UNITED STATES PATENT OFFICE.

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METHOD OF TREATING ELECTROLYTIC SLIMES FOR THE RECOVERY OF METALS THEREFROM.

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To all whom it may concern:

Be it known that I, ALEXANDER J. McNAB, a citizen of Canada, residing at Trail, British Columbia, Canada, have invented a certain new and useful Method of Treating Electrolytic Slimes for the Recovery of Metals Therefrom, of which the following is a specification.

My invention relates to the recovery of precious and other metals from the slimes resulting from the electrolytic refining of base bullion, for example lead bullion. An economical and effective process or method for this purpose has long been sought, and to provide such a method or process is the object of my present invention. The particular slimes which I have in mind are the so-called silver slimes resulting from the electrolytic refining of lead bullion, but the process is, in general, applicable to advantage in the case of other similar by-products, as for example the slimes which result in large quantities from the electrolytic refining of blister copper.

In practicing my process the slime, for example that resulting from lead refining by the Betts electrolytic process, is first treated with a sulfid, polysulfid, or hydrosulfid of an alkali, as sodium, potassium, or ammonium. I prefer sodium polysulfid for the purpose, as this compound is cheap, gives off no offensive odor during subsequent electrolysis, and dissolves the antimony and arsenic of the slime more readily than does the sulfid.

The treatment with polysulfid just mentioned dissolves what antimony, arsenic, tellurium and selenium may be present in the slime in the metallic form or as compounds, converting the same, in general, into sulfids. Thus, the antimony, present both in the metallic form and in compounds, chiefly the latter as antimonids of silver, copper and lead, is converted mostly into Na_3SbS_3, though other similar compounds, as Na_3SbS_4, may be formed. Similarly, the arsenic combines with the re-agent to Na_3AsS_3 or Na_3AsS_4 or both.

The silver, lead, bismuth, copper, and gold present in the slime are left undissolved by the above treatment. The solution, containing the other metals, is separated from the residue in any suitable way, as by filtration, and subjected to electrolysis, preferably with carbon or lead anodes and with cathodes of iron, copper, lead or other suitable metal. In the electrolysis antimony is deposited on the cathode, while the sulfid solution is regenerated. The antimony deposited on the cathode is stripped off as desired, and melted and cast into ingots in the ordinary way. When the solution or bath becomes too foul for further electrolysis, that is, when the bath has accumulated too much arsenic from replenishment of the bath with fresh sulfid solution, so that the bath cannot be electrolyzed without liberating a considerable amount of arsenic as well as antimony, the arsenic may be separated therefrom by crystallization, which can be conveniently effected by heating the bath until it has by evaporation been reduced to a specific gravity of about 35° Baumé, then cooling the bath and allowing crystallization to take place, whereupon the arsenic crystals can be separated by filtration or otherwise.

The residue resulting from the treatment of the slime with the alkali-sulfur compound, may contain, as before stated, silver, metallic or as sulfid, or both, also similar forms of lead, bismuth, copper, and gold. This residue is now roasted, to convert the silver sulfid largely into sulfate, at the same time converting most if not all of the other metallic sulfids into sulfates. The roasted residue is then treated with water or dilute sulfuric acid, preferably the latter, dissolving the copper sulfate, most of the silver sulfate and to some extent the bismuth sulfate. This solution is separated from the residue, which consists mostly of metallic gold and silver, lead sulfate, and basic bismuth sulfate. The silver and bismuth in the above solution is then precipitated by copper or other suitable metal or compound, and the precipitated metals are melted down in a reverberatory furnace, during which the bismuth is oxidized off and recovered as oxid, which can be further treated in any well understood way to convert it into metallic bismuth, bismuth oxychlorid, or other desired form. The filtrate resulting from the precipitation of silver and bismuth may be concentrated and allowed to stand to crystallize the copper sulfate resulting from the treatment of the original solution with copper, and to recover the free sulfuric acid, which is to be used over again.

