Aug. 12, 1941. J. L. WICK, JR., ET AL 2,252,605

COOLING PLATE FOR BLAST FURNACE INWALLS AND MANTLES

Filed March 2, 1938

FIG. 1.

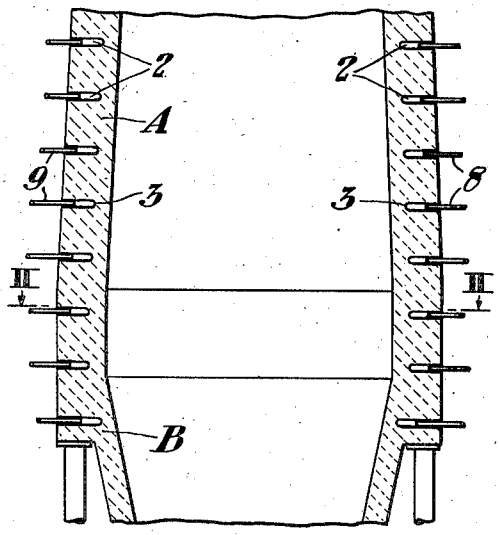


FIG. 2.

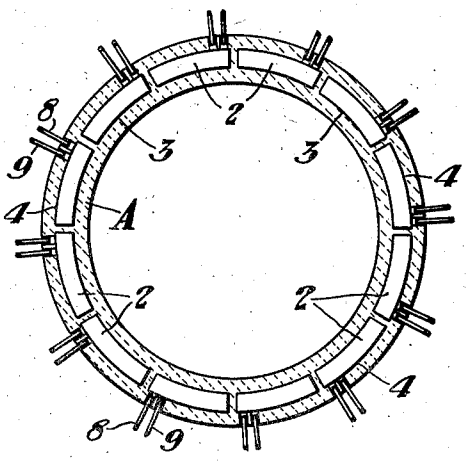


FIG. 3.

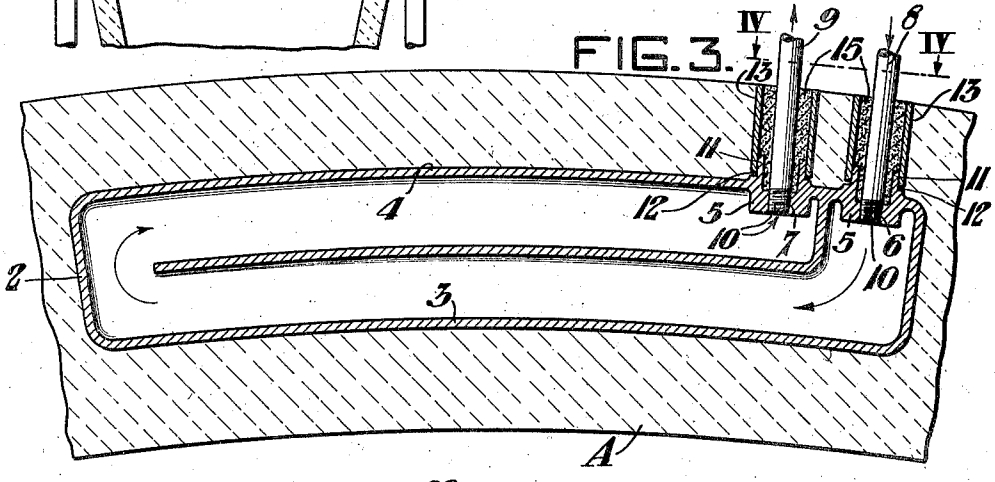


FIG. 5.

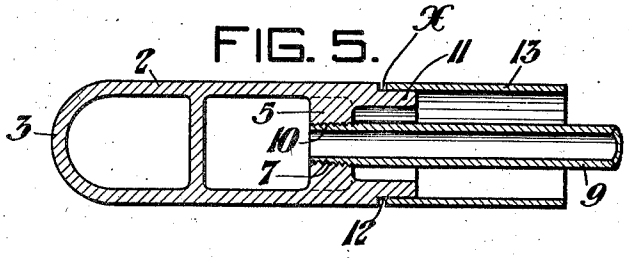


FIG. 4.

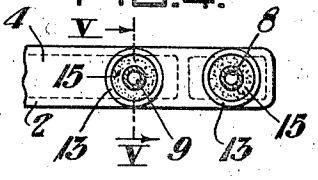
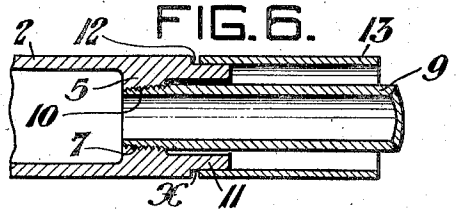


FIG. 6.



