

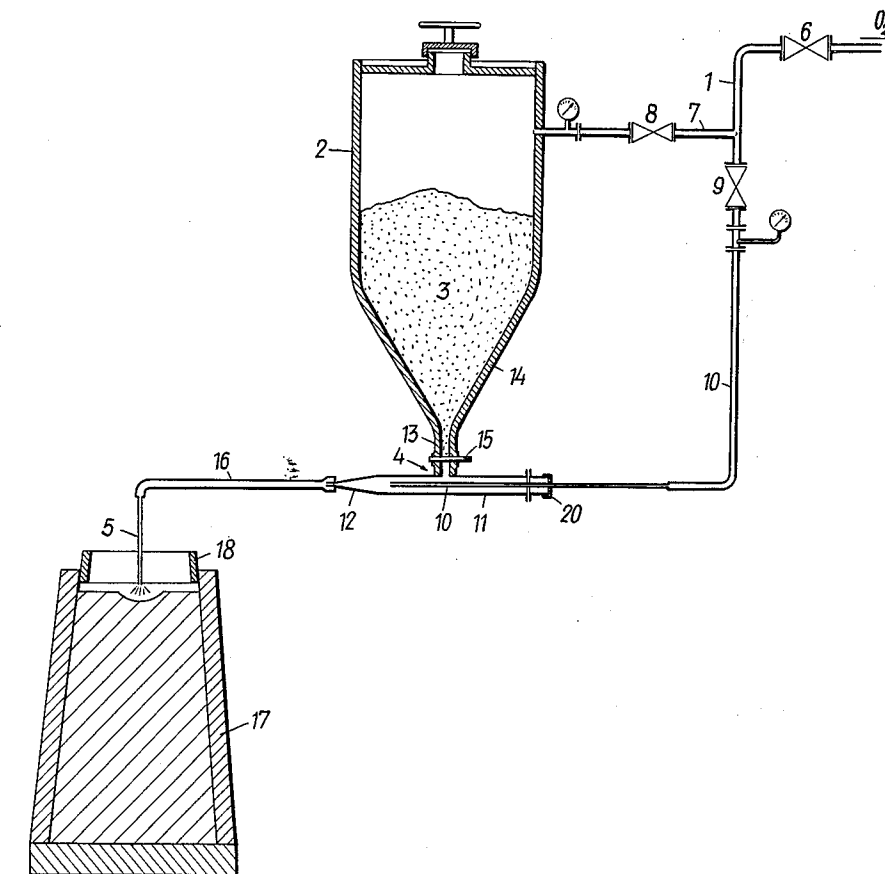
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METHOD AND APPARATUS OF TREATING INGOTS OF IRON OR STEEL

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METHOD AND APPARATUS OF TREATING
INGOTS OF IRON OR STEEL

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tiengesellschaft, Linz, Austria, a company of Austria
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2 Claims. (Cl. 75—51)

This invention relates to a method of treating ingots of iron or steel, particularly of steel ingots having a weight of more than 8 metric tons, and has as its object to avoid or minimize segregation.

In the casting of steel ingots of large size, particularly of ingots having a weight exceeding 8 metric tons, segregation occurs, which is detrimental. The segregation is caused by the content of alloying elements such as sulphur, phosphorus and carbon in the steel. The poured steel begins to solidify from the bottom and the walls of the ingot mould. The portions solidifying first have the smallest content of alloying elements whereas the portion which has remained liquid in the phases of the solidification is progressively enriched. The several alloying elements are subject to this tendency in different degrees. Sulphur and phosphorus have a greater tendency to segregate than carbon. The segregation results in deviations from the as-teamed analysis so that the proportion of alloying elements in the molten metal in the top central portion of the ingot may be a multiple of the desired or permissible values. In that case the head of the ingot is not suitable for the intended use and must be processed as scrap.

It is an object of the invention to eliminate these difficulties. The invention resides in re-refining the teamed block by blowing with oxygen or with a high-oxygen gaseous refining agent as soon as its centre begins to become pasty and simultaneously adding basic slag-forming substance such as lime dust and calcined sodium carbonate. The oxygen jet is suitably blown in a vertical direction onto the central region of the surface of the pasty upper portion of the block and the basic slag-forming substances are blown in finely divided suspended form together with the oxygen. In this way the surplus content of the alloying elements is quickly removed.

The removal of the segregation promoting elements by means of the treatment according to the invention can be checked by intermediate tests. In a preferred procedure the re-refining is carried out until values have been reached which are somewhat lower than those of the desired analysis, whereafter the treatment is discontinued. As the solidification of the ingot continues the segregation of the ingot is resumed and makes up for the deficiency of the removed alloying elements. The desired values will then be obtained when the solidification has been completed.

15-ton ingots of rimming steel have been treated according to the invention. In the following table the carbon, phosphorus and sulphur values in treated ingots are compared with the corresponding values in untreated ingots. In order to show the influence of segregation in dependence on the progress of the solidification the samples have been taken at varying distances from the head of the ingot. Charges 1 to 3 were re-refined (treated) with oxygen and lime dust. This indicates particularly the influence of the treatment on the phosphorus content. Charges 4 and 5 were re-refined (treated) with oxygen to which a mixture of lime dust and calcined sodium carbonate was added. This shows the influence of the treatment on the phosphorus and sulphur contents.

