

UNITED STATES PATENT OFFICE.

JOHN H. ELWARD, OF POLO, ILL., AND JOHN L. HAYES, OF BOSTON, MASS.

IMPROVED PROCESS FOR SEPARATING GOLD AND SILVER FROM ORES.

Specification forming part of Letters Patent No. 52,834, dated February 27, 1866.

To all whom it may concern:

Be it known that we, JOHN H. ELWARD, of Polo, in the county of Ogle and State of Illinois, and JOHN L. HAYES, of Boston, in the county of Suffolk and Commonwealth of Massachusetts, have invented a new and Improved Process for Extracting the Precious Metals from Sulphurets and Ores containing Sulphurets; and we do hereby declare that the following is a full and exact description thereof.

It is well known that free gold, such as is found mixed with earthy deposits in placer-diggings or is combined with quartz after the same has been crushed, is readily separated by the action of mercury, and it is also well known that gold is often included in exceedingly fine particles within sulphurets of iron and copper, and being thus shielded from contact with mercury cannot be perfectly amalgamated.

The object of our invention is to effect the decomposition of sulphurets containing gold and silver, and thereby to free the precious metals contained therein, so as to be acted upon by subsequent processes of amalgamation, and to accomplish this decomposition by means so economical as to effect a great saving over any processes heretofore used.

To enable others skilled in metallurgical arts to use our invention, we will proceed to describe its operation.

Auriferous or argentiferous sulphurets, or ores containing such sulphurets, after being removed from the mine, are broken into lumps of convenient size, and are subjected to any known process of roasting, which may be effected in reverberatory furnaces or in kilns, or by heaping the ore with combustibles upon logs so that a free current of air shall pass through the ignited pile. It is advisable that the temperature to which the ores are subjected shall be as nearly as possible that of a dull red heat. By this process the pyrites containing the precious metals are partially oxidized, the sulphurets being more or less converted into sulphates. We are aware that this portion of the process is well known, and we do not claim it as any part of our invention. We next take the roasted ore while still at a high temperature and immerse it in a bath composed of a strong solution of nitrate of potash or nitrate of soda; but we prefer

crude nitrate of soda, as being more economical. This solution may be contained in suitable vats, and successive portions of the ore may be treated with the same solution. We do not limit ourselves to this mode of applying the solution of nitrates aforesaid to the heated ores, as the application may be made to the ores by sprinkling or drenching. By bringing the heated ores into contact with the solution aforesaid a decomposition of the nitrate takes place. The sulphuric acid of the sulphate contained in the heated ores, having a higher affinity for the alkali than for the bases with which it was before combined, leaves these bases and combines with the alkali of the nitrate, forming a sulphate of the alkali—*e. g.*, a sulphate of soda or potash—which remains neutral, performing no part in the required decomposition. Free nitric acid in excess is disengaged. A portion of the oxygen of the nitric acid so produced combines with the metallic bases, such as the iron, copper, and silver, forming oxides of the metals, and another portion of the oxygen combines with the sulphur of the sulphurets, converting it into sulphuric acid, which, uniting with the oxides of the metals, forms sulphates—*e. g.*, sulphates of iron, copper, and silver. These reactions separate, divide, and decompose the sulphurets, rendering them friable and exposing the precious metals. Where the sulphurets are mixed with quartz the latter is also made friable by the same process. This process should be repeated until entire decomposition is effected.

If the object is the treatment of gold ores for amalgamation, it will be necessary to remove the sulphuric acid from the sulphates formed as above. This may be done by exposing the ores which have passed through the process above described to a full red heat, when the sulphuric acid will distill off and leave the oxides of the base metals and fully expose the particles of gold to the action of the mercury in the amalgamating process. The ores will be sufficiently decomposed by the process above described to be subjected to the usual processes of amalgamation, either in amalgamating-pans with mullers or in arastra mills. If the object is to prepare argentiferous ores, it being necessary to retain the sulphur in the form of sulphuric acid combined with the silver and base metals, the reheating

process is dispensed with. The ore containing the sulphates is in a condition to decompose the chloride of sodium or sea-salt to which it is subjected by well-known processes for the formation of chloride of silver, which yields its silver readily to the mercury. In other words, sulphuric acid is left in the process of preparing silver ores in order to form sulphate of silver, sulphate of silver and chloride of sodium mutually decomposing each other, the sulphuric acid going to the soda to form sulphate of soda, and the chlorine to the silver to form chloride of silver to be amalgamated.

We are aware that nitrates have been used in a dry way for deflagration. We do not claim such use, but limit ourselves to the use of nitrates in solution, as above described.

What we claim as our invention, and desire to secure by Letters Patent, is—

The process of oxidizing sulphurets containing the precious metals and converting them into sulphates by the use of solutions of nitrates, for the purpose and in the manner substantially as above described.

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