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(54) Apparatus and method for recovering heat from fluid-bed type incinerator, and method for inhibiting production of dioxins

Apparat und Verfahren zur Rückgewinnung von Abgaswärme in einer Wirbelschichtverbrennungsanlage und Verfahren zur Verhinderung der Dioxinbildung

Appareil et procédé pour la récupération de chaleur dans un incinérateur à lit fluidisé et procédé pour empêcher la formation des dioxines

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- **PATENT ABSTRACTS OF JAPAN vol. 018, no. 314 (M-1621), 15 June 1994 & JP 06 066417 A (MITSUBISHI HEAVY IND LTD), 8 March 1994**

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Description

REFERENCE TO PATENTS, APPLICATIONS AND PUBLICATIONS PERTINENT TO THE INVENTION

[0001] As far as we know, there are available the following prior art documents pertinent to the present invention:

(1) Japanese Patent Publication No. JP-B-5-23,321 published on April 2, 1993,
(2) Japanese Patent Provisional Publication No. JP-A-8-189,627 published on July 23, 1996,
(3) Japanese Patent Provisional Publication No. JP-A-6-66,417 published on March 8, 1994, and
(4) Japanese Patent Publication No. JP-B-61-24,606 published on June 11, 1986.

[0002] The contents of the prior art disclosed in the above-mentioned prior art documents will be discussed later under the heading of the "BACKGROUND OF THE INVENTION".

BACKGROUND OF THE INVENTION

FIELD OF THE INVENTION

[0003] The present invention relates to an apparatus and a method for recovering heat generated during the incineration of combustible wastes, such as city garbage containing incombustible matters, waste plastics and industrial wastes, in a fluid-bed type incinerator, and a method for inhibiting resynthesis of detrimental dioxins occurring in a combustion waste gas discharged from the incinerator.

RELATED ART STATEMENT

[0004] In a fluid-bed type incinerator, in general, a fluid layer of sand particles and the like as a fluid medium is formed in a lower portion of the incinerator. Combustible wastes charged into the incinerator are burnt while being fluidized together with the sand particles which have been previously heated to a prescribed temperature, in the fluid layer. An air chamber is provided on a bottom of the fluid-bed type incinerator. Air blown into the air chamber from a blower is ejected upward from the air chamber into the incinerator through an air dispersing plate such as a porous plate, and the thus ejected air fluidizes the fluid medium such as sand particles, thereby forming the fluid layer. In the fluid layer, the fluid medium moves up and down to form a fluidized state. A combustion waste gas produced from the combustion of the wastes is, on the other hand, introduced through a flue into a dust collector, in which dust contained in the combustion waste gas is collected.

[0005] As an apparatus for recovering heat generated in the fluid layer by the combustion of combustible wastes in the fluid-bed type incinerator, there are known, for example, an apparatus disclosed in Japanese Patent Publication No. JP-B-5-23,321 (hereinafter referred to as the "prior art 1") and another apparatus disclosed in Japanese Patent Provisional Publication No. JP-A-8-189,627 (hereinafter referred to as the "prior art 2").

[0006] A typical conventional method for recovering heat in the prior art 1 will be described below with reference to Figs. 5 and 6.

[0007] In the conventional apparatus shown in Fig. 5, combustible wastes such as city garbage and industrial wastes are charged through a waste charging port (not shown) provided on the upper portion of a fluid-bed type incinerator 1 into a fluid layer 2 kept at substantially a uniform temperature. The charged wastes are burnt while being fluidized together with the sand particles as a fluid medium, in the fluid layer 2.

[0008] Incombustible matters contained in the wastes to be incinerated are transferred outside the incinerator through an incombustible matter discharge port (not shown) provided on the bottom of the incinerator 1. Slant partitions 5 are provided above an upper portion of an air chamber 4 positioned near an incinerator side wall, of the air chamber 4 partitioned into a plurality of cells. Under the effect of the slant partitions 5, air for fluidizing the fluid medium is reflected toward the center of the incinerator 1. As a result, a rotary flow 3 is produced in the fluid layer of the fluid medium as shown by a large arrow in Fig. 5. Between the slant partition 5 and the incinerator side wall, a heat recovering chamber 6 partitioned by them is formed, and plurality of heat transfer tubes 7 are inserted horizontally from the incinerator side wall toward the slant partition 5. A part of the fluid medium forming the fluid layer 2 passes over the slant partition 5 and enters the heat recovering chamber 6. In the course of sinking of the fluid medium in the heat recovering chamber 6, heat of the fluid medium is recovered by means of the heat transfer tubes 7. The fluid medium after being recovered heat, circulates again to the center portion of the incinerator 1 and is incorporated into the rotary flow 3.

