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(71) Applicant: **KOBELCO ECO-SOLUTIONS CO., LTD.**
Kobe-shi,
Hyogo 651-0072 (JP)

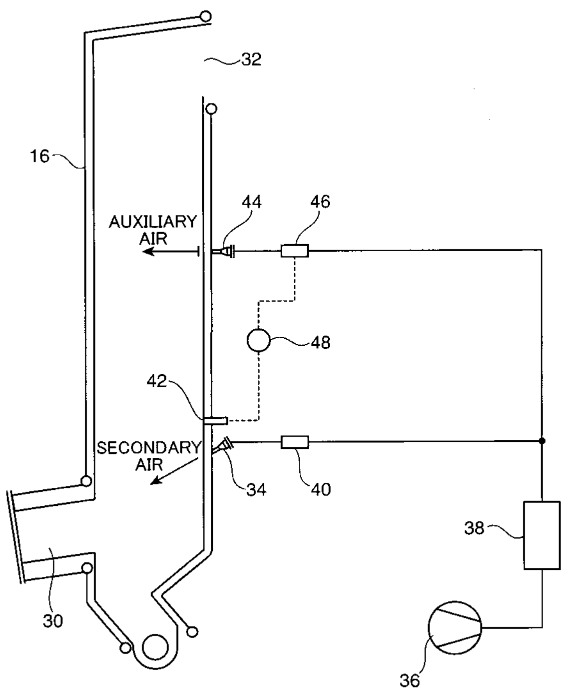
(72) Inventors:
- **HIGUCHI, Go**
  Kobe-shi, Hyogo 651-0072 (JP)
- **KINOSHITA, Taminori**
  Kobe-shi, Hyogo 651-0072 (JP)
- **HAYASHIDA, Toshitaka**
  Kobe-shi, Hyogo 651-0072 (JP)
- **FUJITA, Jun**
  Kobe-shi, Hyogo 651-0072 (JP)

(74) Representative: **Müller-Boré & Partner**
Patentanwälte
Grafinger Strasse 2
81671 München (DE)

(54) SECONDARY COMBUSTION METHOD AND UNIT IN INCINERATION SYSTEM

(57) In an incineration system, abrupt increase in quantity of carbon-monoxide generation is effectively suppressed while avoiding temperature drop in a secondary combustion chamber due to excessive air supply. When secondary air is supplied to a combustion gas in a secondary combustion chamber 16 and secondary combustion of the gas is carried out, presence or absence of flame on the downstream side of a secondary-air supply position is detected by a flame detector 42. When occurrence of flame is detected, more auxiliary air is supplied from a position on the downstream side of a flame detection position into the secondary combustion chamber 16 as compared with a case where occurrence of flame is not detected.

FIG. 2



EP 1 956 292 A1

Description

Technical Field

[0001] The present invention relates to an art of carrying out secondary combustion of a combustion gas generated from a treated object such as municipal waste and industrial waste in a secondary combustion chamber of a gasification andmelting system in gasifying and melting the treated object, or a system comprising a fluidized-bed incinerator.

Background Art

[0002] Patent Document 1 describes a conventional system incinerating wastes or the like. This system includes a fluidized-bed furnace formed with a fluidizing zone on its hearth. The fluidizing zone is supplied with primary air to thereby carry out primary combustion of a treated object inside of the fluidizing zone. Above the fluidizing zone is formed a freeboard as a secondary combustion chamber . The freeboard is supplied with secondary air to thereby carry out secondary combustion of a combustion gas generated through the primary combustion in the fluidizing zone. The system according to Patent Document 1 also includes: an oxygen analyzer for monitoring combustion inside of the furnace on the downstream side of the furnace; a brightness detector detecting brightness inside of the furnace; and a means for executing feedback control of the supply of the secondary air based on a detection signal by them.
Patent Document 1: Japanese Patent Laid-Open Publication No. 3-75402

Disclosure of the Invention

[0003] Concerning treated objects such as municipal wastes, supply or retained heat quantity of them tends to be abruptly increased temporarily, called "excessive supply". This phenomenon may lead the supply of treated objects to exceed an equivalent of air supplied into the system, thereby causing incomplete combustion due to an air shortage, so that a gas having an extremely-high carbon-monoxide concentration can be generated in an instant. On the other hand, taking improvements in the environment into account, the concentration of carbon monoxide in exhaust gas has recently been strictly regulated, which raises a requirement of a reduction in carbon-monoxide concentration.

[0004] To lower the concentration of carbon monoxide, increasing supply of secondary air for preventing incomplete combustion may be effective. However, this will cause excessive supply of secondary air in an ordinary operation without the "excessive supply" of treated objects. The secondary-air excessive supply may lower the temperature in the secondary combustion chamber, thereby generating more dioxin or lowering the power-generation efficiency of a boiler on the downstream side of the furnace.

[0005] As described above, Patent Document 1 discloses a feedback control of the secondary-air supply based on the oxygen analyzer or the brightness detector to control combustion inside of the furnace; however, the feedback control involves a considerable (frequently, one minute or longer) response delay, which makes it practically impossible to promptly respond to a sharp change in the state of combustion due to the treated-object "excessive supply" phenomenon. It is also hard for the brightness detector or the oxygen analyzer to perform precise detection of combustion inside of the furnace, particularly a rise in the concentration of carbon monoxide.

[0006] In view of the problems, it is an object of the present invention to provide an art capable of effectively suppressing abrupt increase in quantity of carbon-monoxide generation while avoiding temperature drop in a secondary combustion chamber due to excessive air supply.

[0007] The inventors have focused attention on the phenomenon that a conspicuous flame occurs on the downstream side of a supply position of secondary air, peculiarly when carbon monoxide is abruptly generated in a large quantity. This phenomenon occurs probably because of an extension of the flame due to residence of an unburned gas. Specifically, in an ordinary operation without the excessive supply of treated objects or the like, a combustion gas generated through primary combustion is completely burned by mixing with the secondary air, thereby extinguishing possible feeble flames remaining almost at the secondary-air supply position. In contrast, when a temporary sharp increase in quantity of the treated objects or the like makes the secondary air relatively in short supply, an unburned gas remains due to incomplete combustion even after the secondary air is supplied, which spreads a flame on the downstream side of the secondary-air supply position. In addition, the inventors have confirmed that timing of a occurrence of the flame exactly coincides with timing of a rise of the carbon-monoxide concentration.

[0008] On the basis of this background, the present invention provides a secondary combustion method in an incineration system for carrying out secondary combustion of a combustion gas generated from a treated object by supplying secondary air to the combustion gas in a secondary combustion chamber of the incineration system incinerating the treated object so as to make an air ratio, a ratio of a combustion-air quantity to a theoretical combustion-air quantity for the object to be disposed, be one or above; this method includes the steps of: detecting presence or absence of a flame on the downstream side of a supply position of the secondary air; and supplying auxiliary air on the downstream side of a detection position of the flame into the secondary combustion chamber in a larger quantity when the flame is detected than when it is not detected.

[0009] Furthermore, the prevent invention provides a secondary combustion apparatus in an incineration system which carries out secondary combustion of a combustion gas generated from a treated object by supplying secondary air to the combustion gas in a secondary combustion chamber of the incineration system incinerating the treated object, so as to make an air ratio, a ratio of a combustion-air quantity to a theoretical combustion-air quantity for the object to be disposed, be one or above; this apparatus includes: a secondary-air supplying means for supplying the secondary air into the secondary combustion chamber; a flame detecting means for detecting presence or absence of a flame on the downstream side of a position where the secondary-air supplying means supplies the secondary air; a auxiliary-air supplying means for supplying auxiliary air into the secondary combustion chamber on the downstream side of a detection position of a flame by the flame detecting means; and a supply controlling means for operating the auxiliary-air supplying means to supply auxiliary air on the downstream side of a detection position of the flame into the secondary combustion chamber in a larger quantity when the flame is detected than when it is not detected.

[0010] The above described method and apparatus perform proper combustion control based on the detection of presence or absence of a flame on the downstream side of a supply position of secondary air. Specifically, when a flame is not detected, the supply of auxiliary air is suppressed to avoid temperature drop in the secondary combustion chamber due to excessive air supply. On the other hand, if a flame is detected, in other words, if an unburned gas still remains regardless of the secondary-air supply, more auxiliary air is supplied on the downstream side of a detection position of the flame into the secondary combustion chamber than when a flame is not detected. This allows the unburned gas to completely burn, thereby effectively suppressing a rise in the concentration of carbon monoxide.

