

EXHAUST GAS TREATING TOWER FOR USE IN EXHAUST GAS
TREATMENT EQUIPMENT AND ELECTRIC HEATER FOR USE
IN THE EXHAUST GAS TREATING TOWER

BACKGROUND OF THE INVENTION

Field of the Invention

The present invention relates to an exhaust gas treating tower for use in exhaust gas treatment equipment for treating exhaust gas produced in the manufacture of electronic circuits such as semiconductor devices and liquid crystal displays, particularly in cleaning process and etching process thereof, and to an electric heater for use in the treating tower.

Description of the Related Art

In the semiconductor device manufacturing process, semiconductor device manufacturing equipment such as a CVD typically operates as follows. Deposition of deposit gas such as SiH_4 (a dangerous gas that is toxic to human body and explosive) → purging of residual SiH_4 gas from the CVD chamber with nitrogen → cleaning of the inside of the CVD chamber with a cleaning gas such as C_2F_6 (a gas that is harmless but has a greenhouse effect) → purging of the cleaning gas from the CVD chamber with nitrogen. This operation cycle is repeated.

Among gases for use in cleaning such a CVD chamber, there are perfluorocarbons, representatives of which include CF_4 , CHF_3 , and C_2F_6 abbreviated by PFCs. Perfluorocompounds free

of carbon such as NF_3 , SF_6 , and SF_4 are also abbreviated by PFCs.

PFCs, such as CF_4 and C_2F_6 , are incombustible, and it is not clear whether or not these compounds, per se, are toxic to a human body; at least they are not known to have an acute or subacute toxicity. When these compounds are emitted in the atmosphere, they remain unchanged in the atmosphere for a long time because the compounds, per se, are stable. It is said that the lives of CF_4 and C_2F_6 in the atmosphere up to their complete consumption thereof are 50,000 years and 10,000 years, respectively. Further, the global warming coefficients (compared with CO_2 assumed 1) of CF_4 and C_2F_6 after lapse of 20 years are 4,400 and 6,200, respectively. Thus, these compounds involves problems that must not be left unsolved in terms of global environment and, accordingly, it is desired that means for making PFCs such as CF_4 and C_2F_6 harmless be established.

However, it is very difficult to make such PFCs harmless with a decomposition process relied upon simple thermal oxidation because the C-F bond of such a PFCs as CF_4 , CHF_3 , or C_2F_6 is very stable (the bond energy of the C-F bond is as large as 130 kcal/mol) and hence is difficult to decompose.

Though it is possible to make C_2F_6 harmless with a decomposition process relied upon simple thermal oxidation if the flow rate of the gas to be treated is limited to 250 liter/min or less at a treating temperature of 1000 °C because the

decomposition of C_2F_6 is achieved if the C-C bond thereof is cleaved, decomposition of CF_4 requires that its C-F bond having the largest bond energy be cleaved and that the treating temperature be raised to fall within the range between $1400^{\circ}C$ and $1500^{\circ}C$ if the foregoing gas flow rate is unchanged.

Fig. 15 illustrates conventional exhaust gas treatment equipment 100 for decomposing an exhaust gas containing perfluorocarbons or perfluorocompounds produced from semiconductor device manufacturing equipment. The exhaust gas treatment equipment 100 includes an exhaust gas decomposition reactor tower 101 having an exhaust gas decomposing chamber 107, a front scrubber 109, a rear scrubber 110, and an exhaust fan 111. The equipment 100 is made very compact for use in a clean room. An electric heater 102 is used in the equipment 100 to cause decomposition reaction of exhaust gas (F) to proceed. As described above, the treating temperature at which the exhaust gas produced in the semiconductor device manufacturing process is subjected to thermal decomposition needs to be as high as $1400-1500^{\circ}C$.

However, it is nearly impossible to use the heater 102 for a long time at such a high temperature because the temperature of $1400-1500^{\circ}C$ is nearly a limit temperature the heater 102 can withstand from the viewpoint of its physical properties and is likely to cause dielectric breakdown to occur at an electric feeding section 105 and at an insulating member 106 surrounding

the same.

In the conventional equipment 100 shown in Fig. 15 the heater 102 is disposed as vertically extending from ceiling 104 of the exhaust gas decomposing chamber 107. Heat generated from the heater 102 rises toward the ceiling 104 of the exhaust gas decomposing chamber 107 and, hence, the ceiling 104 in which the electric feeding section 105 of the electric heater 102 is located is heated to the highest temperature. As a result, the insulation of the electric feeding section 105 requiring a high insulating property as well as that of the insulating member 106 surrounding the electric feeding section 105 becomes substantially lowered, which may cause short-circuiting to occur at the electric feeding section 105. Another problem associated with the conventional equipment 100 is that when the electric heater 102 extending vertically downwardly from the ceiling 104 of the exhaust gas decomposing chamber 107 is continuously used in such a high temperature atmosphere, the heater 102 gradually grows longer due to creep or a like phenomenon and, eventually, a break occurs in the heater 102.

The internal volume of the exhaust gas decomposing chamber 107 is not very large because the equipment 100 is made compact as described above. On the other hand, the electric heater 102 is a standardized product, which, in general, is not designed to match the exhaust gas decomposing chamber 107. Accordingly, the shape of the electric heater 102 is a bottleneck

in designing the equipment 100. Stated otherwise, the manufacturer demands that easy manufacture of the electric heater 102 tailored to the equipment 100 become possible on the manufacturer side.

There exist the following additional problems. When the electric heater 102 is used as extending vertically downwardly from the ceiling 104 of the exhaust gas decomposing chamber 107, the leading edge, or lowermost edge, of the electric heater 102 generates heat of the highest temperature, which ascends toward the ceiling 104 to form a high-temperature atmosphere near the ceiling 104 as described above. On the other hand, the exhaust gas (F) is introduced into the exhaust gas decomposing chamber 107 from the bottom of the chamber 107. The exhaust gas (F) thus introduced is a low-temperature gas containing water because it has been scrubbed with water by the front scrubber 109 located upstream of the equipment 100.

Since this low-temperature exhaust gas (F) first contacts the leading edge portion of the electric heater 104 reaching the highest temperature and then ascends toward the ceiling, it is required that the low-temperature exhaust gas (F) be heated to its decomposition temperature instantaneously in attempt to cause thermal decomposition of the gas (F) to occur at the leading edge portion of the electric heater 102 and, accordingly, the temperature of the leading edge portion of the electric heater 102 has to be raised higher than necessary in order to allow

desired decomposition reaction to be achieved. Even though thermal decomposition of the exhaust gas (F) is intended to proceed in the high-temperature atmosphere near the ceiling 104, the temperature of the leading edge portion of the electric heater 102 needs to be raised higher than 1400-1500°C in order for the temperature of the high-temperature atmosphere to reach 1400-1500°C. In either case the electric heater 102 has to bear too much a burden.

