

No. 693,982.

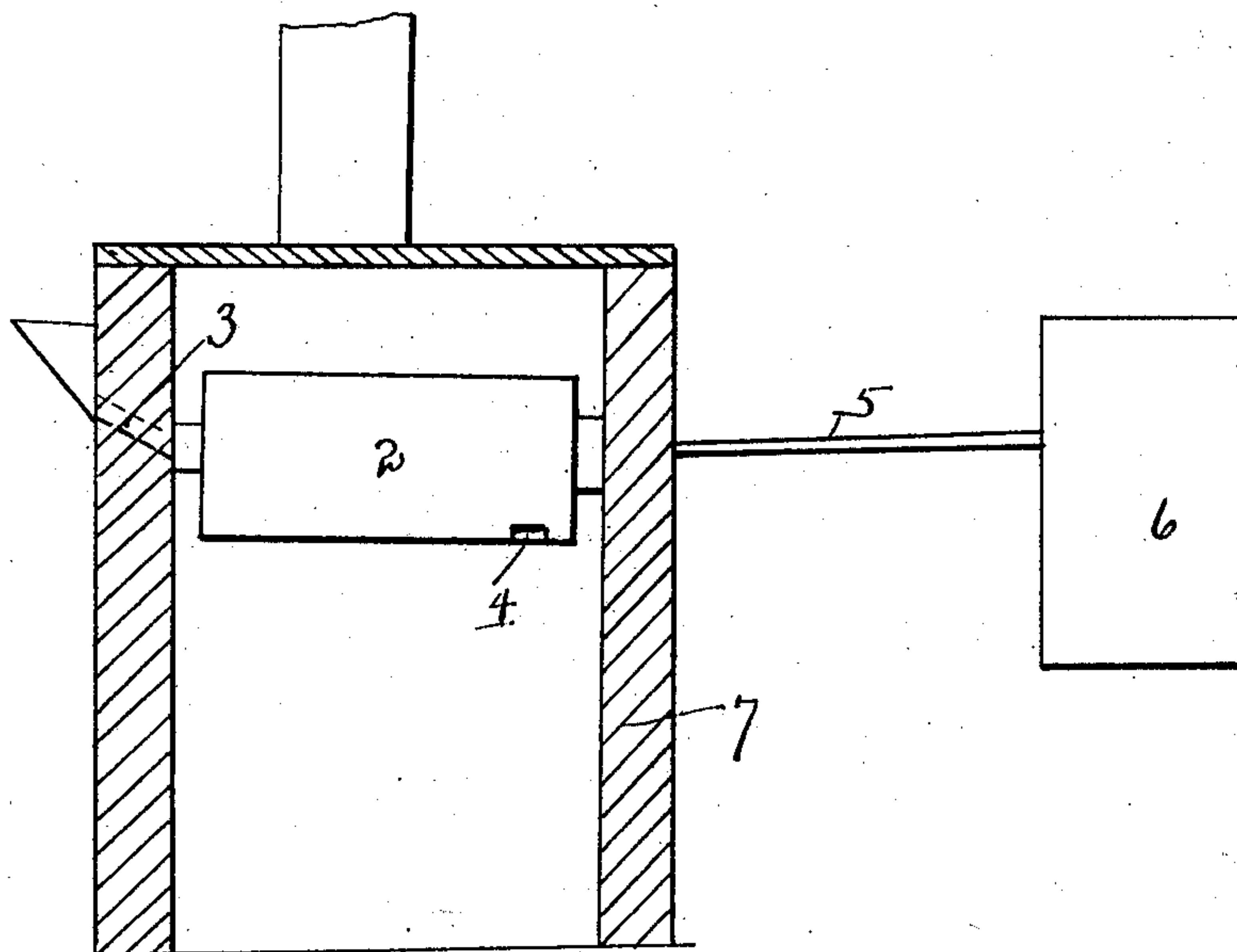
Patented Feb. 25, 1902.

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PROCESS OF REDUCING CARBONACEOUS ORES.

(Application filed Dec. 5, 1900.)

(No Model.)



Witnesses.

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PROCESS OF REDUCING CARBONACEOUS ORES.

SPECIFICATION forming part of Letters Patent No. 693,982, dated February 25, 1902.

Application filed December 5, 1900. Serial No. 38,739. (No specimens.)

To all whom it may concern:

Be it known that I, ROBERT MCKNIGHT, a citizen of the United States, and a resident of the city and county of Philadelphia, and State of Pennsylvania, have invented a new and useful Improvement in Treating Ores, of which the following is a full, clear, and sufficient specification.

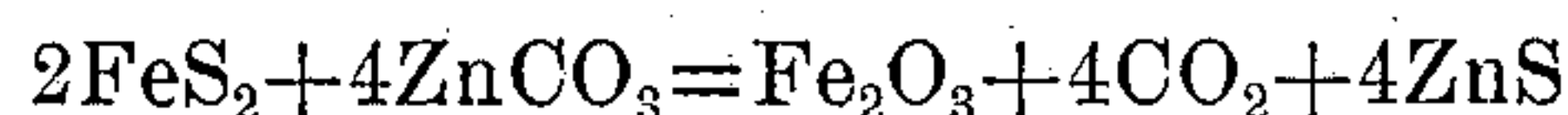
My invention has general reference to methods of treating ores in which the volatilization of the haloids (or oxyhaloids) of the precious metals forms part of the process, and has particular reference to treating those ores in which carbonates have to be reckoned with, either, as is chiefly and probably solely the case, as impurities in the ore or where possibly a carbonate of silver may be present in the ore. In both cases the method is practically the same so far as the treatment of the carbon is concerned.

