

SPECIFICATION

TITLE OF THE INVENTION

A Preheating Device of Scrap Metal

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BACKGROUND OF THE INVENTION

FIELD OF THE INVENTION

The present invention relates to a preheating device mounted on an arc furnace, especially to a furnace-top scrap preheating device for preheating scrap metal in a preheating chamber with gas exhausted from the arc furnace.

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DESCRIPTION OF THE RELATED ART

The patent application laid-open No. 8-136163 and other publications disclose a known furnace-top scrap preheating device in which a preheating chamber is mounted on an arc furnace, scrap metal is contained in the preheating chamber and the exhaust gas from the arc furnace is passed through the preheating chamber to preheat the scrap metal, thereby saving energy.

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In the aforementioned prior-art furnace-top scrap preheating device, a wall of the preheating chamber is heated to a high temperature by the exhaust gas. Therefore, the scrap metal is molten and easily deposited on an inner face of the preheating chamber wall. In this case, even when a fire grate provided on a lower portion of the preheating chamber is opened, the scrap metal in the preheating chamber form a so-called bridge configuration, fail to fall down in the arc furnace and

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probably cause an operation trouble.

SUMMARY OF THE INVENTION

5 An object of the invention is to prevent scrap metal from failing to fall down in an arc furnace because of deposition and to prevent the occurrence of an operational trouble of the arc furnace.

10 According to a first aspect, the invention provides a furnace-top scrap preheating device, in which a preheating chamber capable of containing scrap metal is mounted on an arc furnace and the exhaust gas of the arc furnace is passed through the preheating chamber, and in which a preheating chamber wall is provided with a flow path for passing cooling water and a mechanism for circulating the cooling water. According to the
15 invention, since the preheating chamber wall is constantly cooled, the deposition of the metal scraps and resulting operational trouble in the arc furnace are prevented.

20 Preferably in the furnace-top scrap preheating device, the preheating chamber wall has a double-wall structure, and a spray pipe is laid for spraying the cooling water in the preheating chamber wall.

Preferably in the furnace-top scrap preheating device, the cooling water flows in an inner clearance of the preheating chamber having the double-wall structure.

25 Preferably in the furnace-top scrap preheating device, a water-cooled pipe is laid inside an outer-wall plate of the preheating chamber, and the cooling water flows in the water-

cooled pipe.

According to a second aspect, the invention provides a furnace-top scrap preheating device, in which a preheating chamber capable of containing scrap metal is mounted on an arc furnace and exhaust gas of the arc furnace is passed through the preheating chamber, in which a mechanism for circulating cooling water to cool a preheating chamber wall is provided, and a refractory is lined on a side of a chamber inner surface of the preheating chamber wall. In this constitution, since the preheating chamber wall is constantly cooled, the deposition of the metal scraps is prevented and the quantity of exhaust gas heat taken by the cooling water is reduced. Therefore, an effect of preheating scrap metal can be increased, and the quantity of used cooling water can be decreased.

Preferably in the second aspect of the furnace-top scrap preheating device, a water-cooled pipe is embedded in the refractory lined on the side of the chamber inner surface of the preheating chamber wall. In this constitution, a life of the refractory can be lengthened.

Preferably in the furnace-top scrap preheating device, the preheating chamber wall has a double-wall structure, and the cooling water flows through an inner clearance of the preheating chamber wall. In this case, by connecting the water-cooled pipe and the inner clearance of the preheating chamber wall, the cooling water is circulated.

Preferably, inside the preheating chamber wall of the double-wall structure, a spray pipe is laid for spraying the

cooling water.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention will be described by way of example, with
5 reference to the accompanying drawings, in which:

Fig. 1 is a longitudinal sectional view of a furnace-top scrap preheating device according to a first embodiment of the invention.

Fig. 2 is a side view of the furnace-top scrap preheating
10 device shown in Fig. 1.

Fig. 3 is an enlarged longitudinal sectional view of the furnace-top scrap preheating device according to the first embodiment.

Fig. 4 is a sectional view taken along line A-A shown in
15 Fig. 3.

Fig. 5 is a longitudinal sectional view of a preheating chamber wall according to a modification of the first embodiment.

