(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) **EP 4 350 216 A1**

(12) **EUROPEAN PATENT APPLICATION**
published in accordance with Art. 153(4) EPC

(43) Date of publication:
10.04.2024 Bulletin 2024/15

(21) Application number: **22815861.4**

(22) Date of filing: **19.05.2022**

(51) International Patent Classification (IPC):
F23G 7/08 *(2006.01)* ***C10B 27/06*** *(2006.01)*
F23G 7/06 *(2006.01)*

(52) Cooperative Patent Classification (CPC):
C10B 27/06; F23G 7/06; F23G 7/08

(86) International application number:
PCT/JP2022/020758

(87) International publication number:
WO 2022/255109 (08.12.2022 Gazette 2022/49)

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA ME
Designated Validation States:
KH MA MD TN

(30) Priority: **02.06.2021 JP 2021093187**

(71) Applicant: **JFE Steel Corporation**
Tokyo 100-0011 (JP)

(72) Inventors:
- **TATENO, Tomoki**
  Tokyo 100-0011 (JP)
- **KAWAHATA, Satoshi**
  Tokyo 100-0011 (JP)
- **OKADA, Hideaki**
  Tokyo 100-0011 (JP)
- **TAKAHASHI, Tamotsu**
  Tokyo 100-0011 (JP)
- **KAMEZAKI, Shunichi**
  Tokyo 100-0011 (JP)

(74) Representative: **Hoffmann Eitle**
Patent- und Rechtsanwälte PartmbB
Arabellastraße 30
81925 München (DE)

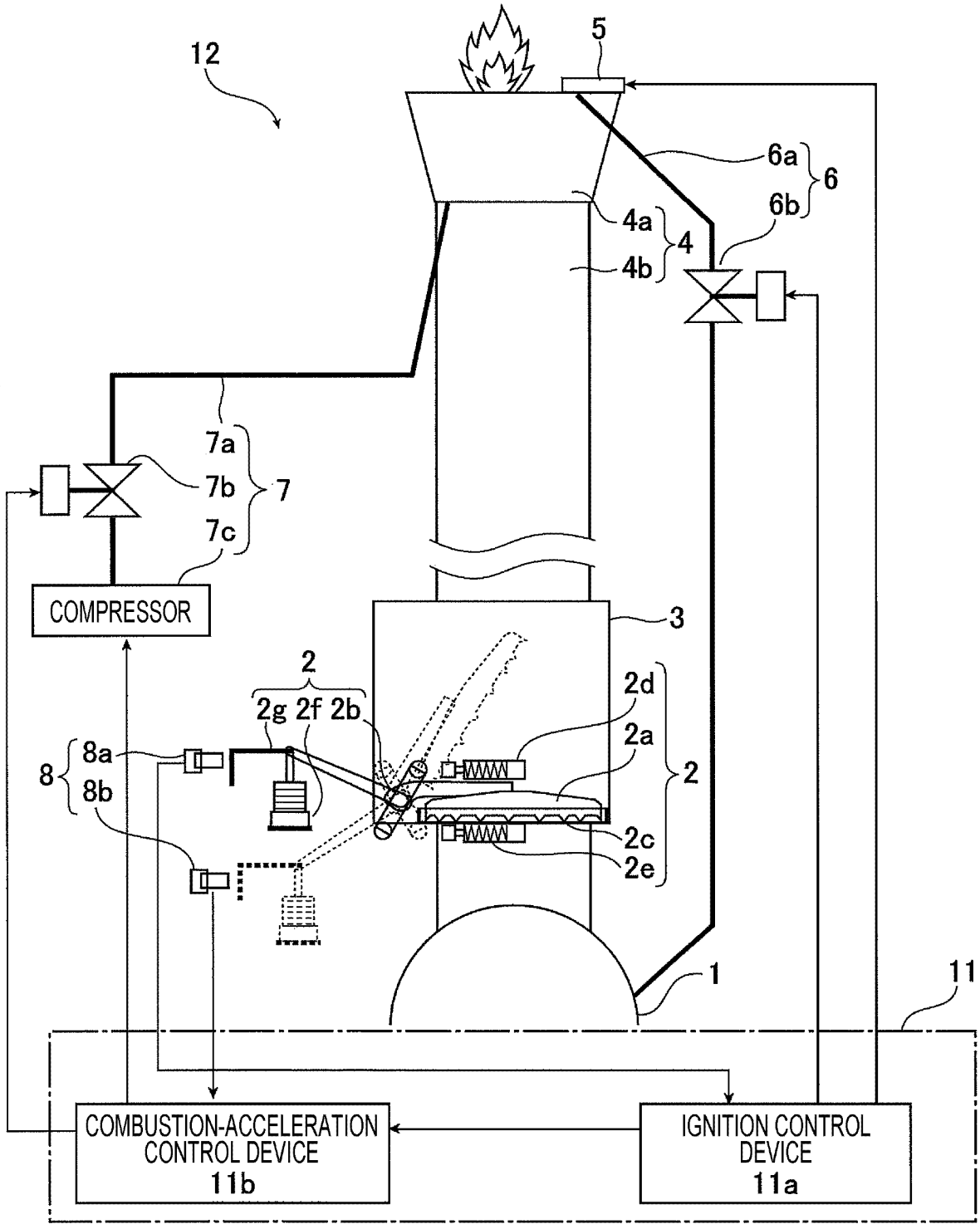
(54) DISSIPATION BLEEDER AND COKE OVEN GAS COMBUSTION METHOD

(57) There are provided a diffusion bleeder and a coke-oven-gas combustion method capable of suppressing excessive use of electric power and gases by performing combustion of a combustible gas contained in a coke oven gas at optimum timing in a coke oven battery to suppress incomplete combustion of the coke oven gas.

A diffusion bleeder 12 that combusts a coke oven gas collected in a gas collection pipe 1 and then diffuses the coke oven gas into the atmosphere includes a diffusion pipe 4 connected to the gas collection pipe and through which the coke oven gas is distributed; a diffusion valve 2 that opens to distribute the coke oven gas from the gas collection pipe 1 to the diffusion pipe 4 when a pressure of the coke oven gas in the gas collection pipe 1 has a set value; an ignition device 5 that ignites the coke oven gas; an ignition-gas supply device 6 that supplies an ignition gas for ignition to the inside of the diffusion pipe 4; a combustion-acceleration-gas supply device 7 that supplies a combustion acceleration gas that accelerates combustion of the coke oven gas to the inside of the diffusion pipe 4; a detector 8 that detects a start of opening of the diffusion valve 2; and a control device 11 that controls the ignition-gas supply device 6, the ignition device 5, and the combustion-acceleration-gas supply device 7. The control device 11 receives a detection signal indicating that the diffusion valve 2 starts to open from the detector 8, transmits a control signal for ordering a start of supplying of the ignition gas to the ignition-gas supply device 6, transmits a control signal for ordering an ignition operation to the ignition device 5, receives a detection signal indicating that the diffusion valve 2 is fully opened, and transmits a control signal for ordering a start of supplying of the combustion acceleration gas to the combustion-acceleration-gas supply device 7.

