UNITED STATES PATENT OFFICE.

WILLIAM A. HALL, OF NEW YORK, N. Y.

PRODUCTION OF SULFUR FROM PYRITES AND OTHER METALLIC SULFIDS.

1,133,636. Specification of Letters Patent. Patented Mar. 30, 1915.

No Drawing. Application filed June 25, 1913. Serial No. 775,739.

To all whom it may concern:

Be it known that I, WILLIAM A. HALL, citizen of the United States, residing at New York, in the county of New York and State of New York, have invented or discovered certain new and useful Improvements in the Production of Sulfur from Pyrites and other Metallic Sulfids, of which the following is a specification.

The present invention represents a modification of the processes described in my Patents No. 1,083,246 and No. 1,083,248, both dated December 30, 1913.

It is assumed that the sulfur in pyrites (FeS_2) consists of one feeble and one fixed atom, and that the feeble atom can be removed by distillation, whereas the fixed atom cannot. Now I have discovered as the result of experimental research that under certain conditions of distillation, both atoms act alike and both can be removed by distillation without the previous conversion into SO_2 and H_2S and the mutual action of these gases. These conditions are (1) the direct application to the pyrites of a substantially non-oxidizing flame, which will preferably be a reducing flame of a gas or gas mixture high in H, without any considerable amount of free oxygen, which would cause the formation of a substantial amount of SO_2, the major portion of the H of the gas burning to produce H_2O, which at the high temperature of the interior of the furnace is decomposed into H and O, by contact with the hot metal of the pyrites, so that the O being in a nascent state may attach itself to the Fe to form iron oxid while a part of the discharged H again burns to H_2O by combining with free O present in the furnace gases, either from leakage or from other sources, and another part of the hydrogen may unite with sulfur of the sulfid, to form H_2S. (2) Withdrawal from the furnace of the S discharged by the reaction above described, together with any produced by reaction of any SO_2 with reducing agents, for example CO, at a level above that at which the gases are admitted, the elemental S vapor being forced to the top of the furnace (or compartment of the furnace) by the pressure created in the lower portion of the furnace or compartment of the furnace, (where the burning gas is admitted) by the expansion of the heated gases.

In carrying out the process of my present invention, I may use the furnace described and claimed in my U. S. Patent No. 1,073,763, dated October 28, 1913, or that shown in my Patent No. 1,083,251, dated December 30, 1913.

It will be seen that I depart entirely from the H_2S and SO_2 combinations heretofore provided for, and effect a set of sequence reactions, in which a stable equivalent in the form of oxygen, is substituted for the sulfur. It is believed that the distillation of both atoms of sulfur is new in principle.

It is understood that while I have referred above to pyrites the invention is equally applicable to other metallic sulfids of similar chemical constitution, such as pyrrhotite, which contains substantially no "feeble" atom of sulfur.

In carrying out my process, I preferably use fine ore, that is ore in the shape of a powder, or small lumps, say up to half inch or so, or mixtures of powder and small lumps. The ore may be introduced on to the uppermost hearth of a reverberatory furnace, such as a McDougall mechanical roaster, or other mechanical ore roaster and will preferably be agitated by means of suitable rabbles or rakes, carried by a revolving central shaft. Into each compartment, the ore is subjected to the action of one or more non-oxidizing flames, which may be reducing flames, as in my prior cases above referred to. The ore is thus maintained at a temperature of about 700 to 900° C., in each of the several compartments and the sulfur will very rapidly distil from the ore. The gases and vapors employed may be drawn off from each compartment of the furnace separately or, may be caused to travel upwardly through the several compartments, and drawn off from the top compartment only, as desired. The gases and vapors drawn off in either manner, will preferably be conveyed to any suitable gas washer, or other device for recovering the sulfur existing in the gases. The gas preferably used for the production of the reducing flames, may be water gas, or other gases rich in hydrogen, such as hydrocarbon gases may be used if desired.

In this process, as distinguished from my copending applications above referred to it is not usually necessary to blow steam into the several compartments, since the combustion of the gas produces sufficient steam for the prevention of the formation of any ma-

terial amounts of SO_2 and for the breaking up of any COS produced. However if, as might occasionally happen, not enough steam for this purpose were produced, I can introduce a small amount of steam, either into the ore heating chambers, or into the exit pipe, to decompose COS.

It might be supposed that the sulfur vapor coming out is not distilled but is obtained from the reaction between H_2S and SO_2, but I have proved conclusively that that is not the case, for the reason that the combination of those two gases is known to be very incomplete, rather slow, requiring catalytic or other assistance, and also ineffective at high temperatures and in the short time available for such reactions, and in our furnace there is only a few seconds of time for the combination, and the temperature is far above that at which these gases best combine.

I do not claim broadly, in this application, the distillation of free sulfur from sulfid ores, by the treatment of said ores with a reducing flame in the presence of steam, since such a process is described and claimed in my U. S. patent above referred to.

What I claim is:—

1. A process of producing sulfur from pyrites (FeS_2) or other metallic sulfids, consisting in distilling off both atoms of sulfur in a furnace by the direct application of a non-oxidizing flame of a gas containing a high percentage of hydrogen, in the presence of a volume of oxygen admixed with the gas and insufficient to cause the formation of any substantial amount of sulfur dioxid, but sufficient to permit combustion of liberated nascent hydrogen or sulfureted hydrogen formed by reaction, and withdrawing the sulfur from the furnace at a level above that at which the oxygen is admitted.

2. In the production of free sulfur from sulfid ore, the step of subjecting said ore to the action of a reducing flame, produced by burning a gas containing a considerable percentage of hydrogen, while agitating said ore.

3. In the production of free sulfur from sulfid ore, the step of subjecting said ore, to the action of a reducing, hydrogen-containing, gas flame, at a temperature at which substantially all of both the fixed and feeble atoms of sulfur distil from said ore, in the form of elemental sulfur.

4. In the production of free sulfur from sulfid ore, the step of subjecting said ore to the action of a reducing flame, of a gas containing a considerable proportion of hydrogen, while allowing the formation of sufficient H_2O, to decompose any COS formed in the process.

5. In the process of obtaining sulfur from sulfide ore, the step of distilling the fixed atom of sulfur from said sulfid ore, by the application to said ore, of a reducing flame high in hydrogen.

6. In the process of obtaining sulfur from sulfid ore, the step of distilling the fixed atom of sulfur from said sulfid ore, by the application to said ore, of a reducing flame high in hydrogen, at a temperature between 700 and 900° C.

7. A process of producing sulfur from sulfid ores, which comprises distilling the fixed and feeble atoms of sulfur, as elemental sulfur, by the application to the ore, of a non oxidizing flame of a fluid fuel containing a high percentage of hydrogen, in the absence of a sufficient amount of oxygen to cause the formation of any material amounts of sulfur dioxid.

In testimony whereof I have affixed my signature in presence of two witnesses.

WILLIAM A. HALL.

Witnesses:

A. B. FOSTER,

A. M. PERKINS.