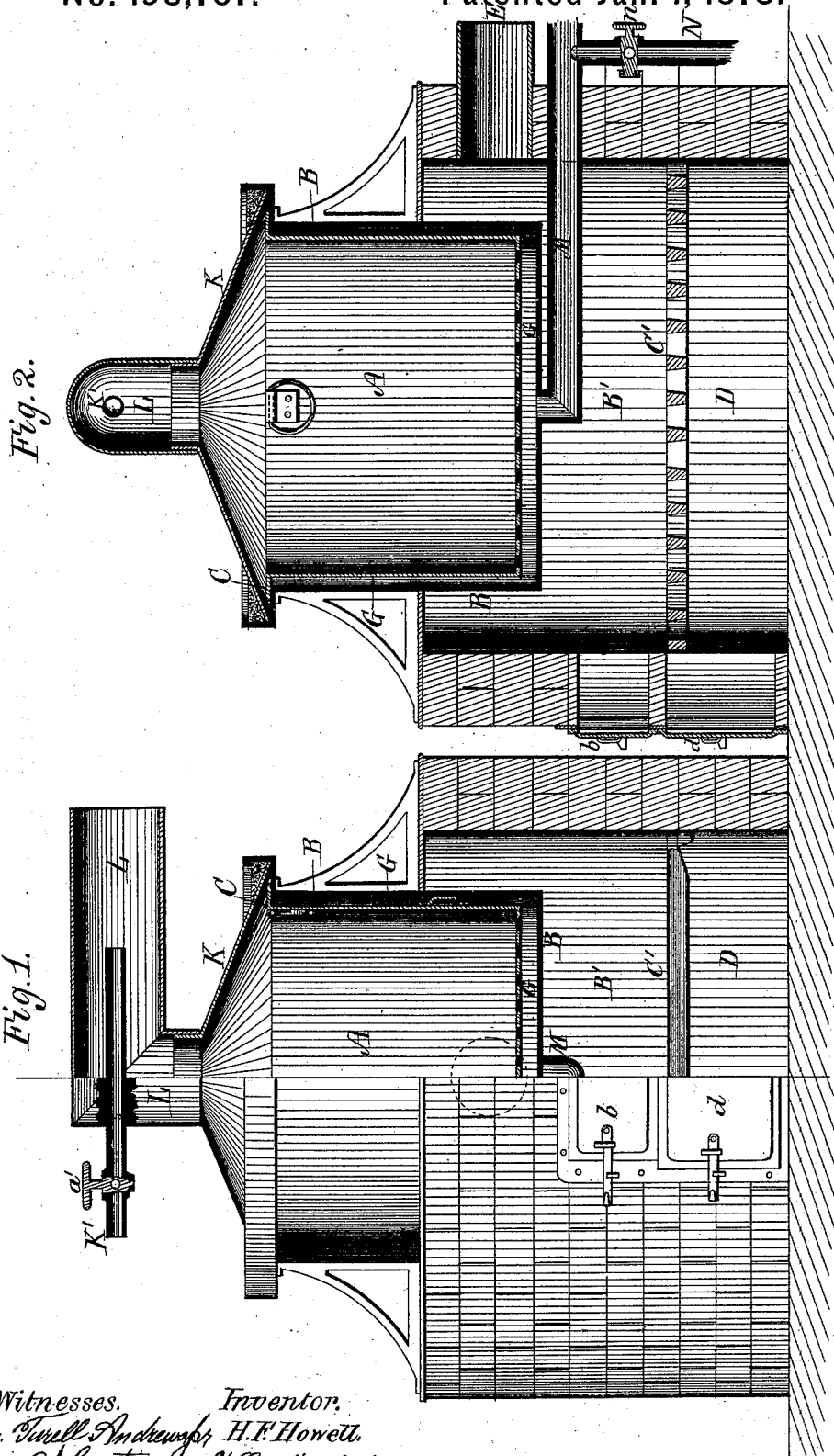


H. F. HOWELL.  
Apparatus for Roasting Ores.

No. 198,767.

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Witnesses.  
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# UNITED STATES PATENT OFFICE.

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## IMPROVEMENT IN APPARATUS FOR ROASTING ORES.

Specification forming part of Letters Patent No. **198,767**, dated January 1, 1878; application filed November 30, 1877.

*To all whom it may concern:*

Be it known that I, HENRY F. HOWELL, of Sarnia, in the county of Lambton, Province of Ontario, Canada, have invented certain Improvements in Apparatus for Treating Refractory Ores, of which the following is a specification:

My invention relates to apparatus and process for desulphurizing auriferous or other ores, especially arsenical pyrites, or mispickel ores, in which the arsenic is volatilized at low temperatures; and consists in means, substantially as hereinafter described, whereby I am enabled to thoroughly and effectually carry off the fumes or vapors of the arsenic which are freed by the roasting of the "charge" in the retort, and would otherwise be condensed in the mass of ore being treated.