Since a greater load than necessary must be imposed on the electric heater 102 to decompose the low-temperature exhaust gas (F) as described above, the lifetime of the heater 102 is considerably shortened, while at the same time the heating energy cost increases.

In addition, a large quantity of deposition of dust contained in the exhaust gas or resulting from the thermal decomposition of the exhaust gas within the exhaust gas treatment equipment is problematic. Such dust deposits everywhere within the equipment and gradually narrow the internal space of the equipment. The narrowing of the internal space of the equipment due to deposition of dust not only significantly affects the thermal decomposition of the exhaust gas but also may lead to an accident.

Since frequent maintenance of the equipment is necessary within a clean room, the maintainability of the equipment in practical use is very important. The electric heater, in

particular, deteriorates heavily due to a high load imposed thereon and hence is frequently replaced with a new one. When consideration is given on the height of the ceiling of a clean room, which is low in general and the height at which the electric heater is removed for replacement, the height of the equipment is limited naturally.

Accordingly, it is a first object of the present invention to provide an exhaust gas treating tower for use in exhaust gas treatment equipment which is capable of ensuring sufficient insulation around the electric feeding section of an electric heater used in an exhaust gas decomposing chamber for causing an exhaust gas produced in the manufacture of semiconductor devices to be thermally decomposed at a high temperature while reducing the load imposed on the electric heater in an energized state, and which is capable of minimizing a heat loss.

A second object of the present invention is to provide an electric heater that can be used with ease under such severe conditions.

A third object of the present invention is to provide an exhaust gas treating tower having a structure for preventing dust from depositing within the tower over a long time.

A fourth object of the present invention is to provide an exhaust gas treating tower having a structure with a superior maintainability.

SUMMARY OF THE INVENTION

According to one aspect of the present invention, there is provided an electric heater comprising: a plurality of electric heater units each having electric feeding sections at opposite ends thereof and a heat generating section extending between the electric feeding sections; and an energizing bridge member formed of a same material as the electric feeding sections and spanning across adjacent electric feeding sections located on one side, wherein:

the energizing bridge member defines fitting holes each in clearance fit with each of the adjacent electric feeding sections of the electric heater units associated with the energizing bridge member; and

the energizing bridge member and the adjacent electric feeding sections are bonded to each other with an inorganic adhesive formed from the same material as the electric feeding sections and filling a clearance defined between each of the fitting hole and the electric feeding section fitted therein.

With this construction, the plurality of electric heater units can be connected to each other through the energizing bridge member defining the fitting holes and, hence, the electric heater can be tailored in size to an exhaust gas decomposing chamber. Thus, the electric heater of the present invention is very convenient for use. Further, since the energizing bridge member and the electric feeding sections associated thereto are

bonded to each other by filling the clearance between each fitting hole and the electric feeding section fitted therein with the inorganic adhesive formed from the same material as the electric feeding sections, electric contact between the energizing bridge member and the electric feeding sections associated thereto is ensured despite their clearance fit relation to each other and, hence, no trouble occurs in energizing the electric heater. It is to be noted that the electric heater of the present invention can be used in decomposition of a corrosive and/or explosive exhaust gas resulting from the manufacture of semiconductor devices as well as in a part requiring an elevated temperature as high as about 1400°C.

According to another aspect of the present invention, there is provided an exhaust gas treating tower for use in exhaust gas treatment equipment, comprising:

(a) a tower main body defining an exhaust gas decomposing chamber therein;

(b) a bottom member fitted to a bottom portion of the tower main body;

(c) a gas supply pipe extending through the bottom member and standing upright in the tower main body for introducing an exhaust gas from a leading end thereof into the exhaust gas decomposing chamber; and

(d) an electric heater having an electric feeding section located in the bottom member and extending upright from the

bottom member.

In the exhaust gas treating tower of the construction defined above, the electric feeding section of the electric heater disposed in the exhaust gas decomposing chamber is located in the bottom member fitted to the bottom portion of the tower main body. Since the bottom portion of the tower main body is heated to a temperature lower than that of any other portion in the tower main body, the bottom member is kept at a relatively low temperature even when the temperature of an upper part (ceiling) within the tower main body becomes high. Further, since the gas supply pipe for allowing exhaust gas to pass therethrough extends through the bottom member, the bottom member is deprived of heat by exhaust gas passing through the gas supply pipe and, accordingly, the temperature of the bottom member is lowered. Thus, the electric feeding section located in the bottom member and an insulating member surrounding the electric feeding section are not damaged as to their insulation. On the other hand, the exhaust gas is preheated and, hence, thermal decomposition of the exhaust gas by means of the electric heater is facilitated.

In addition, since the electric heater stands upright on the bottom member, the leading edge of the electric heater at which the highest temperature is reached forms the topmost portion of the heater. Accordingly, the exhaust gas ascends within the gas supply pipe from a low-temperature region to a high-temperature

region with its temperature rising due to preheating. Unlike the prior art configured to bring low-temperature exhaust gas into contact with a high-temperature portion of the electric heater, there is no need to impose an excessive load on the electric heater and, hence, the electric heater can enjoy a largely prolonged lifetime.

Preferably, the exhaust gas treating tower further comprises dust removing means disposed at a ceiling portion of the tower for intermittently jetting an inert gas from an opening of the dust removing means oriented parallel with a ceiling portion of the exhaust gas decomposing chamber.

Alternatively, the exhaust gas treating tower may further comprise dust removing means disposed at a bottom portion of the tower for intermittently jetting an inert gas from an opening of the dust removing means defined in a lower portion of the gas supply pipe.

Dust contained in the exhaust gas and dust resulting from thermal decomposition of the exhaust gas are very fine and deposit everywhere within the exhaust gas treating tower like fluff. Dust thus deposited gradually narrows the internal space of the tower and, eventually, impairs the function of the tower. Deposition of dust within the exhaust gas decomposing chamber is particularly serious. For this reason, the dust removing means is provided for intermittently jetting an inert gas into the exhaust gas decomposing chamber, particularly toward the

ceiling of the chamber or into the lower portion of the gas supply pipe where dust is easy to deposit, thereby removing deposited dust away by blowing. The provision of such dust removing means makes it possible to prolong the maintenance interval significantly.

The inert gas is intermittently jetted because it is possible to blow dust off effectively with a high pressure of the inert gas upon jetting and because the amount of the inert gas can be saved.

In a preferred embodiment, the exhaust gas treating tower further comprises a cabinet accommodating the tower main body therein, the cabinet being provided with bearings, and shafts outwardly extending from opposite lateral sides of the exhaust gas treating tower and rotatably supported by the bearings of the cabinet.