The residue of metallic gold and silver, lead sulfate and basic bismuth sulfate, is

charged into a reverberatory furnace, the lead and bismuth oxidized off, and the bismuth recovered by any of the well known chemical processes. The mixture of gold and silver resulting from this fusion may be parted by any suitable and convenient chemical or electrochemical process, to recover the silver and gold.

What I claim is:

1. The herein-described method of treating electrolytic slimes for the recovery of metals therefrom, which consists in treating the slime with an alkali-sulfid, separating from the residue the solution thus formed, separating a metal from the solution by electrolysis, and roasting the residue and recovering metals therefrom, as set forth.

2. The herein-described method of treating electrolytic slimes for the recovery of metals therefrom, which consists in treating the slime with an alkali-sulfid, whereby antimony and arsenic in the slime are converted into soluble sulfids; depositing antimony on a cathode by electrolysis; and separating arsenic from the electrolyzed bath by crystallization; as set forth.

3. The herein-described method of treating electrolytic slimes for the recovery of metals therefrom, which consists in treating the slime with an alkali-sulfid, whereby antimony and arsenic in the slime are converted into soluble sulfids: separating the solution from the residue and separating antimony from the solution by electrolysis; and recovering metals from the said residue by roasting and subsequent treatment, as set forth.

4. The herein-described method of treating electrolytic slimes containing silver for the recovery of metals therefrom, which consists in converting one or more of the metals of the slime into soluble sulfids; separating the soluble sulfids, in solution, from the residue; roasting the residue and converting more or less silver therein into sulfate, in solution; and precipitating metallic silver from the said solution by a suitable reagent; as set forth.

5. The herein-described method of treating electrolytic slimes for the recovery of metals therefrom, which consists in converting one or more metals thereof into insoluble sulfids and one or more into soluble sulfids; separating the soluble sulfids, in solution, from the insoluble sulfids, or residue; subjecting the sulfid solution to electrolysis to recover a metal therefrom; and roasting the said residue and recovering metals therefrom; as set forth.

6. The herein described method of treating electrolytic slimes containing silver for the recovery of metals therefrom, which consists in treating the slime with an alkali-sulfid; separating from the residue the solution thus formed; electrolyzing the solution to remove antimony therefrom; crystallizing arsenic out of the electrolyzed bath; roasting the residue resulting from the treatment with alkali-sulfid; treating the roasted residue with a reagent to dissolve silver sulfate therefrom, and separating the same from the residue; and precipitating the silver from the sulfate solution; as set forth.

7. The herein-described method of treating electrolytic slimes containing silver for the recovery of metals therefrom, which consists in converting more or less of the metals of the slime into soluble and insoluble compounds; separating the dissolved compounds from the residue; roasting the residue and dissolving therefrom silver sulfate; precipitating the silver from the sulfate solution by a suitable reagent; charging into a reverberatory furnace the residue resulting from the separation of silver sulfate, to oxidize off lead and bismuth; and parting the metals resulting from the fusion in the furnace; as set forth.

8. The herein-described method of treating electrolytic slimes for the recovery of antimony, arsenic, bismuth, gold and silver therefrom, which consists in converting antimony and arsenic into soluble sulfids and separating the same, in solution, from the other substances; roasting the other substances or residue, containing bismuth, gold and silver; and converting more or less of the silver into soluble sulfate and bismuth into soluble and insoluble sulfates; separating the sulfate solution and precipitating the silver and bismuth in metallic form; charging the precipitated silver and bismuth into a reverberatory furnace, oxidizing off the bismuth, recovering the same and the silver; charging into a reverberatory furnace the residue resulting from the separation of bismuth and silver sulfates, containing metallic gold and silver and insoluble bismuth sulfate; oxidizing off the bismuth and recovering the oxid; parting the mixture of metallic gold and silver resulting from the fusion in the furnace; and recovering the antimony and arsenic from the solution of their sulfids; as set forth.

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Witnesses:
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