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US 4,566,343 A
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IMMERSION DEVICE FOR MOLTEN METAL AND METHOD

ABSTRACT

The invention relates to an immersion device for molten metal. The invention further relates to a method for making steel.

An immersion device for molten metal comprising a measuring head, a carrier (2) for the measuring head and a lance (1) which is detachably connected to the carrier (2) or can be connected to the carrier (2) by a detachable tubular connecting element (3). There is a gas path (4) from the lance (1) to the detachable tubular connecting element (3) and a gas tight connection between a connecting surface (6) of the lance (1) and the detachable tubular connecting element (3). The tubular connecting element (3) comprises wiping means (5) in the form of fins (5) which wipes the connecting surface (6) of the lance (1) during attaching the tubular connecting element to the lance (1) and/ or detaching the tubular connecting element from the lance (1).

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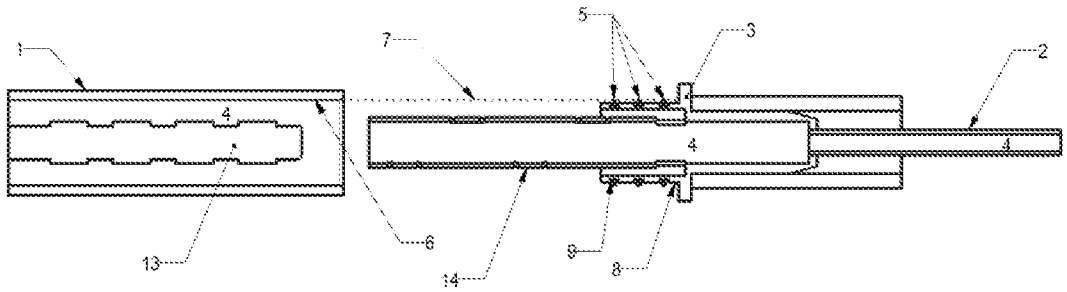

Figure 1

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IMMERSION DEVICE FOR MOLTEN METAL AND METHOD

[0001] The invention relates to an immersion device for molten metal comprising a carrier for a measuring head and a lance which is detachably connected to the carrier or can be connected to the carrier by a detachable tubular connecting element comprising a gas path from the lance to the detachable tubular connecting element and a gas tight connection between a connecting surface of the lance and the detachable tubular connecting element. The invention further relates to a method for making steel.

[0002] An immersion device comprising a lance and a carrier is known from EP 0143498 A2. A lance of an immersion device is or can be connected to the carrier by a detachable tubular connecting element or coupling piece as known from US 2014/0318276 A1.

[0003] The measuring head of the carrier may comprise a sampler for taking samples from melts having a melting point higher than 600 °C, in particular for metal or cryolite melts, especially iron or steel melts. The carrier may have an immersion end and a sample chamber assembly arranged on the immersion end of the carrier. The assembly may have an inlet opening and a sample cavity for the melt and can be arranged at least partially inside the carrier.

[0004] The measuring head of the carrier may comprise one or more sensors. Sensor output terminals are electrically attached to a contact end of the lance.

[0005] The lance serves for the automated machine handling or manual handling of the carrier having the measuring head. Using the lance, the carrier comprising the measuring head is immersed in the metal melt and withdrawn from the melt after obtaining the measurement and/or sample. The carrier having the measuring head is a disposable article, which is disposed of after being used once, while the lance is used multiple times.

[0006] Disposable carriers having a measuring head for obtaining measurements and metallurgical samples are described for example in US 5515739 and US 8479579 B2. These devices typically comprise a measuring head with sensors for detecting one or more of temperature, oxygen content, carbon content, bath level and a representative sample of the liquid steel. The measuring head is supported by the carrier protecting the internal wiring and electrical connections. The carrier is comprised of overlying layers of cardboard tubes. During immersion

into molten metal, the outer circumference of cardboard deteriorates quickly but is sufficiently thick to last tens of seconds during which measurements are obtained and a metallurgical metal sample withdrawn from the bath. The measuring head is removed from the lance, the metallurgical sample retrieved and the spent probe is discarded. The DC voltage data of the sensors are automatically fed to a computer which compares the actual bath conditions with a model prediction to suggest further actions to be taken to complete the steelmaking process to the target requirements.