In this arrangement the exhaust gas treating tower is pivotally supported in the cabinet and hence can be laid horizontally or slanted when an internal structural component fitted with the electric heater for example is to be replaced with a new one or to be repaired. When the exhaust gas treating tower vertically supported within the cabinet is laid horizontally or slanted, the top or bottom of the tower can be drawn out of the cabinet and fixed, whereby it is possible to easily remove an internal structural component out of the tower or insert it into the tower from the side on which the top or bottom of the tower is

drawn out of the cabinet. Thus, this arrangement solves at a time the problems essential to the prior art such as operations at a high place, the ceiling of a clean room too low, and very difficult removal or insertion of an internal structural component from the bottom of the exhaust gas treating tower due to intricate piping in the cabinet or the complicated structure of the cabinet for accommodating the tower.

According to yet another aspect of the present invention, there is provided an exhaust gas treating tower for use in exhaust gas treatment equipment, comprising:

(a) a tower main body defining an exhaust gas decomposing chamber therein, the exhaust gas decomposing chamber having a bottom portion provided with a cooling section;

(b) a bottom member fitted to a bottom portion of the tower main body and cooled by the cooling section;

(c) a gas supply pipe extending through the bottom member and standing upright in the tower main body for introducing an exhaust gas from a leading end thereof into the exhaust gas decomposing chamber; and

(d) an electric heater having an electric feeding section located in the bottom member and extending upright from the bottom member.

The exhaust gas treating tower of this construction exhibits not only the advantages of the former exhaust gas treating tower but also an advantage of effectively cooling the

bottom member by means of the cooling section thereby effectively preventing dielectric breakdown at the electric feeding section and at a portion surrounding the electric feeding section. The cooling section may comprise a coolant flow pipe disposed inside or outside the bottom member, or an indirect cooling jacket (not shown) formed on the outer periphery of the bottom portion of the tower main body, or a direct cooling jacket to be described below. The cooling fluid used in the cooling section may be any one of various coolants such as water.

The cooling section preferably comprises:

(a) a cooling wall forming a side wall of the bottom portion of the exhaust gas decomposing chamber and extending to the bottom member;

(b) a cooling fluid flow circuit formed on an outer peripheral surface of the exhaust gas treating tower so as to circumscribe the tower main body;

(c) a cooling fluid jetting pipe disposed in the cooling fluid flow circuit for jetting a cooling fluid circumferentially of the tower main; and

(d) cooling fluid jetting slits defined in the cooling fluid flow circuit along an inner periphery of the cooling wall.

Alternatively, the cooling section may comprise:

(a) a cooling wall forming a side wall of the bottom portion of the exhaust gas decomposing chamber and extending to the bottom member; and

(b) cooling fluid jetting pipes disposed along the cooling wall for jetting a cooling fluid circumferentially of the cooling wall.

Unlike an indirect cooling jacket or a coolant flow pipe, the cooling section of the direct cooling jacket type allows the cooling fluid jetted from the slits formed along the inner periphery of the cooling wall to be directly exposed along the inner periphery of the cooling wall and to be formed into a helical cooling layer to flow down without splashing. This arrangement ensures a higher cooling effect and hence greatly contributes to protection of the electric feeding section against dielectric breakdown.

The exhaust gas treating tower according to the third aspect of the present invention may further comprise a shielding wall extending vertically downwardly from a lower edge of a lining member defining the exhaust gas decomposing chamber so as to cover an upper portion of the inner periphery of the cooling wall.

The vertically downwardly extending shielding wall shields vapor resulting from heating of the cooling fluid helically dropping along the inner peripheral slope of the cooling wall thereby inhibiting vapor to enter the exhaust gas decomposing chamber, hence, preventing the vapor from interfering with the thermal decomposition of the exhaust gas. Though the possibility that rising vapor of the cooling fluid

generating in the cooling section enters the exhaust gas decomposing chamber is low because a down-flow is always present in the exhaust gas decomposing chamber due to discharge of the gas from the chamber through a gas discharge port defined in the bottom of the chamber, the provision of the shielding wall makes it possible to eliminate such possibility.

Preferably, the exhaust gas treating tower according to the third aspect of the present invention further comprises dust removing means disposed at a ceiling portion of the tower for intermittently jetting an inert gas from an opening of the dust removing means oriented parallel with a ceiling portion of the exhaust gas decomposing chamber.

Alternatively, the exhaust gas treating tower according to the third aspect of the present invention may further comprise dust removing means disposed at the bottom portion of the tower for intermittently jetting an inert gas from an opening of the dust removing means defined in a lower portion of the gas supply pipe.

The provision of such dust removing means makes it possible to remove dust deposited within the exhaust gas decomposing chamber as well as to prolong the maintenance interval significantly, as described in relation to the exhaust gas treating tower according to the second aspect of the present invention.

In a preferred embodiment, the exhaust gas treating tower

according to the third aspect of the present invention further comprises a cabinet accommodating the tower main body therein, the cabinet being provided with bearings, and shafts outwardly extending from opposite lateral sides of the exhaust gas treating tower and rotatably supported by the bearings of the cabinet.

This arrangement makes it possible to lay the exhaust gas treating tower horizontally or slant it thereby allowing an internal structural component to be removed out of the tower or inserted into the tower from the side on which the tower is drawn out of the cabinet as well as to limit the height of the equipment, as described in relation to the exhaust gas treating tower according to the second aspect of the present invention.

These and other objects, features and attendant advantages of the present invention will become apparent from the reading of the following detailed description of the present invention in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a schematic sectional view illustrating the configuration of exhaust gas decomposition treatment equipment as a first embodiment of the present invention;

Fig. 2 is an explanatory sectional view illustrating the configuration of exhaust gas decomposition treatment equipment as a second embodiment of the present invention;

Fig. 3 is a horizontal sectional view of a cooling section of

the equipment shown in Fig. 2;

Fig. 4 is an enlarged fragmentary vertical sectional view of the equipment shown in Fig. 2;

Fig. 5 is an explanatory sectional view illustrating the configuration of exhaust gas decomposition treatment equipment as a third embodiment of the present invention;

Fig. 6 is an enlarged fragmentary vertical sectional view of the equipment shown in Fig. 5;

Fig. 7 is a front elevational view, partly in section, of an electric heater used in the present invention;

Fig. 8 is a plan view of the electric heater shown in Fig. 7;

Fig. 9 is an explanatory sectional view illustrating the configuration of an exhaust gas treating tower provided with dust removing means according to the present invention;

Fig. 10 is an explanatory sectional view illustrating the configuration of another embodiment of the exhaust gas treating tower shown in Fig. 9;

Fig. 11 is an explanatory view illustrating a suspension structure of exhaust gas decomposition treatment equipment according to the present invention;

Fig. 12 is an explanatory view illustrating another embodiment of the suspension structure shown in Fig. 11;

Fig. 13 is a graph of a harm-removing cycle test according to the present invention;

Fig. 14 is a graph of a harm-removing cycle test according

to the prior art; and

Fig. 15 is a schematic sectional view illustrating the configuration of exhaust gas decomposition treatment equipment according to the prior art.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

The present invention will now be described in detail with reference to the accompanying drawings, in which like reference characters designate like or corresponding parts throughout several views.