[0011] In detail, it may be appreciated that the auxiliary air is supplied into the secondary combustion chamber only when a flame is detected (i.e., the auxiliary-air supply may be set to zero when a flame is not detected). Alternatively, it may be appreciated that the auxiliary air is supplied into the secondary combustion chamber with the secondary air in operation and the auxiliary-air supply is increased when a flame is detected.

[0012] In the above described secondary combustion apparatus, it is more desirable to equate the distance between a flame detection position by the flame detecting means and a auxiliary-air supply position by the auxiliary-air supplying means substantially with a distance by which a gas inside of the secondary combustion chamber moves toward the downstream side of the flame detection position within a dead time taken from the detection of the flame by the flame detecting means until the beginning of increase in the supply of refill air by the auxiliary-air supplying means. This distance setting makes it possible to start increasing the auxiliary-air supply in suitable timing and in a suitable position after the flame detecting means actually detects a flame, thereby making the supply of the auxiliary air more effective.

[0013] The secondary-air supplying means and the auxiliary-air supplying means may be completely mutually independent; however, it is more appreciated that they include a common air-supply source for a simpler configuration into account. Specifically, it may be appreciated that the auxiliary-air supplying means includes a auxiliary-air supply nozzle for injecting air supplied from the air-supply source as auxiliary air into the secondary combustion chamber; and the supply controlling means includes an on-off valve positioned between the air-supply source and the auxiliary-air supply nozzle and a valve operating means for increasing opening of the on-off valve when the flame detecting means detects a flame. This facilitates switching of the auxiliary-air supply independent from the secondary-air supply in spite of commonality of the air-supply source.

[0014] The flame detecting means may be a visible-ray sensor, but it may preferably an ultra-violet sensor having a detection wavelength of 4000 Å or below. The ultra-violet sensor sufficiently excludes, from a target for detection, radiant light from a wall surface surrounding the secondary combustion chamber. This ultra-violet sensor is suitable for executing control in such a way that the auxiliary-air supplying means supplies auxiliary air only when the output of the ultra-violet sensor is a specified value or above.

Brief Description of the Drawings

[0015]

Fig. 1 is a view showing a whole configuration of a gasification and melting system according to a first embodiment of the present invention.

Fig. 2 is a view showing a secondary combustion apparatus provided in a waste-heat boiler of the gasification andmelting system.

Fig. 3 is a graphical representation showing a relationship between the wavelength and relative sensitivity of each sensor.

Fig. 4 is a sectional view of a fluidized-bed incinerator according to a second embodiment of the present invention.

Fig. 5 is a graphical representation showing a correlation between a threshold value set for the output signal of a flame detector, and hit ratio and detection ratio.

Figs. 6A, 6B and 6C are graphical representation showing variations as time elapses in an output signal of a flame detector and an actual CO concentration inside of exhaust gas when the flame detector is arranged in a different position from the present invention.

Fig. 7A is a graphical representation showing temporal variations in an output signal of a flame detector and an actual CO concentration inside of exhaust gas in Practical Example 1 of the present invention.

Fig. 7B is a graphical representation showing temporal variations in an output signal of the flame detector and an actual CO concentration inside of exhaust gas when the flame detector is arranged in a different position from the present invention.

Fig. 8 is a graphical representation showing temporal variations in CO concentration when no auxiliary air is supplied in flame detection.

Fig. 9 is a graphical representation showing temporal variations in CO concentration inside of exhaust gas in Practical Example 2 of the present invention.

Best Mode for Implementing the Invention

[0016] A first embodiment of the present invention will be described with reference to Figs. 1 to 3.

[0017] Fig. 1 shows a gasification andmelting system according to this embodiment. The system includes in order from the first step: a feeder 10; a fluidized-bed gasification furnace 12; a swirling-flow ash melting furnace 14; a waste-heat boiler 18 including a secondary combustion chamber 16; a gas cooling chamber 20; a bag filter 22; an induced draft fan 24; and a smokestack 26.

[0018] The feeder 10 includes a refuse hopper (not shown), and a screw feeder supplying refuse fed into the refuse hopper quantitatively to the fluidized-bed gasification furnace 12. The fluidized-bed gasification furnace 12 includes a hearth where a fluidizing zone is formed of fluidizing media such as sand. In the fluidized-bed gasification furnace 12 is performed a primary combustion of refuse fed into the fluidizing zone at a low temperature while keeping the temperature of the fluidizing zone, for example, at 450 to 650 °C.

[0019] In the swirling - flow ash melting furnace 14, there is formed a swirling - flow of combustion air, into which a pyrolysis gas sent from the fluidized-bed gasification furnace 12 is mixed to be burned at a high temperature of approximately 1300 °C. This high-temperature combustion generates heat, which melts an ash content of the pyrolysis gas on the furnace wall into slag; the molten slag is discharged from the furnace bottom. On the other hand, a high-temperature gas discharged from the melting furnace 14 is introduced into the secondary combustion chamber 16 of the waste-heat boiler 18.

[0020] In the secondary combustion chamber 16, secondary air is supplied to the gas introduced from the melting furnace 14 so as to make the air ratio be one or above, thereby further burning the gas secondarily. Some details will be described later.

[0021] The gas having passed the waste-heat boiler 18 is cooled down to about 150 to 200 °C by contact with cooling water sprayed in the gas cooling chamber 20 . The cooled gas is discharged from the system through the bag filter 22, the induced dr.aft fan 24 and the smokestack 26.

[0022] Next will be described secondary combustion in the secondary combustion chamber 16 with reference to Fig. 2.

[0023] The secondary combustion chamber 16 includes a gas inlet 30 in a lower-end part and a gas outlet 32 in an upper-end part thereof. The high-temperature gas discharged from the swirling - flow ash melting furnace 14 is introduced into the secondary combustion chamber 16 through the gas inlet 30.

[0024] There is provided a secondary-air supply nozzle 34 a little above the gas inlet 30 in order to supply secondary air into the secondary combustion chamber 16 making an air ratio (a ratio of a combustion-air quantity to a theoretical air quantity) be one or above. In the figure, it is arranged so as to inject the secondary air obliquely downward. The secondary-air supply nozzle 34 is supplied with the secondary air through an air pre-heater 38 and an on-off valve 40 from a blower 36 as an air-supply source.

[0025] Furthermore, this secondary combustion apparatus is characterized by including a flame detector 42 for detecting presence or absence of a flame on the downstream side of (in the figure, above) the supply position of the secondary air by the secondary-air supply nozzle 34. The flame detector 42 can be, for example, a light sensor, and desirably, should have a detection wavelength as short as possible.

[0026] Fig. 3 shows a wavelength of a radiation from a furnace wall having each temperature of approximately 550 °C and approximately 1600 °C and a detectable wavelength of each sensor. As can be seen from the figure, the wavelengths of the radiation from the furnace-wall are relatively long in a range from the visible-light region to the infrared region. Accordingly, a sensor whose detectable wavelength is long will probably detect such radiant light. In contrast, a sensor having a shorter detectable wavelength, particularly, an ultra-violet sensor (e.g., a flame sensor "Ultra-vision" by Yamatake Corporation generally used as a misfire detector for a gas-firing burner or an oil-firing burner) can precisely detect presence or absence of a flame without receiving any disturbance by a radiation of the furnace wall.

[0027] Moreover, a auxiliary-air supply nozzle 44 is provided on the downstream side of (in the figure, above) the flame detection position of the flame detector 42, keeping a specified distance therefrom. The auxiliary-air supply nozzle 44 is connected to the common blower 36 and air pre-heater 38 in parallel with the secondary-air supply nozzle 34. Between the air pre-heater 38 and the auxiliary-air supply nozzle 44 is provided an on-off valve 46, which is connected to a valve operator 48 for open/close operation of the on-off valve 46.

[0028] In this embodiment, the on-off valve 46 is a pneumatic valve, which has a valve body opened and closed by an air pressure in response to an electric signal outputted from the valve operator 48. However, the present invention is not limited to a specific configuration of such an on-off valve. The on-off valve is permitted as long as it opens and closes corresponding to some control-signal input.

[0029] The valve operator 48 is connected to the flame detector 42 to operate the on-off valve 46 based on a detection signal outputted from the flame detector 42. Specifically, it judges a flame detected and opens the on-off valve 46 for a specified time only when the level of the detection signal is equal to, or more than, a specified threshold value set in advance.