[0007] The accuracy of the input data is dependent upon a high quality electrical connection between the output connector of the probe and receiving contacts of the lance. Whereas for example a connector of a sensor is used just once and the sensor discarded after each use, the receiving contacts of the lance must be designed to withstand repeated use. When immersed into the molten steel, the cardboard carriers are heated, emitting water vapor, tar and resins present in the cardboard, carriers. The water vapor transports these tars and resins which deposit upon the colder metallic portions of the electrical contact and its housing resulting in interruption and deterioration of the electrical sensor signals resulting in an unavailability of data or incorrect data. Each successive use of the lance deposits more and more the tars and resins and when these harden, they present a barrier to subsequent electrical connection necessitating a rigorous cleaning regime that is both labor and time intensive. To combat this, a slight nitrogen purge gas is sent down the internal hollow portion of the auxiliary lance and emerges at the connector end of the lance to flush the vapor away from the contacts. Although this purge is an improvement, it does not entirely eliminate the problem. Such an internal hollow portion of the auxiliary lance is part of a gas path within the meaning of the present invention.

[0008] This condition and a solution are well described in JP 2000-28438 A. The immersion device is equipped with an electronic circuit which digitizes the DC voltage signals and transmits these first by a single antenna wire and then by radio transmission thus avoiding, not eliminating the problem of water, tar and resin deposition on the electrical contact members of the lance. The time and expense of cleaning is compared to the additional technical effort of the radio transmitter and as a result has found limited use.

[0009] With a sampler as described in US 2014/0318276 A1, it is possible to use an inert gas purge from the lance to the sampling chamber. Reproducible gas pressure is required to obtain these rapid analysis samples thereby necessitating an electrical and gas contact system that is

free of the water, tar and resin condensates that have prevented trouble free operation of the lance measuring system.

[0010] A lance having a tubular end portion may comprise O-ring seals on the outer circumference. This tubular end portion comprising the O-ring seals has to be inserted into a detachable tubular connecting element of a coupling piece or of a carrier in order to provide a gas tight connection between the lance and the coupling piece respectively the carrier. The lance and the coupling part thus provide a gas path which may be directed to a sampling chamber.

[0011] While immersed the purge gas flow is then as anticipated however once the coupling piece is disconnected, deposition of the tars and the resin on the O-rings may take place preventing a gas tight connection between the tubular end portion of the lance and a tube of a further coupling piece.

[0012] The object of the invention is to substantially overcome or at least ameliorate one or more of the above disadvantages, or at least provide a useful alternative.

[0013] A first aspect of the present invention provides an immersion device for molten metal comprising a measuring head, a carrier for the measuring head and a lance which is detachably connected to the carrier or can be connected to the carrier.

[0014] Preferably, the lance is connected to the carrier by a detachable connecting element comprising a gas path from the lance to the carrier characterized in that there is a wiping means which wipes the connecting surface of the lance during attaching the lance and/ or detaching the lance.

[0015] Thus, replacing the carrier respectively the carrier together with the connecting element cleans the connecting surface of the lance which guarantees a gas tight connection between the tubular end portion of the lance and the tubular connecting element and allows a trouble free operation.

[0016] In at least a preferred embodiment, the wiping means are one or more fins which allow a good cleaning effect.

[0017] In at least a preferred embodiment, the wiping means and the tubular connecting element are made from one piece, thereby reducing the number of parts.

[0018] In at least a preferred embodiment, the one or more wiping means are pressed against the connecting surface of the lance when the tubular connecting element is connected to the lance. The same is true, if there is a direct connection between the carrier and the lance.

[0019] In at least a preferred embodiment, the wiping means protrudes from a tubular surface of the tubular connecting element respectively carrier which allows a good cleaning effect.

[0020] In at least a preferred embodiment, the wiping means is separated from a tubular surface of the tubular connecting element respectively carrier by one or more slits which allows a good cleaning effect due to a more flexible behavior of the wiping means.

