(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) Publication number : **0 594 326 A1**

(12) EUROPEAN PATENT APPLICATION

(21) Application number : **93307955.0**

(22) Date of filing : **06.10.93**

(51) Int. Cl.^{5} : **C21C 5/46**, C21C 1/02, F27D 3/16, C22B 9/05

(30) Priority : **17.10.92 GB 9221842**

(43) Date of publication of application : **27.04.94 Bulletin 94/17**

(84) Designated Contracting States : **BE DE ES FR GB IT LU NL SE**

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(54) Lance for inrtroducing reactants into molten metal.

(57) The invention relates to a lance used to introduce reactants into molten metal, e.g. steel and aims to provide a lance of improved service life.

The lance of the invention comprises an inner tube (21) and a refractory casing (25), the inner tube having an inlet (22) adjacent one end and an outlet (26) adjacent its other end, whereby reactant can be injected through the lance, in which the inner tube (21) is spaced from an outer tube (23) to provide an annular air gap (24) between the two tubes, the refractory casing (25) being provided on the outer tube (23) and a gas pipe (27) extending between the inner and outer tubes (21,23), the gas pipe (27) having its outlet adjacent the region of the outlet (26) of the inner tube (21), whereby gas passing through the pipe (27) can exit to atmosphere through the annular air gap (24).

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This invention relates to a lance of the type used to introduce reactants into molten metal, e.g. steel, in a molten metal handling vessel. Thus, a lance may be used, for example, to introduce desulphurisation agents into molten steel.

Conventionally, lances are usually of monolithic construction consisting of a thick-walled inner-tube of steel with welded reinforcement ribs of sectional steel and various types of holding elements and with barbed wire wrapped round to bind the refractory material. There is no air gap between the inner tube and the refractory material.

In hot-metal desulphurisation with desulphurising agents based on CaC_2, the lance service lives achieved are considerably better than those using Mg-based desulphurisation agents. Thus, extensive industrial trials have been carried out in the past in order to find out what influencing factors are responsible for the reduced service lives of lances.

The most important influencing factors, such as lance temperature, dwell time of desulphurising agent in the lance, conveying rates of desulphurisation agent and mixing of CaC_2 to Mg, are now well known.

The main prerequisite for long service life of a lance is still, as always, good, uniform conveyance of the desulphurising agent.

Further influencing factors, as indicated, are the magnesium concentration and dwell time of the magnesium in the lance. At a mixing ratio CaC_2 to Mg > 4:1 hardly any, or only very slight, caking occurs in the lance and in the region of the outlet orifices.

The aim of the operator of a desulphurisation unit is to optimise the total quantity of desulphur-isation agent (kg per ton of hot metal) in order to reduce hot metal losses on the one hand and to minimise treatment times on the other hand. This can be achieved by using a higher grade desulphurising agent, i.e. a concentration of CaC_2 to Mg of up to 2:1 or by injecting pure magnesium.

From a technical point of view it is possible to inject and convey minimum quantities of desulphurising agent. This can be achieved using sensitive conveying equipment with sophisticated measuring and controlling devices, which are available today. However, the injection lance is still a weak point in the whole conveying system.

It is well known that the efficiency of the desulphurising agents depends on the dwell time of the individual particles in the melt, i.e. the lower the injection rate, the higher is the utilisation rate of the desulphurising agent.

However, a low injection input with corresponding transport gas quantity, conflicts with the required long service life of the lance. Because of the low cooling effect of the desulphurising agent and the transport gas at low conveying rates, the lance heats up more quickly so that temperatures of up to 1000°C may be reached at the injection tube. This leads to caking of magnesium particles, which melt at approximately 650°C and may even cause vaporisation of magnesium in the lance. The logical consequences of this are higher wear of the refractory material and blockage of the lance, particularly with multiple orifice lances.

The present invention aims to improve the operating reliability and, hence, availability of a hot-metal unit by providing a lance which does not allow an excessively high temperature increase during use.

