UNITED STATES PATENT OFFICE.

ERNST OTTO FRANCKE, OF TUPIZA, BOLIVIA, AND CARL FRANCKE, OF CASSEL, GERMANY, ASSIGNORS OF ONE-THIRD TO CHARLES ADAMS, OF MANITOU, COLORADO.

PROCESS OF ROASTING AND AMALGAMATING GOLD AND SILVER ORES.

SPECIFICATION forming part of Letters Patent No. 293,157, dated February 5, 1884.

Application filed June 26, 1883. (No specimens.) Patented in Bolivia August 31, 1880.

To all whom it may concern:

Be it known that we, ERNST O. FRANCKE, residing at Tupiza, in the Republic of Bolivia, and CARL FRANCKE, a citizen of Germany, residing at Cassel, have invented certain new and useful Improvements in Processes of Roasting and Amalgamating Gold and Silver Ores; and we do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

This invention relates to certain improvements in roasting and amalgamating refractory silver and gold bearing ores, which usually contain, besides the sulphide of silver, the sulphides, antimonides, tellurides, and selenides of iron, lead, zinc., &c., to a greater or less extent, for the purpose of separating the precious from the base metals and salts, as more fully hereinafter specified.

In the processes of roasting and amalgamating ores as heretofore practiced, it has been the main object to chloridize the silver to the greatest possible extent during the roasting, in order to bring it into condition for the subsequent process of amalgamation. Such treatment, however, has not been found profitable when applied to the refractory ores above mentioned; and it is the object of our improvement to provide a process by which a large percentage of the silver may be extracted from such ores with convenience and profit. In our improved process of roasting and amalgamating ores, we attach no importance whatever to the chloridization in the act of roasting, but aim mainly to produce sulphates and chlorides of iron, copper, and possibly zinc, in the roasting process, to act as reagents in the subsequent treatment of the ores.

Our invention consists, first, in an improved process of treating ores by subjecting the same, in connection with common salt, to a temperature sufficient only to partially chloridize the silver and produce the sulphates of iron and copper, and possibly zinc, and too low to affect the arsenides, antimonides, tellurides, and selenides, as more fully hereinafter specified; second, in an improved process of treating the ores by subjecting the same, in the form of pulp, with common salt and quicksilver, under the influence of heat, in copper or copper-lined pans having copper agitators, as more fully hereinafter set forth.

In carrying out our invention an ore containing, besides the sulphides of silver, iron, and copper, the arsenides and antimonides may be taken, for example, such being, as is well known, one of the most refractory ores. The salted ore is roasted in an ordinary calcining-furnace at a temperature sufficient to convert the sulphides of iron and copper into the sulphate, but not sufficiently elevated to affect the arsenides and antimonides. The ore is kept at a proper temperature until the desired reactions are effected, which may be determined by its appearance, at which time the process is interrupted. It has been found by experience that about the proper time to stop the process is indicated when the ore has lost its metallic appearance and has assumed an earthy appearance, the ore giving off at the same time the peculiar antimonial smell. At this point about one-third of the silver will be found to be chloridized, although the amount will vary somewhat, according to the character of the ore, the main object at this stage being to leave arsenides, antimonides, selenides, and tellurides intact, and to convert the sulphides of the base metals, with the exception of sulphide of lead (if the ore should contain any) and the sulphide of silver, into sulphates. The roasting of the ore should be very light, the point being to convert the sulphides, with the exception of the sulphides of lead and silver, into sulphates, and that the arsenides, antimonides, selenides, and tellurides be left undisturbed. This differs essentially from the roasting for other amalgamating processes, which all aim to a total chloridization of the silver, which is only obtained by long and complete roasting. In our process we give no importance whatever to the chloridizing of the silver in roasting, only aiming at the formation of the sulphates of iron and copper, and possibly zinc, in the roasting process. After the ore is sufficiently roasted, it has added to it additional common salt,

