April 24, 1951 G. H. SITTNER 2,550,502

APPARATUS FOR PURIFYING METALS

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Fig. 2.

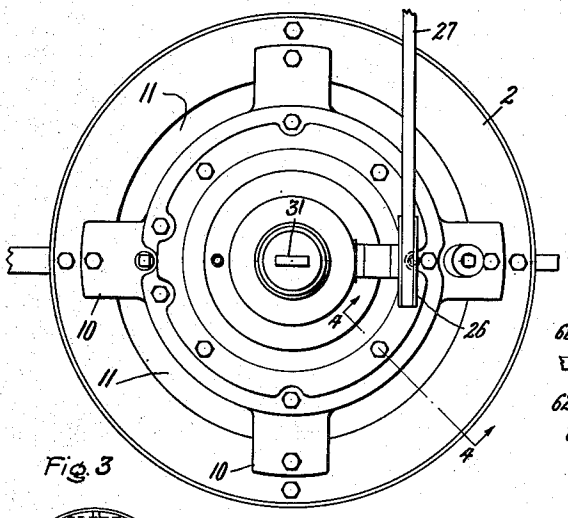


Fig. 3

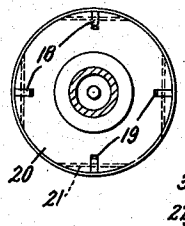


Fig. 1.

Fig. 4.

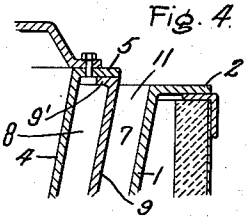


Fig. 6.

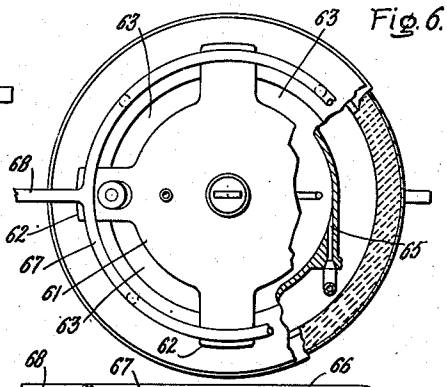
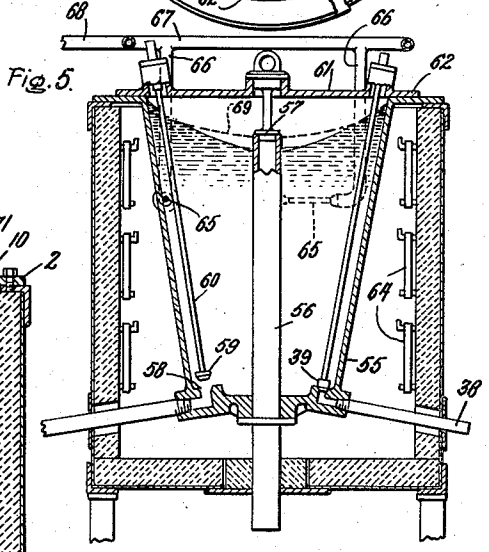


Fig. 5.



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Fig. 8.

