METHOD FOR MELTING ZINC DUST

Erwin C. Handwerk, George T. Mahler, and Harry C. Haupl, Palermo, Pa., assignors to The New Jersey Zinc Company, New York, N. Y., a corporation of New Jersey

Application December 21, 1945, Serial No. 636,420

3 Claims. (Cl. 75—86)

1 This invention relates to the melting of finely divided metals such as metal powders, turnings, chips and the like, and more especially to the melting of zinc dust or blue powder. The object of the invention is to provide an improved method of melting zinc dust and other finely divided metals.

The melting of zinc dust and other finely divided metals presents special difficulties because of the large surface areas characteristic of finely divided metal particles, and the frequent and indeed usual presence of oxide films on the surfaces of the particles. Moreover, finely divided metal particles tend to agglomerate and sometimes to sinter in the course of melting, and effective dispersion or breaking-up of these agglomerated or sintered particles requires special care and attention for satisfactory and complete melting. Furthermore, the surfaces of finely divided metal particles, particularly when flamed with oxide coatings, are difficultly wet by the molten metal, and melting and coalescence of the particles is thereby retarded and sometimes even inhibited.

The present invention provides an effective and rapid method for melting zinc dust and other metal powders. In accordance with the invention, melting is carried out in a heated chamber having a bath or body of molten metal in the bottom thereof, and a shower of molten metal particles, derived from the bath, is produced in the chamber by hurling by centrifugal action a substantially continuous and upwardly-directed shower of the molten metal of such violence as to provide by itself and by its splashing against the confining upper portion of the chamber turbulent sheet-like showers of molten metal within the chamber. The particles of finely divided metal such as zinc to be melted are introduced into the shower of molten metal whereby they mingle and contact with the particles of molten metal and are thereby melted or entrapped in falling through the chamber. The molten metal shower is preferably produced by throwing into the chamber rapidly succeeding upwardly-directed sheets or showers of molten metal which splash against the walls and roof of the chamber and thereby produce a shower or rain of molten metal particles through which the finely divided metal to be melted passes from its point of delivery to the chamber. Such solid metal particles as fall on the molten metal are stirred into it by agitating the molten metal, preferably by the same agency that produces the molten metal shower.

The foregoing and other novel features of the invention will be best understood from the following description taken in conjunction with the accompanying drawings, in which illustrate, by way of example, a melting apparatus in which the invention may advantageously be practiced, and in which:

Fig. 1 is a longitudinal sectional elevation of the melting apparatus,

Fig. 2 is a top plan of the apparatus, and

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

The apparatus as illustrated in the drawings comprises a generally elongated refractory furnace structure enclosing a chamber divided by a depending partition or baffle 5 into a heating zone or compartment A and a melting zone or compartment B. The chamber has a bottom or sole 6 supporting a bath or body of molten metal into which the partition 5 dips while permitting free communication of molten metal beneath the partition's lower edge. The compartment A is provided with an oil or gas burner 7 by which it is heated by reverberatory firing. The products of combustion escape through a stack 8, in the roof of the compartment A, provided with a suitable damper 9 for regulating the draft. The heating compartment A communicates, beneath the lower edge of its end wall 10, with a discharge well 14 having an overflow spout 12 determining the level (a) of the body of molten metal in the furnace chamber. The lower portion of the end wall 10 dips into the molten metal between the heating compartment and the discharge well and seals the compartment from the atmosphere at this point. A collecting trough 13 receives the molten metal overflowing the spout 12 and conveys it to casting equipment or the like.

A feed hopper 14 having a gas-tight feeder 15 is mounted on the roof of the melting compartment B for introducing finely divided metal (e. g., zinc dust) into the compartment. A generally cylindrical rotor 16 is mounted transversely within the melting compartment B in such manner that it dips into the bath of molten metal. The rotor is positioned at one side of the delivery end of the feed hopper, and rotates in such a direction that the side of the rotor towards the delivery end moves downwardly so as to stir the finely divided metal into the molten metal. As viewed in Fig. 1, the direction of rotation of the rotor is clockwise, as indicated by the arrow.