(in all about ten per cent. parts, and about forty per cent., of water, by weight,) after which the mass is placed in the amalgamating-pans. The pans are constructed of metallic, copper, or wood lined with copper, and agitators or grinders are constructed of copper, all iron or other metal being carefully excluded, for the reason that such metals would be detrimental to the subsequent reactions, as will hereinafter appear. To each pound of silver contained a few pounds of quicksilver are added, after charging the pan with the ore pulp, and the charge is heated by steam-heat, preferably by the direct application of live steam. The quicksilver is introduced in the form of a shower, being pressed through canvas. The agitators are rotated, forcing the pulp toward the periphery of the pan and back, during which the following reactions take place—viz, the sulphate before mentioned, resulting from the decomposition of the sulphides, in connection with the common salt, are mutually decomposed, forming subchloride of copper and sulphate of soda. If the ore does not contain sufficient copper, a small quantity of blue vitriol may be added. The subchloride of copper thus formed and the sulphide of silver in the ore will be mutually decomposed, forming chloride of silver and sulphide of copper, which is precipitated, and metallic copper, which, in a nascent state and while under the influence of the galvanic currents established by the contact of the quicksilver and copper in a solution of metallic salts, will decompose the chloride of silver, forming chloride of copper, which is again converted into subchloride of copper by contact with the copper of which the apparatus is constructed, the metallic silver being dissolved by the quicksilver, forming silver amalgam. Thus it will be perceived the subchloride of copper is the main reagent to induce the amalgamation of the silver, rendering an initial chloridization of the silver in the roasting operation unnecessary. Care must be taken not to have too much quicksilver at any time, as it may attack the copper and carry metallic copper into the amalgam, especially when grinding. The quicksilver, as above stated, is introduced in small quantities, varying from one and one-half to two pounds to each one pound of silver at the start, and when samples, taken from time to time, show that the amalgam is dry, and has somewhat the appearance of silver filings, another similar quantity of quicksilver is added, in two consecutive charges, at an interval of from about one and one-half to two hours. As soon as the quicksilver commences to dissolve the copper the amalgam of the silver is at an end. If the roasting has been conducted properly, nearly all of the silver will have been extracted from the ore; but in any case the amalgamation is complete when the quicksilver begins to dissolve the copper, which can be determined by a practical metallurgist by sampling the amalgam from time to time and noting its appearance and feel when rubbed between the fingers. The grinding-plates may now be raised and more mercury added to the mass, so as to collect the amalgam; or the whole mass may be transferred to a wooden settler, more mercury added, and the amalgam collected and treated as usual. When the ore contains iron, as it sometimes does, the sulphate of iron, as well as sulphate of copper, will be formed during the roasting process, which will be converted into chloride of iron, and will act in conjunction with the subchloride of copper in the subsequent amalgamating process.

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

1. The process described of extracting precious metals from refractory ores, the same consisting in roasting the ores with salt at such low temperature as will transform the sulphides of iron, copper, &c., into the sulphates and leave the arsenides, antimonides, selenides, and tellurides undisturbed, and subsequently amalgamating said roasted ore, substantially as herein described and set forth.

2. The process herein described of treating refractory ores, consisting in salting and roasting the same at a low temperature for conversion of certain sulphides into sulphates without disturbing other metallic salts, as described, and afterward treating the same in a pulp with common salt and quicksilver, under the influence of heat and in the presence of metallic copper, whereby, through a series of reactions, the silver is reduced to a metallic state and amalgamated, substantially as set forth.

3. The process herein described of treating refractory ores, consisting of the following steps: first roasting the ores at a low temperature, then subjecting them, while in a state of pulp with water, to the action of common salt and quicksilver, under the influence of heat and in the presence of metallic copper, and finally adding quicksilver at successive intervals in small quantities, substantially as and for the purpose set forth.

In testimony whereof I affix my signature in presence of two witnesses.

ERNST OTTO FRANCKE.

Witnesses:

F. AVELINO ARAMAYO,

R. RODRIGUEZ FESTIGO.

In testimony whereof I affix my signature in presence of two witnesses.

CARL FRANCKE.

Witnesses:

ALVESTO S. HOGUE,

JEAN GRUND.