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

(11) EP 1 312 860 A1

(12) **EUROPEAN PATENT APPLICATION**
published in accordance with Art. 158(3) EPC

(43) Date of publication:
21.05.2003 Bulletin 2003/21

(21) Application number: **01956985.4**

(22) Date of filing: **21.08.2001**

(51) Int Cl.[7]: **F23G 7/06**, F23N 5/08

(86) International application number:
PCT/JP01/07136

(87) International publication number:
WO 02/016830 (28.02.2002 Gazette 2002/09)

(84) Designated Contracting States:
DE FR GB
Designated Extension States:
AL LT LV MK RO SI

(30) Priority: **22.08.2000 JP 2000250940**
27.09.2000 JP 2000294632

(71) Applicant: **EBARA CORPORATION**
Ohta-ku, Tokyo 144-8510 (JP)

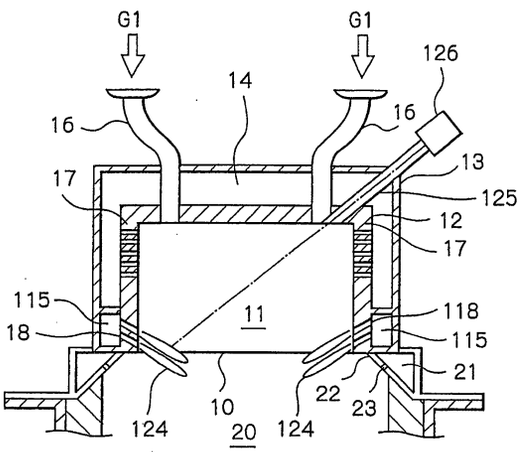
(72) Inventors:
- **TSUJI, Takeshi**
  Yokohama-shi, Kanagawa 235-0022 (JP)
- **KAWAMURA, Kohtaro**
  Machida-shi, Tokyo 194-0012 (JP)
- **NAKANIWA, Masaru**
  Ebina-shi, Kanagawa 243-0413 (JP)
- **OKUDA, Kazutaka**
  Kawasaki-shi, Kanagawa 214-0033 (JP)
- **ISHIKAWA, Keiichi**
  Yokohama-shi, Kanagawa 224-0041 (JP)
- **MIYAZAKI, Kazutomo**
  Yokohama-shi, Kanagawa 224-0041 (JP)
- **NAKAMURA, Rikiya**
  Yokohama-shi, Kanagawa 221-0073 (JP)
- **KOMAI, Tetsuo**
  Fujisawa-shi, Kanagawa 251-0042 (JP)
- **OHASHI, Tomonori**
  Kawasaki-shi, Kanagawa 211-0022 (JP)
- **TAKEMURA, Yoshiro**
  Hiratsuka-shi, Kanagawa 254-0905 (JP)

(74) Representative: **Wagner, Karl H., Dipl.-Ing.**
Wagner & Geyer,
Patentanwälte,
Gewürzmühlstrasse 5
80538 München (DE)

(54) METHOD AND DEVICE FOR COMBUSTION TYPE EXHAUST GAS TREATMENT

(57) A combustion type waste gas treatment method wherein waste gas discharged from an industrial product manufacturing process is introduced into combustion flames to thermally or oxidatively decompose a combustible component in the waste gas. Hydrogen gas and oxygen gas are generated by electrolysis of water and supplied as a gas for combustion to form the combustion flames. A pipe or a hole through which' the combustion flames can be viewed directly is formed in a wall of the burner part upstream of the combustion flames. The combustion flames are detected with a UV sensor through the pipe or the hole.

Fig. 5



EP 1 312 860 A1

Description

TECHNICAL FIELD

[0001] The present invention relates to a combustion type waste gas treatment method and apparatus for treating waste gas discharged from processes for manufacturing industrial products such as semiconductors and liquid crystals, for example, a hazardous and combustible or hardly decomposable waste gas containing silane gas (SiH_4) or a halogen-containing gas (NF_3, ClF_3, SF_6, CHF_3, C_2F_6, CF_4, etc.), by combustion or thermal decomposition and/or oxidative decomposition.

BACKGROUND ART

[0002] A conventional combustion type waste gas treatment apparatus has a burner part and a combustion chamber provided, for example, at the downstream side of the burner part. A combustible gas (auxiliary burning gas) is supplied into the burner part and burned to form flames, and waste gas is burned with the flames. Regarding the combustible gas, hydrogen gas, city gas, propane gas or the like is used as fuel gas, and oxygen or air is usually used as an oxidizing agent.

[0003] In the conventional combustion type waste gas treatment apparatus, because fuel gas such as hydrogen gas, city gas, propane gas or the like is used as the combustible gas, it is necessary to lay piping for supplying such fuel gas to the combustion type waste gas treatment apparatus. In a case where city gas, propane gas or the like is used as fuel gas, carbon monoxide (CO), which possesses high toxicity, is undesirably generated during incomplete combustion.

[0004] Hydrogen gas has ignitionability and explosiveness. However, once hydrogen gas has started to burn, there is substantially no possibility that blow-off of flames may occur. Consequently, extremely stable combustion is obtained. Thus, hydrogen gas is suitable for use as fuel gas for combustion in the combustion type waste gas treatment apparatus. However, the use of hydrogen gas has the disadvantage that the cost is high and hence the running cost is unfavorably high. In addition, the longer the length of piping for supplying hydrogen gas from a storage container to the waste gas treatment apparatus, the more likely that the gas may leak from a joint portion of the piping.

[0005] In the combustion type waste gas treatment apparatus, the ignition of combustion flames is confirmed by a combustion flame ignition confirmation method wherein the combustion flames are detected by using a UV (ultraviolet) sensor. However, the method of detecting the combustion flames by using a UV sensor involves the problem that a by-product, e.g. dust, generated during the waste gas treatment may undesirably close the light-collecting aperture. The method of detecting the combustion flames by using a UV sensor also has the following problem. In a case where reflected light of flames from the inner wall of the combustion part is to be detected, if a by-product having UV absorbing characteristics adheres to the inner wall of the reaction part, UV light is absorbed. Therefore, flames cannot be detected. There is also a problem that because of the high temperature of the reaction part, the light-collecting aperture may be heated to a high temperature and undesirably closed by melting or corrosion.

[0006] Further, in the combustion type waste gas treatment apparatus, the supply of auxiliary burning gas to the burner part is carried out through a nozzle hole opening on the inner wall surface of the burner part, and flames are formed by burning of the auxiliary burning gas blown off from the nozzle hole. In this regard, the flames may blow off when the amount of waste gas introduced into the burner part fluctuates. There is also a problem that backfire may occur in the fuel piping for supplying the auxiliary burning gas or elsewhere.

DISCLOSURE OF THE INVENTION

(Problems Which the Invention is to Solve)

[0007] The present invention has been made in view of the above-described circumstances to provide an apparatus capable of making waste gas harmless without unnecessary stay of a combustible substance in the system and without the need of a complicated piping arrangement and unlikely to cause a gas leakage accident. That is, it is an object of the present invention to provide a combustion type waste gas treatment method and apparatus using a mixed gas of hydrogen gas and oxygen gas as fuel gas for combustion to reduce the installation cost and the running cost and capable of substantially eliminating the leakage of hydrogen gas and oxygen gas.

[0008] An object of the present invention is to eliminate the above-described problems and to provide a combustion type waste gas treatment apparatus capable of accurately detecting the presence or absence of combustion flames at all times with a UV sensor. Another object of the present invention is to provide a combustion type waste gas treatment apparatus free from the occurrence of blow-off of flames due to fluctuations in the amount of waste gas introduced into the burner part and hence capable of forming stable combustion flames and also free from the danger of backfire spreading into the auxiliary burning gas supply piping.

(Means for Solving the Problems)

[0009] To solve the above-described problems, a first invention provides a combustion type waste gas treatment method in which waste gas is introduced into combustion flames to thermally or oxidatively decompose a combustible component in the waste gas. In the combustion type waste gas treatment method, hydrogen gas and oxygen gas are generated by electrolysis of water

and supplied as a gas for combustion to form the combustion flames. In the first invention, the hydrogen gas and the oxygen gas are preferably supplied to form the combustion flames as a mixed gas without changing the ratio of the gases as generated.

