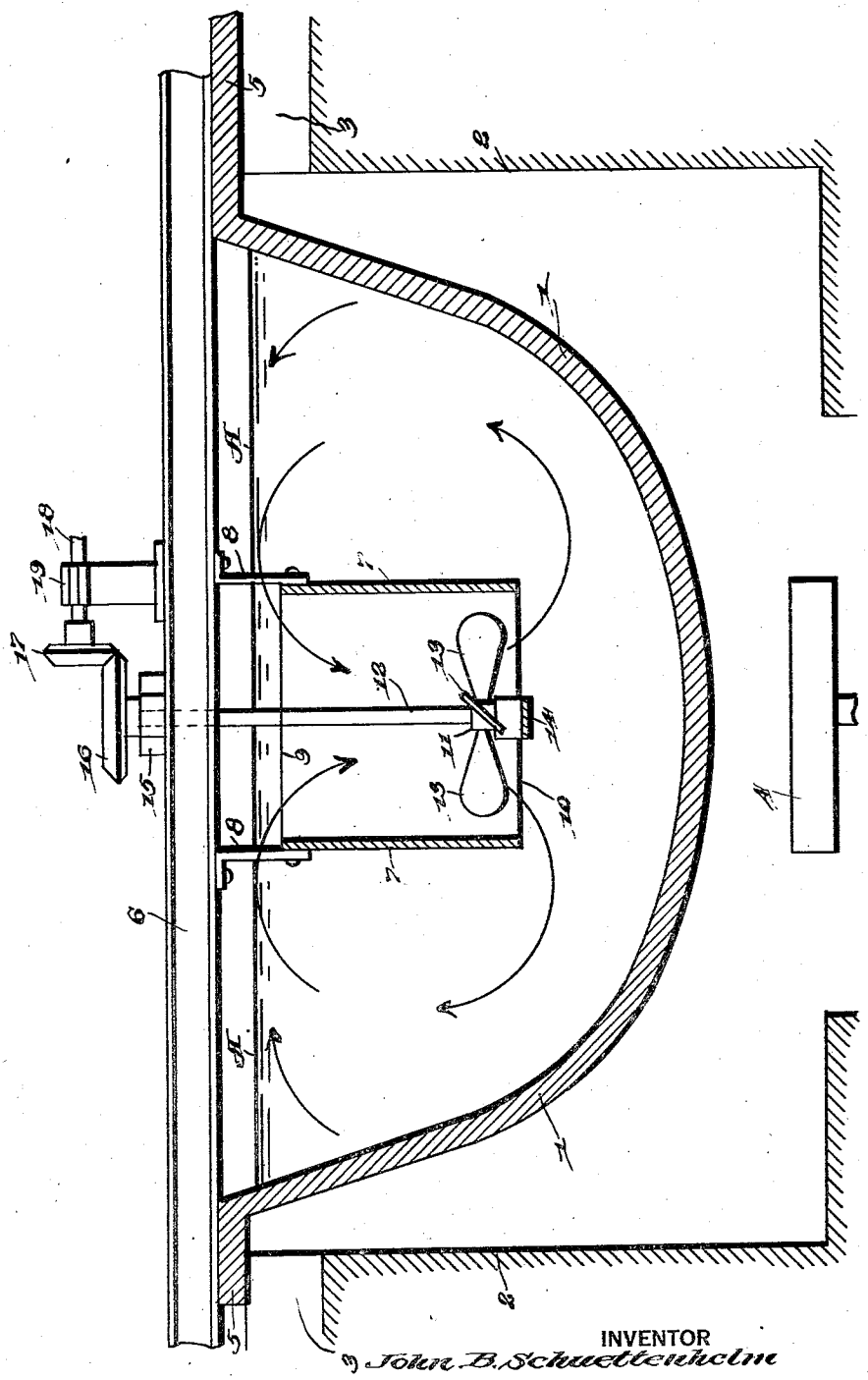
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LEAD PURIFYING PROCESS

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LEAD-PURIFYING PROCESS

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The object of this invention is to provide an improved method for eliminating impurities from lead, and the improved process has been successfully employed on antimonial lead and common lead bullion, and the invention is not restricted to the common lead bullion as it leaves the blast furnace but is operative with equal efficiency either before or after softening.

