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APPARATUS FOR REFINING ZINCIFEROUS LEAD

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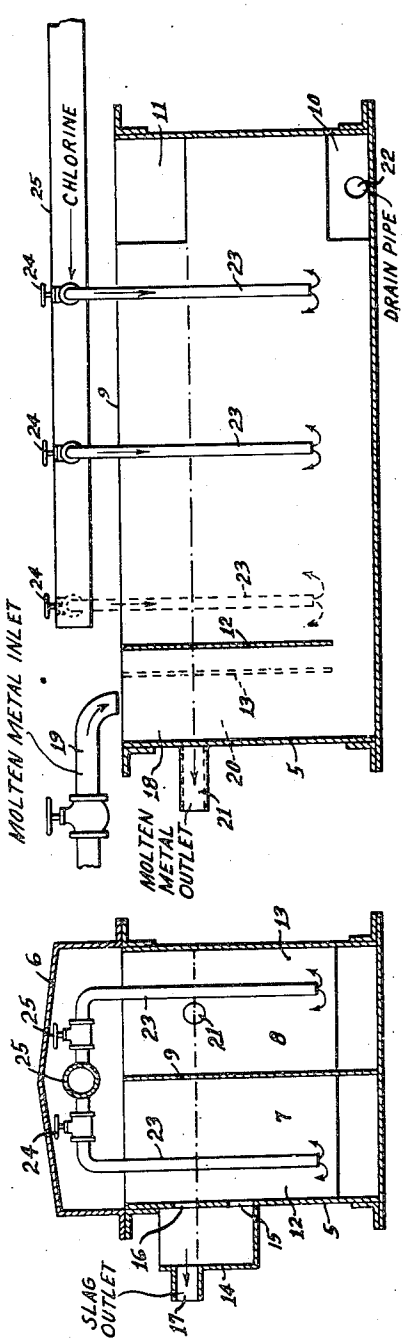


FIG. 2

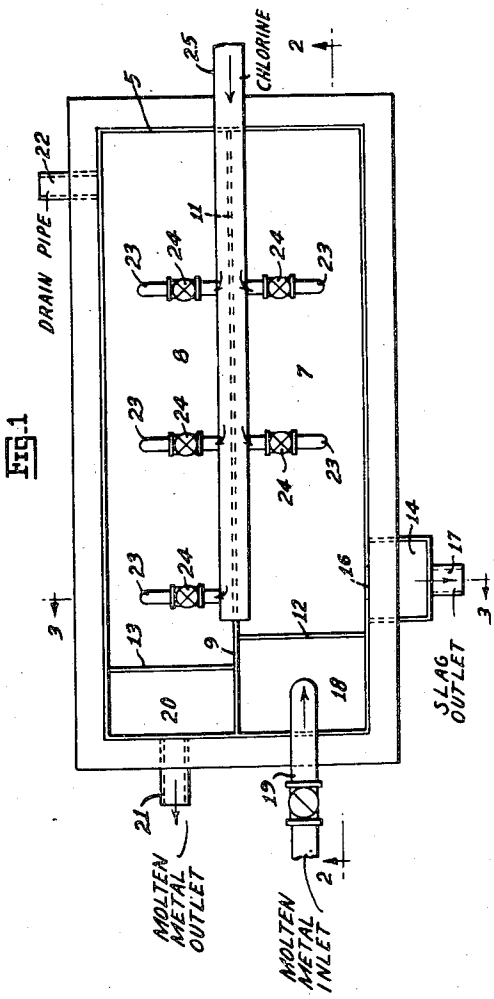


FIG. 1

FIG. 3

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APPARATUS FOR REFINING ZINCIFEROUS LEAD

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4 Claims. (Cl. 266—37)

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This invention relates to apparatus suitable for refining of zinciferous lead, and has for its object the provision of certain improvements in apparatus suitable for refining zinciferous lead with chlorine. This application is a division of my copending application Serial No. 515,231, filed December 22, 1943, now Patent No. 2,411,940.

In desilverizing argentiferous lead by the Parkes process, the desilverized lead contains upwards to 0.55% zinc. This zinc must be removed to render the lead salable. While several methods are known and practiced for dezincing such zinciferous lead, the present invention is primarily concerned with the process in which the zinc is removed by the preferential action of chlorine on zinc when the chlorine is brought into contact with a mixture of lead and zinc in the molten state. As is well known in the art, chlorine reacts preferentially with zinc as long as any zinc is present in the molten metal, in accordance with the following reaction:

$$Zn+Cl_2 \rightarrow ZnCl_2$$

If and when the zinc has been practically all removed and chlorine remains in contact with the dezinced lead, the following reaction will take place:

$$Pb+Cl_2 \rightarrow PbCl_2$$

While this reaction and the resultant formation of lead chloride is not desirable, in practice it is permitted to take place in order to completely dezinc the lead at a satisfactory rate, and consequently some lead chloride is produced with and at the same time as the final zinc chloride is produced. This formation of lead chloride gives rise to lead losses of considerable magnitude, and further contaminates the otherwise pure zinc chloride product, so that the contaminated product must be purified before it can be sold as zinc chloride.