[0030] In other words, the valve operator 48 injects auxiliary air only during the specified time from the auxiliary-air supply nozzle 44.

[0031] The distance between the secondary-air supply position and the flame detection position can be suitably set. However, it is preferable to shorten this distance to an extent that permits a flame occured from the secondary-air supply position to be certainly detected.

[0032] The distance between the flame detection position and the auxiliary-air supply position can also be suitably set. However, it is preferable to consider a dead time from the detection of the flame until the beginning of an actual injection of the auxiliary-air from the auxiliary air supply nozzle 44. In other words, this distance should desirably be set substantially equal to a distance by which a gas moves toward the downstream side of the flame detection position within the dead time. Since the dead time is substantially equal to time taken to open the on-off valve 46, the distance may be set based on the operational characteristics of the on-off valve 46.

[0033] The following is a description about an action of the secondary combustion apparatus.

[0034] First is explained an action when the fluidized-bed gasification furnace 12 and the swirling - flow ash melting furnace 14 are in ordinary operation, in other words, when a normal amount of refuse is treated without a so-called "excessive supply" phenomenon. In this case, since a high-temperature gas introduced into the secondary combustion chamber 16 contains little unburned gas, mixing the high-temperature gas with secondary air injected from the secondary-air supply nozzle 34 can achieve complete combustion, thus preventing occurrence of a flame on the downstream side of the secondary-air supply position. Hence, the flame detector 42 outputs a detection signal below the threshold value, which lets the valve operator 48 keep the on-off valve 46 closed. This prevents the auxiliary-air supply nozzle 44 from supplying auxiliary air excessively, thereby avoiding temperature drop in the secondary combustion chamber 16.

[0035] In contrast, when the "excessive supply" phenomenon, where treated objects charging the fluidized-bed gasification furnace 12 temporarily increase sharply in weight or heat quantity, is occurred, secondary air supplied from the secondary-air supply nozzle 34 becomes relatively short, so that even mixing the secondary air with a high-temperature gas cannot achieve complete combustion, thus leaving an unburned gas. The unburned gas spreads a flame upward from the secondary-air supply nozzle 34. However, the output signal (detection signal) from the flame detector 42 responds to the flame, and it becomes equal to, or more than, the threshold value to let the valve operator 48 open the on-off valve 46 for a specified time, so that auxiliary air is injected from the auxiliary-air supply nozzle 44. This auxiliary-air injection allows of combustion of a gas unburned in the secondary-air supply position, thereby effectively suppressing abrupt increase in carbon-monoxide concentration.

[0036] Fig. 4 shows a fluidized-bed incinerator 50 including a secondary combustion chamber according to a second embodiment of the present invention.

[0037] The fluidized-bed incinerator 50 has a hearth, on which a fluidizing zone 52 is formed, and a primary-air supply chamber 54 is provided under the fluidizing zone 52. Air is sent into the primary-air supply chamber 54 and blows out as primary air into the fluidizing zone 52 to fluidize the fluidizing zone 52.

[0038] Above the fluidizing zone 52 is provided a refuse-charging inlet 56 , further above which, a freeboard 58 is formed as a secondary combustion chamber. Below the freeboard 58 is set a secondary-air supply position 60 for supplying secondary air so as to make an air ratio be one or above, and the flame detector 42 is provided just above the position 60. Further, above the flame detector 42 is set a auxiliary-air supply position 62 for supplying auxiliary air only when the flame detector 42 detects a flame.

[0039] There are included a means for supplying secondary air from the secondary-air supply position 60 and a means for supplying auxiliary air from the auxiliary-air supply position 62, which are equivalent to those of Fig. 2.

[0040] Also in this embodiment, in an ordinary operation with no abnormal variation in refuse-charging quantity or heat quantity, only secondary air with no auxiliary air is supplied into the freeboard 58, which enables avoiding temperature drop in the freeboard 58 due to excessive air supply. On the other hand, when a temporary abrupt rise occurs in refuse-charging quantity or heat quantity, it generates a flame on the downstream side of the secondary-air supply position 60 and the flame detector 42 detects the flame to output the detection signal, which lets the auxiliary-air supplying means supply auxiliary air into the freeboard 58 from the auxiliary-air supply position 62 for a specified time. This supply allows of complete combustion of a gas unburned in the secondary-air supply, thereby effectively suppressing abrupt increase in the carbon-monoxide concentration of combustion gas discharged from the furnace top.

[0041] One can suitably set the above described threshold value, that is, a threshold value for judging presence or absence of the flame based on the output signal of the flame detector 42. In general, as indicated by the graphs of Fig. 5, the greater the threshold value is set, the higher a hit ratio (=the number of actual carbon-monoxide occurrences with judgment that a flame is detected/ the number of judgment that a flame is detected) will be, while the lower a detection ratio (=the number of actual carbon-monoxide occurrence/the total number of carbon-monoxide occurrences) will be. Hence, the threshold value is preferably set with consideration as to a balance of the hit ratio and the detection ratio.

[0042] The supply of auxiliary air is not limited to the case where a flame has been detected. The present invention also includes, for example, an aspect where a small quantity of auxiliary air is constantly supplied with secondary air in operation, and the supply of the auxiliary air is increased (e.g., the on-off valve 46 shown in Fig. 2 is more opened) only when a flame is detected.

[0043] Figs. 6 and 7 show a measurement result for the purpose of verifying advantages of the apparatus shown in Fig. 4.

[0044] For this measurement, the flame detector 42 are provided, in the apparatus, not only at the position shown by the solid line (referred to below as "the practical-example position"), but also at respective positions PA, PB, PC and PD shown by the double-dashed chain lines in the figure, and output signals from the respective flame detectors 42 are acquired.

[0045] Further is provided a CO-concentration sensor other than the flame detectors 42 on the downstream side of the bag filter 22 shown in Fig. 1, which measures CO concentration of a gas actually discharged from the bag filter 22.

[0046] Figs. 6A, 6B and 6C each shows an output signal of the flame detector 42 arranged in each of the positions PA, PB and PC shown in Fig. 4 and an output signal of the CO-concentration sensor. Similarly, Fig. 7A shows an output signal of the flame detector 42 arranged in the practical-example position and an output signal of the CO-concentration sensor, and Fig. 7B shows an output signal of the flame detector 42 arranged in the position PD and an output signal of the CO-concentration sensor.

[0047] As shown in Fig. 6A, the detection signal of the flame detector 42 in the position PA, closely facing the interface of the fluidizing zone 52, varies more frequently than the number of actual abrupt increases in the CO concentration. This signal cannot teach a timing of sharp rise in the CO concentration rises.

[0048] The position PB is a position where a bird's-eye view of the interface of the fluidizing zone 52 can be obtained from substantially right overhead near a feeding inlet 56, and the position PC is a position where the furnace inside can be monitored horizontally from 400 mm under the secondary-air supply position 60. As shown in Figs. 6B and 6C, the output signal of the flame detector 42 in each position varies merely slightly, thus indicating no clear rise. Either signal also cannot teach a timing of sharp rise in the CO concentration rises.

[0049] The position PD is a position where the furnace inside can be overlooked from the furnace top. As shown in Fig. 7B, the output signal of the flame detector 42 in this position is also feeble, thus indicating only a little correlation with variations in CO concentration.

[0050] In contrast, as shown in Fig. 7A, the output signal of the flame detector 42 arranged in the practical-example position indicates sharp rises, and furthermore, the output signal of the CO-concentration sensor rises sharply after a substantially-fixed time lag from the rise of the signal of the flame detector 42. This means there is a remarkable correlation between the flame detection signal and the actual CO-concentration variation. Therefore, the output signal of the flame detector 42 in the practical-example position enables detecting sharp rises in CO concentration with appreciate probability.

[0051] Figs. 8 and 9 show monitoring results on variations in CO concentration in actual exhaust gas in the case where secondary air and auxiliary air is supplied when the flame detection is performed (the practical example of the present invention) and in the case where only secondary air is constantly supplied (a comparative example of the present invention). This monitoring is performed by a CO-concentration sensor provided on the downstream side of a bag filter in the same way as the above in the incineration system including the apparatus of Fig. 4.

[0052] As shown in Fig. 8, in the comparative example, there is indicated a sharp rise in concentration of carbon monoxide with high probability after a rise in the flame detection signal, and further, its peak value often exceeds 150 ppm. Moreover, as is not shown in the figure, there is also an abrupt increase more than 200 ppm in CO concentration, depending upon a refuse-charging quantity.

