixed centrally above and between the fire places, with its vertical axis corresponding with that of the shaft A. The ore to be treated is, after being finely pulverized, fed down this conductor F, into the heated shaft A, being introduced into said conductor on an air current from a fan blower or through a sieve (not

shown). If it be an ore containing sufficient sulphur for maintaining by its combustion a proper temperature, it will, if sufficient air be admitted with it, become thoroughly desulphurized by the combined action of the heat and oxygen, before reaching the dry hearth, reservoir or furnace G, which is constructed beneath the shaft A, as shown. If it be an oxide ore, or one containing but a small amount of sulphur, pulverized coal may be introduced with it, so that, by its combustion, the proper temperature may be maintained in the shaft A; the desired temperature being between a dull, red and a white heat, according to the character of the ore to be treated. If salt be introduced down the heated shaft, finely pulverized and mixed with the ore, the latter will be brought into the best condition for subsequent chlorination, amalgamation, or leaching with suitable chemical solutions for the purpose of obtaining the precious metals it may contain. The ore, as it accumlates in the dry hearth or furnace (of the form shown in Figs. 1 and 2) may be drawn out through the door H.

Just beyond the outer wall of the shaft A, and in the roof of the horizontal flue I, is shown a hood plate or damper K, so arranged as to slide up or down in suitable guides, not shown, to diminish or increase the area of the throat of said dry hearth, as may be desired, as shown by dotted lines. By fixing this hood as shown by full lines, a narrow opening or throat is left between its lower edge and the bridge wall L, so that, if desired, the hot air and gases from the shaft A, being thereby retarded and retained in the dry hearth, reservoir or furnace, may operate to bring the mass of ore therein deposited to a higher temperature. This hood or damper serves the additional purpose of retaining much of the ore in the dry hearth that would otherwise pass through into the flue, for many of the smaller particles of ore that would otherwise pass through would strike against the hood or damper and rebound back into the hearth. The damper thus serves not only as an ordinary damper, but it has the additional function above described. The gases generated by the combustion of the ore constituents, and of the introduced fuel if there be any, together with some of the finest ore dust, will pass out through the furnace or dry hearth into the smoke flue I, where they will be partially wet down and condensed by water sprays issuing from the water pipes N, as indicated in Fig. 1, and fall upon the sloping bottom of said flue, and flow off through a pipe *p*, into a suitable reservoir (not shown) for further treatment. The residue of the dust and gases will pass on through an opening or openings *s* in the end wall of the flue I, into the spray wheel chamber O, where it is wetted down by the action of the draft and spray wheel R, which, when in operation, causes the downward draft of the hot air and flames from the fire places at the top of the shaft A, and of the ore introduced into said shaft. Water, or water with the proper chemical re-agents in suspension or solution, in sufficient quantity for the production of the requisite amount of spray, is introduced upon the spray wheel through the pipe *n*, and this spray with the absorbed gases and dust, is thrown by the wheel R, upon and through the cob or lattice work Q, which fills the base of the smoke stack R′, and thence drains off, through a pipe *v*, into a suitable reservoir, not shown. This lattice or cob work Q, may be made of any dimension desired, if the combined areas of the openings are fully sufficient for the free upward passage of the air to be expelled through them. Its great value lies in the extensive condensing and arresting surface which it presents to the escaping steam, water-spray, gases and dust.

In Fig. 3 is shown another form of dry hearth, reservoir or furnace covered by this invention. In this case the bottom of the dry hearth or furnace G, instead of being flat, as shown in Figs. 1 and 2, is made concave or bowl-shaped, as shown, for the purpose of holding the molten metal when extracted from the ore. This form of hearth or furnace is adapted for smelting or matting; and for this purpose, it is made of greater area, that it may hold a much larger amount of ore than the furnace shown in Fig. 1, and its side walls are outwardly curved, as shown in Fig. 4, so that it is, in effect, a reverberatory furnace; and, that it and the ore falling into it may be heated to any desirable temperature for the fusion of the ore and the separation of the metal from the gangue, an auxiliary fire-place Y, is constructed in the rear, to furnish additional heat, and preferably pulverized fuel may be introduced by means of a fan or pulverizer, as indicated at X, through an opening or tuyere *t*, in the rear wall of the furnace, over the throat of this fire-place, so that it will there ignite and burn over the mass of ore in the furnace bottom. But the fire-place Y may be made of sufficient dimensions to furnish the required heat to the furnace.

In order to prepare this smelting hearth or furnace for the reception of the ore into it from above, a fire is made in the auxiliary fire-place Y, and urged until it is sufficiently hot to set fire to the pulverized fuel that may be introduced over it; then the hood plate K, which, in this instance, may be made to serve as a damper, is lowered, as indicated by dotted lines, Fig. 3, to close the throat of the furnace; then the pulverized coal, mingled with air sufficient for its combustion, is introduced over the throat of the auxiliary fire place into the furnace by means of the fan or pulverizer above referred to, and is there consumed with intense heat, while a portion of the flame and gaseous products of combustion ascend the shaft A, and escape through the conductor F, and the fire place pipes E. Thus in a very short time the temperature of this furnace can be raised throughout to the ore melting