[0010] A second invention provides a combustion type waste gas treatment apparatus having a burner part for forming combustion flames from hydrogen gas and oxygen gas, and a device for electrolysis of water to generate hydrogen gas and oxygen gas. In the second invention, a combustion chamber is preferably provided downstream of the burner part. In the combustion chamber, waste gas to be treated is introduced into the combustion flames to carry out thermal oxidative decomposition of the waste gas.

[0011] To solve the above-described problems, a third invention provides a combustion type waste gas treatment apparatus having a burner part and a combustion chamber at the downstream side of the burner part. The burner part is supplied with an auxiliary burning gas to form combustion flames extending from the burner part toward the combustion chamber. Waste gas is introduced into the combustion flames to oxidatively decompose the waste gas. A pipe or a hole through which the combustion flames can be viewed directly is formed in a wall of the burner part upstream of the combustion flames. A UV sensor is provided to detect the combustion flames through the pipe or the hole.

[0012] Because the pipe or hole allowing direct viewing of the combustion flames is provided not downstream but upstream of the combustion flames, the combustion type waste gas treatment apparatus is free from the problem that a by-product, e.g. dust, generated during waste gas treatment, closes the light-collecting aperture to thereby disable the UV sensor from detecting the combustion flames. Further, because the combustion flames are viewed directly through the pipe or the hole, even if a by-product having UV absorbing characteristics adheres to the inside of the reaction part, it will not obstruct the collection of light and will not interfere with the UV sensor detecting the combustion flames. Because the pipe or hole allowing direct viewing of the combustion flames is provided in a side wall of the burner part upstream of the combustion flames, at which the temperature is relatively low, there is no likelihood of the light-collecting aperture being closed by melting or corrosion due to high temperature.

[0013] Preferably, in the third invention, a UV light-transmitting member is disposed at the joint between the pipe or hole allowing direct viewing of the combustion flames and the UV sensor to isolate the UV sensor from the atmosphere in the burner part, and a purge gas is supplied from the UV light-transmitting member in the pipe or the hole toward the burner part. With the arrangement in which a UV light-transmitting member is disposed at the joint between the pipe or the hole and the UV sensor to isolate the UV sensor from the atmosphere in the burner part and a purge gas is supplied from the UV light-transmitting member in the pipe or the hole toward the burner part, the problem that the light-collecting aperture may be closed with a by-product or the like is eliminated.

[0014] Preferably, in the third invention, the pipe or hole allowing direct viewing of the combustion flames is closed at an end thereof remote from the burner part, and light from combustion flames in the pipe or the hole is transmitted to the UV sensor through an optical fiber. Thus, because light from combustion flames in the pipe or the hole is transmitted to the UV sensor through the optical fiber, the UV sensor can be installed where there is no problem in terms of the space, heat resistance, etc. when the UV sensor cannot be installed at the end of the pipe or the hole remote from the burner part owing to the problems of the space, heat resistance, etc.

[0015] A fourth invention provides a combustion type waste gas treatment apparatus having a burner part and a combustion chamber at the downstream side of the burner part. The burner part is supplied with an auxiliary burning gas to form combustion flames extending from the burner part toward the combustion chamber. Waste gas is introduced into the combustion flames to oxidatively decompose the waste gas. In the combustion type waste gas treatment apparatus, the supply of the auxiliary burning gas to the burner part is carried out through a nozzle hole that opens on the inner wall surface of the burner part. The nozzle hole comprises a group of at least three nozzle openings formed close to each other. Thus, because the nozzle hole comprises a group of at least three nozzle openings, it is possible to prevent blow-off of the combustion flames or other similar problem even if there are fluctuations in the amount of waste gas introduced into the burner part. In a case where a carbon-containing fuel gas exhibiting a low flame propagation velocity is used as an auxiliary burning gas, the nozzle hole is formed from a group of at least six nozzle openings, whereby it is possible to prevent blow-off of the combustion flames or other similar problem even if the amount of waste gas introduced fluctuates.

[0016] In the fourth invention, the injection velocity of the auxiliary burning gas injected from the group of nozzle openings is preferably set higher than the propagation velocity of the flames. By setting the injection velocity of the auxiliary burning gas injected from the nozzle openings higher than the flame propagation velocity as stated above, it is possible to prevent backfire from spreading into the auxiliary burning gas supply piping or elsewhere. The flame propagation velocity is determined by the kind of fuel gas used as the auxiliary burning gas, the mixing ratio of air or oxygen to be premixed, the configuration and arrangement of the nozzle openings, etc., and the auxiliary burning gas injection velocity is determined by the supply pressure of the auxiliary burning gas and the total sectional area of the nozzle openings. Therefore, by taking into consideration these factors, the total sectional area of the nozzle openings or the like is set so that the auxiliary burning gas injection

velocity is higher than the flame propagation velocity.

OPERATION OF THE INVENTION

[0017] In the present invention, an H_2/O_2 generator having a device for electrolysis of water is provided to generate hydrogen gas and oxygen gas by electrolysis of water using the H_2/O_2 generator, and a mixed gas of hydrogen and oxygen gases generated is supplied to the burner part. Therefore, it is unnecessary to supply an oxidizing agent gas from the outside. If the H_2/O_2 generator is disposed as close to the burner part as possible and the burner part is supplied with a mixed gas of hydrogen and oxygen in the ratio of the gases as generated, the length of piping required can be minimized. In addition, because it is unnecessary to supply the hydrogen gas and the oxygen gas through respective lines, the piping arrangement is simplified, and the pipe laying cost is reduced.

[0018] The arrangement may, of course, be such that two different kinds of gas are supplied to the burner part through separate lines to perform mixed combustion by using a burner having a double nozzle structure or the like. Further, because the length of piping is short, the possibility of leakage of hydrogen and oxygen gases reduces. The possibility of ignition occurring in such short piping is weak. It is, needless to say, necessary to pay attention to backfire from the nozzle from the structural or operational point of view when the present invention is carried out. Further, because water is electrolyzed to obtain fuel on the spot, no excess combustible gas will stay in the system. In an emergency, it is possible to cope with the situation by stopping the operation of the H_2/O_2 generator. Therefore, the present invention is safe, and the running cost is reduced.

BRIEF DESCRIPTION OF THE DRAWINGS

[0019]

Fig. 1 is a diagram showing a system configuration example of the combustion type waste gas treatment apparatus according to the present invention.
Fig. 2 is a diagram showing a structure example of unit equipment including the combustion type waste gas treatment apparatus according to the present invention.
Fig. 3 is a vertical sectional view showing a specific structural example of the combustion type waste gas treatment apparatus according to the present invention.
Fig. 4 is an A-A sectional view of Fig. 3.
Fig. 5 is a diagram showing a structural example of a burner part in the combustion type waste gas treatment apparatus according to the present invention.
Fig. 6 is a diagram showing an example of the installation structure of a flame direct viewing pipe in the combustion type waste gas treatment apparatus according to the present invention.
Fig. 7 is a diagram showing another example of the installation structure of the flame direct viewing pipe in the combustion type waste gas treatment apparatus according to the present invention.
Fig. 8 is a diagram showing a structural example of the burner part of the combustion type waste gas treatment apparatus according to the present invention.
Fig. 9 is a diagram showing a structural example of a group of auxiliary burning gas nozzle openings in the combustion type waste gas treatment apparatus according to the present invention.
Fig. 10 is a diagram showing an example of the general arrangement of the combustion type waste gas treatment apparatus according to the present invention.

(Description of Reference Characters)

[0020] 1: H_2/O_2 generator, 2: waste gas treatment apparatus, 3: piping, 4: waste gas inlet pipe, 5: exhaust pipe, 10: burner part, 11: flame stabilizing portion, 12: cylindrical member, 13: outer cylinder, 14: air chamber, 15: burning gas chamber, 16: waste gas inlet pipe, 17: air nozzle, 18: burning gas nozzle, 20: combustion chamber, 21: secondary air chamber, 22: partition plate, 23: secondary air nozzle, 24: outer vessel, 25: inner wall, 26: space, 27: thermal insulator, 28: purge air inlet pipe, 29: UV sensor, 30: pilot burner, 31: cooling part, 32: discharge part, 33: nozzle, 34: exhaust pipe, 35: drain port, 36: inner wall, 37: thermal insulator, 37': space, 38: purge air inlet pipe, 39: pilot burner, 40: cooling part, 41: discharge part, 42: nozzle, 43: exhaust pipe, 44: drain port, 100: housing, 101: exhaust duct, 115: auxiliary burning gas chamber, 118: auxiliary burning gas nozzle, 124: combustion flame, 125: flame direct viewing pipe, 126: UV sensor, 127: joint, 128: quartz glass plate, 129: seal member, 130: purge gas inlet pipe, 131: optical fiber, 133: air nozzle opening group, 134: auxiliary burning gas nozzle opening group, 135: outer vessel.

