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CA 2637123 C 2013/12/03

(11)(21) 2 637 123

(12) BREVET CANADIEN
CANADIAN PATENT

(13) C

(86) Date de dépôt PCT/PCT Filing Date: 2006/10/11
(87) Date publication PCT/PCT Publication Date: 2007/08/09
(45) Date de délivrance/Issue Date: 2013/12/03
(85) Entrée phase nationale/National Entry: 2008/07/14
(86) N° demande PCT/PCT Application No.: EP 2006/009800
(87) N° publication PCT/PCT Publication No.: 2007/087839
(30) Priorité/Priority: 2006/01/31 (DE10 2006 004 669.2)

(51) Cl.Int./Int.Cl. *C10B 15/02* (2006.01),
C10B 21/10 (2006.01)

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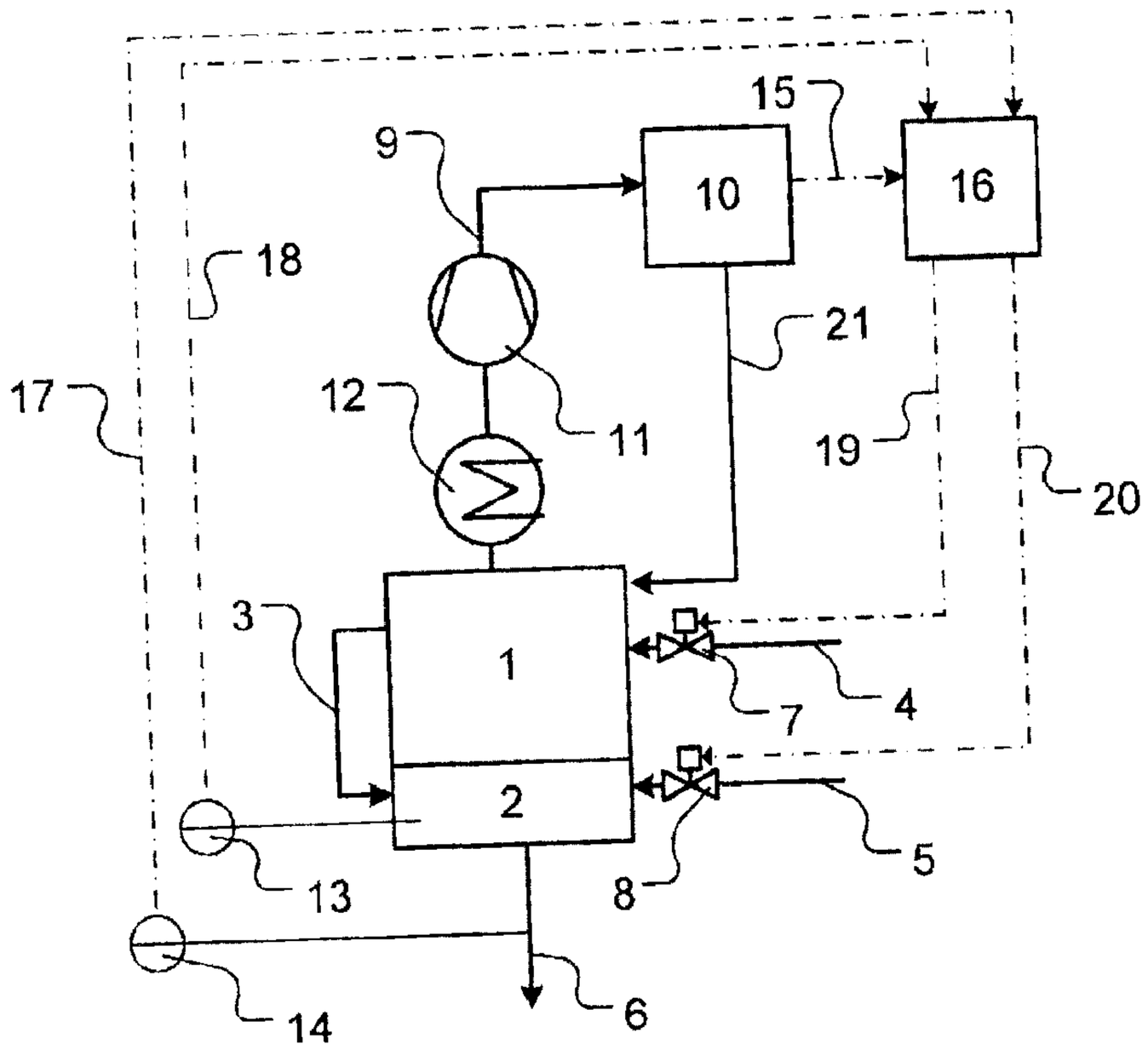
(54) Titre : FOUR A COKE A COMMANDE OPTIMISEE ET PROCEDE DE FONCTIONNEMENT
(54) Title: COKE OVEN WITH OPTIMISED CONTROL AND METHOD FOR CONTROL



