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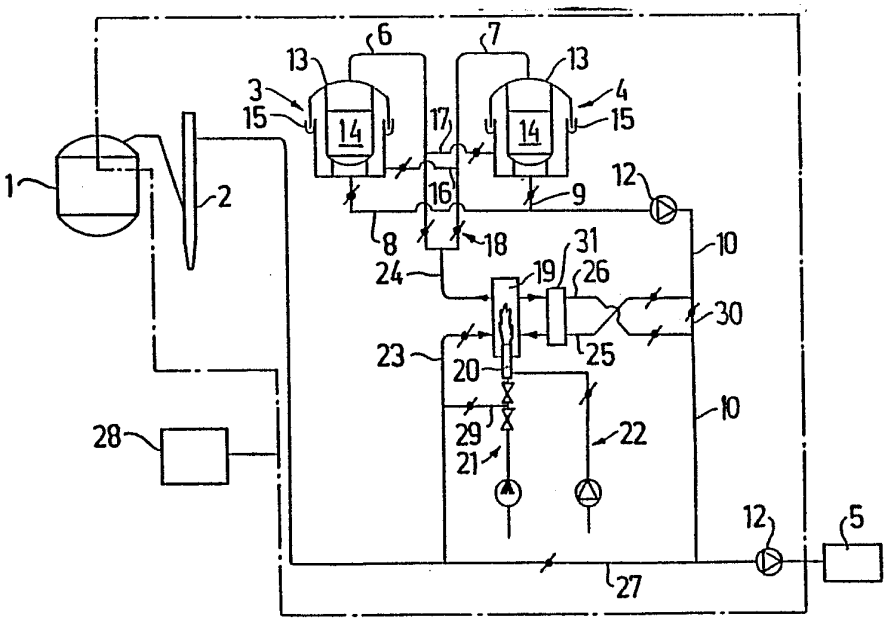
(54) Title: METHOD AND DEVICE FOR PRE-HEATING WASTE METAL FOR FURNACES



(57) Abstract

Method and device for pre-heating waste metal for furnaces, flue gases generated in a furnace (1) being supplied simultaneously or sequentially to two pre-heating places (3, 4) with waste metal containers (14), said flue gases being made to flow through a combustion chamber (19) provided with a burner (20) before being supplied to the pre-heating places (3, 4), said burner (20) producing a variable amount of hot gases for admixture with the flue gases from the furnace (1) and overheating thereof. After flowing through the waste metal containers (14) burnt flue gases are supplied to a purification plant (5) for flue gases and unburnt flue gases to the combustion chamber (19) for further burning, after which the flue gases now burnt are supplied to said purification plant (5).

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Method and device for pre-heating waste metal for furnaces

This invention relates to a method and a device for pre-heating waste metal for furnaces, flue gases generated in a furnace being supplied simultaneously or sequentially to two pre-heating chambers with waste metal containers.

In the electric steel industry waste metal can be utilized as main raw material in electric arc furnaces. Moreover, waste metal can be used as cooling agents in basic oxygene furnaces.

In both cases a controlled pre-heating of the waste metal will bring an improved operation economy.

Methods and devices of the kind mentioned by way of introduction are previously known where the flue gases after flowing through the pre-heating chambers are recycled to a combustion chamber or dust collector directly connected to the furnace for post-combustion of unburnt flue gases. However, it has been found that the combustion of flue gases in such a combustion chamber will be incomplete and uncontrollable due to a temperature from the furnace varying in time. Moreover, the waste metal cannot be heated as cold flue gases are generated in the furnace e.g. at times with no connected power.

It is the object of this invention to provide an improved method and an improved device of the kind indicated above, and this object has been achieved by means of the characteristic features of the method and the device defined in the claims.