[0009] In another apparatus shown in Fig. 6 of the prior art 1, a plurality of straight heat transfer tubes 7 are substantially vertically arranged in a heat recovering chamber 6 of a fluid-bed type incinerator 1 along a side wall thereof. An upper portion and a lower portion of each of the plurality of heat transfer tubes 7 are connected to an upper water

chamber 9 and a lower water chamber 10, respectively. The upper water chamber 9, the heat transfer tubes 7 and the lower water chamber 10 communicate with each other.

[0010] According to this apparatus, therefore, it is possible to arrange a plurality of straight heat transfer tubes substantially vertically around a free board section and a heat recovering chamber 6 above a main combustion chamber of the incinerator 1, thereby enabling to make the incinerator 1 compact.

[0011] The prior art 2 discloses a heat recovering apparatus in which a plurality of heat transfer tubes are inserted horizontally from the incinerator side wall horizontally into the incinerator, as in the apparatus of the prior art 1 shown in Fig. 5.

[0012] The above-mentioned conventional apparatuses of the prior arts 1 and 2 have the following problems.

(1) In the conventional heat recovering apparatus, which is provided with the plurality of heat transfer tubes 7 inserted into the heat recovering chamber 6, each having a horizontal tube portion in the middle thereof as shown in Fig. 5, incombustible matters such as fine wires, which have a relatively small bulk specific gravity, and exhibit a behavior similar to that of the fluid medium, come into the heat recovering chamber 6, cling to the heat transfer tubes 7, accumulate in spaces between the heat transfer tubes 7, and may clog off the spaces between the heat transfer tubes 7.

Clogging of the spaces between the heat transfer tubes 7 caused by incombustible matters disturbs the flow of the fluid medium in the fluid layer 2, thereby impairing satisfactory formation of the fluid layer 2 and smooth heat recovery. Further, when replacing the heat transfer tubes 7, the heat transfer tubes 7 cannot easily be pulled out from outside the incinerator 1 because of the incombustible matters clinging to the heat transfer tubes 7, and it is necessary to remove incombustible matters by entering the incinerator 1.

(2) Because the plurality of heat transfer tubes 7 inserted into the incinerator side wall are horizontally arranged, the spaces between the heat transfer tubes 7 and holes in the incinerator side wall for the heat transfer tubes 7 are filled with the fluid medium. This requires very troublesome operations for pulling out the heat transfer tubes 7 for replacement and inserting new heat transfer tubes into the incinerator 1.

(3) Because the plurality of heat transfer tubes 7 are arranged so as to be immersed into the fluid layer 2 of the fluid medium, it is necessary to take out the fluid medium in the incinerator 1 to outside with a view to preventing the occurrence of a burn and other accidents caused by the splash of the high-temperature fluid medium from the fluid layer 2 to outside the incinerator 1 during the replacement of the heat transfer tubes 7. The fluid medium loses the heat quantity accumulated therein through the operation of taking out the fluid medium to outside the incinerator 1. In order to incinerate combustible wastes again in the incinerator 1, therefore, the incinerator 1 must be started up from the cold state, and this requires much time.

(4) In a heat recovering apparatus as shown in Fig. 6, in which the plurality of heat transfer tubes 7 are arranged in the vertical direction, the same problems as described above are encountered regarding the replacement of heat transfer tubes 7, although there occur a decreased number of troubles as mentioned above caused by incombustible matters. More specifically, in order to prevent the occurrence of burn and other accidents caused by the splash of the high-temperature fluid medium from the fluid layer 2 to outside the incinerator 1, it is necessary to take out the high-temperature fluid medium in the incinerator 1 to outside, and because of the compacted incinerator body, replacement of the heat transfer tubes 7 requires much time and cost.

[0013] When replacing the heat transfer tubes 7 of the conventional fluid-bed type incinerator 1 because of wear thereof or for inspection, the operation of the incinerator 1 must be discontinued for a long period of time so as to prevent troubles caused by incombustible matters while ensuring safety.

