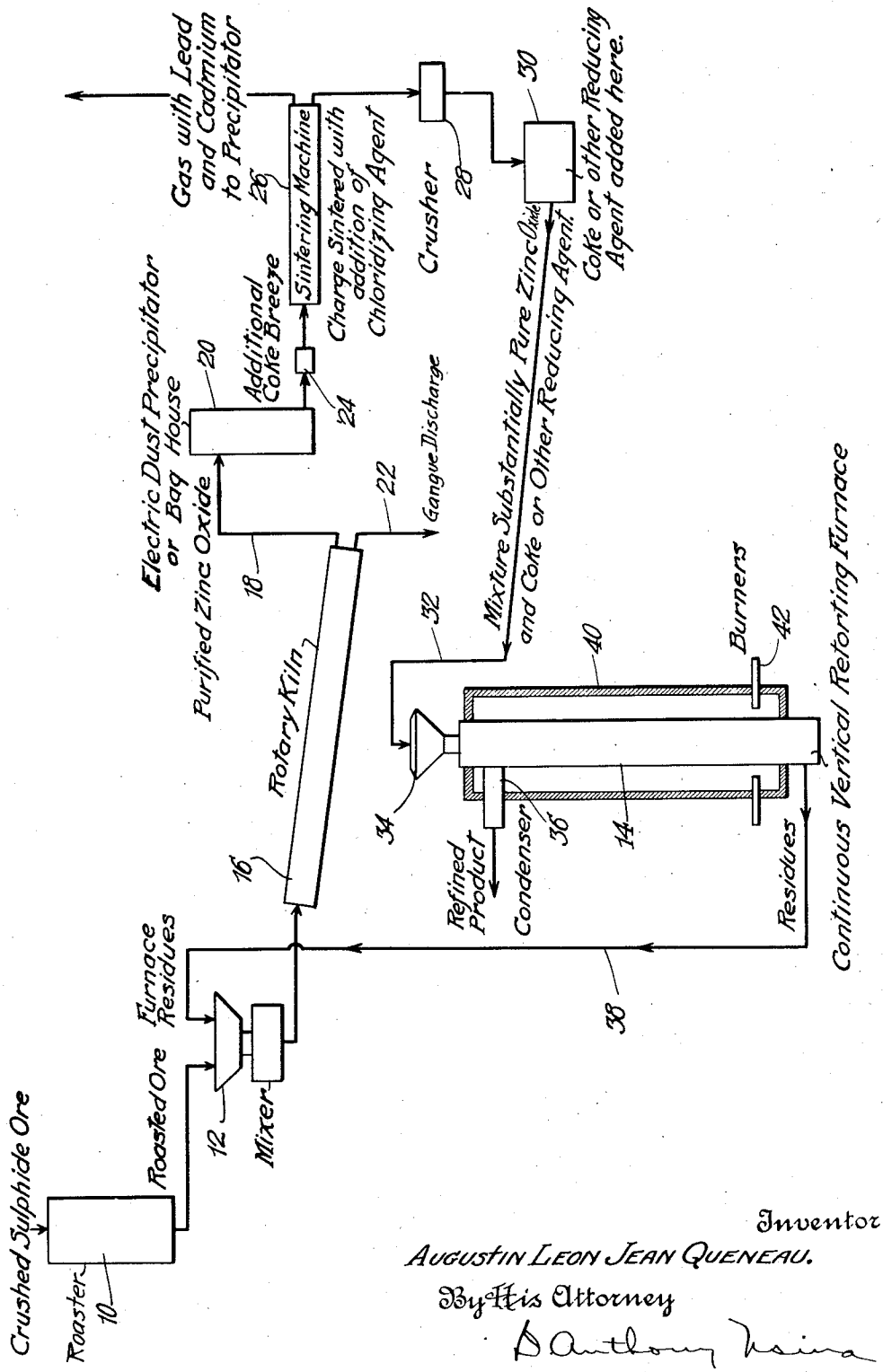
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RECOVERY OF METALS FROM ORES

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RECOVERY OF METALS FROM ORES

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This invention relates to the recovery of metals from their ores and aims to provide an improved method whereby ores may be treated in vertical retorts in such manner that smelting of the ore can be carried on continuously. The invention is particularly directed to the recovery of zinc from sulfide ores which present peculiar problems of treatment in vertical retorts because of the tendency of the gangue to adhere to the side walls of the vertical retort and, therefore, to impede the travel of the charge through the retort. An important feature of my improved method involves certain purifying steps hereinafter more fully referred to whereby the charge is treated so as to free it from those constituents of the ore which tend to adhere to the side walls of the vertical retort.

