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APPARATUS FOR TREATING METALS

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Fig. 1

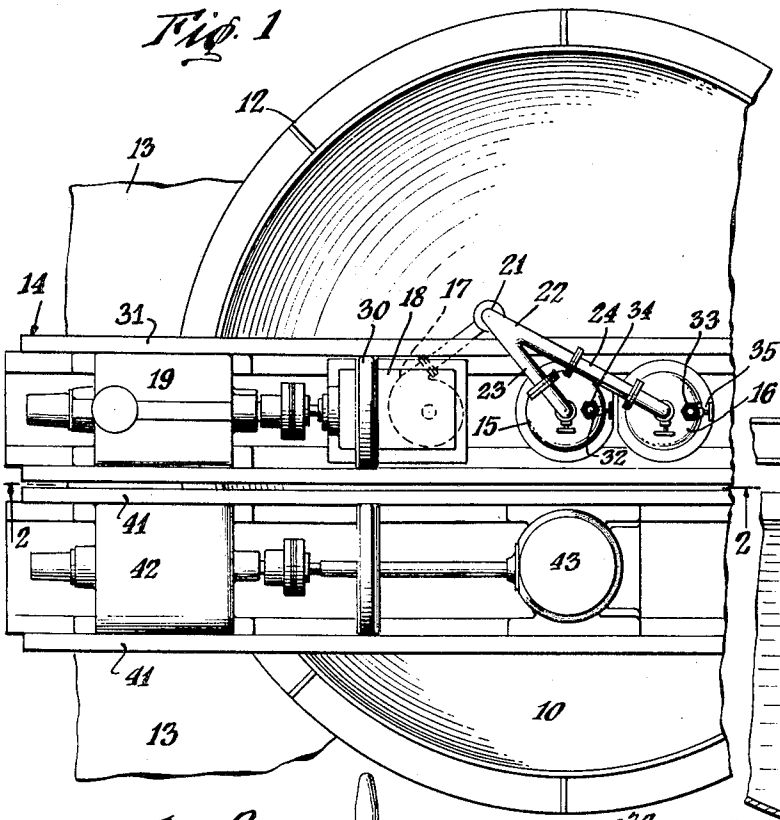


Fig. 3

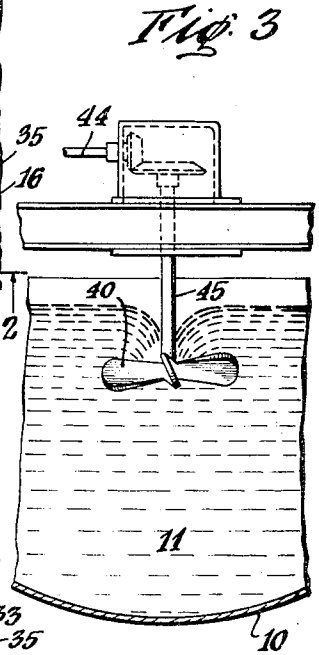
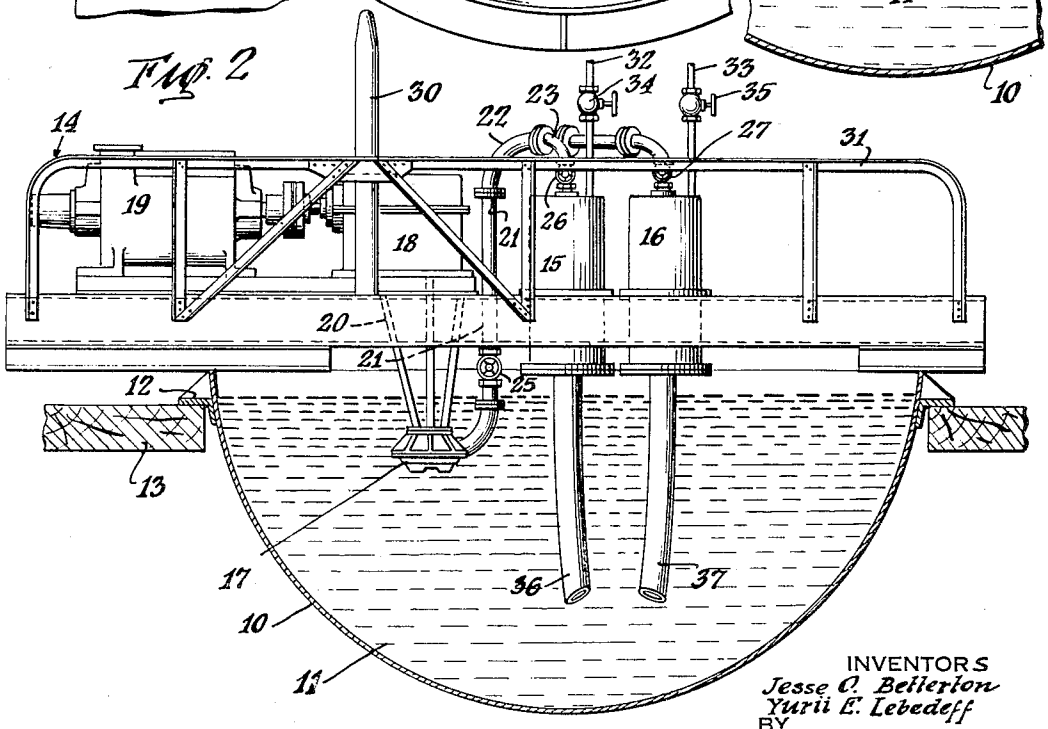


