UNITED STATES PATENT OFFICE.

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PROCESS OF SEPARATING PRECIOUS METALS FROM THEIR ORES.


Application filed December 5, 1899. Serial No. 739,228. (No specimen.)

To all whom it may concern:

Be it known that I, FRANKLIN R. CARPENTER, a citizen of the United States, residing at Deadwood, county of Lawrence, State of South Dakota, have invented an Improved Process of Separating Precious Metals from Their Ores, of which the following is a specification.

My invention relates to a method of smelting ores containing the precious metals. All methods known to me and heretofore in use are what may be called "concentration" methods, giving at least two, but usually three, products in the furnace—to wit, slag and matte or slag, matte, and metallic lead. When matte or matte and lead are formed, one or both, as the case may be, not only is subsequent treatment required, but in order to form either, from "dry ores" or those free from lead, (to which my invention especially relates,) lead or matte forming materials must be added to the charge, thus reducing the capacity of the furnace and increasing the cost of smelting.

At Deadwood, South Dakota, and at Cripple-creek, Colorado, are found ores which consist mainly of earthy elements carrying gold. It is to this class of ores that my invention particularly relates. They may be smelted with the addition of lime only, forming a slag or molten mass; but the usual way is to add either matte-forming or lead-producing materials, or both, to the charge, which separate from the slag and collect or concentrate the gold and silver. If lead is added, a slag must be formed which will precipitate metallic lead carrying with it the gold and silver. These slags are highly complex, and to obtain the best results definite ratios of metallic bases to earthy or alkaline bases must be observed and the amount of silica in the charge kept low, forming usually a monosilicate slag in which large quantities of iron are necessary. If it is desired to practice matte smelting, sulfid material (iron pyrites, copper sulfids, &c.) must be added and frequently handled at a loss.

The so-called "dry" or silicious ores of Deadwood, South Dakota, which I have been engaged in smelting for ten years, average about seventy-four per cent. silica, ten to fifteen per cent. iron oxid, and some lime, magnesia, and alumina and only about twenty dollars or less in gold and silver. Smelting these ores by ordinary lead smelting is not profitable, as the making of the necessary lead-smelting slag is too costly. At present sufficient limestone is added to the charge to make a slag and also iron and copper ores in the form of sulfids to form a matte. I propose to obviate all this trouble and permit the use of a slag not as all possible in lead smelting and hardly so in matte smelting and yet obtain all the advantages of the old methods. I have discovered that the addition of either lead or sulfids is unnecessary, and I propose in the first smelting to form only a "magma" or slag, which, of course, still carries the gold and silver, and I do not intentionally form matte or any special slag, the reduction and separation of metals not being the object sought. This is accomplished by so charging the furnace that only a slag is formed and no metals reduced and separated. This result may be obtained by having only coke and slag-forming ingredients in the furnace—such, for instance, as silicious ores, limestone, and iron oxid. Reduction in the sense that ferric oxid is reduced to ferrons oxid occurs; but there is no reduction in the sense that metallic iron is reduced and separated. This molten mass or magma when passed over hot lead in a forehearth, reverberatory furnace, or other device readily gives up its gold and silver to the hot lead. Such a use of a lead-bath for desilverizing matte is of course common; but as matte has a far greater affinity for gold and silver than the earthly slag above described it is much more difficult, and, in fact, impossible, to absolutely cleanse the matte in this way; but the slagged material or magma above described, having little or no affinity for gold or silver, readily gives up to the lead the last traces of the contained gold and silver.

In practicing the old methods tapping of the products of the furnace into forehearths or reverberatory furnaces for the more perfect separation of matte, slag, and lead is old.

What I wish here to claim as new is the
smelting of dry ores without the intention of forming matte or lead and without the addition of lead or matte forming materials and the subsequent cleansing of the slag or magma so obtained by bringing it into contact with or passing it over molten lead.

My improvements therefore, broadly considered, may be said to comprise a method of simple smelting in a blast-furnace for the formation of slag, in which the reduction and separation of metals are not sought for beyond the reduction necessary to form slags, and the subsequent treatment of the products of this smelting in a reverberatory furnace or forehearth, where the slag may be either allowed to flow off or be skimmed off after it has given up its gold and silver, leaving behind a base bullion for the usual subsequent treatment.

To carry out my invention, I first charge a blast-furnace with dry ores and sufficient basic material to form the desired slag, but insufficient fuel to effect any material reduction of the contained metals, my purpose being solely to get a fluid mass or magma for subsequent treatment. A convenient charge for the furnace would be coke, siliceous ores, limestone, and iron oxid. The magma produced in this way is passed over and in contact with a molten metallic lead bath in a reverberatory furnace or forehearth. I prefer a lead-bath; but of course a metallic bath having a greater affinity for gold and silver than the magma might be employed, but a lead-bath is the best so far as my experience extends. Two or more foreheaths or reverberatory furnaces may be used, as shown in the accompanying drawings, where each tapping may be disposed of before another is made, so as not to contaminate the clean slag with the unclean, as would be the case in a blast-furnace where there is a constantly descending stream of unclean slags. The use of two or more foreheaths will also permit a continuous process.

In the accompanying drawings, Figure 1 represents a vertical central section through an apparatus adapted for carrying out my invention, and Figure 2 represents a transverse section thereof.

The apparatus which I employ comprises a blast-furnace A, having tap-holes Z Z and tuyers Z', and two reverberatory furnaces B B', each connected with the blast-furnace by a discharge-duct C C'. The lead-bath may be renewed by providing separate inlet and outlet openings or lead-wells.

In Figure 2 I have indicated where the inlet-well should be located at X, and at Y have indicated where the outlet-well should be placed.

In operation the smelted products flow from the blast-furnace into the reverberatory furnace or furnaces. The molten mass or magma after being subjected to the action of the lead-bath flows off or is skimmed off, and the base bullion thus produced is also removed and treated in usual ways.

The operation of a blast-furnace is of course continuous, while that of a reverberatory furnace is discontinuous, as its feed must be stopped while its charge is being worked, but by using several reverberatory furnaces in succession the products of the blast-furnace may be treated as rapidly as they are produced, thus utilizing the full capacity of the blast-furnace.

I claim as my invention—

1. The hereinbefore-described process of treating dry ores for the separation of the contained gold and silver, which consists in smelting the ores without the addition of lead or matte-forming material and then bringing the resultant mass, while still fluid, into contact with a molten-metal bath capable of absorbing the precious metals from the matte.

2. The herein-before-described process of treating gold and silver-bearing dry ores composed mainly of earthy elements for the separation of the gold and silver therefrom, which consists in smelting the ores without the addition of lead or matte-forming material and then passing the resultant mass, while still fluid, into contact with a molten bath of lead.

3. The hereinbefore-described process of treating dry ores for the separation of gold and silver which consists in smelting the ores with sufficient basic material to form a slag, and insufficient fuel to effect any material reduction of the contained metals, and then bringing the resulting molten mass into contact with a molten-metal bath capable of absorbing the precious metals from the matte.

In testimony whereof I have hereunto subscribed my name.

FRANKLIN R. CARPENTER.

Witnesses:

ARTHUR HOWE CARPENTER,
EDWIN VANLISE.