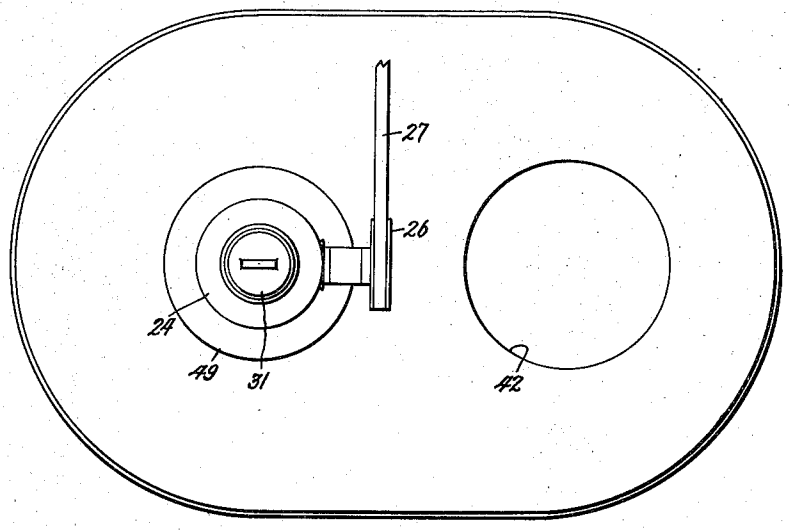
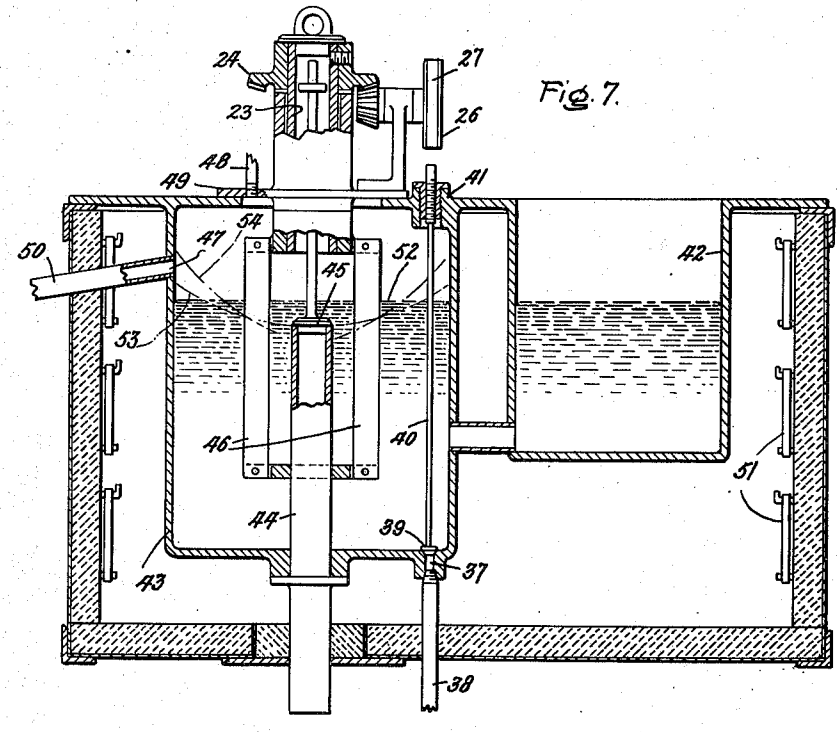


Fig. 7.



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APPARATUS FOR PURIFYING METALS

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2 Claims. (Cl. 266—37)

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My invention relates to apparatus for melting and purifying metals. More particularly the invention deals with apparatus for the melting and separation of impurities from lead while in the molten state.

In the manufacture of electric cables, molten lead is fed from a lead melting pot to the cylinder of a lead press and is extruded therefrom onto the insulated cable to serve as a lead sheath which is impervious and prevents the admission of air or water to the cable or the loss of insulating oils. The lead melting pots now in use do not supply lead to the lead cylinder free from deleterious admixtures such as slag inclusions, oxides and other impurities. Nevertheless, it has long been a desire of the cable manufacturing industry to obtain a pot which would perform this operation as it has been found that cables covered by pure lead are far superior in service to those sheathed in lead containing impurities.

It is, therefore, an object of my invention to provide a novel apparatus for melting and separating or cleaning impurities from molten lead prior to discharge to cable extrusion presses.

It is another object of my invention to provide apparatus for discharging impurities from lead melting and cleaning apparatus while in operation without shutting down the apparatus.

It is a further object of my invention to provide apparatus for the separation of solid impurities from molten lead and permit simultaneous or separate discharge of purified molten lead and the impurities from the apparatus.

In accordance with my invention I rotate a molten mass of lead or metal containing solid impurities to centrifugally force the heavier and purified portion of the mass from the lighter impurities which I discharge from the surface and center of the rotating mass while the purified portion is discharged from the periphery thereof.

My invention will be better understood from the following description when taken in connection with the accompanying drawings and the scope of my invention will be pointed out in the appended claims. In the drawing, Fig. 1 is an elevation view partly in section, of a metal melting and cleaning apparatus of my invention illustrating purified metal being discharged therefrom; Fig. 2 is a top plan view of the apparatus shown in Fig. 1; Fig. 3 is a section taken on the line 3—3 of Fig. 1; Fig. 4 is an enlarged partial section taken on the line 4—4 of Fig. 2; Fig. 5 is an elevation view partly in section illustrating a modification of my invention; Fig. 6 is a top plan view partly in section of the apparatus shown by Fig. 5, Fig. 7 is an elevation view partly in section illustrating still another modification of my invention, and Fig. 8 is a top plan view of the Fig. 7 modification.