[0053] In the practical example of the present invention, since auxiliary air is supplied in response to a rise in the flame detection signal, subsequent increases in CO concentration are strikingly suppressed, as shown in Fig. 9.

Claims

1. A secondary combustion method in an incineration system for carrying out secondary combustion of a combustion gas generated from a treated object by supplying secondary air to the combustion gas in a secondary combustion chamber of the incineration system incinerating the treated object so as to make an air ratio equivalent to the ratio of a combustion-air quantity to a theoretical combustion-air quantity for the object to be disposed be one or above, **characterized by** including the steps of:

    detecting presence or absence of a flame on the downstream side of a supply position of the secondary air; and
    supplying auxiliary air on the downstream side of a detection position of the flame into the secondary combustion chamber in a larger quantity when the flame is detected than when a flame is not detected.

2. The secondary combustion method in an incineration system according to claim 1, **characterized in**

that the auxiliary air is supplied into the secondary combustion chamber only when a flame is detected.

3. The secondary combustion method in an incineration system according to claim 1, **characterized in that:**

the auxiliary air is supplied into the secondary combustion chamber with the secondary air in operation; and
the supply of the auxiliary air is increased when a flame is detected.

4. The secondary combustion method in an incineration system according to any of claims 1 to 3, **characterized in that:**

an ultra-violet sensor having a detectable wavelength of 4000 Å or below is provided in a detection position of a flame; and
the auxiliary air is supplied only when the output of the ultra-violet sensor is a specified value or above.

5. A secondary combustion apparatus in an incineration system which carries out secondary combustion of a combustion gas generated from a treated object by supplying secondary air to the combustion gas in a secondary combustion chamber of the incineration system incinerating the treated object so as to make an air ratio equivalent to the ratio of a combustion-air quantity to a theoretical combustion-air quantity for the object to be disposed be one or above, **characterized by** including:

a secondary-air supplying means for supplying the secondary air into the secondary combustion chamber;
a flame detecting means for detecting presence or absence of a flame on the downstream side of a position where the secondary-air supplying means supplies the secondary air;
a auxiliary-air supplying means for supplying auxiliary air into the secondary combustion chamber on the downstream side of a detection position of a flame by the flame detecting means; and
a supply controlling means for operating the auxiliary-air supplying means to supply auxiliary air in a larger quantity when the flame is detected than when a flame is not detected.

6. The secondary combustion apparatus in an incineration system according to claim 5, **characterized in that** the supply controlling means operates the auxiliary-air supply means to supply the auxiliary air into the secondary combustion chamber only when the flame detecting means detects a flame generated.

7. The secondary combustion apparatus in an incineration system according to claim 5, **characterized in that** the supply controlling means operates the auxiliary-air supply means to supply the auxiliary air into the secondary combustion chamber with the secondary air in operation and increase the supply of the auxiliary air when a flame is detected.

8. The secondary combustion apparatus in an incineration system according to any of claims 5 to 7, **characterized in that** the distance between a flame detection position by the flame detecting means and a auxiliary-air supply position by the auxiliary-air supplying means is substantially equal to a distance by which a gas inside of the secondary combustion chamber moves toward the downstream side of the flame detection position within a dead time taken from the detection of the flame by the flame detecting means until the beginning of increase in the supply of auxiliary air by the auxiliary-air supplying means.

9. The secondary combustion apparatus in an incineration system according to any of claims 5 to 7, **characterized in that:**

the secondary-air supplying means and the auxiliary-air supplying means include a common air-supply source;
the auxiliary-air supplying means includes a auxiliary-air supply nozzle for injecting air supplied from the air-supply source as auxiliary air into the secondary combustion chamber; and
the supply controlling means includes an on-off valve positioned between the air-supply source and the auxiliary-air supply nozzle and a valve operating means for increasing opening of the on-off valve when the flame detecting means detects a flame.

10. The secondary combustion apparatus in an incineration system according to any of claims 5 to 7, **characterized in that:**

the flame detecting means is an ultra-violet sensor having a detectable wavelength of 4000 Å or below; and
the supply controlling means operates the auxiliary-air supplying means to supply auxiliary air only when the output of the ultra-violet sensor is a specified value or above.