Fig. 6 is a longitudinal sectional view of a preheating
20 chamber wall according to another modification of the first embodiment.

Fig. 7 is a longitudinal sectional view of a furnace-top scrap preheating device according to a second embodiment.

Fig. 8 is a side view showing the furnace-top scrap
25 preheating device shown in Fig. 7 with a preheating device outer plate excluded therefrom.

Fig. 9 is an enlarged longitudinal sectional view of a

preheating chamber wall according to the second embodiment.

Fig. 10 shows an appearance of the preheating chamber wall of Fig. 9 as seen from side A'-A'.

Fig. 11 is a sectional view taken along line B-B of Fig. 9.

5 Fig. 12 is a sectional view taken along line C-C of Fig. 10.

Fig. 13 is an enlarged longitudinal sectional view of a preheating chamber wall according to a modification of the second embodiment.

10 Fig. 14 is a diagrammatic representation showing an exhaust gas treatment device of an arc furnace provided with the furnace-top scrap preheating device according to the invention.

Fig. 15 is an enlarged longitudinal sectional view of a scrap catcher shown in Fig. 14.

15 Fig. 16 is an enlarged longitudinal sectional view of a scrap catcher according to a modification of the embodiment shown in Fig. 14.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

FIRST EMBODIMENT

20 A first embodiment of the invention is now described with reference to Figs. 1 to 4.

As shown in Figs. 1 and 2, an arc furnace 1 is tiltably provided via rollers 6 on a base 2, and has a molten-metal discharge port 3 for discharging molten metal to the outside.
25 An electrode 4 is supported by an electrode support unit 5 and its tip end extends downward in the arc furnace 1.

Support bases 7 are provided on both sides of the arc

furnace 1, and a furnace-top scrap preheating device 50 is laid on rails 8 provided on the support bases 7. Wheels 25 are attached to lower ends of a frame 9 in such a manner that the preheating device 50 can move along the rails 8.

5 Preheating chambers 10 and 11 are vertically arranged in the frame 9 and supported by the frame 9. On a bottom of the upper preheating chamber 10, a pair of fire grates 12 having a fork configuration are rotatably mounted in such a manner that the fire grates 12 can be opened downward by operating
10 cylinders 13. Also on a bottom of the lower preheating chamber 11, a pair of fire grates 14 having a fork configuration are rotatably mounted in such a manner that the fire grates 14 can be opened downward by operating cylinders 15.

 An open end of an extended portion 16 attached to a lower
15 end of the lower preheating chamber 11 is aligned with an upper open end of the arc furnace 1. The open ends are formed in circular arcs, and can slide relative to each other for allowing the arc furnace 1 to tilt. Further, an upper open end of the preheating chamber 10 is provided with a pair of shutters 18
20 which can be opened and closed by cylinders 17.

 Also, bucket supports 19 are mounted on an upper end of the frame 9 for receiving a bucket 20 formed like a clam shell for conveying scrap metal. The bucket 20 is suspended from a crane wire.

25 By opening the shutters 18, the scrap metal conveyed by the bucket 20 can fall down in the preheating chamber 10. Also by opening the fire grates 12 of the preheating chamber 10, the

scrap metal fall from the preheating chamber 10 into the preheating chamber 11. Further by opening the fire grates 14 of the preheating chamber 11, the scrap metal can fall from the preheating chamber 11 into the arc furnace 1.

5 In the furnace-top scrap preheating device 50, to introduce the exhaust gas of the arc furnace 1 into the preheating chamber 10, a side wall of the extended portion 16 is connected with a side wall of the preheating chamber 10 by a circulating duct 21.

10 Also, an exhaust gas port 23 is formed in a side wall of the preheating chamber 11 and connected to an exhaust gas duct 24. Therefore, in the preheating device 50, exhaust gas generated in the arc furnace 1 flows through the scrap metal in the preheating chamber 11 into the exhaust gas duct 24, and simultaneously
15 flows through the circulating duct 21 directly into the preheating chamber 10. The exhaust gas also flows down through the scrap metal in the preheating chamber 10 into the exhaust gas duct 24 and is let off from the exhaust gas duct 24.