The most generally used zinc ores are sulfides. In the usual practice of recovering zinc from sulfide ores, the latter are roasted to eliminate sulfur and to obtain sulfuric acid as a by-product. In this treatment, the sulfur content of the ore is brought down to approximately 4 percent or less. The partly de-sulfurized ore is then usually sintered to bring down the sulfur content to approximately three-fourths of one percent.

This sintered ore is usually crushed to make a charge which will pass through a half inch mesh screen. This charge is then mixed with about 40 percent of coke breeze, anthracite fines or similar reducing material and is charged into retorts horizontally disposed in a gas-fired furnace. The zinc is driven off in the form of a vapor and recovered in condensers usually connected with the retorts. In this conventional method of operation, the metal values (such as zinc) recovered is approximately 86 percent of the total amount of the ore charge. This conventional retorting practice is essentially a batch process. That is to say, it is not a continuous operation. The charge is usually placed in the retorts one morning and is not removed until the following morning and this prior practice calls for a comparatively large working crew whose duties are heavy and arduous and which are performed in a hot, dusty and unhealthy atmosphere.

Many trials and attempts have been made covering a period of about seventy years to provide a workable method for the continuous smelting of ores such as zinc or the like in vertical retorts but as far as I am aware, these have proved unsuccessful. In the treatment of ores it is my observation and belief that vertical retorts heretofore used have only been successively operated on ores of extreme purity, or by-products which contain no gangue material. Heretofore vertical retorts could only be used with zinc bearing materials in which the gangue was of a non-slagging nature.

With the vertical retorting furnaces heretofore used, I have observed after years of practical consideration of the matter that only pure zinc bearing material such as galvanized skimmings could be treated successfully in practice, that is, with the downward travel of the charge taking place unimpeded. And I have determined that the reason for the failure of the vertical retort to be used in a continuous method of smelting zinc is doubtless due to the tendency of the gangue materials to form accretions on the highly heated retort walls and thus prevent the charge from moving downward uniformly. Such downward travel of the charge is an essential requirement for continuous operation of smelting zinc in a vertical retort and as far as I am aware, I am the first to have devised a method of smelting the usual grade of zinciferous or similar ore in a vertical retort.

My novel method will be fully apparent from the following description when read in connection with the accompanying drawing in which the single figure is a diagram illustrative of the method.

Referring to the diagram, crushed sulfide ore is fed to a conventional form of roaster 10 so as to drive off the sulfur which is recovered in the usual manner in the form of sulfuric acid. The roaster discharges an ore product in which the sulfur is reduced to about 4 percent. This de-sulfurized ore is mixed, for example, as indicated, at the mixer 12 with furnace residues obtained from the

continuous vertical retort furnace 14 to be hereinafter more fully referred to.

The mixed charge consisting of partly desulfurized ore and furnace residues is fed to a large rotary kiln 16 which in practice is about 10 feet in diameter and 150 to 200 feet in length. In this kiln the volatile elements are reduced by carbon and substantially all driven out of the charge. An oxidizing atmosphere is maintained in the rotary kiln, therefore, the reduced volatile values separated from the gangue are reoxidized and passed in the form of fume to a suitable electric dust precipitator 20 as indicated by the flow line 18. Alternatively the valuable products may be passed through a suitable bag-house. Thus, it is clear, that the valuable constituents of the charge are separated from the earthy gangue or waste such as silica, lime, magnesia, manganese and heavy metals such as copper, nickel, etc., which is discharged as indicated by the flow line 22. The zinc oxide delivered to the precipitator 20 is usually contaminated by a small percentage of divided carbon and approximately 2 or 3 percent of sulfur in the form of sulfate or sulfite and small amounts of ash.

To further purify the charge which is to be subsequently treated continuously in a vertical retort furnace, I add coke breeze at the station indicated at 24 in the flow diagram. The mixture is then fed to a sintering machine 26 in which the charge is subjected to the action of a chloridizing agent. The chlorine bearing material used may be sodium chloride, calcium chloride or the like. By sintering the charge in the presence of such a chloridizing agent, I am enabled to effect substantially or approximately a total elimination of the sulfur content of the charge no matter in what form the sulfur may have existed.

