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REPUBLIC OF SOUTH AFRICA PATENTS ACT, 1978

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COMPLETE SPECIFICATION

(Section 30(1) - Regulation 28)

01 Official app	olication No.	22	Lodging date		.J&K I	Reference				
886670			8th September, 1988			P 10321 ZA/Mvs				
51 International classification C22B.										
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Full name(s) of Inv	ventor(s)									
Johan	Pieter Ro	os D	E VILLIERS,	Lawrence	Bruce N	McRAE				
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"THE PRODUCTION OF MATTES CONTAINING PLATINUM GROUP METALS AND GOLD"

FIELD OF THE INVENTION

THIS INVENTION relates to the production of mattes containing platinum group metals and gold from concentrates containing the same by way of the pyrometallurgical smelting of a concentrate to produce the platinum group metal and gold containing matter phase and a slag phase.



BACKGROUND TO THE INVENTION

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In the processing of naturally occurring ores containing PGMs (Platinum Group Metals), different types of concentrates are produced, generally by flotation, in which the PGMs are present and these concentrates are generally subjected to pyrometallurgical treatment in order to form a PGM containing matte and a slag which is depleted of PGMs, although sometimes a metallic collector phase is employed in place of the matte phase.

10 Usually such PGMs are accompanied by a chromium content intthe form of chromite and certain ores such as that generally known in South Africa as Merensky reef, have arlow chromium oxide content (of the order of 0,3% by mass of the flotation concentrate) whilst other ores, 15 such as that known in South Africa as the UG-2 reef, have a relatively high chromium oxide content (of the the flotation of mass by 3,5% order Other South African high chromium concentrate). oxide-containing ores are those from the so-called LG-6 20 reef (3 - 6% chromium oxide by mass of the flotation concentrate) and those from the so-called MG-4 reef or

/similar chromite

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or blends of such concentrates which may have a nett chromium oxide content of down to almost that of the Merensky reef concentrate.

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in the pyrometallurgical smelting of the relatively inght chromium containing concentrates, there is a tendency for the chromium to form a spinel in the smelting furnace which accumulates and, accordingly, leads, over a period of time to unacceptable dead to volume of the furnace.

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one effort to avoid this problem forms the subject matter of South African Patent No. 77/4202 to J.C.I.

Company Limited entitled "Smelting Process". In this proposal for dealing with concentrates containing at 15 least 2% by weight of chromium (equivalent to 2,9% Cr2O3 or 7,3% chromite), the smelting is generally carried out in the presence of sufficient carbonaceous reductant to result in the formation of three phases, namely, a slag phase, a matte phase and a ferro-nickel 20 alloy phase, and in this case the PGMs are contained in the latter phase which acts as a collection phase, as

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opposed to the matte phase, although in certain cases

India further proposal made by applicant in South African Patent No. 82/2966 it is proposed to avoid such in build-up of chromium spinel in a smelting furnace by employing extremely high power densities, of the order of 400kW/m² during smelting to achieve a substantial mixing between the slag and matte phases and thereby effect coalescence between the matte particles so that 10 they may grow in size and settle more readily out of the slag.

It was believed that this turbulence would minimise the settling out of spinel on the hearth of the furnace.

This proposal operates effectively but has been found to suffer from the disadvantage that the furnace linings can, if conditions are not maintained correctly, or the linings are not designed for the purpose, be deleteriously affected.

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It is the object of this invention to provide 20 improvements and beneficial modifications to the

process forming the subject matter of our said Patent
No. 80/2966.

SUMMARY OF THE INVENTION

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In Allordance with this invention there is provided a provided the treatment of a pgm containing containing operation carried out to procure, a matter phase and a slag phase, the smelting operation being carried out at power densities of between 150kW/m² and 750kW/m² and at a voltage of from 100 to 300 volts (after start-up is complete) the 100 process being characterised in that a reductant is added in order to lower the partial pressure of oxygen during the smelting operation the quantity of such reductant being insufficient to cause the formation of a metallic collection phase.

reductant to be a carbonaceous reductant; for the smelting to be carried out in a preferred range of power densities of between 150kW/m² and 350kW/m² and most preferably at about 290kW/m² with the voltage 20 preferably being in the range of from 120 to 180 volts;

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for the chromium oxide content of the PGM containing, concentrate to be less than about 2,9% by mass of the concentrate and preferably, less than about 2,8% by mass; for the carbonaceous reductant (carbon) to be added in an amount of between 1% and 4% by mass based on the PGM containing concentrate; and for tapping of the tfurnace to be carried out without the step of allowing settling of the phases during a special quiescent time period as envisaged by our said Patent 10No. 82/2966. The omission of the quiescent period avoids the possibility of spinel settling out during such period and also optimises operational time of the smelter.