Accordingly, the invention provides a lance comprising an inner tube having an inlet adjacent one end and an outlet adjacent its other end, whereby reactant can be injected through the lance, an outer tube from which the inner tube is spaced to provide an annular air gap between the two tubes, the outer tube having a refractory casing, and a gas pipe extending between the inner and outer tubes and having its outlet adjacent the region of the outlet of the inner tube, whereby gas passing through the pipe can exit to atmosphere through said annular air gap.

Cooling gas can, therefore, be delivered between the inner and outer tubes, which will normally be of steel, and to the region of the outlet of the nozzle. In a preferred embodiment, the gas tube will be fitted to extend around the inner-tube in a spiral configuration, at least for part of the length of the inner tube approaching and up to the outlet end. For the remainder of the length of the inner tube, or at least for the remainder of the portion that extends inside the refractory encased outer tube, the gas pipe may extend parallel to the longitudinal axis of the tube.

Thus, it can be seen that the objective of the invention is met by providing a lance of such a construction that it can be very effectively cooled with suitable delivery of cooling gas. The lance is based in a refractory fixture which is relatively insensitive to the conditions of use owing to the different coefficient of expansion of the lance materials used (steel:refractory = 10:1).

The inner tube is conveniently mounted inside the outer tube by means of spacers, which in the preferred embodiment, will ensure that the two tubes are concentrically disposed.

The invention will now be further described by way of example only with reference to the accompanying drawings in which:-

Figure 1 is a longitudinal cross-section through a conventional prior art lance, and...

Figure 2 is a longitudinal view in part-section of a lance of the invention.

In Figure 1 lance 10 has a thick-walled steel inner tube 11 with welded reinforcing ribs 12. Tube 11 is set in a refractory casing 13 for the proportion of its length that will be immersed in molten metal during use. The lance has an inlet 14 at the unencased end of tube 11, inlet 14 being connectable to a source of reactant to be injected. The other end of tube 11 has an outlet 15 which emerges into an outlet passageway 16 in the refractory casing, thereby forming the outlet of the lance.

Figure 2 shows an improved lance 20 of the invention. This comprises a steel inner tube 21 extending inside and spaced from the walls of a steel outer tube 23 by spacers (not shown), and extending beyond outer tube 23 to its inlet end 22. Outer tube 23 has a protective refractory casing 25. The spacing of tubes 21 and 23 provides an annular air gap 24.

At its other end, inner tube 21 feeds to radially-disposed outlets 26, which extend through refractory casing 25 to the exterior of the lance.

A gas pipe 27, connectable to a source of cooling gas, passes longitudinally along the outside of inner tube 21 between tube 21 and outer tube 23. It ends adjacent outlets 26 so that the cooling effect of the gas is also felt by the outlets. The cooling gas passed through pipe 27 therefore emerges in annular gap 24 adjacent the outlets of the lance and passes back along between the tubes 21 and 23 to exit at the opposite end of tube 23 to the nozzle outlet end, thereby cooling the whole of that portion of the lance that is immersed in molten metal in use.

Furthermore, through the double-walled design the inner tube 21 is well insulated, thus preventing uncontrolled heating of the inner tube if the cooling system breaks down.

The refractory casing 25 has a steel reinforcement 28 which extends longitudinally and substantially parallel to tube 23. The reinforcement 28 is anchored to the outlet end only of inner tube 21 by anchor pieces 29. These are the only anchorage points used over the whole length of the refractory casing 25. Thus, despite the very different coefficients of expansion of the steel components of the lance and the refractory casing, this means of attachment allows the refractory casing and the outer tube to move freely in relation to one another as they expand or contract on heating or cooling without risk of cracking of the refractory material. Reinforcement 28 may be, for example, a number of longitudinally-extending steel bars spaced around and equidistant from the tube 23.

In operation the lance is preferably cooled with compressed air at a pressure, for example, of 6 bar. The passage of cooling gas is commenced as treatment of molten metal through the lance commences and will normally end a pre-determined time after the end of the treatment.

