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BOTTOMS FOR METALLURGICAL FURNACES OF
THE BESSEMER CONVERTER TYPE
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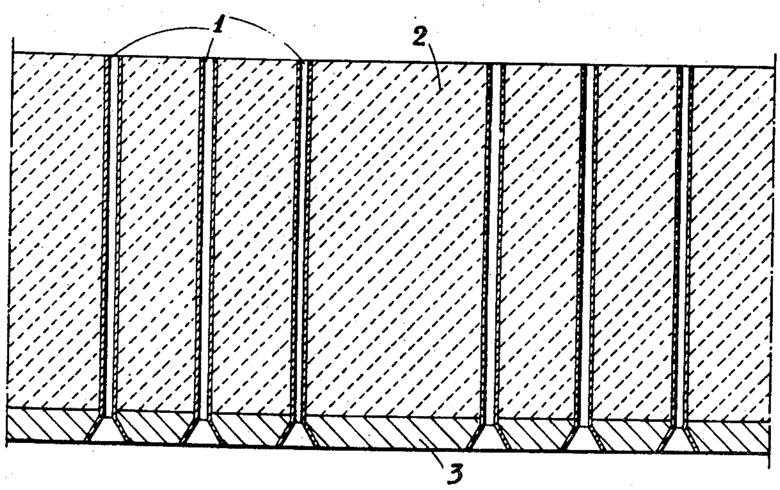

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BOTTOMS FOR METALLURGICAL FURNACES OF THE BESSEMER CONVERTER TYPE

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4 Claims. (Cl. 266—35)

This invention concerns metallurgical furnaces, especially Bessemer converters, and is a continuation of our application Serial No. 143,602, filed February 10, 1950, now abandoned, and assigned to the assignee of the present application.

In the converter refining process (Thomas Bessemer process) the refining gases (air, oxygen, enriched air, pure oxygen or a mixture of oxygen and other refining and cooling agents) are blown from below, from the sides or also from above through tuyeres (nozzles) into the iron bath to be refined.

At the nozzle outlet places the oxygen (free and combined) contained in the refining gases reacts immediately with iron, forming ferrous oxide. If the excess pressure in the blast boxes in relation to the ferrostatic pressure of the bath is too small, or if the fall of pressure due to friction in the individual tuyeres is too great, the tuyeres begin to burn away in the shape of funnels and this leads to a progressive wear and tear of the tuyere outlet. This burning away is to be attributed not only to thermal overheating but above all to the chemical influence of the ferrous oxide.

Ferrous oxide is a very powerful liquefying agent for all basic and acid refractory materials. In the blast refining process the tuyeres and thus the floor or bottom are extensively protected by the carrier gas (nitrogen), so that the ferrous oxide formed is immediately carried into the bath through the agitation of the bath brought about by the nitrogen. With increasing oxygen enrichment however, the agitation of the bath becomes smaller, particularly in the dephosphorizing period which is present in the basic process. The ferrous oxide concentration and temperature immediately above the nozzle thus becomes greater. With increasing temperature and ferrous oxide concentration the destruction of the tuyeres both in basic and acid bottoms is accelerated. As experiments have shown the tuyeres burn to funnel shaped holes even after only one or two charges. The emergent cross section becomes continuously greater and the escape velocity of the refining gas continuously less. The iron to be refined can always penetrate deeper into the widened (burnt out) tuyeres, and the ferrous oxide can therefore react more with the basic and acid refractory substances. The funnel shaped end deep burning out leads then to destruction of the bottom. With the use of pure oxygen or a mixture of oxygen and other gaseous or solid refining means, tuyeres and bottoms of usual construction made of basic or acid refractory material can no longer be economically used.

The present invention is directed to the problem of preventing or at least substantially lessening this funneling out or cratering of the furnace bottom in the vicinity of the tuyeres. As explained above, such cratering occurs particularly with an oxygen-enriched blast, and also with pure oxygen or a mixture of pure oxygen and other refining agents.

It has been proposed in the past to form the tuyeres of

iron tubes primarily to achieve better heat conductivity. However, the use of iron tubes to provide the blast nozzles or tuyeres actually increases crater formation in the furnace bottom because these tubes increase the formation of ferrous oxide. The damging effects of this material are fully discussed above. Consequently, although it has been proposed to use iron tubes to provide the blast nozzles or tuyeres, this practice has not to our knowledge been used to any substantial extent. In fact, it is obvious that with higher oxygen content blasts, the iron tubes will actually increase the formation of ferrous oxide.

