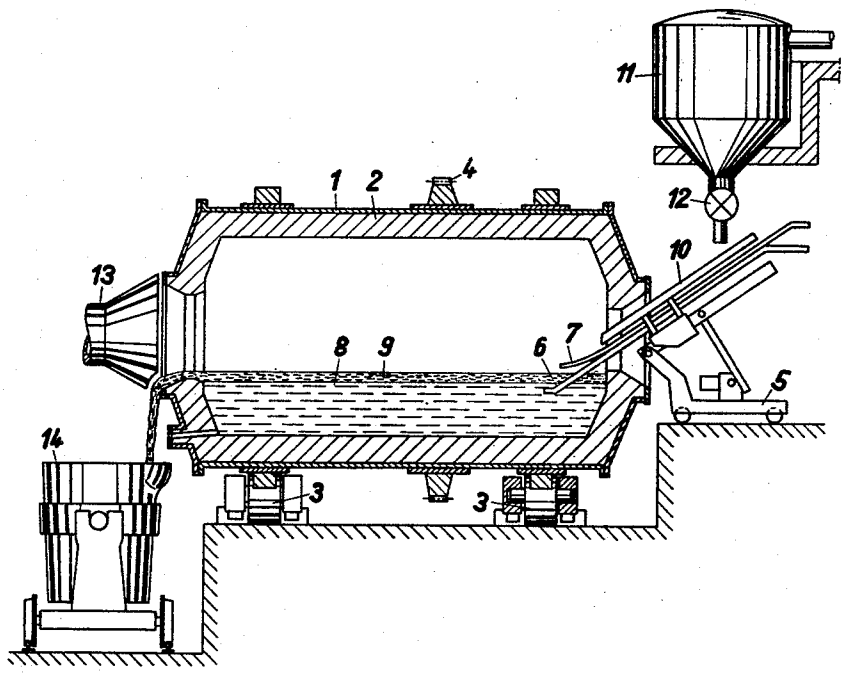
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PROCESS FOR REFINING METALS

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PROCESS FOR REFINING METALS

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The present invention relates to a method of refining metals in a drum furnace rotatable about a substantially horizontal axis and retaining the metal bath, which has been introduced into the drum furnace prior to the refining operation, until the refining process has been completed, said rotatable drum furnace having its end walls provided with openings and having blast nozzles extending through one of said openings.

With heretofore known methods of the type involved, the customary quantity of metal to be refined is together with the required quantity of slag formers charged into the drum furnace prior to blowing in the refining medium. The metal bath and the slag layer remain in the furnace during the refining operation. During the refining operation, the drum furnace is slowly rotated. The refining medium is blown onto the metal bath surface or into the metal bath surface or both onto and into the metal bath surface through nozzles extending into the drum furnace through an end wall thereof. In view of the combustion of carbon monoxide rising from the bath in the drum chamber above the metal bath, large quantities of heat are produced which are transferred from the combustion gases to the furnace lining above the bath surface and are returned to the metal bath when the heated lining immerses below the surface of the metal bath. This method is, therefore, characterized by a very good thermal efficiency.

However, this process has the drawback that the slag layer floating on the metal bath is strongly overheated at those portions of the bath surface where an intensive reaction occurs, and in this condition seriously attacks the refractory lining of the refining drum. The extent to which the lining is worn with the predominantly employed basic refining process in which a lining of dolomite and magnesite is used can easily be determined from the magnesium oxide content of the slag which content is predominantly derived from the lining. It has been found that with a refining drum having a capacity for a charge of about 60 tons of pig iron, up to 3,000 kilograms of dolomite per charge is drawn from the lining into the slag layer. This wear of the lining necessitates expensive repairs or replacement of the drum lining and causes costly periods during which the refining drum has to stand idle.

It is, therefore, an object of the present invention to provide a method of refining metals in rotary drum furnaces, which will overcome the above mentioned drawbacks.