Usually the lance is cleaned with nitrogen after the treatment (the transport gas delivery line may, for example, be turned on three times). This mode of operation ensures that any loose deposits in the coveying line or in the lance are blown out. Magnesium particles already adhering to the lance wall and outlet orifices cannot be removed this way, however, and this is normally carried out mechanically, as far as such deposits can be reached.

Magnesium residues can, however, be burnt off with air in the hot lance. This advantage can be utilised by using compressed air instead of nitrogen to clean the lance after treatment. An additional change-over valve from nitrogen to compressed air can be easily fitted for this purpose.

Claims

1. A lance (20) having an inner tube (21) and a refractory casing (25), the inner tube having an inlet (22) adjacent one end and an outlet (26) adjacent its other end, whereby reactant can be injected through the lance, characterised in that the inner tube (21) is spaced from an outer tube (23) to provide an annular air gap (24) between the two tubes, the refractory casing (25) being provided on the outer tube (23) and a gas pipe (27) extending between the inner and outer tubes, the gas pipe having its outlet adjacent the region of the outlet (26) of the inner tube (21), whereby gas passing through the pipe (27) can exit to atmosphere through the annular air gap (24).

2. A lance according to Claim 1, characterised in that the inner tube (21) and outer tube (23) are of steel.

3. A lance according to Claim 1 or 2, characterised in that the gas pipe (27) extends around the inner tube (21) in a spiral configuration.

4. A lance according to Claim 3, characterised in that the gas pipe (27) extends around the inner tube (21) in a spiral configuration for a part of the length of the inner tube approaching and up to the outlet end (26) and extends parallel to the length of the inner tube (21) for the remainder of its length within the refractory encased outer tube (23).

5. A lance according to any preceding claim, characterised in that the inner tube (21) is concentrically disposed within the outer tube (23) by means of spacers.

6. A lance according to any preceding claim, characterised in that inner tube (21) leads to a plurality of radially-disposed outlets (26) which extend through the refractory casing (25) to the exterior of the lance.

7. A lance according to any preceding claim, characterised in that gas passed through pipe (27) emerges in annular gap (24) adjacent the outlet (26) and passes back along between inner tube (21) and outer tube (23) to exit at the opposite end

of tube (23) to the outlet end (26).

8. A lance according to any preceding claim, characterised in that the refractory casing (25) has a steel reinforcement (28) extending longitudinally and substantially parallel to outer tube (23).

9. A lance according to Claim 8, characterised in that the reinforcement (28) is anchored to the outlet end (26) only of inner tube (21) by anchor pieces (29).

10. A lance according to Claim 8 or 9, characterised in that reinforcement (28) comprises a number of longitudinally-extending steel bars spaced around and equidistant from outer tube (23).

11. A lance according to any preceding claim characterised in that it is connectable to a source of compressed air at a pressure of, e.g., 6 bar.

12. A lance according to Claim 11, characterised in that it is provided with a changeover valve whereby nitrogen can be supplied through the lance for cleaning purposes.