FIG. 1

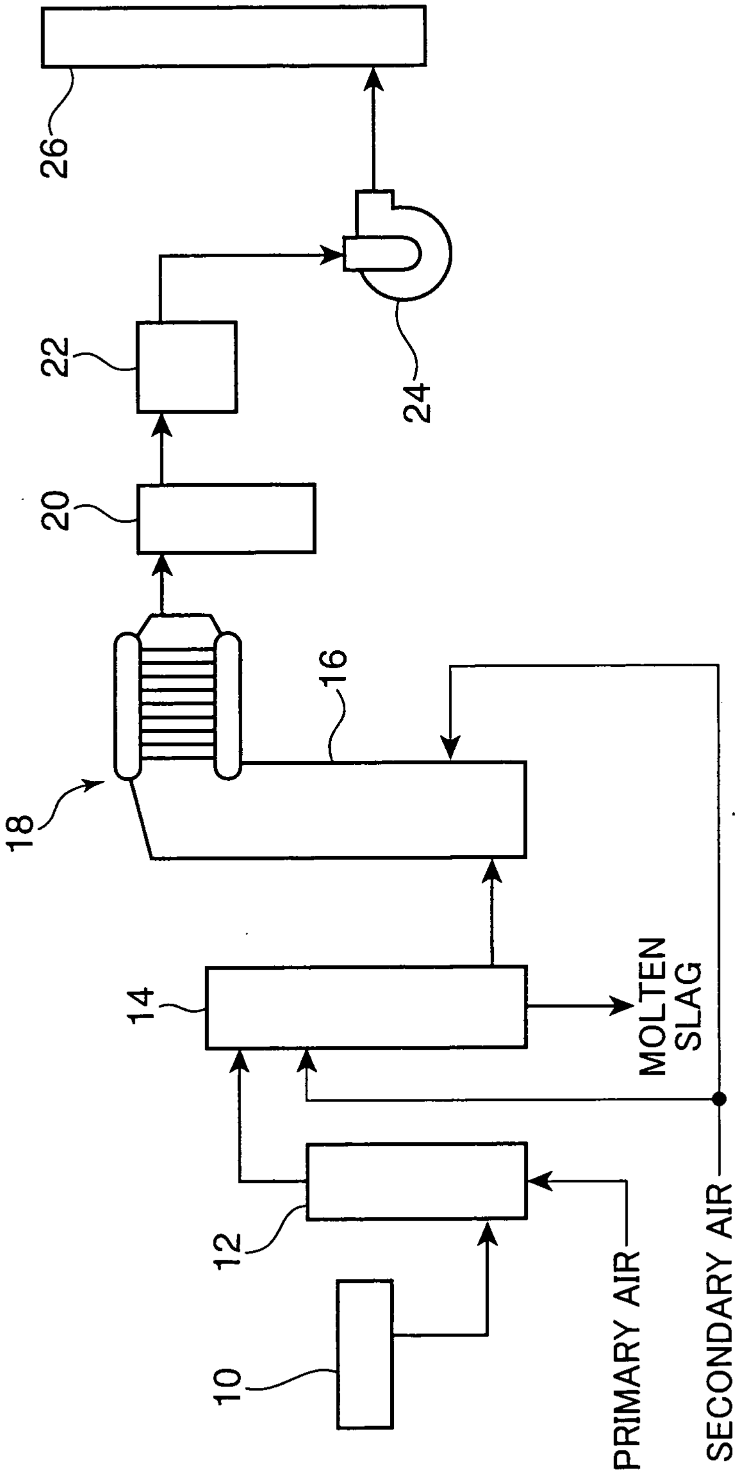

10
12
14
16
18
20
22
24
26
PRIMARY AIR
SECONDARY AIR
MOLTEN SLAG

FIG. 2

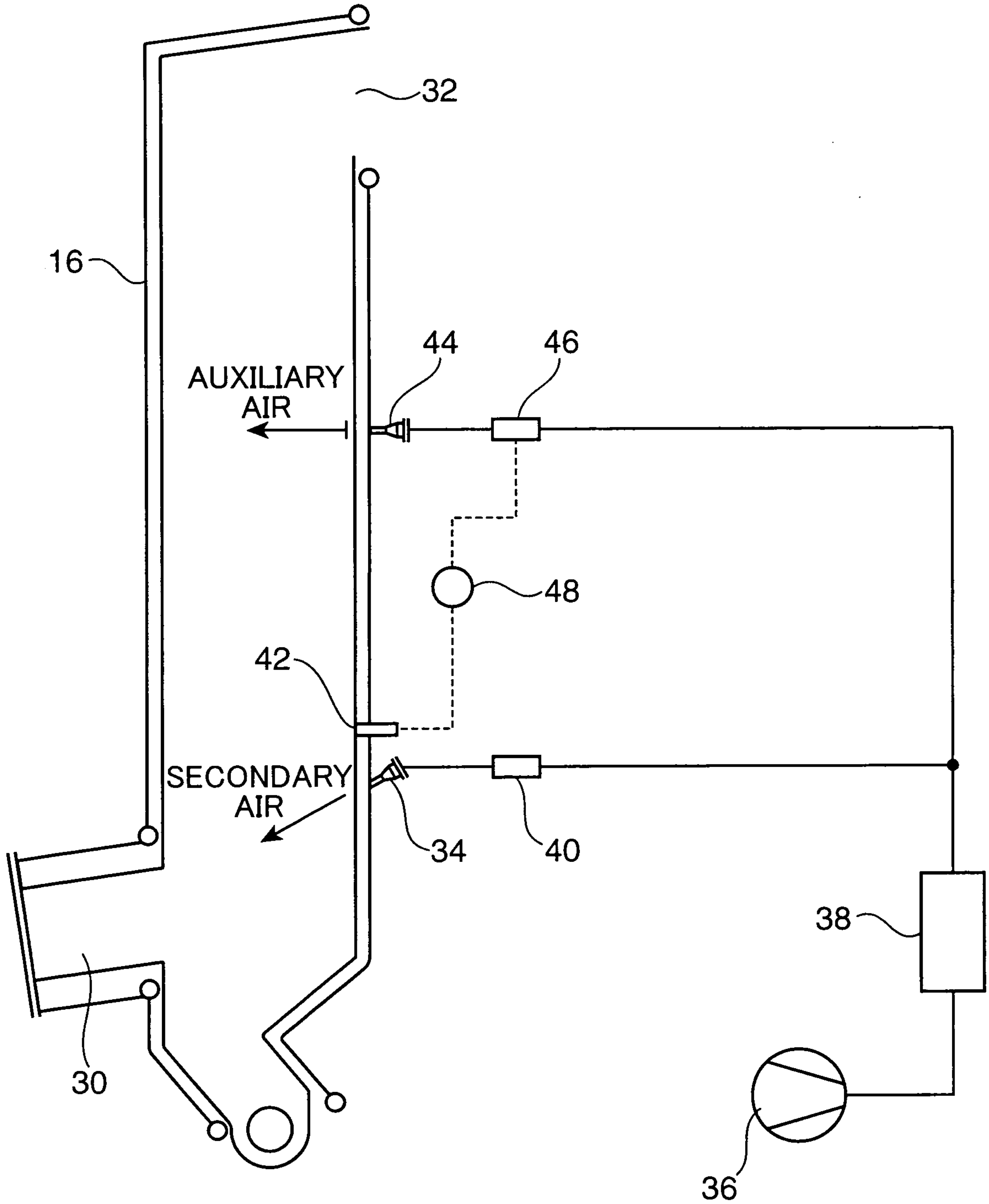
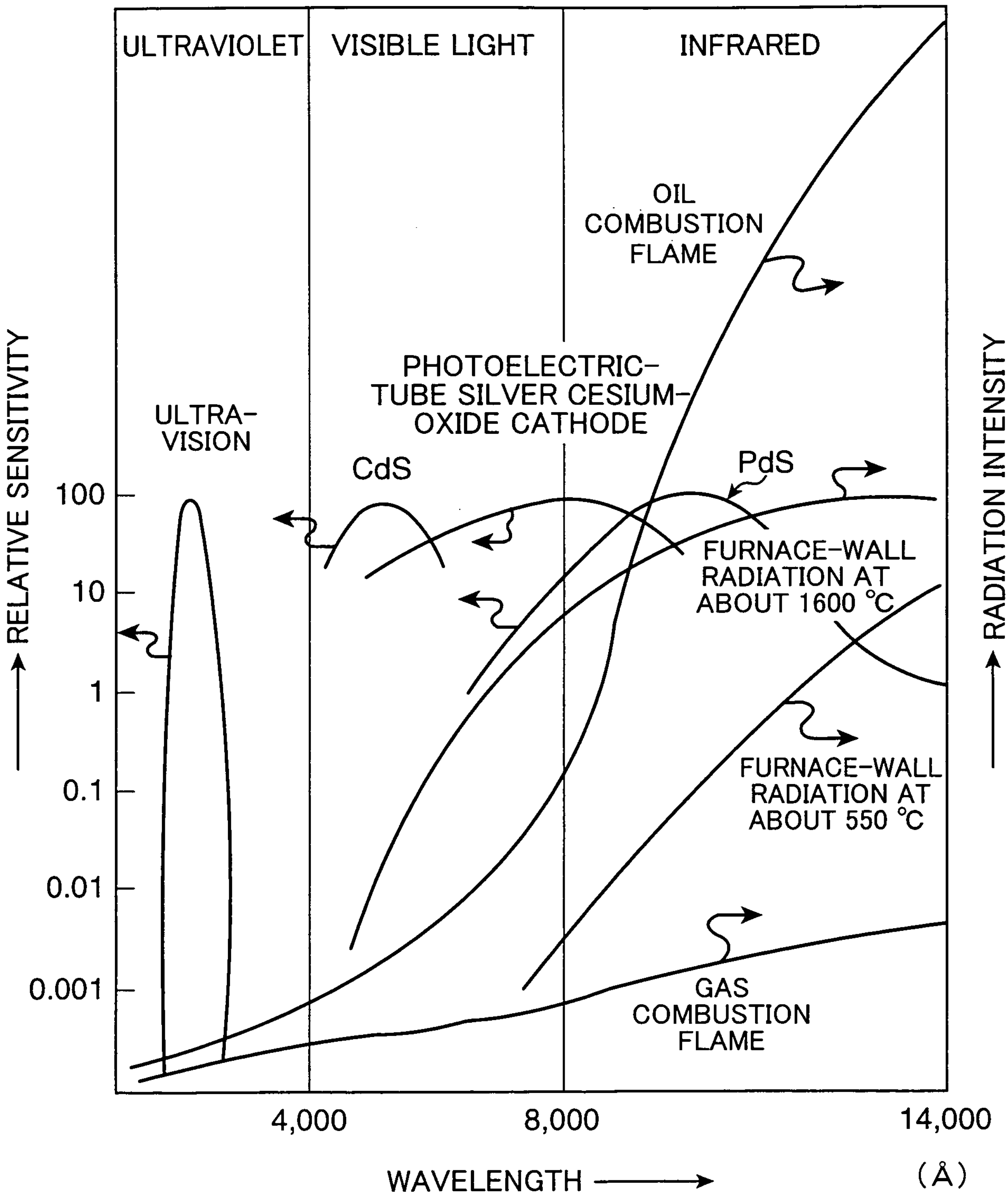


FIG. 3


ULTRAVIOLET
VISIBLE LIGHT
INFRARED
OIL COMBUSTION FLAME
PHOTOELECTRIC-TUBE SILVER CESIUM-OXIDE CATHODE
ULTRA-VISION
CdS
PdS
FURNACE-WALL RADIATION AT ABOUT 1600 °C
FURNACE-WALL RADIATION AT ABOUT 550 °C
GAS COMBUSTION FLAME
RELATIVE SENSITIVITY
RADIATION INTENSITY
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0.1
0.01
0.001
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8,000
14,000
WAVELENGTH
(Å)

