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APPARATUS FOR RECOVERING AN UNBURNT WASTE GAS IN AN OXYGEN TOP-BLOWING CONVERTER

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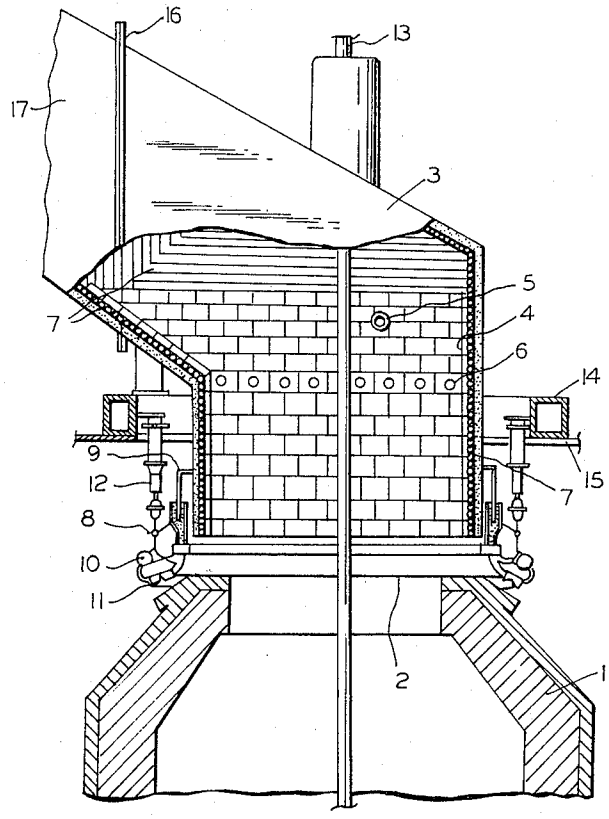
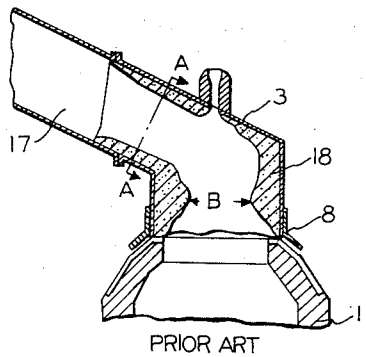
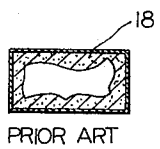


FIG. 1



PRIOR ART

FIG. 2



PRIOR ART

FIG. 3

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APPARATUS FOR RECOVERING AN UNBURNT WASTE GAS IN AN OXYGEN TOP-BLOWING CONVERTER

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The present invention relates to an apparatus for recovering the waste gas in an oxygen top-blowing converter and more particularly to a waste gas recovery hood.

Generally, in a top-blowing converter, in the blowing of molten pig iron by using pure oxygen, especially in the middle period of the blowing when the decarburizing reaction is most active, a part of the contents of the furnace will inevitably splash into the hood due to severe boiling thereof, however carefully the oxygen blowing is carried out. In a conventional top-blowing converter of a type wherein waste gas is burnt in the furnace mouth, however, the contents of the furnace consisting mostly of slag and partly of metal splashed out by boiling will remain molten, as the temperature of the waste gas in the hood will have reached 1800° to 2000° C. due to the combustion in this period and these materials will be deposited only thinly on the wall surface of the hood, even if the hood wall is cooled with water. During the blowing the surface of such deposit will always melt and drop down. Thus, there has been no trouble caused during the operation.

On the other hand, in an apparatus for recovering waste gas in the unburned condition in an oxygen top-blowing converter, it has become clear that, in case of refining molten pig iron by blowing in pure oxygen, the boiling of the metal will be so severe that a part of the boiling metal will splash and will stick to the end part of the waste gas recovering hood, thereby greatly impeding the recovery of the waste gas.

In our endeavours to eliminate this defect, we have succeeded in preventing the splashed metal from sticking to the waste gas recovering hood.

An object of the present invention is to prevent the splashed metal from sticking to the end part of the waste gas recovering hood in an apparatus for recovering waste gas in the unburned condition in an oxygen top-blowing converter and especially in the middle period of the oxygen blowing.

