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METHOD OF TREATING A FERROUS MELT WITH A POROUS SINTERED METAL BODY IMPREGNATED WITH A TREATING AGENT

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An iron or steel melt often must be subjected to additional alloying or refining treatments in the melting furnace and even after the same before the melt can be cast to ingots in moulds. Examples of such after-treatments of the melt are deoxidation, desulfurization, denitrogenizing, dephosphorizing, deslagging, degasing and alloying but also other treatments may be required by which the content of some non-desirable substance in the melt is removed or decreased to a desired degree. Many of these treatments have been known since the beginning of production process for the steel or ferro-alloys; others have been invented later on when the utilization of impure raw materials has brought about the introduction of non-desired impurities. Modern technique demands more and more highly alloyed steels and these are often very difficult to work in heated as well as in cold condition. It has often turned out that the malleability is unfavorably affected by even very small contents of impurities which have no influence on the working of simpler steels. In order to decrease or remove such contents of impurities new refining methods have been invented for the molten steel and also the additions to the steel melt, e.g. ferro-alloys, for the same reason should be refined by means of similar refining processes.

In deoxidizing, desulfurizing, dephosphorizing, denitrogenizing etc. the content of oxygen, sulfur, phosphorus, nitrogen etc. of the melt is to be decreased, and this is performed by means of substances which have a higher affinity for oxygen, sulfur, phosphorus, nitrogen etc. than for the elements entering into the steel or alloy. The compounds of oxygen, sulfur, phosphorus and nitrogen formed from such additions should preferably be non-soluble in the melt and should have such a melting point, specific gravity, viscosity etc. that they can easily and as completely as possible be separated from the metal melt and collected in the slag.

When degasing a melt the same should be intimately brought into contact with the degasing agent. This degasing agent generally is a gas and a condition for a good degasification is that the partial pressure of the gas constituent to be removed is low in the purifying gas and that the latter is supplied and distributed in such a way that it comes into a most intimate contact with all parts of the melt. As degasifying agents there can be used gases which not at all or only very slowly react with the main constituents of the melt, e.g. helium, argon, nitrogen etc. Alternatively there could be added to the melt a substance, suitably a metal or alloy with a boiling point below the solidifying point of the melt, which metal or alloy when contacting the melt is gasified. Such metals or alloys are, for instance, calcium, silicon-calcium-alloys, magnesium, nickel-magnesium-alloys and others. In most cases of the last mentioned examples the additions have a very strong deoxidizing influence and it is even possible that the influence of the metal gas formed at the contact with the melt as a "washing agent"

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has been overlooked. Since these last mentioned additions have a very low specific gravity, the contact with the melt with certainty will be bad and the degasifying influence incomplete and insignificant. Blowing of gas into the melt according to the first mentioned alternative is difficult to perform in such a manner that gas becomes well distributed and all parts of the melt treated.

The present invention relates to supply bodies for metal melts which make possible an effective washing of the bath or the melt with gas and/or simultaneously have a strong deoxidizing, desulfurizing, dephosphorizing, denitrogenizing, etc. action and may in some other way exert a refining action and possibly also alloy with the melt.

The supply bodies according to the invention are mainly characterized in that they consist of a porous body or skeleton produced from at least one of the elements of the melt, the pore volume of which is partially or completely filled with a refining and/or alloying agent. More particularly the supply body may consist of a skeleton of a solid porous body of iron or steel or its alloys or of alloying metals intended for iron and steel alloys, the pore volume of which is completely or partially filled with a refining substance which at the temperature of the bath or melt, melts and in some cases is gasified so that it is emitted in the bath or melt.

The skeleton may consist of a powdrous metal bonded to briquettes or other shaped bodies by means of binding agents or by sintering, said bodies having a suitable size so that they can easily and effectively be added to a melt.

The refining agent can consist of an alkali metal, alkaline earth metal, magnesium, zinc or lead or of an alloy of such metals or of another chemical element or of a compound having a low melting point in relation to the solidifying temperature of the melt or with no or only insignificant affinity for the main constituents of the melt.

Since the material of the skeleton consists of one or more metals, one or more metal alloys, intermetallic compounds, compounds between metals and metalloids such as carbides, silicides etc. or mixtures of these different substances, said skeleton, when contacting the melt will be dissolved or disintegrated without contaminating the same and it shall further not at all or only to an insignificant degree react with the degasifying or refining agent in such a way that the purifying action of this agent is lost. As has already been mentioned the material of the skeleton can be brought to a suitable porous form by briquetting and/or sintering a material which has been crushed to a suitable grain size or mechanically or otherwise transformed to chips or particles with or without the addition of binding agents as well as by atomizing or granulating and agglomeration in a manner known per se.