point, and the shaft A be heated to a high degree. When the furnace is thus sufficiently heated, the hood or damper K, is raised so as to open the furnace throat, the draft and spray wheel is set in motion, and the introduction of the ore through the conducting pipe F, is begun, while the air-borne, pulverized fuel is still fed horizontally into the furnace by the fan or pulverizer. The fine particles of air-borne ore falling down the heated shaft, and becoming thereby desulphurized and oxidized, pass through the horizontal sheet of the carbonizing and deoxidizing flame and gases of the pulverized fuel, entering through the tuyere *t*, which instantly reduce the bulk of the oxides to metals that fall with the gangue into the bottom of hearth or furnace, where they both accumulate in a molten condition. Because of its less specific gravity the molten gangue or slag floats on the top of the molten metal, and what unreduced oxides the slag may contain are reduced by the deoxidizing flame in the furnace and then sink through the liquid slag into the metal bath below. It is found that when the ore is reduced to sufficient fineness, all the sulphur is eliminated from it in its brief passage of one or two seconds down the heated shaft A, and that hence no sulphides reach the hearth to retard the reduction of the metals. When it is desired to tap out the melted slag and metal, the feeding in of the ore is suspended, and when this operation is over the feeding of the ore is resumed as before. What re-agents or fluxes are necessary in working the ores may be laid upon the hearth in the form of grouting, may be spread upon the surface of the charge in the furnace through suitable doors, not shown, may be introduced down the shaft with the raw ore, or may be introduced with the pulverized fuel. The exit or smoke flue leading to the spray wheel has in it several perforated walls Z, constructed of brick or tile, or other acid-resisting material, laid with wide spaces through them for the passage of the furnace gases; and these walls being constantly wetted and cooled by water from the pipe N, serve to cool and condense the greater portion of the escaping gases, smoke and metallic fumes, and to arrest most of the ore dust from the volume passing on to the spray wheel, where the residue is wetted down.

I am aware that water sprays, perforated walls kept wet with water, and jets of steam, have long been used for arresting and condensing the gases, dust and metallic fumes in the flues of ore-roasting furnaces. But so far as known, the effect of these separately or in combination is only partial, for the resulting steam or mist escaping from the furnace flues is found in all cases to contain a very appreciable amount of metallic dust. In order to prevent this loss, and to prevent the injurious effects upon the surrounding vegetation from this dust deposit, I have combined with these usual condensing devices an exhaust fan and spray wheel, upon which cold water alone, or water holding chemical re-agents, such as chloride of lime, quick lime, carbonate of soda, chloride of sodium, chloride of potassium, and such other re-agents as may be advantageous in treating any special ores, is introduced, to be converted into a fine spray and be thrown forward upon and into a pile of cob or lattice work which may partly or completely fill the smoke stack. This draft and spray wheel may be made of any desired dimensions and be run at any required speed, and any required supply of water or chemical solution may be introduced upon said wheel, while the pile of cob or lattice work may easily be of such dimensions as to present an absolutely effective condensing surface. Hence it is obvious that this improved, combination, condensing device must effect the desired results.

The devices for condensing the fumes herein shown but not claimed will be found shown and claimed in an application of mine bearing the Serial No. 483,475, and filed August 18, 1893.

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

1. An ore roasting, smelting or matting furnace constructed substantially as herein shown and described, with an upright ore-feeding and desulphurizing shaft, expanding from above downward, having about its top opposite fire-places with a gas expansion chamber between them, each fire-place having a sloping grate and sloping back wall and constructed to deflect and radiate the heat therefrom directly into said combustion chamber an ore-receiving dry hearth or furnace at the bottom of said shaft, and, at the top, communicating with it; and a flue leading from the exit or throat of said dry hearth or furnace to a smoke stack; as and for the purposes set forth.

2. An ore roasting, smelting or matting furnace constructed substantially as herein shown and described, with an upright ore feeding and desulphurizing shaft having opposite fire places about its top, a gas expansion chamber between them, a reverberatory dry hearth or furnace at the bottom of said shaft and at its top communicating with it; an auxiliary fire place connected with said reverberatory furnace and a flue extending from the exit of said furnace for the escape of the gases therefrom, as set forth.

3. An ore roasting, smelting or matting furnace, constructed substantially as herein shown and described with an upright ore feeding and roasting shaft having fire places about its top; a reverberatory dry hearth or furnace at the bottom of said shaft and at its top communicating with it; an auxiliary fire place connected with said reverberatory furnace, the rear wall of said reverberatory furnace being provided with an opening or tuyere for the introduction of air-borne, pulverized fuel, substantially as set forth.

4. The combination with the upright shaft, the hearth or furnace at the bottom thereof, and with the flue leading from the exit of said hearth or furnace, of an adjustable damper, substantially as herein shown and described; said damper being designed for adjusting or closing the furnace throat or exit, as set forth.

5. An ore roasting, smelting or matting furnace constructed substantially as herein shown and described, with a vertical, cylindrical shaft, expanding from above downward and forming a free passage, being interiorly devoid of shelves, inclined planes, or other ore-arresting devices, terminating in a reverberatory hearth or furnace, said shaft being provided with opposite fire places at the top each fire-place having a sloping grate and sloping back wall and constructed to deflect and radiate the heat therefrom directly into said combustion chamber and being designed for heating and conducting into its terminal receptacle hot pulverized ores which may be fed into its top, as set forth.

In testimony that I claim the foregoing I have hereunto set my hand, in the presence of two witnesses, this 28th day of February, 1893.

JACOB J. STORER.

Witnesses:
FRANK MARTIN,
JOHN H. FARMER.