(57) Abrégé/Abstract:
This invention relates to a coke oven built in flat-type construction, i.e. a so-called non-recovery or heat-recovery coke oven consisting of at least one measuring device to measure the concentration of gas constituents of the coke oven chamber, coke oven sole and/or waste gas channel, and in which the optimum supply of primary and/or secondary air is determined and controlled via a process computer on the basis of this data. Also covered by this invention is a cokemaking process using a coke oven of this type.

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Abstract

This invention relates to a coke oven built in flat-type construction, i.e. a so-called non-recovery or heat-recovery coke oven consisting of at least one measuring device to measure the concentration of gas constituents of the coke oven chamber, coke oven sole and/or waste gas channel, and in which the optimum supply of primary and/or secondary air is determined and controlled via a process computer on the basis of this data. Also covered by this invention is a cokemaking process using a coke oven of this type.

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Coke Oven with Optimised Control and Method for Control

[0001] This invention relates to a coke oven built in flat-type construction, i.e. a so-called non-recovery or heat-recovery coke oven consisting of at least one measuring device to measure the concentration of gas constituents in the coke oven chamber, coke oven sole and/or waste gas channel, and wherein the optimal supply of primary and/or secondary air is determined and controlled via a process computer on the basis of this data. This invention also covers a cokemaking process utilising a coke oven of this type.

[0002] Heating of heat-recovery ovens is usually performed by combustion of gas evolving on cokemaking and/or by burning the portions of light-volatile matter of coal to be carbonised. Combustion is controlled in such a manner that part of the gas above the coal charge burns off with primary air in the oven chamber. This partly burnt gas is fed through gas channels that are also designated as “downcomers“ to the oven sole and completely burnt there by the addition of further combustion air, which is called secondary air.

[0003] In this way, heat is directly supplied from the top and indirectly from the bottom to the coal charge, thus taking a positive impact on the coking rate and, thereby, on the performance rate of coke ovens. To execute the method it is required to exactly rate and variably control the supplied primary and secondary air throughout the coking time that may take up to 96 hours. Heat-recovery and non-recovery coke ovens in flat-type construction are widely described in prior art disclosures. For example, reference is taken to US 4,344,820, US 4,287,024, US 5,114,542, GB 1 555 400 or CA 2 052 177 C.

[0004] According to the conventional state of the art in technology, primary air is sucked in from the atmosphere through ports in the doors. Secondary air is sucked in through ports near to ground and conducted through channels into the heating flues which mainly extend horizontally under the coke oven chamber. The ports for primary and secondary air are either opened permanently or provided with flaps designed to adjust the amount of air to be aspirated.

[0005] As the coke oven batteries are very extensive, and since usually a very high temperature prevails therein and because a serious development of dust is encountered, only manually adjustable venting flaps are disclosed in prior art technology. US Patent No. 5,928,476 describes such a coke oven battery, wherein three manually operable ports are provided in each coke oven door, in which or in front of which one plate or disk each adapted to the port cross-section and supported at a central axle is arranged. These port flaps can be varied in their position manually through levers.

