

# UNITED STATES PATENT OFFICE.

CHRISTOPHER JAMES, OF SWANSEA, ENGLAND.

## PROCESS OF REDUCING ZINC.

SPECIFICATION forming part of Letters Patent No. 482,438, dated September 13, 1892.

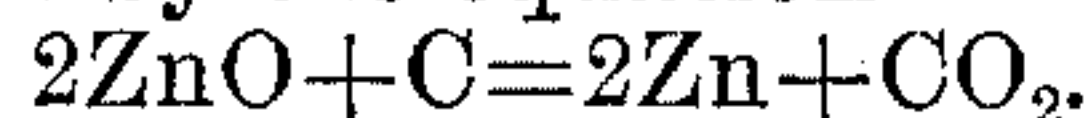
Application filed December 23, 1891. Serial No. 416,369. (No specimens.) Patented in England July 7, 1891, No. 11,563; in Belgium August 17, 1891, No. 95,768; in Spain September 23, 1891, No. 12,373, and in France November 16, 1891, No. 215,113.

*To all whom it may concern:*

Be it known that I, CHRISTOPHER JAMES, residing at Swansea, Great Britain, have invented an improved method or process for the production of zinc or spelter from ores or compounds containing the same, (for which I have obtained Letters Patent in Great Britain and Ireland July 7, 1891, No. 11,563; in Belgium August 17, 1891, No. 95,768; in Spain September 23, 1891, No. 12,373, and in France November 16, 1891, No. 215,113,) of which the following is a specification.

This invention relates to an improved method of or process for producing metallic zinc from any ores or compounds containing the same, and has for its object diminution of the usual known calcining operations, the utilization of the natural sulphur of the ore to assist or effect reduction, the employment of reverberatory or gas furnaces instead of the costly and troublesome retort-furnaces hitherto used, the greater percentage of metallic zinc recovered from the ore, and the better collection of the zinc in a distinct condenser, avoiding the present heavy losses through cracked retorts, imperfect clay connections, and waste of metal in the retort refuse.

In the ordinary methods now in use zinc ores are calcined till all the zinc present, either as carbonate or sulphide, is changed to an oxide. This is then mixed with coal or other carbonaceous matter placed in retorts, a large number of which are arranged in the same furnace and subjected to a great heat. The oxide of zinc formed by the calcination is reduced by the coal added to the charge, as expressed by the equation



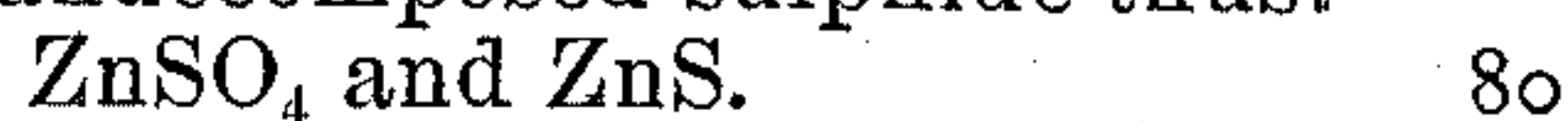
The zinc thus reduced to metal is at once volatilized by the heat at which the furnace is worked and leaves (as gas) the gangue of the ore and the unconsumed coal. This gas is condensed in the cooler part of the retort and in suitable connections outside the retorts.

This process is exceedingly wasteful and expensive. The zinc is only very partially reduced by the coal, and so much zinc is left in the retort refuse that ores containing a large percentage of zinc cannot be profitably worked. Enormous losses occur through the cracking and breaking of the clay retorts, and

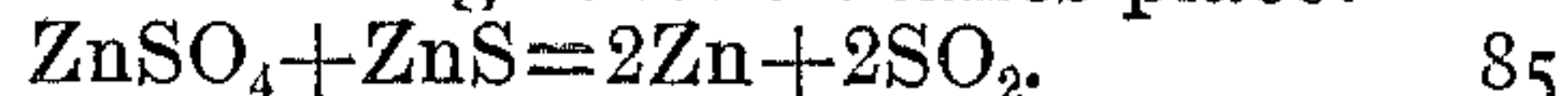
the process is generally extravagant in labor, coal, and zinc.

In my present improved process I calcine the crude ore; but I so limit the calcination of the ore (mixed ores or otherwise) that sufficient sulphur is left in the ore (either as undecomposed sulphide or as sulphate formed by the calcination) to effect an after reduction to metallic zinc in a neutral or slightly-reducing furnace at a melting heat.

The charge of partially calcined or sulphated ore I put, conveniently for the second step of my process, in a reverberatory furnace, in which I maintain as nearly as possible a neutral or slightly-reducing atmosphere and in which I can apply any amount of heat without fear of loss from the breaking of clay retorts and consequent leakage. The zinc is entirely reduced by the neutral reaction of the sulphate and sulphide of zinc under the neutral or slightly-reducing atmosphere and is preferably volatilized by the high degree of heat maintained in the furnace. This reaction I may illustrate, chemically, as follows: The zinc blende or sulphide by partial calcination will before complete calcination pass through the stage of mixed sulphate and undecomposed sulphide thus:



By stopping the calcination at this point and melting the mixed products in a neutral or slightly-reducing reverberatory or refinery furnace the following reaction takes place:



The volatilized zinc is conducted into a separate condensing-chamber surrounded by a water-jacket casing or partly filled with tubes through which the zinc-gas passes, the tubes being surrounded with water. In the chamber or tubes the zinc is condensed and is then ladled out ready for the market. The reduction, as above described, where the sulphur in the ore is utilized in reduction is more natural and perfect than when coal or similar carbonaceous matter is used.

In my process the sulphur and oxygen are present in exact proportions necessary for its complete reduction under heat with a neutral atmosphere. One great superiority of this process arises from the collection and condensation of the zinc being effected in a large,



distinct, and easily-accessible chamber or in an apparatus equally open to frequent examination, so that no loss of zinc takes place through leakage, while the small amount of  
5 oxide of zinc, which may be formed by any free oxygen which can pass into the furnace, I collect in suitable flues and chambers to be again used as calcined zinc ores. The expense of working such a furnace will be very  
10 small compared to the ordinary retort-furnace, the repairs much less, while the labor and loss of time caused by the breaking and consequent changing of damaged retorts is entirely avoided. By my above method of  
15 reduction ores containing less than ten per cent. of zinc can be profitably worked in consequence of the decreased cost following the use to effect reduction of the natural sulphur of the ore in lieu of coal, which latter is  
20 not only expensive itself, but renders the retort refuse unfit for any after treatment for the recovery of other metals than zinc contained in the ore. By my method the refuse from the retorts or furnace will be in a better  
25 condition for further treatment, while very nearly all the zinc originally present in the ore is driven off and condensed.

It is obvious that my process, so far as the

utilization of the natural sulphur of the ores to effect the reduction of the oxide of zinc, might be carried on in the ordinary retorts with some advantage as regards the present system of extreme calcination and subsequent carbonization for reduction; but a much better advantage would be obtained by the use of reverberatory or gas furnaces, as hereinbefore described.

Having now described my invention, what I claim is—

A process for the treatment of sulphide-zinc ores, consisting of partially calcining the ore, discontinuing the calcination when a portion of the ore is brought to the condition of a sulphate, melting the partially-calcined ore in a reverberatory or suitable furnace, and collecting the volatilized zinc by condensation in a chamber distinct from the furnace, substantially as described.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

CHRISTOPHER JAMES.

Witnesses:

REGINALD WM. JAMES,  
RICHARD A. HOFFMANN.