EP 4 350 216 A1

FIG. 2


12
5
6a
6
6b
4a
4
4b
7a
7b
7
7c
COMPRESSOR
3
2
2g 2f 2b
2d
2a
2
8
8a
8b
2c
2e
1
11
COMBUSTION-ACCELERATION CONTROL DEVICE
11b
IGNITION CONTROL DEVICE
11a

Description

Technical Field

[0001] The present invention relates to a diffusion bleeder that combusts a coke oven gas and diffuses the coke oven gas into the atmosphere and a coke-oven-gas combustion method using the diffusion bleeder.

Background Art

[0002] A coke oven battery has a structure in which a heat regenerator is disposed in a lower portion thereof and a carbonization chamber and a combustion chamber are alternately arranged in an upper portion thereof. Here, a fuel gas is combusted in the combustion chamber and coal is carbonized inside the carbonization chamber adjacent to the combustion chamber, thereby obtaining coke.

[0003] A coke oven gas generated by the carbonization of the coal is gathered in an ascension pipe set in each carbonization chamber and is collected in a gas collection pipe called a dry main through a bend pipe. A pressure control valve is provided inside the gas collection pipe, and the pressure inside the gas collection pipe is controlled to be 4 to 5 mmH_2O at normal time by the pressure control valve to prevent an explosion caused by entry of air from the outside. The coke oven gas collected in the gas collection pipe is then sent through an intake blower to a gas purification process.

[0004] While the coke oven gas is required to be diffused into the atmosphere in emergency time in which, for example, the intake blower stops due to a trouble such as a pressure increase inside the gas collection pipe or a power failure, the coke oven gas contains, as by-products of incomplete combustion, combustible gases including methane, carbon monoxide, hydrogen, and the like in an uncombusted state and is diffused into the atmosphere after the combustible gases contained in the coke oven gas are combusted to be neutralized. At this time, when incomplete combustion of the combustible gases contained in the coke oven gas occurs, black smoke is generated at the time of diffusion into the atmosphere. Therefore, to diffuse the coke oven gas into the atmosphere, it is required to diffuse the coke oven gas after completely combusting the combustible gases contained in the coke oven gas.

[0005] Here, as an apparatus used for diffusion of the coke oven gas, a diffusion bleeder is widely known. As illustrated in Fig. 5, a general diffusion bleeder 100 has a diffusion pipe 40 formed by an outer pipe 40a and an inner pipe 40b and in which a coke oven gas is distributed and a casing 30 in which an open valve 20a, called a flap, and actuators 20d and 20e, such as cylinders, are provided, and includes a diffusion valve 20 that diffuses the coke oven gas inside a gas collection pipe 10 into the atmosphere. The diffusion bleeder 100 is mounted on the upper side of the gas collection pipe 10.

[0006] In the case when the coke oven gas is required to be diffused, the diffusion valve 20 is opened by using the actuators 20d and 20e, such as cylinders, when a pressure of the coke oven gas inside the gas collection pipe 10 has a set value, to diffuse the coke oven gas through the diffusion pipe 40 to the outside. An upper portion of the diffusion pipe 40 has a double structure that includes the outer pipe 40a in communication with the atmosphere and the inner pipe 40b in communication with a source of the coke oven gas. The coke oven gas is pressure-fed from the source into the inner pipe 40b, and a negative pressure generated consequently is used to take in air through a gap between the outer pipe 40a and the inner pipe 40b. In the coke oven gas, components are not constant and calories fluctuate, and therefore, pilot light for ignition is required to combust the coke oven gas stably. Therefore, at an upper portion of the outer pipe 40a, there are provided an ignition-gas supplying device 60 including an ignition-gas supply pipe 60a and an ignition-gas supply valve 60b that are used for supplying a gas (hereinafter, referred to as "ignition gas") for pilot light, and an ignition device 50, such as an igniter. The ignition gas is combusted to serve as pilot light, and the combustible gases in the coke oven gas are combusted to be neutralized. During combustion of the coke oven gas, the ignition gas is continuously supplied to avoid extinction of fire.

[0007] The diffusion bleeder 100 illustrated in Fig. 5, however, has a problem that, since the diffusion valve 20 is opened manually or by using the actuators 20d and 20e, such as cylinders, after the pressure of the coke oven gas inside the gas collection pipe 10 has a set value, it takes time to actually open the diffusion valve 20 after diffusion of the coke oven gas is required.

[0008] In addition, there is a problem that, since the gases are not sufficiently mixed and stirred in the inside of the diffusion pipe 40 by only taking in air through the gap between the outer pipe 40a and the inner pipe 40b, it is not possible to completely combust the combustible gases in the coke oven gas and a large amount of the combustible gases in an uncombusted state are diffused into the atmosphere.

[0009] Regarding such problems, PTL 1 discloses a configuration in which a counterweight for counteracting a moment generated by the own weight of a diffusion valve is mounted on the diffusion valve to open the valve automatically in response to an increase in the pressure of a coke oven gas inside a gas collection pipe and diffuse the coke oven gas into the atmosphere.

[0010] In addition, PTL 2 discloses a configuration in which an injection pipe through which a combustion acceleration gas that accelerates combustion inside a diffusion pipe is provided in a gap between an outer pipe and an inner pipe to accelerate combustion of a coke oven gas.

Citation List

Patent Literature

[0011]

PTL 1: Japanese Unexamined Patent Application Publication No. 2006-124508
PTL 2: Japanese Unexamined Patent Application Publication No. 2017-96615

Summary of Invention

Technical Problem

[0012] However, with the technologies disclosed in PTL 1 and PTL 2, there is a time lag between opening of a diffusion valve and activation of an ignition device or injection of a combustion acceleration gas, and a coke oven gas moves in the diffusion pipe 40 during the time lag is not completely combusted and is diffused as it is into the atmosphere. Further, to combust combustible gases in a coke oven gas, it is required at all times to continue activation of an ignition device and injection of a combustion acceleration gas, and there is thus a problem in terms of costs related to the use of electric power and gases.

[0013] The present invention has been made in consideration of such circumstances, and an object of the present invention is to provide a diffusion bleeder and a coke-oven-gas combustion method that are capable of suppressing incomplete combustion of a coke oven gas and suppressing excessive use of electric power and gases by combusting combustible gases contained in the coke oven gas at optimum timing in a coke oven battery.

Solution to Problem

[0014] A summary of the configuration of the present invention for solving the aforementioned problems is as follows.