Referring first to Fig. 1 illustrating exhaust gas decomposition treatment equipment (A) as the first embodiment of the present invention, the exhaust gas decomposition treatment equipment (A) includes various constituent units, such as a front scrubber 30, an exhaust gas treating tower 1, a rear scrubber 40, piping, wiring, gauges, an exhaust fan 50 and a cistern 60, for effecting three functions: (a) thermal decomposition of PFCs, (b) cleaning and discharge of fluorocompounds or removing of the fluorocompounds by fixation, and (c) removing of other combustible components by combustion. Though these units are shown as spaced apart from each other in the drawing, they are actually interconnected through piping and wiring and integrally accommodated in a compact cabinet 27. The cabinet 27 is a rectangular parallelepiped that is about 2 meters high, about 1 meter long and about 1 meter wide and

comprises a trestle 120 forming the skeleton of the cabinet 27 and panels 5b fitted to the exterior of the trestle 120, the trestle 120 being formed on its internal surface with substantially U-shaped bearings 29 projecting inwardly.

In Fig. 1, the front scrubber 30 connects with semiconductor device manufacturing equipment through an exhaust gas duct 31. Exhaust gas (F) containing residual gases used in the semiconductor device manufacturing process, exhaust gases having undergone various chemical reactions during the manufacture of semiconductor devices, purge gases and the like is introduced into the front scrubber 30.

The front scrubber 30, either standing on the cistern 60 or located separately from the cistern 60, is connected to the cistern 60 through piping for feeding drain to the cistern 60. Roughly speaking, the front scrubber 30 comprises a scrubber main body 30a in the form of a straight tube having a top portion connected to the exhaust gas duct 31, and spray nozzles 32 disposed within the scrubber main body 30a at a location adjacent the top portion for spraying a chemical liquid such as an alkaline liquid, acidic liquid or water. The chemical liquid thus sprayed is collected into the cistern 60.

A circulating water pump 33 is provided between the spray nozzle 32 and the cistern 60 for lifting water stored in the cistern 60 to the spray nozzle 32. City water is supplied to the circulating water pump 33 to make up for a loss of water due to

overflow from the cistern 60. Though the cistern 60 appears to be divided into a cistern 60a on the exhaust gas supply side and a cistern 60b on the reacted exhaust gas discharge side in the drawing, they are continuous with each other at the bottom.

The exhaust gas treating tower 1 stands on the cistern 60 or a base 11. Alternatively, the tower 1 is spaced separately from the cistern 60 as pivotally suspended within the cabinet 27 by means of opposite support shafts 28 outwardly projecting from an upper peripheral wall of a tower main body 3, the shafts 28 being supported by the bearings 29 inwardly projecting from the cabinet 27 so that the tower 1 can be held in a vertically standing position or a horizontally laid position at which the lower end portion of the tower main body 3 can be drawn out of the cabinet 27. In the case where the tower main body 3 is held as suspended within the cabinet 27, the bottom member 4 fitted to the bottom portion of the tower main body 3 can be easily removed.

With respect to the structure of the exhaust gas treating tower 1, the tower main body 3 comprises a cylindrical jacket 3a made of steel and a lining member 3b formed of a refractory material. The exhaust gas decomposition chamber 1a is defined by the lining member 3b. The lining member 3b covers the entire inner periphery of the jacket 3a and becomes in direct contact with the exhaust gas (F). A bottom member 4 fitted with an insulating member 9 is attached to the bottom portion of the

tower main body 3. In the case of Fig. 1 the tower main body 3 and the bottom member 4 are removably attached to the base 11 by means of fastening members 10 such as anchor bolts, while in the case of Fig. 2 the two members 3 and 4 are removably fixed to each other by means of fastening members 10a such as bolt and nut combinations. The jacket 3a is formed on its opposite lateral sides with the opposite support shafts 28 having a circular section which project from an upper portion of the jacket 3a and are rotatably supported by the respective bearings 29 formed on the trestle 120 forming the cabinet 27.

A gas supply pipe 6 made of a metal having superior heat resistance and corrosion resistance extends centrally of the insulating member 9, and an electric heater 7 is disposed as enclosing the gas supply pipe 6. The gas supply pipe 6 extends through a central portion of the insulating member 9, while an electric feeding section 8b of the electric heater 7 is located in the insulating member 9 as circumscribing the gas supply pipe 6. The height of the gas supply pipe 6 is same as or higher than the height of the electric heater 7. A cylindrical portion 23 forming part of the bottom member 4 contains the insulating member 9 filled with a solidified inorganic refractory material. The electric heater 7, gas supply pipe 6 and the bottom member 4 bearing the insulating member 9 are internal structural components 45 of the exhaust gas treating tower 1. The gas supply pipe 6 inserted into the exhaust gas decomposing chamber

1a is connected to a scrubbed gas feed pipe 34 extending from the ceiling portion of the cistern 60 on the exhaust gas supply side 60a connected to the front scrubber 30 or from the bottom of the scrubber 30. The tower main body 3 has a lower portion defining a gas discharge port 5 connected to the rear scrubber 40 on the downstream side through a decomposed gas feed pipe 35.

The electric heater 7 comprises two or three electric heater units 71, 72, ... and an energizing bridge member 8c interconnecting adjacent ends of the electric heater units 71, 72, ... on one side. Each of the electric heater units 71, 72, ... comprises a solid or hollow bar formed mainly of silicon carbide and formed with electric feeding sections 8a and 8b at the opposite ends, and the portion extending between the electric feeding sections 8a and 8b forms a heat generating section 7a. The energizing bridge member 8c formed of the same material as the electric feeding sections 8a and 8b defines fitting holes 8d, 8d in clearance fit with the electric feeding sections 8a, 8a. The number of fitting holes 8d, 8d is equal to the number of electric feeding sections 8a, 8a connected to the energizing bridge member 8c. The energizing bridge member 8c and the electric feeding sections 8a, 8a of the electric heater units 71, 72, ... are bonded to each other by filling the clearance defined between each fitting hole 8d and each electric feeding section 8a in clearance fit with each other with an inorganic adhesive 8e formed from the same material as the electric feeding sections 8a

and 8b. Fig. 7 shows the electric heater 7 of gate shape having two electric heater units 71 and 72 interconnected through the energizing bridge member 8c. Connector fittings 8f are attached to other electric feeding sections 8b, 8b.