The rotor 16 is carried by a hollow or axially-bored metal shaft 17 horizontally mounted in bearings 18 outside the furnace structure. The
rotor may be constructed of graphite, silicon carbide or other suitable refractory, and is separated from direct contact with the shaft 11 by a sleeve 19 of insulating cement. The shaft 11 has a plurality of circumferentially spaced peripheral ribs 20 embedded in the cement sleeve, and the bore of the rotor has a plurality of spaced recesses 21 filled with the cement of the sleeve, so that the shaft, sleeve and rotor are effectively keyed together. The shaft 11 is cooled by the flow of a cooling medium, such as water, through its axial bore, the cooling medium being supplied to the bore at one end of the shaft by a pipe 22 and discharged from the other end through a pipe 23.

The peripheral surface of the rotor 16 has a plurality of circumferentially spaced pockets or cups 24. The shaft 17 is positioned at a level substantially above that of the molten metal adapted to be held in the furnace chamber, and the rotor 16 is of such outside diameter that its lowermost pocket is beneath the molten metal level (a). The rotor is rotated by means of a pulley 25 secured to the shaft 17 and operatively connected to a suitable source of power, such as a gasoline motor (not shown).

The compartment B is provided with effective seals for preventing the leakage of molten metal through and the freezing of molten metal in the apertures in the side walls through which the shaft 17 extends. Thus, the rotor 16 has a laterally extending sleeve 26 at each end of the rotor surrounding the cement sleeve 19 where the latter extends through the walls of the compartment. The rotating sleeves 25 extend through stationary sleeves 27. Each stationary sleeve 27 has a constricted portion 28, near its outer end, to provide a close clearance with the rotating sleeve 26, and is elsewhere spaced from the rotating sleeve to provide an elongated inner annular space 29. The outer ends of the concentric sleeves 18, 26 and 27 are enclosed in a gas seal comprising a tight fitting cap or housing 31 having a gland bushing 32 through which the shaft 17 extends. A suitable non-oxidizing gas, such as carbon monoxide, is pumped into the caps 31 through the inlet pipes 33 to maintain a sufficiently high gas pressure within the caps to prevent the entrance of air between the stationary sleeves 27 and the rotating sleeves 26. A vent 34 is provided in the roof of the compartment B for the escape of the gas, which, if combustible, is burned at the discharge end of the vent. The temperature prevailing in the compartment B is not sufficient to produce any vapor pressure of metal therein.

The sleeves 28 and 27 are so shaped that molten metal does not accumulate in the elongated annular space 29 between the sleeves but, on the contrary, runs out by gravity into the molten metal at the bottom of the compartment. The lower ends of the stationary sleeves 27 extend into annular grooves 34 in the ends of the rotor 16, and the lower portions of these ends are internally beveled or thinned to form spouts 35 for discharging the metal into the molten metal in the compartment B. The annular grooves 34 are outwardly flared to facilitate the flow of molten metal therefrom. The upper portion of the end of each sleeve 27 is beveled or thickened to form a backwardly sloping spout 36 for guiding any molten metal falling on or wetting the upper surface of the sleeve towards the compartment wall and thence downwardly over the sleeve to the body of molten metal.

Cooling of the shaft 17 permits the use of a metal shaft, and the sleeve 19 of insulating cement inhibits appreciable cooling of the melting compartment B.