Fig. 2



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APPARATUS FOR TREATING METALS

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9 Claims. (Cl. 266—34)

This invention relates to an apparatus for treating metals, and more particularly to an apparatus for the removal of zinc from lead, such as zinc bearing lead, resulting from the desilverization practice in lead refining. The invention provides for the removal of the zinc as a slag and for the processing of the slag for the production of a valuable high zinc end product substantially free from lead.

The apparatus is suitable for use in removing a portion of the zinc from the lead bath by means of chlorine gas and removing a further portion by means of an oxidizing agent, such as air, steam or water, and combining the portions so removed to produce a zinc oxychloride slag having a controllable amount of chlorine present therein and by deleading the oxychloride slag to produce a zinc product which can be readily processed for the production of commercial zinc oxide. In a preferred use of the apparatus, the above process is so carried out that the various by-products are utilized in a cyclic manner and the final products are removed from the lead in a commercially usable form.

The invention also consists in certain new and original features of construction and combinations of parts hereinafter set forth and claimed.

Although the novel features which are believed to be characteristic of this invention will be particularly pointed out in the claims appended hereto, the invention itself, as to its objects and advantages, and the manner in which it may be carried out, may be better understood by referring to the following description taken in connection with the accompanying drawing forming a part thereof, in which

Fig. 1 is a broken plan view of one form of apparatus by which the present process may be carried out;

Fig. 2 is a section taken on the line 2—2 of Fig. 1 showing the dezincing chambers; and

Fig. 3 is a broken elevation of the stirring device.

Like reference characters denote like parts in the several figures of the drawing.

In the following description and in the claims, various details will be identified by specific names for convenience but they are intended to be as generic in their application as the art will permit.

Referring to the drawing more in detail the apparatus is shown as comprising a kettle 10 which is adapted to contain a bath 11 of molten lead. The kettle 10 is provided with a rim 12 which rests upon a supporting member 13, such as a floor, by which the kettle is held in operating position with respect to suitable heating devices not shown.

Resting upon the rim of kettle 10 is a framework 14 comprising longitudinal members which support a pair of chambers 15 and 16, pump 17, gear box 18 and driving motor 19. Pump 17 is suspended below framework 14 as by struts 20 and is adapted to be immersed in bath 11 whereby material from said bath is discharged through pipe 21 into chambers 15 and 16. Said pipe 21 is provided with a forked section 22, the two branches 23—24 of which communicate through the top of chambers 15 and 16 respectively and are adapted to apply molten metal thereto. Valve 25 may be included in pipe 21 in a position near pump 17 so that the flow of metal can be prevented when the pump is first placed in position and the operation is begun. This permits the pump to be brought up to full operating speed before any metal is discharged into chambers 15 and 16. Valves 26 and 27 are located in branches 23—24 respectively of forked member 22 to permit regulation of the relative quantities of metal applied to the two chambers. Pump 17 is driven by motor 19 through suitable gears (not shown) which are enclosed in gear box 18. Bracket 30 may be secured to the assembly in a position to receive a lifting device and permit the entire assembly to be removed from the kettle. Rim 31 may also be secured to framework 14 for strengthening purposes and to provide a guard rail for the operator.