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Referring now to Figures 1, 2, 3 and 4 of the drawings, I have shown a cone-shaped melting pot or chamber 1 having an annular flange 2 projecting outwardly from the top edge thereof by which the weight of the pot is transmitted by columns, not shown, to a supporting structure 3. Another cone-shaped pot or chamber 4, which I call a centrifugal chamber and which also has an annular flange 5 is mounted concentrically within the melting pot 1 and the interior of the chamber is interconnected with the interior of pot 1 by apertures or openings 6 in the wall of the centrifugal pot adjacent its base. The annular space between the two pots is partially divided into two concentric annular spaces 7 and 8 by a cone-shaped baffle 9 integral with and projecting downwardly from an annular ring 9' mounted by means of lugs 10, integral therewith, on flange 2. The lugs 10 are bolted to flange 2 and the ring 9' is bolted to flange 5 of centrifugal pot 4 with a gasket, not shown, therebetween so that the inner annular space 8 is sealingly covered while the outer annular space 7 is partially uncovered, as indicated by the numeral 11, between the supporting lugs 10. Centrifugal chamber 4 is provided with an opening 12 in the wall thereof adjacent the top which is aligned with a passage 13 interconnecting opening 12 with an opening 14 in the wall of melting chamber 1. A pipe 15 leading to the lead press, not shown, is aligned with passage 13 and sealingly connected to the chamber 1. A valve 16, operable from the exterior of the apparatus, serves to close off the passage 13 if so desired. A tube 17 is axially mounted within the centrifugal chamber 4 and passes to the exterior through the base thereof and the base of chamber 1. The tube 17 is so positioned that the open end thereof within the centrifugal chamber is at an elevation above the bottom of opening 12 in the wall of the chamber. A rotor or agitator comprising four blades or paddles 18 is mounted for rotation within centrifugal chamber 4 and about axial tube 17. The lower ends of blades 18 are interconnected and the upper ends are supported in slots 19 of support plate 20 by pins 21. Plate 20 is in turn supported by cover 22, enclosing the top of centrifugal chamber 4, through drive tube 23 and bevel gear 24 affixed thereto. Bevel gear 25 meshing with gear 24 mounted on the same shaft

with a pulley 26 are also mounted on cover 22 and serve as a means for rotating agitator blades 18 from an external source through pulley belt 27. A cylindrical baffle 29 is mounted on agitator plate 20 and projects downwardly within chamber 4 to an elevation below opening 12 in the wall thereof. Drive tube 23 is provided rather than a solid drive shaft so as to permit external operation of valve 30 which is employed to seal off the open end of the tube 17. Cover 31 is provided to seal off the upper open end of tube 23 if so desired. An external source of low pressure inert gas such as nitrogen is connected to chamber 4 by means of pipe 32 screwed into a tapped opening in cover 22 while a higher pressure source of inert gas is connected to inner annular chamber 8 by means of pipe 33 screwed into a tapped opening in flange 5. The melting pot 1 is surrounded by heating means such as electrical heating elements 34 which are in turn enclosed from the exterior by insulation 35.