It is another object of this invention to provide a method of refining metals as set forth above which will considerably reduce the wear of the drum lining and thereby also the costs of operation of rotary drum furnaces used in connection with such method.

These and other objects and advantages of the invention will appear more clearly from the following specification in connection with the accompanying drawing illustrating an arrangement for carrying out the method according to the invention.

It has been found according to the invention that the wear of the lining depends largely upon the area of contact between the lining and the slag layer resting on the metal bath during the refining operation, the thickness of said slag layer being determined by the quantity of the slag formers required for the reaction with the metal bath. Accordingly, the objects outlined above have been realized according to the invention by introducing slag formers continuously or intermittently into the drum furnace at one portion thereof, preferably by blowing in the slag formers together with the refining medium, and by allowing the slag to flow off corresponding to the introduced amounts of new slag formers at another portion of said drum spaced from said first portion so that the slag flows through the furnace in a thin layer from the point of supply to the point of discharge. Since, in this way, the thickness of the slag layer is reduced, the wear of the lining is considerably reduced and a material saving in the costs of operation is obtained by reduced repair and replacement of the lining.

The reduction in wear of the lining obtained by the method according to the invention over heretofore known methods will become evident from the following two numerical examples:

Example I

The entire quantity of slag required for the refining process remains in the refining drum throughout the refining operation in conformity with heretofore known methods.

Timing of refining	60 minutes.
Quantity of metal	60 tons.
Quantity of slag	13 tons.
Length of bath	12 meters.
Width of bath	1 meter.
Thickness of slag layer	30 centimeters.
Area of contact between slag and lining	7.8 square meters.
Rate of speed at which the refractory lining dissolves with slag rich in Fe_2O_3	390 kilograms dolomite per square meter hour.
Quantity of lining dissolved during the refining time period	390×7.8=3,000 kilograms per hour.
Specific loss in dolomite	50 kilograms dolomite per ton of steel.

Example II

The slag flows off continuously in conformity with the method of the present invention, and corresponding amounts of slag formers are added and flow in a thin layer over the metal bath.

Time of refining	60 minutes.
Quantity of metal	60 tons.
Quantity of slag in the refining drum	3 tons.
Length of bath	12 meters.
Width of bath	1 meter.
Thickness of flowing slag layer	7 centimeters.
Area of contact between slag and lining	1.8 square meters.
Rate of speed at which the lining dissolves	390 kilograms of dolomite per square meter hour.
Amount of lining dissolved during refining	390×1.8=700 kilograms per hour.
Specific loss in dolomite	12 kilograms of dolomite per ton of steel.

The effectiveness of the reaction between the metal bath and the slag layer is with the method according to the invention not harmfully affected by the reduction in the thickness of the slag layer but is rather improved. The magnitude of the area of contact between metal bath and slag layer is retained and fresh slag formers adapted

to react are charged into the drum in conformity with the continuous discharge of the consumed slag.

The slag formers may be introduced into the drum by means of a chute or in a manner known per se by blowing in said slag formers together with the refining medium in a continuous manner or in batches. Advantageously, the slag formers are introduced through an opening in one end wall of the furnace and are removed as used slag through an opening in the other end wall. The reduction in thickness of the slag layer yields the advantage of facilitating the formation of drizzling metal rain and the boiling