With respect to common lead bullion, which must later be de-silverized, it is important to previously eliminate or reduce the copper content as far as possible as this is a great advantage in the subsequent removal of gold and silver. Gold and silver are removed by zinc and if the copper is not previously removed, more zinc must be employed in the de-silverization than would be necessary if the copper had not been eliminated. Further, if copper is present in the de-silverizing process, the gold-silver-zinc dross will obviously contain at least a moiety of copper which latter is detrimental in the subsequent refining of both gold and silver.

The presence of either copper or arsenic or both in antimonial lead or common lead bullion constitutes an impurity that results in penalizing dockage of the lead product under present market requirements, and such product will command a correspondingly higher price dependent upon the extent to which these impurities are eliminated. Of course lead contains many other foreign substances some of which are valuable by-products, when removed, and some of which are worthless and which are impurities in fact.

It is the primary object of this invention to provide an improved process whereby copper and arsenic can be removed from either antimonial lead bullion or common lead bullion to such negligible extent as to avoid dockage entirely, or practically so.

My improved process is essentially of the drossing type and is carried out with the mass in a molten state and subjected to circulation of a prescribed character such as will successively immerse the dross downwardly from, and then restore it to the surface, subsequent to each of a plurality of skimming recovery operations, this feature of the invention serving to reduce the lead content of the skimmings. The temperature of the molten mass may be gradually reduced as the process proceeds, and because of the fact that copper and arsenic are both of lighter specific gravity than lead, this temperature reduction which may be made in a single stage, serves to freeze the former and thereby increases impurity recovery.

A feature of primary importance consists in a reagent that has a sufficient affinity for copper and arsenic to cause separation of the same from the lead and thereby render these impurities free to be drossed at the surface in a manner to facilitate the operations of skimming off these impurities with a minimum loss of lead, and in the most improved form of the invention, this reagent is, or consists of ammonium chloride.

A further feature of this novel reagent is that it functions selectively by separating copper and arsenic from the lead without separating gold, silver and many other foreign substances thereby very greatly facilitating the subsequent de-silverizing process.

The invention has many other objects and features which will be more fully described in connection with the accompanying drawing and which will be more particularly pointed out in and by the appended claims.

In the accompanying drawing, I have shown in vertical section, an apparatus for carrying out the process of this invention.

In the drawing, I have shown a drossing kettle 1, disposed in brickwork 2, having suitable outlets 3. A burner 4, provides a controllable source of heat for the kettle 1. However, this structure is merely suggestive and any like expedient may be employed in substitution thereof, within the province of my invention.

Superimposed on the flanges 5, of the kettle 1, and spanning the latter, is a beam structure 6, which leaves the kettle accessible on opposite sides of the former.

Reference will next be made to a means for diffusing the reagent throughout the mass in the kettle.

As shown, said means may consist of a cylinder or casing 7, adapted to be pendently

supported by hangers 8, from the beam structure 6, in a vertical position and with both ends of the casing open. The level of the molten mass in the kettle 1, is indicated at A, and will be substantially constant, and the disposition of the casing 7, is such that its upper or ingress end 9, will be below the level A, and the lower or egressing end 10, will be at a substantial depth in the mass, as shown.

Within and near the egress end 10, of the casing 7, I have shown a circulating means which may be in the form of a propeller having a hub 11, secured to shaft 12. Attached to said hub 11, are blades 13, canted to exert a downward thrust on the mass as the propeller is rotated in one direction. The lower end of shaft 12 may be journalled in a bearing 14, and the upper end is shown journalled in a bearing 15, mounted on beam 6. A gear 16, on shaft 12, is shown in mesh with a gear 17, on shaft 18, suitably journalled in a bearing 19, and to which shaft 18, power may be applied in any suitable manner, causing rotation of the propeller in one direction.

It will now be clear from the foregoing, and by reference to the arrows, that when the propeller is rotating, the mass will be drawn radially inwardly near the surface and forced downwardly through the casing and the mass will then move radially outwardly and upwardly to compensate for displacement of the surface mass. Therefore, the dross will be successively immersed downwardly from the surface thereby intermingling with the mass, and the next dross formed will afford a new content of impurities. However, it will be clear that the above circulating movement of the mass, alone and unaided by a reagent, would not be either practical or effective.

Having described a desirable form of apparatus, I will next describe one manner in which the process may be performed, first with common lead bullion.