Another object of the present invention is to increase the yield in producing steel and to make continuous operation possible in an apparatus for recovering unburnt waste gas in an oxygen top-blowing converter.

The other objects and effects of the present invention will be clear from the following specification.

The present invention will now be described with reference to the drawings in which:

FIGURE 1 is a partly sectioned view of an apparatus of the present invention;

FIGURE 2 is a view showing metal as deposited on a hood;

FIGURE 3 is a sectional view on line A—A in FIGURE 2.

In FIGURE 1, a hood **3** has an air-tight mechanism **8** connecting it to the top part **2** of a converter **1** and a a joint **16** connecting it to a cooler **7**.

The air-tight mechanism **8** consists of an upwardly and downwardly movable skirt **10**, a water-sealed apron **9** and a skirt operating cylinder **12**. An inert gas is jetted out through a nozzle **11**, building up a gas curtain between it and the converter. Cooling water pipes **7** are provided on the inside surface of hood **3**. A layer **4** of a non-basic refractory material such as, for example, silica bricks is provided over said water pipes **7**. The layer of these bricks covers the whole periphery of the end part of the hood up to ⅔ to ¾ of the total height of the vertical part of the hood from the forward end thereof. The hood **3** is mounted on a receiving base **14** provided on a supporting base **15**. A fluxing material charging port **5** is provided in the hood. Hood pressure detecting holes **6** and a pure oxygen blowing lance **13** are also provided.

The top-blowing converter of the present invention is an apparatus as is described above. However, according to the present invention, a more complicated and ingenious construction is given to the hood of the present invention than any conventional converter hood for the purpose of keeping the gas passage as air-tight as possible during blowing. A skirt **10** having nitrogen curtain jetting slit **11** on the periphery thereof and for freely adjusting the clearance with respect to the furnace mouth **2** is attached to the lower surface of the hood **3**. During the blowing, the clearance between the skirt **10** and the furnace mouth **2** is kept less than 300 mm. and, in order to prevent the entry of air, a nitrogen curtain is used and the internal pressure of the hood in the furnace mouth is controlled so that it is always from 0 to several mm. Ag when carrying out the operation. In such case, the gas in the hood will be composed of 60 to 90% CO and less than 0.1% O_2 and will not be burnt at all. The actually measured value of the temperature within the hood even in a large converter of 130 tons is only 1350° to 1450° C. at most on the inside surface of the hood **3**. Therefore, as the temperature within the furnace at the time of boiling will have reached 1500° to 1550° C., the furnace contents splashed out by boiling during blowing and splashed up into the hood **3** will be cooled down and, further, these splashed contents will quickly stick to the wall surface of the hood as the latter is cooled by water and the thickness of the layer will gradually grow during the blowing. A week after the beginning of operation of a prior art collection apparatus, the substance jetted out of the converter will coagulate in the manner shown in FIGURES 2 and 3. The thickest part of the coagulation or the part B in FIGURE 2 will be about ½ of the inside diameter of the hood **3**. Further, in the end part of the hood **3**, the coagulation will hang and will stick to the air-tight mechanism **8**. As a result, the raising and lowering of the skirt **10** will become difficult, the detecting holes for the control of the hood pressure will be clogged, whereby the control of the pressure within the hood will become impossible. Moreover, even the suction of the waste gas will be impeded, making the continuous operation impossible. The decrease in the yield of steel resulting from sticking of contents to the hood must be taken into account.

In the detailed investigations of the coagulation of the material splashed up out of the converter, it has been found that the material consists mostly of a high basic slag having a ratio of CaO/SiO_2 of 3:1 to 5:1, in which iron grains are mixed and that the material itself has a melting point of about 1400° C.