BEST MODE FOR CARRYING OUT THE INVENTION

[0021] An embodiment of the present invention will be described below with reference to the drawings. Fig. 1 is a diagram showing the system configuration of the combustion type waste gas treatment apparatus according to the present invention. Reference numeral 1 denotes an H_2/O_2 generator for generating hydrogen gas and oxygen gas by electrolysis of water. Reference numeral 2 denotes a waste gas treatment apparatus 2 for treating hazardous and combustible waste gas G1 from a semiconductor manufacturing system by thermal oxidative decomposition. A mixed gas ($H_2+(1/2)O_2$) of hydrogen and oxygen from the H_2/O_2 generator 1 is sup-

plied to a burner part (detailed later) of the waste gas treatment apparatus 2 through piping 3.

[0022] In the burner part, the mixed gas of hydrogen and oxygen burns to form flames toward a combustion chamber. The waste gas G1 from a waste gas inlet pipe 4 is introduced into the flames to thermally and oxidatively decompose the waste gas G1 to make it harmless. The treated waste gas is discharged through an exhaust pipe 5. As the H_2/O_2 generator 1, an existing one can be used. The length of the piping 3 can be minimized by disposing the H_2/O_2 generator 1 in the vicinity of the burner part. Supplying a mixed gas of hydrogen and oxygen dispenses with supplying hydrogen gas and oxygen gas through separate lines. Therefore, the piping arrangement is simplified, and the amount of gas staying in the system reduces by an amount corresponding to the reduction in length of the piping 3. It is also possible to eliminate gas leakage accidents. Consequently, safety improves.

[0023] In the combustion type waste gas treatment apparatus, as shown in Fig. 2, the H_2/O_2 generator 1 and a combustion chamber 20 having a burner part 10 are provided close to each other. Therefore, the H_2/O_2 generator 1 and the combustion chamber 20 can be packaged into a single housing 100. At this time, it is desirable that the housing 100 should be provided with an exhaust duct 101. By doing so, when there is a leakage in the piping, safety can be ensured even more reliably. Installation in a plant becomes easier than in a case where hydrogen gas and oxygen gas are separate from each other. The exhaust gas passing through the exhaust duct 101 is released into the atmosphere through a water scrubber in the plant.

[0024] Figs. 3 and 4 are diagrams showing a specific structural example of a waste gas treatment apparatus 2 according to the first and second inventions. Fig. 3 is a vertical sectional view, and Fig. 4 is an A-A sectional view of Fig. 3. The waste gas treatment apparatus is formed in the shape of a cylindrical closed vessel. The waste gas treatment apparatus has a burner part 10 in an upper stage and a combustion chamber (combustion reaction part) 20 in an intermediate stage. The waste gas treatment apparatus further has a cooling part 31 and a discharge part 32 in a lower stage. As a cooling medium in the cooling part 31, for example, a liquid, e. g. water, or a gas, e.g. air, is used.

[0025] The burner part 10 has a cylindrical member 12 forming a flame stabilizing portion 11 opening toward the combustion chamber. The burner part 10 further has an outer cylinder 13 surrounding the cylindrical member 12 with a predetermined space therebetween. Between the cylindrical member 12 and the outer cylinder 13, an air chamber 14 for holding air for combustion is formed, together with a burning gas chamber 15. The air chamber 14 is connected to an air source (not shown). The burning gas chamber 15 is connected to the above-described H_2/O_2 generator 1 through piping 3.

[0026] Waste gas inlet pipes 16 (corresponding to the waste gas inlet pipe 4 in Fig. 1) are connected to the top of the cylindrical member 12 covering the upper side of the flame stabilizing portion 11 to introduce a hazardous waste gas G1 discharged from a semiconductor manufacturing system, a liquid crystal panel manufacturing system, etc. The waste gas G1 does not always need to a combustible gas. The waste gas G1 may be any gas that can be thermally decomposed in the flame stabilizing portion 11 by adjusting combustion flames. The cylindrical member 12 is provided with air nozzles 17 for providing communication between the air chamber 14 and the flame stabilizing portion 11 and further provided with a plurality of burning gas nozzles 18 for providing communication between the burning gas chamber 15 and the flame stabilizing portion 11.

[0027] In this example, as shown in Fig. 4, the air nozzles 17 extend at a predetermined angle to the tangential direction with respect to the cylindrical member 12 to blow off air so as to form swirling flows in the flame stabilizing portion 11. Similarly, the burning gas nozzles 18 extend at a predetermined angle to the tangential direction with respect to the cylindrical member 12 to blow off a burning gas so as to form swirling flows in the flame stabilizing portion 11. The air nozzles 17 and the burning gas nozzles 18 are disposed equally in the circumferential direction of the cylindrical member 12.

[0028] The combustion chamber 20 is a space for oxidatively decomposing waste gas at a stage subsequent to the burner part 10 by supplying secondary air. The combustion chamber 20 is defined by a cylindrical inner wall 25 provided inside a hermetic cylindrical outer vessel 24 formed from a metal or the like. The inner wall 25 is disposed to be contiguous with the flame stabilizing portion 11. The inner wall 25 is formed from a fiber-reinforced ceramic material, for example. A thermal insulator 27 of a porous ceramic material is inserted into a space 26 between the inner wall 25 and the outer vessel 24. A purge air inlet pipe 28 is connected to the outer vessel 24 to introduce air for purging into the space 26.

[0029] The combustion chamber 20 is provided with a UV sensor 29 for detecting flames and a pilot burner 30 for ignition in the burner part 10. A plurality of nozzles 33 are provided on the lower edge of the cooling part 31 below the combustion chamber 20 at equal spaces in the circumferential direction. Water is injected from the nozzles 33 toward the center of the discharge part 32 to form a curtain of water, thereby cooling the waste gas and capturing particles contained in the waste gas. Thus, the nozzles 33 constitute a scrubber device. The side wall of the discharge part 32 is provided with an exhaust pipe 34 for discharging the treated waste gas. The bottom of the discharge part 32 is provided with a drain port 35 for discharging water injected from the nozzles 33.

[0030] In the waste gas treatment apparatus with the above-described structure, the burning gas in the burning gas chamber 15 is blown off through the burning gas nozzles 18 toward the flame stabilizing portion 11 to pro-

duce swirling flows. When ignited with the pilot burner 30, the burning gas forms combustion flames swirling in the cylindrical member (cylinder) 12. Meanwhile, the waste gas G1 to be treated is blown off toward the flame stabilizing portion 11 from the waste gas inlet pipes 16, which open on the inner wall surface of the top of the cylindrical member 12. The waste gas G1 blown off mixes with the swirling flows of the burning gas (containing air) and burns. Further, the waste gas G1 passes through the combustion chamber 20 in which it is made harmless by thermal oxidative decomposition. The treated waste gas G1 is cooled by a curtain of water from the nozzles 33 and discharged through the exhaust pipe 34.

[0031] The combustion type waste gas treatment apparatus according to the present invention is not necessarily limited to the arrangement shown in Figs. 2 and 3. The combustion type waste gas treatment apparatus may be arranged in any form, provided that the apparatus has a burner part and a combustion chamber at the downstream side of the burner part, supplies a burning gas to the burner part, burns the burning gas to form flames, and burns the waste gas by the flames. That is, the essential thing is to use a mixed gas of hydrogen and oxygen from a commercially available H_2/O_2 generator, which generates hydrogen gas and oxygen gas by electrolysis of water, as a burning gas to be supplied to the burner part. There is no particular restriction on the arrangement of the gas treatment system. There is also no restriction on the number and arrangement of nozzles related to the burner, air supply, and so forth, as a matter of course. The arrangement of the constituent elements downstream of the combustion chamber 20 is also optional.