20 As enlarged shown in Figs. 3 and 4, a wall constituting the preheating chamber 10 and 11 has a double-wall structure constituted of an outer-wall plate (shell) 30 and an inner-wall plate (shell) 31. In the structure, a spray pipe 32 is laid in an inner clearance 36. Cooling water is sprayed through multiple spray holes formed in the spray pipe 32 toward the inner-wall
25 plate 31. As shown in Fig. 2, the wall is divided into plural panels 33. Each of the panels 33 is provided with a water-supply pipe 34 and a discharge pipe 35. Additionally, the

extended portion 16 has a water-cooled structure in the same manner as the preheating chambers 10 and 11. Each panel 33 has therein a vent hole 37 to the atmosphere.

In the furnace-top scrap preheating device 50 having the
5 aforementioned constitution, the inner-wall plate 31 in contact with the scrap metal in the preheating chambers 10 and 11 is constantly cooled by the cooling water sprayed from the spray pipe 32. Even when the scrap metal in the preheating
10 chambers 10 and 11 are molten by the heat of the flowing exhaust gas, the metal is not deposited. Just by opening the fire grates 12 and 14, the preheated scrap metal easily fall down into the lower preheating chamber 11 and the arc furnace 1, respectively.

In the structure in which the cooling water is sprayed, no
15 water pressure is applied to the inner clearance 36. Therefore, the structure does not need to be pressure-resistant, sealed or reinforced against the water pressure. Weight and manufacture cost can be reduced. Further, even if water leakage occurs, water leaks only slightly, thereby causing no
20 steam explosion or another accident. Maintenance, repair or the like can be facilitated.

In a modification shown in Fig. 5, water-cooled pipes 40 are arranged at a constant interval inside the outer-wall plate 30 via a spacer 41 for circulating the cooling water in the water-
25 cooled pipes 40. Also in this case, since the scrap metal in the preheating chambers 10 and 11 are constantly in contact with the water-cooled pipes 40, the metal deposition is prevented.

Another modification shown in Fig. 6 has a double-wall structure constituted of the outer-wall plate 30 and inner-wall plate 31 and a so-called water-cooled jacket structure in which the cooling water is circulated in the inner clearance 36. Also
5 in this case, since the inner-wall plate 31 is prevented from overheating, the metal deposition can be prevented. Usually, after a preheating operation the scrap metal can automatically fall down smoothly.

SECOND EMBODIMENT

10 A second embodiment of the invention is now described referring to Figs. 7 to 12. As shown in Figs. 7 and 8, a constitution of the second embodiment is the same as that of the first embodiment except the wall structure of the preheating chambers 10 and 11. Therefore, the same members are denoted
15 with the same codes, and the description thereof is not repeated.

In the second embodiment, as enlarged in Figs. 9 to 12, the wall of the preheating chambers 10 and 11 is constituted of plural panels 71 which are attached with bolts or the like to an outer plate 74 of a preheating device. Specifically, each panel
20 71 has a double-wall structure constituted of an outer-wall plate (shell) 60 and an inner-wall plate (shell) 61. In an inner clearance 62 a partition 63 for vertically dividing the inner clearance 62 and baffle plates 64 for forming a snaking water path 73 are provided. Further, water inlets 65 and discharge
25 ports 66 are provided so as to communicate with the inner clearance 62, respectively.

A water-cooled pipe 67 arranged in a snaking manner on a

side of a chamber inner surface of a preheating chamber wall is welded to the inner-wall plate 61. Both ends 70a and 70b of the water-cooled pipe 67 are communicated with the inner clearance 62, respectively. Further, the water-cooled pipe 67 is embedded
5 in a castable refractory 68 which is applied on the side of the chamber inner surface of the preheating chamber wall. To prevent the refractory 68 from collapsing, anchor pins 69 are attached to an outer peripheral surface of the water-cooled pipe 67 and an inner surface of the inner-wall plate 61.

10 As shown in Fig. 9, peripheral edges of the outer-wall and inner-wall plates 60 and 61 are folded inwardly like a frame and bonded together to form a water path 72 which surrounds an outer periphery of the panels 71. A pitch P of the water-cooled pipe 67 provided in the snaking form is about 100 to 200mm.