The rear scrubber 40 is of a typical configuration. Briefly, the rear scrubber 40 has scrubbing layers 41 and spray nozzles 42 disposed immediately above the scrubbing layer 41 in the inside thereof and stands on the cistern 60 or is located separately from the reacted gas discharge side 60b of the cistern 60 and is connected thereto through piping for feeding drain from the rear scrubber 40 to the cistern 60. The outlet of the rear scrubber 40 is connected to an exhaust fan 50 serving to emit treated gas to the atmosphere.

The exhaust gas decomposition treatment equipment (A) shown in Fig. 1 operates as follows. Exhaust gas (F) discharged from the semiconductor device manufacturing equipment is introduced into the front scrubber 30 where the gas (F) is brought into contact with a chemical liquid (alkaline liquid, acidic liquid or water) in a spray state sprayed from the spray nozzle 32. Thus, dust contained in the exhaust gas (F) is caught by fine droplets of the chemical liquid and then fed to the cistern 60. At the same time, water-soluble components contained in the exhaust gas (F) are absorbed by the chemical liquid and hence removed from the gas (F).

The exhaust gas (F) of which the temperature is lowered

and which is moistened due to scrubbing at the front scrubber 30 is fed to the gas supply pipe 6 through the scrubbed gas feed pipe 34. The exhaust gas (F) first contacts the insulating member 9 and cools the same and then ascends within the gas supply pipe 6 while being heated by the ambient temperature. The exhaust gas (F) sufficiently preheated within the gas supply pipe 6 is emitted from the top of the gas supply pipe 6 into the exhaust gas decomposing chamber 1a.

Around the top of the gas supply pipe 6 is located the leading edge portion of the electric heater 7 at which the temperature is the highest. Since the exhaust gas (F) emitted from the top of the gas supply pipe 6 after having been sufficiently preheated contacts the leading edge portion of the electric heater 7, then a high-temperature atmosphere held at a sufficiently high temperature that is present adjacent the ceiling of the exhaust gas decomposing chamber 1a, the exhaust gas (F) is decomposed immediately.

The electric heater 7 used for thermal decomposition is described below in more detail. Since the electric heater 7 stands upright on the insulating member 9 located in the bottom portion of the tower main body 3, the leading edge portion of the electric heater 7 reaching the highest temperature forms the top portion of the heater 7 and the atmospheric gas having contacted the high-temperature leading edge portion of the electric heater 7 stays around the ceiling of the tower main body 3 and hence

keep the temperature of the atmosphere around the ceiling highest. On the other hand, the electric feeding sections 8b,8b of the electric heater 7 are embedded in the insulating member 9 located in the bottom portion of the tower main body 3 where heat does not stay and hence are not heated very much. As a result, the insulating performance of the insulating member 9 is maintained whereby the electric heater 7 in operation can assuredly be prevented from short-circuiting due to dielectric breakdown.

In treating the exhaust gas (F), it is possible to allow the thermal decomposition of the exhaust gas (F) to proceed in the absence of free oxygen except a trace amount of oxygen less than an explosion lower limit that remains unconsumed as residual of oxygen added in the semiconductor device manufacturing process performed by the semiconductor device manufacturing equipment without intentionally adding oxygen (or air) to the exhaust gas (F) in the exhaust gas decomposing chamber 1a. Alternatively, it is possible to allow the thermal decomposition of the exhaust gas (F) to proceed in the presence of oxygen added to the introduced exhaust gas (F) that has been admixed with an inert gas such as nitrogen to lower the explosive gas concentration to a value less than the lower explosion limit. The exhaust gas (F) thus thermally decomposed is fed to the rear scrubber 40 where it is scrubbed and cooled with a chemical liquid such as an alkaline liquid, acidic liquid or water and then emitted to the outside

atmosphere by means of the exhaust fan 50.

In case that the exhaust gas treating tower 1 needs to be disassembled due to failure of the electric heater 7 or breakage of an internal structural component such as the lining member 3b, an internal component such as the electric heater 7 can be easily drawn out of the tower 1 for replacement with a new one or for repair if the bottom member 4 is detached from the tower main body 3 by releasing the fastening members 10 or 10a. An embodiment of a repairing method to be employed in such a case is described later.

The second embodiment of the present invention shown in Fig. 2 is described below. The second embodiment is the same as the first embodiment except that the exhaust gas treating tower is provided with a cooling section 12. For convenience of illustration, the different feature is focused in the following description.

The exhaust gas treating tower 1 is formed with a cooling fluid flow circuit 14 extending around the outer periphery thereof, and a portion of the exhaust gas treating tower 1 situated under the cooling fluid flow circuit 14 forms a cooling wall 13. The cooling fluid flow circuit 14 is a hollow portion defined by the jacket 3a and a flow circuit wall 15 circumscribing the jacket 3a and is configured to circumscribe the entire circumference of the tower main body 3. The cooling fluid flow circuit 14 is attached with a conduit 16 at a single or plural

points, and a jet pipe attached to the conduit 16 is inserted into the cooling fluid flow circuit 14. The leading end portion of the jet pipe 17 is bent in the circumferential direction of the cooling fluid flow circuit 14 and, hence, a cooling fluid is jetted circumferentially within the cooling fluid flow circuit 14 from the jet pipe 17. Downwardly inclined slits 18 that are open as oriented toward the bottom member 4 are defined between the lower peripheral edge of the jacket 3a defining the cooling fluid flow circuit 14 and the upper peripheral edge of the cooling wall 13 over the entire circumference of the exhaust gas treating tower 1.

The cooling wall 13 is constructed of a heat-resistant and corrosion-resistant metal plate and is of a truncated cone shape tapered downward in the embodiment shown. Though the cooling wall 13 may be of a cylindrical shape, it is preferably of such a downwardly tapered truncated cone shape for smooth flowing down of the cooling fluid 20.

As in the first embodiment, the bottom member 4 fitted with the insulating member 9 to be located within the cooling wall 13 is removably attached to the bottom portion of the tower main body 3. Between the cooling wall 13 and the bottom member 4 is formed a cooling fluid sump 21 collecting the cooling fluid 20 with which the insulating member 9 is directly cooled.

A cylindrical shielding wall 19 formed of a corrosion-resistant metal extends vertically downwardly from the lower

edge of the lining member 3b so as to cover an upper portion of the inner periphery of the cooling wall 13. An inert gas supply nozzle 26 extends through the cooling wall 13 until it reaches a location below the shielding wall 19. Inert gas (I) jetted from the inert gas supply nozzle 26 into the bottom portion of the exhaust gas decomposing chamber 1a whirls round within the bottom portion and is discharged from a gas discharge port 5 together with decomposed exhaust gas (F).