Suitable inlet pipes 32 and 33 are associated with chambers 15 and 16 and are provided with valves 34 and 35 respectively. These pipes serve to admit the reagent in controllable quantities to the reaction chambers wherein it contacts with the molten metal from pipes 23 and 24. Said chambers are also provided with discharge pipes 36 and 37 respectively which extend from the bottom of the chambers into the bath of metal and are preferably inclined toward each other whereby mixing of the products of reaction from the two chambers is obtained.

A separate stirring device comprising an impeller 40 and suitable driving means is mounted on a separate framework comprising longitudinal means 41 which are also supported across the rim of the kettle. Said framework carries driving motor 42 and gear box 43 containing a suitable reduction gear by which the impeller 40 is rotated. Shafts 44 and 45 connect the gears with the driving motor and impeller respectively. The impeller is designed so that upon rotation thereof at a predetermined speed a vortex is produced

in the metal bath by means of which the material resting upon the surface of said bath is drawn below said surface and a thorough mixing of the various portions of the bath is obtained.

The process as applied to the dezincing of lead may be carried out by pumping lead from the Parkes desilverization process into kettle 10 at a temperature of 750° F. to 800° F. Zinc oxychloride slag from a preceding operation is then added to the dezincing kettle together with a small percentage (by weight) of commercial sodium borate, borax and/or sodium chloride. The latter materials operate as fluxes and serve to increase the fluidity of the slag whereby the reactions are more efficiently carried out.

The bath and slag are then mixed by starting the mixing apparatus including impeller 40 which is operated to produce a good vortex. This mixing may be carried out, for example, for some 30 minutes and serves to bring the oxychloride slag into intimate contact with the bath whereby a considerable portion of the lead held mechanically is removed and also the lead resulting from the reduction of oxidized lead in the slag by reaction with the zinc present in the said bath and both are thus removed from the slag by entering the said metal bath. The slag may then be removed from the surface of the bath as by skimming or tapping and treated for further deleading in a manner to be hereinafter described.

After the slag has been removed the dezincing apparatus is then applied to the bath and a supply of reagent, such as chlorine gas, is connected to one of the inlet pipes, for example, pipe 32 and the other of said pipes 33 is connected to a source of oxidizing agent, such as compressed air.

Pump 17 is then started and brought up to operating speed, after which, valves 25, 26 and 27 are opened and the molten lead supplied to the two chambers 15 and 16. Valve 25 is preferably kept closed until the pump has been brought up to operating speed so that molten metal is not applied through the pipes or to the reaction chambers until sufficient quantities thereof can be circulated to prevent the apparatus from freezing. Thereafter, the relative supply of the metal to the two chambers is controlled by suitable regulation of valves 26 and 27.

After the circulation has been established, the oxidizing agent, such as compressed air, is admitted to chamber 16 by suitable regulation of valve 35 and serves to react with the metal flowing through the chamber and to preferentially combine with the zinc to form zinc oxide. While the reaction with the zinc is exothermic the rapidity of the reaction is not sufficient under the above conditions to generate sufficient heat to balance the heat lost from the reaction chamber and from the metal bath. The process is accordingly carried on as above described until the temperature of the bath decreases to approximately 750° F. Thereafter, chlorine gas is admitted to chamber 15 by suitable regulation of valve 34 to react with the metal passing therethrough and form zinc chloride and to produce sufficient heat to maintain the temperature of the bath substantially constant. By balancing the amount of reaction taking place in the two chambers, as by means of valves 26 and 27 and valves 34 and 35, it is possible to conserve the heat which is produced so as to maintain the temperature of the bath substantially constant with the use of a minimum amount of fuel.

During the above reaction a quantity of zinc chloride slag resulting from the removal of the final zinc from previous operations is added to the bath and serves as an additional flux to first remove the oxidized coatings from the metallic portions of the dross, thus allowing them to coalesce and settle back into the bath and second to render the resulting oxychloride slag fluid at the temperatures employed in the process. At convenient intervals the mixing machine is also operated to cause an intimate mixture of the zinc oxide and zinc chloride which is obtained from the two chambers whereby a zinc oxychloride slag is produced. Borax and/or sodium chloride may also be added at this stage of the operation to increase the fluidity of the slag and to produce a fluid, uniform oxychloride slag of zinc which contains some lead.