The processes and apparatus heretofore commonly used for dezincing zinciferous lead produce a zinc chloride slag or product contaminated with lead chloride. Furthermore, no entirely satisfactory method is available for separating or removing the slag of mixed zinc and lead chlorides from the surface of the molten refined lead except by laborious skimming or ladling. This method of handling the slag is costly, and taken with the cost of the subsequent purification of the slag, so increases the cost of the dezincing treatment as to frequently render it of doubtful economy.

The present invention aims to overcome the

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foregoing objectionable and costly features in the heretofore commonly practiced methods of dezincing zinciferous lead by the action of chlorine. I have discovered that it is possible to refine the zinciferous lead with chlorine, purify the resulting zinc chloride slag, and separate the purified zinc chloride from the refined lead in substantially one operation. Based on this discovery, the present invention provides improved apparatus suitable for use in refining zinciferous lead by the action of chlorine. In accordance with the invention, apparatus is provided so that chlorine may be introduced at spaced intervals along the length of an elongated bath of molten zinciferous lead of progressively decreasing zinc content and thereby there is formed on the surface of the molten metal a molten slag of mixed zinc and lead chlorides of progressively decreasing lead chloride content in the direction of the progressively increasing zinc content of the molten metal bath. Provision is made so that molten lead (preferably substantially zinc-free) may be withdrawn from the molten metal bath approximate the end of its minimum zinc content, and so that zinc chloride (preferably substantially free from lead chloride) may be withdrawn from the bath approximate its other end. The apparatus is arranged so that the operation may be carried out in a continuous manner by continuously supplying molten zinciferous lead to that end of the elongated bath of maximum zinc content, continuously withdrawing molten lead (preferably substantially zinc-free) from the other end of the bath, and continuously withdrawing molten zinc chloride (preferably substantially free of lead chloride) from the bath approximate the supply of zinciferous lead thereto and at a level above the level of the bath.

The apparatus of the invention is particularly adapted for dezincing zinciferous lead with chlorine, but is also adapted for various other treatments of molten metals. Generally speaking, the apparatus comprises a container having a novel arrangement of partitions and baffles inducing and permitting countercurrent movement of a bath of molten metal and an overlying layer of molten slag, with means for supplying and withdrawing metal from the molten metal bath and for withdrawing slag from the overlying layer thereof.

The invention will be better understood from the following description taken in conjunction with the accompanying drawings in which,

Fig. 1 is a top plan of the apparatus of the invention,

Fig. 2 is a longitudinal sectional elevation on the section line 2—2 of Fig. 1, and

Fig. 3 is a transverse sectional elevation on the section line 3—3 of Fig. 1.

As illustrated in the drawings, the apparatus comprises a rectangular container or tank 5 open at the top, but covered, in operation, with a suitable hood 6 (Fig. 3). The container is divided into two compartments 7 and 8 by a centrally positioned longitudinal partition 9. The height of the partition 9 corresponds substantially with the depth of the container 5. One end of the partition fits snugly against the adjacent end of the container and the other end of the partition is provided with two openings 10 and 11 at different levels. The opening 10 is at or near the bottom of the container, while the opening 11 is near the top of the container, and the two openings thus permit communication between the two compartments 7 and 8 near the bottom and top thereof, respectively. The two communicating compartments 7 and 8 form an elongated treatment zone having an effective length about twice the length of the container.

The compartment 7 of the container has a transverse baffle 12 near the end opposite the openings 10 and 11 of the partition 9. The baffle 12 depends from the top of the container to within a short distance of the bottom, thereby providing a space beneath the baffle for the flow of molten metal. The compartment 8 has, at the same end, a similar transverse and depending baffle 13, although the baffle 13 is somewhat nearer the end of the container than is the baffle 12.

An external (slag-discharge) well 14 is provided adjacent the compartment 7 and slightly further from the end of the container than the baffle 12. Communication between the compartment 7 and the well 14 is provided by two openings 15 and 16 at different levels in the side wall of the container (Fig. 3). The well 14 has a discharge outlet 17 at about the same level as the upper opening 16.

The baffle 12 forms, in effect, a charging well 18 communicating (beneath the baffle 12) with the compartment 7. Molten metal is supplied to the charging well 18 from a delivery pipe 19. The baffle 13 forms, in effect, a discharging well 20 at the same end of the container, in communication (beneath the baffle 13) with the compartment 8. The discharge well 20 has an outlet 21 at approximately the same level as the lower edge of the opening 11, and slightly lower than the upper opening 16 into the slag-discharge well 14. An outlet 22 communicating with the bottom of the compartment 8 is provided for emptying the container.