[0032] Fig. 5 is a diagram showing the arrangement of a burner part of a combustion type waste gas treatment apparatus according to the third and fourth inventions. A burner part 10 has a cylindrical member 12 forming a flame stabilizing portion 11 opening toward a combustion chamber 20 located therebelow. The burner part 10 further has an outer cylinder 13 surrounding the cylindrical member 12 with a predetermined space therebetween. Between the cylindrical member 12 and the outer cylinder 13, an air chamber 14 for holding air for combustion is formed, together with an auxiliary burning gas chamber 115. The air chamber 14 is connected to an air source (not shown). The auxiliary burning gas chamber 115 is connected to an auxiliary burning gas supply source through auxiliary burning gas supply piping (not shown).

[0033] Waste gas inlet pipes 16 are connected to the top of the cylindrical member 12 covering the upper side of the flame stabilizing portion 11 to introduce a hazardous and combustible waste gas G1 discharged from a semiconductor manufacturing system, a liquid crystal panel manufacturing system, etc. The cylindrical member 12 is provided with air nozzles 17 for providing communication between the air chamber 14 and the flame stabilizing portion 11 and further provided with a plurality of auxiliary burning gas nozzles 118 for providing communication between the auxiliary burning gas chamber 115 and the flame stabilizing portion 11.

[0034] The air nozzles 17 are arranged to blow off air so as to form swirling flows in the flame stabilizing portion 11, as will be detailed later. Similarly, the auxiliary burning gas nozzles 118 are arranged to blow off an auxiliary burning gas so as to form swirling flows in the flame stabilizing portion 11. The air nozzles 17 and the auxiliary burning gas nozzles 118 are disposed equally in the circumferential direction of the cylindrical member 12.

[0035] A secondary air chamber 21 is formed around the boundary between the flame stabilizing portion 11 and the combustion chamber 20 so as to surround the opening of the flame stabilizing portion 11. The secondary air chamber 21 communicates with an air source (not shown) for supplying secondary air. A partition plate 22 dividing the secondary air chamber 21 from the combustion chamber 20 is provided with secondary air nozzles 23 equally disposed in the circumferential direction to blow off secondary air into the combustion chamber 20 to oxidize the waste gas. In addition, the space 21 is supplied with a cooling medium to form a cooling structure. Water or the like is used as the cooling medium. The cooling medium flowing through the space 21 cools the cylindrical member 12 heated by flames formed at the opening of the cylindrical member 12.

[0036] A flame direct viewing pipe 125 is provided to extend through the cylindrical member 12 and the outer cylinder 13, which form the wall of the burner part 10. The flame direct viewing pipe 125 allows direct viewing of combustion flames 124 formed by combustion of the auxiliary burning gas injected from the auxiliary burning gas nozzles 118. As illustrated in the figure, the flame direct viewing pipe 125 is provided upstream of the combustion flames 124, and a UV sensor 126 for detecting the combustion flames 124 is provided at an end of the flame direct viewing pipe 125 remote from the burner part 10.

[0037] Because the flame direct viewing pipe 125 is provided not downstream but upstream of the combustion flames 124 as stated above, the apparatus is free from the problem that a by-product, e.g. dust, generated during the waste gas treatment closes the light-collecting aperture of the flame direct viewing pipe 125 to thereby disable the UV sensor 126 from detecting the combustion flames 124. Further, because the combustion flames 124 are viewed directly through the flame direct viewing pipe 125, even if a by-product having UV absorbing characteristics adheres to the inside of the reaction part (mainly the inside of the combustion chamber 20), it will not obstruct the collection of light. Accordingly, the UV sensor 126 can detect the combustion flames 124. Further, the flame direct viewing pipe 125 is provided in a wall portion of the burner part 10 that is upstream of the combustion flames 124, at which the temperature is relatively low. Therefore, there is no like-

lihood of the light-collecting aperture being closed by melting or corrosion due to high temperature.

[0038] Fig. 6 is a diagram showing another example of the installation structure of the flame direct viewing pipe in the combustion type waste gas treatment apparatus according to the present invention. It should be noted that in Fig. 6 the same reference characters as those in Fig. 5 denote the same or corresponding portions. The same shall apply to other drawings. As illustrated in the figure, a quartz glass plate 128 that transmits UV light is disposed at a joint 127 between the flame direct viewing pipe 125 and the UV sensor 126, and seal members 129 are interposed between the quartz glass plate 128 and the joint 127 to isolate the UV sensor 126 from the atmosphere in the burner part 10. A purge gas inlet pipe 130 is connected to the flame direct viewing pipe 125 to supply a purge gas PG (e.g. air) through the flame direct viewing pipe 125.

[0039] As has been stated above, the quartz glass plate 128 is disposed at the joint 127 between the flame direct viewing pipe 125 and the UV sensor 126 to isolate the UV sensor 126 from the atmosphere in the burner part 10, and the purge gas PG is supplied through the flame direct viewing pipe 125. With this arrangement, there will be no possibility that the light-collecting aperture of the flame direct viewing pipe 125 may be closed with a by-product or the like. It should be noted that the quartz glass plate 128 has a sufficient thickness to withstand the pressure in the burner part 10. Heat-resistant packings are used as the seal members 129.

[0040] Fig. 7 is a diagram showing another example of the installation structure of the flame direct viewing pipe in the combustion type waste gas treatment apparatus according to the present invention. As illustrated in the figure, an end of the flame direct viewing pipe 125 remote from the burner part 10 is closed. A purge gas inlet pipe 130 is connected to the flame direct viewing pipe 125, thereby allowing a purge gas (PG) to be supplied through the flame direct viewing pipe 125. In addition, light from combustion flames 124 in the flame direct viewing pipe 125 is transmitted to the UV sensor 126 through an optical fiber 131.

[0041] Because light from the combustion flames 124 in the flame direct viewing pipe 125 is transmitted to the UV sensor 126 through the optical fiber 131 as stated above, the UV sensor 126 can be installed where there is no problem in terms of the space, heat resistance, etc. when the UV sensor 126 cannot be installed at the end of the flame direct viewing pipe 125 remote from the burner part 10 owing to the problems of the space, heat resistance, etc. In the above-described examples, the side wall of the burner part 10 is formed from the cylindrical member 12 and the outer cylinder 13, and the air chamber 14 is present therebetween. Therefore, the flame direct viewing pipe 125 is provided to extend through the cylindrical member 12 and the outer cylinder 13. However, in a case where the side wall of the burner part 10 is formed from a single wall-forming member, the arrangement may be such that a hole for direct viewing of flames is provided in a portion of the side wall upstream of the combustion flames, and a UV sensor is provided at the flame direct viewing hole.

[0042] Fig. 8 is a diagram showing a structural example of a burner part of a combustion type waste gas treatment apparatus according to the present invention. As illustrated in the figure, air nozzle opening groups 133 are formed in the inner wall surface of the cylindrical member 12 of the burner part at equal spaces in the circumferential direction. Each air nozzle opening group 133 comprises a plurality (5 in the figure) of openings (air injection ports) 17a of the air nozzles 17. The air nozzle openings 17a constituting each group 133 are disposed in series in the vertical direction. In addition, auxiliary burning gas nozzle opening groups 134 are disposed at equal spaces in the circumferential direction below the air nozzle opening groups 133. Each auxiliary burning gas nozzle opening group 134 comprises a plurality (3 in the figure) of openings (auxiliary burning gas injection ports) 118a of the auxiliary burning gas nozzles 118. The auxiliary burning gas nozzle openings 118a constituting each group 134 are disposed close to each other. It should be noted that the number of openings 118a of auxiliary burning gas nozzles 118 that constitute each auxiliary burning gas nozzle opening group 134 is not necessarily limited to three but may be three or more.

[0043] The auxiliary burning gas injected from the opening 118a of each individual auxiliary burning gas nozzle 118 constituting the auxiliary burning gas nozzle opening groups 134 burns to form combustion flames 124 (see Fig. 8). In other words, each opening 118a serves as a flame forming port. In a case where the openings 118a are disposed dispersedly, the combustion flames 124 may blow off when the amount of waste gas G1 introduced into the burner part 10 fluctuates. In this example, the number of openings 118a of auxiliary burning gas nozzles 118 that constitute each auxiliary burning gas nozzle opening group 134 is three or more, as stated above. With this arrangement, it is possible to prevent blow-off of the combustion flames even if there are fluctuations in the amount of waste gas G1 introduced into the burner part 10.

