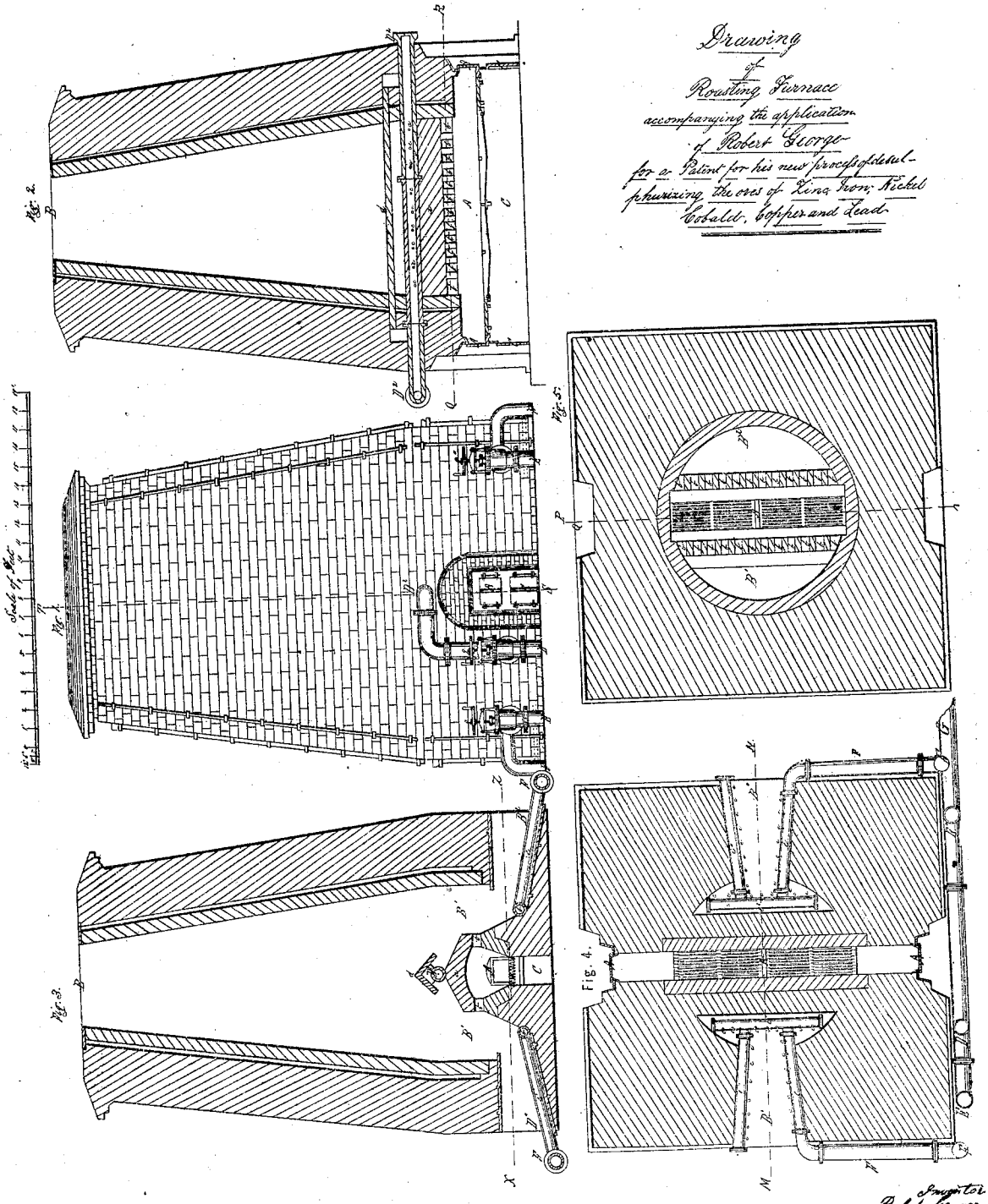
R. George.

Furnace for Melting Ores.

No. 27710 Patented Apr. 3, 1860.