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COOLING PLATE FOR BLAST FURNACE INWALLS AND MANTLES

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2 Claims. (Cl. 122—6)

This invention relates to blast furnaces which are used in the production of pig iron from ore, and more particularly to water-cooled inwall or mantle plates for cooling the upper portion of the shaft or stack thereof.

According to conventional design, a blast furnace is a tall circular structure built of suitable refractory material and generally divisible into three main parts. The bottom section is known as the "hearth" or "crucible" and is that portion of the furnace which serves as a receptacle for the molten metal and slag. The refractory material of this section of the furnace is usually exteriorly reenforced by a heavy metal jacket made of steel plates. The second or intermediate section of the blast furnace is called the "bosh" and is usually where the greatest diameter is attained. The refractory material of this section of the furnace is usually not exteriorly reenforced by a heavy metal jacket, as in the case of the hearth or crucible. The third section of the blast furnace is the shaft or stack and comprises the "inwall," by which term it is most often identified. The inwall of the shaft or stack is of substantial thickness and, as in the case of the hearth or crucible, usually exteriorly reenforced by a metal jacket.

At the upper limits of the bosh is found the mantle which conforms to the shape of the blast furnace at that point and totally encircles it. The mantle is made up of heavy steel plates and angles upon which rests the weight of the shaft or stack, which, as previously described, comprises the inwall. It is supported by a series of pillars which rest on foundations supported by the main furnace foundations. This construction allows the entire bosh and hearth, or crucible, to be removed without disturbing the rest of the furnace.

It is, of course, highly desirable to cool the refractory brick work of the blast furnace, and this is usually done by cooling the jacket of the hearth or crucible by a suitable water circulating system. In the case of the bosh, water-cooled bosh plates are disposed to extend from the exterior of the furnace inwardly to a point adjacent the interior thereof. These bosh plates are relatively flat hollow bodies usually of greater length than width and provided with interior passageways for permitting the inward and outward passage of cooling water.

They are arranged radially of the blast furnace and are provided with flat or convex nose portions of reduced width which are exposed to the greatest heat and wear. Because of their relatively small size and frequent failure in service, bosh plates are constructed and arranged for ready installation and removal.

The shaft or stack of the blast furnace, which, as previously mentioned, comprises the inwall, is cooled by what are known as inwall plates. These inwall plates are also used to cool the mantle, which is often considered part of the inwall, and are, therefore, sometimes called mantle plates.

Inwall or mantle plates differ materially from bosh plate for the reason that they are usually considerably larger and shaped like segments of cylinders to conform to the contour of the inwall or mantle of the furnace. It is, of course, true that inwall or mantle plates are relatively flat hollow bodies which are provided with interior passageways in order that they may be water cooled. However, inwall or mantle plates are constructed and arranged for the circulation of the cooling water circumferentially of the inwall or mantle and are usually disposed well therewithin. Therefore, they are not removable through the exterior reenforcing metal jacket. When an inwall or mantle plate fails, the water connections therefor are used to introduce cement or the like into the same, whereby it thereafter no longer functions as a cooling medium, but through this expediency is permitted to contribute somewhat to the refractory qualities of the shaft or stack.

Most inwall or mantle plates are cast with integral elongated neck portions which frequently fail while the plate per se is capable of further duty. Due to the fact that the inwall or mantle plate is not removable from the inwall or mantle, it must then, as previously stated, be filled with cement or the like and its use as a cooling medium discontinued.

According to the teachings of the present invention, the inwall or mantle of a blast furnace is cooled by inwall or mantle plates which, although conventionally shaped in their body portions, are so constructed and arranged with respect to associated instrumentalities as to enable their water connections to be readily removed therefrom and replaced as need be. This feature obviates the necessity of cementing inwall or mantle plates when only their water connections have failed.

Another object is to provide an inwall or mantle plate in which the usual elongated neck portions are deleted, and provision made for connecting water conduits directly to the main body thereof; together with means for protecting the water conduits from the corrosive action of gases which pass through the refractory brickwork of the shaft or stack and around the inwall or mantle plates.

Another object is to provide an inwall or mantle plate in which not only are the water conduits connected directly to the main body thereof, but in which means are provided for changing the diameter of the connection after the plate has been installed from a position exteriorly of the shaft or stack.

The invention, then, comprises the features

hereafter fully described, and as particularly pointed out in the claims, the following description and the annexed drawing setting forth in detail a certain illustrative embodiment of the invention, this being indicative of but one of a number of ways in which the principle of the invention may be employed.

In the drawing:

Figure 1 is a fragmentary sectional elevation of a conventional blast furnace illustrating the manner in which it is cooled;

Figure 2 is a plan of the inwall or mantle plate of the invention;

Figure 3 is an enlarged plan, mostly in section; and,

Figure 4 is a view similar to Figure 2 but showing the inwall or mantle plate of the invention ready for service.

