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[54] **REFINING OF STAINLESS STEELS**

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[51] **Int. Cl.** **C21c 5/32**

[58] **Field of Search** 75/59, 60

[56] **References Cited**

UNITED STATES PATENTS

3,330,645 7/1967 De Moustier 75/60

3,706,549 12/1972 Knuppel 75/60

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[57] **ABSTRACT**

In a process for refining stainless steel where oxygen and ammonia are introduced into a molten steel, e.g. for decarburisation and/or introducing nitrogen into the steel, the ammonia is introduced separately from the oxygen through a tuyere comprising at least two co-axial pipes. The ammonia is preferably introduced through a pipe which is not an outermost pipe. This procedure reduces the risk of the melt solidifying around the ammonia pipe and avoids the need to use combustible oxygen/ammonia mixtures.

4 Claims, 2 Drawing Figures

Fig.1

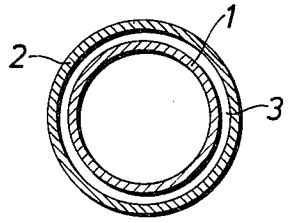
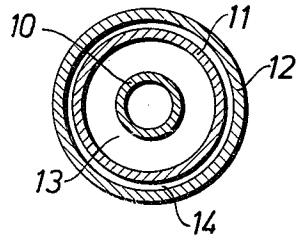


Fig.2



REFINING OF STAINLESS STEELS

This invention relates to a process for refining stainless steels by simultaneous introduction of oxygen and ammonia into the molten steel.

Copending Application Ser. No. 295,355 filed Oct. 5, 1972 by M. K. A. Johnsson and L. A. Eriksson describes a method by which a melt of steel with a high percentage of chromium, particularly a stainless steel, is decarburised using oxygen and either ammonia or steam. Ammonia is introduced for two reasons. Firstly, to lower the partial pressure of carbon monoxide, because it develops hydrogen, which allows a high degree of decarburisation, and, secondly to increase the nitrogen content of the steel. In principle, several methods are available for introducing the oxygen and ammonia into the melt. For instance, as described in Application Ser. No. 295,355, it is possible to introduce oxygen through a central pipe and the ammonia through a pipe which envelopes the oxygen pipe. This arrangement is not entirely satisfactory because the introduction of ammonia effects a high degree of cooling, which may cause the opening between the oxygen pipe and ammonia pipe to be blocked by the metal solidifying. It is also possible, in principle, to use a single pipe through which a gas mixture containing both oxygen and ammonia could be introduced. However, such gas mixture is combustible, and it could burn in the delivery pipe eventually causing the pipe to be burnt out.

An object of the invention is to introduce the ammonia in a way which will eliminate the drawbacks mentioned above. The present invention provides a process for refining a steel containing chromium which comprises simultaneously introducing molecular oxygen and ammonia into the steel in a molten condition, the oxygen and ammonia being introduced separately from one another through different sections of a tuyere comprising at least two coaxial pipes and presenting an innermost section and an outermost section.

Specific embodiments falling within the framework of the invention will now be described with reference to FIGS. 1 and 2 of the accompanying drawing, in which

FIG. 1 is a sectional view through a tuyere made up of two concentric pipes, and

FIG. 2 is a sectional view through a tuyere with three concentric pipes.

In the tuyere of FIG. 1, a central tube 1 is enclosed by a coaxial tube 2 of large diameter thus providing an outermost section 3 between central tube 1 and coaxial tube 2 and an innermost section inside tube 1.

In the tuyere of FIG. 2, a central tube 10 is enclosed by an intermediate coaxial tube 11 of larger diameter than tube 10 and by an outer coaxial tube 12 of larger diameter than tube 11. The tuyere thus has an innermost section inside tube 10, an intermediate section 13 between tubes 11 and 10 and an outermost section 14 between tubes 12 and 11.