[1] A diffusion bleeder that combusts a coke oven gas collected in a gas collection pipe and diffuses the coke oven gas into an atmosphere, the diffusion bleeder including a diffusion pipe connected to the gas collection pipe and through which the coke oven gas is distributed; a diffusion valve that opens to distribute the coke oven gas from the gas collection pipe to the diffusion pipe when a pressure of the coke oven gas in the gas collection pipe has a set value; an ignition device that ignites the coke oven gas; an ignition-gas supply device that supplies an ignition gas for ignition to an inside of the diffusion pipe; a combustion-acceleration-gas supply device that supplies a combustion acceleration gas that accelerates combustion of the coke oven gas to the inside of the diffusion pipe; a detector that detects a start of opening of the diffusion valve; and a control device that controls the ignition-gas supply device, the ignition device, and the combustion-acceleration-gas supply device, in which the control device receives a detection signal indicating that the diffusion valve starts to open from the detector, transmits a control signal for ordering a start of supplying of the ignition gas to the ignition-gas supply device, transmits a control signal for ordering an ignition operation to the ignition device, receives a detection signal indicating that the diffusion valve is fully opened, and transmits a control signal for ordering a start of supplying of the combustion acceleration gas to the combustion-acceleration-gas supply device.

[2] A coke-oven-gas combustion method in which a coke oven gas collected in a gas collection pipe is combusted in a diffusion pipe, the method including a diffusion-start detection step in which a start of opening of a diffusion valve that is provided between the gas collection pipe and the diffusion pipe is detected when a pressure of the coke oven gas in the gas collection pipe has a set value; an ignition-gas supply step in which supplying of an ignition gas for ignition to an inside of the diffusion pipe is started; an ignition step in which the ignition gas is lit to serve as pilot light for ignition and ignite the coke oven gas; and a combustion-acceleration-gas supply step in which, after completion of the ignition step and after full opening of the diffusion valve is detected, supplying of a combustion acceleration gas that accelerates combustion of the coke oven gas to the inside of the diffusion pipe is started.

Advantageous Effects of Invention

[0015] It becomes possible by using the diffusion bleeder and the coke-oven-gas combustion method according to the present invention to activate an ignition device, supply an ignition gas, and supply a combustion acceleration gas in response to opening of a diffusion valve. It is thus possible to combust a combustible gas contained in a coke oven gas at optimum timing and possible to suppress incomplete combustion of the coke oven gas and suppress excessive use of electric power and gases.

Brief Description of Drawings

[0016]

[Fig. 1] Fig. 1 schematically illustrates a sectional view of a heat regenerator and a carbonization chamber of a coke oven battery.
[Fig. 2] Fig. 2 schematically illustrates an example of a configuration of a diffusion bleeder according to an embodiment of the present invention.
[Fig. 3] Fig. 3 illustrates an example of a flowchart

at the time of starting combustion and stopping combustion in a diffusion bleeder according to an embodiment of the present invention.

[Fig. 4] Fig. 4 is a flowchart illustrating a flow of processing in a coke-oven-gas combustion method according to an embodiment of the present invention.

[Fig. 5] Fig. 5 schematically illustrates a configuration of a diffusion bleeder of the related art. Description of Embodiments

[0017] A configuration of a diffusion bleeder according to an embodiment of the present invention will be described below.

[0018] Fig. 1 is a sectional view of a heat regenerator 22 and a carbonization chamber 23 of a coke oven battery 21. In the coke oven battery 21, the heat regenerator 22 is disposed in a lower portion of an oven body, and a combustion chamber (not illustrated) and the carbonization chamber 23 are alternately arranged at an upper portion of the heat regenerator 22. A coke oven gas that is generated from the carbonization chamber 23 in the process of carbonization of coal passes through an ascension pipe 24 and a bend pipe 25 and gathers in a gas collection pipe 1, which is called a dry main. When the pressure inside the gas collection pipe 1 is abnormality increased due to a facility trouble or the like, a diffusion valve 2 is opened as an emergency measure, and the coke oven gas inside the gas collection pipe 1 is diffused through a diffusion pipe 4 into the atmosphere.

[0019] Fig. 2 schematically illustrates an example of a diffusion bleeder 12 according to the present embodiment. As illustrated in Fig. 2, the diffusion bleeder 12 further includes a combustion-acceleration-gas supply device 7, a detector 8, and a control device 11, in addition to the diffusion valve 2 including a counterweight 2f, the diffusion pipe 4, an ignition device 5, and an ignition-gas supply device 6.

[0020] On the upper side of the diffusion valve 2, the diffusion pipe 4 connected to the gas collection pipe 1 and through which the coke oven gas is distributed is disposed. The ignition-gas supply device 6 supplies an ignition gas to the diffusion pipe 4 and the ignition device 5. The combustion-acceleration-gas supply device 7 supplies a gas (hereinafter referred to as "combustion acceleration gas") for accelerating combustion of the coke oven gas. The detector 8 detects opening of the diffusion valve 2. The control device 11 controls operation of the ignition device 5, the ignition-gas supply device 6, and the combustion-acceleration-gas supply device 7.

[0021] As in the diffusion bleeder 100 previously described with Fig. 5, the diffusion pipe 4 has a double structure that includes an outer pipe 4a in communication with the atmosphere and an inner pipe 4b in communication with a source of the coke oven gas through the diffusion valve 2.

[0022] The diffusion valve 2 includes a casing 3 that has an opening through which the coke oven gas passes; an open valve 2a that opens and closes an opening 2c by rotating about a rotary shaft 2b, the open valve 2a being called a flap; an open actuator 2d and a close actuator 2e that rotationally drive the open valve 2a connected to the rotary shaft 2b by a link mechanism or the like; the counterweight 2f that is located opposite the open valve 2a in point symmetry with respect to the rotary shaft 2b and that is provided to counteract a moment generated by the own weight of the open valve 2a; and a striker 2g that is mounted on the counterweight 2f to be interlocked with the counterweight 2f.

[0023] The counterweight 2f is provided to counteract the moment generated by the own weight of the open valve 2a and is configured such that, as a moment acting on the open valve 2a due to the pressure of the coke oven gas is larger than a moment due to the own weight of the open valve 2a when the internal pressure of the gas collection pipe 1 becomes a set pressure, the open valve 2a rotates as indicated by the dotted line in Fig. 2 without actuation of the open actuator 2d, the opening 2c is opened, and the open valve 2a is opened. Here, the set pressure means a pressure that corresponds to a value of a weight that is obtained by subtracting the weight of the counterweight 2f from the weight of the open valve 2a. It is also possible to rotate the open valve 2a and open the opening 2c by actuating the open actuator 2d. Then, it is possible by actuating the close actuator 2e to rotate the open valve 2a and close the opening 2c.

[0024] The ignition device 5 is provided at an upper portion of the outer pipe 4a and is constituted by an igniter or the like that is provided for combustion of the coke oven gas inside the diffusion pipe 4.