[0006] The German patent DE102005055483.0-24 of the applicant discloses a central adjusting element that permits a continuous control of primary and secondary air.

[0007] In practice, however, it became evident that varying coal qualities due to different coal crushing degrees, coal moisture or inert portions, etc. were difficult to master with prior art coke ovens and that unnecessarily long coking times had to be planned to attain high coke quality.

[0008] Now, therefore, some embodiments of this invention may remedy the described deficiencies in an economic manner and to assure an optimised supply of primary air and/or secondary air in order to improve coke oven performance rate and, thereby, coking time, too.

[0009] Some embodiments of the invention provide a coke oven built in flat-type construction, i.e. a so-called non-recovery or heat-recovery coke oven consisting of a coke oven chamber and a coke oven sole consisting of channels, with the coke oven chamber and the coke oven sole being connected to each other via gas channels, and wherein opening ports for the supply of primary air and one or more opening port(s) or channel(s) conducting to these opening ports for the supply of secondary air into the coke oven sole are provided in the oven wall or in the oven door, and wherein shutoff devices are arranged in front of the opening ports or in the channels conducting to these opening ports.

[0009a] Some embodiments of the invention provide a coke oven built in flat-type construction as a non-recovery or heat-recovery coke oven, consisting of a coke oven chamber with a coke oven wall and a coke oven door, and a coke oven sole consisting of channels which are connected to a waste gas channel, with the coke oven chamber and coke oven sole being connected to each other via gas channels, and wherein one or several opening port(s) or channel(s) for supplying primary air and one or more opening port(s) or channel(s) conducting to these opening ports for supplying secondary air into the coke oven sole are provided for in the oven wall or oven door, and wherein shutoff devices are arranged in front of these opening ports or in the channels conducting to these opening ports, wherein the coke oven is connected with at least one measuring device to measure the concentration of gas constituents of the coke oven chamber, coke oven sole or waste gas channel, and this measuring device in turn is linked to a computer unit in such a way that this computer unit receives data and measured results from the measuring device, and this computer unit is connected via control lines to one or more adjusting device(s) of said shutoff devices.

[0010] Accordingly,

- at least one measuring device to measure the concentration of gas constituents in the coke oven chamber, coke oven sole and/or gas channels is linked to the coke oven, and

- this measuring device in turn is connected to a computer unit in such a way that this computer unit can receive data and measured results from the measuring device, and

- the computer unit is linked to one or more adjusting device(s) of the shutoff devices, with said shutoff devices representing valves, flaps, slide gates, or the like.

[0011] An improved variant resides in arranging a temperature measuring device in the coke oven sole or in the waste gas channel of the coke oven, wherein

said temperature measuring device is also connected to the computer unit in such a way that it can receive data and measuring results from the temperature measuring device.

[0012] The measuring devices ideally represent analysers to measure hydrogen, nitrogen, carbon monoxide or carbon dioxide, said measuring devices being connected via a line to the coke oven chamber. The concentration of these main constituents or of one of these main constituents correlates very well with the coking state of the coke cake.

[0013] Above all it is hydrogen burning off as the last coal constituent that is an ideal indicator to indicate the end of coking time. Hence, with the coke oven embodying this invention, it is possible to control the cokemaking process in such a manner that the end of the coking time is achieved , in a way, concurrently to achieving 0 % by vol. of H_2. For if H_2 has burnt off prematurely, this leads to an increased combustion and/or incineration of coke valuables which represents an economic drawback.

[0014] In another variant of this invention, the measuring device is a lambda probe arranged in the coke oven sole or in the waste gas channel to determine the content of oxygen. By means of the lambda probe, and by a feedback with the control of secondary air, it can be assured that a complete combustion will always occur in the coke oven sole without too drastic a drop in temperature which would lead to a prolongation in coking time.

[0015] With an advanced variant of this invention, at least one analyser for the determination of hydrogen, nitrogen, carbon monoxide or carbon dioxide as well as a lambda probe for the determination of oxygen are provided for.

