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(54) **MODIFICATION BODY**

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(57) **ABSTRACT**

The invention relates to a modification body for the production of spheroidal graphite cast iron and to the method for producing a cast part using the modification body according to the invention, and to the cast part itself. The modification body serves for the production of spheroidal graphite cast iron, in particular with a predominantly ferritic structure, containing a carrier material, preferably an iron-silicon alloy, wherein the modification body contains 7-16 weight percent of boron.

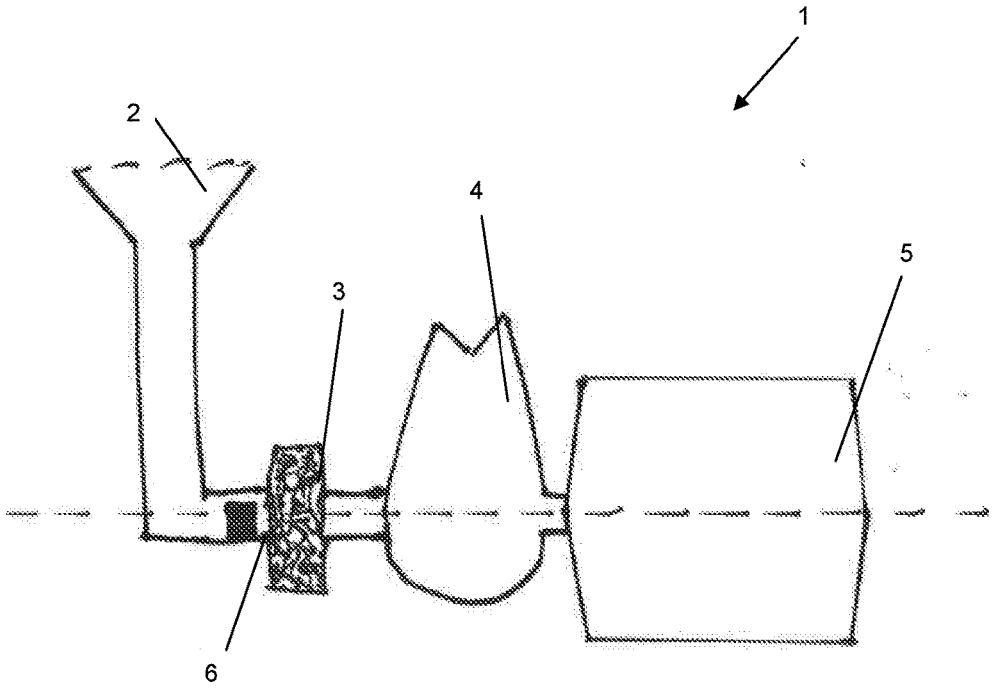

FIG. 1

MODIFICATION BODY

CROSS REFERENCE TO RELATED APPLICATIONS

[0001] This application claims benefit to European Patent Application No. EP 15 194 848.6, filed Month Nov. 17, 2015, which is incorporated by reference herein.

FIELD

[0002] The invention relates to a modification body for the production of spheroidal graphite cast iron, to a method for producing a cast part using such a modification body, and to a cast part produced using such a method.

BACKGROUND

[0003] Cast iron generally contains between 2 and 4 weight percent of carbon. The carbon is intimately mixed with the iron and the form that the carbon adopts in the solidified cast iron defines the features and properties of the cast iron parts. If the carbon adopts the form of graphite, the cast iron is rather soft and can be processed mechanically.

[0004] Graphite can occur in various forms. Spheroidal graphite cast iron has high strength, but it is necessary to take into account the structure types. Cast iron with spherical graphite having a purely ferritic structure, and thus contains no cementite, is soft and easily worked. By contrast, spheroidal graphite cast iron and a pearlitic structure has good abrasion properties due to the high strength. In turn, a pearlitic/ferritic structure is stronger than a purely ferritic structure.

[0005] The production of cast iron involves the use of steel scrap and also circulating material as starting material. Since such a starting material generally contains a large amount of Mn and Cu, the pearlite content in the resulting cast iron or cast part is higher than desired. In addition, the excessive pearlite content in the cast part is promoted by accelerated cooling.