Since the vertically downwardly extending shielding wall 19 is provided and the inert gas is jetted into the bottom portion of the exhaust gas decomposing chamber 1a from the inert gas supply nozzle 26, vapor resulting from heating of the cooling fluid 20 helically flowing down on the inner peripheral slope of the cooling wall 13 is shielded by the shielding wall 19 and hence is inhibited to enter the exhaust gas decomposing chamber 1a. Thus, the thermal decomposition of the exhaust gas (F) cannot be impeded by such vapor of the cooling fluid 20. Though the possibility that ascending vapor of the cooling fluid 20 generated in the cooling section 12 enters the exhaust gas decomposing chamber 1a is low because a down-flow is always present in the exhaust gas decomposing chamber 1a due to discharge of the gas from the chamber 1a through the gas discharge port 5 defined in the bottom portion of the chamber 1a, the provision of the shielding wall 19 makes it possible to further lower such possibility.

Figs. 5 and 6 illustrate a variation of the cooling section 12, where jet pipes 17a are directly attached to the cooling wall 13 along the circumference thereof instead of the provision of the flow circuit wall 15 and a liquid collecting ring 24 is provided on the inner periphery of the cooling wall 13. A clearance allowing the cooling fluid 20 to pass therethrough is defined between the liquid collecting ring 24 and the cooling wall 13. The cooling fluid 20 jetted from the jet pipes 17a flows down helically along the inner periphery of the cooling wall 13. A portion of the cooling fluid 20 passes through the clearance and flows further downward, while the rest is dammed up with the liquid collecting ring 24. In this case also, the shielding wall 19 and the inert gas supply nozzles 26 serve to shield vapor of the cooling fluid 20 and inhibit entry of vapor into the exhaust gas decomposing chamber 1a.

It should be noted that since the cooling sections 12 shown in Figs. 2 to 6 use water as the cooling fluid 20 and are of the direct cooling jacket type configured to allow the cooling fluid 20 to flow as exposed directly in the bottom portion of the exhaust gas treating tower 1, the exhaust gas treating tower 1 is made to have a sufficient height so that the high-temperature atmosphere within the tower 1 is not influenced directly from the cooling fluid 20. In the case where an inert gas such as nitrogen or argon gas is used as the cooling fluid 20, the exhaust gas treating tower 1 may have a reduced height as compared with the

case where the cooling fluid 20 is water.

Instead of the cooling section of the direct cooling jacket type shown in Fig. 2, it is possible to employ a cooling section of an indirect cooling jacket type (not shown) in which a coolant flow pipe (not shown) is provided inside or outside the bottom member 4 for circulating the cooling fluid 20 within the coolant flow pipe.

Dust removing means 2 provided in the exhaust gas treating tower 1 according to the present invention is described below with reference to Figs. 9 and 10. The ceiling portion 1b of the tower main body 3 is fitted with first dust removing means 2a comprising a plurality of pipes (three pipes spaced at intervals of 120° in this embodiment) each having a lower open end oriented toward the top of the electric heater 7 or toward the space between the top of the electric heater 7 and an inner wall 1c of the tower main body 3. Each of the pipes further defines perforations 2i extending through the peripheral wall of its projecting portion. The dust removing means 2a may have a leading (lower) end portion bent along the ceiling portion 1b as shown in Fig. 10. The main object of the dust removing means 2a fitted to the ceiling portion is to blow off dust deposited on the ceiling portion 1b and on an upper portion of the inner wall 1c. Of course, the dust removing means 2a may have a leading end bent tangentially of the center circle of the tower main body 3 so that inert gas (I) can whirl round along the ceiling portion

1b.

In the case where the dust removing means 2a has a leading open end oriented toward the top of the electric heater 7 or toward the space between the top of the electric heater 7 and the inner wall 1c of the tower main body 3 as described above, the dust removing means 2a is capable of blowing off dust (G) deposited on the top of the electric heater 7 and on an upper portion of the inner wall 1c.

The exhaust gas treating tower 1 is further provided with second dust removing means 2b comprising a pipe inserted into a lower portion of the gas supply pipe 6 for intermittently jetting inert gas (I) from the lower portion of the gas supply pipe 6 toward the upper open end of the gas supply pipe 6. The second dust removing means 2b is capable of blowing off dust (G) deposited on the gas supply pipe 6, particularly on an inner peripheral surface of the pipe 6 adjacent the upper open end thereof.

The exhaust gas treating tower 1 is still further provided with third dust removing means 2c comprising a plurality of pipes (three pipes spaced at intervals of 120° in this embodiment) extending from the side wall of the bottom member 4 attached to the tower main body 3. Leading end (2h) of each pipe of the third dust removing means 2c is bent upward between the lower edge of the inner wall 1c of the tower main body 3 and the electric heater 7 so that inert gas (I) is intermittently jetted

between the lower edge of the inner wall 1c of the tower main body 3 and the electric heater 7 thereby blowing off dust (G) deposited around this region.

Generally, nitrogen gas is used as the inert gas (I). It is, of course, possible to use another inert gas such as argon gas as the need arises. Though the dust removing means 2 comprises a pipe, it may be of any other construction without any particular limitation. The tower main body 3 is provided with a nozzle 11 inserted through the peripheral wall thereof at a location adjacent the ceiling portion 1b for jetting oxygen (or air) into the exhaust gas decomposing chamber 1a to facilitate the thermal decomposition of the exhaust gas (F).

Brief description is made of the operation of the embodiment shown in Figs. 9 and 10 while avoiding repetition of description. Exhaust gas (F) discharged from the semiconductor device manufacturing equipment passes through the front scrubber 30 and the scrubbed gas feed pipe 34 and is introduced into the exhaust gas decomposing chamber 1a. In the middle of this passage the exhaust gas (F) contacts and cools the insulating member 9 and is then sufficiently preheated by the ambient temperature during its ascent within the gas supply pipe 6. A small amount of dust (G) remaining in the exhaust gas (F), which the front scrubber 30 has failed to remove, adheres to the inner periphery of the gas supply pipe 6.

When the exhaust gas (F) heated during its ascent within

the gas supply pipe 6 contains SiH_4 (silane), the gas (F) produces a large quantity of dust (G) mainly resulting from decomposition of SiH_4 at a middle portion of the gas supply pipe 6 heated to 400-500°C. Dust (G) deposited on the inner periphery of the gas supply pipe 6 is blown into the exhaust gas decomposing chamber 1a by the pressure of the inert gas (I) intermittently jetted upwardly from leading open end (2r) of the second dust removing means 2b disposed in the lower portion of the gas supply pipe 6. As a result, the large quantity of dust (G) is introduced into the exhaust gas decomposing chamber 1a and deposits on the ceiling portion 1b thereof.