[0044] In a case where a carbon-containing fuel gas (city gas, propane gas, etc.) exhibiting a low flame propagation velocity is used as an auxiliary burning gas, the number of openings 118a of auxiliary burning gas nozzles 118 constituting each auxiliary burning gas nozzle opening groups 134 is set six or more, as shown in Fig. 9. With this arrangement, the auxiliary burning gas is injected from these openings 118a, and thus the thermal power is increased. Therefore, it is possible to prevent blow-off of the combustion flames or other similar problem even if the amount of waste gas introduced fluctuates.

[0045] Further, the injection velocity of the auxiliary burning gas injected from the auxiliary burning gas noz-

zle opening groups 134 is set higher than the flame propagation velocity to prevent backfire from spreading into the auxiliary burning gas chamber 115 and the auxiliary burning gas supply piping for supplying the auxiliary burning gas into the auxiliary burning gas chamber 115. The flame propagation velocity is determined by the kind of fuel gas used as the auxiliary burning gas, the mixing ratio of air or oxygen to be premixed, the configuration and arrangement of the auxiliary burning gas nozzle opening groups 134, etc. The auxiliary burning gas injection velocity is determined by the supply pressure of the auxiliary burning gas (in this example, the pressure in the auxiliary burning gas chamber 115) and the total opening sectional area of the auxiliary burning gas nozzle opening groups 134. By taking into consideration these factors, the total opening sectional area of the auxiliary burning gas nozzle opening groups 134, for example, is set so that the auxiliary burning gas injection velocity is higher than the flame propagation velocity.

[0046] Next, an example of the general arrangement of the combustion type waste gas treatment apparatus according to the present invention and the operation thereof will be described. Fig. 10 is a vertical sectional view showing a structural example of the waste gas treatment apparatus. The A-A sectional view of Fig. 10 is equal to Fig. 4. The waste gas treatment apparatus is formed in the shape of a cylindrical closed vessel as a whole. The waste gas treatment apparatus has a burner part 10 in an upper stage and a combustion chamber (combustion reaction part) 20 in an intermediate stage. The waste gas treatment apparatus further has a cooling part 40 and a discharge part 41 in a lower stage. As a cooling medium in the cooling part 40, for example, a liquid, e.g. water, or a gas, e.g. air, is used.

[0047] The air nozzles 17, as shown in Fig. 4, extend at a predetermined angle to the tangential direction with respect to the cylindrical member 12 to blow off air so as to form swirling flows in the flame stabilizing portion 11. Similarly, the auxiliary burning gas nozzles 118 extend at a predetermined angle to the tangential direction with respect to the cylindrical member 12 to blow off an auxiliary burning gas so as to form swirling flows in the flame stabilizing portion 11. The air nozzles 17 and the auxiliary burning gas nozzles 118 are disposed equally in the circumferential direction of the cylindrical member 12.

[0048] The combustion chamber 20 is a space for oxidatively decomposing waste gas at a stage subsequent to the burner part 10. The combustion chamber 20 is defined by a cylindrical inner wall 36 provided inside a hermetic cylindrical outer vessel 135 formed from a metal or the like. The inner wall 36 is disposed to be contiguous with the flame stabilizing portion 11. The inner wall 36 is formed from a fiber-reinforced ceramic material, for example. A thermal insulator 37 of a porous ceramic material is inserted into a space 37' between the inner wall 36 and the outer vessel 135. A purge air inlet pipe 38 is connected to the outer vessel 135 to introduce air for purging into the space 37'.

[0049] A plurality of nozzles 42 are provided on the lower edge of the cooling part 40 below the combustion chamber 20 at equal spaces in the circumferential direction. Water is injected from the nozzles 42 toward the center of the discharge part 41 to form a curtain of water, thereby cooling the waste gas and capturing particles contained in the waste gas. The side wall of the discharge part 41 is provided with an exhaust pipe 43 for discharging the treated waste gas. The bottom of the discharge part 41 is provided with a drain port 44 for discharging water injected from the nozzles 42.

[0050] In the waste gas treatment apparatus with the above-described structure, the auxiliary burning gas in the burning gas chamber 115 is blown off through the auxiliary burning gas nozzles 118 toward the flame stabilizing portion 11 to produce swirling flows. When ignited with a pilot burner 39, the auxiliary burning gas forms combustion flames swirling in the cylindrical member (cylinder) 12. Meanwhile, the waste gas G1 to be treated is blown off toward the flame stabilizing portion 11 from the waste gas inlet pipes 16, which open on the inner wall surface of the top of the cylindrical member 12. The waste gas G1 blown off mixes with the swirling flows of the auxiliary burning gas and burns. Further, the waste gas G1 passes through the combustion chamber 20 in which it is made harmless by thermal decomposition. The treated waste gas G1 is cooled by a curtain of water from the nozzles 42 and discharged through the exhaust pipe 43.

ADVANTAGEOUS EFFECTS OF THE INVENTION

[0051] According to the present invention, an H_2/O_2 generator having an electrolytic device is provided in place of a fuel gas tank, and hydrogen gas and oxygen gas are generated through electrolysis of water by the H_2/O_2 generator. The hydrogen gas and oxygen gas thus generated are supplied to the burner part. Therefore, a safe operation can be performed with a simplified piping arrangement. Further, if the H_2/O_2 generator is disposed in the vicinity of the burner part, the length of piping for supplying the mixed gas of hydrogen gas and oxygen gas to the burner part can be minimized. If they are supplied in the form of a mixed gas, in particular, the hydrogen and oxygen gases need not be supplied through separate lines.

[0052] In addition, the above-described arrangement reduces the possibility of leakage of hydrogen and oxygen gases. Further, because a fuel gas is produced by electrolysis of water, costly hydrogen gas is not needed, and a necessary amount of fuel gas can be supplied in accordance with the amount of gas to be made harmless.

[0053] According to the present invention, a pipe or hole allowing direct viewing of combustion flames is provided upstream of the combustion flames. Consequently, there is no possibility that a by-product, e.g. dust, gen-

erated during waste gas treatment, may close the light-collecting aperture. Even if a by-product having UV absorbing characteristics adheres to the inside of the reaction part, it will not obstruct the collection of light. Accordingly, the UV sensor can accurately detect the presence or absence of combustion flames. Further, because the pipe or hole allowing direct viewing of combustion flames is provided in a side wall of the burner part that is upstream of the combustion flames, at which the temperature is relatively low, there is no likelihood of the light-collecting aperture being closed by melting or corrosion due to high temperature.

[0054] In addition, a UV light-transmitting member is disposed at the joint between the pipe or hole and the UV sensor to isolate the UV sensor from the atmosphere in the burner part, and a purge gas is supplied from the UV light-transmitting member in the pipe or the hole toward the burner part. With the arrangement, there is no possibility that the light-collecting aperture may be closed with a by-product or the like.

[0055] Further, because light from combustion flames in the pipe or the hole is transmitted to the UV sensor through an optical fiber, the UV sensor can be installed where there is no problem in terms of the space, heat resistance, etc. when the UV sensor cannot be installed at the end of the pipe or the hole remote from the burner part owing to the problems of the space, heat resistance, etc.

[0056] According to the present invention, each nozzle opening group is formed by disposing at least three openings close to each other. Therefore, it is possible to prevent blow-off of the combustion flames or other similar problem even if there are fluctuations in the amount of waste gas introduced into the burner part. Further, it is possible to prevent backfire from spreading into the auxiliary burning gas supply piping by setting the injection velocity of the auxiliary burning gas injected from the nozzle openings higher than the flame propagation velocity.

Claims

1. A combustion type waste gas treatment method in which waste gas is introduced into combustion flames to thermally or oxidatively decompose a combustible component in the waste gas, wherein hydrogen gas and oxygen gas are generated by electrolysis of water, and said hydrogen gas and oxygen gas are supplied as a gas for combustion to form said combustion flames.

2. A combustion type waste gas treatment method according to claim 1, wherein said hydrogen gas and said oxygen gas are supplied to form the combustion flames without changing a ratio of said gases as generated.

3. A combustion type waste gas treatment apparatus comprising a device for electrolysis of water to generate hydrogen gas and oxygen gas, and a burner part for forming combustion flames from the hydrogen gas and oxygen gas generated by said device for electrolysis of water.

4. A combustion type waste gas treatment apparatus according to claim 3, wherein a combustion chamber in which waste gas is introduced into said combustion flames to carry out thermal oxidative decomposition of the waste gas is provided downstream of said burner part.

