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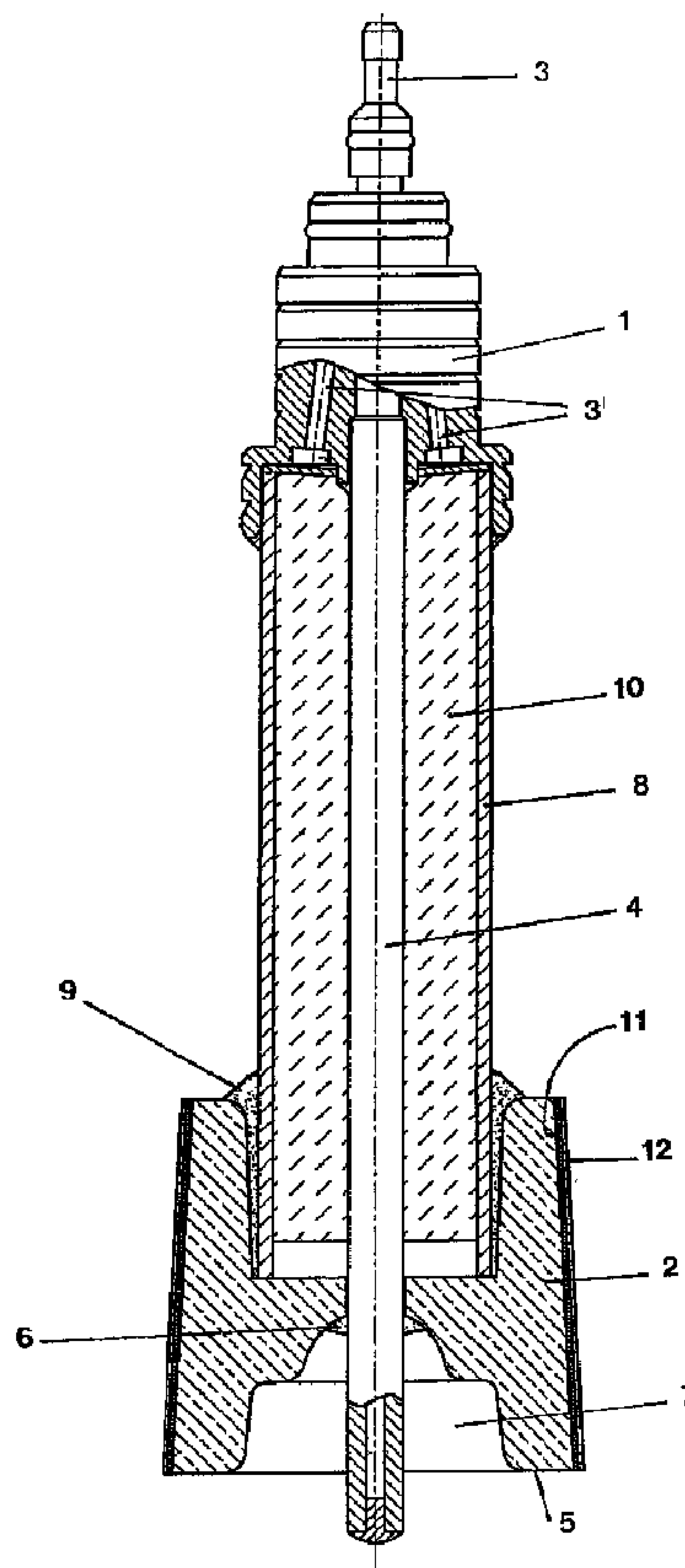
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(54) Title: DEVICE FOR COLLECTING GASES IN MOLTEN METALS AND MEASUREMENT METHOD



(57) Abrégé/Abstract:

The invention relates to a method for measuring a gas content in a molten metal, wherein gas is introduced into the molten metal, there enters into a gas exchange with gas contained in the molten metal, and then is taken up and fed into a measurement device for evaluation, wherein at least two different gases are introduced into the molten metal and evaluated, wherein both gases have a respective carrier gas and optionally an admixture of a gas, whose percentage in the molten metal is to be determined.

Abstract

The invention relates to a method for measuring a gas content in a molten metal, wherein gas is introduced into the molten metal, there enters into a gas exchange with gas contained in the molten metal, and then is taken up and fed into a measurement device for evaluation, wherein at least two different gases are introduced into the molten metal and evaluated, wherein both gases have a respective carrier gas and optionally an admixture of a gas, whose percentage in the molten metal is to be determined.

Device for Collecting Gases in Molten Metals and Measurement Method

This application is a division of Canadian Application No. 2,634,401 filed on June 6, 2008.