[0025] The ignition-gas supply device 6 is used to supply a small amount of the coke oven gas (ignition gas) for pilot light for ignition of the coke oven gas to the ignition device 5 and includes an ignition-gas supply pipe 6a and an ignition-gas supply valve 6b. The ignition-gas supply pipe 6a is connected at one end thereof to the gas collection pipe 1, and a tip portion at the other end thereof is provided on the inner side of the outer pipe 4a to project in the vicinity of the ignition device 5. When the coke oven gas is diffused, the ignition gas that is supplied from the tip portion through the ignition-gas supply valve 6b disposed at an intermediate portion of the ignition-gas supply pipe 6a is ignited and combusted by the ignition device 5 and becomes pilot light for ignition of the coke oven gas distributed through the inside of the diffusion pipe 4. As an alternative to the small amount of the coke oven gas, a combustible gas, such as oxygen, may be used as the ignition gas.

[0026] The combustion-acceleration-gas supply device 7 includes a combustion-acceleration-gas supply pipe 7a that is for supplying the combustion acceleration gas for accelerating combustion through a gap between the outer pipe 4a and the inner pipe 4b; the combustion-acceleration-gas supply valve 7b that is disposed at the combustion-acceleration-gas supply pipe 7a and that opens to distribute the combustion acceleration gas; and

a compressor 7c for pressure-feeding the combustion acceleration gas. When the coke oven gas is diffused, the combustion acceleration gas compressed by the compressor 7c flows in together with gases (hereinafter, referred to as "accompanying gases") including a peripheral gas such as air and the like through the gap between the outer pipe 4a and the inner pipe 4b. The combustion acceleration gas and the accompanying gases are stirred with the coke oven gas in the diffusion pipe 4, and complete combustion of the coke oven gas is accelerated in the diffusion pipe 4.

[0027] While the combustion acceleration gas is not particularly limited as long as the combustion acceleration gas is a gaseous body, the combustion acceleration gas is preferably a non-combustible gas to prevent explosion and incomplete combustion inside the outer pipe 4a. In particular, a non-combustible gas that contains at least one or more of air, nitrogen gas, and water vapor is preferable. Even when the nitrogen gas is employed as the combustion acceleration gas, complete combustion of the combustible gas is accelerated since, as described above, oxygen that is contained in the accompanying gases, such as air, together with the nitrogen gas reacts with the combustible gas in the coke oven gas.

[0028] Here, the pilot light for ignition by the ignition device 5 and the ignition-gas supply device 6 triggers the combustion of the coke oven gas in a wide range in the inside of the diffusion pipe 4. In addition, supplying of the combustion acceleration gas to the inside of the diffusion pipe 4 through the gap between the outer pipe 4a and the inner pipe 4b by the combustion-acceleration-gas supply device 7 also accelerates the combustion of the coke oven gas in a wide range in the inside of the diffusion pipe 4. In other words, it is possible to efficiently accelerate the combustion of the coke oven gas in a wide range in the inside of the diffusion pipe 4 by activating the ignition device 5 and supplying the ignition gas through the ignition-gas supply device 6 and the combustion acceleration gas through the combustion-acceleration-gas supply device 7 to the inside of the diffusion pipe 4 before the opening 2c starts to be opened by the rotation of the open valve 2a of the diffusion valve 2 and causes the coke oven gas to flow from the gas collection pipe 1 to the inside of the diffusion pipe 4.

[0029] The detector 8 detects opening and closing of the opening 2c by the open valve 2a of the diffusion valve 2 and is constituted by a closure detector 8a that detects a state in which the opening 2c is completely closed and an opening detector 8b that detects a state in which the opening 2c is completely opened.

[0030] The detector 8 is installed at the counterweight 2f located opposite the open valve 2a in point symmetry with respect to the rotary shaft 2b of the diffusion valve 2 and detects the presence of the striker 2g when the striker 2g interlocked with the counterweight 2f enters a region in which the striker 2g is detectable.

[0031] The closure detector 8a is set at a location where the closure detector 8a is able to detect the striker 2g in a state in which the open valve 2a completely closes the opening 2c and where the striker 2g is out of a range in which the closure detector 8a is able to detect the striker 2g when the open valve 2a starts opening of the opening 2c even slightly.

[0032] The opening detector 8b is set at a location where the opening detector 8b is able to detect the striker 2g in a state in which the open valve 2a rotates in a direction away from the opening 2c and reaches an ascent limit and in which the open valve 2a is fully opened and where the striker 2g is out of a region in which the opening detector 8b is able to detect the striker 2g when the open valve 2a rotates in a direction toward the opening 2c and is away from the ascent limit.

[0033] The closure detector 8a and the opening detector 8b each transmit a detection signal to the control device 11 in response to detection of the striker 2g. A method of detecting the striker 2g by the detector 8 may be either one of an optical contactless method, such as a laser and a contact method, such as a limit switch.

[0034] The control device 11 controls the ignition-gas supply device 6, the ignition device 5, and the combustion-acceleration-gas supply device 7 and is constituted by a general-purpose information processing device, such as a computer including a CPU and the like or a workstation. One example of the control device 11 illustrated in Fig. 2 is constituted by an ignition control device 11a that controls ignition and combustion of the diffusion bleeder 12 by controlling the ignition device 5 and the ignition-gas supply device 6, and a combustion-acceleration control device 11b that controls supplying of the combustion acceleration gas to the diffusion pipe 4 by controlling the combustion-acceleration-gas supply device 7.

[0035] After receiving the detection signal indicating that the diffusion valve 2 starts to open from the detector 8, the control device 11 transmits a control signal for ordering a start of supplying of the ignition gas to the ignition-gas supply device 6 and then transmits a control signal for ordering an ignition operation to the ignition device 5. After the ignition operation is completed and a detection signal indicating that the diffusion valve 2 is fully opened is received, a control signal for ordering a start of supplying of the combustion acceleration gas is transmitted to the combustion-acceleration-gas supply device 7.

[0036] Here, a specific control processing by the control device 11 at the time of starting of combustion in the diffusion bleeder 12 will be described with a flowchart in Fig. 3(a). The ignition control device 11a of the control device 11 receives a detection signal indicating that opening of the diffusion valve 2 is started from the detector 8 (closure detector 8a) (S1). Next, the ignition control device 11a transmits a control signal for ordering valve opening for starting distribution of the ignition gas (S2) to the ignition-gas supply valve 6b of the ignition-gas supply device 6. Further, the ignition control device 11a transmits a control signal for ordering a start of the

ignition operation (S3) to the ignition device 5. The ignition control device 11a transmits an ignition-operation completion signal (S4) to the combustion-acceleration control device 11b. After receiving a detection signal indicating that the diffusion valve 2 is fully opened from the detector 8 (opening detector 8b), the combustion-acceleration control device 11b transmits a control signal for ordering activation of the compressor 7c (S5). Further, the combustion-acceleration control device 11b transmits a control signal for ordering valve opening for starting distribution of the combustion acceleration gas (S6) to the combustion-acceleration-gas supply valve 7b.

[0037] As described above, immediately after the opening of the diffusion valve 2 is started, the pilot light for ignition of the coke oven gas is lit by the ignition device 5 and the ignition-gas supply device 6 in response to transmission of the control signals by the ignition control device 11a. It is possible with this pilot light for ignition to achieve stable ignition and combustion of the coke oven gas that flows into the diffusion pipe 4 when the diffusion valve 2 is opened.