The tuyere or tuyeres as illustrated in FIGS. 1 or 2 can be fitted in a converter as described in Application Ser. No. 295,355, particularly with reference to FIGS. 2 – 4 of the drawings of that application. The nature of the chromium containing alloys to be treated and general method of decarburisation which is normally preceded by a preheating in which any silicon present and, if necessary, some of the chromium, is oxidised, and normally followed by the steps of introducing nitrogen if desired, reducing oxidised chromium and then flushing out residual hydrogen is described in detail in Application Ser. No. 295,355, the disclosure of which is incorporated in this specification by these references. The following Examples are given to illustrate the invention:

EXAMPLE 1

A stainless steel containing about 1% by weight carbon, 0.7% by weight silicon, about 1% by weight manganese, about 18% by weight chromium, about 6% by weight nickel and the remainder iron and impurities was melted in an electric are furnace and placed in a converter of the type described in FIG. 2 of Application Ser. No. 295,355 but with tuyeres as illustrated in FIG. 1 of the accompanying drawing.

In the initial stage of refining the purpose of which is to raise the temperature in the melt by burning off silicon, chromium and/or any other readily oxidisable substance, undiluted oxygen is introduced through the central pipe 1 while a mixture of steam and oxygen is introduced throught the outer section 3, the steam content being sufficiently high that sufficient cooling is provided for the protection of the tuyere and the surrounding lining, but not so high as to risk blocking by solidification of the melt. In the next stage of refining (decarburisation), steam and oxygen are introduced through the central pipe 1 as well as through the outer-section 3. In the next stage of refining (absorption of nitrogen), ammonia is introduced through one of the pipes, preferably the inner pipe 1. The quantity of ammonia introduced will depend on the desired percentage of nitrogen in the finished steel. The ammonia in inner pipe 1 is preferably mixed with steam. Through the outer section 3 a mixture of oxygen and steam is introduced simultaneously and the mixing ratio is adjusted so as to protect the tuyere and the adjacent parts of the converter from overheating as well as from blocking by solidification of the melt. In the next stage of refining (reduction), in which any oxidised chromium is reduced and returned to the melt, ammonia possibly mixed with argon can also be introduced, for example through outer section 3.

Ammonia can also be introduced simultaneously during this stage through the inner tube 1. In the final stage of refining (removing residual hydrogen), undiluted argon, or another gas without hydrogen is blown through inner tube 1 and outer section 3, to lower the percentage of hydrogen in the melt.

EXAMPLE 2

The stainless steel and converter used are as described in Example 1 but the converter is fitted with tuyeres as illustrated in FIG. 2 of the accompanying drawing. The refining sequence is the same as that described in Example 1.

In the initial stage of refining, a mixture of oxygen and steam is introduced through inner tube 10, undiluted oxygen throught the intermediate section 13 and an oxygen-steam mixture through the outer section 14. During the decarburisation stage, a mixture of oxygen and steam are introduced through pipe 10, and both sections 13 and 14. During nitrogen absorption stage, undiluted ammonia is introduced through the inner pipe 10 whose dimensions are chosen so that the flow of ammonia will not be excessive. Simultaneously, a mixture of oxygen and steam are introduced through

both intermediate section **13** and outer section **14.** During the reduction stage, which comes next, undiluted ammonia is introduced through inner tube **10.** Simultaneously steam is introduced through intermediate section **13** and a mixture of ammonia and argon through outer section **14.** An alternative in this stage is to introduce undiluted steam through inner pipe **10** and intermediate section **13** and at the same time undiluted ammonia through outer section **14.** During the final stage argon is introduced through all the pipes as in Example 1.

I claim:

1. A process for refining a steel containing chromium which comprises simultaneously introducing molecular oxygen and ammonia into the steel in a molten condition, the oxygen and ammonia being introduced separately from one another through different sections of a tuyere comprising at least two coaxial pipes and presenting an innermost section and an outermost section, the ammonia being introduced through a section of tuyere other than the outermost section and the oxygen being introduced through the outermost section.

2. A process according to claim **1** wherein the tuyere comprises three coaxial pipes and presents an innermost section, an intermediate section and an outermost section and ammonia is introduced through at least one of the innermost and intermediate sections and oxygen is introduced at least through the outermost section.

3. A process according to claim **1** wherein a mixture of ammonia and steam is introduced through a section other than the outermost section.

4. A process according to claim **2** wherein a mixture of ammonia and steam is introduced through at least one of the innermost and intermediate sections.

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