Figures 5 and 6 are respectively a sectional view on the line 5—5 of Figure 4 and a detail view of a part of Figure 5.

Referring more particularly to the drawing, the letters A and B, respectively, designate the bosh and shaft or stack (including the inwall) of a conventional blast furnace. The mantle B of the blast furnace, which supports the shaft or stack A (including the inwall) permits the entire bosh, and hearth or crucible to be removed without disturbing the rest of the furnace.

Referring to Figure 2, the inwall or mantle plate of the invention is shown at 2 as comprising a large relatively flat hollow body which is substantially rectangular in section and shaped in plan to conform to a segment of a cylinder, thereby providing a concave inner edge 3 and a convex outer edge 4. Referring to Figure 3, it will be seen how the inwall or mantle plate 2 circulates the cooling water circumferentially of the furnace, as previously described. At suitable locations along the convex outer edge 4 of the inwall or mantle plate 2, water is fed to and from the same by suitable connections which may be placed side by side, in remote positions, or otherwise. As shown in Figure 3, the inwall or mantle plate 2 of the present invention is provided at its water intake and outlet connections with interior boss portions 5 which are apertured and internally screw-threaded, as shown at 6 and 7, respectively. The diameter of the apertures 6 is small as compared with the diameter of the boss portions 5, thereby providing in each instance a wall of substantial thickness. According to this construction, the water inlet and outlet conduits 8 and 9, respectively, may be externally screw-threaded, as shown at 10, and connected directly to the internal screw threads 6 of the boss portion 5 of the inwall or mantle plate 2. In the event of stripping the threads 6 of the boss portion 5, the latter, due to its substantial wall thickness, may be easily rethreaded. This feature is of considerable importance due to the very frequent breakage of water conduits adjacent the inwall or mantle plate in the ordinary operation of the blast furnace.

According to the further teachings of the invention, the water intake and outlet connections are provided with exterior boss portions 11 in alignment with the interior boss portions 5. These exterior boss portions 11 are provided with cylindrical exteriors 12 for receiving sleeves 13 which extend from the inwall or mantle plate 2 to the exterior of the shaft or stack. These sleeves 13 form exterior housings for the water intake and outlet conduits 8 and 9, respectively, and serve as guideways for the ready installation or removal of the latter.

After the water intake and outlet conduits have been suitably attached to the threads 6 of the boss portions 5 of the inwall or mantle plate 2, the sleeves 13 are placed in position with suitable insulating medium 15, such as asbestos wool fibers, cement or the like, disposed between them and the water conduits. This insulating medium prevents the passage or circulation of gases which escape from the furnace and pass around the inwall or mantle plate and which are likely to pass between the sleeves (i. e. casings and water conduits or fluid intake and outlet).

Referring to Figure 5 of the drawing, another feature of the invention is shown as comprising the spacing, as at X, of the inner ends of the sleeves 13 from the inner ends of the cylindrical exteriors 12 of the boss portions 11 of the inwall or mantle plates. This spacing permits slight relative movement of the inwall or mantle plates with respect to the sleeves 13 in case of lateral deflection, and thereby avoids breakage from this cause.

Other modes of applying the principles of the invention may be employed, changes being made as regards the details described, providing the features stated in any of the following claims, or the equivalent of such, be employed.

We claim:

1. In a metallurgical blast furnace comprising a refractory stack extending above the mantle thereof, a hollow cooling plate buried within the wall of said refractory stack whereby refractory portions of the said stack are provided between the inner and outer walls thereof and the said hollow cooling plate, the exterior wall of said stack having a pair of passages communicating with said hollow cooling plate, fluid intake and fluid outlet connections for said hollow cooling plate, each of said connections being in alignment with one of said passages and terminating inwardly of the exterior wall of said stack, a protection pipe disposed in each of said passages and connected to said hollow cooling plate in such manner as to provide some flexibility between said pipe and plate, and fluid inlet and outlet conduits extending through said protection pipes and detachably secured to their respective connections on said hollow cooling plate whereby said conduits may be easily replaced when damaged, etc.

2. In a metallurgical blast furnace comprising a refractory stack extending above the mantle thereof, a hollow cooling plate buried within the wall of said refractory stack whereby refractory portions of the said stack are provided between the inner and outer walls thereof and the said hollow cooling plate, the exterior wall of said stack having a pair of passages communicating with said hollow cooling plate, a pair of seat means on said hollow cooling plate, fluid intake and fluid outlet connections within said seat means, each of said seat means being in alignment with one of said passages and terminating inwardly of the exterior wall of said stack, a protection pipe disposed in each of said passages and flexibly connected to the seat means in alignment therewith, and fluid inlet and outlet conduits extending through said protection pipes and detachably secured to their respective connections on said hollow cooling plate whereby said conduits may be easily replaced when damaged, etc.

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