[0038] Furthermore, since supplying of the combustion acceleration gas by the combustion-acceleration-gas supply device 7 is started after the diffusion valve 2 is fully opened and the combustion of the coke oven gas is stabilized, it is possible to avoid extinction of fire due to supplying of the combustion acceleration gas pressure-fed in a state in which combustion of the coke oven gas is unstable, and complete combustion of the coke oven gas in the diffusion pipe 4 is accelerated. In other words, it is possible to execute control of the ignition device 5, the ignition-gas supply device 6, and the combustion-acceleration-gas supply device 7 at optimum timing after detection of the start of opening of the diffusion valve 2 based on an increase in the internal pressure of the gas collection pipe 1. By controlling the devices at the optimum timing, it is possible to suppress a situation in which a combustible gas contained in the coke oven gas is diffused in an incompletely combusted state into the atmosphere.

[0039] Fig. 3(b) is a flowchart at the time of stopping combustion in the diffusion bleeder 12. The ignition control device 11a of the control device 11 receives a detection signal indicating that the open valve 2a completely closes the opening 2c from the detector 8 (closure detector 8a) (S11). In response to this, the ignition control device 11a transmits a control signal for ordering valve closure for stopping distribution of the ignition gas to the ignition-gas supply valve 6b of the ignition-gas supply device 6 (S12). Further, the ignition control device 11a transmits a control signal for ordering a stoppage of the ignition operation to the ignition device 5 (S13). The ignition control device 11a transmits an ignition-operation stop signal to the combustion-acceleration control device 11b (S14). Then, the combustion-acceleration control device 11b transmits a control signal for ordering a stoppage of the compressor 7c (S15). Further, the combustion-acceleration control device 11b transmits, after the stoppage of the compressor 7c, a control signal for ordering valve closure for stopping distribution of the combustion acceleration gas to the combustion-acceleration-gas supply valve 7b (S16).

[0040] Here, the configuration illustrated in Fig. 2 is a configuration in which the detection signal from the detector 8 is received by the control device 11 but may be a configuration in which the detection signal from the detector 8 is transmitted as it is to the ignition device 5, the ignition-gas supply device 6, and the combustion-acceleration-gas supply device 7 to control the operation of each of the devices.

[0041] In the coke-oven-gas combustion method according to the present embodiment, the coke oven gas collected in the gas collection pipe 1 is combusted in the diffusion pipe 4 by performing the following steps. As illustrated in Fig. 4, the method includes a diffusion-start detection step S21, an ignition-gas supply step S22, an ignition step S23, and a combustion-acceleration-gas supply step S24. Each of these steps will be described below.

[0042] The diffusion-start detection step S21 is a step in which a start of opening of the diffusion valve 2 provided between the gas collection pipe 1 and the diffusion pipe 4 is detected when the pressure of the coke oven gas in the gas collection pipe 1 has a set value. In the present embodiment, the control device 11 of the diffusion bleeder 12 executes the step S1 indicated in Fig. 3(a).

[0043] The ignition-gas supply step S22 is a step in which supplying of the ignition gas for ignition to the inside of the diffusion pipe 4 is started. In the present embodiment, the control device 11 of the diffusion bleeder 12 executes the step S2 indicated in Fig. 3(a).

[0044] The ignition step S23 is a step in which the ignition gas is lit to serve as the pilot light for ignition and ignite the coke oven gas. In the present embodiment, the control device 11 of the diffusion bleeder 12 executes the step S3 indicated in Fig. 3(a).

[0045] The combustion-acceleration-gas supply step S24 is a step in which supplying of the combustion acceleration gas that accelerates the combustion of the coke oven gas to the inside of the diffusion pipe 4 is started after completion of the ignition step (S23) and after full opening of the diffusion valve 2 is detected. In the present embodiment, the control device 11 of the diffusion bleeder 12 executes the steps S4, S5, and S6 indicated in Fig. 3(a).

[0046] As described above, it is possible by using the diffusion bleeder 12 according to the present invention to control the ignition device 5, the ignition-gas supply device 6, and the combustion-acceleration-gas supply device 7 at optimum timing in response to the opening of the diffusion valve 2. It is thus possible to combust the combustible gas contained in the coke oven gas at optimum timing and possible to suppress incomplete combustion of the coke oven gas and suppress excessive use of electric power and gases.

Reference Signs List

[0047]

1	gas collection pipe
2	diffusion valve
3	casing
4	diffusion pipe
5	ignition device
6	ignition-gas supply device
7	combustion-acceleration-gas supply device
8	detector
11	control device
12	diffusion bleeder

Claims

1. A diffusion bleeder that combusts a coke oven gas collected in a gas collection pipe and diffuses the coke oven gas into an atmosphere, the diffusion bleeder comprising:

a diffusion pipe connected to the gas collection pipe and through which the coke oven gas is distributed;
a diffusion valve that opens to distribute the coke oven gas from the gas collection pipe to the diffusion pipe when a pressure of the coke oven gas in the gas collection pipe has a set value;
an ignition device that ignites the coke oven gas;
an ignition-gas supply device that supplies an ignition gas for ignition to an inside of the diffusion pipe;
a combustion-acceleration-gas supply device that supplies a combustion acceleration gas that accelerates combustion of the coke oven gas to the inside of the diffusion pipe;
a detector that detects a start of opening of the diffusion valve; and
a control device that controls the ignition-gas supply device, the ignition device, and the combustion-acceleration-gas supply device,
wherein the control device receives a detection signal indicating that the diffusion valve starts to open from the detector, transmits a control signal for ordering a start of supplying of the ignition gas to the ignition-gas supply device, transmits a control signal for ordering an ignition operation to the ignition device, receives a detection signal indicating that the diffusion valve is fully opened, and transmits a control signal for ordering a start of supplying of the combustion acceleration gas to the combustion-acceleration-gas supply device.

2. A coke-oven-gas combustion method in which a coke oven gas collected in a gas collection pipe is combusted in a diffusion pipe, the method comprising:

a diffusion-start detection step in which a start of opening of a diffusion valve that is provided between the gas collection pipe and the diffusion pipe is detected when a pressure of the coke oven gas in the gas collection pipe has a set value;
an ignition-gas supply step in which supplying of an ignition gas for ignition to an inside of the diffusion pipe is started;
an ignition step in which the ignition gas is lit to serve as pilot light for ignition and ignite the coke oven gas; and
a combustion-acceleration-gas supply step in which, after completion of the ignition step and after full opening of the diffusion valve is detected, supplying of a combustion acceleration gas that accelerates combustion of the coke oven gas to the inside of the diffusion pipe is started.

