BLAST FURNACE CONSTRUCTION

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ABSTRACT OF THE DISCLOSURE

A blast furnace having a single continuous shell, a brick wall of uniform thickness above the tuyere and positioned within the shell, the brick wall being divided at the belly of the furnace into an upper and lower brick wall, a ring of plates on the inside of the shell at the line of division and above the crown of the brick wall above the ring of plates, a plurality of supporting members fixed to the external surface of the shell at the belly along the periphery of the shell, and supporting means supporting said members.

This invention relates to an improved construction of a blast furnace and more particularly to a brickwork for the furnace and a process of supporting the furnace shaft shell.

In the blast furnaces now in wide use, the furnace bodies are consumed all over the inside surface extending from the top of the shaft to the bottom of the belly of the furnace by the erosive and abrasive actions of nascent gases at high temperatures and such charges as ores, sintered ores, and coke during the operation. The trend is remarkable especially in a furnace which employs heavy oil blasting. Accordingly, when a furnace is repaired or newly built, various improvements are made in respect of the refractory materials in use, the laying process, and so on in order to elongate the life of the furnace and to enhance the iron-smelting capacity. As a countermeasure for preventing the above-mentioned erosion and abrasion in a blast furnace, it is attempted to increase the number of the cooling plates inserted in the shaft, belly, and crown of the furnace so that the cooling effect may prevent the furnace bricks from being eroded and worn. Of such blast furnaces as mentioned above, those to be now in actual use are generally classified into the following two types with regard to their constructions. Namely, there are such a thick wall type furnace as shown in FIG. 1, in which the laid bricks above the belly are supported by means of bearing struts for shaft through a ring plate, and such a free-standing (thin wall type) furnace as shown in FIG. 2, in which the laid bricks are supported by the basin bricks.

In the accompanying drawings, FIG. 1 shows conventional furnace constructions; FIGS. 1 and 2 are views in longitudinal section of a thick wall type furnace and a thin wall type free-standing type furnace respectively.

FIG. 3 is a view in longitudinal section of a furnace embodying the present invention.

FIG. 4 is an enlarged view of the part A of the furnace shown in FIG. 3.

FIG. 5 is a cross-sectional view taken on the line X—X of the part shown in FIG. 4.

The constructions of these conventional furnaces will be detailed in order to clarify the characteristics of the invention of this application. First, in FIG. 1, the blast furnace having the shell 8 supported by the struts is composed of a chamotte brick wall 1 forming the shaft 8 and the belly 9, a chamotte brick wall 2 serving as the belly 9 and the bosh 10 with the tuyere 15, and a bottom cast iron brick wall 3. Packings 6 and 7 are inserted respectively between a shaft shell 4 and the brick wall 1 and between a bosh shell 5 and the corresponding brick wall so as to allow the expansion of the furnace bricks and to serve for gas sealing. The furnace brick wall 1, the shell 4, the bosh shell 5 connected to an ingoing plate 1, the packing 6, cooling plates 11, a top ore-bearing metal article 12, etc., are supported by bearing struts 13 for shaft through the ring plate 17. The loads of the furnace wall 2 of laid bricks constituting a part of the belly 9 and the bosh 10, cooling plates 14, a tuyere shell 15, etc., are supported by the bottom wall 3. Thus structurally the furnace is extremely stable; however, the furnace is required to have an excessively thick wall so that the wall may meet the bearing struts for shaft through the ring plate and therefore necessitates the use of a fairly large amount of brick. In addition, since the furnace is so constructed as the wall 1 is thick at the belly 9 and the bosh wall is thin and further since the shaft-bearing shell-redundant article is provided extending in the direction of the furnace periphery, it is difficult to arrange the cooling plates uniformly. Accordingly, it results that the brick portion ahead of the cooling plates is consumed in less than one month after the operation starts (inaugural kindling). As apparent from the result, the uneven arrangement of the tips of the cooling plates gives rise to brick erosion.

In addition, the full of the charge damages the cooling plates at the upper portion of the bosh 10. All of these jointly cause no existence of protecting brick in the vicinity of the junction of the belly 9 and the bosh 10, and the profile line 16 shifts to the line 16' showing the erosion tendency. This means that there occurs gas leakage in the vicinity of the junction and so the shell around the junction is exposed to the high temperature inside the furnace, thus further shortening the life of the furnace. In order to remove the above-mentioned defect of the thick wall type furnace, the thin-wall free-standing type furnace is employed. Namely, as shown in FIG. 2, the furnace is so constructed as the brick walls 29 and 30 extending from the top of the shaft 8 to the bottom of the belly 9 are almost uniform in thickness, and the belly bottom is directly connected with a bosh wall 31 provided in conjunction with a basin brick pile 32. All of these are supported by a single shell 33. Besides, the bosh wall 31 and the bottom wall 32 are cooled by means of external water piping 35. In the said thin wall type furnace, the cooling plates 34 may be so inserted as to be uniformly arranged, and therefore have such effects as the furnace can be cooled uniformly, and there is hardly any possibility of gas leakage in the vicinity of the joint of the belly 9 and the bosh 10. However, the bosh wall 31 of this furnace is required to have a very large thickness so as to fulfill the strength requirement. In addition, the shell 33, supporting the whole furnace, is very thick. Accordingly, when the belly wall 30 or the bosh wall 31 is greatly eroded or when the brick strength is lowered by high temperatures, some bricks of the furnace wall fall off in many occasions. Besides, concerning the installation, it is very difficult to increase the number of the tuyeres in view of the way in which the shell supports the furnace.

