

# UNITED STATES PATENT OFFICE.

ALGERNON K. JOHNSTON, OF NEW YORK, N. Y.

IMPROVED MODE OF ROASTING, DESULPHURIZING, AND DISINTEGRATING ORES OF GOLD, SILVER, &c.

Specification forming part of Letters Patent No. **48,281**, dated June 20, 1865.

*To all whom it may concern:*

Be it known that I, ALGERNON K. JOHNSTON, of the city, county, and State of New York, have invented a new and useful Method of Roasting, Desulphurizing, and Disintegrating Ores of Gold, Silver, or other Precious Metals which Contain Sulphur, Arsenic, or Phosphorus, and that I do not know or believe the same to have ever before been known or used.

Herewith I give a full and complete description of my process, so that any one skilled in this art may be able by following my direction to accomplish the desired result. My object is to so act on the sulphurets, arseniates, or phosphurets of iron, copper, silver, lead, or nickel containing the precious metals, or either of them, that the sulphur, arsenic, or phosphorus may be eliminated, and the ore thus so prepared for subsequent treatment that the precious metal may be obtained in larger quantity, more cheaply, and more expeditiously than has ever before been done.

It is a fact widely known that the gold and silver bearing rocks of our country are very ordinarily contained in sulphurous ores of iron and copper; also, that the sulphur thus in contact with the gold prevents the work of amalgamation from being thoroughly and effectually accomplished. The presence of arsenic or phosphorus will have the same effect. Ores containing these substances, particularly sulphur, have hitherto been ordinarily roasted in heaps in the open air, or sometimes in ovens, furnaces, or kilns, then stamped and washed, and next amalgamated on copper plates or in the Freiburg pans. In some instances—as in the gold-fields of the Southern States—the roasting is omitted, and the ores, simply stamped, are washed and amalgamated. These processes are open to many and serious objections—among others this, that by roasting as ordinarily conducted the outer surface only of the ore is freed from sulphur, and the air immediately furnishing oxygen to the highly-heated ore, a metallic oxide at once forms on the surface, similar to the dross which collects on a dipper of melted lead, thereby preventing further egress of sulphur or ingress to the oxygen of the air. If the ore is very finely divided it is frequently found that when thus heated such a coating has completely incased the rich particle and rendered its union with quicksilver not simply difficult, but impossible. By either

of these processes only a small percentage of their contained gold is saved, in many cases not more than twenty-five per cent. of the amount obtained from the ore by accurate analysis.

In order to arrive at a more satisfactory plan we shall not be led astray if we correctly interpret the course nature adopts to secure this end, and by which the gulch-mines of California and Montana have been made so rich, or the action of the same agency upon the tailings or previously-exhausted gold ores. These it was common to throw in heaps as useless rubbish. More recently it is found that if these heaps are well stirred, so that each portion may be well exposed to the atmosphere and rain, after a few years more gold may be obtained than was separated when the ore was first treated. Indeed, results not less than this have been obtained when no care has been taken to assist the access of air, but the tailings have been left as they were originally thrown from the works. In my method essentially the same thing is done artificially, with this difference only, that in it increased heat is substituted for time, so that the effect produced on the ore by months of exposure at the ordinary temperature of the atmosphere is secured by a similar exposure for days, only at a greatly increased temperature; and this is indeed what we might have expected, since it is well known that heat is one of the most effectual and energetic promoters of chemical action.

The ore before or after stamping (it can be best used about the size of hens' eggs or a little larger) is put into a furnace so constructed that it may be heated, and in this state be subjected to jets or currents of steam. These jets should be emitted at various places on the heated ores. A considerable variety of furnaces may be adopted, the ores being heated by fires within the stack or furnace or by furnaces built on the sides of the stack containing the ore and having flues to convey the heat to the ore. I prefer one of such construction that the ore, being introduced at the top, may be acted on in its descent through the furnace or stack and finally withdrawn from the base, such a furnace being capable of being continuously worked, additional ore being added at the top as the desulphurized ore is withdrawn. The furnace described in the patent of Robert

George is of this kind. Into one of these furnaces from twenty to one hundred tons of ore (depending on the capacity of the furnace) may be placed, (piled at the bottom, so that air may play from top to bottom,) and a considerable fire started on the grates. When a red heat, or thereabout, is attained steam from an adjacent steam-boiler should be allowed to enter gently and regularly, care being taken to regulate its admission, so as not to chill the ores, and constant care being had that the fires be maintained on the grates. After several days, varying with the peculiar nature of the ore and the size of the pieces introduced, the pyrites will be found to have attained a new color—in some cases very light, in others very dark—always uniform for the same ore, and also to have become friable and of such a nature that if water is thrown upon it it will crumble and crack, much as does burned limestone. If, on removing a piece and breaking it, it is found that the same color does not obtain throughout its mass, it is evidence that it should be longer subjected to the influence of the heat and moisture. The *rationale* of the process seems to be that at the temperature of the oven the steam or water (for jets of water may be substituted for or used together with steam) is decomposed, giving its oxygen to the iron or other metallic base, while its hydrogen unites with the sulphur, arsenic, or phosphorus present and forms the gases well known to result from such union of elements. These escape into the air or are burned in the furnace. By this means the precious metal, freed from these

deleterious substances, is readily formed into an amalgam in the ordinary way. A further and great advantage, too, is that the readily friable and partially decomposed rock taken from the oven does not need to be passed under stamps, and requires only the slightest attention from rollers.

I am well aware that steam has been used for the purpose of desulphurizing coal, in smelting and refining iron, and in desulphurizing ores of iron, zinc, copper, nickel, and lead, for the purpose of obtaining these metals. Also, I am aware that others claimed the use of carbonic oxide, carbonic acid, and carbureted hydrogen in treating auriferous ores, (substances which can only interfere with and impede the proper smelting of the ores.) None of these things, then, are claimed by me, nor do I claim or confine myself to any particular furnace; but

What I do claim as my invention, for which I desire Letters Patent of the United States, is—

The treatment of sulphurets, arseniates, and phosphides of iron, copper, nickel, or lead, containing any of the precious metals, with and by steam, with or without the presence of atmospheric air, for the purpose of freeing such ores from sulphur, arsenic, or phosphorus and preparing the precious metal for amalgamation or other subsequent treatment.

ALGERNON K. JOHNSTON.

Witnesses:

ALBION P. STROUT,  
ALLEN C. STROUT.