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LINING OF THE INTERNAL SURFACE OF A BLAST FURNACE

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Fig. 1.

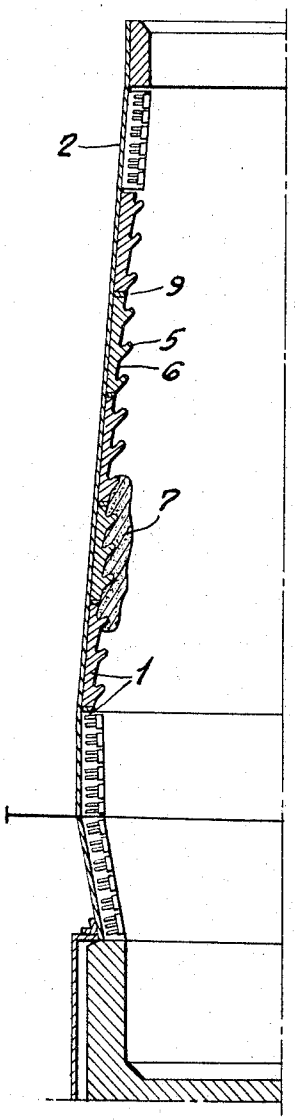


Fig. 5.

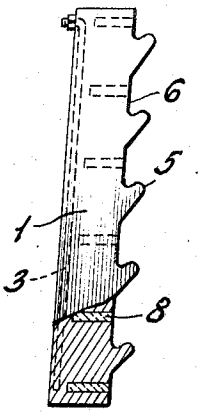


Fig. 2.

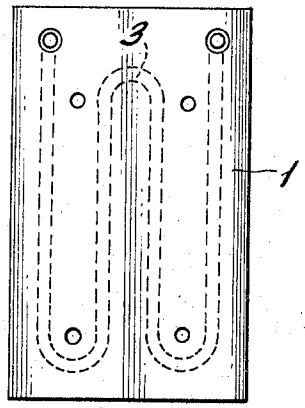


Fig. 4.

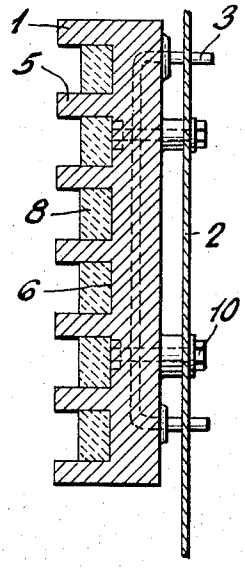
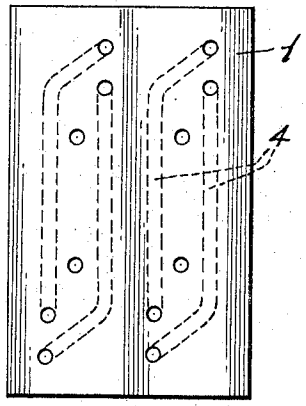


Fig. 3.



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LINING OF THE INTERNAL SURFACE OF A BLAST FURNACE

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ABSTRACT OF THE DISCLOSURE

A lining for the internal surface of a blast furnace in which vertically arranged metal plates are installed in the shaft, body and boshes thereof with the plates being provided with alternate projections and recesses on the surfaces thereof facing the interior of the furnace for promoting the formation on such surfaces of a protective layer of hardened slag and cooling means within the plates.

The present invention relates to the lining of the internal surface of blast furnaces comprising metal plates and means for cooling and securing the plates.

It is known that blast furnaces usually operate at an increased pressure of blast-furnace gas and a high temperature of blast air, melting fluxed sinter rich in iron. This arrangement allowed considerable intensification of the operation and an increase in the output of blast furnaces, but at the same time it shortened the life of the refractory lining.

At the present time, the life of the refractory lining of the shaft, boshes and body is rather short. In addition, the lining burns down non-uniformly over the height and periphery of the blast furnace thereby causing a distortion of its prorfile, difficulties in the control of the blast-furnace process, forced shutdowns and idle operating periods. As a consequence, the technical and economical factors of the furnace operation are impaired. Due to the foregoing, there have been proposed and tested various types of lining for the internal surface of blast furnaces.

For example, horizontal and vertical metal plates provided with internal cooling, in combination with a thick refractory lining have been used and the plates intended to cool the refractory lining. However, under the existing conditions of operation, the life of the lining of the internal surface of walls of the shaft, body and boshes of a blast furnace was found to be rather unsatisfactory. The refractory lining burns down rapidly, sometimes even falling down, and as a result, the blast furnace must be shut down. There is also known a lining for the shaft, body and boshes of a blast furnace, which comprises smooth, vertical metal plates without refractory brick. The plates are secured with steel bandages, and externally cooled with water. However, the lining of such design has not come into wide use since the assembly of the plates is a very difficult operation, and the plates do not provide a required stability and sealing of the walls of the shaft, body and boshes.

An object of the present invention is the provision of a lining for the internal surface of walls of the shaft, body and boshes of a blast furnace which is simple in structural design, reliable in operation, and allowing an increase in the life of the blast furnace between repairs.