15 Cooling water is supplied under pressure from the water inlet 65, passed through the water path 72, circulated in a substantially lower half portion of the inner clearance 62 as shown by arrows in Fig. 11, passed from the end 70a through the water-cooled pipe 67, returned via the end 70b back into an
20 upper half portion of the inner clearance 62, circulated in the water path 73 as shown by arrows, and thereafter discharged via the water path 72 to the discharge port 66.

By cooling the inner-wall plate 61 and the inner clearance 62 as aforementioned, their heat resistance and durability can be
25 remarkably increased. Also, since the castable refractory 68 is provided, the exhaust gas flowing through the preheating chambers 10 and 11 does not directly contact the water-cooled

pipe 67, the inner-wall plate 61 or the like. Further, the refractory 68 serves as a heat insulating material, so that the quantity of the exhaust gas heat taken by the cooling water can be reduced by about 40%. The quantity of the required cooling
5 water can be minimized.

The refractory 68 is gradually worn by the scrap metal, thereby exposing the water-cooled pipe 67. However, when the diameter of the water-cooled pipe 67 is 50 to 80mm, by setting the pitch P of the water-cooled pipe 67 at about 100 to 200mm,
10 the refractory 68 is worn only by about the half of the pipe diameter. As a result, the life of the refractory can be lengthened. Also, by setting the pitch P of the water-cooled pipe 67 at about 100 to 200mm, even when the refractory 68 is worn, the scrap metal having a usual size are hardly caught in
15 the clearance in the water-cooled pipe. When the fire grates 12 and 14 are opened, the preheated scrap metal can fall down smoothly. Also, even when the refractory 68 is completely worn, the outer plate of the preheating chamber can be prevented from being heated by the exhaust gas of a high temperature, because
20 the inner clearance 62 is cooled by water.

On the other hand, in a modification shown in Fig. 13 the panel 71 has a double-wall structure constituted of the outer-wall plate 60 and the inner-wall plate 61. Additionally, a spray pipe 80 is laid in the inner clearance 62 for spraying cooling
25 water to the inner-wall plate 61 from multiple spray holes formed in the spray pipe 80. Further, the water-cooled pipe 67 is laid on the side of the chamber inner surface of the preheating

chamber wall and embedded in the refractory 68 in the same manner as the aforementioned embodiment.

In this structure, since the cooling water to be sprayed is supplied from a channel separate from the water-cooled pipe 67, 5 water pressure is scarcely applied to the inner clearance 62. Therefore, the inner clearance 62 does not need to have a pressure-resistant sealed structure. As a result, since a structural reinforcement against the water pressure is unnecessary, weight and manufacture cost can be reduced. 10 Even if water leakage occurs, water leaks only slightly, thereby causing no steam explosion or another accident. Maintenance, repair or the like can be facilitated.

An exhaust system of the exhaust gas from the furnace-top scrap preheating device of the aforementioned embodiment is 15 now described referring to Figs. 14 to 16.

The exhaust gas port 23 is formed in the side wall of the preheating chamber 11 and connected to the exhaust gas duct 24. A closable connecting port 114 is provided for letting outside air into the exhaust gas duct 24 as required. In the exhaust gas 20 duct 24 a scrap catcher 120 is provided for removing scraps from the exhaust gas. Behind the scrap catcher 120 connected are a deodorizing tower 130, a cooling tower 140, a suction blower 150 and a bag filter 160.

The exhaust gas of the arc furnace 1 is drawn by the 25 suction blower 150 via the scrap catcher 120, the deodorizing tower 130 and the cooling tower 140 and fed to the bag filter 160.

Ducts are connected to the bag filter 160 for taking in the

exhaust gas from a construction via a hood 161 above the molten-metal discharge port 3 and a hood 162 above the preheating chamber 10, respectively.

The deodorizing tower 130 is provided therein with plural
5 burners 131 for burning and deodorizing combustibles and odorous gas. Also, pipes 141 are arranged in the cooling tower 140 for circulating cooling water to cool the exhaust gas by means of heat exchange.