Common lead bullion may be transferred directly from the lead blast furnace to the kettle 1, the bullion having a temperature of approximately twelve hundred degrees F. (1200 deg. F.). At this temperature, the lead bullion contains a considerable proportion or quantity of impurities dissolved, or alloyed, having of course a lead content therein. Such impurities are composed chiefly of copper, arsenic, zinc, iron, bismuth and sulphur.

It may be noted that at this stage or temperature, the copper and zinc are probably to a great extent in the form of sulphides, as copper sulphide and zinc sulphide, although a percentage of these elements may be present in metallic form, as for instance, antimony, arsenic and bismuth. The bullion also contains precious metals, namely, gold and silver. The copper content in this blast furnace common lead bullion is approximately one percent (1%) and arsenic will be present in a proportion of about twenty-five hundredths (.25%).

Of course at this high temperature of 1200 degs. F., it is not necessary to employ the burner 4, or any source of heat, in fact, the mass now in the kettle 1, is either cooled or allowed to cool to about eight or nine hundred degrees F., at which latter temperature, either after, or without previously operating the propeller, an initial dross will form on the surface when the mass is quiescent. Further, this initial dross forms, without the aid of a reagent. Hence, the impurities in the initial dross are those, primarily, which are free, but impregnated with lead.

This initial dross is skimmed off and it contains the greatest percentage of copper, and as a result of this initial skim, the copper content in the lead mass is reduced to about fifteen hundredths (.15%) percent, and the arsenic is reduced to about twenty-two hundredths (.22%) percent, which elimination is of course far from sufficient to render the lead profitably marketable. As gold, silver and bismuth are not recovered by this process, and obviously are not removed from the mass by this initial dross and skim, no reference need be made to either and their relative content in the molten mass will remain the same as it initially was.

I will next describe the next or second step in the process which involves the use of my novel reagent. At this point it is informative to state that while in some cases the temperature of the mass may be gradually lowered and a succession of drossings and skims made to complete the recovery of impurities, is is not absolutely essential to the success of the invention, as in actual practice, I have obtained equally good results by cooling the lead bullion almost to the freezing point and making recovery in a single treatment operation, which is an obvious advantage over any other process known to me.

Thus, assuming that the mass has been allowed to cool in the kettle 1, almost to the freezing point of the lead bullion, and with a content of the latter of ninety five tons (95 tons) I add to the lead bullion about thirty (30) pounds of sal ammoniac and start the propeller to thoroughly diffuse the reagent throughout the molten mass. Then the propeller is arrested to allow the mass to become quiescent, and the copper and arsenic, which have been separated by the reagent from the lead, will dross at the surface primarily because of the fact that both are of lighter specific gravity than lead. This single or reagent dross is then skimmed off, and as a result of this reagent, this drossing will reduce the copper content from fifteen (.15%) hundredths percent, as in the initial lead bullion to about one hundredths (.01%) and

the arsenic content will be reduced from twenty-two (.22%) hundredths percent, as in the initial lead bullion to about ten hundredths (.10%) percent, in the final lead bullion.

In cases where I have performed the process by gradually reducing the temperature of the mass and making a series of dosages of the reagent, and alternately skimming, I found that in the first reagent skim, the dross contained about five (5%) percent copper and about three (3%) percent arsenic. In the final drossing, the dross contained about three (3%) percent copper and about six (6%) percent arsenic, a decrease of the former and an increase of the latter in the successive drosses.

It is both informative and important to state that in the total process, the quantity of dross skimmed off will be only about two or three tons, from a mass of ninety five tons of bullion. To the best of my knowledge and belief, this process involves a smaller quantity of dross, for the copper and arsenic recovery, than any process known to me.

Reference will next be made to the treatment of antimonial lead bullion.

Antimonial lead is transferred directly from the blast furnace to the kettle in a manner similar to common lead bullion. The initial dross is also taken off in a similar manner while the mass is cooling to 800 degrees, or in fact, if the mass is cold, it will be disposed in the drossing kettle 1, and its temperature will be raised to about 800 or 900 degrees F., to reduce the mass to a molten state, and may if desired, although not necessarily, be gradually cooled or reduced in temperature while the process is carried out. If the process is carried out in stages or steps, the propeller will be operated, after a dosage of the reagent, to diffuse the reagent thruout the mass, and then the propeller will be arrested to permit the impurities to dross at the surface and be skimmed off, as will now be understood, this operation, or operations continuing in successive order until the mass cools beyond any possibility of recovery of the impurities. The total amount of the reagent for this bullion, is substantially the same as with common lead bullion. As with common lead bullion, the treatment of antimonial lead bullion may be completed by one operation with the reagent when the metal is close to its freezing point.