The evolution of hydrochloric acid results in completely eliminating sulphur, silver, lead, cadmium, etc. The thus sintered and purified oxide is then fed to a crusher 28 so as to reduce the charge to a size which will pass through a one-half inch mesh screen. To this charge, I then add a reducing agent such as coke breeze, anthracite fines or the like, this addition taking place as indicated diagrammatically at the station 30. The ratio of reducing agent to the crushed charge may vary. By way of example, I may add approximately 60 percent of reducing agent by weight. This mixture of substantially pure zinc oxide and coke or similar reducing agent is transferred as indicated by the flow line 32 to the usual charging hopper 34 at the top of a vertical retort 14. In this retort the zinc oxide is reduced, resulting in the evolution of carbon monoxide and zinc vapor. The latter passes to the usual condenser 36 and the zinc vapor condenses into molten zinc and the carbon monoxide burns to carbon dioxide at the mouth of the condenser. The ore charge descends continuously through the vertical retort and gradually becomes lower and lower in zinc value and when the charge reaches the lower part of the retort, it contains only a small percentage of zinc. The residues are removed from the bottom of the retort together with the remaining large excess of the reducing fuel which was introduced. And such residues and reducing material are transferred as indicated by the flow line 38 to the mixer 12 above referred to wherein such residues are mixed with the partly desulfurized ore.

In some cases, additional carbonaceous material will be added to the furnace residues.

The vertical retort may be of any conventional design and usually includes an outer furnace wall 40 and suitable burners 42.

My improved method described above has the advantage that the time required for the production per ton of metal is greatly reduced. Much heavy and unhealthy labor accompanying the operation of the usual discontinuous retort furnaces is done away with. The method provides a practical solution of problems above mentioned whereby a vertical retort furnace can be used for the continuous treatment of practically any type of zinc bearing ore.

From the description, it will be apparent that not only the slag forming materials are removed from the ore but also the sintered zinc oxide produced is obtained free from the contaminating metals such as cadmium, lead, etc., usually found in the zinc recovered in the horizontal retorting furnaces used in the conventional prior and present-day practice.

In my improved method as pointed out, the slag forming elements from the zinc oxide contents of the ore are practically totally eliminated, a great bulk of the impurities being eliminated in a rotary kiln and the remainder being eliminated by the chloridizing sintering operation.

The sintered nodules carry only zinc oxide. This being true, it is possible for the charge of zinc oxide and reducing agent to move downward freely in the vertical retort furnace as fast as the final residues are removed at the bottom of the retort. Thus, it is seen that the charge may be fed in a continuous manner to the top of the retort and the residues may continuously be removed from the bottom thereof. The excess of carbon used in the vertical retort charge to maintain the same free at all times for the upward passage of gases, is not a detriment, since subsequent use of such carbonaceous material is made for the treatment of the residues in the rotary kiln for the concentration of the zinc contents of the roasted ore as it is primarily purified.

Various modifications may be made by those skilled in the art and the diagram and de-

scription forming part of the specification are to be interpreted in an illustrative rather than a limiting sense.

What I claim is:—

1. In the recovery of zinc from its ores, the method which consists in roasting a charge of ore to drive off sulphur, lead and cadmium products, mixing retort residues with the charge, subjecting the mixture to heat in an oxidizing atmosphere and separating the desired oxide from the gangue, subjecting the oxide to a chloridizing treatment for purification, mixing a reducing agent with the purified oxide and passing said mixture of reducing agent and purified oxide vertically downward through a heated retort to condense the desired refined product.

2. In the recovery of zinc from its ores, the method which consists in roasting a charge of ore to drive off volatile products, adding a reducing agent to the charge, subjecting the mixture to heat in an oxidizing atmosphere and separating the resulting oxide from the gangue, subjecting the oxide to a chloridizing sintering treatment to purify it, crushing the sintered mass and mixing a reducing agent therewith, and charging the mixture of purified oxide and reducing agent to a vertical retort.

3. The method of claim 2 including the step of mixing the residues from the retort with the charge subjected to treatment in the oxidizing atmosphere.

4. In the recovery of zinc from sulfide ores, the method which consists in roasting the ore, treating the roasted charge in a rotary kiln, and separating the zinc oxide from the gangue, sintering the oxide in the presence of a chloridizing agent to purify it, crushing the sintered mass and mixing a reducing agent therewith, and charging the latter mixture to a vertical retort and recovering the refined zinc product by condensation of the vapors in said retort.

5. The method of claim 4 including the step of mixing of retort residues with the roasted charge treated in said rotary kiln.

6. The method of claim 4 including the step of mixing of retort residues with the roasted charge treated in said rotary kiln, the said sintering step including subjecting the oxide to purification by a chloridizing agent.

7. The method of claim 1 characterized by the fact that the charge is continuously passed through the vertical retort.

8. The method of claim 1 characterized by the fact that the charge is continuously passed through the vertical retort and the residues are continuously removed from the bottom of the retort.

In witness whereof, I have hereunto signed my name.

AUGUSTIN LEON JEAN QUENEAU.