[0016] Furthermore, another embodiment of this invention covers a method for coal carbonisation in which the afore-mentioned coke oven is implemented in one of the disclosed embodiments, wherein

- the oven is charged with coal and wherein the cokemaking process is started,

- the concentration of one or more gas constituent(s) is analysed during carbonisation,

- this data are transmitted to a computer unit,

- this computer unit determines the supply of primary and/or secondary air on the basis of stored discrete values or model computations, and

- this computer unit activates the control elements of the shutoff devices for primary and/or secondary air via control lines, and thus

- it regulates the primary and/or secondary air.

[0017] Some embodiments of the invention provide a method for coal carbonisation, wherein a coke oven as described above is implemented, with said oven being charged with coal and the cokemaking process being started, the concentration of one or more gas constituent(s) being analysed during carbonisation, resulting data of the gas constituent concentration analysing being transmitted to the computer unit, the computer unit determining the supply of primary or secondary air or both on the basis of stored discrete values or model computations, and activating the adjusting devices of said shutoff devices for primary or secondary air via control lines, thus regulating the primary or secondary air or both.

[0018] In an improved variant of this method,

- the temperature in the coke oven sole and/or waste gas channel is determined, and

- this data is transmitted to a computer unit, and

▪ subsequently this computer unit determines the supply of primary and/or secondary air on the basis of stored discrete values or model computations, and

▪ the control elements of the shutoff devices for primary and/or secondary air are controlled via control lines, and thus

▪ the primary and/or secondary air is controlled and regulated during coal carbonisation.

[0019] The method embodying this invention is applied in such a manner that during coal carbonisation the mean temperature in the coke oven sole falls by 350°C to 400°C and does not fall under 1000°C. Furthermore, an optimisation resides in controlling and regulating the oxygen concentration in the waste gas channel at a constant level within a range of 7.5 to 8.5 percent by volume.

[0020] The invention is described by taking an example based upon the variant of the embodiment shown in Fig.1, with the invention not being restricted to the example of this embodiment.

Fig. 1 is a schematic view of a coke oven according to an embodiment of the invention.

Fig. 1 illustrates a coke oven consisting of a coke oven chamber 1 and a coke oven sole 2, wherein the individual chambers or channels of the coke oven sole 2 are not illustrated. Via gas channel 3 the coke oven chamber 1 is connected to the coke oven sole 2. Primary air can be supplied through line 4 into the coke oven chamber 1, with a control flap 7 being arranged in the line 4. Secondary air can be supplied through line 5 into the coke oven sole 2, with a control flap 8 being arranged in the line 5. Line 9 serves for taking a small gas volume stream from coke oven chamber 1 and connects coke oven chamber 1 with an analyser 10 which in the illustrated example is suitable for H2 measurement. The gas to be measured and conveyed in line 9 is aspirated by means of compressor 11 and conveyed to the

analyser 10. A heat exchanger 12 is installed upstream to compressor 11 to cool the gas. Via line 21, the gas volume stream is passed back into the coke oven chamber 1.

[0021] Furthermore, the temperature measuring device 13 arranged in the coke oven sole 2 and the lambda probe 14 arranged in the waste gas channel 6 are schematically illustrated. Via the data buses 17 and 18, the measured values are transmitted to the computer unit 16 which also receives the measured values from the analyser 10 via data bus 15. Via control lines 19, the computer unit 16 controls the control flap 7 and thus regulates the volume stream of primary air and, respectively, the temperature in the coke oven chamber 1. Furthermore, the computer unit 16 controls the control flap 8 via the control line 20, thereby regulating the volume stream of secondary air and, thus, the temperature in the coke oven sole 2 as well as the content of oxygen in the waste gas channel 6.

[0022] By applying the method described hereinabove and the device embodying this invention, it was managed to reduce the coking time substantially. Now it is possible to reliably achieve a coking time of less than 48 hours, which represents a remarkable increase in oven performance rate as compared with the state of the art in technology.