Especially suitable for the treatment of steel melts are shaped bodies produced from iron powder and/or comminuted ferro-alloys or mixtures of these substances and produced with or without the addition of binding agents, which shaped bodies have been sintered by heating to a suitable temperature in a protecting gas. Such sintering is advantageous since the shaped body thus acquires sufficient mechanical strength to resist the often relatively high internal pressures occurring when the refining agent enclosed in the pores of the shaped body is gasified. The grain size of the material from which the shaped bodies are made is of a certain importance. If a finely grained material is used the pores become so small that the impregnation is very time-consuming. Further, the heated body then becomes unnecessarily expensive. Coarser material results in bigger pores which may be disadvantageous, since the degasifying or refining agent in such a case can be emitted too rapidly after the addition to the melt. A suitable grain size for most

purposes is 0.05–1 mm., but coarser as well as finer grains can be used. The porosity in percent should not be too high since the specific gravity of the impregnated shaped bodies would be undesirably low. If on the other hand a greater porosity is required in order to make possible or facilitate the impregnation, the refining agent can be alloyed with a heavier substance in order to avoid a too low specific gravity of the shaped body. The porosity can vary between 5 and 70% but should suitably be between 15 and 50%. As an example a silicon iron briquette with 30% porosity can be mentioned. If such a briquette is impregnated with magnesium, the specific gravity becomes about 5.0. If the same briquette is instead impregnated with a magnesium-zinc-alloy the specific gravity becomes about 5.5. Magnesium melts at 650° C. and is then relatively viscous. The magnesium-zinc-alloy in this example melts at 341° C. and is free flowing. Consequently, the impregnation is much simpler to perform in the latter case.

The refining agent is introduced into the skeleton by impregnating in gaseous or liquid form. In the latter case pieces of the skeleton material are introduced into a melt, consisting of or containing the refining agent or into a solution of the same at a suitable temperature, or the solution or melt can be pressed under suitable pressure through suitable guiding means against one or more surfaces of the porous skeleton body which should then have a suitable regular form. In order to facilitate the penetration into the porous skeleton of substance according to the first mention alternative, the pore system can be evacuated before the refining agent is supplied, or the pore system can be filled with a gas which reacts with and is consumed by the refining agent during its penetration into the pore system. If the refining agent is of such a kind that it is attached or harmed by the constituents of air the above mentioned treatments should be carried out in a suitable protecting gas and the impregnated lumps should be treated in such a way that they are protected against the influence of air, e.g. by coating with a protecting layer of a film-forming material such as paraffine or the like.

Below some examples are given of supply bodies according to the invention:

(1) A sintered sponge iron briquette with 30% porosity is filled with metallic sodium to a net specific gravity of about 5.7. The sodium content is about 5%. 1 kg. of this sodium impregnated briquette delivers about 325 litres of sodium gas at 760 mm. pressure and 1600° C. temperature.

(2) A sintered silicon iron briquette with 40% porosity is filled with sodium. The silicon content is about 22%, sodium content about 10% and specific gravity about 4.3. 1 kg. of this sodium-filled briquette delivers about 750 litres of sodium gas at 760 mm. pressure and 1600° C. temperature.

(3) A sintered silicon-iron briquette with 40% porosity is filled with magnesium. The silicon content is about 20%, magnesium content about 15% and specific gravity 4.6. 1 kg. of this magnesium impregnated briquette delivers about 1000 litres of magnesium gas at 760 mm. pressure and 1600° C. temperature.

(4) A sintered silicon-iron briquette with 20% porosity is filled with calcium-magnesium. The silicon content is about 24%, magnesium content about 5%, calcium content about 1% and specific gravity about 5.5.

(5) A sintered silicon-iron briquette with 30% porosity is filled with calcium-zinc. The silicon content is about 20%, calcium content about 7.5%, zinc content about 6% and specific gravity about 5.2.

(6) A sintered silicon-iron briquette with 30% porosity is filled with magnesium-zinc. The silicon content is

about 20%, magnesium content 7.5%, zinc content about 9% and specific gravity 5.5.

(7) A sintered silicon-manganese briquette with 30% porosity is filled with sodium. The silicon content is about 18.5%, manganese content about 65%, sodium content about 6.5% and specific gravity about 4.65.

(8) A sintered nickel briquette with 30% porosity is filled with sodium. The nickel content is about 95%, sodium content about 5% and specific gravity about 6.45.

Examples 1–3 above are suitable for deslagging and degasifying steel, Example 4 for the production of so called nodular cast iron, Examples 4–6 for desulfurizing and dephosphorizing pig iron, Example 7 for deslagging steels for roller bearings and Example 8 for deslagging and purifying nickel, high alloyed nickel steels, corrosion resistant steels, etc.

The invention also involves a method for producing the above described shaped bodies which is mainly characterized in that a strong porous shaped body is first produced as a skeleton after which the pore volume of this body is completely or partially filled with the refining agent.

I claim:

1. The method of treating molten cast iron which comprises introducing into said molten cast iron a porous sintered iron body the pores of which are at least partly filled with magnesium.

2. The method of treating a molten metal selected from the group consisting of iron, pig iron, steel, ferro alloys, nickel and nickel steels which comprises introducing into said molten metal a porous sintered metal body comprising a metal selected from said group, said porous body having its pores at least partially filled with a treating agent having a melting point below the temperature of said molten metal and comprising a metal selected from the group consisting of the alkali metals, the alkaline earth metals, magnesium, zinc and lead.

3. The method as defined in claim 2 in which the porous sintered metal body has a porosity of from 5% to 70%.

4. The method as defined in claim 2 in which the treating agent comprises a refining agent for the molten metal.

5. The method as defined in claim 2 in which the treating agent comprises an alloying agent for the molten metal.

6. The method as defined in claim 2 in which the treating agent has a boiling point which is below the temperature of the molten metal.

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