The ore is treated with sulfur to convert the carbonates into sulfids or at times sulfates, enough oxygen being supplied in practice by admission of air to react with the sulfur and the carbonate, so that the product of the reaction will be either an oxid of the metal which was in combination with the carbon or a sulfid or sulfate of it, together with carbon dioxid, the latter being always present and also possibly SO_2 or SO_3 . These reactions take place at a low heat and the carbon dioxid comes off, and the ore is soon rid of all carbon that can interfere with the subsequent reactions. These subsequent reactions are the reactions between the oxygen, a haloid salt of an alkaline or alkaline-earth metal, and the sulfid or possibly sulfate of the ores, by which a non-volatile oxysalt of the alkaline or alkaline-earth metal and a volatile haloid salt of the precious metal are produced. As these stages—to wit, the first one that in which the reaction by which the ore is freed from carbon and the second one by which the precious metal is converted into a volatile, haloid salt, or oxyhaloid salt—of the process in practice blend with each other, it is not practicable to say precisely where each leaves off and the other begins. Without dividing the process into steps, but viewing it as a whole, as the heat begins to be applied the carbon dioxid passes off and the sulfur in the charge

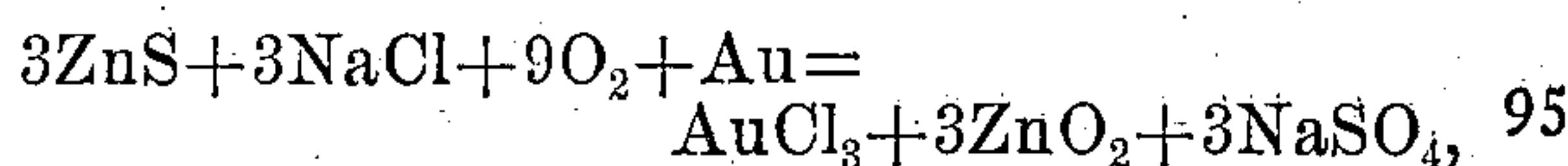
begins to combine with or which has been added to the metal previously combined with the carbon. As it progresses the sulfates are formed or the baser metal of the ore oxidizes and the sulfur unites with the oxygen to form sulfur dioxid, which is oxidized to trioxid, and reacting with the haloid salt above mentioned forms the non-volatile sulfate of the alkaline or alkaline-earth metal.

Describing now particularly and in detail the way in which I carry out in practice in the best way of which I am aware my invented art, I intimately mix the pulverized ore and a suitable sulfid—such, for instance, as, on account of cheapness, FeS_2 (iron pyrites)—and common salt and heat them with access of air. This is best done in a chamber shut off from the products of combustion, but with a suitable port for air admission, and provided also with means for carrying off the volatilized product apart from the fumes of combustion. The material should be stirred or otherwise agitated, if practicable, to aid in producing uniformity in the reaction. The first volatile product of the reaction is usually the CO_2 , which is carried off and allowed to escape. Subsequently the haloid (or oxyhaloid) salt of the precious metal is volatilized and passes over and is collected and the precious metal suitably separated out. In some cases the carbon can be carried off by converting it, all or partly, into carbon monoxid, or even the carbon unites with some other element of the ore when it is displaced by the sulfur, or all of these reactions occur together.

Taking now a typical ore to illustrate a particular instance of the use of my process, a mixture of Smithsonite and flour-gold, the reaction probably would be



and subsequently



the Fe_2O_3 , the ZnO_2 , and the NaSO_4 remaining in the gangue, while the CO_2 is allowed to escape and the AuCl_3 is volatilized and collected. It will be seen that with this ore a plentiful supply of air is requisite during the latter phase of the reaction.

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

1. The art of treating ores containing precious metals and carbonates, which consists in heating the ore in the presence of sulfur, until the carbonates are converted into sulfur compounds, and continuing the heating in the presence of a haloid salt of an alkaline or alkaline-earth metal, with access of air, until the alkaline metal or alkaline-earth metal combines with the sulfur and with oxygen to form a non-volatile sulfate of the alkaline or alkaline-earth metal, and the liberated halogen unites with the precious metal, as a haloid salt or an oxyhaloid of said precious metal, and volatilizing and collecting said haloid or oxyhaloid salt; substantially as described.
2. The art of treating ores containing precious metals and carbonates of a baser metal, which consists in heating the ore in the presence of sulfur and a haloid salt of an alkaline or alkaline-earth metal, until the carbonic acid radical passes off, and continuing the heating with access of air, until the sulfur combines with oxygen and the alkaline or alkaline-earth metal, and forms a sulfate of such alkaline or alkaline-earth metal, and the liberated halogen unites with the precious

metal, and volatilizing the precious metal as a haloid or oxyhaloid; substantially as described.

3. The art of treating ores containing precious metals and impurities in the form of carbonates, which consists in heating the ore with sulfur, apart from the products of combustion, and with the regulation of the admission of air, until the carbonates are converted into sulfids, and continuing the heating with access of air in the presence of a haloid salt of an alkaline metal, and until a haloid salt of the metal to be recovered is formed, and continuing the heating until the same passes off; substantially as described.

4. The art of treating ores containing precious metals and impurities in the form of carbonates, which consists in heating the ore with access of air with sulfur until the carbonates are converted into sulfur compounds, and continuing the heating of the ore with access of air with a chlorid of an alkaline metal, until a chlorid of the precious metal is formed and the same is volatilized and driven off; substantially as described.

Dated this 20th day of November, 1900.

ROBERT MCKNIGHT.

Witnesses:

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