As shown in an enlarged sectional view of Fig. 15, in the
10 scrap catcher 120 a partition 121 is extended downward to form a U-shaped channel constituted of a descending path 122 and an ascending path 123. Below the channel a scrap pool 124 is provided sufficiently apart from a lower end of the partition 121. A bottom of the scrap pool 124 is closed with openable bottom
15 plates 125. The partition 121 is slightly tilted toward the descending path 122, so that an inner diameter of the descending path 122 is smaller than that of the ascending path 123. Baffle plates 126 are provided below the ascending path 123 for preventing the scraps from ascending. Also, guide plates 127
20 are provided in an upper portion of the ascending path 123 for guiding the exhaust gas to an exhaust port.

In the exhaust gas exhausting system having the aforementioned constitution, the exhaust gas guided via the exhaust gas duct 24 into the scrap catcher 120 flows downward
25 straight along the descending path 122 and thereafter upward straight along the ascending path 123. Since the partition 121 is tilted in such a manner that the inner diameter of the

descending path 122 is smaller than the inner diameter of the ascending path 123, an exhaust-gas descending speed V_1 of e.g. 8 to 10m/s is higher than an exhaust-gas ascending speed V_2 of e.g. 5 to 7m/s. Since the exhaust gas rapidly descends and changes its direction, the scraps mixed in the exhaust gas stall and hit the scrap pool 124. The scraps are firmly captured in the scrap pool 124. By decelerating the ascending speed of the exhaust gas along the ascending path 123, the scraps are prevented from being blown upward. Further, the baffle plates 126 effectively prevent the scraps from coming up where they are. In this manner, the scraps pooled in the scrap pool 124 are discharged to the outside by opening the bottom plates 125 at appropriate times.

In a modification of Fig. 16, by bending a lower portion of the partition 121 toward the descending path 122, the inner diameter of the descending path 122 is reduced. Also in this configuration, the difference in speed between the descending path 122 and the ascending path 123 can be kept.

The embodiments in which the exhaust gas is let off from the lower preheating chamber 11 have been described. The number of the preheating chambers, the exhaust gas port and the like are not restricted to the embodiments and can be modified in various manners.

In the exhaust gas treatment device, since the scrap catcher is provided in the exhaust-gas exhausting system, the scraps flowing from the furnace-top preheating chamber can be firmly collected. Therefore, no scraps flow into the deodorizing

tower and the cooling tower, thereby facilitating maintenance.

While the preferred embodiments of the invention have been described, it is to be understood that the invention is not limited thereto, and may be otherwise embodied within the scope
5 of the following claims.



WHAT IS CLAIMED IS:

1. A furnace-top scrap preheating device which is provided with a preheating chamber capable of containing scrap metal on an arc furnace, exhaust gas of said arc furnace being
5 passed through said preheating chamber and

wherein a preheating chamber wall is provided with a flow path for passing cooling water and a mechanism for circulating the cooling water, so that the metal is prevented from being deposited.

10 2. A furnace-top scrap preheating device according to claim 1 wherein the preheating chamber wall has a double-wall structure and a spray pipe is laid for spraying cooling water inside said preheating chamber wall.

3. A furnace-top scrap preheating device according to
15 claim 1 wherein a water-cooled pipe is laid inside an outer-wall plate of the preheating chamber and the cooling water is passed through said water-cooled pipe.

4. A furnace-top scrap preheating device according to claim 1 wherein the preheating chamber wall has a double-wall
20 structure and the cooling water flows in an inner clearance of said preheating chamber wall.

5. A furnace-top scrap preheating device which is provided with a preheating chamber capable of containing scrap metal on an arc furnace, exhaust gas of said arc furnace being
25 passed through said preheating chamber and

wherein a mechanism for circulating cooling water to cool a preheating chamber wall is provided and a refractory is lined



on a side of a chamber inner surface of said preheating chamber wall.

6. A furnace-top scrap preheating device according to claim 5 wherein a water-cooled pipe is embedded in the refractory lined on the side of the chamber inner surface of the preheating chamber wall.

7. A furnace-top scrap preheating device according to claim 5 or 6 wherein the preheating chamber wall has a double-wall structure and the cooling water flows in an inner clearance of said preheating chamber wall.

8. A furnace-top scrap preheating device according to claim 5 or 6 wherein the preheating chamber wall has a double-wall structure and a spray pipe is laid for spraying cooling water inside said preheating chamber wall.