5. A combustion type waste gas treatment apparatus having a burner part and a combustion chamber positioned at a downstream side of the burner part, wherein the burner part is supplied with an auxiliary burning gas to form combustion flames extending from the burner part toward the combustion chamber, and waste gas is introduced into the combustion flames to oxidatively decompose the waste gas,

said combustion type waste gas treatment apparatus comprising a pipe or a hole through which the combustion flames can be viewed directly, said pipe or hole being formed in a wall of the burner part upstream of the combustion flames, and a UV sensor for detecting the combustion flames through said pipe or hole.

6. A combustion type waste gas treatment apparatus according to claim 5, wherein a UV light-transmitting member is disposed at a joint between said pipe or hole allowing direct viewing of the combustion flames and said UV sensor to isolate said UV sensor from an atmosphere in said burner part, and a purge gas is supplied from the UV light-transmitting member in said pipe or hole toward said burner part.

7. A combustion type waste gas treatment apparatus according to claim 5, wherein said pipe or hole allowing direct viewing of the combustion flames is closed at an end thereof remote from said burner part, and light from combustion flames in said pipe or hole is transmitted to said UV sensor through an optical fiber.

8. A combustion type waste gas treatment apparatus having a burner part and a combustion chamber positioned at a downstream side of the burner part, wherein the burner part is supplied with an auxiliary burning gas to form combustion flames extending from the burner part toward the combustion chamber, and waste gas is introduced into the combustion flames to oxidatively decompose the waste gas, wherein the auxiliary burning gas is supplied to the burner part through a nozzle hole that

opens on an inner wall surface of the burner part, said nozzle hole comprising a group of at least three nozzle openings formed close to each other.

9. A combustion type waste gas treatment apparatus according to claim 8, wherein an injection velocity of the auxiliary burning gas injected from said group of nozzle openings is higher than a propagation velocity of the flames.