Drawing
of
Roasting Furnace
accompanying the application
of Robert George
for a Patent for his new process of desul-
phurizing the ores of Zinc from Nickel
Cobalt, Copper and Lead.



Witnesses
Edmd. Wilson
Thos. Gallop

Inventor
Robt. George

UNITED STATES PATENT OFFICE.

ROBERT GEORGE, OF MINERAL POINT, WISCONSIN.

IMPROVEMENT IN METALLURGIC OPERATIONS APPLICABLE TO CERTAIN ORES OF ZINC, LEAD, IRON, COBALT, AND NICKEL.

Specification forming part of Letters Patent No. **27,710**, dated April 3, 1860.

To all whom it may concern:

Be it known that I, ROBERT GEORGE, of Mineral Point, in the county of Iowa, in the State of Wisconsin, have invented a new and Improved Method of Roasting and Desulphureting the Sulphurets and Sulphates of Lead, Iron, Copper, Zinc, Cobalt, and Nickel; and I do hereby declare that the following is a full and exact description thereof, reference being had to the accompanying drawings, and to the letters of reference marked thereon.

In the separation of sulphur from the above-named ores or minerals two methods have hitherto been employed, to wit:

First. Roasting or oxidizing the ores. This was done by mixing them with combustible materials and burning in heaps in the open air, or by heating them in furnaces or ovens. The combining sulphur was thus driven off, particularly in the case of iron and copper; or the ores were desulphureted by being brought in contact with the oxygen of the atmospheric air previously heated, thus oxidizing the metallic base and expelling sulphurous acid (SO_2) from zinc-blende, or producing sulphuric combinations, as in the roasting of galena or sulphate of copper.

Second. The use of fluxes, as with iron, by which, according to the laws of chemical affinity, the sulphur forms new combinations, and thus the metal is freed from its presence.

Both methods are not only difficult but imperfect, particularly in the case of iron ores and zinc-blende. Consequently, a long time is required to give a man the necessary experience and practice, and owing to the high price of labor in this country they are almost impracticable; but since large bodies of the above-named minerals are known to exist in the United States, it is desirable to find a method by which they can be rendered more useful and valuable, and thus add to the material wealth of the country by developing its natural resources.

The defectiveness of the present methods of desulphuration arises from a slow and imperfect oxidation of the ores, the supply of oxygen being drawn from the atmospheric air alone, which only contains one part of oxygen to four of nitrogen. A rapid and complete oxidation requires that the affinity of the minerals for oxygen should not only be intensified by heating the minerals or ores, but also demands a continual contact of all its parts with oxygen. Then it must appear evident that it, by the usual process of calcination, no such strong current of air can be produced and maintained as will supply the necessary oxygen, and at the same time drive off the nitrogen from the ore to be desulphurated, the oxidation will not only be interrupted, but will prove very imperfect. The difficulty must be still greater when the ores to be oxidized are already found with an oxidized coating, difficult of penetration to the current of air, and if penetrated through the pores, allowing no means of expelling the nitrogen which enters with the air; but the outer surface of the ores, becoming first oxidized, is easily melted, as in the case of galena or lead ore, and thus the pores become so obstructed to the entrance of the air that the process of oxidation and desulphuration is checked and rendered very imperfect. Now, oxidation and consequent desulphuration of the ores above named can evidently be effected by a direct application of oxygen without the presence of nitrogen much sooner and more perfectly than by a current of air. Experience has established the fact that zinc, iron, cobalt, and nickel raised to a certain degree of heat will decompose water. The same is done in a still more energetic manner by the sulphurets and sulphates of zinc, iron, nickel, cobalt, copper, and lead, while the sulphur combined with these metallic bases in minute particles, atom with atom, may be heated to so high a degree that a strong double affinity is formed, the hydrogen uniting with the sulphur and the oxygen with the metallic bases with equal intensity. As water is a combination of one atom of oxygen with one atom of hydrogen, in order to effect a decomposition it becomes necessary to use one atom of the decomposing metal, which, by the process of decomposition, becomes oxidized, while the hydrogen evolved *in status nasceus*, possesses a well-known affinity for sulphur, forming sulphureted hydrogen, (HS), so that as the metal becomes oxidized, atom with atom, the freed sulphur combines itself thoroughly with the hydrogen and, thus transformed into gas, is driven out. It is important that the proper degree of heat be applied to the ores, whereby they are enabled to de-