The invention relates to a device for collecting gases in molten metals comprising an immersion end having a collection body, a gas supply line opening at the immersion end, and a gas discharge line for the gases penetrating the collection body, wherein the gas collection body has an end face arranged on the immersion end and side walls. In addition, the invention relates to a method for measuring a gas content in a molten metal, wherein gas is introduced into the molten metal, there enters into a gas exchange with gas contained in the molten metal, and then is taken up and fed to a measurement device for evaluation, wherein at least two different gases are introduced into the molten metal and evaluated, wherein both gases have a respective carrier gas and optionally an admixture of a gas, whose percentage in the molten metal is to be determined.

Such devices are known, for example, from DE 10 2005 011 181 A1 or from EP 307 430 B1. In such devices, gases from a molten metal are collected and fed to a measurement device, so that the contents of certain gases contained in the molten metal can be measured. For this purpose, a gas supply line for feeding reference gas or carrier gas into the molten metal is led through the gas collection body and out of it at its end face. With the help of the gas supply line, reference gas is blown into the molten metal. The reference gas becomes enriched with the gases in the molten metal or, according to another procedure, the reference gas has a higher concentration of the gas to be measured than the molten metal, so that the resulting gas mixture has a smaller concentration of the gas component to be measured than the reference gas. The resulting gas mixture is taken up by the gas collection body, fed through the gas discharge line to the

measurement device, and evaluated. The measurement method is described in detail, for example, in EP 307 430 B1. Such measurement methods are also described in EP 563 447 A1.

Similar devices are known from US 6,216,526 B1 and from EP 295 798 A1.

An object of the present invention is to improve the known gas collection devices and to increase the efficiency of the collection process and also the measurement method.

The object is achieved by the features of the independent claims. Preferable embodiments follow from the dependent claims. Due to at least one part of the gas collection body having a gas impermeable layer, it is thus possible to capture a larger portion of the gases by the gas collection body and to feed this portion to the gas discharge line and thus to the measurement device, because the gases penetrating into the gas collection body, at least essentially, can no longer leave the gas collection body except from the gas discharge line, so that a significantly larger portion of the gases taken up in the gas collection body can be fed to the measurement device. In this way, the measurement is simpler, quicker, and finally also more precise.

It is expedient that at least one part of the outer side walls have a gas impermeable layer. The gas collection body itself can have on its end face a hollow space, already known from the prior art (see above). The gases coming out of the melt initially collect in this hollow space. They then penetrate into the gas collection body, because they cannot escape any other way from the hollow space. Due to the side shielding by the gas impermeable layer, the gases can escape only into the gas discharge line. For this purpose, the gas impermeable layer can be arranged on the

surface of the side walls of the gas collection body. It is advantageous that the layer be formed of at least two sub-layers arranged one on top of from the other. The lower sub-layer facing the interior of the gas collection body can be made of metal, in particular, from a metal with a higher melting point than iron. The metals can be, in particular, molybdenum, titanium, vanadium, chromium, niobium, or an alloy with at least one of these metals. The lower, inner sub-layer is gas-tight. An outer sub-layer facing away from the interior of the gas collection body and made of ceramic can be applied on this inner sub-layer. This outer sub-layer can act as a protective layer for the lower sub-layer made of metal arranged between it and the gas collection body. The outer sub-layer can be formed preferably from oxide ceramic or a silicate, in particular from zirconium dioxide, aluminum oxide, chromium dioxide, zirconium silicate, aluminum silicate, or spinel.

The gas collection body can be almost completely surrounded with the layer, wherein only the end-face gas inlet into the gas collection body and the entrance to the gas discharge line from the gas collection body are not coated. It is sensible to leave the entire end face of the gas collection body uncoated or even only the surface of the end-face hollow space of the gas collection body. Preferably, at least one of the sub-layers is applied by plasma spraying.

Expediently, the gas collection body can have a cylindrical or conical side wall. The gas discharge line is preferably arranged on the back wall of the gas collection body lying opposite the end face. The gas discharge line can be arranged, for example, on a gas supply connector or in an opening of the gas collection body.

The device is used according to the invention for measuring the gas content in a molten metal. Measurements are possible, for example, in a wide variety of different molten metals. The gas collection body itself is impermeable to the molten metal, but exhibits very good gas permeability and receptivity for the gases to be measured.