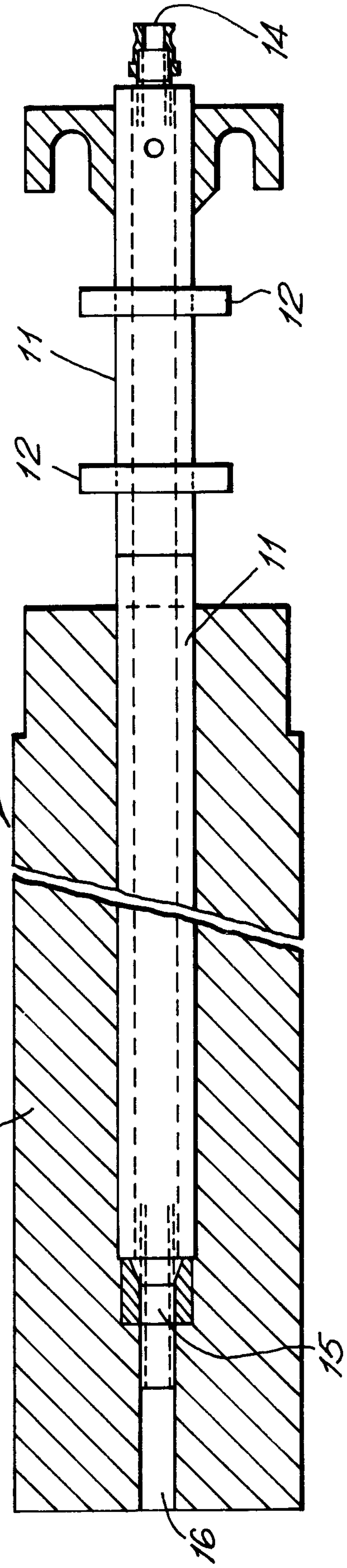

FIG.1.

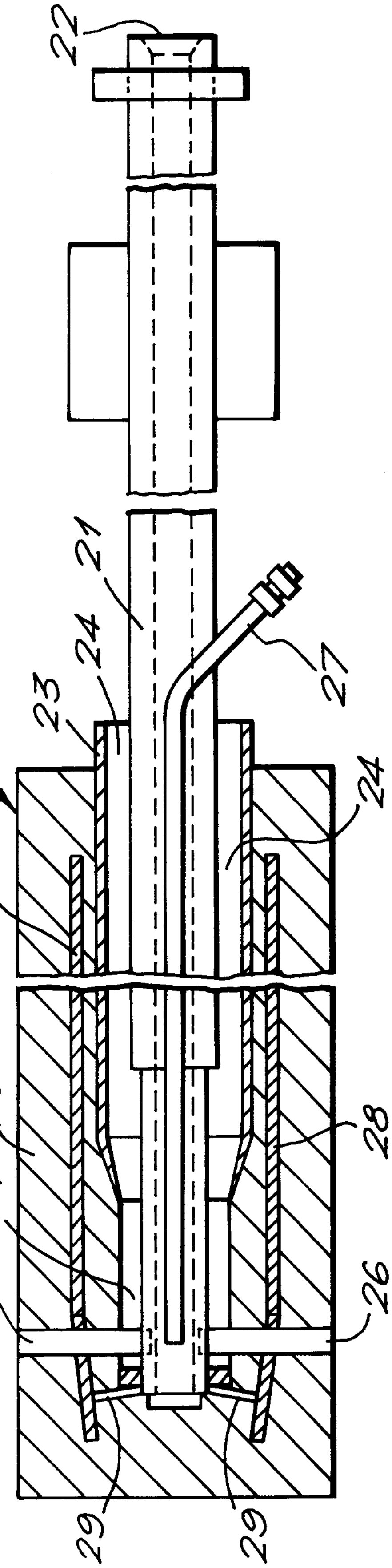

FIG.2.

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EUROPEAN SEARCH REPORT

Application Number
EP 93 30 7955

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.5)
X	US-A-4 913 735 (PALMER) * column 4, line 21 - column 5, line 13; figures 2,4,8 *	1,2,5,7,11	C21C5/46 C21C1/02 F27D3/16 C22B9/05
Y		3,4,6,8-10,12	
Y	DE-A-35 01 970 (PLIBRICO CO GMBH,DÜSSELDORF) * page 9, line 15 - page 10, line 5; claims 9-11; figure 1 *	3,4	
Y	DE-A-34 23 192 (KRUPP POLYSIUS) * page 15, line 5 - line 10; figure 2 *	6	
Y	EP-A-0 062 217 (MONO CONSTRUCTION LIMITED) * page 6, last paragraph - page 7, paragraph 3; claims 1-6; figures 1-3 *	8-10,12	
A	BE-A-1 000 803 (CENTRE DE RECHERCHES METALLURGIQUES)		

TECHNICAL FIELDS SEARCHED (Int.Cl.5)

C21C
F27D
C22B

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	1 February 1994	Oberwalleney, R

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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