Fig. 1

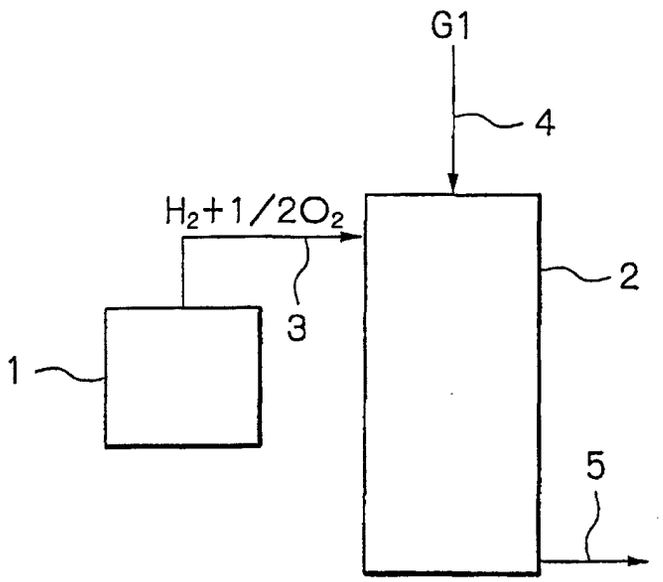


Fig. 2

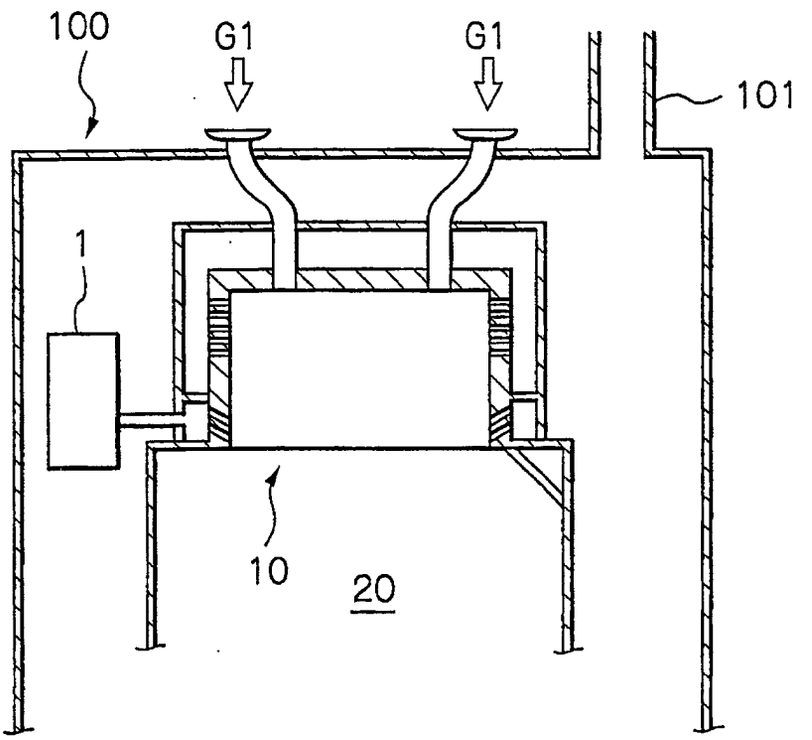


Fig. 3

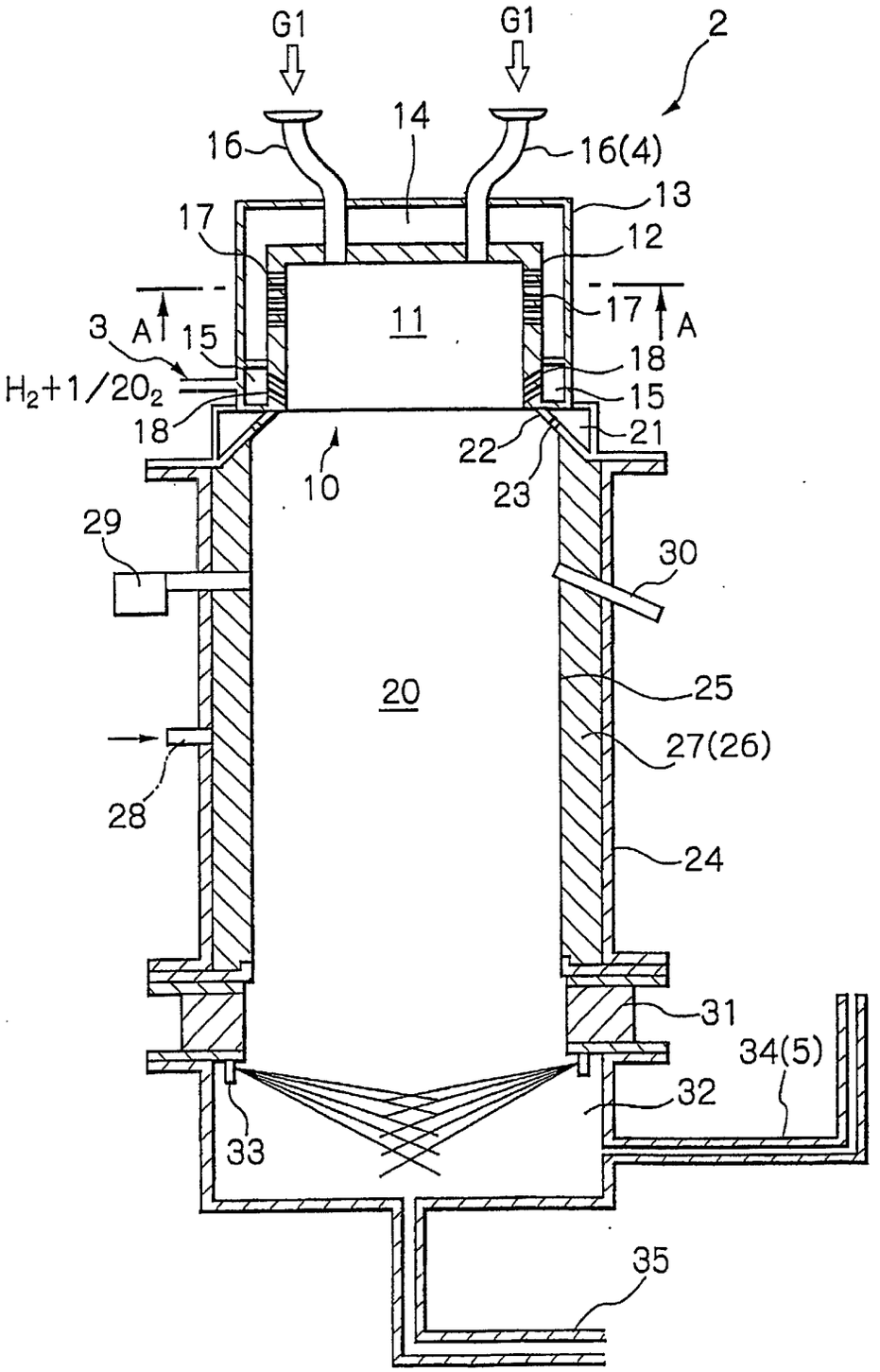

G1
G1
2
14
16
16(4)
13
17
12
11
17
A
A
3
15
18
$H_2+1/2O_2$
15
18
21
22
23
10
29
30
20
25
27(26)
28
24
31
34(5)
32
33
35

Fig. 4

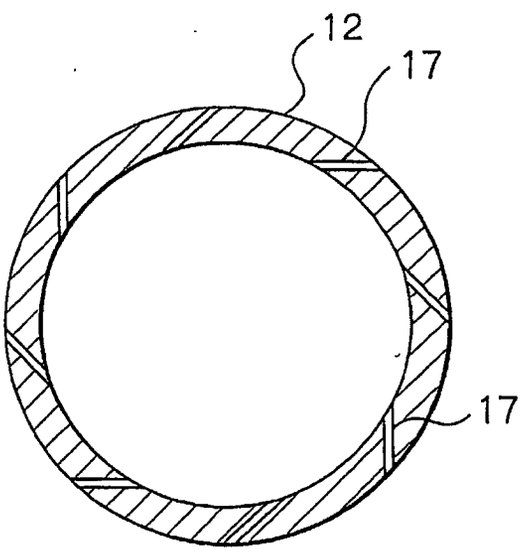


Fig. 5

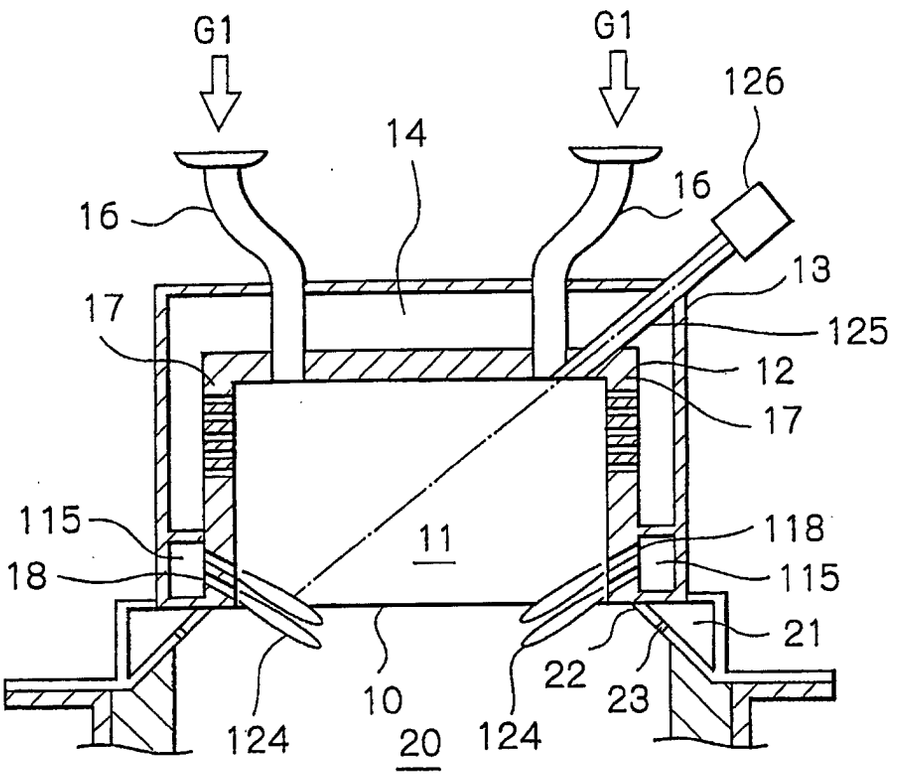

G1
G1
126
14
16
16
13
17
125
12
17
115
11
118
18
115
21
22
23
10
124
20
124

Fig. 6

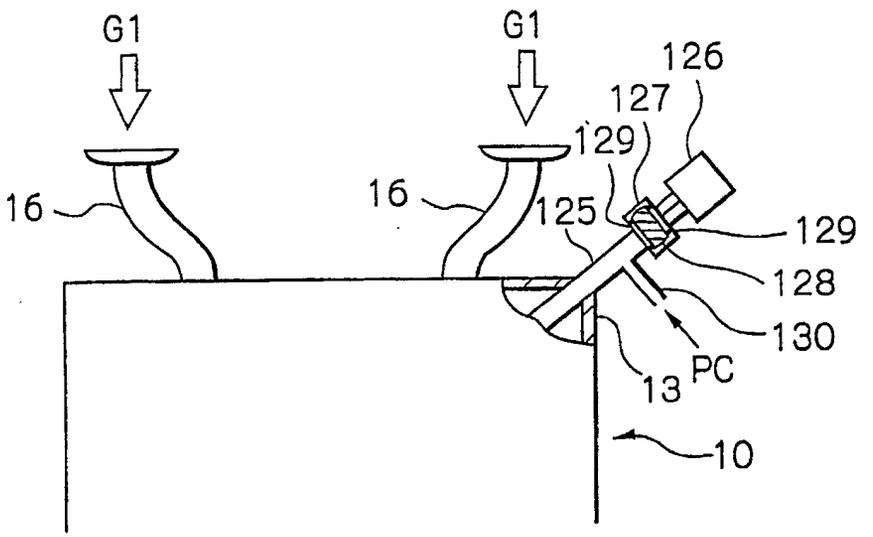


Fig. 7

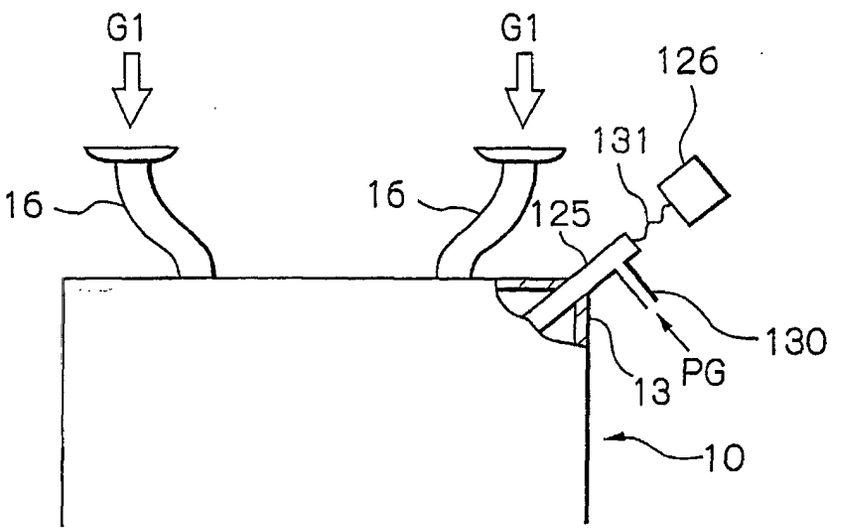


Fig. 8

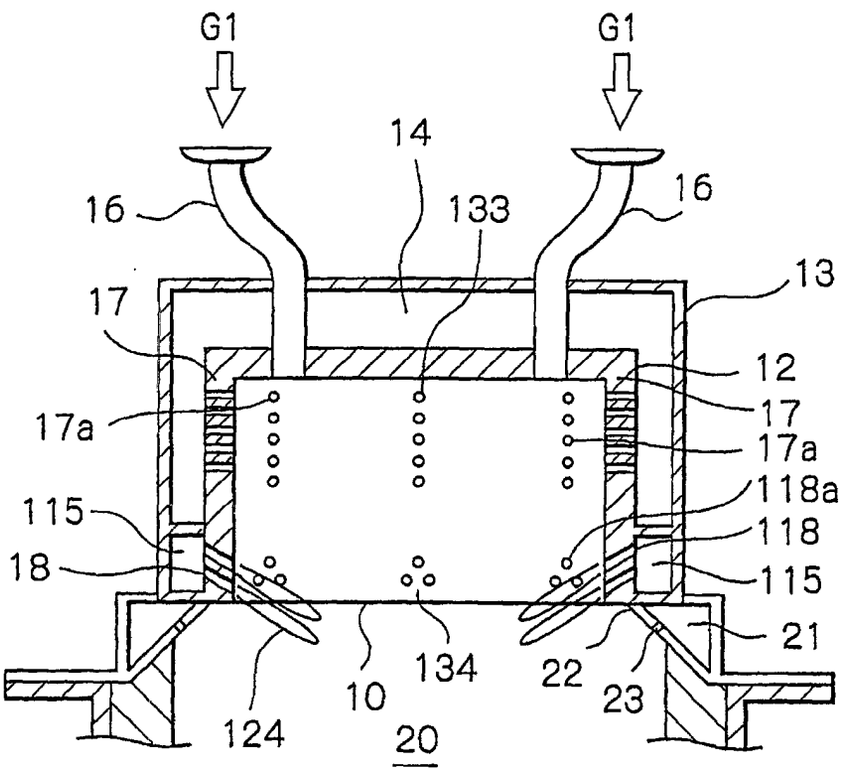

G1
G1
14
16
133
16
13
17
12
17
17a
17a
118a
115
118
18
115
21
22
23
134
10
124
20

Fig. 9

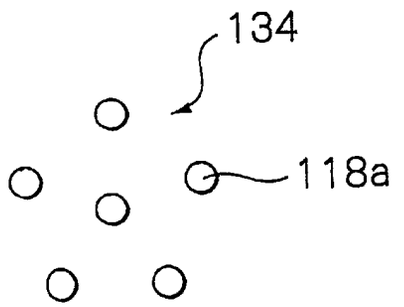
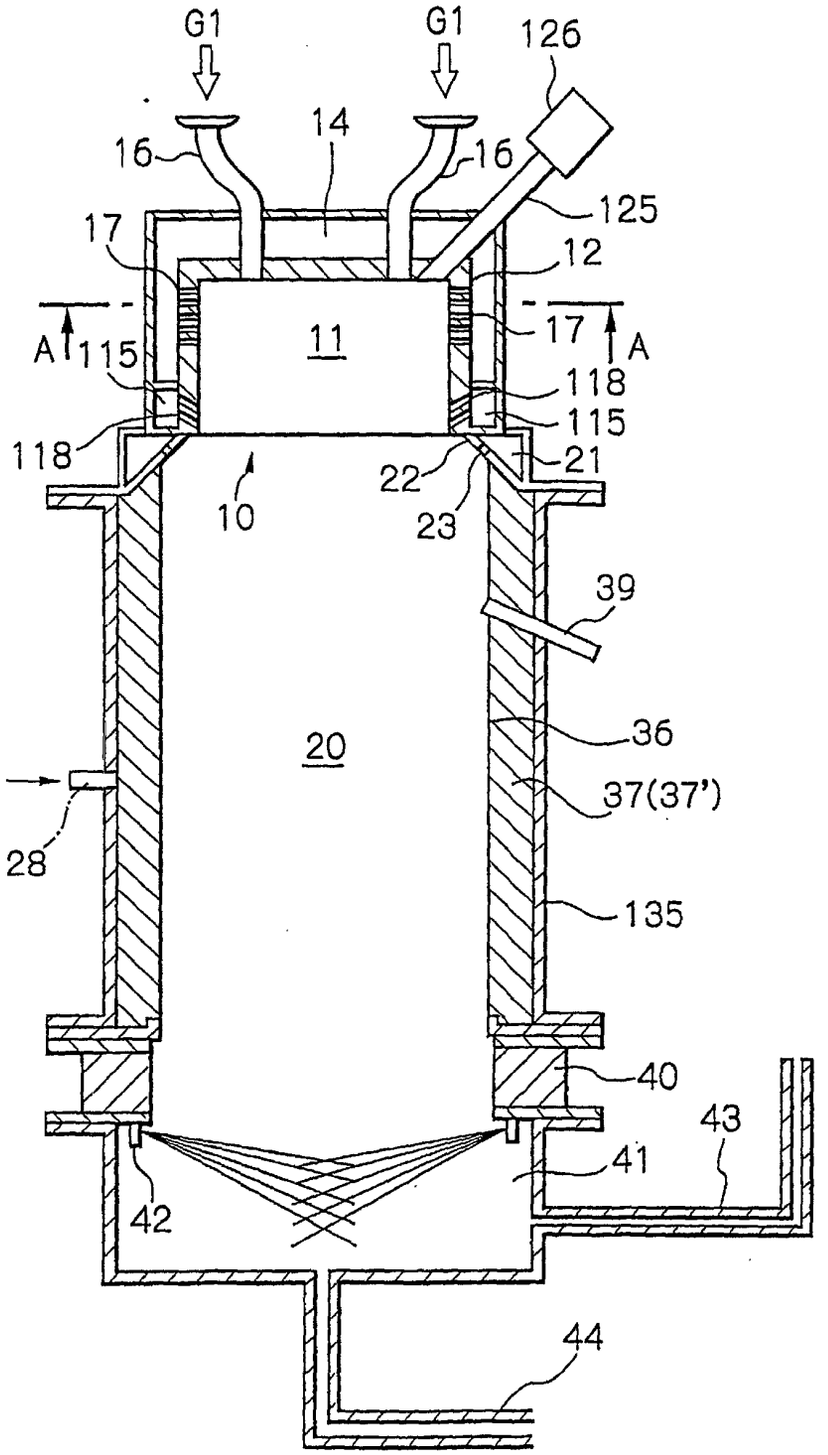


Fig. 10


G1
G1
126
14
16
16
125
17
12
A
115
11
17
A
118
115
118
21
22
10
23
39
20
36
37(37')
28
135
40
43
41
42
44

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP01/07136

A. CLASSIFICATION OF SUBJECT MATTER
Int.Cl[7] F23G 7/06, F23N 5/08

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)
Int.Cl[7] F23G 7/06, 5/00, 5/44, F23L 7/00, F23N 5/08

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
Jitsuyo Shinan Koho 1926-1996 Toroku Jitsuyo Shinan Koho 1994-2001
Kokai Jitsuyo Shinan Koho 1971-2001 Jitsuyo Shinan Toroku Koho 1996-2001

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.
X	JP 11-147027 A (Suga Test Instr. Co., Ltd.), 02 June, 1999 (02.06.99), (Family: none)	1-4
Y	JP 3039292 U (Chugin Kankou K.K.), 30 April, 1997 (30.04.97), (Family: none)	1-4
Y	JP 7-103443 A (Maeda Corporation), 18 April, 1995 (18.04.95), (Family: none)	1-4
Y	JP 8-145341 A (Tokyo Gas K.K.), 07 June, 1996 (07.06.96), (Family: none)	5,7
Y	Microfilm of the specification and drawings annexed to the request of Japanese Utility Model Application No. 44275/1992 (Laid-open No. 6944/1994), (Kobe Steel, Ltd.), 28 January, 1994 (28.01.94), (Family: none)	5-7