Referring now to the drawing in detail, the rotary drum furnace illustrated therein comprises a metal shell 1 having a refractory lining 2 and being rotatably journalled on roller bearings 3. The shell 1 is provided with a gear 4 for meshing engagement with a motor (not shown in the drawing) so that the drum may be solwly rotated about its longitudinal axis. In front of the opening in the right-hand (with regard to the drawing) end wall of the drum there is arranged a trolley 5 carrying nozzles 6 and 7 for conveying a refining medium into the interior of the drum. In the particular arrangement shown, the nozzle 6 is immersed in the metal bath 8, whereas the nozzle 7 extends into the space above the metal bath 8. The trolley 5 also carries a chute 10 extending up to and below a hopper 11 for receiving therefrom slag formers. At the bottom side of the hopper 11 there is arranged a pocket wheel 12 as is clearly shown in the drawing. A waste gas pipe 13 adjoins the opening in the left-hand end wall (with regard to the drawing) of the rotary drum furnace. Beneath the said last mentioned opening there is arranged a slag pot carriage 14. During the refining process, the rotary drum furnace is rotated while a gaseous refining medium as for instance technically pure oxygen is blown through nozzle 6 into the metal bath 8. Air or oxygen-enriched air is through nozzle 7 blown into the space above the metal bath for combustion of the carbon monoxide arising from the metal bath. The waste gases escape through the waste gas pipe 13. The pocket wheel 12 continuously conveys pulverous or granular slag former material, as for instance lime, from the hopper 11 to the chute 10 which latter conveys the slag former to the interior of the drum furnace. The slag formers produce a thin slag layer 9 which during its reaction with the metal bath flows on the metal bath through the drum furnace and is discharegd in a continuous manner through the left-hand end wall of the drum into the slag pot carriage 14.

It is, of course, to be understood that the present invention is, by no means, limited to the particular construction but also comprises any modifications within the scope of the appended claims.

What we claim is:

1. In a method of refining carbon containing pig iron in the presence of an oxygen containing atmosphere in a drum furnace rotatable about a substantially horizontal axis and adapted to retain pig iron to be refined throughout the refining process, the employment of the following steps: forming a liquid slag layer, feeding in succession new quantities of slag formers into said drum furnace at one portion thereof while the refining process is being carried out, and during said refining process, corresponding to the feeding of new slag formers into said drum furnace and at the same rate thereof at another drum furnace portion spaced from said first drum furnace portion withdrawing slag from the slag layer forming on the pig iron bath in said drum furnace while maintaining the slag layer forming on the pig iron bath at a desired thinness whereby the area of contact of said slag with the furnace lining is reduced, and while retaining the pig iron bath in said drum furnace until the desired refining of said pig iron bath in said drum furnace has been completed.

2. A method according to claim 1, in which the slag formers are fed into the drum furnace in a continuous manner.

3. A method according to claim 1, in which the slag formers are fed into the drum furnace in an intermittent manner.

4. In a method of refining carbon containing pig iron in the presence of an oxygen containing atmosphere in a drum furnace rotatable about a substantially horizontal axis and adapted to retain the pig iron to be refined throughout the refining process, the employment of the following steps: forming a liquid slag layer, feeding a refining medium and together therewith slag formers into said drum furnace at one portion thereof while the refining process is being carried out, and during said refining process continuously withdrawing slag at another drum furnace portion spaced from said first drum furnace portion from the slag layer forming on the pig iron bath in said drum furnace while maintaining the slag layer forming on the pig iron bath at a desired thinness whereby the area of contact of said slag with the furnace lining is reduced, and while retaining the pig iron bath in said drum furnace until the desired refining of said pig iron bath in said drum furnace has been completed.

5. In a method of refining carbon containing pig iron in the presence of an oxygen containing atmosphere in a drum furnace rotatable about a substantially horizontal axis and adapted to retain pig iron to be refined throughout the refining process, the employment of the following steps: forming a liquid slag layer feeding in succession new quantities of slag formers into said drum furnace at one portion thereof while the refining process is being carried out, and during said refining process, withdrawing from another portion of said drum furnace slag from the slag layer forming on said pig iron bath, and maintaining thereby the salg layer on said pig iron bath at a thickness of approximately 7 centimeters during said process.

References Cited in the file of this patent

UNITED STATES PATENTS

1,320,483	Lund	Nov. 4, 1919
1,328,803	Bagley	Jan. 27, 1920
2,622,977	Kalling	Dec. 23, 1952
2,902,358	Kalling et al.	Sept. 1, 1959
2,918,365	Kanamori	Dec. 22, 1959