To effect these results, my invention embraces, first, the employment of a heated air-chamber surrounding the retort, whereby the heat of the furnace is diverted from direct contact with the exterior of the retort which contains the ores, and acts upon such retort only through the medium of the air-chamber, by which means the heat is uniformly distributed over the surface of the retort, and condensation in the ores of the vapors of the arsenic avoided.

My invention, secondly, embraces the method of assisting to create, through the mass of ore held for treatment in the retort, a strong draft of hot air, for the purpose of materially accelerating the progress of the combustion and volatilization of the arsenic, sulphur, and other volatile elements, and the destructive distillation of the carbonaceous material embodied in the charge; such method consisting in introducing into the air-supply pipe a jet of steam under pressure, which produces a partial vacuum, and compels the air to enter and fill it, while at the same time a portion of the steam enters the charge of ore.

Thirdly, my invention embraces the method of introducing a jet of steam into the escape-pipe, through which the volatile products in the retort are carried off, (either to the condensing-chamber, if such products are to be utilized, or into the atmosphere,) the condensation of this jet of steam having the effect of producing a partial vacuum above the retort,

and inducing through the charge a powerful draft of hot air from the air chamber or pipes below, the same being as hereinafter described.

For a full comprehension of the nature and operation of my improvements, reference must be had to the accompanying drawings, in which—

Figure 1 is a sectional elevation, and Fig. 2 a vertical section, of a retort embodying my improvement.

In such drawings, A represents a retort, preferably circular in form, and of a size varying with the desired capacity for treatment, but usually being from three to five feet in diameter, and about two feet in depth, such retort being disposed within a similarly-shaped shell or casing, B, of somewhat greater depth and diameter, and being formed with a concentric flange, C, which surrounds its mouth, and rests upon the upper edge of the said casing B.

The casing B is partially built up in brick-work, and supported therein in any suitable manner; and its bottom constitutes the top of the furnace, which is shown at B', the grate of such furnace being shown at C', and the ash-pit at D, while *b* and *d* are, respectively, the fuel-supply door and ash-pit door, and E the flue for carrying off the smoke and waste products of combustion from the furnace.

The space or chamber G, intervening between the side walls of the retort A and case B, may be about three-quarters of an inch, and between the bottoms of the two of about three inches; and the bottom of the retort A is perforated with small holes, of such size and in such number as practice may determine best.

The top of the retort A is covered by a frusto-conical hood, K, which is sealed at bottom to the top of the retort by a sand joint, while L is a large pipe rising from the top of the hood, for the purpose of carrying off the fumes of the retort, such pipe being led to the open air, or, in instances where the arsenious or other volatile products are to be utilized, to any suitable condensing flue or receiver; and it is well that a sliding joint exist in the pipe immediately above the hood, in order that the latter may be readily removed in charging or emptying the retort.

K' in the accompanying drawings represents

a pipe, provided with a stop-cock, *a'*, at any suitable point, this pipe *K'* communicating at one end with the interior of the pipe *L*, and at the other end with a steam-generator, or other source of steam-supply, or with any other device for producing a partial vacuum. By admitting a blast of steam under pressure through the pipe *K'* into the escape-flue *L*, a partial vacuum is created in the hood over the charge of ore in the retort, thus not only causing the vapors of arsenic and sulphur in such charge to be rapidly eliminated and carried off into the discharge-flue, but to greatly expedite the passage of air and steam from the chamber below through the mass of ore.

*M* in the drawings represents a pipe, provided with a stop-cock at any suitable point, and passing at one end through the brick-work and air-chamber *B*, and communicating with the interior of the retort *A*, and at the other end with an air-forcing machine or other source of supply under pressure, while *N* is a steam-pipe communicating at one end with the interior of the air-pipe *M*, and at the other with a steam-generator, and provided with a stop-cock, *n*, and preferably with a petcock, the latter being to carry off condense-water, and prevent its getting access to the chamber *G*.

By admitting a jet of steam into the pipe *M* such steam creates a partial vacuum, which compels a rush of air to fill it, and thus causes a powerful draft, while a portion of the steam passes with the air into the charge of ore in the retort.

By this method the combined steam and air can be driven into the lower part of the retort and through the mass of ore in any proportion, and this proportion may be directly controlled by the attendant. This is of especial importance to prevent slagging of the sulphuret.