The operation above described may be continued until the zinc content of the bath is reduced to comparatively low limits, as for example, .10% to .15%. It is usually undesirable to carry the reaction below this point inasmuch as the selective oxidation of zinc depends upon the relative quantities of zinc and lead and the slag would become unduly contaminated with lead oxide if the reaction were further continued. Accordingly, the operation is stopped and the oxychloride slag, which contains some lead oxide in solution, is removed as by skimming or tapping and is applied to subsequent baths for deleading, as above described.

After removing the oxychloride slag, circulation of the metal is continued through reaction chamber 15 and the application of chlorine thereto is continued until the zinc is removed from the lead to the desired low percentage. The zinc chloride slag, containing small amounts of lead chloride which results from this operation, is then skimmed from the kettle and used as a flux in the dezincing of further quantities of lead bullion in accordance with the above process. The remaining lead is substantially free from zinc and is suitable for commercial use.

The final deleading of the zinc oxychloride slag referred to above may be accomplished by melting the same over a bath of metallic zinc or a lead-zinc alloy in the presence of sufficient sodium chloride and/or borax to cause the slag to remain fluid at the temperature involved. The operation is preferably carried out by melting the slag and zinc or lead-zinc alloy in a suitable kettle, placing the suitable mixing device therein under a heat insulating cover of conventional type and mixing at a temperature of approximately 850° F. The borax may, if desired, be added to the vortex produced by the mixing machine and the mixing continued until a complete reaction between the slag and the zinc of the bath has been obtained. Thereafter, the bath is allowed to settle and the slag may be skimmed or tapped therefrom substantially free from lead. By the use of the lead-zinc or metallic zinc bath the lead in the oxychloride slag will be reduced to percentages of .8% to 1.9%.

The oxychloride slags are sensitive to slight changes in temperature and are easily chilled with resultant loss of fluidity. For this reason the temperatures in the deleading kettle must be accurately controlled and the heat insulating cover is of particular importance. Temperatures in excess of 900° F. are objectionable due to the formation of a zinc iron alloy, the iron being derived from the kettle.

In accordance with the present process the necessity for such high temperatures is avoided

by the use of a suitable amount of flux which increases the fluidity of the slag at the temperatures above specified. The fluidity is of considerable importance inasmuch as the lead present in the slag, as a result of reduction by the zinc of the bath employed, is in the nature of prills which must be allowed to coalesce and settle out of the final slag.

The cover for the deleading kettle may be handled by a suitable overhead crane. In suitable position the circulating pump is in the bath of molten slag below the cover with the motor in the outside atmosphere above the cover.

The total additions of borax comprises approximately 2½% of the weight of the final deleaded oxychloride slag and the sodium chloride additions may amount to 5% to 10% thereof.

By the above process oxychloride slags may be produced which vary in chlorine content from normal zinc chloride up to oxychloride slags containing 75% of the zinc as ZnO and 25% as $ZnCl_2$. It is obvious that chlorine gas will only be required in chemically equivalent amounts to the $ZnCl_2$ existing in the final slag.

The process is made possible by reason of the fact that zinc is preferentially oxidized by either air, steam or water at low temperatuers in the range of 630° F. to 750° F. Obviously, the reagents may be introduced into the bath in various ways such, for example, as through the reaction cylinder of the dezincing machine or through outlets located under the blades of the mixing machine, or in any other manner, thus allowing a thorough dissemination of these reagents through the molten bath.

A dry dross is produced, but due to the low temperatures most of the lead in the dross is present as metallic particles and all of the zinc as fine powdered zinc oxide. This condition permits the process to be treated with a flux, such as the zinc chloride slag above mentioned, which is capable of removing the oxidized coatings from the surfaces of the lead prills and allowing them to coalesce and settle out of the slag.

While certain novel features of the invention have been disclosed and are pointed out in the annexed claims, it will be understood that various omissions, substitutions and changes may be made by those skilled in the art without departing from the spirit of the invention.

What is claimed is:

1. An apparatus for treating metals comprising a plurality of reaction chambers, means for applying molten metal to said chambers and for controlling the relative quantities of said metal applied to each of said chambers, means for independently introducing reagents into each of said chambers and means for discharging the products of reaction together with the unreacted metal from said chambers.

