

UNITED STATES PATENT OFFICE.

GUSTAVE M. GOUYARD, OF DENVER, COLORADO.

PROCESS OF CONCENTRATING ZINC-BEARING SULPHIDE ORES.

SPECIFICATION forming part of Letters Patent No. 495,550, dated April 18, 1893.

Application filed November 25, 1891. Serial No. 413,084. (No specimens.)

To all whom it may concern:

Be it known that I, GUSTAVE M. GOUYARD, a citizen of the United States, residing at Denver, in the county of Arapahoe and State of Colorado, have invented certain new and useful Improvements in Processes of Concentrating Zinc-Bearing Sulphide Ores; and I hereby declare the following to be a full, clear, and exact description of the same, such as will enable others skilled in the art to which it appertains to apply the invention.

As is well understood, the usual practice for obtaining the precious metals from sulphide ores bearing zinc, lead, &c., and containing silver, &c., consists in first concentrating the ores (which is done at the mines) for the removal of the lead and iron, and secondly, the roasting of the ores as a preliminary to smelting (which is done at the works) for the elimination of the sulphur; and in said roasting process, when the sulphur is nearly eliminated, the heat is so increased as to fuse and cake the lead, and form a mass for the smelting furnace. The close specific gravity of iron (7.78) and zinc (7.13) renders the concentration process a very delicate and difficult one to conduct cheaply on a commercial scale; and the presence of a very large per cent. of zinc in the concentrate, as delivered to the smelter, adds considerably to the cost of smelting.

My invention has therefore for its object, first to facilitate the concentration of refractory zinc-bearing sulphide ores, such as are found in Colorado and elsewhere; and second, the production of a concentrate comparatively low in zinc, and therefore of greatly increased value to the smelter. The zinc bearing sulphide ores referred to, and to which my invention more especially applies, consist of zinc, iron, lead, silver, silica, and other foreign substances in small quantities. The zinc in such ores is known as sphalerite or zinc in the form of zinc blende, and the iron occurs generally in two forms, about ninety-eight (98%) per cent. of the whole being iron pyrites (FeS_2) and the balance (two per cent.) being pyrrhotite (Fe_7S_8).

My invention, therefore, generally stated, consists in subjecting zinc bearing sulphides, of the class above stated, or their equivalents to the following steps: first so roasting the

ore as to obtain a magnetic oxide of iron, secondly, passing the ore thus roasted, through a magnetic separator for the elimination of the magnetic oxide, and finally, concentrating the tailings of the magnetic separator for the elimination of zinc. In order, however, to obtain the best results, the roasting of the ore should be so conducted, that the final stage, or that wherein the sulphur is almost—or entirely—driven off, shall be conducted without materially increasing the heat of the furnace and in the presence of a reducing atmosphere, whereby a portion of the contained lead is precipitated or deposited on the iron and can be eliminated therewith in the subsequent step of magnetic separation or elimination of the iron, and this particular method of roasting the ore for the purposes of separation and concentration, forms in itself a subordinate, but valuable, feature of my invention, as, where more than five per cent. (5%) of lead is present with the iron product, the lead is allowed and paid for, and not otherwise.

As mines and smelters almost universally compute by the ton of two thousand (2,000) pounds, therefore, wherever hereinafter a percentage is specified, it is to be understood as a percentage of such a ton of ore or product as the case may be, and wherever I refer to weight (as for instance eleven and one-half ounces silver) it is such an amount to the ton of ore or product as the case may be.

I will now proceed to describe my invention in detail. I take an ore, which for the purposes of illustration may be said to contain thirty six per cent. sulphur, nineteen per cent. lead, twenty one and three tenths per cent. iron, seventeen and three tenths per cent. zinc, one per cent. silica, and eleven and one half ounces silver:

(36% S.—19% Pb—21.3% Fe—17.3% Zn—
1% SiO_2 —11, $\frac{1}{2}$ oz Ag.)