On the basis of said investigations we have succeeded in preventing this material from sticking to the hood **3** by coating the whole periphery of the end part of the unburnt gas recovering hood in close contact with the top part of the converter with a non-basic refractory material to a required height. If the inside surface of the hood is lined with acid bricks, for instance, silica bricks, the refractory bricks and the splashed up material consisting mostly of a highly basic slag having a ratio of

$$CaO/SiO_2$$

of 3:1 to 5:1, react with each other to produce a glassy product of a low melting point which always coats the surface of the bricks, whereby a wet appearance is given

to the same and no coagulation will stick thereto. In case neutral bricks, for instance, chromium, carbon or silicon carbide bricks are used, a coagulation will slightly stick to the bricks, but when it reaches a certain thickness, it will naturally peel off the bricks due to its own weight. Thus, the brick surface after the coagulation has peeled off will also have a wet appearance as in the former case. But, in this case, there is a defect that the metal tends to bite into the joints between the bricks when it splashes out and the bricks are likely to fall when the metal falls.

Further, if graphite bricks are used, the deposit will be small and the loss of the bricks caused by melting will be low. Therefore, as a material for lining graphite is the best, except for the high cost thereof. Because of the relatively low temperature of the inside surface of the end part of the hood at the time of blowing which is 1350° to 1450° C., or a temperature at least lower than the final molten steel temperature of 1600° C. and further because the refractory substance is being cooled on the back surface by the water-cooled pipes, the refractory substance will stand up over the flowing of many charges, for instance with silicon bricks for 60 charges, more than 300 charges with neutral bricks and about 800 charges with graphite bricks. Therefore, we can use any of non-basic refractory bricks, neutral bricks, carbon bricks or graphite bricks for lining the whole part of the hood to be lined. It is also possible to line the upper part of the vertical part of the hood **3** with non-basic refractory material and the lower part thereof with graphite, whereby economic and favorable results may be obtained.

The part of the hood to which the splashed up material sticks most easily, that is, the whole periphery of the vertical part of the hood covering ⅔ to ¾ of the total height from the lower end of the hood **3** should be lined with the bricks. The thickness of the lining of bricks is preferably about 10 cm. If the lining bricks are thick, a temperature difference between the surface of the bricks **4** on the inside of the hood **3** and the brick surface in contact with the water pipes **7** will be produced and the bricks will be spalled. Therefore, it is more effective for the present invention to use highly thermally conductive bricks. Further, in the present invention, the lining is not limited to bricks, but can also be a muddy non-basic mortar. For instance, when the water pipes were coated with commercial PS–160 (composed mostly of 45.8 to 50.6% SiO_2 and 41 to 45.2% Al_2O_3) to a thickness of 2 mm. (4.4 kg./m.^{2}), a favorable result was obtained.

By the above treatment, the inside surface of the hood **3** will always be kept clean and, even during continuous blowing, the fluxing material charging port **5** and the furnace pressure detecting holes **6** will not be clogged, the skirt will move freely up-and-down and the desired waste gas recovering operation will be carried out normally and safely. Further, as the diameter of the hood **3** is equal to that of the furnace mouth, the furnace contents splashed out by boiling will flow back into the furnace. Thus according to the present invention, the yield of steel production previously averaging 90% has been revised to 92.5%, that is, a high yield such as could hardly be obtained in a conventional type of converter, in which waste gas is burnt and the diameter of the hood is always so much larger than that of the furnace mouth that the splashed up material is likely to drop out of the furnace.

As described above, by means of an apparatus according to the present invention not only can a metallurgical success be achieved in the recovery of an unburnt waste gas produced in an oxygen top-blowing converter in a safe and sure manner, but also an economic advantage can be obtained in the form of a high yield in producing steel such as is hardly possible in any conventional gas-burning type converter.

What is claimed is:

1. An apparatus for recovering from an oxygen top-blowing converter waste gas in an unburned state, which comprises a vertical hood adapted to be positioned in close contact with the top part of the converter and an oblique hood connected to said vertical hood, said oblique hood being adapted to be connected with a cooler, the interior of the walls of said hoods having water pipes lining them, and a good heat conducting graphitic refractory material layer covering said water pipes and forming the inside surface of said hoods and being present in such a thickness that substantially no temperature difference exists between the surface of the refractory material on the inside of the hoods and the portion of the material in contact with the water pipes during gas recovery.

2. An apparatus as claimed in claim **1**, in which the refractory material on the walls of the oblique hood is acid bricks and the refractory material on the walls of the vertical hood is graphitic bricks.

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