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RECOVERY OF METAL VALUES FROM FUME DEPOSITS

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This invention is particularly useful in the recovery of metal values from fume deposits (commonly referred to as fumes or fume residue) containing tin, lead, zinc, antimony, arsenic, and other similar volatizable metals which may originate, for example, in the smelting of ores or scrap metals, and are generally collected in a baghouse or in Cottrell electric precipitators, or by other means. It may also be applied to other alloys or mixtures of metal values containing some or all of those elements.

Bag-house fume deposits usually contain tin as tin oxide or dioxide; lead as lead oxide and/or lead sulfate; zinc as zinc oxide and/or zinc sulfate; antimony, arsenic and bismuth as the oxides of these elements and copper and iron as entrained metals or compounds of these metals. The usual methods of treating such materials involve either the separation of the various metallic ingredients by wet methods or by smelting and fluxing, or by a combination of both. In general, it may be said that such methods are costly and complicated and involve a large circulating load of partly treated material.

It is an object of the present invention to provide an improved method for recovering such metal values. It is also an object to provide a method whereby the various metals may be more completely and expeditiously separated from each other. It is another object to provide a method for uniting and removing discrete particles of molten metal from mixtures of discrete particles in a solid mass or in a powdered material. Another object is to provide a procedure in which a more complete separation of antimony from the tin may be readily obtained. It is also an object to provide a method including the separation of metals by vacuum distillation. Other objects will become apparent.

In the drawings, Figure 1 is a flow sheet illustrating the improved procedure.

Figure 2 is a side elevation of the means for compressing the reduced mass, portions of the device being shown in section.

Figure 3 illustrates a vertical, longitudinal section at the middle of a form of apparatus suitable for carrying out the vacuum distillation.

When mixtures of oxides of different metals, such as occur in fume deposits or mixtures of oxides of different metals with other non-reacting substances, are subjected at elevated temperatures to the action of hot reducing gases (or of mixtures of hot gases in which reducing gases are included, and in such concentrations of the reducing gas that the oxides of some of the metals, but not of all of the metals present in the mixture, will be reduced to a metallic state), the gaseous reduction which takes place may yield a product consisting of small pellets of reduced metal dispersed among the particles of the unreduced metal oxides or of the inactive foreign material. Under such circumstances these pellets of reduced metal will not run together into a solid mass of molten metal unless the whole mass of material is raised to temperatures so far above the actual melting point of the metal or metals that the result is similar to what would have been accomplished by direct smelting.

It has now been found that, if such fume deposits are subjected to gaseous or other reduction, for example, with hydrogen or carbon monoxide or hydrocarbon gases, or combinations of these, or with solid carbonaceous reducing agents, so that the tin and lead are reduced, in a large part, to the metals and are present in the form of small discrete pellets in the unreduced metals or inactive foreign materials, and this material is subjected to pressure in a mold, such as the container of a hydraulic press, at a temperature in excess of the melting point of the reduced metals of the mass and below the melting point of the remainder of the mass, the individual pellets may be made to flow together into larger masses of molten metal and may be extruded through apertures in the container and collected as molten bullion. The unreduced metals, consisting of the oxide or sulfide of zinc, and of any of the other metals not completely reduced to the metallic state, will remain in the container, together with the inactive foreign materials, as a cake which may be ejected after the molten metals have been extruded from it.

The cake resulting from this extrusion may then be given an oxidizing roast to drive off any combined sulfur and may be recycled through the gaseous reduction and compression steps. If the zinc oxide content of the cake residue, after the oxidizing roast, is sufficiently high to warrant its recovery, it may be extracted by leaching in acid, after which the residue from the leaching step may be recycled through the reduction and compression steps.

The metallic bullion obtained by gaseous reduction, followed by compression, as described above, will contain those metallic elements which are reduced by the gases or other reducing agent used, in about the same proportion as they were in the original fume deposit. In order to effect separation of these metallic elements from each other, and especially the tin from the lead, the