UNITED STATES PATENT OFFICE.

ROBERT M. FRYER, OF SAN FRANCISCO, CALIFORNIA.

IMPROVEMENT IN PREPARING GOLD AND SILVER ORES FOR MILLING.

Specification forming part of Letters Patent No. **205,536**, dated July 2, 1878; application filed May 1, 1877.

To all whom it may concern:

Be it known that I, ROBERT M. FRYER, of the city and county of San Francisco, and State of California, have invented an Improved Process for Treating Gold and Silver Ores in Furnaces Preparatory to Milling; and I do hereby declare the following to be a full, clear, and exact description thereof.

The object of my invention is to change the texture of quartz-rock without making it slag, and thus more easily and thoroughly convert the base metals into oxides, and thereby liberate the particles of gold and silver which are held in combination.

My theory is based upon the proposition that, if the fire-assay can determine the amount of metal which is contained in a sample of the ore, the working process should yield an approximate amount—at least it should return within ten per cent. of the assay value of the ore, due allowance being made for mechanical loss.

It is a well-known fact that no roasting process has yet been discovered that will practically save more than sixty or seventy per cent. of the gold or silver contained in gold or silver bearing ores, so that nearly one-third of the precious metal finds its way to the dump-pile. My investigations have confirmed me in the opinion that the cause of this disproportion between the assay value of the ore and the working returns lies in the want of proper treatment in the furnace.

The furnace treatment must be so thorough and complete that every particle of precious metal is detached or liberated from the embrace or cohesion of particles in which it is held, and the base metals must be thoroughly oxidized, so that no obstacle will be interposed in the subsequent process of separation to prevent the free amalgamation and elimination of every particle of precious metal.

My invention therefore consist in subjecting each charge of ore to a gradually-increasing temperature in the presence of a gradually-increasing inflow of atmospheric air until I obtain what I call a "malignant" heat, by which I mean a temperature varying from 1,800° to 3,000° Fahrenheit, where, in presence of an abundant supply of oxygen, the texture of the quartz-rock is changed without making it a slag, and the silicic acid, silicates, earthy and metallic oxides give off their oxygen to the metallic sulphides, producing an oxidation of metallic substances, except gold and silver, by a rearrangement of oxygen atoms, thus reducing the ore to such a friable condition that it can be easily crushed and the particles of precious metals separated from it.

This process can be accomplished in any suitable furnace which is provided with means for admitting a large quantity of air; but I prefer to use that furnace for which Letters Patent No. 170,625 were issued to me on the 30th day of November, 1875.

I do not use fluxes of any kind. I can also use coal or other fuel; but I prefer to use wood, as I can obtain the necessary preparatory heat while the wood is carbonizing, so that by the time the wood is converted into charcoal I can, without further trouble, by introducing a sufficient quantity of air, obtain the malignant heat above mentioned. The ore need not be pulverized, as is necessary in other roasting processes; but it can be introduced into the furnace in lumps.

In my improved furnace I introduce the wood and charge of ore at the same time, first introducing the wood, and subsequently the ore on top of it. I then fire the fuel and close the draft-openings, so as to support a low degree of combustion, which will carbonize the wood and meanwhile heat the ore uniformly through each particle. When the wood is thoroughly carbonized I open the draft-openings gradually until I obtain a maximum or malignant temperature, always observing to supply a sufficient inflow of air to prevent the ore from slagging and to thoroughly oxidize the base metals contained in the ore. Each charge of fuel will thus completely roast each charge of ore, and the process will commence with the introduction of each charge to the furnace, and will terminate upon its removal therefrom.

In using other furnaces and other fuels great care must be taken to admit the air to the ore from the bottom upward, so that it will come in contact with every particle of ore and fuel; otherwise the ore will be liable to slag and the process will be incomplete.

When the ore is removed from the furnace

the base metals will be thoroughly oxidized, and the ore will be in a friable condition, so that it can be easily crushed by any ordinary apparatus, and the particles of gold and silver will readily separate from the mass, so as to be recovered by amalgamation.

The malignant heat above referred to, besides thoroughly roasting the ore, cleanses or purifies the surfaces of the particles of gold or silver, so that amalgamation will readily take place.

By this process I can obtain practical working results very nearly approaching the assay results of the ore. I have practically demonstrated that I can take the most rebellious ores and by the above treatment render them completely tractable, and save within a small per cent. of the full value of the precious metals contained in them.

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

The process of preparing gold and silver ores for milling, rendering them friable, and making the metal cleaner for amalgamation, which consists in subjecting each charge of ore to a low degree of heat and a minimum amount of air, and then increasing the amount of air until a malignant heat varying from 1,800° to 3,000° Fahrenheit is obtained, substantially as and for the purpose above described.

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

ROBT. M. FRYER. [L. S.]

Witnesses:

ROBT. L. J. HALL,

JNO. L. BOONE.