One advantage of the invention in comparison with previous solutions is that the invention suggests a combustion chamber provided with a controlled burner of its own, by means of which unburnt gases from the elec-

tric arc furnace, on one hand, and, on the other hand, from the pre-heating chambers are post-combusted and destructed at a temperature controllable in time. Moreover, a larger amount of energy is added to the flue gases which is then recycled to the process via a hotter waste metal. The location of the combustion chamber is independent of the position of the electric arc furnace. In other words, it can thus be placed in a direct connection with the pre-heating chambers. Moreover, the waste metal can also be heated at times with cold flue gases from the furnace by means of the burner.

An illustrative exemple of the invention will be described below with reference to the enclosed drawing which shows schematically a device according to the invention.

A pre-heating device according to the invention is shown with reference to the figure. Flue gases generated in an electric arc furnace/basic oxygene furnace are evacuated via a dust collector 2 to a combustion chamber 19 provided with a burner 20 and thereafter further to two pre-heating chambers 3 and 4.

The burner 20 is intended to produce hot flue gases for admixture with flue gases from the furnace 1 and for post-combustion of unburnt gases from the furnace 1 and from the pre-heating chambers 3 and 4.

The burner 20 can be fired e.g. by means of oil, carbon powder, gas or biofuel (powder). In the figure 21 designates the fuel supply system of the burner and 22 its air supply system.

It is also possible to have the burner 20 consist of an electric plasma burner for production of hot air which can be mixed with the flue gases from the furnace 1 and/or the chambers 3 and 4.

The combustion chamber 19 is provided with connecting ducts for flue gases; an inlet duct 23 for flue gases from the furnace 1, an outlet duct 24 for super-

heated flue gases to the pre-heating chambers 3 and 4, an inlet duct 25 for unburnt flue gases from the chambers 3 and 4 and an outlet duct 26 for burnt flue gases to the gas cleaning plant 5 for flue gases. A by-pass duct 27 for flue gases is arranged between the inlet duct 23 and the outlet 10 and a by-pass duct 30 is arranged between the ducts 25 and 26.

The pre-heating chambers 3 and 4 are each provided with an inlet duct 6 and 7, respectively, and an outlet duct 8 and 9, respectively. The outlet ducts 8 and 9 are connected to a common outlet 10.

In order to achieve evacuation of the flue gases flue gas fans 12 with a variable speed are arranged in the outlet 10 and immediately upstream the plant 5, respectively.

The pre-heating chambers 3 and 4 comprise each a liftable roof 13 which is intended to be sealingly adapted on top of a waste metal container 14 in the respective chamber 3 and 4. Said containers 14 which can constitute for example a basket or a chute placed on a carriage are preferably provided with a water-cooled jacket and a water-cooled bottom with automatic connection of cooling water and emptying of the water circuits upon charging of the waste metal in the furnace in order to be able to withstand the high gas temperatures (500-1000°C). The sealing between the covers 13 and the chambers 3 and 4, respectively, can be achieved for instance by means of an annular waterseal 15.

The pre-heating chambers 3 and 4 are mutually connected by means of a crosswise connection system, i.e. the chamber 3 is connected to the inlet duct 7 by means of a passage 16 while the chamber 4 is connected to the inlet duct 6 by means of a passage 17.

In order to enable control of the flue gas flow the ducts included in the device are provided with adjustable and controllable flue gas dampers 18.

The flow of the flue gases through the chambers 3 and 4 will be described in the following. The flue gases are led via the inlet duct 6 to the chamber 3 containing a waste metal basket 14 next in turn to be charged. The flue gases flow through the waste metal container 14 and further through holes in the bottom of the container 14 into the chamber 3. The crosswise connection system makes it possible to lead the flue gases via the ducts 16 and 7 to the pre-heating chamber 4 in which the flow is in the same way as in the chamber 3. The flue gases are thereafter evacuated through the outlet duct 9 and the outlet 10 either to the flue gas cleaning plant 5 or to the combustion chamber 19.

The flue gases can also be led directly from the chamber 3 to the outlet 10 without passing the chamber 4.

Of course the flue gases can first be made to pass the chamber 4 if it is found that the waste metal container 14 therein is next in turn for charging. The crosswise connection system is then utilized in the same way as described above.