Pipes 23 having valves 24 depend from a header 25 into the compartments 7 and 8 at spaced intervals in the length thereof. These pipes serve to supply chlorine to the molten lead, and it will be noted that a substantial distance separates the (slag-discharge) well 14 and the nearest chlorine delivery pipe 23.

In employing the apparatus illustrated in the drawings for dezincing lead with chlorine, a molten zinciferous lead is delivered from the pipe 19 to the charging well 18 communicating with the compartment 7. The molten metal may be derived from any suitable source, such as a furnace, kettle or the like, and may be supplied to the delivery pipe 19 in any appropriate manner. The molten metal flows under the baffle 12, through compartment 7, through opening 10 into compartment 8, under baffle 13 into the discharging well 20 and rises to the level of the overflow or outlet pipe 21. The overflow pipe 21 controls the level of the bath of molten lead in compartments 7 and 8, and the lower edge of the opening 11 (adjustable if desired) is at approximately the level of the molten lead bath. Molten metal is delivered to the charging well 18 in a continuous stream, and, after filling the container to the level controlled by the overflow pipe 21, is conducted back to a molten metal reservoir.

Chlorine gas is introduced into the molten metal bath through the pipes 23, the rate of chlorine delivery of each pipe being capable of individual adjustment through the valves 24. With molten metal flowing or circulating through the container, chlorine in controlled amount is allowed to pass through the pipes 23 into the moving elongated stream or bath of molten metal. The chlorine reacts with the zinc and some lead to form a molten slag of mixed zinc and lead chlorides which rises to the surface and floats on the molten metal. Baffle 13 traps the molten slag on the metal discharge end of the container, and in order to leave the container the slag must rise to the level of the opening 16 of the slag-discharge well 14. Thus, as slag is continuously formed and builds up to a level slightly higher than the opening 16, a continuous flow of slag is maintained from compartment 8, through opening 11 (the lower edge of which is approximately coincident with the molten metal level), into compartment 7, and thence to the slag-discharge well 14. The flow of the molten slag is countercurrent to the flow of the molten metal upon which it floats.

By appropriate control of the rate of impure metal delivery (through pipe 19), or of the chlorine delivery rate, or both, the metal becomes progressively lower in zinc content in the direction of its flow until it reaches the metal discharge well 20 as dezinced metal. In the final stages of dezincing, that is towards the end of the compartment 8 adjacent the metal discharge well 20, some lead chloride will be formed, and, mixed with zinc chloride, will flow towards the slag discharge well 14. In the course of its flow, and more particularly towards the end of the compartment 7 adjacent the charging well 18 where the zinc content of the molten metal is highest, the lead chloride reacts with zinc to form zinc chloride and lead, in accordance with the following reaction:

$$PbCl_2+Zn \rightarrow ZnCl_2+Pb$$

Thus, the lead chloride content of the molten slag decreases in the direction of its flow, until approximate the slag discharge well 14 the slag is substantially free of lead chloride. In order to avoid any formation of lead chloride near the slag discharge well, no chlorine is introduced into the molten metal for some distance from the well in the direction of the molten metal flow. The relatively high zinc content of the molten metal in the vicinity of the slag discharge well insures the removal of lead chloride from the slag before it flows into the slag discharge well. From the slag discharge well 14 to the metal discharge well 20, the lead chloride content of the floating slag progressively increases.

The zinc chloride slag, substantially free of lead

chloride, flows by gravity from the compartment 7, through the opening 16 into the slag discharge well 14. The relatively quiescent condition of the molten metal and slag in this well permits any metal entrained in the slag to settle out, and to return to the compartment 7 through the lower opening 15. Since the opening 16 is at a higher level than the metal overflow pipe 21, only slag can be discharged through the opening 16. The molten and purified zinc chloride (slag) flows by gravity through the outlet 17 into any suitable container. It may be barreled for shipment without further treatment, or it may be discharged into water, dissolved and recovered as zinc chloride solution.

The apparatus of the invention permits the complete dezincing of zinciferous lead and the production and recovery of substantially pure zinc chloride in a single operation. The rate of passage of the molten metal through the container depends upon the zinc content of the metal. While I now prefer to effect the complete dezincing of the lead with one passage through the container, it is to be understood that the molten metal may be recirculated through one container until completely dezinced, or passed consecutively through two or more containers in series. The invention results in higher and more satisfactory metal recovery, reduces labor requirements, and saves wear and tear on unnecessary equipment.