Since the top portion of the gas supply pipe 6 is heated to such a high temperature as to cause the thermal decomposition of the exhaust gas (F), the exhaust gas (F), if containing C_2F_6 as exhaust gas discharged from the cleaning process, can effectively be decomposed in the presence of oxygen (or air) introduced into the atmosphere present adjacent the ceiling portion 1b when it contacts the leading edge portion of the electric heater 7 and the high-temperature atmosphere held at a sufficiently high temperature in the vicinity of the ceiling.

Dust (G) deposited on the ceiling portion 1b is removed by first dust removing means 2a fitted to the ceiling portion 1b. Specifically, inert gas (I) jetted from the first dust removing means 2a having the lower open end 2i and the perforations 2i of the peripheral wall is partially jetted from the lower open end 2i

toward the top portion of the electric heater 7 and the inner wall 1c to blow off dust (G) deposited thereon, while the rest of the inert gas (I) is jetted along the ceiling portion 1b to blow off dust (G) deposited on the ceiling portion 1b.

Dust (G) falls within the exhaust gas decomposing chamber 1a toward the bottom member 4 together with decomposed exhaust gas (F). Such dust (G) deposits on a lower portion of the inner wall 1c. The dust (G) deposited on this portion is removed by third dust removing means 2c. Specifically, the third dust removing means 2c fitted to the bottom member 4 and having the open end 2h oriented toward the ceiling intermittently jets inert gas (I) toward the ceiling against the down-flow of the decomposed exhaust gas (F) to bring about a whirlpool, which in turn blows off dust (G) deposited on the lower portion of the inner wall 1c effectively. The dust (G) thus blown off is fed through the decomposed gas feed pipe 35 extending from the bottom member 4 to the subsequent scrubber 40 together with decomposed exhaust gas (F). The exhaust gas (F) thus introduced into the scrubber 40 is scrubbed and cooled with a chemical liquid such as an alkaline liquid, acidic liquid or water and then emitted to the outside atmosphere by means of the exhaust fan.

Fig. 13 is a graph showing the dust (SiH_4 and C_2F_6) removing effect of the dust removing means 2, while Fig. 14 shows a comparative example. Since the dust removing means 2

is intermittently actuated in the case of Fig. 14, the amount of dust (G) within the exhaust gas treating tower 1 is small and does not increase, and there is no drop in the SiH_4 and C_2F_6 removing efficiency and in the heater output after 160 running cycles of the semiconductor device manufacturing equipment have been completed. Thus, the maintenance interval of the exhaust gas treatment equipment (A) can be considerably prolonged.

In the case of the comparative example, in contrast, gradual deposition of dust (G) in the exhaust gas treating tower 1 narrows the internal space of the tower 1, with the result that the pressure difference between the inlet and outlet of the tower 1 gradually rises. The SiH_4 removing efficiency begins lowering at the 40th running cycle of the semiconductor device manufacturing equipment and rapidly lowers at about the 42nd or 43rd running cycle. Likewise, the C_2F_6 removing efficiency rapidly lowers at about the 43rd running cycle. Similarly, the heater output steeply lowers at about 43rd running cycle. Thus, with the comparative example, the semiconductor device manufacturing line needs to be stopped before the 40th running cycle at the latest so that the exhaust gas treatment equipment of the comparative example is disassembled for cleaning.

The maintenance of the exhaust gas treating tower 1 is performed in the following manner. The thermal decomposition of exhaust gas (F) in the exhaust gas treating tower 1 is caused

by the electric heater 7. A temperature as high as 1400°C or higher is necessary for the thermal decomposition as described above. In addition, the exhaust gas (F) to be thermally decomposed is explosive, corrosive and highly toxic. Thus, the electric heater 7 is used under very severe conditions that an ordinary electric heater comprising a metal resistor cannot withstand. For this reason, the electric heater 7 employs a ceramic resistor formed mainly of silicon carbide. Since even such an electric heater gradually deteriorates or damages and since internal structural components 45 such as the lining member 3a and gas supply pipe 6 also damage, it is necessary for the internal structural components 45 to be drawn out of the exhaust gas treating tower 1 periodically so that the electric heater 7 or gas supply pipe 6 is replaced with a new one or the lining member 3a is reinforced or repaired.

In performing such maintenance, the pipes and wires connected to the exhaust gas treating tower 1 are detached therefrom to make the tower 1 free, then the tower 1 is rotated about the support shafts 28 as shown in Fig. 11 so as to allow the bottom portion of the tower 1 to be drawn out of the cabinet 27, and the tower 1 is fixed in a slanted or horizontally laid state. The exhaust gas treating tower 1 is fixed by any means without any particular limitation. In this embodiment, the exhaust gas treating tower 1 is anchored to an anchor bar 25 spanning through the trestle 120 so as to be held in a slanted or

horizontally laid state. Thereafter, the fastening members 10a are loosened to allow the internal structural components 45 to be drawn out of the tower main body 3 from the bottom portion thereof. When necessary operations such as to replace the electric heater 7 or the gas supply pipe 6 with a new one and to reinforce or repair the lining member 3a have been completed, the internal structural components 45 are secured to the bottom portion of the tower main body 3 again by means of the fastening members 10a.

Thereafter, the anchor bar 25 is removed to cause the exhaust gas treating tower 1 to rotate to resume its upright position, and the tower 1 is secured to the trestle 120, followed by restoration of connection of the pipes and wires to the tower 1. Thus, a series of maintenance operations are completed.

Fig. 12 illustrates another embodiment of the suspension structure where the electric heater 7 extends vertically downwardly from the top of the tower main body 3. When this embodiment is subjected to maintenance, the internal structural components 45 including the electric heater 7 attached to the top of the tower main body 3 is drawn out of or insert into the tower main body 3. In this embodiment, the support shafts 28 projecting from opposite sides of a lower portion (or an upper portion) of the jacket 3a of the tower main body 3 are supported by bearings 29 formed on the trestle 28 so as to allow the tower main body 3 to stand or lie.

When the exhaust gas treating tower 1 is subjected to maintenance, the tower 1 is laid about the support shafts 28 so that the top portion of the tower main body 3 comes out of the cabinet 27. Then, the exhaust gas treating tower 1 is anchored to anchor bar 25 spanning through the trestle 28 for example so as to be held as slanted or laid horizontally. In a manner similar to the foregoing, the internal structural components 45 including the electric heater 7 are drawn out of the tower main body 3 for necessary maintenance operations to be performed and then fitted again to the tower main body 3.

According to the present invention, the electric feeding section of the electric heater standing upright in the exhaust gas decomposition chamber is located in the bottom member fitted to the bottom portion of the exhaust gas treating chamber. Since the bottom member is held at the lowest temperature, the electric feeding section is kept at a relatively low temperature even when the temperature of an upper part (ceiling) within the tower main body becomes high, whereby the electric feeding section can be prevented from short-circuiting. Further, since the gas supply pipe for allowing low-temperature exhaust gas to pass therethrough extends through the bottom member, heat exchange occurs between the bottom member and the gas supply pipe and, accordingly, the exhaust gas is preheated while the bottom member is cooled. Thus, the electric feeding section can be prevented from short-circuiting further assuredly.

