

UNITED STATES PATENT OFFICE.

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PROCESS OF TREATING REBELLIOUS ORES OF THE RARE METALS.

SPECIFICATION forming part of Letters Patent No. 726,884, dated May 5, 1903.

Application filed July 26, 1902. Serial No. 117,191. (No specimens.)

To all whom it may concern:

Be it known that I, WILLIAM F. DOWNS, a citizen of the United States, and a resident of Jersey City, in the county of Hudson and State of New Jersey, have invented certain new and useful Improvements in Treating Rebellious Ores of the Rare Metals, of which the following is a specification.

My invention relates to the extraction of some of the rare metals from ores containing certain rebellious elements.

By "rare" metals I mean metals like tungsten, titanium, iridium, and the like.

By "rebellious" elements I mean arsenic, tellurium, sulfur, phosphorus, and similar elements when they exist in such quantity and condition in the ore as to make it difficult to employ the usual extracting processes in recovering the rare metals referred to.

The purpose of my invention is more particularly to change the nature of such rebellious elements by altering their condition with respect to the metals desired to be extracted from the ores, whereby such metals are left distributed in a condition so that they may be treated by ordinary economical processes then available.

I accomplish my purpose by intimately mixing with the rebellious ores a suitable quantity of a sodium compound and an agent capable of releasing the sodium therefrom under the influence of heat and then heating the mixture so made to a temperature sufficient to release the sodium. A combination of the sodium and of the rebellious element takes place. The volatile impurities and compounds then formed escape, and the metal desired to be recovered is left distributed in a condition throughout the mass from which it can be recovered in the usual way.

For the better understanding of my process I shall describe its application to the treatment of a tungsten ore containing sulfur, the tungsten being a typical rare element and the sulfur a typical rebellious element and the treatment being parallel to that which would take place in an ore of another rare metal containing the same or another rebellious element.

Sulfur is commonly eliminated from an ore containing it by one or more roastings. This is expensive, sometimes difficult to accom-

plish, and is frequently attended by a loss of the rare metal contained in the ore. It may not be desirable entirely to dispense with roasting, because a portion of the sulfur may be readily removed at a comparatively low temperature, and it may be that it is cheaper to get rid of such portion by such roasting rather than to leave it to be eliminated by the subsequent processes. It is, however, the residuum of these materials remaining after such roasting which it is so difficult to eliminate and which it is the purpose of my process to remove.

In practicing my invention the preliminary roasting of the ore is conducted as usual when necessary. After this has been accomplished the partially-roasted ore (or where no roasting has taken place the original ore) is reduced to a finely-divided state by grinding or any similar well-known treatment. Indeed the grinding may when deemed desirable precede the roasting, as in the case of a coarse hard ore difficult to break up into small particles. I similarly reduce to a finely-divided state a sodium compound, preferably a sodium salt, such as the carbonate. I also reduce to a finely-divided state the agent which I employ to release the sodium from its compound under the influence of heat. The agent which I use is carbon, preferably in the form of charcoal. The proportion of the sodium compound to the carbon in the mixture will of course be determined by the relation of their atomic weights, according to the well-known laws under which the subsequent reactions take place, and these must be chemically calculated or ascertained by previous experiment in each instance. I then intimately mix the finely-ground ore with the sodium salt and charcoal and under usual circumstances form the mass into briquets of any suitable form and size, having in mind the manner and place in which the heat is to be applied in the subsequent steps of the operation. If it is found desirable, a small portion of milk of lime may be added in the formation of the briquets on account of its well-known adhesive properties. In some cases it may not be necessary to form briquets. Assuming that the subsequent operations are to take place in a furnace, the briquets are then introduced into the furnace and subjected to