While I have particularly described the apparatus of the invention in connection with the method described and claimed in my aforementioned copending application, the apparatus may be used with advantage in various other treatments of molten metal in an elongated treatment zone, and particularly where countercurrent movement through the elongated zone of molten metal and floating slag or the like can be advantageously utilized. The arrangement of partition and baffles provides within the container an effective treatment zone about twice the actual length of the container. The openings or ports permitting flow of molten metal between the wells and compartments are positioned below the normal molten metal level, while the openings or ports through which slag floating on the surface of the molten metal may flow are positioned at or slightly above the molten metal level. In this way, molten metal and slag are effectively separated, and can be separately treated, while moving or flowing in relatively opposite directions with the advantages incident to the treatment of countercurrently moving reacting bodies or materials.

I claim:

1. An apparatus for treating molten metal comprising a container, a longitudinal partition dividing the container into two adjacent compartments and having approximate one end of the container two openings at different levels permitting communication between said two compartments, a molten metal charging well communicating with one of said compartments and a molten metal discharging well communicating with the adjacent compartment, each of said wells being positioned at the end of the container opposite the end where the two compartments communicate as aforesaid and the communication between each well and its compartment being beneath the upper of said two openings in the partition, an outlet for said molten metal discharging well at approximately the level of the upper opening in said partition, and a slag-discharge well approximate said charging well and having an opening permitting communication between the slag discharge well and the compartment in communication with said charging well, the opening in the slag-discharge well being at a higher level than said outlet.

2. An apparatus for treating molten metal comprising a container, a longitudinal partition dividing the container into two adjacent compartments and having approximate one end of the container two openings at different levels permitting communication between said two compartments, the upper opening in said partition being at approximately a predetermined level for molten metal in the container and the lower opening being near the bottom of the container, a molten metal charging well communicating with one of said compartments and a molten metal discharging well communicating with the adjacent compartment, each of said wells being positioned at the end of the container opposite the end where the two compartments communicate as aforesaid and the only communication between each well and its compartment being near the bottom of the compartment, an outlet for said molten metal discharging well at approximately the level of the upper opening in said partition, whereby said outlet establishes the aforesaid predetermined level for the molten metal, a slag-discharge well approximate said molten metal charging well and having two openings at different levels permitting communication between the slag-discharge well and the compartment in communication therewith, the upper opening in the slag-discharge well being at a higher level than said molten metal outlet and the lower opening being beneath the normal molten metal level in the container, and an outlet for said slag-discharge well at approximately the level of the upper opening in that well.

3. An apparatus for dezincing zinciferous lead comprising a container, a longitudinal partition dividing the container into two adjacent compartments, said partition having near one end thereof two ports providing communication between the two compartments (1) at approximately a predetermined level for molten lead in the container and (2) near the bottom of the container, a charging well for delivering molten zinciferous lead to one compartment at the end opposite the end where the two compartments communicate and wholly below said predetermined level, a discharging well for withdrawing molten dezinced lead from the other compartment at the same end of the container as said molten metal charging well and wholly below said predetermined level, an outlet for said discharging well at approximately the level of the upper of said two ports in the partition, whereby said outlet establishes the aforesaid predetermined level for molten lead, a slag-discharge well positioned near said molten metal charging well for withdrawing molten slag from the container at a level higher than said predetermined level, and pipes for introducing chlorine into each compartment at spaced intervals along the length thereof except in the vicinity of said slag withdrawing means, said pipes being arranged to deliver the chlorine at a point well below said predetermined level.

4. An apparatus for dezincing zinciferous lead comprising a container, a longitudinal partition dividing the container into two adjacent compartments and having near one end thereof two

ports at different levels permitting communication between the two compartments, the upper port in said partition being at approximately a predetermined level for molten lead in the container and the lower port being near the bottom of the container, a well communicating with one of said compartments for delivering molten zinciferous lead to that compartment and a second well communicating with the adjacent compartment for collecting molten dezinced lead, each of said wells being positioned at the end of the container opposite the end where the two compartments communicate and the only communication between each well and its compartment being near the bottom of the compartment, said well for collecting molten dezinced lead having an outlet at approximately the level of the upper port in said partition, whereby said outlet establishes the aforesaid predetermined level for molten lead, a slag-discharge well approximate said well for the delivery of molten zinciferous lead and having two ports at different levels permitting communication between the slag-discharge well and the compartment in communication therewith, the upper port in the slag-discharge well being at a

higher level than said outlet and the lower port being beneath said predetermined level in the container, an outlet for said slag-discharge well at approximately the level of the upper port in that well, and means for introducing chlorine into each compartment at spaced intervals along the length thereof but not in the vicinity of said slag-discharge well, said means being arranged to deliver the chlorine at a point well below said predetermined level.

WILLIAM WALLACE SHROPSHIRE.

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