FIG. 1

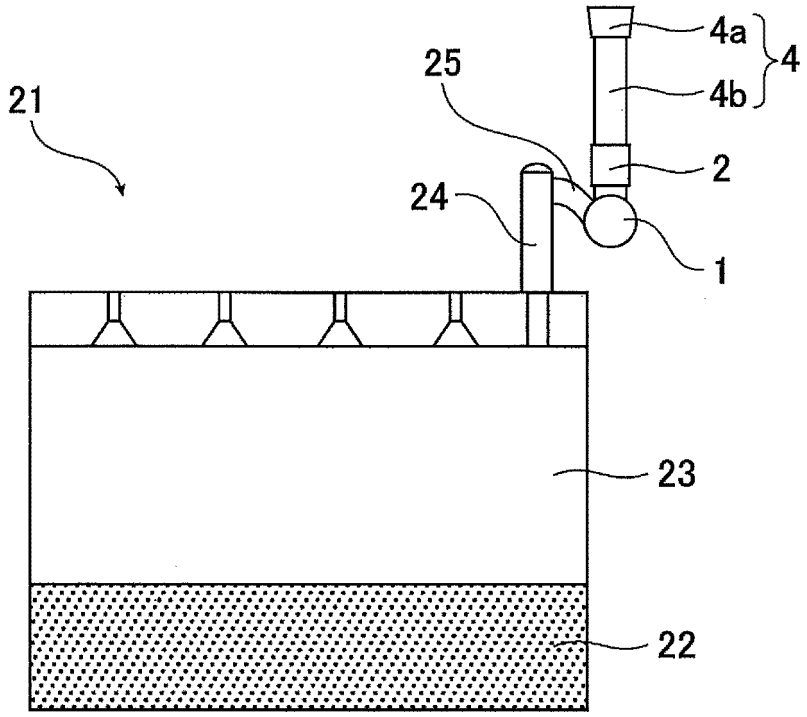


FIG. 2

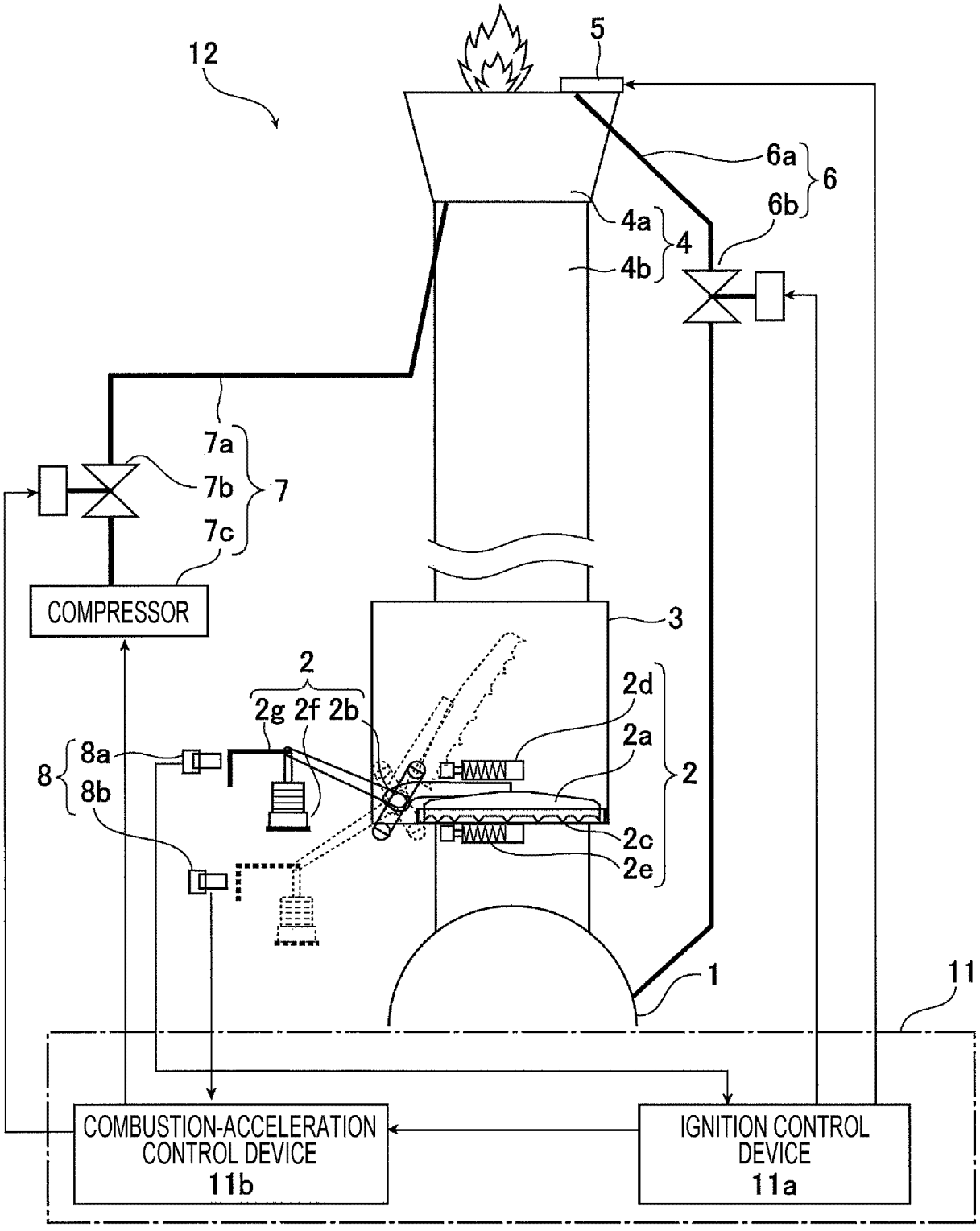

12
5
6a
6
6b
4a
4
4b
7a
7b
7
7c
COMPRESSOR
3
2
2g 2f 2b
2d
2a
2
8
8a
8b
2c
2e
1
11
COMBUSTION-ACCELERATION CONTROL DEVICE
11b
IGNITION CONTROL DEVICE
11a