We have discovered that, despite its lower melting point, copper may be used to provide the blast nozzle tubes or tuyeres and that this will prevent, or at least substantially lessen, cratering of the furnace bottom. In fact, the wearing away of the upper surface of the furnace bottom which occurs during furnace operation is substantially uniform. The reason for this is that copper has a smaller oxygen affinity than iron and it also has a very high heat conductivity. The ferrous oxide arising in the refining process directly over the nozzles does not combine with the copper protective tubes of the single tuyeres. Furthermore, the ferrous oxide cannot react either directly or indirectly with the refractory material from the inner side of the nozzles. It would not appear that copper, having a lower melting point than iron, would withstand the intense heat present in furnaces of the type under discussion. However, because of the greater heat conductivity of copper and the cooling action of the refining agents flowing through the nozzles or tuyeres, premature melting of the copper tubes will not occur. This result is further true because the copper does not combine with oxygen as readily as does iron and thus there is not as much oxide formed between the oxygen and copper as there is between the oxygen and iron. According to our invention, the blast nozzle tubes or tuyeres may consist of copper or a copper alloy which has an oxygen affinity and heat conductivity substantially similar to copper.

Referring to the single figure of the drawing, there is shown there a cross-section in elevation of a furnace bottom of the Bessemer converter type. In place of the usual wooden tubes or needles—as they are sometimes called, there are a plurality of copper tubes 1 which are embedded in the refractory crushed material 2. As indicated by the legend on the drawing, this refractory material 2 may be either acid or basic refractory and the tubes 1 extend completely through it as shown in the drawing. Furthermore, the furnace bottom includes a base plate 3 containing openings as shown in the drawing and the tubes 1 extend from these openings, through the refractory material, to the interior of the furnace. In fact the copper tubes 1 can be placed into the bottom plate 3 in the same manner as the wooden rods or needles which are customarily used. In other words, the over-all construction of the usual furnace bottom is not changed. According to the present invention copper tubes are used instead of the usual wooden rods or needles. Thus the present invention is an improvement upon furnace bottoms of the type conventionally used.

By using smooth metal tubes of copper, the frictional resistance compared with that of the rough surface of tuyeres formed in the refractory material directly is substantially smaller, and thus the energy consumed in supplying the refining agent is smaller. The tubes 1 need not have a large wall thickness. In fact, the most preferable thickness of the wall of the copper tubes is in the range of 1 to 1.5 mm. In effect, each tube is a liner for the blast passage with which it is associated.

While we have described and illustrated an embodiment of our invention, we wish it to be understood that we do not intend to be restricted solely thereto but that we do intend to cover all modifications which would be apparent to one skilled in the art and which come within the spirit and scope of our invention. Thus, for example, we intend to cover tubes made of metals which have an oxygen affinity and heat conductivity substantially the same as that of copper.

What is claimed as our invention is:

1. A bottom for a metallurgical furnace of the Bessemer converter type, said bottom comprising a mass of refractory material which occupies a major portion of the depth of said bottom, and a plurality of copper tubes embedded in said refractory material and extending completely through said refractory material to provide blast passages for said furnace, each of said tubes consisting of a single wall of copper, said copper tubes having a smaller oxygen affinity than iron and very high heat conductivity whereby cratering of the refractory material in the vicinity of the tubes is substantially lessened and it is unnecessary to water cool the tubes.

2. A bottom for a metallurgical furnace of the Bessemer converter type, said bottom comprising a mass of refractory material which occupies a major portion of the depth of said bottom, and a plurality of tubes made of a copper alloy which has an oxygen affinity and heat conductivity substantially similar to copper, said tubes being embedded in said refractory material and extending completely through said refractory material to provide blast passages for said furnace, each of said tubes consisting of a single wall of said copper alloy, said copper alloy tubes having a smaller oxygen affinity than iron and very high heat conductivity whereby cratering of the refractory material in the vicinity of the tubes is substantially lessened and it is unnecessary to water cool said tubes.

3. A bottom for a metallurgical furnace of the Bessemer converter type, said bottom comprising a mass of refractory material which extends substantially entirely throughout the depth of said bottom, said refractory material having a plurality of substantially vertical blast passages extending completely through said material from top to bottom, each of said passages being lined by only a single copper tube which extends substantially entirely throughout the length of the passage with which it is associated and which has a wall thickness in the range from 1 to 1.5 millimeters.

4. A bottom for a metallurgical furnace of the Bessemer converter type, said bottom comprising a mass of refractory material which extends substantially entirely throughout the depth of said bottom, said refractory material having a plurality of substantially vertical blast passages extending completely through said refractory material from top to bottom, each of said blast passages being lined by only a single tube made of a copper alloy which has an oxygen affinity and heat conductivity substantially similar to copper, each tube extending substantially entirely throughout the length of the passage with which it is associated and having a wall thickness in the range from 1 to 1.5 millimeters.

References Cited in the file of this patent

FOREIGN PATENTS

9,354 Germany -------------- Apr. 6, 1880

OTHER REFERENCES

Iron Age. November 28, 1946, page 49 relied on.

Blast Furnace and Steel Plant, pages 800–804, July 1954.