[0021] In at least a preferred embodiment, the one or more wiping means are ring-shaped which allows a gas tight connection between a connecting surface of the lance and the detachable tubular connecting element respectively carrier.

[0022] In at least a preferred embodiment, the connecting surface of the lance is an inner surface of a tubular end portion of the lance. The connecting surface is thus protected which prevents a contamination of the connecting surface.

[0023] In at least a preferred embodiment, the wiping means are formed from metal or plastic which allows a good cleaning effect.

[0024] In at least a preferred embodiment, the wiping means provide the gas tight connection between the connecting surface of the lance and the detachable tubular connecting element respectively carrier. Further parts like O-rings are possible but not necessary in order to provide a gas tight connection which reduces the number of parts.

[0025] In at least a preferred embodiment, the carrier comprises a cardboard tube.

[0026] In at least a preferred embodiment, the measuring head comprises a sampler for molten metal or a sensor for detecting a temperature of molten metal, an oxygen content of molten metal, a carbon content of molten metal or a bath level of molten metal.

[0027] In at least a preferred embodiment, the lance is formed from metal for stability reasons.

[0028] In at least a preferred embodiment, the lance and the carrier cover an internal wiring and/or one or more electrical connections.

Brief Description of the Drawings

[0029] Preferred embodiments of the present invention will be described by way of examples only, with reference to the accompanying drawings:

[0030] Fig. 1 shows a section of an immersion device as an example of the invention.

Detailed Description of the Drawings

[0031] A section of an immersion device for molten metal according to the invention comprising a carrier for the measuring head comprising a hollow tube 2 and a lance in the form of a hollow tube 1 is shown in Fig. 1. The lance 1 can be connected to the carrier comprising the tube 2 by a detachable tubular connecting element 3.

[0032] The immersion device comprises a gas path 4 provided by the tubular lance 1, the tubular connecting element 3 and the tubular carrier 2 when the tubular lance 1, the tubular connecting element 3 and the tubular carrier 2 are connected together.

[0033] The detachable tubular connecting element comprises wiping means in the form of three ring-shaped fins 5 on an outer circumference of the tubular connecting element 3 which wipe the inner connecting surface 6 of the lance 1 during inserting the tubular connecting element 3 into the lance 1 and during detaching the tubular connecting element 3 from the lance 1. The fins 5 and the tubular connecting element 3 are made from one piece in order to avoid the production of a plurality of pieces and a need to attach the fins 5 to the tubular connecting element 3. Further, the one piece production comes with the advantage that the fins 5 are connected to the tubular connecting element 3 in a reliable and gas tight manner. Since the fins 5 extend beyond the circumference (represented by the broken line 7) of the inner connecting surface 6, the fins 5 are pressed against the connecting surface 6 of the lance 1 when the tubular connecting element 3 is connected to the lance 1. As a consequence, there is a gas tight connection between the fins 5 and the inner connecting surface 6. Since each fin 5 surrounds the tubular connecting element 3

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in a circular manner, there is a gas tight connection between the lance 1 and the tubular connecting element 3 when the tubular connecting element 3 has been inserted into the lance 1.

[0034] The fins 5 protrude from a tubular outer surface 8 of the tubular connecting element 3 as shown in Fig. 1. The fins 5 are separated from the adjacent tubular outer surface 8 of the tubular connecting element 3 by circular slits 9 so that the fins are more flexible which allows a good cleaning effect and a reliable gas-tight connection.

[0035] The connecting surface 6 of the lance 1 is an inner surface of a tubular end portion 10 of the lance 1. The inner diameter of the lance 1 can be reduced compared with the inner diameter of the tubular end portion 10 as shown in Fig. 1.

[0036] The hollow tube 2 of the carrier may be a cardboard tube. The lance 1 can be made of metal and the tubular connecting element 3 is made of plastic. The lance 1 and the hollow tube 2 of the carrier cover an internal wiring 11, 12 and electrical connectors 13, 14. The electrical connector 14 of the hollow tube 2 of the carrier is inserted into the electrical connector 13 of the lance 1 when the lance 1 is attached to the hollow tube 2 of the carrier via the tubular connecting element 3.