Normally the flue gases are first supplied to the chamber containing the hot waste metal basket, so-called cascade heating. However, it is also possible first to supply the flue gases to the chamber containing the cold waste metal basket, for instance a new inserted basket. In this latter heating cycle, so-called reversible heating, a high temperature (800-1000°C) is obtained by means of the hot flue gases in the upper part of the cold waste metal basket. The flue gases are thereafter made to flow via the crosswise connection system through the next chamber with a waste metal basket previously heated in the same way. The possible unburnt flue gases after heating the waste metal in the waste metal basket colder from the beginning will then be ignited, post-combusted and destructed to some ex-

tent in the waste metal in the waste metal basket hot from the beginning. Thus, in this way a started post--combustion of the flue gases already in the waste metal basket with a following post-combustion in the combustion chamber 19 provided with the burner 20 is achieved.

In case pre-heating is not concerned the gases can be evacuated from the furnace 1 directly via the by-pass duct 27 to the gas cleaning plant 5.

When the device is in operation the flue gases generated in the furnace 1 stream into the combustion chamber 19 via the duct 23. The superheated flue gases leave the chamber 19 via the duct 24 and flow thereafter through the pre-heating chambers 3 and 4 in the way previously described. After flowing through the chambers 3 and 4 the flue gases can be led directly to the plant 5 via the ducts 10 and 30 or be recycled through the combustion chamber 19 via the ducts 25 and 26.

In order to increase the temperature in the combustion chamber 19 and to improve the power efficiency a heat exchanger 31 is arranged between the ducts 25 and 26.

The ratio of gases generated by the burner 20 to flue gases generated in the furnace 1 can be varied thanks to the fact that the capacity of the burner 20 is adjustable steplessly. If the furnace 1 does no generate any flue gases at all the burner 20 can generate alone a sufficient amount of flue gases for pre-heating the waste metal.

When the furnace 1 is an basic oxygene furnace there will be difficulties in leading the hot unburnt gases to the chambers 3 and 4 and the combustion chamber 19, respectively, and therefore the burner 20 in this case accounts alone for the pre-heating of the waste metal. On the other hand, the hot flue gases are

more suitable for use as fuel. For example, the gases can be supplied to the fuel supply system 21 via the duct 29 after treatment.

Process control of the pre-heating device can be carried out by means of a microprocessor 28 which also controls the part systems included in the device in addition to the control of dampers 18, roof lifting device (not shown) and fans 12.

The invention is not restricted to what has been shown and described, but amendments and modifications thereof are possible within the scope of the inventive idea defined in the claims.

CLAIMS

1. A method for pre-heating waste metal for furnaces, flue gases generated in a furnace (1) being supplied simultaneously or sequentially to two pre-heating places (3, 4) with waste metal containers (14), characterized in that the flue gases are made to flow through a combustion chamber (19) provided with a burner (20) before being supplied to the pre-heating places (3, 4), that the burner (20) produces hot gases for admixture with the flue gases from the furnace (1) and superheating thereof and that burnt flue gases from the pre-heating places (3, 4) are supplied to a gas cleaning plant (5) for flue gases and unburnt flue gases are supplied to the combustion chamber (19) for post-combustion of the flue gases, after which the flue gases thus burnt are supplied to said gas cleaning plant (5).

2. The method of claim 1, characterized in that the amount of flue gases produced by the burner (20) is adjusted steplessly, said burner (20) producing a sufficient amount of hot gases alone for supply to the pre-heating places (3, 4) in the case when hot flue gases are not generated in the furnace (1).

3. The method of claim 1 or 2, characterized in that the flue gases from the furnace (1) are supplied to the fuel supply system (21) of the burner (20) completely or partly.

4. The method of any one of claims 1-3, characterized in that the flue gases are first made to flow through the colder waste metal container, after which the flue gases are made to flow through the waste metal container, which is hotter from the beginning, in order to bring about the started post-combustion of flue gases in the latter waste metal container.