FIG. 4

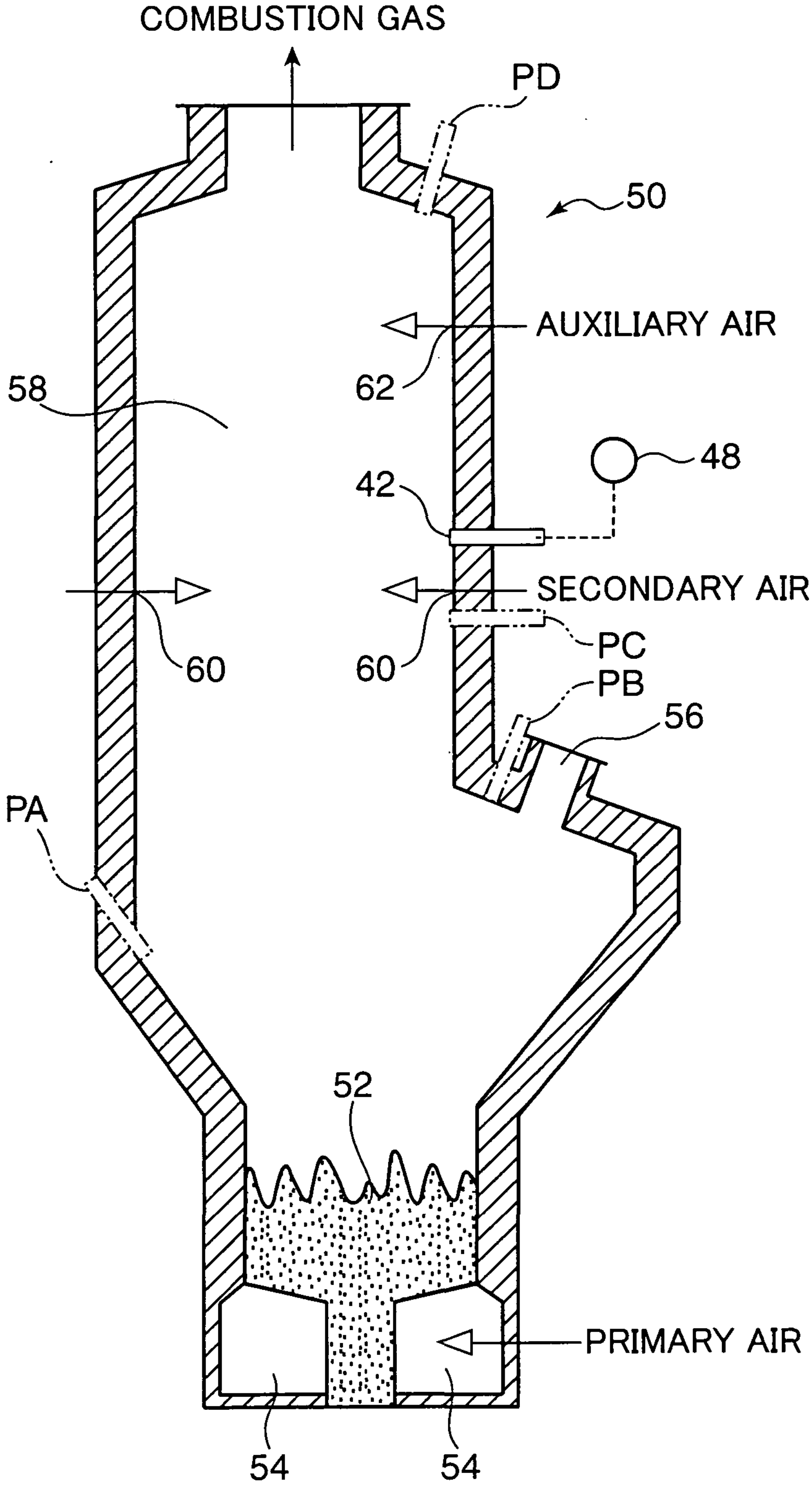

COMBUSTION GAS
PD
50
AUXILIARY AIR
58
62
48
42
SECONDARY AIR
PC
60
60
PB
56
PA
52
PRIMARY AIR
54
54

FIG. 5

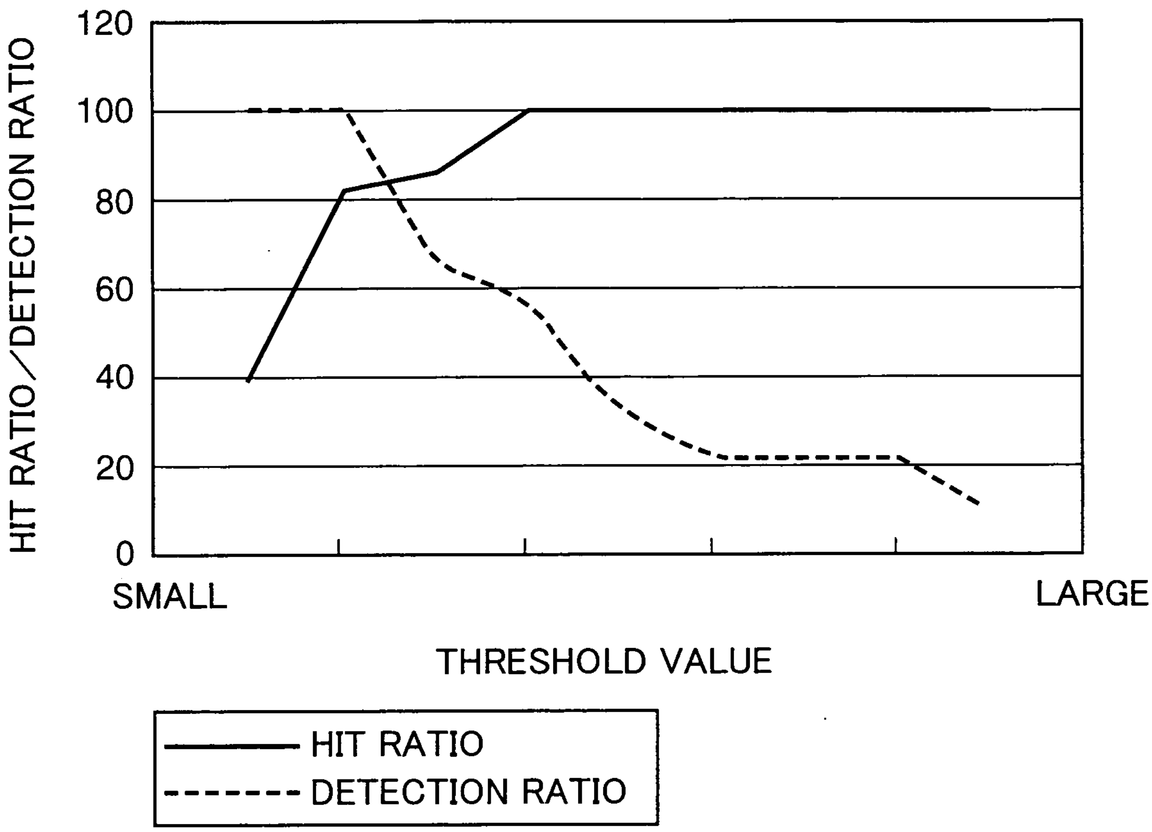

HIT RATIO/DETECTION RATIO
120
100
80
60
40
20
0
SMALL
LARGE
THRESHOLD VALUE
HIT RATIO
DETECTION RATIO

FIG. 6A

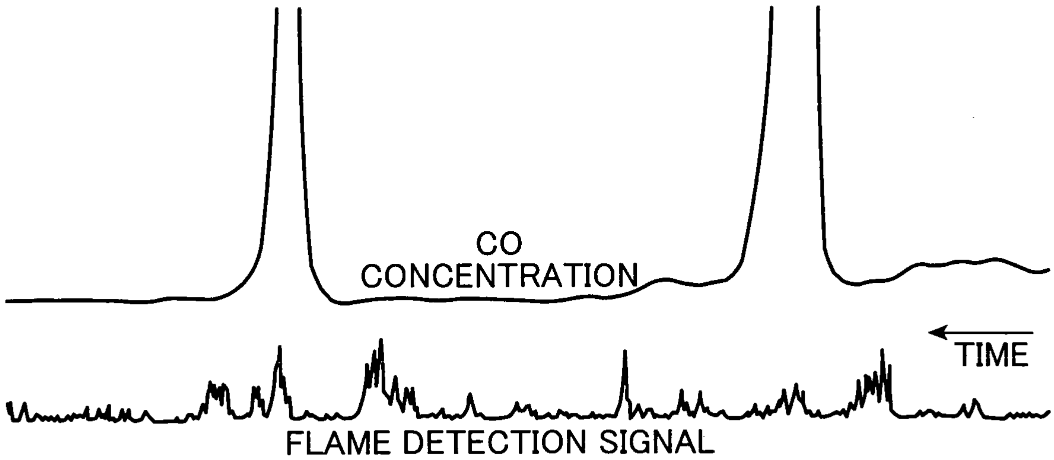


FIG. 6B

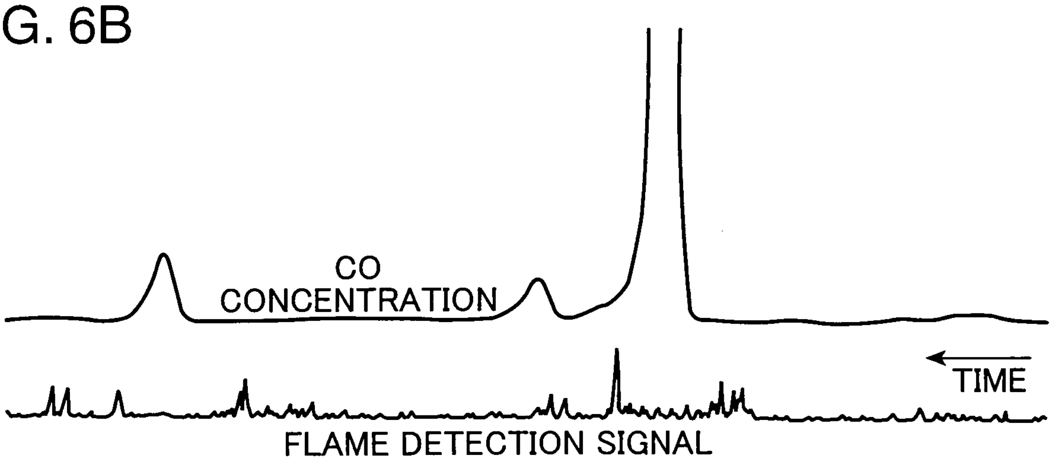


FIG. 6C

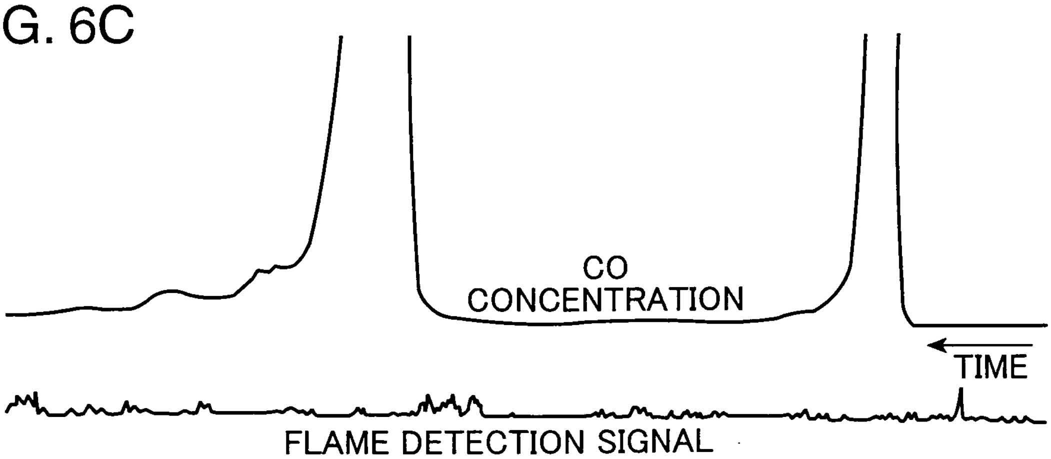


FIG. 7A

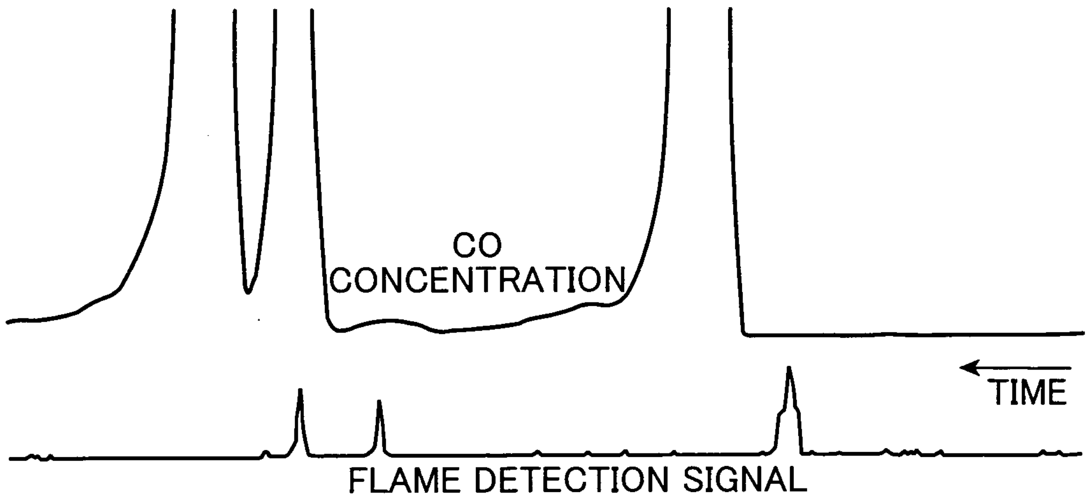

CO
CONCENTRATION
TIME
FLAME DETECTION SIGNAL

FIG. 7B

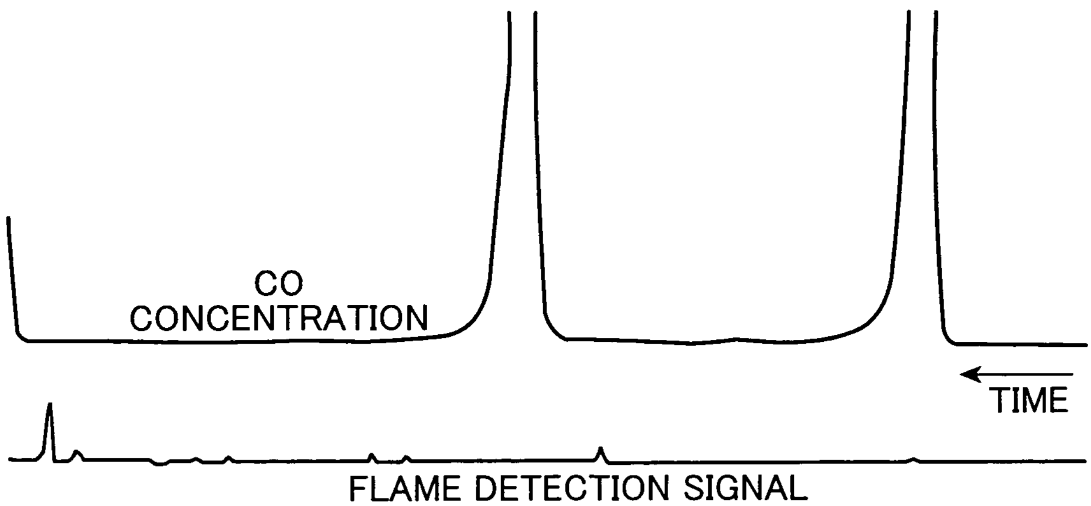

CO
CONCENTRATION
TIME
FLAME DETECTION SIGNAL

FIG. 8

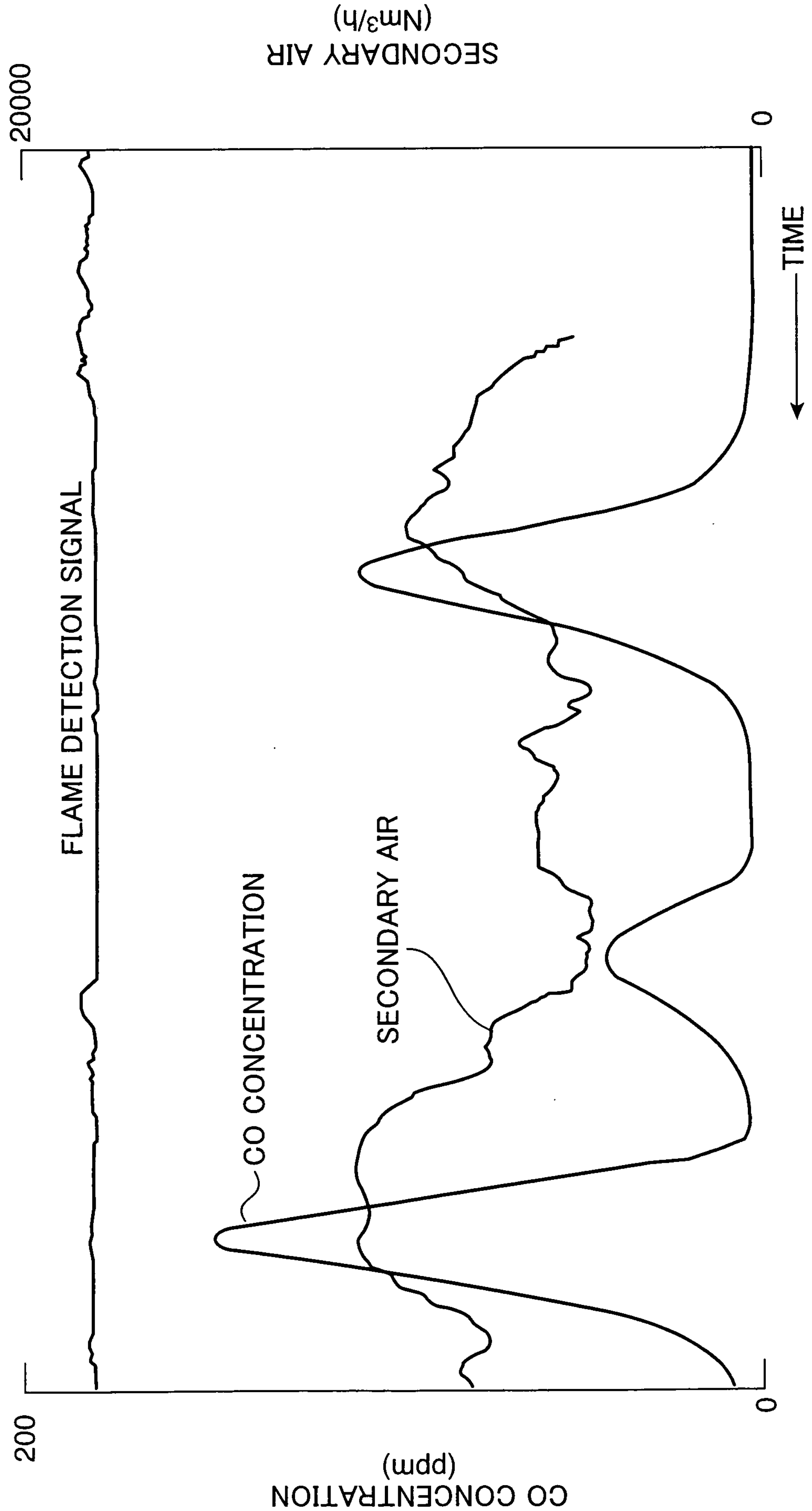
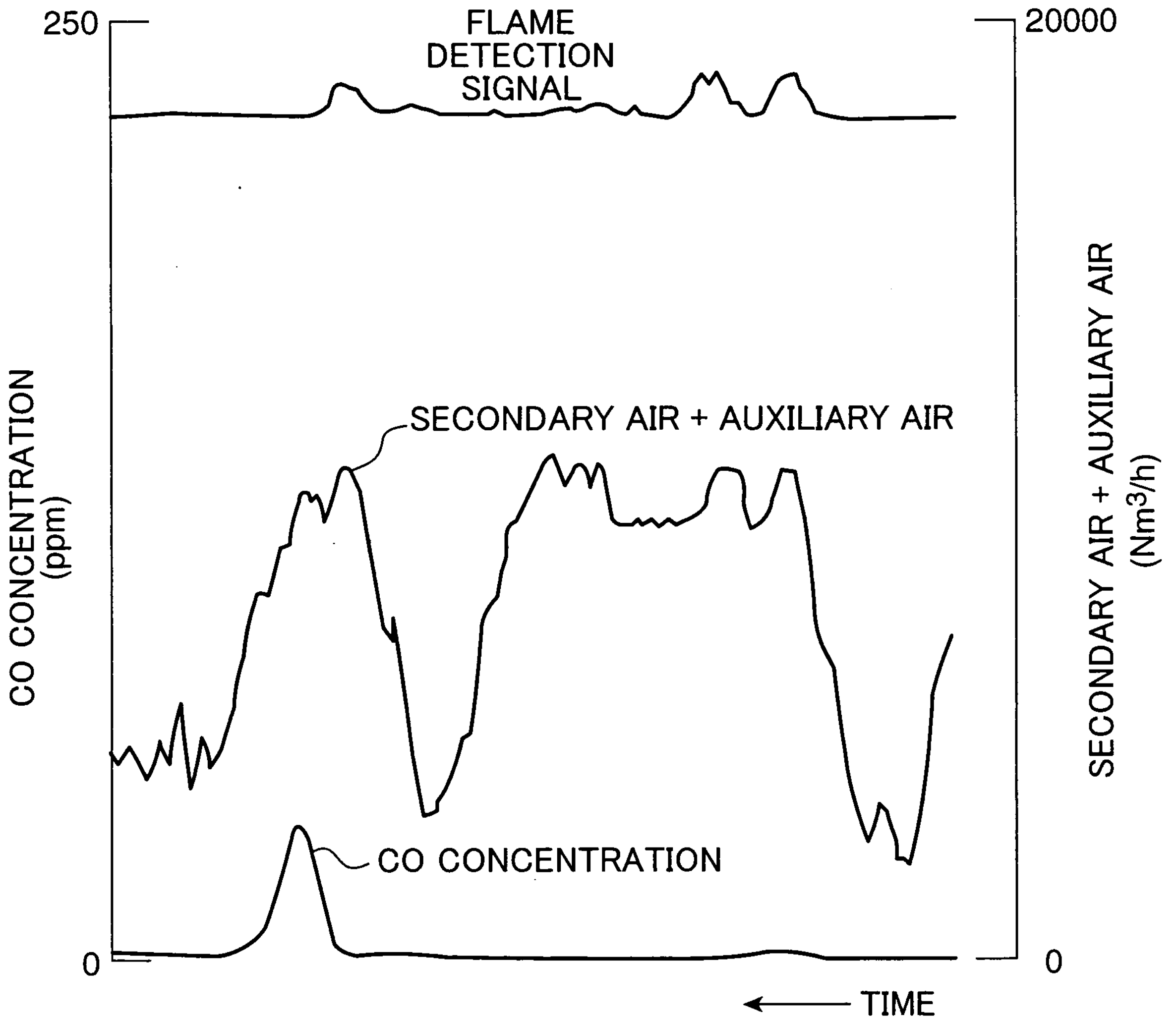

SECONDARY AIR
(Nm3/h)
20000
0
FLAME DETECTION SIGNAL
CO CONCENTRATION
SECONDARY AIR
TIME
200
0
CO CONCENTRATION
(ppm)

FIG. 9


250
FLAME DETECTION SIGNAL
20000
CO CONCENTRATION (ppm)
SECONDARY AIR + AUXILIARY AIR