[0037] A ring-shaped stopper 15 for the hollow tube 2 of the carrier and the lance 1 protrudes from the outer surface 8 of the tubular connecting element 3 which facilitates the handling of the connection.

[0038] The inner diameter of the hollow tube 2 of the carrier is reduced compared with diameter of the outer surface 16 of the tubular connecting element with the exception of a tapering end portion 17. Therefore, it is possible to introduce the end portion comprising the surface 16 in a gas-tight manner into the hollow tube 2 of the carrier.

[0039] The carrier may comprise an outer hollow shaft formed for example from cardboard. A measuring head may be attached to the immersion end of the outer hollow shaft. The outer hollow shaft of the carrier may have a length of 2 m to 3m, for example a length about 2,5 m. When the lance 1 is connected to the carrier, the outer hollow shaft of the carrier may cover part of the lance 1.

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CLAIMS

1. Immersion device for molten metal comprising a measuring head, a carrier for the measuring head and a lance which is detachably connected to the carrier, wherein the lance and the carrier cover one or more electrical connectors, and there is a wiping means which are one or more fins which wipe a connecting surface of the lance during attaching the lance and/ or detaching the lance, wherein the connecting surface of the lance is an inner surface of a tubular end portion of the lance, wherein the wiping means protrudes from a tubular surface of a detachable connecting element or from a tubular surface of the carrier, and wherein there is a gas tight connection between the fins and the inner connecting surface.

2. Immersion device according to any one of the preceding claims wherein the wiping means are part of a detachable connecting element made in one piece.

3. Immersion device according to any one of the preceding claims wherein the wiping means is pressed against the connecting surface of the lance.

4. Immersion device according to any one of the preceding claims wherein the wiping means is separated from a tubular surface of a detachable connecting element or from a tubular surface of the carrier by one or more slits.

5. Immersion device according to any one of the preceding claims wherein the wiping means is ring-shaped.

6. Immersion device according to any one of the preceding claims wherein the wiping means provides a gas tight connection between the connecting surface of the lance and the detachable connecting element.

7. Immersion device according to any one of the preceding claims wherein the wiping means is part of the gas tight connection.

8. Immersion device according to any one of the preceding claims wherein the carrier comprises a cardboard tube.

9. Immersion device according to any one of the preceding claims wherein the measuring head comprises a sampler for molten metal or a sensor for detecting a temperature of molten metal, an oxygen content of molten metal, a carbon content of molten metal or a bath level of molten metal.

10. Immersion device according to any one of the preceding claims wherein the lance is formed from metal.

11. Immersion device according to any one of the preceding claims wherein the lance and the carrier cover an internal wiring.

12. Immersion device according to one of the preceding claims further comprising at least one O-ring for providing the gas tight connection.

13. Method for steelmaking wherein an immersion device according to any one of the preceding claims is used for controlling molten metal and that the carrier and the measuring head are replaced after being used for controlling molten metal.

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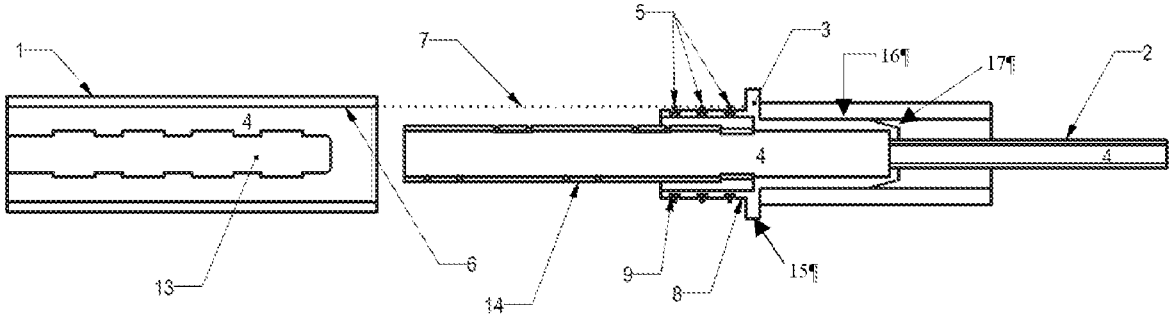

Figure 1