By the employment of the hot-air chamber *G*, surrounding the retort, I divert the heat of the furnace from direct contact with any one restricted part of the retort, and compel such heat to distribute itself generally about such retort in the form of hot air in such chamber; and by this means, as before stated, I avoid the condensation in the mass of ore of the arsenious or other vapors, and compel such vapors to pass to the escape-flue; and this effect is aided by the hood *K*.

I will now describe, briefly, the operation of the apparatus before described, and the process which it carries out.

The mass of ore to be treated is first ground to a powder of the requisite fineness; and as it is essential that the ore thus prepared shall contain about twenty-five per cent. of neutral matter to prevent slagging, this matter should be added, if the ore is of such nature that it does not possess it naturally.

To the mass I now add about its own bulk of some carbonaceous material, such as brown-coal, tan-bark, peat, &c., or analogous substances, and thoroughly incorporate the two,

and then moisten the whole with salt and water, but not to such an extent that the latter shall escape from the mass.

The use of salt and water may be dispensed with; but it has been found very serviceable, not only in my own experiments, but for many years in Germany, where it has been employed extensively; and the action of the salt leaves the metal clean and in favorable state for amalgamation.

I now place upon the perforated bottom of the retort *A* a quantity of straw or other carbonaceous matter, and then fill the retort with the mass adulterated and moistened, as before explained, the straw serving to prevent escape of the ore through the perforations of the bottom.

The hood *K*, which had been previously raised or removed, is now lowered to place into its sand joint, the fire started in the furnace, and the retort heated to the proper degree, when the cock is opened, and air under pressure is driven through the pipe *M* into the air-chamber *G*, surrounding the retort, in which it becomes heated to a temperature of from 500° to 600° Fahrenheit. The first effect of the heat upon the charge in the retort is to dry up the moisture therein, which having been accomplished, the hot air ignites the sulphur in the charge, and the sulphur, in its turn, ignites the brown-coal or other carbonaceous element, and the combustion of the two thoroughly effects the volatilization of the arsenic, sulphur, or other matters capable of volatilization.

Certain advantageous effects are also produced by the decomposition of water in the steam, while the combustion of the brown-coal or its substitute leaves the ore in a porous state, highly favorable for the escape of the vaporized matters.

The destruction of the combustible matter continues until it ceases for want of fuel, when the operation is completed, and the retort may be emptied.

Although I have described a method or process which consists, in part, of the employment of a carbonaceous material mixed with the charge of ore for purposes stated, and again, in part, of the employment of salt or salt and water, wherewith to moisten the mass of ore, I do not claim as of my own invention such steps in the process of desulphurizing ores, but only when they are carried on in my retort.

The use of carbonaceous material as an admixture of the ore, and of salt or salt and water, is not only described and claimed in Letters Patent of the United States numbered 186,654, and issued on the 23d day of January, 1877, to Z. A. Willard, of Boston, Massachusetts, but has existed in Germany for many years, and is fully described in a work entitled "A Practical Treatise on Metallurgy," adapted from the last German edition of Prof. Kerl's Metallurgy, by William Crookes, F. R. S., &c., and Ernst Röhrig, Ph. D., M. E., 1868. In this work, on pages 211, 364, and 365, Augustin's

process is explained as employing salt or salt and water. On page 366 the use of steam in the roasting process is alluded to, while on page 367 it is stated that Roeszner and Patera have found a mixture of salt water and chlorine water to be an excellent reagent for extracting gold and silver at the same time, while on the same page it is stated that Markus roasts in a muffle with the use of a steam-jet, and so on through the work. On pages 383, 384, and 385 of said work the use of carbonaceous material incorporated with the mass for purposes stated is explained.

Therefore I do not claim as my invention the incorporation of a carbonaceous material with the charge, nor the use of salt and salt and water therewith.

I do not confine myself to the use of the steam-jet pipe, arranged as shown, for inducing a partial vacuum above the mass in the retort, although it is a very effectual and inexpensive means of producing it, as a vacuum-pump of proper construction, or other devices, may be employed for the purpose. Nor do I restrict myself to the precise construction of the retort A and casing B as a means of diverting the direct heat of the furnace from the

said retort, and providing an intermediate air-chamber, as this construction may vary without departing from the spirit and gist of my invention in this respect.

I claim—

1. The combination with the retort, provided with an opening above for escape of the fumes, of an air-chamber surrounding the bottom and sides of the retort, and a draft-conduit communicating with said chamber, the combination being and acting as set forth.

2. The combination of the retort, the escape opening or flue above the same, and a draft-accelerator for producing a partial vacuum in the retort and increasing the draft through the same, with an air-chamber surrounding the bottom and sides of the retort, and a draft-conduit communicating with said chamber, substantially as set forth.

3. The combination of the retort A, flue L, pipe K', air chamber or jacket B, and air and steam pipes M N, arranged for joint operation, as shown and described.

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Witnesses:

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