In purifying lead or any other metal according to my invention, the chambers are heated by electric heating elements 34 and pig lead containing slag and other solid impurities is dropped through openings 11 into the melting chamber 7. As the lead melts the molten mass rises in chambers 7 and 8 and in centrifugal chamber 4 through ports or openings 6 until it reaches roughly a level indicated by broken line 36 in all three chambers. During this part of the process both passage 13, the open end of axial tube 17, and the open end of drive tube 23 are respectively closed by valves 16, 30, and cover 31. In addition, to prevent oxidation of the high temperature molten lead in centrifugal chamber 4, inert gas at low pressure is being introduced therein through pipe 32. Then the mass of molten metal in chamber 4 is rotated by driving the rotor or agitation blades 18. This rotation centrifugally forces the heavier and pure metal to the peripheral area of the rotating mass away from the lighter solid impurities which, of course, remain at the center and float on the surface thereof. The mass is also cleared of gases by this action. At a predetermined time thereafter, inert gas at sufficiently high pressure is introduced into annular chamber 8 which raises the level of the metal in chambers 7 and 4. When the low point of the vortex surface in chamber 4 reaches an elevation equal to or slightly above the top of tube 17, as observed through drive tube 23 after removal of cover 31, control valve in pipe 33, not shown, is closed and valve 30 is raised which permits the solid impurities to be discharged axially out of the apparatus through impurities discharge tube 17. Then valve 16 is raised from its seat which allows purified molten metal to flow from the periphery of the mass through passage 13 and pipe 15 to the lead sheathing extrusion press. The baffle 29 which projects down into the molten mass acts as a skimmer if an excess of impurities is allowed to accumulate on top of the lead. When sufficient lead is removed from the centrifugal chamber the gas pressure in chamber 8 is reduced and the surface level rises in this chamber and lowers in centrifugal chamber 4 to a point below the lower edge of opening 12 through which a small amount of inert gas is allowed to exhaust to keep the reducing atmosphere at this point. Obviously, the flow of metal may be controlled by valve 16 as well as by the valve in gas pipe 33. It should be observed that the process is continuous in the sense that as the total quantity of the mass is reduced by being slowly drawn off through the passage 13 the mass may be continually made up by the addition of pig lead through the openings 11. Moreover, the process is further continuous in that the impurities may be discharged simultaneously as they are being separated from the purified mass without shutting down the apparatus. At the conclusion of operation the small quantity of molten lead which remains in the chambers below the lower edge of baffle 9 projecting from the ring 9' may be drained by gravity through opening 37 and pipe 38. Opening 37 is normally closed during operation, by valve 39 operable from the exterior by extension rod 40 which is threadedly supported in a boss 41 integral with one of the lugs 10. It is to be observed that I have employed gas pressure to control the surface level of the rotating mass and, merely as a desirable embodiment, I have shown the centrifugal chamber 4 as being cone-shaped with ports or openings 6 near the smallest diameter thereof since the impurities in the molten mass are thereby introduced into the centrifugal or separating chamber near the axis of the rotating mass from which they are eventually discharged after floating to the surface thereof. For uniformity of design and for compactness I have also shown the melting chamber 1 as being cone-shaped and concentric about the centrifugal chamber 4. However, my invention should not be limited to these particular features inasmuch as it will be clearly apparent to anyone familiar with the art that modifications of the particular embodiment illustrated may be employed without departing therefrom.

For example, Figure 7 illustrates a modification of my invention incorporating a separate cylindrical melting pot or chamber 42 interconnected with a cylindrical centrifugal pot or chamber 43 at a point in the wall thereof relatively distant from the base as compared with the main embodiment. Otherwise, this modification is substantially similar to the main embodiment in that an axially disposed impurities drain tube 44 with a discharge control valve 45, a rotatable agitator comprising blades 48, a purified metal discharge opening 47 in the wall of the centrifugal chamber adjacent the top, and means 49 for the introduction of low pressure inert gas through the cover 49 are provided. However, it is to be observed that a control valve in the pipe or passage 50 has been dispensed with, the elevation of the top of the drain tube 44 is below the bottom of opening 47 and pressure means for discharge control is absent since the discharge of both the impurities and the purified metal is controlled entirely by the speed of rotation of the agitator blades. As in the main embodiment, pig lead is melted in pot 42 by heating elements 51 until the level of the molten mass roughly raises to an elevation indicated by broken line 52 above the top of drain tube 44. Then the rotation of the agitator is started to bring the impurities to the center of the mass as previously described, and after a time the agitator speed is either increased or decreased, as the case may be, so that the vortex surface will assume a position as indicated by the broken line 53, after which valve 45 is raised to permit discharge of impurities down drain tube 44. Thereafter, the agitator speed is increased so as to raise the surface of the rotating mass at the periphery thereof to a position indicated by broken line 54 so that purified molten metal may flow through opening 47 into passage 50. As in the main embodiment, the

discharged metal can be continuously made up without shutting down the operation by the continual addition of pig lead to melting pot 52.

Thus far my invention has been described in connection with apparatus in which a mechanical agitator is employed to rotate a molten mass of metal and thereby separate the impurities from pure metal by centrifugal force and in which purified molten metal is discharged from the periphery and the surface of the mass. However, it should be apparent that the employment of other means for rotating a mass of molten metal is clearly within the scope of my invention. Moreover, practice of my invention is not contingent upon the employment of a separate melting chamber nor the discharge of metal from the surface of a rotating mass within a centrifugal chamber since purified metal will always be concentrated at any point of the periphery of the rotating mass.