the action of heat. As the heat rises its action upon the mass is such as to drive off such portions of the rebellious elements and their compounds as are removable at the several temperatures attained. Finally a point is reached where the temperature is sufficient to release the metallic sodium from its compound or salt by the reducing action of the charcoal. The volatile nascent sodium thus brought into intimate contact with the particles of the ore forms compounds with the rebellious elements, which are usually volatile and are driven off by the heat, and those which are not volatile are usually soluble and may be removed by leaching, while the rare element in the ore is reduced to a condition where it may be treated in the usual manner. Suppose, for instance, the ore to be treated contains scheelite or tungstate of lime and some sulfur, the latter either in the form of a compound or in a free state. In this case the preliminary roasting, or if no preliminary roasting took place the first application of heat, would tend to drive off a considerable portion of the sulfur. There would, however, be formed a residue which it would be difficult to remove and which would probably leave the ore unmarketable. In such case when the proper heat was reached in the furnace the carbonate of soda and charcoal would break up, nascent metallic sodium would be formed, and this would unite with the sulfur of the ore to form a sulfid of soda, bisulfite of soda, or possibly sulfate of soda. The sulfid is volatile. The bisulfite and the sulfate are soluble. Hence the volatile compounds may be removed by heat and the non-volatile compounds of the rebellious elements by leaching. Of course if the presence of the non-volatile compounds formed does not interfere with the subsequent operations employed for the extraction of the metal desired they may be permitted to remain and the cost of their removal saved. By these steps the rebellious element has been changed to a non-rebellious condition, and the ore can then subsequently be treated for the recovery of the desired metal in any approved manner.

It will be readily appreciated by those skilled in the art to which my invention relates that other alkaline metals, such as potassium, are the equivalent of sodium in carrying out my invention and that it may be applicable to the removal of rebellious elements other than those named and to the treatment of ores of metals in addition to those above set forth.

What I claim as new is—

1. The process of treating ores containing rare metals and rebellious elements which consists in intimately mixing the ore with a sodium compound and an agent capable of releasing metallic sodium therefrom, heating the mixture to a temperature sufficient to release the sodium whereby a combination of the sodium with the rebellious elements of the

ore results and leaves the metal to be recovered distributed throughout the mass, permitting the volatile impurities and compounds to escape and finally recovering the desired metal from the mass.

2. The process of treating ores containing rare metals and rebellious elements which consists in intimately mixing the ore with a sodium compound and an agent capable of releasing metallic sodium therefrom, heating the mixture to a temperature sufficient to release the sodium whereby a combination of the sodium with the rebellious elements of the ore results and leaves the metal to be recovered distributed throughout the mass, permitting the volatile impurities and compounds to escape, removing the non-volatile compounds formed and finally extracting the desired metal from the mass.

3. The process of treating ores containing rare metals and rebellious elements which consists in roasting the same, in intimately mixing the roasted ore with a sodium compound and an agent capable of releasing metallic sodium therefrom, heating the mixture to a temperature sufficient to release the sodium, whereby a combination of the sodium with the rebellious elements of the ore results and leaves the metal to be recovered distributed throughout the mass, permitting the volatile impurities and compounds to escape, and finally recovering the desired metal from the mass.

4. The process of treating ores containing rare metals and rebellious elements which consists in roasting the same, in intimately mixing the roasted ore with a sodium compound and an agent capable of releasing metallic sodium therefrom, heating the mixture to a temperature sufficient to release the sodium, whereby a combination of the sodium with the rebellious elements of the ore results and leaves the metal to be recovered distributed throughout the mass, permitting the volatile impurities and compounds to escape, removing the non-volatile compounds formed, and finally extracting the desired metal from the mass.

5. The process of treating ores containing rare metals and rebellious elements which consists in intimately mixing the ore with a sodium compound and carbon, heating the mixture to a temperature sufficient to release the sodium, whereby a combination of the sodium with the rebellious elements of the ore results and leaves the desired metal distributed throughout the mass, permitting the volatile impurities and compounds to escape and finally recovering the desired metal from the mass.

6. The process of extracting rare metals from ores containing sulfur, arsenic, tellurium, or similar impurities which consists in roasting the ores; reducing the roasted mass to a finely-divided state; making the powder so formed into briquets with a suitable pro-

portion of a sodium compound and carbon; heating the briquets to a temperature sufficient to release the sodium; removing the remaining compounds of sodium and the impurities and recovering the desired metal from the residue.

Witness my hand this 25th day of July,

1902, at the city of New York, in the county and State of New York.

WILLIAM F. DOWNS.

Witnesses:

HERMAN MEYER,
S. J. COX.