According to the invention, the measurement method is characterized in that the concentration of the admixed gas lies either below in each case of gas introduction or above in each case of gas introduction the concentration of the gas to be measured in the molten metal. Here, the method starts with the assumed gas concentration in the molten metal, and a concentration either significantly below or significantly above the expected concentration in the molten metal is selected for the gas to be introduced. Then, for the two gases, the gas to be measured is either absorbed or desorbed in the molten metal. Thus, the measurement is performed with two (or more) gases, which are independent of each other. Here, the same or different carrier gases can be used. The gases introduced into the melt absorb gas from the melt if the concentration of the gas to be determined in the molten metal is higher than the concentration of this gas in the introduced gas, so that, as the introduced gas, also a pure carrier gas can be used and the concentration of the gas to be measured can be zero in the introduced gas. In the opposite case, the molten metal absorbs gas from the introduced gas, because in each case the goal is naturally equilibrium. For the measurement, the circumstance can be used that the absorption and the desorption characteristics of different gases in molten metals can be different.

As the carrier gas, inert gases can be used, preferably argon and/or nitrogen. As the admixed gas, carbon monoxide can be used, so that the carbon monoxide content in the molten metal can be measured.

An embodiment of the invention will be explained in more detail below with reference to a drawing.

Figure 1 shows a device according to the invention, partially in section.

The device shown in the drawing is fixed to an attachment nozzle 1 on a carrier tube (not-shown) and is immersed with this tube into a molten metal. The gas collection body 2 is immersed into the molten metal, in order to perform the gas exchange.

In the attachment nozzle 1 there are gas connections 3; 3'. Here, the central gas connection 3 opens into the gas supply line 4 arranged centrally in the device. This supply line is guided centrally through the gas collection body and ends beneath the end face 5 of the gas collection body. Carrier gas is introduced into the molten metal through the gas supply line 4. The gas supply line 4 is made essentially of a quartz tube, which can be bent on its immersion end, so that the opening is oriented in the direction of the gas collection body 2. The gas supply line 4 is fixed in the gas collection body 2 by means of cement 6. The carrier gas flowing into the molten metal through the gas supply line 4 absorbs gases from the molten metal, rises into the hollow space 7 of the gas collection body 2, and penetrates from there and from the end face 5 into the gas collection body 2. This is formed of a porous material, for example of cement. A ceramic

body, for example aluminum oxide, is also possible. The gas penetrates upward into the gas discharge line through the pores of the gas collection body. This discharge line is formed essentially of a quartz glass tube 8, which is fixed in the gas collection body 2 by cement 9. In the quartz glass tube there is a porous filling 10 made of aluminum oxide, for example in a spherical shape. Through the filling 10 the carrier gas mixed with gas from the molten metal is discharged through the gas connections 3' to a measurement device. There, the extracted gas is compared with the gas introduced into the molten metal, and thus the gas absorbed (or desorbed) from (or to) the melt is evaluated, and the gas content in the molten metal is determined thereby. This process is sufficiently well known *per se* and described, for example in EP 307 430 B1 (or similarly in EP 563 447 A1). Argon is used as the carrier gas of the introduced gas. Carbon monoxide at a percentage of more than 2.5% (for example 5% and 10%) is admixed with the carrier gas for measuring the carbon monoxide content in the molten steel, since the expected gas content lies at 2.5%.

The gas collection body 2 has on its conical outer surface a gas impermeable layer made of a lower sub-layer 11 and an outer sub-layer 12. The lower sub-layer 11 is formed of molybdenum. The outer sub-layer 12 is used as a protective layer and is made of spinel.

In principle, the gas impermeable layer can also be arranged on the end of the gas collection body 2 facing the immersion end. However, in the normal case this is not necessary, because the surfaces provided there are small, so that gas leakage occurs only to an insignificant extent. Therefore, in practice all of the gas taken up by the device is fed into the gas discharge line defined by the quartz glass tube 8.

With the device, the content of hydrogen or nitrogen in molten steel can also be determined.

Claims

1. Method for measuring a gas content in a molten metal, wherein gas is introduced into the molten metal, there enters into a gas exchange with gas contained in the molten metal, and then is taken up and fed to a measurement device for evaluation, wherein at least two different gases are introduced into the molten metal and evaluated, wherein both gases have a respective carrier gas and optionally an admixture of one gas, whose percentage in the molten metal is to be determined, characterized in that the concentration of the admixed gas lies either below in each case of gas introduction or above in each case of gas introduction the concentration of the gas to be measured in the molten metal.
2. Method according to Claims 1, characterized in that the introduced gases have different carrier gases.
3. Method according to Claims 1 or 2, characterized in that an inert gas is used as the carrier gas.
4. Method according to Claim 3, wherein the inert gas is one or more selected from the group consisting of argon and nitrogen.
5. Method according to any one of Claims 1 to 4, characterized in that the admixed gas is carbon monoxide.
6. Method according to Claim 2, characterized in that the concentration of the gas admixed to the carrier gas can be zero in the base of a lower concentration than the concentration of the gas to be measured.

FIG. 1