Thus in Fig. 5 I have illustrated another modification which comprises a combined centrifugal and melting chamber 55, an axially positioned impurities drain tube 56 with valve 57 to close off the open end thereof, a purified metal discharge opening 58 with valve 59 operable from the exterior by means of extension rod 60 and a cover 61 supported by supporting lugs 62 on the top flange of chamber 55. Pig metal, introduced into the chamber through openings 63 between lugs 62 is melted by electric heating elements 64 or other heating means, and the mass of molten metal is rotated by means of jets of inert gas ejected from a plurality of nozzles or openings 65 tangentially positioned in the wall of the chamber. The gas is fed to each nozzle through risers 66 from header 67 and feed pipe 68 in which is a control valve, not shown. When it is desired to discharge impurities which have collected at the surface and center of the mass the gas pressure to the nozzles is raised or lowered, as the case may be, to respectively either increase the speed of rotation of the mass and thus lower the surface level at the center, or decrease the speed of rotation and thereby raise the surface at the center. In either case, when the center of the surface is at or slightly above the end of discharge or drain tube 56 as indicated by broken line 69, valve 57 is raised and the impurities are allowed to drain down tube 56 and out of the apparatus. It is to be noted that in this modification various speeds of rotation of the mass are employed to control only the discharge of impurities since the purified metal may be drawn off by gravity from the periphery of the rotating mass, through opening 58 adjacent the base of the pot 55. Obviously this opening may be located at any point in the wall of the pot.

While I have, in accordance with the patent statutes, shown and described a particular embodiment of my invention and modifications thereof, other changes and modifications will be obvious to those skilled in the art and I, therefore, aim in the appended claims to cover all such changes and modifications as fall within the true spirit and scope of my invention.

What I claim as new and desire to secure by Letters Patent of the United States is:

1. In a lead melting and cleaning apparatus a melting and pressure chamber, a centrifugal chamber having a discharge opening adjacent the top in the wall thereof with a valve therein

controlling the flow of molten lead through said opening and another opening in the wall of said centrifugal chamber adjacent the base thereof interconnecting said chamber with said melting and pressure chamber, a rotatable agitator within said centrifugal chamber with the axis of rotation thereof coincident with the axis of said chamber, an impurities drain tube axially disposed within said centrifugal chamber, an end of said tube within said chamber located at an elevation above said discharge opening in the wall of said chamber, and heating means mounted in heat exchange relationship to said chambers to melt and maintain the lead in said chambers in a molten state.

2. In an apparatus for melting and cleaning a mass of molten metal by centrifugal action, a cone-shaped melting chamber, a cone-shaped centrifugal chamber concentrically disposed within and spaced from said melting chamber, a covering means partially enclosing the annular space between said chambers, a cone-shaped baffle projecting into said annular space from said covering means so that a portion of said annular space is divided into two separate and concentric annular spaces, the inner one of which is completely and sealingly covered, a pipe connection opening in said cover enclosing said inner space, said centrifugal chamber having an opening in the wall and adjacent the base thereof interconnecting said chamber with said melting chamber, a molten metal discharge opening adjacent the top in the wall of said centrifugal chamber and a valve in said opening for controlling the flow of molten metal therethrough, an impurities drain tube axially disposed within said chamber and passing exteriorly through the base thereof, the end of said tube within said chamber located at an elevation above said molten metal discharge opening in the wall of said chamber, a valve controlling the flow of impurities through said tubes, a mechanical agitator axially mounted for rotation within said chamber and about said tube, a cylindrical baffle mounted on the upper portion of said agitator and projecting downwardly to a point below the location of said molten metal discharge opening, a cover enclosing the top of said centrifugal chamber with a pipe connection opening and an axially disposed opening therein for interconnecting said agitator with an external driving means and for operating said discharge tube valve from the exterior, and heating means mounted in heat exchange relationship to said chambers to melt and maintain the metal in said chambers in a molten state.

GEORGE H. SITTNER.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
566,921	Mays	Sept. 1, 1896
1,101,548	Hoffman	June 30, 1914
1,301,544	Crombie	Apr. 22, 1919
2,025,768	Nieman	Dec. 31, 1935
2,099,593	Bender	Nov. 16, 1937
2,241,806	Burkey	May 13, 1941
2,335,569	Monson et al.	Nov. 30, 1943
2,404,364	Cooper et al.	July 23, 1946