SECONDARY AIR + AUXILIARY AIR (Nm³/h)
CO CONCENTRATION
0
0
TIME

INTERNATIONAL SEARCH REPORT

International application No. PCT/JP2006/321736

A. CLASSIFICATION OF SUBJECT MATTER
F23G5/16(2006.01)i, *F23G5/50*(2006.01)i

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)
F23G5/16, F23G5/50

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

Jitsuyo Shinan Koho	1922-1996	Jitsuyo Shinan Toroku Koho	1996-2006
Kokai Jitsuyo Shinan Koho	1971-2006	Toroku Jitsuyo Shinan Koho	1994-2006

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 11-264532 A (Hitachi Zosen Corp.), 28 September, 1999 (28.09.99), Claim 3; Par. No. [0048]; Fig. 1 (Family: none)	1-7,9,10
Y	JP 07-217843 A (Tokyo Gas Co., Ltd.), 18 August, 1995 (18.08.95), Par. Nos. [0008], [0010]; Fig. 1 (Family: none)	1-7,9,10
A	JP 2003-262317 A (Ishikawajima-Harima Heavy Industries Co., Ltd.), 19 September, 2003 (19.09.03), Claim 1; Fig. 1 (Family: none)	1-10

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

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"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
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"&" document member of the same patent family

Date of the actual completion of the international search 28 November, 2006 (28.11.06)	Date of mailing of the international search report 05 December, 2006 (05.12.06)
Name and mailing address of the ISA/ Japanese Patent Office Facsimile No.	Authorized officer Telephone No.

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2006/321736

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP 10-267243 A (Mitsubishi Heavy Industries, Ltd.), 09 October, 1998 (09.10.98), Claim 1; Fig. 1 (Family: none)	1-10
A	JP 03-075402 A (Ebara Corp.), 29 March, 1991 (29.03.91), Claims; Fig. 1 (Family: none)	1-10

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REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP 3075402 A **[0002]**