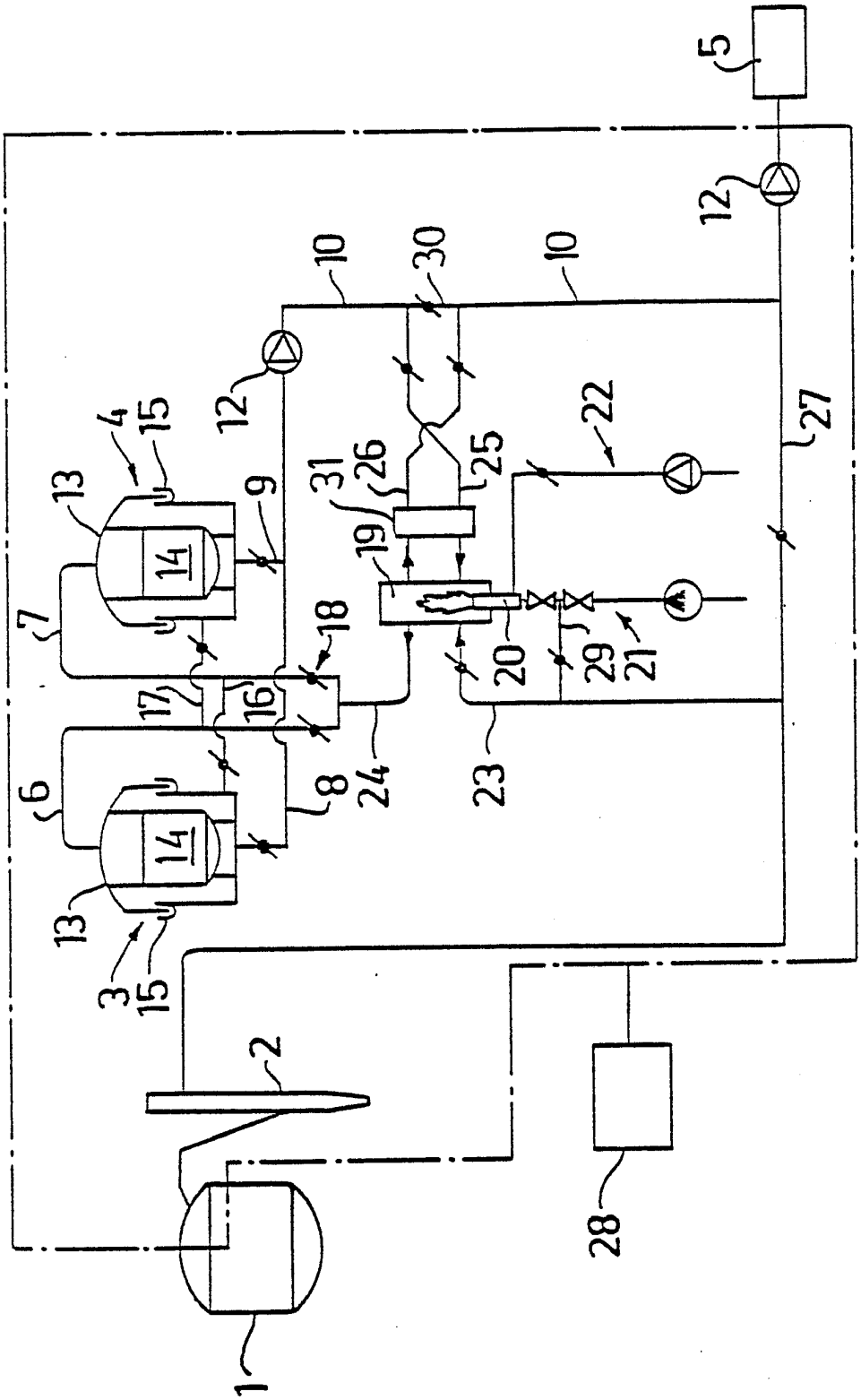
5. A device for pre-heating waste metal for fur-