2. An apparatus for treating metals comprising a plurality of closed reaction chambers adapted to contain gaseous reagents, means for passing the metal to be reacted therewith in a substantially continuous flow through all of said chambers and means for controlling the relative quantities of metal applied to each of said chambers.

3. An apparatus for dezincing lead comprising a kettle adapted to contain molten lead, a plurality of closed reaction chambers mounted above said kettle, means for applying different gaseous reagents to said chambers, a pump suspended in the bath of molten metal contained in said kettle, means associated with said pump for applying a continuous stream of molten lead to each of said chambers whereby said lead reacts with the gaseous reagents contained therein and means for discharging the products of reaction in said chambers comprising discharge pipes depending from said chambers and extending in the bath of molten metal a substantial distance below the surface thereof.

4. An apparatus for dezincing lead comprising a kettle adapted to contain molten lead, a plurality of closed reaction chambers mounted above said kettle, means for applying different gaseous reagents to said chambers, a pump suspended in the bath of molten metal contained in said kettle, means associated with said pump for applying a continuous stream of molten lead to each of said chambers whereby said lead reacts with the gaseous reagents contained therein and means for discharging the products of reaction in said chambers comprising discharge pipes depending from said chambers and extending in the bath of molten metal a substantial distance below the surface thereof, said pipes being inclined toward each other whereby mixing of the products of reaction in the two chambers is facilitated.

5. In dezincing lead the combination comprising a kettle adapted to contain a bath of molten lead, a pair of reaction chambers mounted above said kettle, one of said chambers being operatively associated with a source of chlorine gas and the other of said chambers being operatively associated with a source of compressed air, means for continuously withdrawing portions from said molten bath and causing one part of the portions so withdrawn to pass through one of said chambers while causing the second part of the portions so withdrawn to pass through the other of said chambers and means for discharging the products of reaction from said chambers into said bath at a point below the surface thereof.

6. An apparatus for treating molten metals comprising a kettle adapted to receive a bath of said metals, a framework adapted to rest upon the rim of said kettle, said framework carrying a pair of reaction chambers, a pump, a driving motor and a driving train interconnecting said motor and said pump, said pump being positioned to extend below the surface of the molten bath when the framework is resting upon said rim, pipes interconnecting said pump and said chambers and adapted to receive molten metal from said bath and apply the same to said chambers in a position to pass substantially through the entire length thereof, inlet means associated with each of asid chambers for applying a gaseous reagent thereto, each of said chambers having a downwardly extending discharge pipe incorporated therewith and adapted to extend below the surface of the bath when said framework is positioned on the rim of said kettle.

7. An apparatus for treating molten metals comprising a kettle adapted to receive a bath of said metals, a framework adapted to rest upon the rim of said kettle, said framework carrying a pair of reaction chambers, a pump, a driving motor and a driving train interconnecting said motor and said pump, said pump being positioned to extend below the surface of the molten bath when the framework is resting upon said rim, pipes interconnecting said pump and said chambers and adapted to receive molten metal from said bath and apply the same to said chambers in a position to pass substantially through the entire length thereof, valves associated with said

pipes for controlling the relative quantities of metal applied to the respective chambers, inlet means associated with each of said chambers for applying a gaseous reagent thereto, each of said chambers having a downwardly extending discharge pipe incorporated therewith and adapted to extend below the surface of the bath when said framework is positioned on the rim of said kettle.

8. An apparatus for treating molten metals comprising a kettle adapted to receive a bath of said metals, a framework adapted to rest upon the rim of said kettle, said framework carrying a pair of reaction chambers, a pump, a driving motor and a driving train interconnecting said motor and said pump, said pump being positioned to extend below the surface of the molten bath when the framework is resting upon said rim, pipes interconnecting said pump and said chambers and adapted to receive molten metal from said bath and apply the same to said chambers in a position to pass substantially through the entire length thereof, inlet means associated with each of said chambers for applying a gaseous reagent thereto, and discharge means associated with each of said chambers and adapted to extend below the surface of the bath when said framework is positioned on the rim of said kettle.

9. In combination, a source of metal, a plurality of reaction chambers, means for supplying metal from the source thereof to each of said chambers, means for controlling the flow of metal into each of said chambers, means for independently introducing reagents into said chambers and means for returning both unreacted metal and products of reaction to the source of metal.

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