FIG. 3

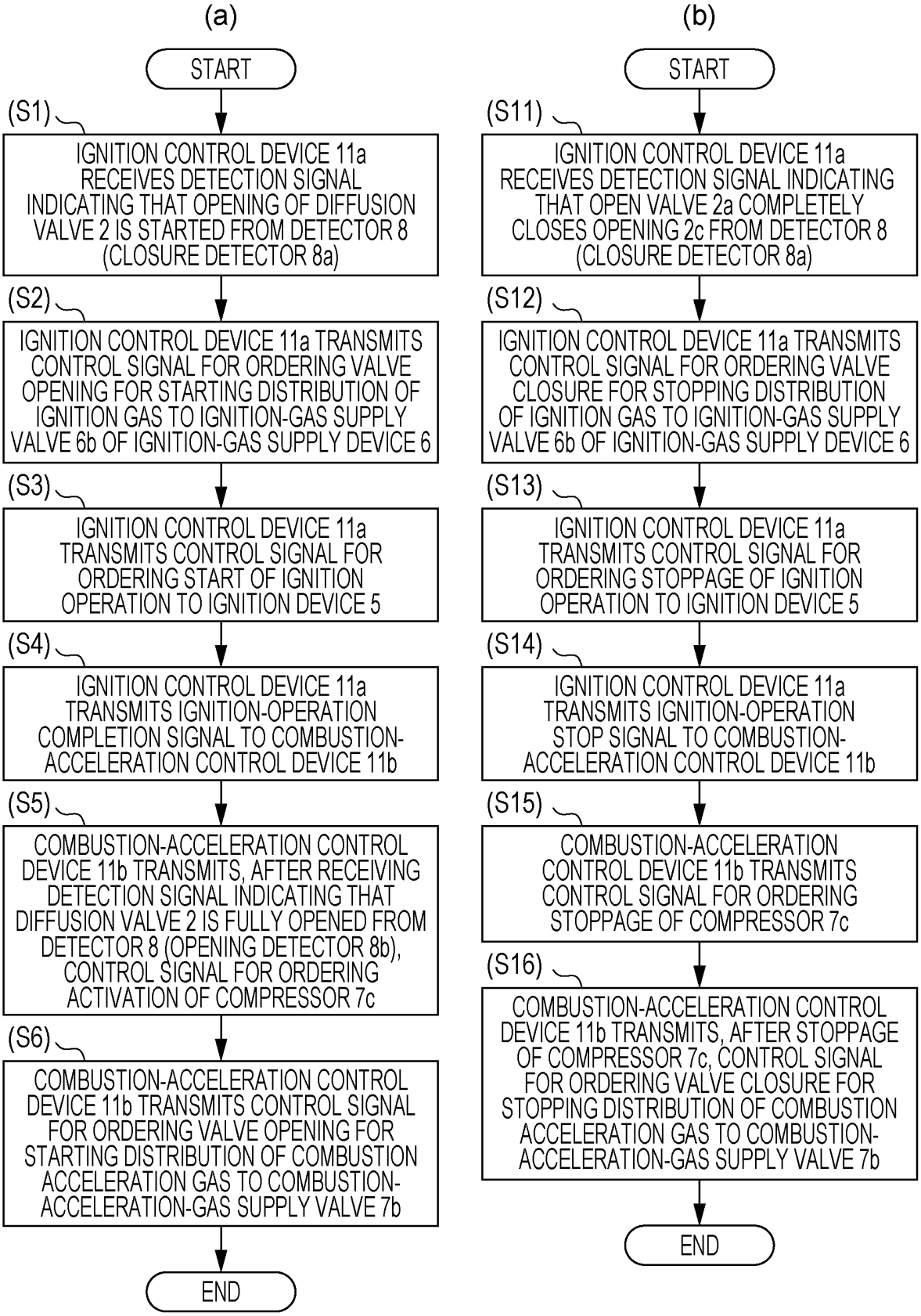

(a)
START
(S1)
IGNITION CONTROL DEVICE 11a RECEIVES DETECTION SIGNAL INDICATING THAT OPENING OF DIFFUSION VALVE 2 IS STARTED FROM DETECTOR 8 (CLOSURE DETECTOR 8a)
(S2)
IGNITION CONTROL DEVICE 11a TRANSMITS CONTROL SIGNAL FOR ORDERING VALVE OPENING FOR STARTING DISTRIBUTION OF IGNITION GAS TO IGNITION-GAS SUPPLY VALVE 6b OF IGNITION-GAS SUPPLY DEVICE 6
(S3)
IGNITION CONTROL DEVICE 11a TRANSMITS CONTROL SIGNAL FOR ORDERING START OF IGNITION OPERATION TO IGNITION DEVICE 5
(S4)
IGNITION CONTROL DEVICE 11a TRANSMITS IGNITION-OPERATION COMPLETION SIGNAL TO COMBUSTION-ACCELERATION CONTROL DEVICE 11b
(S5)
COMBUSTION-ACCELERATION CONTROL DEVICE 11b TRANSMITS, AFTER RECEIVING DETECTION SIGNAL INDICATING THAT DIFFUSION VALVE 2 IS FULLY OPENED FROM DETECTOR 8 (OPENING DETECTOR 8b), CONTROL SIGNAL FOR ORDERING ACTIVATION OF COMPRESSOR 7c
(S6)
COMBUSTION-ACCELERATION CONTROL DEVICE 11b TRANSMITS CONTROL SIGNAL FOR ORDERING VALVE OPENING FOR STARTING DISTRIBUTION OF COMBUSTION ACCELERATION GAS TO COMBUSTION-ACCELERATION-GAS SUPPLY VALVE 7b
END
(b)
START
(S11)
IGNITION CONTROL DEVICE 11a RECEIVES DETECTION SIGNAL INDICATING THAT OPEN VALVE 2a COMPLETELY CLOSES OPENING 2c FROM DETECTOR 8 (CLOSURE DETECTOR 8a)
(S12)
IGNITION CONTROL DEVICE 11a TRANSMITS CONTROL SIGNAL FOR ORDERING VALVE CLOSURE FOR STOPPING DISTRIBUTION OF IGNITION GAS TO IGNITION-GAS SUPPLY VALVE 6b OF IGNITION-GAS SUPPLY DEVICE 6
(S13)
IGNITION CONTROL DEVICE 11a TRANSMITS CONTROL SIGNAL FOR ORDERING STOPPAGE OF IGNITION OPERATION TO IGNITION DEVICE 5
(S14)
IGNITION CONTROL DEVICE 11a TRANSMITS IGNITION-OPERATION STOP SIGNAL TO COMBUSTION-ACCELERATION CONTROL DEVICE 11b
(S15)
COMBUSTION-ACCELERATION CONTROL DEVICE 11b TRANSMITS CONTROL SIGNAL FOR ORDERING STOPPAGE OF COMPRESSOR 7c
(S16)
COMBUSTION-ACCELERATION CONTROL DEVICE 11b TRANSMITS, AFTER STOPPAGE OF COMPRESSOR 7c, CONTROL SIGNAL FOR ORDERING VALVE CLOSURE FOR STOPPING DISTRIBUTION OF COMBUSTION ACCELERATION GAS TO COMBUSTION-ACCELERATION-GAS SUPPLY VALVE 7b
END