After various studies aiming to remove the above-mentioned drawbacks of the conventional furnaces, we have succeeded in providing a novel furnace construction which is extremely economical and very effective in cooling. In the inventive furnace, the thin wall type is employed and the cooling plates are arranged uniformly, while the problem of preventing the disadvantageous phenomenon which is likely to occur to a thin wall type furnace, namely, the brick breakdown in the case of a great erosion at the bosh or in the case of the lowering of the brick strength due to high temperatures, is perfectly solved.
The present invention is characterized by "the construction of a blast furnace of a separate bricklaying type, in which bearing metal articles for brick are attached to the inside of the shell so as to divide the brick pile load in plural, the brick surfaces and the shell surfaces of the shaft, belly, and bosh are aligned in their respective brick files, supporting members are fixed to the outside of the shell at the belly, and the supporting members are supported by means of slings or struts."

The present invention will be hereunder more particularly explained in conjunction with an exemplary embodiment shown in the accompanying drawings. As shown in FIGS. 3, 4 and 5, first by using chamotte brick, a shaft wall 18, bosh wall 20 and a furnace wall portion forming a belly 19 having an engaging section at which the extensions of both walls 18 and 20 meet each other, are formed so as to have a uniform thickness, and then a furnace bottom 21 is formed of carbon brick. At the belly 19, the shaft wall 18 and the bosh wall 20 are extended downward and upward respectively so that each of the furnace wall profile line 22 and the profile of a shell 23 forms a continuous line.

At the above-mentioned engaging section where the extension of the shaft wall 18 ends, a ring of metal plates 24 for brick are fixed to the inner surface of the shell 23 so as to support the load of the brick above the engaging section and so as to be separated from the end of the extension of the bosh wall 20, so that there exists between the upper and lower walls a gap wide enough for brick expansion. Next, the outside of the brick pile of the shaft, belly and bosh is covered with a single continuous shell 23, and between each wall and the shell is packed with a packing material 25 to allow free brick expansion and to serve for gas sealing. A plurality of supporting members 26 are attached by welding or the like to the outer surface of the shell at the belly 19, and the supporting members 26 are in turn supported by means of supports 27.

In this invention, a plurality of struts 27 are employed as the supporting means, which are however, not limited to the struts but may be slings such as links. An embodiment of this invention proved that eight or nine struts are sufficient for a 1,500-ton blast furnace.

According to the present invention which provides such a furnace construction as stated above, it is possible to make the wall extending from the top of the shaft to the bottom of the bosh uniformly thin, which has hitherto been difficult in the conventional blast furnaces, and in addition, the furnace wall load may be divided by the attachment of the bearing metal articles for brick into three parts, namely, the loads of the shaft, belly, and bosh; thus, it is a matter of course that the brick falling and breakdown due to erosion and strength lowering can be prevented, and because of the thin wall construction, the tips of the whole cooling plates 28 may be arranged in a uniform plane, and further, since the shell reinforcing metal articles arranged in the direction of the furnace periphery are provided outside the furnace, the cooling plates 28 can be distributed uniformly.

Hence, the cooling effect extends all over the furnace wall and therefore keeps the wall from such local damage as found in the conventional furnaces. Furthermore, the belly is free from any gas leak due to an uneven arrangement of cooling plates resulting from different wall thickness, thus elongating the life of the furnace to a large extent. Meanwhile, from the economical viewpoint, the amount of the brick in use for a 1,500-ton blast furnace is, for example, 3,073 tons with respect to 3,788 tons in the case of a conventional furnace of the same capacity, that is, the brick is saved by 18.8%.

What we claim is:
1. A blast furnace having a single continuous shell, a brick wall of uniform thickness above the tuyere and positioned within the shell, the brick wall being divided at the belly of the furnace into an upper and lower brick wall, a ring of plates on the inside of the shell at the line of division for supporting the load of the brick wall above the ring of plates, a plurality of supporting members fixed to the external surface of the shell at the belly along the periphery of the shell, and supporting means supporting said members.
2. A blast furnace as claimed in claim 1 in which cooling members are provided in the brick wall, the ends of said cooling members being a uniform distance from the shell.
3. A blast furnace as claimed in claim 1 in which said supporting means are struts.
4. A blast furnace as claimed in claim 1 in which said supporting means are slings.

References Cited

UNITED STATES PATENTS
1,889,160 11/1932 Strain et al. ........ 266--25
2,413,988 1/1947 Miller ............... 266--25
2,567,007 9/1951 Brassett et al. .... 266--43 X
2,915,305 12/1959 Craig ................ 263--29 X

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