The above object is accomplished by using a lining for the internal surface of the walls of a blast furnace which includes vertical metal plates provided in the shaft, body and boshes such as, for example cast iron plates, and a means for cooling and securing the plates. According

to the present invention, the means for cooling the plates are located inside the plates, while the internal surface of the plates is provided with alternating projections and recesses which contribute to the formation of a protective layer of hardened slag on the working surface of the plates.

When using technical water for cooling the plates, the cooling means is defined by a coil placed within the plates and having inlet and outlet ends. When using the so-called evaporative cooling, direct-flow pipes are provided within the plates and sealing of the vertical and horizontal clearances therebetween is effected by filling the clearances with a putty, for example, a cast iron putty.

To provide for a better adhesion of the hardened slag layer on the working surface of the plates, a refractory material is built in the plates, such as, brick which partially protrudes on the working surface of a plate.

Additional objects and advantages of the invention will become more readily apparent to persons skilled in the art from the following detailed description and annexed drawings and in which drawings:

FIG. 1 is a fragmentary side view partly in elevation and partly in cross-section of a blast furnace provided with the proposed lining for the internal surface of the furnace walls;

FIG. 2 is a diagrammatic view showing a plate complete with a coil provided therein for passing technical water;

FIG. 3 is a diagrammatic view showing a plate complete with direct-flow pipes for evaporative cooling;

FIG. 4 is a cross sectional view showing one for the versions of securing plates to the jacket of the blast furnace; and

FIG. 5 is a detailed sectional view of one of the embodiments of the working surface of a plate.

Vertical metal plates **1** provided in the shaft, body and boshes of a blast furnace and enclosed within a metal jacket or shell **2** each have located therewithin coils **3** of pipe, and into which technical water is forced supplied from the water-supply line of the plant through pressure collectors (not shown in the drawing). The coils **3** may be connected in consecutive order in sections of several pieces each over the vertical or horizontal line. With evaporative cooling there are employed direct-flow pipes **4** (FIGURE 3) which are connected with each other over the vertical line. Water, preliminarily purified from salts, is supplied by gravity or under pressure from a tank or separator (not shown on the drawing) into the pipes. On heating, the water evaporates, and a result of which, a steam-water mixture forms in the pipes, with the mixture passing upwardly and then returning to the tank or separator.

It will be noted that the internal surface of the plates is provided with alternating projections **5** and recesses **6** which may be of various shapes, as shown in FIGS. 4 and 5. The projections and recesses extend transversely of the plate and contribute to the formation of a layer of hardened slag **7** for protecting the plates from wear and burning. A firmer adhesion between the hardened slag layer **7** and the working surface of a plate occurs when a refractory material in the plate such as, for example, brick that partially protrudes on the working surface. Putty **9** such as a cast iron putty, is used to fill the horizontal and vertical clearances between adjacent plates, which improves the sealing of the blast-furnace lining. The vertical metal plates **1** are secured to the jacket **2** by means of bolts **10** or other means.

As the layer of the hardened slag **7** wears away or partially slides downwardly, this layer will be regenerated by the slag sticking on a rough surface of a plate. More particularly, the blast furnace will be, as it were, self-lining. Such a lining of the blast furnace will provide

for the retention of a given profile of the furnace during the whole period of its operation between overhauls of the lining, thus contributing to obtaining the best technical and economic factors of the furnace operation.

The cost of the proposed lining of the internal surface of the walls of the shaft, body and boshes of an experimental blast furnace was found during its operation to be by as much as 50 to 55 percent lower than the cost of an ordinary thick-walled structure provided with a refractory lining of blocks or bricks.

Blast furnaces provided with such a lining for the internal surface of the walls of the shaft, body and boshes permit, without an increase in diameters of the hearth and throat of the blast furnace, an increase in the output by as much as 4.6 to 7.8 percent and a decrease in the consumption of coke by as much as 1.0 to 2.8 percent without changing the blast-furnace practice and with the same quality of the coke and sinter used. The content of carbon dioxide in the blast-furnace gas increased by as much as 0.6 to 1.0 percent.

On the existing blast furnaces the refractory lining of blocks or bricks may be replaced during an overhaul with the proposed lining without replacing the metal structures of the jacket thereby contributing to an increase in both the useful capacity and output of a furnace.

This invention is not to be confined to any strict conformity to the showings in the drawings but changes or modifications may be made therein so long as such changes or modifications mark no material departure from the spirit and scope of the appended claims.

What is claimed is:

1. A lining for the internal surface of a blast furnace having a shell, shaft, body and boshes, comprising vertical metal plates installed in the shaft, body and boshes, said metal plates being provided with alternate projections and recesses on the surface thereof facing toward the inside of the furnace with such projections and recesses promoting the formation on said surfaces of a stable protective layer of hardened slag consisting of semi-melted charge materials, means within said plates for cooling said plates and means for securing said plates to said shell.

2. The lining for the internal surface of a blast furnace as claimed in claim 1 in which said recesses are partially filled with refractory elements.

3. The lining for the internal surface of a blast furnace as claimed in claim 1 in which the clearances between adjacent plates are filled with a cast iron putty for sealing the lining.

4. The lining for the internal surface of a blast furnace as claimed in claim 1 in said projections and recesses extend transversely of the plate.

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