[0006] In order to reduce or suppress the excessive formation of pearlite, the strategy high-purity steel scrap and/or high-grade pig iron, which contain little Mn and Cu, can be added into the casting alloy. Market availability of steel scrap and pig iron of this type is limited, and they are therefore expensive to source. If the excessive Mn and/or Cu content is identified only after melting, this can at best be corrected only by diluting the melt with a melt having low Mn and/or Cu content. However, this is expensive and in most cases very difficult to achieve, such that the parts produced have excessive pearlite content and therefore excessive strength, and cannot be used for the intended purpose and must be scrapped.

SUMMARY

[0007] In an embodiment, the present invention provides.

BRIEF DESCRIPTION OF THE DRAWING

[0008] The present invention will be described in even greater detail below based on the exemplary figures. The invention is not limited to the exemplary embodiments. All features described and/or illustrated herein can be used alone or combined in different combinations in embodiments of the invention. The features and advantages of various embodiments of the present invention will become apparent by reading the following detailed description with reference to the attached drawings which illustrate the following:

[0009] The FIGURE shows a schematic illustration of a casting system having a modification body according to an embodiment of the invention.

DETAILED DESCRIPTION

[0010] A modification body and an associated method for the production of spheroidal graphite cast iron are described herein that can reduce the pearlite structure in cast iron or a cast part and thus ensure a lower hardness and a greater elongation at break, without increasing the production cost of the cast iron or the cast part.

[0011] A modification body according to an embodiment of the invention serves for the production of spheroidal graphite cast iron, in particular with a predominantly ferritic structure, containing a carrier material, preferably an iron-silicon alloy.

[0012] A modification body according to an embodiment of the invention is configured to be inserted into the casting system, where the cast iron or the melt flows around it. A modification body according to an embodiment of the invention is configured to be added to the melt and dissolved thereby prior to casting. This produces a cast part made of spheroidal graphite cast iron, having a boron content of 0.002-0.008 weight percent.

[0013] The pearlite-reducing influence of boron is known, but hitherto considered negative in the production of spheroidal graphite cast iron since excessive boron content can lead to microporosity and carbides, which are problematic above 0.01 weight percent, and, when further increased, also lead to great degeneration of graphite.

[0014] In order to reduce the pearlite content in the cast iron, and thus increase the elongation at break and reduce the hardness, at least one modification body according to an embodiment of the invention, containing 7 to 16 weight percent of boron, is inserted, prior to casting, into the casting system for a cast part. During the mould-filling procedure, the cast iron, or the melt, flows around the modification body such that the modification body continuously yields boron which is taken up by the cast iron. To that end, at least one modification body is inserted, prior to casting, into the casting system. It is also possible for multiple modification bodies to be arranged in the casting system. The number of modification bodies arranged in the casting system can be chosen depending on the required boron content in the cast part.

[0015] A cast part according to an embodiment of the invention, made of spheroidal graphite cast iron, has a boron content of 0.002-0.008 percent weight, which suppresses or reduces pearlite formation and achieves the desired properties in terms of hardness and elongation at break.

[0016] As described herein, at least one modification is configured to be arranged between the pouring cup and the filter prior to casting and the cast iron, or the melt, is flowed around the modification body during casting. It is also possible for at least one modification body to be configured to be added directly to the cast iron or to the melt prior to casting.

[0017] A number and an arrangement of modification bodies can be chosen depending on the boron content required in the cast part, or to achieve a desired hardness and elongation at break.

[0018] A cast part with spheroidal graphite according to an embodiment of the invention, produced using a method according to an embodiment of the invention, preferably has a predominantly ferritic structure.

[0019] A method according to an embodiment of the invention and the use of the modification body according to an embodiment of the invention results in the production of a cast part made of spheroidal graphite cast iron, which preferably does not exceed a Brinell hardness of 170 HB. A Brinell hardness of 140-170 HB has been found to be advantageous.

[0020] The structure of a cast part made of spheroidal graphite cast iron according to an embodiment of the invention is preferably predominantly ferritic.

[0021] In an example case, a melt of spheroidal graphite cast iron has, due to the use of impure steel scrap as the starting material, a Mn content of 0.35 wt %, which is too high for the desired application since, according to the analysis specifications in this case the maximum permissible Mn content is 0.25 wt %. As a consequence of the excessive Mn content in the present melt or cast iron, the cast parts had a Brinell hardness of 190 HB instead of the maximum 170 HB which is permissible according to the specifications. The actual Brinell hardness of 190 HB and a corresponding pearlite content of 30% by area, instead of a maximum prescribed pearlite content of 25% by area, resulted in the cast parts having to be scrapped.