compose water, and that they never by conducting water are reduced below the degree of heat necessary to effect its decomposition. Both of these conditions can be successfully met by conduction of steam, and the elasticity of steam not only conduces to aid a perfectly-even distribution of oxygen in a furnace erected for the desulphuration of ores, in which they are sufficiently heated to effect a decomposition; but steam will, by proper management, prevent the melting of the oxidized coating of the minerals or ores, and through its expansive power open and widen the existing pores, and thus penetrate to the center of the masses and particles of ore until a complete decomposition takes place.

For further explanation and illustration of the desulphuration of ores above enumerated, I have in the annexed drawings represented a desulphurating-furnace as invented only by myself, and which is worked in the following manner:

Figure 1, front view of the furnace with the sectional line S T; Fig. 2, vertical section of the same, extending through the center from front to rear, as indicated by line from S to T; Fig. 3, vertical section at right angles with the former, with the sectional line X to Z; Fig. 4, horizontal section from X to Z of Fig. 3; Fig. 5, horizontal section from Q to R of Fig. 2.

The various colors represent the materials of which the furnace is constructed. Red indicates stone or brick; yellow, fire-brick; and blue, iron.

The letters represent the various parts of the furnace, as follows: A, fire-place for burning coal; B B′ B″, interior of furnace, in which the ores are placed for roasting; C, ash-pit; D D′, steam-pipe passing into the furnace and through it horizontally, as in Fig. 2, perforated on both sides for the emission of steam; E E′, steam-pipes entering lower part of the furnace; F and F′, continuation of steam-pipes E and E′ to B″ and B″ below fire-place; G, main steam-pipe directly connected with the boiler leading the steam to pipes D, E, and E′; *a*, arch above fire-place A; *b b*, openings for the passage of heat from the fire-place to the ore above; *c*, small holes for the emission of steam from steam-pipes; *d*, cast-iron plates to protect steam-pipe D from the ores as they are thrown in; *e e′ e″*, continuation of steam-pipes F and F′ in lower part of furnace; *f*, curved pipe connecting with pipes F and F′; *g g′ g″*, screw-valves to regulate the passage of steam.

The same letters in all the figures represent the same portion of the furnace.

Operations are conducted as follows: The ores are continually supplied from the top B. When they are sufficiently roasted to decompose the steam, the valves of the steam-pipe D are opened and the steam thus brought in contact with the whole body of the ores. By the openings or passages B″ B″ the ores are drawn out. Should it appear that they are not sufficiently desulphurated, more steam is emitted through the pipes F and F′, which will strike the ores at the bottom of the furnace with greater certainty, while the direct heat from the fire-place will act in concert with it in rapidly desulphurating the ores. The openings B″ B″ are designed also to admit air into the furnace, which, co-operating with the heat of the fire, assists in the roasting process; but the main design is that the air thus entering the furnace should unite with the sulphurated hydrogen gas evolved during the process of oxidation, and forming sulphurous acid (SO) and water would be consumed.

As the roasted ores arrive at B″ B″ always in a red-hot state, and the removal thereof would be difficult for the workmen, the steam-pipes *e e′ e″* may be used to cool the desulphurated ores sufficiently to be removed without danger.

What I claim as my invention and discovery, and desire to secure by Letters Patent, is—

The peculiar combination and arrangement of the several parts of the furnace, as described, with the application of steam for desulphurating sulphuret of zinc, (blende black-jack,) and sulphurous ores, sulphates, and sulphurets of iron, nickel, cobalt, copper, and lead, as described, and for the purpose set forth.

ROBERT GEORGE.

Witnesses:

THOS. J. ALLEN,
THEODOR ENGELS.