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1	List of Reference Numbers
1	Coke oven chamber
2	Coke oven sole
3	Gas channel
4	Line (primary air)
5	Line (secondary air)
6	Waste gas channel
7	Shutoff element (primary air)
8	Shutoff element (secondary air)
9	Line
10	Analyser
11	Compressor
12	Heat exchanger
13	Temperature measuring instrument
14	Lambda probe
15	Data bus
16	Computer unit
17	Data bus
18	Data bus
19	Data bus
20	Data bus

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CLAIMS:

1. A coke oven built in flat-type construction as a non-recovery or heat-recovery coke oven, consisting of a coke oven chamber with a coke oven wall and a coke oven door, and a coke oven sole consisting of channels which are connected to a waste gas channel, with the coke oven chamber and coke oven sole being connected to each other via gas channels, and wherein one or several opening port(s) or channel(s) for supplying primary air and one or more opening port(s) or channel(s) conducting to these opening ports for supplying secondary air into the coke oven sole are provided for in the oven wall or oven door, and wherein shutoff devices are arranged in front of these opening ports or in the channels conducting to these opening ports,

wherein

- the coke oven is connected with at least one measuring device to measure the concentration of gas constituents of the coke oven chamber, coke oven sole or waste gas channel, and

- this measuring device in turn is linked to a computer unit in such a way that this computer unit receives data and measured results from the measuring device, and

- this computer unit is connected via control lines to one or more adjusting device(s) of said shutoff devices.

2. A coke oven according to claim 1,

wherein

- the shutoff devices are valves, flaps or slide gates.

3. A coke oven according to any one of the preceding claims 1 or 2,

wherein

a temperature measuring device is arranged in the coke oven sole or in the waste gas channel, said temperature measuring device also being connected to the computer unit in such a way that it receives data and measured results from the temperature measuring device.

4. A coke oven according to any one of the preceding claims 1 to 3,

wherein

the measuring device is an analyser for the determination of hydrogen, nitrogen, carbon monoxide or carbon dioxide.

5. A coke oven according to claim 4,

wherein

the analyser is linked via a channel to the coke oven chamber.

6. A coke oven according to any one of the preceding claims 1 to 3,

wherein

the measuring device is a lambda detector for the determination of oxygen and arranged in the coke oven sole or in the waste gas channel.

7. A coke oven according to any one of the preceding claims 1 or 2,

wherein

both an analyser for the determination of hydrogen, nitrogen, carbon monoxide or carbon dioxide as well as a lambda detector in the coke oven sole or in the waste gas channel for the determination of oxygen are provided.

8. A method for coal carbonisation,

wherein

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- a coke oven according to any one of the preceding claims 1 to 7 is implemented, with

- said oven being charged with coal and the cokemaking process being started,

- the concentration of one or more gas constituent(s) being analysed during carbonisation,

- resulting data of the gas constituent concentration analysing being transmitted to the computer unit,

- the computer unit determining the supply of primary or secondary air or both on the basis of stored discrete values or model computations, and

- activating the adjusting devices of said shutoff devices for primary or secondary air via control lines, thus

- regulating the primary or secondary air or both.

9. A method for coal carbonisation according to claim 8,

wherein

- the temperature in the coke oven sole or waste gas channel or both are determined, and

- the resulting data of the temperature determination are transmitted to a computer unit,

- this computer unit determines the supply of primary or secondary air on the basis of stored discrete values or model computations, and

- activates the control elements of the shutoff devices for primary or secondary air via control lines, thus

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- regulating the primary or secondary air or both

during coal carbonisation.