[0022] For that reason, for a casting weight of 50 kg, a 50-gram modification body containing 10% boron was inserted into each casting mould into the casting system, preferably between the pouring cup and the filter or upstream of the filter. As a result, boron is continuously given off to the melt during the casting procedure, such that the cast parts have a boron content of 0.006 wt %, resulting in a pearlite content of 19% by area and a Brinell hardness of 167 HB, and the cast parts were accordingly fit for use and corresponded to the stipulated specifications.

[0023] The FIGURE shows a schematic view of a casting system **1**, wherein the modification body **6** according to the invention is arranged upstream of the filter **3**, indicating a possible arrangement of the modification body **6**. The melt of spheroidal graphite cast iron is introduced into the casting system **1** via the pouring cup **2**. The melt flows around the modification body **6**, drawing therefrom the desired quantity of boron. Then, the melt flows through the filter **3** in order for undesirable impurities to be filtered out. The melt in the subsequent feeder **4** serves to continuously re-supply the melt in the cast part **5** during cooling.

[0024] While the invention has been illustrated and described in detail in the drawings and foregoing description, such illustration and description are to be considered illustrative or exemplary and not restrictive. It will be understood that changes and modifications may be made by those of ordinary skill within the scope of the following claims. In particular, the present invention covers further embodiments with any combination of features from different embodiments described above and below.

[0025] The terms used in the claims should be construed to have the broadest reasonable interpretation consistent with the foregoing description. For example, the use of the article "a" or "the" in introducing an element should not be interpreted as being exclusive of a plurality of elements. Likewise, the recitation of "or" should be interpreted as being inclusive, such that the recitation of "A or B" is not exclusive of "A and B," unless it is clear from the context or the foregoing description that only one of A and B is intended. Further, the recitation of "at least one of A, B and C" should be interpreted as one or more of a group of elements consisting of A, B and C, and should not be interpreted as requiring at least one of each of the listed elements A, B and C, regardless of whether A, B and C are related as categories or otherwise. Moreover, the recitation of "A, B and/or C" or "at least one of A, B or C" should be interpreted as including any singular entity from the listed elements, e.g., A, any subset from the listed elements, e.g., A and B, or the entire list of elements A, B and C.

1. A modification body for the production of spheroidal graphite cast iron with a predominantly ferritic structure, the modification body comprising:

a carrier material; and

boron,

wherein the boron content of the modification body is 7-16 percent weight.

2. A method for production of a cast part made of spheroidal graphite cast iron, the method comprising:

inserting, into a casting system prior to casting, at least one modification body comprising a carrier material and boron, wherein the boron content of the modification body is 7-16 percent weight.

3. The method for the production of a cast part made of spheroidal graphite cast iron according to claim **2**, wherein the at least one modification body is inserted, prior to casting, into the casting system between a pouring cup and a filter.

4. The method for the production of a cast part made of spheroidal graphite cast iron according to claim **2**, wherein at least one modification body is added to a melt prior to casting.

5. The method for the production of a cast part made of spheroidal graphite cast iron according to claim **2**, wherein a number of the at least one modification body is chosen so as to achieve a boron content in the cast part of 0.002-0.008 percent weight.

6. The method for the production of a cast part made of spheroidal graphite cast iron according to claim **2**, wherein a number of the at least one modification body is chosen so as to achieve a Brinell hardness of at most 170 HB.

7. A cast part, the cast part being produced by a method comprising:

inserting, into a casting system prior to casting, at least one modification body comprising a carrier material and boron, wherein the boron content of the modification body is 7-16 percent weight,

wherein the cast part is made of spheroidal graphite cast iron and has a boron content of 0.002-0.008 percent weight.

8. The cast part according to claim **7**, wherein the cast part has a maximum Brinell hardness of 170 HB.

9. The cast part according to claim **7**, wherein the cast part has a predominantly ferritic structure.

10. The modification body according to claim **1**, wherein the carrier material is an iron silicon alloy.

11. The method for the production of a cast part made of spheroidal graphite cast iron according to claim **5**, wherein the cast part made of spheroidal graphite cast iron has a predominantly ferritic structure.

12. The method for the production of a cast part made of spheroidal graphite cast iron according to claim **6**, wherein the Brinell hardness is in the range 140-170 HB.

13. The cast part according to claim **8**, wherein the Brinell hardness is in the range 140-170 HB.

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