5. Cooling of the shaft 17 permits the use of a metal shaft, and the sleeve 19 of insulating cement inhibits appreciable cooling of the melting compartment B. The rotor 16 is rotated at a relatively high speed, say around 100 to 150 R. P. M., counterclockwise as viewed in Fig. 1, so that the pockets 24 in rapid succession pick up and throw sheets or showers of molten zinc upwardly into the compartment. The pockets 24 have a generally scooped shape, so the relatively long advancing flat section and a shallow semicircular depression at the inner end or bottom of the pockets. As the pockets terminate short of the circumferential peripheral ends of the rotor, so that little or no molten zinc is thrown laterally against the side walls of the compartment. The upwardly directed and rapidly succeeding sheets or showers of molten zinc splashed into the shower or rain of molten zinc particles falling through the compartment also against the roof of the compartment, with the result that the compartment is substantially filled with sheet-like showers and moving particles of molten zinc which form an ideal environment for dissolving or entrapping solid particles of zinc dust and carrying them to the molten zinc bath, where they promptly melt. Additionally, the position of the rotor 16 at one side of the delivery end of the feed hopper with the sides of the rotor approximately in the falling particles of zinc dust moving downwardly stirs the zinc dust into the molten zinc. As a result of this effective stirring of the zinc dust into the molten zinc and the agitation of the molten metal by the rotor, the zinc dust is promptly and completely melted.

The heat required for melting is furnished by the reverberatory firing of the compartment A by the fuel burner 1. This heat is readily transmitted to the melting chamber through the partition or dividing wall 5 and through the common body of molten metal in the compartments A and B. Molten metal is continuously withdrawn from the discharge well 11, over the spout 12, at a rate substantially equivalent to the rate at which zinc dust is introduced into the melting compartment B, thus maintaining the normal volume of molten metal in the compartments A and B.

The invention provides a highly efficient method of transforming zinc dust to molten zinc. If not too heavily oxidized, the zinc dust can be completely melted down to molten metal without a flux or binder such as, for example, salammoniac or equivalent flux may be desirable. In the absence of zinc dust, the invention is applicable to the melting of other metal powders, turnings, chips etc.

We claim:

1. The method of melting finely divided zinc in a heated melting chamber having a body of molten zinc in the bottom thereof which comprises hurling by centrifugal action a substan-
2,457,558

5 tially continuous and upwardly-directed shower of said molten zinc of such violence as to provide by itself and by its splashing against the con-
fining upper portion of the chamber turbu-
3. The method of melting finely divided zinc

tent sheet-like showers of molten zinc within the

chamber, and introducing the finely divided zinc
into said shower of molten zinc whereby the par-
ticles of zinc to be melted mingle and contact
with the molten zinc thrown upwardly into the
chamber and are melted or entrapped thereby.

2. The method of melting finely divided zinc
in a heated melting chamber having a body of
molten zinc in the bottom thereof which com-
prises hurling by centrifugal action a substan-
tially continuous and upwardly-directed shower
of said molten zinc of such violence as to pro-
provide by itself and by its splashing against the
confining upper portion of the chamber turbu-
3. The method of melting finely divided zinc

lent sheet-like showers of molten zinc within

the chamber, introducing the finely divided zinc
into said shower of molten zinc whereby the par-
ticles of zinc to be melted mingle and contact
with the molten zinc thrown upwardly into the
chamber and are melted or entrapped thereby,
continuously withdrawing molten zinc from said
chamber into a communicating enclosed cham-
mer at a rate substantially equivalent to the rate
at which finely divided zinc is introduced by
maintaining a substantially uniform volume of
molten zinc in the bottom of said communicat-
ing chamber, and supplying to said communicat-
ing chamber the heat required for maintaining
the body of zinc in molten condition.

5

20

15

25

35

30

REFERENCES CITED

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

UNITED STATES PATENTS

<table>
<thead>
<tr>
<th>Number</th>
<th>Name</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>1,647,381</td>
<td>Thoralidne</td>
<td>Nov. 1, 1927</td>
</tr>
<tr>
<td>1,884,088</td>
<td>Miller</td>
<td>Oct. 25, 1932</td>
</tr>
<tr>
<td>2,081,421</td>
<td>Betterton et al.</td>
<td>May 25, 1937</td>
</tr>
<tr>
<td>2,348,194</td>
<td>Crane et al.</td>
<td>May 9, 1944</td>
</tr>
</tbody>
</table>

FOREIGN PATENTS

<table>
<thead>
<tr>
<th>Number</th>
<th>Country</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>55,473</td>
<td>Sweden</td>
<td>May 34, 1922</td>
</tr>
</tbody>
</table>