However, in antimonial lead bullion, the copper content before introducing the reagent, is relatively higher than in the common lead bullion. In actual practice, I have reduced the copper content in antimonial lead bullion from one (1%) percent to fifteen (.15%) hundredths percent and I have reduced the arsenic from ten (.10%) hundredths percent to four (.04%) hundredths percent.

In practicing the invention with antimonial lead bullion I have skimmed off, when operating the process in stages, a dross containing thirty (30%) percent copper and one (1%) percent arsenic. In the final skim the dross contained fifteen (15%) percent copper, and the arsenic removal in the final dross and skim ranged from one (1%) percent to three (3%) percent. The quantity of dross removed was about three tons from eighty five tons of antimonial lead bullion. I used substantially twenty five pounds of reagent for eighty five tons of lead bullion.

This antimonial lead bullion contains eighteen (18%) percent antimony, one (1%) percent copper and ten (.10%) hundredths percent arsenic, before treatment with this process.

It will be understood that the percentages of copper and arsenic, and also the weight of the dross, are given in approximate figures as precisely the same results cannot be obtained in all operations because of varying conditions which cannot be controlled to a precise degree.

The melting point of copper is 1930 degrees F., which is, of course, much higher than the melting point of lead. The melting point of arsenic is difficult to determine as arsenic volatilizes when subjected to heat without going through the stage of becoming liquid, and hence, it is impossible to determine what it does when in solution with molten lead.

As previously stated, my novel reagent consists of what is commercially known as Sal Ammoniac, and which is chemically known as ammonium chloride.

This substance constitutes a reagent for the function described, of the greatest potency and which can be used either in a gaseous or solid form, the latter being preferable because it is more readily handled. The low cost, relatively speaking, together with the relatively small quantity necessary are of material importance, and the latter feature, alone, illustrates its effectiveness.

The great potency of this reagent, to the best of my knowledge and belief, is due to its intensive affinity for both copper and arsenic, whereby each is so quickly and almost completely separated from the lead as to surpass in efficiency all other reagents I have ever known or used.

Because this reagent, and its constituents, are volatile when subjected to the hot mass, it does not leave, or add, any matter deleterious to either the lead or the dross.

A further feature of importance is that this reagent is selective in its function, having an affinity for copper and arsenic but not for gold or silver. Hence, in the case of common lead bullion, which must be subsequently de-silverized, the previous removal of copper by this process, without affecting the gold or

silver, is very beneficial. This is due to the fact that when the gold and silver are subsequently removed by zinc, the almost total absence of copper does not interfere with subsequent refining treatment of these precious metals.

While I have disclosed one specific embodiment of the invention, I do not wish to be limited thereto except for such limitations as the claims may import.

I claim:

1. The herein-described process of recovering copper and arsenic in the form of dross from hot impure lead to purify the latter, comprising, skimming off the initial dross of a molten mass of lead, in causing the molten mass constantly to circulate downwardly from and upwardly to the surface in endless paths to successively cause the dross to sink from and then ascend to the surface, in introducing a charge of ammonium chloride into the circulating molten mass to separate the copper and arsenic from the lead whereby both the former will rise by upward currents and gravity to the surface, in skimming off the dross to recover the copper and arsenic content thereof with the mass quiescent, and in repeatedly and alternately introducing charges of the ammonium chloride and circulating and ceasing to circulate the mass, and in gradually reducing the temperature of the mass as the process proceeds to freeze the copper and arsenic and thereby facilitate isolation of the same due to their relatively higher melting points as compared to lead, whereby the dross will gradually become drier as the process proceeds.

2. The herein-described process of recovering copper and arsenic in the form of dross from hot impure lead to purify the latter, comprising, causing the molten mass of lead to circulate downwardly from and upwardly to the surface to successively cause the dross to sink from and then ascend to the surface, in introducing a charge of ammonium chloride into the circulating molten mass to separate the copper and arsenic from the lead, in allowing the lead to cool, and in skimming off the dross when the mass is quiescent to recover the copper and arsenic.

In witness whereof, I have hereunto set my hand.

J. B. SCHUETTENHELM.