naces, flue gases generated in a furnace (1) being supplied simultaneously or sequentially to two pre-heating places (3, 4) with waste metal containers (14), characterized by a combustion chamber (19) provided with a burner (20) for production of a variable amount of hot gases for admixture with the flue gases from the furnace (1) and superheating thereof, said combustion chamber (19) being provided with an inlet (23) for flue gases generated in the furnace (1), outlet (24) for superheated flue gases to the pre-heating places (3, 4), an inlet (25) for unburnt flue gases from the pre-heating places (3, 4), an outlet (26) for burnt flue gases to a gas cleaning plant (5) for burnt flue gases and a by-pass duct (30) between the inlet (25) and the outlet (26) for supply of burnt flue gases from the pre-heating places (3, 4) direct to said gas cleaning plant (5).

6. The device of claim 5, characterized in that the fuel supply system (21) of the burner (20) is provided with an inlet (29) for flue gases generated in the furnace (1).

7. The device of claim 5 or 6, characterized in that the inlet (25) for unburnt flue gases and the outlet (26) for burnt flue gases are connected to a heat exchanger (31) arranged between the inlet and the outlet (25, 26).

8. The device of any one of claims 5-7, characterized in that the device is provided with a flue gas damper (18) for control of the flue gas flow and flue gas fans (12) for evacuating said flue gases.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INTERNATIONAL SEARCH REPORT

International Application No PCT/SE87/00195

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all) [6]

According to International Patent Classification (IPC) or to both National Classification and IPC [4]

F 27 B 3/26, F 27 D 13/00

II. FIELDS SEARCHED

Minimum Documentation Searched [7]

Classification System	Classification Symbols
IPC 4	F 27 D 13/00, 17/00; C 21 C 5/38, /40; F 27 B 3/00, /10, /20, /26, 19/00, /04
US Cl	13:1, 2, 9, 33; 266:144, 155, 156, 160; .../...

Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched [8]

SE, NO, DK, FI classes as above

III. DOCUMENTS CONSIDERED TO BE RELEVANT [9]

Category [10]	Citation of Document, [11] with indication, where appropriate, of the relevant passages [12]	Relevant to Claim No. [13]
A	GB, A, 2 162 293 (GODO STEEL LTD) 29 January 1986	
A	US, A, 4 375 958 (DATE ET AL) 8 March 1983 See figure 4	1-8
A	US, A, 4 437 186 (INAI) 13 March 1984	
A	US, A, 4 478 574 (OKUNO ET AL) 23 October 1984	

* Special categories of cited documents: [10]

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"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step

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IV. CERTIFICATION

Date of the Actual Completion of the International Search	Date of Mailing of this International Search Report
1987-06-18	1987 -06- 24
International Searching Authority	**Signature of Authorized Officer**
Swedish Patent Office	Mårten Hulthén

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Form PCT/ISA/210 (second sheet) (January 1985)

FURTHER INFORMATION CONTINUED FROM THE SECOND SHEET

II Fields Searched (cont).

US Cl 373:1, 2, 8, 9, 78-80;
432:9, 21, 72, 159, 164, 179-182

V. ☐ OBSERVATIONS WHERE CERTAIN CLAIMS WERE FOUND UNSEARCHABLE [1]

This international search report has not been established in respect of certain claims under Article 17(2) (a) for the following reasons:

1. ☐ Claim numbers....., because they relate to subject matter not required to be searched by this Authority, namely:

2. ☐ Claim numbers....., because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3. ☐ Claim numbers....., because they are dependent claims and are not drafted in accordance with the second and third sentences of PCT Rule 6.4(a).

VI. ☐ OBSERVATIONS WHERE UNITY OF INVENTION IS LACKING [2]

This International Searching Authority found multiple inventions in this international application as follows:

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims of the international application.

2. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims of the international application for which fees were paid, specifically claims:

3. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claim numbers:

4. ☐ As all searchable claims could be searched without effort justifying an additional fee, the International Searching Authority did not invite payment of any additional fee.

Remark on Protest

☐ The additional search fees were accompanied by applicant's protest.

☐ No protest accompanied the payment of additional search fees.