This ore I first roast at a low heat, or as is now commonly done at the smelting works, until the sulphur is nearly eliminated, and at this stage of the roasting process, instead of raising the heat as is done at the smelting works, I maintain the same low steady heat as near as possible, and also at this stage produce in the furnace a reducing atmosphere, adding fine pulverized coal in order to con-

vert the two forms of iron, viz: Iron pyrites (FeS_2) and pyrrhotite (Fe_7S_8) into a single form (Fe_3O_4) or a magnetic oxide of iron. Incidental to the operation of roasting as thus conducted, there is deposited or precipitated upon the magnetic oxide a certain per cent. of the contained lead, which can be eliminated with the iron in a subsequent stage of the process. As a result of this first roasting step, I get a product containing five per cent. sulphur, twenty eight and one half per cent. lead, twenty five and eight tenths per cent. iron, sixteen and seven tenths per cent. zinc, one and two tenths per cent. silica, and fourteen ounces of silver.

(5% S—28.5% Pb—25.8% Fe—16.7% Zn—1.2% SiO_2 —14 oz Ag.)

This product is then passed through a magnetic separator, and I obtain two products as follows: The first which I term "magnetic" and which constitutes about forty six (46%) per cent. of the mass, contains

11 oz Ag—17.3% Pb—1.3% SiO_2 —45.5% Fe—7.5% Zn.

The second which I term "non-magnetic" which constitutes about fifty four (54%) per cent., and which contains

15.6 oz Ag—37% Pb—1.4% SiO_2 —9.5% Fe—24.8% Zn.

It will be noted that the first or "magnetic" product, while it runs high in iron (45.5 per cent.) runs very low in zinc (7.5 per cent.); and that the second or "non-magnetic" product runs low in iron (9.5 per cent.) and high in lead (37 per cent.) and zinc (24.8 per cent.). This second or "non-magnetic" product is then concentrated by any of the well known methods, and as the specific gravity of lead (11.36) is so much greater than that of zinc (7.13) the lead is readily separated. As a result of this concentration I obtain two products: The first which I term "lead concentrate" will contain

22.2 oz Ag—71% Pb—0.5% SiO_2 —9% Fe—7% Zn,

while the second which I will term "zinc concentrate," will contain

9 oz Ag—3% Pb—2% SiO_2 —10% Fe—42.2% Zn.

By the process hereinbefore described I ob-

tain, as will be noted, first the "magnetic" product

11 oz Ag—17.3% Pb—1.3% SiO_2 —45.5% Fe—7.5% Zn:

rich in iron ore; and second, the "lead concentrate"

22.2 oz Ag—71% Pb—0.5% SiO_2 —9% Fe—7% Zn.

rich in lead; and in both, the zinc has been reduced to seven or eight (7% or 8%) per cent., and the sulphur to five (5%) per cent. or less; a very desirable feature, as the smelters give a better price for products low in zinc and which contains little or no sulphur.

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

1. As a step in the concentration of zinc bearing sulphide ores of the class specified, the process herein described which consists in subjecting the ore at the final stage of roasting and when the sulphur is nearly or entirely eliminated to a low heat in the presence of a reducing atmosphere which reduces the iron in the ore from its two forms (FeS_2 and Fe_7S_8) to the common form of magnetic oxide (Fe_3O_4) and precipitates lead thereon, then separating magnetically the roasted product whereby is obtained a magnetic product containing a large percentage of iron oxide (Fe_3O_4) and lead, and a non-magnetic product which is concentrated; substantially as and for the purpose specified.

2. The process of separating lead and iron from sulphide ores carrying lead, iron, zinc, and sulphur which consists in crushing the ore, roasting the ore, and mixing at the last stage of roasting a small percentage of fine pulverized coal which renders the iron in the ore magnetic and precipitates the lead on the iron, and then separating magnetically the magnetic material which consists of the iron and lead precipitated thereon, from the non-magnetic parts of the ore, and thus obtaining a valuable magnetic product substantially as described.

In testimony whereof I affix my signature, in presence of two witnesses, this 21st day of November, 1891.

GUSTAVE M. GOUYARD.

Witnesses:

ALMARIN B. PAUL,
J. H. CRAGG.