

UNITED STATES PATENT OFFICE.

ALFREDO LOTTI, OF MARSEILLE, FRANCE.

PROCESS OF SMELTING LEAD AND COPPER ORES.

No. 847,017.

Specification of Letters Patent.

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To all whom it may concern:

Be it known that I, ALFREDO LOTTI, a resident of Marseille, in the Republic of France, have invented certain new and useful Improvements in Processes of Smelting Lead and Copper Ores, of which the following is a specification.

The object of my present invention is to provide means whereby ores containing the sulfids of lead and copper can be desulfurized to a considerable extent by the aid of waste heat of the smelting process and at the same time the desulfurized product can be agglomerated into a form eminently well adapted to subsequent reduction in a blast-furnace, the operation whereof is thereby greatly facilitated. This will be appreciated from the well-known fact that the capacity of a furnace is increased and the cost of smelting correspondingly decreased in proportion to the coarse material in the charge. In the present practice sulfid fines have to be roasted in special furnaces, usually with the application of heat from carbonaceous fuel, which is always necessary in the case of lead-sulfid ores, and after roasting the ore can be charged into the blast-furnace only in limited proportion or must be sintered or compressed into briquets, all of which expedients involve extra expense.

It is well known that in the preparation of a charge of lead or copper ore for smelting in the blast-furnace it is not only advantageous, but also often necessary in order to obtain a satisfactory fusion, to have a certain proportion of the charge in lump form and, further, in many cases to have in the charge a certain proportion of slag from a previous smelting, the proportion of old slag employed sometimes amounting to thirty or thirty-five per cent. of the weight of the charge.

In adding old slags, rich or poor, to the charge they are broken up to suitable size after having cooled and are then mixed with the ore in the desired proportion. In this method of operation the heat of the slag is entirely lost, although the heat is considerable, amounting ordinarily to about four hundred calories per kilogram of slag, and, moreover, it is difficult, if not impossible, to obtain an intimate mixture of this slag with the ore during the subsequent fusion.

I have studied the agglomeration of lead and copper ores with slags already in the state of fusion employing a proportion of

slag varied according to the character of the ore. I have found in most cases, with minor modifications to conform to the particular conditions in each case, that by throwing the ore into a predetermined proportion of molten slag and stirring rapidly or mixing by any other system which permits of a good subdivision of the slag and ore a spongy incandescent material is produced, dense fumes of sulfur, sulfur dioxide, and sulfur trioxide being evolved at the same time. In the case of lead ores the material thus produced consists of the sulfid and oxid of lead mixed with slag. If this spongy and friable material still at the temperature of combustion of the sulfids be subjected to a current of compressed air in a suitable apparatus or to the oxidizing influence of air in other suitable ways, the remaining sulfur of the ore is to a large extent burned off, the temperature of the charge rising considerably during this process, even to the degree of bright-red heat. During the oxidation of the charge by means of the air-blast, fumes of sulfur dioxide and sulfur trioxide are disengaged and sometimes also yellow fumes of sulfur, which will condense in globules if the ore is pyritous. After one to three hours of this treatment the desulfurization of the ore which can come in contact with the air is completed, and the charge entirely agglomerated forms a single block, remaining, however, of spongy character. It is only necessary then to break it up to suitable size as preliminary to smelting in the blast-furnace. It may, however, be passed on directly to the blast-furnace, the block remaining still red in its interior, and this is in general advantageous in order to facilitate the elimination of any remaining sulfur and save fuel. The physical character of this material, which consists of slag intimately mixed with ore, is very favorable to a good and rapid fusion. Moreover, the mixture of the sulfid of lead with the sulfate and oxid formed during the treatment with air is very favorable in the subsequent smelting, since these compounds of lead react to produce the metal.

It sometimes happens in this process that ores rich in sulfur produce in the smelting a little more matte than if they were treated by the ordinary method of roasting; but in such case the difficulty may be overcome by re-treating a certain proportion of the matte, crude or roasted, along with the ore. This

system has the advantage of oxidizing to a large extent the matte, which then acts as a flux in the subsequent smelting.

In the application of the process to low-grade copper mattes and to the sulfid ores of copper, arsenical or antimonial, it is to be observed that their agglomeration in the reverberatory furnace or in the various forms of mechanical furnace that are in use is impossible, and it is therefore necessary to employ such material in granular form in the smelting-furnace or else to make it into briquets, both of which methods are expensive. By my process such ore can be desulfurized and put in excellent form for smelting at considerable economy. In the case of raw ore it is mixed with the proper proportion of molten slag. In some cases a variable proportion of silicious sand, or preferably of finely-crushed fluorspar rich in silica, is added prior to treating with air. In either case the charge is blown with air, the treatment varying according to the quantity of sulfur present, the character of the gangue, &c. The treatment with air is done while the mixture is still hot, the sulfids being at the temperature of combustion. The rapid treatment with air of material containing about fifteen per cent. sulfur produces an elevation of temperature sufficient to melt a portion of the sulfids and scorify a certain proportion of the gangue. After one to three hours a block of material easily fusible is discharged from the apparatus.

This method is not to be confused with the treatment of copper mattes in the Bessemer converter, since neither the principle nor the apparatus nor the end to be attained are the same. The object of my process is to achieve a preliminary desulfurization of the crude ores and present the desulfurized ore in a

form eminently well suited for subsequent smelting in the blast-furnace. The process thereby enables a double economy to be achieved: first, a saving in the roasting of the raw ore, since in most cases the heat of the slag and that of the combustion of the sulfur are sufficient to effect the desulfurization and agglomeration of the charge, and, second, in the subsequent smelting, since the preliminary operation converts the ore into a form that is most economical for reduction in the blast-furnace.

Calcareous gangues or basic gangues in general are not favorable to the process if they occur in too great quantity.

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

1. The process of mixing sulfid ore with molten slag and passing air through the mixture.

2. The process of adding sulfid ore to molten slag, effecting an intimate mixture of said elements, and passing air through the mixture.

3. The process of adding sulfid ore to molten slag, effecting an intimate mixture of said elements, and treating the mixture with air to effect desulfurization.

4. The process of adding silicious matter to sulfid ores or matte, roasting the mixture, adding the roasted material to molten slag, effecting an intimate mixture of said elements and treating the mixture with air to effect desulfurization.

Signed at Marseille, France, this 27th day of June, 1905.

ALFREDO LOTTI.

Witnesses:

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