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METHOD WHEN DEGASSING CARBON-CONTAINING METAL MELTS

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The invention concerns a method for degassing carbon-containing metal melts especially melts of alloyed steels.

The invention is based on the well known method, to degas metal melts, which is described in the British patent application No. 772,515, which means blowing of jets of inert gases towards the surface of the melt. The inert gases act as a vacuum with respect to the dissolved gases in the melt.

During the refining of, for example, alloyed steels according to known methods, especially in the case of oxygen blowing, it is impossible to avoid formation of considerable amounts of "iron fume" in connection with the oxidation of iron as well as of more expensive alloying metals, for example Cr. These metal oxides are retained in suitable slags. By adding reducing agents or metals these metal oxides have to be reduced back into the melt in order to decrease the losses. The refining is usually carried out in an electric arc furnace, involving the further disadvantage of a rediffusion of carbon into the newly refined melt.

The purpose of the invention is to find a method for selective oxidation of undesired elements in steel melts in connection with the degassing of metal melts in order to counteract the above mentioned disadvantages and also to counteract the formation of "iron fume."

The addition of an inert gas can be regarded as a dilution of the oxygen acting in the direction of a selective oxidation, namely an oxidation of carbon and other easily oxidizable elements like silicon and manganese but not of elements that do not oxidize so easily, for example chromium, iron, nickel and cobalt. Another reason for the fact that these latter elements do not oxidize is the comparatively low temperature at the bath surface which is partly due to the dilution of the oxygen, partly to the cooling action of the inert gas.

As inert gas we prefer to use a rare gas, especially argon, because these gases do not react with any component of the metal melt.

It is the composition of the melt and especially its carbon content which determines the maximum of oxygen content in the inert gas. If this maximum limit is exceeded, the formation of the iron fume is heavily increased, the fume being readily visible. This will enable the operator to control the oxygen content so that the allowed limit is not exceeded during the whole refining period. It is preferable to start blowing with only the inert gas in order to get a degassing of the melt before oxygen is added. Thereafter such an amount of oxygen is added to the gas, that heavy formation of fume is avoided. As the carbon content of the melt decreases the oxygen content is reduced. When the desired carbon content has been obtained it is preferable to blow only inert gas.

The process of oxidizing according to the invention is followed by an increase of temperature in the steel bath. In order to avoid that the temperature gets too high it is preferable to blow alternatingly with a mixture of oxygen and inert gas and with inert gas only. During the blowing with inert gas only, which can be effected several times, a degassing takes place, which is more effective than if

the degassing were carried out only before and after the oxidizing blowing process.

In order to avoid that the temperature gets too high in that part of the steel bath where the gas jet containing oxygen hits the bath surface it is preferable to move the contact surface between the bath and the gas jet. This can be done by moving the nozzle through which the gas mixture is blown, or by using several stationary nozzles while alternatingly supplying the gas mixture to one of said nozzles, or to several nozzles at the same time.

It is preferable that such an excess pressure is created in the part of the furnace lying above the metal that air cannot penetrate into the furnace. This can easily be arranged by adjusting the outlet opening for the gas in the top of the furnace, so that the gas pressure will be 10–50 mm. water head.

Usually the process can be carried out without adding slag-forming constituents. If the oxidation should result in oxides, e.g. acid slags, which have a tendency of attacking the lining of the furnace it is preferable to add, for example, basic slag-forming constituents to counteract such an attack. The amount of these slags is, however, small in comparison with the amount of slag which has to be added when using known methods.

As an example we will describe the degassing and refining of the heat resistant, austenitic steel NYBY–ARW–4 having the following approximate chemical composition:

C=0.05%, Cr=15%, Ni=25%, Si=0.4%, Mn=0.3%, V=0.3%, Mo=0.3% active Ti-content=2%.

The term "active Ti-content" relates to the content of titanium which is not chemically combined with, for example, oxygen, carbon or nitrogen. It is important that the contents of oxygen, carbon and nitrogen in the steel are low before the addition of titanium, partly in order to avoid losses of titanium, partly in order to avoid the formation of undesired titanium compounds in the steel.

At first a steel melt was made containing all the elements desired except titanium and with a carbon content of 0.10%. The melting took place in a radiation tube furnace. The temperature of the melt was kept at about 1650° C. During the heating and melting, a powerful jet of practically pure argon was blown against the charge and the surface of the bath. This practically pure argon was obtained by leading commercial grade argon having an oxygen content of about 2% through layers of iron chips plus titanium sponge at a temperature of 875° C. After the steel had been molten and degassed the purification apparatus for the argon was shut off which resulted in blowing argon containing about 2% oxygen against the surface of the bath. During this last mentioned blowing the above described selective oxidation took place and was continued until the carbon content in the melt had been reduced below 0.01%. After that the mentioned purification apparatus for the argon was again put into use and the desired amount of titanium was added in the form of a titanium-nickel alloy, which had been degassed in the described manner with the help of pure argon. The finished steel was cast and allowed to solidify in a protecting atmosphere of pure argon.

The loss of titanium was only 3% of the added total amount of titanium. The lost quantity of titanium was found in the thin layer of slag which was formed on the surface of the steel bath.

When manufacturing, for example, low carbon stainless steels using scraps, the same method is used in principle but with the modification that the purification of the commercial grade argon gas is not necessary.

The method according to the invention can be applied advantageously not only when manufacturing common

or special steels but also for the remelting of scraps while simultaneously adjusting the chemical composition.

The method can be combined with simultaneous blowing of argon or argon plus oxygen into the melt.

What is claimed is:

1. A method for decarburizing and degassing molten steel, comprising blowing at least one powerful jet of an inert gas against the surface of the molten steel, thereafter adding oxygen to said jet of inert gas in a quantity sufficient for oxidizing carbon but insufficient for producing heavy iron fume, and continuing adding oxygen until the desired carbon content has been reached.

2. The method according to claim **1**, characterized in that the final blowing is effected with inert gas only.

3. The method according to claim **1**, characterized in that the addition of oxygen is increased comparatively fast to a maximum and subsequently decreased in relation to the decreasing carbon content of the melt.

4. The method according to claim **1**, characterized in that the process of oxidation is made in several steps, alternating with degassing blowings by means of the inert gas.

5. The method according to claim **1**, in which the inert gas is argon and in which substantially pure argon is blown against a charge of the carbon-containing metal whilst the same is being melted and then degassed, whereafter oxygen-containing argon is blown against the surface of the melt.

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