10. A method for coal carbonisation according to any of the preceding claims 8 or 9,

wherein

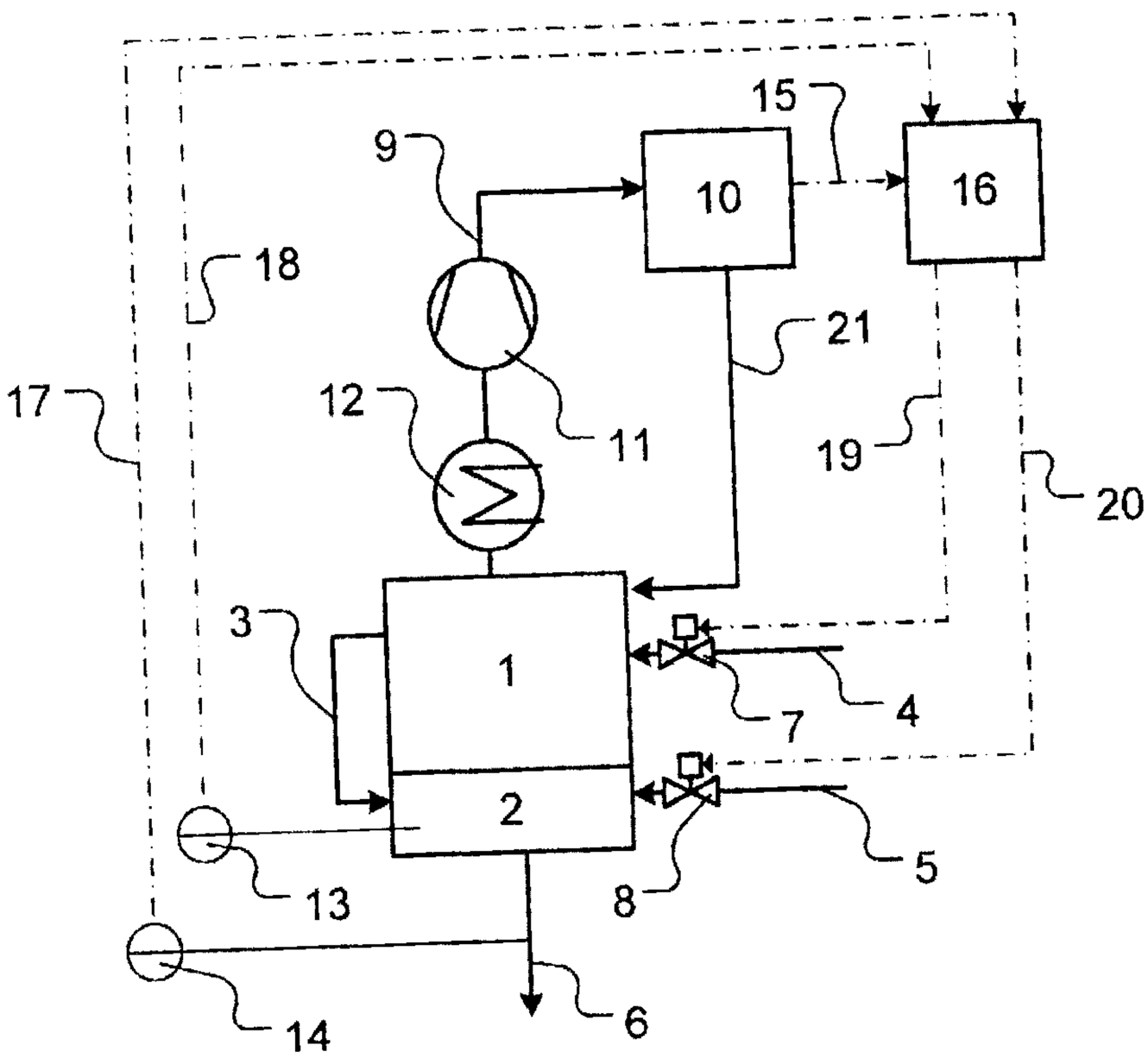
the mean temperature in the coke oven sole during coal carbonisation falls by 350°C to 400°C and does not fall under 1000°C.