Since the exhaust gas is preheated during its ascent within the gas supply pipe by the vertically extending electric heater, there is no need to impose an excessive load on the electric heater thereby minimizing a heat loss, while at the same time, the lifetime of the electric heater can be prolonged significantly.

If the exhaust gas treating tower is provided with a cooling section, the tower not only exhibits the foregoing cooling effect but also enjoys an advantage of effectively cooling the bottom member by means of the cooling section, thereby effectively preventing dielectric breakdown at the electric feeding section.

Since a plurality of electric heater units are interconnected through the energizing bridge member defining fitting holes in clearance fit with the electric heat units to form the electric heater, the electric heater can be tailored in size to the exhaust gas decomposing chamber and hence is very convenient for use.

The exhaust gas treating tower is further provided with dust removing means having an opening oriented toward a dust-deposited part within the exhaust gas decomposing chamber of the tower main body for intermittently jetting an inert gas into the exhaust gas decomposing chamber. The dust removing means makes it possible to blow off very fine and light dust like fluff and remove it from the tower, thereby preventing deposition

of dust within the tower. Thus, it is possible to prevent the internal space of the tower from narrowing due to deposition of dust and, hence, the function of the tower is not impaired over a long time, thus prolonging the maintenance interval significantly as compared with the maintenance interval required of the prior art equipment.

Further, since the exhaust gas treating tower is rotatably supported in the cabinet, it can be laid horizontally or slanted when subjected to its maintenance. Thus, the bottom or top portion of the exhaust gas treating tower can be drawn out of the cabinet with the tower being fixed in a slanted or horizontally laid state thereby allowing necessary maintenance operations to be performed with the tower in this state. Thus, the present invention solves at a time the problems essential to the prior art such as operations at a high place, the ceiling of a clean room too low, and very difficult removal or insertion of an internal structural component from the bottom of the exhaust gas treating tower due to intricate piping in the cabinet or the complicated structure of the cabinet for accommodating the tower.

While only certain presently preferred embodiments of the present invention have been described in detail, as will be apparent for those skilled in the art, certain changes and modifications may be made in embodiments without departing from the spirit and scope of the present invention as defined by

the following claims.



What is claimed is:

1. An electric heater comprising: a plurality of electric heater units each having electric feeding sections at opposite ends thereof and a heat generating section extending between the electric feeding sections; and an energizing bridge member formed of a same material as the electric feeding sections and spanning across adjacent electric feeding sections located on one side, wherein:

the energizing bridge member defines fitting holes each in clearance fit with each of the adjacent electric feeding sections of the electric heater units associated with the energizing bridge member; and

the energizing bridge member and the adjacent electric feeding sections are bonded to each other with an inorganic adhesive formed from the same material as the electric feeding sections and filling a clearance defined between each of the fitting holes and the electric feeding section fitted therein.

2. An exhaust gas treating tower for use in exhaust gas treatment equipment, comprising:

(a) a tower main body defining an exhaust gas decomposing chamber therein;

(b) a bottom member fitted to a bottom portion of the tower main body;

(c) a gas supply pipe extending through the bottom member



and standing upright in the tower main body for introducing an exhaust gas from a leading end thereof into the exhaust gas decomposing chamber; and

(d) an electric heater having an electric feeding section located in the bottom member and extending upright from the bottom member.

3. The exhaust gas treating tower according to claim 2, further comprising dust removing means disposed at a ceiling portion of the tower for intermittently jetting an inert gas from an opening of the dust removing means oriented parallel with a ceiling portion of the exhaust gas decomposing chamber.

4. The exhaust gas treating tower according to claim 2, further comprises dust removing means disposed at a bottom portion of the tower for intermittently jetting an inert gas from an opening of the dust removing means defined in a lower portion of the gas supply pipe.

5. The exhaust gas treating tower according to claim 2, further comprising a cabinet accommodating the tower main body therein, the cabinet being provided with bearings, and shafts outwardly extending from opposite lateral sides of the exhaust gas treating tower and rotatably supported by the bearings of the cabinet.



6. An exhaust gas treating tower for use in exhaust gas treatment equipment, comprising:

(a) a tower main body defining an exhaust gas decomposing chamber therein, the exhaust gas decomposition chamber having a bottom portion provided with a cooling section;

(b) a bottom member fitted to a bottom portion of the tower main body and cooled by the cooling section;

(c) a gas supply pipe extending through the bottom member and standing upright in the tower main body for introducing an exhaust gas from a leading end thereof into the exhaust gas decomposing chamber; and

(d) an electric heater having an electric feeding section located in the bottom member and extending upright from the bottom member.

7. The exhaust gas treating tower according to claim 6, wherein the cooling section comprises:

(a) a cooling wall forming a side wall of the bottom portion of the exhaust gas decomposing chamber and extending to the bottom member;

(b) a cooling fluid flow circuit formed on an outer peripheral surface of the exhaust gas treating tower so as to circumscribe the tower main body;

(c) a cooling fluid jetting pipe disposed in the cooling fluid flow circuit for jetting a cooling fluid circumferentially of the



tower main body; and

(d) cooling fluid jetting slits defined in the cooling fluid flow circuit along an inner periphery of the cooling wall.

8. The exhaust gas treating tower according to claim 6, wherein the cooling section comprises:

(a) a cooling wall forming a side wall of the bottom portion of the exhaust gas decomposing chamber and extending to the bottom member; and

(b) cooling fluid jetting pipes disposed along the cooling wall for jetting a cooling fluid circumferentially of the cooling wall.

9. The exhaust gas treating tower according to claim 6, further comprising a shielding wall extending vertically downwardly from a lower edge of a lining member defining the exhaust gas decomposing chamber so as to cover an upper portion of the inner periphery of the cooling wall.

10. The exhaust gas treating tower according to claim 6, further comprising dust removing means disposed at a ceiling portion of the tower for intermittently jetting an inert gas from an opening of the dust removing means oriented parallel with a ceiling portion of the exhaust gas decomposing chamber.



11. The exhaust gas treating tower according to claim 6, further comprising dust removing means disposed at the bottom portion of the tower for intermittently jetting an inert gas from an opening of the dust removing means defined in a lower portion of the gas supply pipe.

12. The exhaust gas treating tower according to claim 6, further comprising a cabinet accommodating the tower main body therein, the cabinet being provided with bearings, and shafts outwardly extending from opposite lateral sides of the exhaust gas treating tower and rotatably supported by the bearings of the cabinet.