☒ 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 document 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
15 October, 2001 (15.10.01)	30 October, 2001 (30.10.01)
Name and mailing address of the ISA/ Japanese Patent Office	Authorized officer
Facsimile No.	Telephone No.

Form PCT/ISA/210 (second sheet) (July 1992)

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP01/07136

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	JP 9-119627 A (Mitsubishi Heavy Industries, Ltd.), 06 May, 1997 (06.05.97), (Family: none)	6
X	JP 11-218317 A (Ebara Corporation), 10 August, 1999 (10.08.99),	8
Y	& WO 9927301 A1 & EP 1033533 A1	1-7

Form PCT/ISA/210 (continuation of second sheet) (July 1992)

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP01/07136

Box I Observations where certain claims were found unsearchable (Continuation of item 1 of first sheet)

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

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

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

3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box II Observations where unity of invention is lacking (Continuation of item 2 of first sheet)

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

There is no technical relation including one or more same or corresponding special technical features between the inventions relating to Claims 1-4, 5-7, and 8-9, and the inventions relating to Claims 1-9 are not considered to be a group of inventions so linked as to form a single general inventive group.

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

2. ☒ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.

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

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

Remark on Protest

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

☐ No protest accompanied the payment of additional search fees.

Form PCT/ISA/210 (continuation of first sheet (1)) (July 1992)