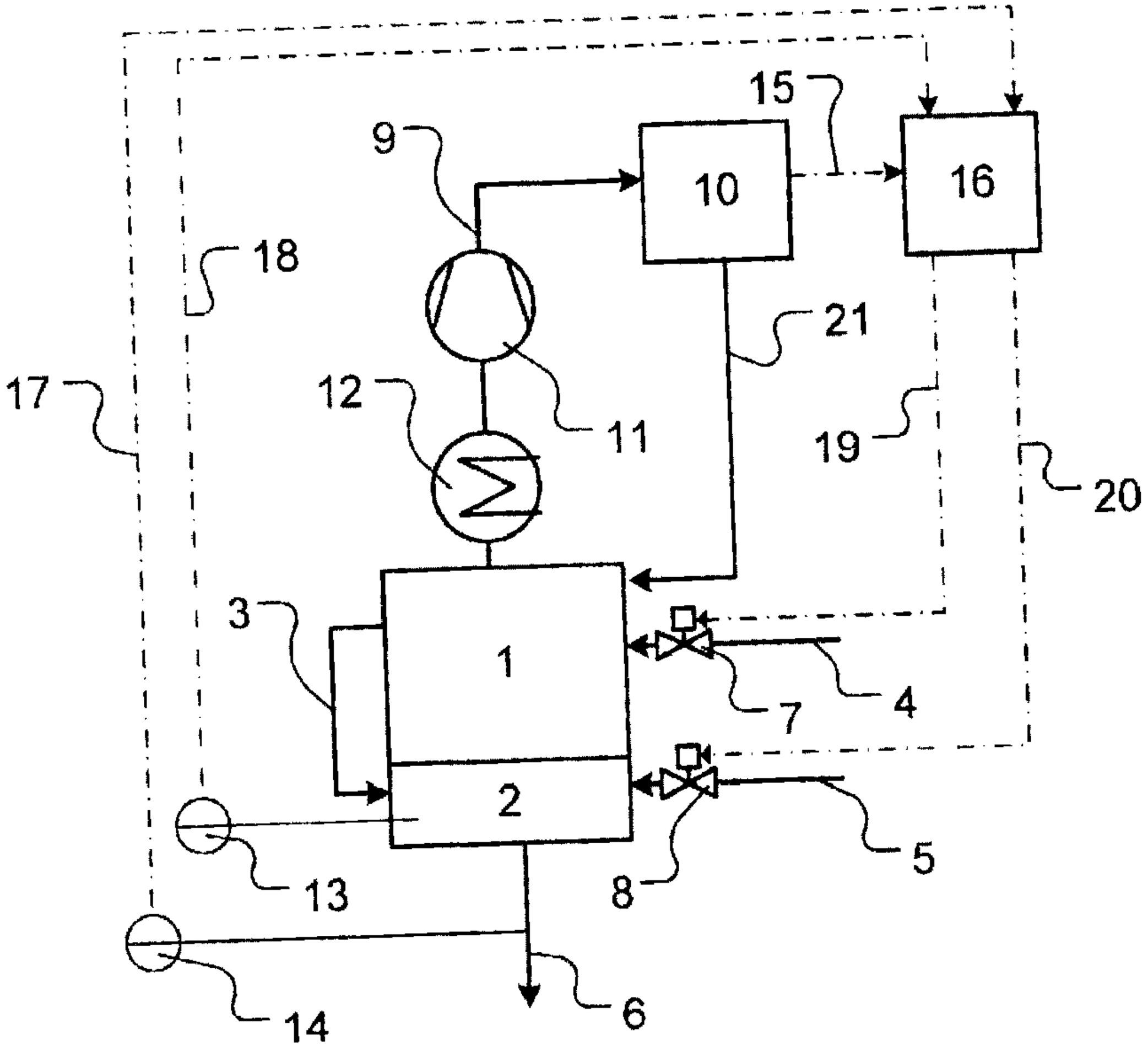
11. A method for coal carbonisation according to any of the preceding claims 8 to 10,

wherein

the concentration of oxygen in the waste gas channel constantly lies in the range of 7.5 to 8.5 percent by volume.

Fig. 1

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