further the invention provides for the still PGM 15 containing concentrate together with the carbon and any other additives intimately to be mixed agglomerated, for example pelletised or briquetted, prior to smelting and for additional sulphides, such as pyrite from various sources including 20containing gold, copper sulphide or nickel sulphide to be added in order to increase the sulphide content of the concentrate in cases where insufficient sulphides are present for the formation of a satisfactory matte

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undernthest particular apprevailing unconditions, nor twhere the presence of, for example, a high iron oxide content of the concentrate results in the formation of mattes with too high an iron-to-sulphur ratio, especially when reaction of iron oxide with carbon, either added or coming from the electrodes, occurs. Such iron rich matters are difficult to break and would have to be transferred in the molten state to a converter process as is commonly used, or granulated, which can be hazardous. It would be a disadvantage if a converting process requiring the use of oxygen instead of air were to be used and in which a quantity of cold, crushed matte would be required to be added to the converter as a coolant.

15 Laboratory studies have shown that the inclusion of carbon in the fluxed concentrate-containing charge causes a reduction of Fe₂O₃ in the slag to FeO. destabilises the spinel structure and the formation of secondary magnetite around small grains of chromite 20 spinels contained in the matte is inhibited. FeO then becomes component a of the matte, and upon solidification, it exsolves as a separate phase.

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The tinclusion poficarbon also causes the reduction of FeO to Fe which dissolves in the matte phase. The lowering of the FeO content of the slag causes a decreased solubility of sulphur in the slag phase with a resultant increase in the mass of matte that is formed.

Also r noted has been an increased partitioning of chromium to the matte and a decreased concentration and, presumably, activity of Cr₂O₃ in the slag, thereby 10 minimising the precipitation of spinels in the slag.

It is to be noted that insufficient carbon should be added to result in the formation of three phases as the object of this particular invention is to provide a matte containing the PGMs as opposed to a metallic 15 collection phase which would form a third phase in the system.

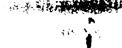
The smelting temperature is in the range of 1450°C to 1600°C and preferably, in the range of 1475°C to 1550°C.

It is to be noted that the addition of reductant to 20 lower the partial pressure of oxygen affects the

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partitioning of chromium in the matte phase relative to the slag phase with a decrease in chromium in the slag phase with increasing oxygen partial pressure. Thus the addition of reductant has the effect of increasing the chromium content of the matte phase thereby conveying it out of smelter.

Clearly any required fluxes such as lime, ferric oxide, hematite ore or mixtures thereof can be added as may be required.



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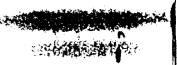
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WHAT IS CLAIMED IS :-

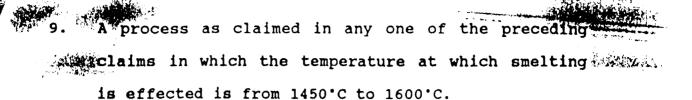
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- 1. A process for the treatment of a PGM containing concentrate by a smelting operation carried out to produce a matte phase and a slag phase, the smelting operation being carried out at power densities of between 150kW/m² and 750kW/m² and at a voltage of from 100 to 300 volts (after start-up is complete) the process being characterised in that a reductant is added in order to lower the partial pressure of oxygen during the smelting operation the quantity of such reductant being insufficient to cause the formation of a metallic collection phase.
 - 2. A process as claimed in claim 1 in which the reductant is a carbonaceous reductant.

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- 3. A process as claimed in either of claims 1 or 2 in which the reductant is added in an amount of from 1 to 4% by mass of the PGM containing concentrate.
- 4.. A process as claimed in any one of the preceding claims in which the smelting is carried out at a power density of fom 150kW/m² to 350kW/m².
 - 5. A process as claimed in claim 4 in which the smelting is carried out at a power density of about 290kW/m^2 .
- 106. A process as claimed in any one of the preceding claims in which the furnace is operated at a voltage of from 120 to 180 volts.
- 7. A process as claimed in any one of the preceding claims in which the chromium oxide content of the PGM containing concentrate is less than about 2,9% by mass of concentrate.
 - 8. A process as claimed in any one of the preceding claims in which the furnace is tapped without any special quiescent period as described.



- 10. A process as claimed in claim 9 in which the temperature is from 1475°C to 1550°C.
 - 11. A process as claimed in any one of the preceding claims in which the concentrate, reductant and any other ingredients are mixed and agglomerated prior to smelting.
 - 10 12. A process as claimed in any one of the preceding claims in which additional sulphides are added to provide for the formation of a satisfactory matter phase.
 - 13. A process as claimed in claim 12 in which the additional sulphide is a pyrite optionally containing gold.
 - 14. A process according to claim 1 and substantially as herein described.

DATED this 8th day of SEPTEMBER, 1988

C.K. JOB

JOHN & KERNICK For the Applicant