FIG. 4

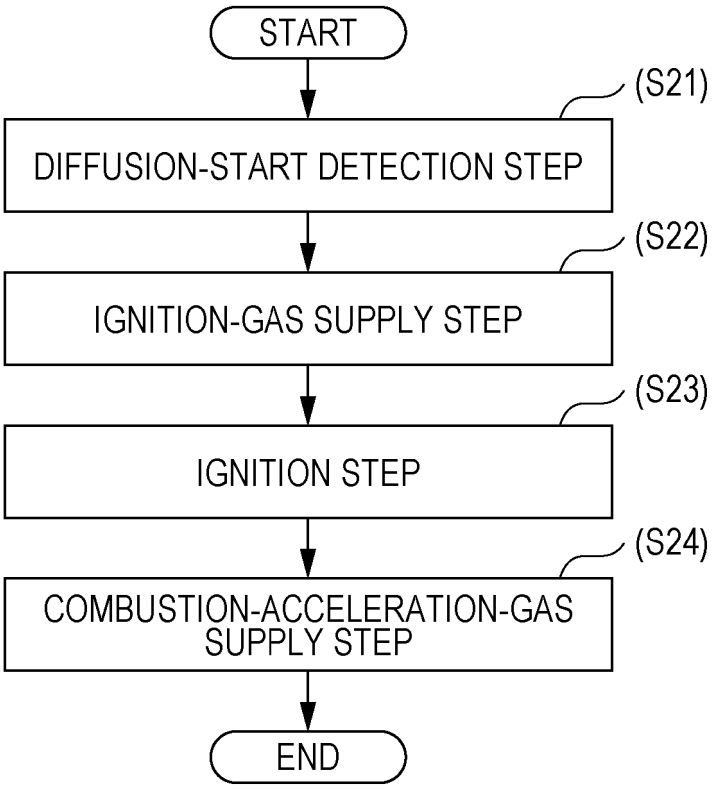
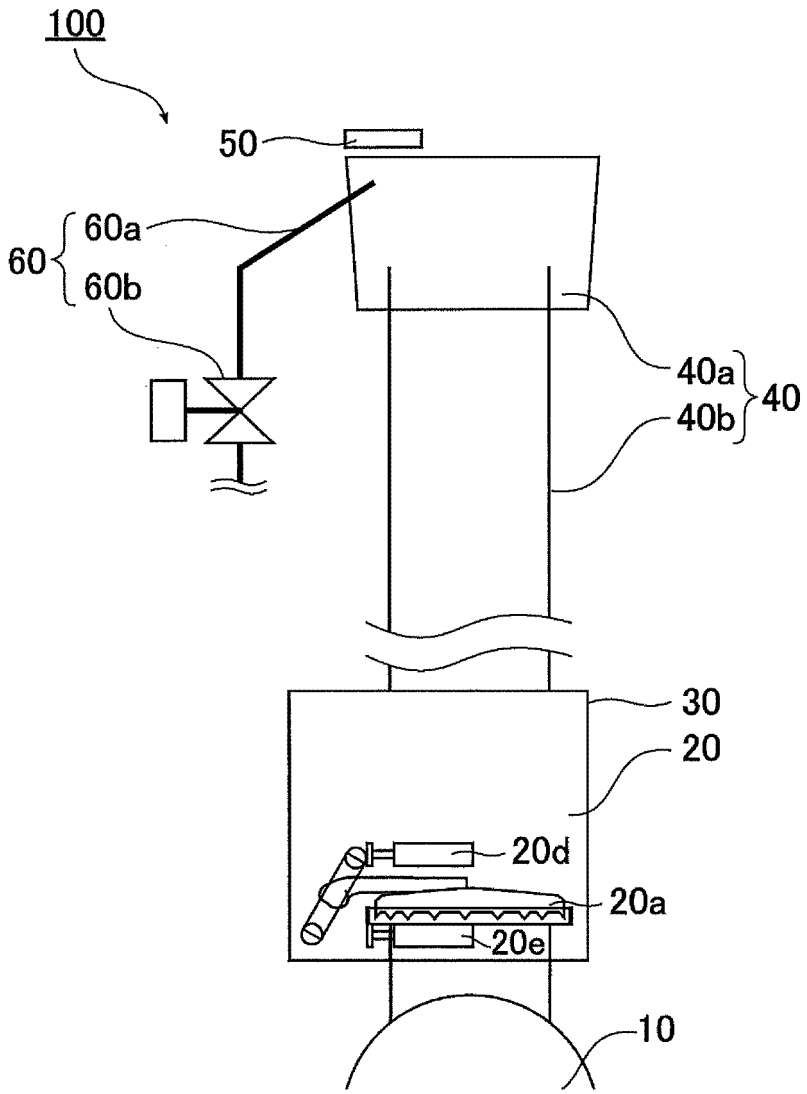

START
(S21)
DIFFUSION-START DETECTION STEP
(S22)
IGNITION-GAS SUPPLY STEP
(S23)
IGNITION STEP
(S24)
COMBUSTION-ACCELERATION-GAS SUPPLY STEP
END

FIG. 5



INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2022/020758

A. CLASSIFICATION OF SUBJECT MATTER

F23G 7/08(2006.01)i; ***C10B 27/06***(2006.01)i; ***F23G 7/06***(2006.01)i
FI: F23G7/08 Z; C10B27/06 Z; F23G7/06 C

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

F23G7/06-7/08; C10B27/06

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Published examined utility model applications of Japan 1922-1996
Published unexamined utility model applications of Japan 1971-2022
Registered utility model specifications of Japan 1996-2022
Published registered utility model applications of Japan 1994-2022

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	JP 2017-96615 A (JFE STEEL CORP.) 01 June 2017 (2017-06-01) in particular, paragraphs [0014]-[0026], fig. 2, 3	1-2
Y	JP 2006-124508 A (JFE STEEL CORP.) 18 May 2006 (2006-05-18) in particular, paragraph [0006]	1-2
Y	JP 60-89619 A (ISHIKAWAJIMA HARIMA HEAVY INDUSTRIES CO., LTD.) 20 May 1985 (1985-05-20) in particular, p. 3, lower right column, lines 15-18	1-2
Y	WO 2004/081450 A1 (RE-TEC INC.) 23 September 2004 (2004-09-23) in particular, description, p. 9, line 2 to p. 11, line 15	1-2
A	CN 103789472 A (SHANXI TAIGANG STAINLESS STEEL CO., LTD.) 14 May 2014 (2014-05-14) in particular, paragraphs [0034]-[0037]	1-2

☐ Further documents are listed in the continuation of Box C. ☑ See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier application or patent but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
14 July 2022	**26 July 2022**
Name and mailing address of the ISA/JP **Japan Patent Office (ISA/JP)** **3-4-3 Kasumigaseki, Chiyoda-ku, Tokyo 100-8915** **Japan**	Authorized officer Telephone No.

Form PCT/ISA/210 (second sheet) (January 2015)

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/JP2022/020758

Patent document cited in search report	Publication date (day/month/year)	Patent family member(s)	Publication date (day/month/year)
JP 2017-96615 A	01 June 2017	(Family: none)	
JP 2006-124508 A	18 May 2006	(Family: none)	
JP 60-89619 A	20 May 1985	(Family: none)	
WO 2004/081450 A1	23 September 2004	US 2006/0194160 A1 in particular, paragraphs [0044]-[0054] EP 1617144 A1 CA 2518430 A1 AU 2004219831 A1 KR 10-2005-0118675 A CN 1759274 A TW 200427948 A	
CN 103789472 A	14 May 2014	(Family: none)	

Form PCT/ISA/210 (patent family annex) (January 2015)

REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- JP 2006124508 A **[0011]**
- JP 2017096615 A **[0011]**