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TREATMENT BY BLOWING OXYGEN AND FINELY
DIVIDED LIME DUST
[Weight of ingot 15 metric tons]

	C	Mn	P	S
Charge 1:				
Analysis as teamed	0.08	0.38	0.018	0.027
Ingot I (treated)—				
Sample (a)—Distance from				
head 6%	0.06		0.020	0.043
Sample (b)—Distance from				
head 57%	0.10		0.014	0.032
Ingot II (untreated)—				
Sample (a)—Distance from				
head 6%	0.13		0.032	0.046
Sample (b)—Distance from				
head 57%	0.09		0.025	0.034
Charge 2:				
Analysis as teamed	0.09	0.45	0.019	0.024
Ingot I (treated)—				
Sample (a)—Distance from				
head 6%	0.05		0.015	0.012
Sample (b)—Distance from				
head 16%	0.14		0.025	0.030
Ingot II (untreated)—				
Sample (a)—Distance from				
head 6%	0.12		0.033	0.058
Sample (b)—Distance from				
head 16%	0.26		0.055	0.102
Charge 3:				
Analysis as teamed	0.12	0.35	0.015	0.022
Ingot I (treated)—				
Sample (a)—Distance from				
head 6%	0.10		0.019	0.045
Sample (b)—Distance from				
head 16%	0.14		0.022	0.064
Ingot II (untreated)—				
Sample (a)—Distance from				
head 6%	0.27		0.037	0.125
Sample (b)—Distance from				
head 16%	0.32		0.039	0.126

TREATMENT BY BLOWING OXYGEN AND A MIXTURE OF
LIME DUST AND FINELY DIVIDED CALCINED SODIUM
CARBONATE

	C	Mn	P	S
Charges 4:				
Analysis as refined	0.10	0.42	0.018	0.025
Ingot I (treated)—				
Sample (a)—Distance from				
head 6%	0.07		0.016	0.017
Sample (b)—Distance from				
head 16%	0.15		0.026	0.031
Ingot II (untreated)—				
Sample (a)—Distance from				
head 5%	0.19		0.032	0.067
Sample (b)—Distance from				
head 17%	0.21		0.046	0.073
Charge 5:				
Analysis as teamed	0.14	0.39	0.020	0.023
Ingot I (treated)—				
Sample (a)—Distance from				
head 6%	0.11		0.023	0.018
Sample (b)—Distance from				
head 15%	0.18		0.031	0.027
Ingot II—(untreated)—				
Sample (a)—Distance from				
head 7%	0.20		0.029	0.051
Sample (b)—Distance from				
head 16%	0.19		0.048	0.068

Apparatus which can be used to advantage for carrying out the method according to the invention is diagrammatically shown on the accompanying drawing.

The main parts of this apparatus comprise a supply conduit 1 for oxygen or a high-oxygen gaseous refining agent, a pressurized supply container 2 for finely divided basic substances 3, an injector 4 and a blowing tube 5. By means of a regulating valve 6 a pressure of, e.g., 10 kg./sq. cm. superatmospheric pressure is adjusted in the supply conduit 1. The conduit 1 is connected by a branch conduit 7 to the top part of the supply container 2. By means of the regulating valve 8 the same internal pressure as in conduit 1, e.g., 10 kg./sq. cm. superatmospheric pressure, is maintained in the container 2. The conduit 1 is continued by a regulating valve 9 and a conduit section 10 connected to the injector 4. This portion of

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the conduit is maintained at a lower pressure than the supply container. The pressure may be approximately 6 kg./sq. cm. superatmospheric pressure. The injector comprises a concentric tube 11, which surrounds the conduit tube 10 and which tapers at the tip 12. The inner tube 10 is fitted in the outer tube 11 by means of the stuffing box 20 and is axially slidable therein. By means of a connecting pipe 13 the tube 11 communicates with the tapered bottom 14 of the supply container. This connecting pipe may incorporate a control cock 15. Owing to the higher pressure in the supply container the finely divided substances, lime dust and calcined sodium carbonate, are forced through the connecting pipe 13 into the tip 12 of the shell tube 11 and are entrained there by the oxygen jet. The front end 12 of the tube 11 is connected by the conduit portion 16 to the blowing tube 5. The blowing tube is centrally and vertically disposed over the ingot contained in the ingot mould 17. The upper part of the ingot mould may be lined with an annular insert 18 of sheet metal or refractory material.

What I claim is:

1. A method of treating ingots of a metal of the class consisting of iron and steel comprising pouring the molten

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metal into an ingot mold, cooling the metal to form a solidified outer portion and form a pasty central region in the upper portion of the ingot in the mold, then blowing a jet of high-oxygen gas having finely-divided basic slag-forming agents comprising lime and calcined sodium carbonate suspended therein against the pasty central region of the ingot and continuing blowing until phosphorus and sulfur in said central region are reduced to not substantially in excess of their desired final content in the ingot, and terminating blowing to enable segregation of the sulfur and phosphorus to continue in said central region of the ingot.

2. The method set forth in claim 1 in which blowing is continued until phosphorus and sulfur in the upper region of the ingot are reduced to less than their desired final content in the ingot.

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