[0014] In an incinerator for incinerating industrial wastes or household wastes, on the other hand, a combustion waste gas produced during the combustion of wastes is introduced through a flue into a dust collector, and after the collection of dust and the like, diffused to the open air.

[0015] The combustion waste gas produced during the combustion of wastes in the incinerator contains dioxins having a strong toxicity though in a slight amount, which include polychlorinated dibenzo-p-dioxin and polychlorinated dibenzofuran. Inhibition of the production of these dioxins is now an important problem.

[0016] For the inhibition of production of dioxins, the following methods are known:

(1) A method for inhibiting the production of dioxins in an incinerator by appropriately adjusting combustion conditions comprising the combustion temperature, the gas staying time and the gas turbulence condition during the combustion, which are set forth in the Guideline established by the Ministry of Health and Welfare, when incinerating wastes in the incinerator (hereinafter referred to as the "prior art 3").

(2) Japanese Patent Provisional Publication No. JP-A-6-66,417 discloses a method for inhibiting the production of dioxins in an incinerator, which comprises the steps of: charging calcium compounds such as calcium hydroxide, calcium oxide and calcium carbonate into the incinerator together with wastes, and burning same in the incinerator to cause a reaction with a hydrogen chloride gas causing the production of dioxins, so as to keep the concentration of hydrogen chloride at the incinerator exit on a level lower than a certain value, thereby inhibiting the production of dioxins in the incinerator (hereinafter referred to as the "prior art 4").

[0017] Further, Japanese Patent Publication No. JP-B-61-24,606 discloses a method for removing hydrogen chloride contained in a combustion waste gas discharged from an incinerator, which comprises the step of: when forming a fluid layer comprising inert particles in an incinerator to burn wastes in said fluid layer, adding granular dolomite containing particles having a particle size of from about 2 to 5 mm in an amount of at least about 80 wt.% into the incinerator, thereby removing hydrogen chloride in a combustion waste gas (hereinafter referred to as the "prior art 5").

[0018] According to the adjustment of the combustion conditions of the prior art 3 and the charging of the calcium compounds into the incinerator of the prior art 4, it is possible to reduce the contents of dioxins in the combustion waste gas at a combustion waste gas discharge port of the incinerator.

[0019] However, even when the production of dioxins in the incinerator can be inhibited by any of the foregoing methods disclosed in the prior arts 3 and 4, a problem is posed in that dioxins are resynthesized in a flue by means of chlorine (Cl), hydrogen chloride (HCl) and others remaining in the combustion waste gas, while the combustion waste gas discharged from a combustion waste gas discharge port of the incinerator, is introduced through the flue into a dust collector for collecting dust, thus resulting in the increase of the concentration of the dioxins.

[0020] Further, the prior art 5 discloses a method for removing hydrogen chloride in a combustion waste gas by adding granular dolomite containing particles having a particles size of from about 2 to 5 mm, but discloses nothing about inhibition of production of dioxins.

SUMMARY OF THE INVENTION

[0021] An object of the present invention is therefore to overcome the problems in the above-mentioned prior arts and to provide an apparatus and a method for recovering heat generated in a fluid-bed type incinerator during the incineration of combustible wastes such as industrial wastes in the incinerator, which apparatus and method permit the performance of replacement operation of a plurality of heat transfer tubes safely in a short period of time without causing incombustible matters in the wastes to cling to the heat transfer tubes, as well as a method for inhibiting the production of dioxins, which enables to inhibit the resynthesis of dioxins in a flue running from the incinerator to the dust collector, while a combustion waste gas discharged from a combustion waste gas discharge port of the incinerator, is introduced through the flue into the dust collector for collecting dust.

[0022] In accordance with one of the features of the present invention, there is provided a method for recovering heat from an incinerator, which comprises the steps of:

removably arranging, in a fluid-bed type incinerator having a fluid layer, a plurality of U-shaped heat transfer tubes each having two vertical tube portions and a bent tube portion in said incinerator from a wall thereof in a vertical direction so that said bent tube portion is immersed into the fluid layer;

passing a heat receiving medium sequentially through one of said vertical tube portions, said bent tube portion and the other of said vertical tube portions of each of said plurality of heat transfer tubes, thereby recovering heat generated from combustion of wastes in said fluid layer via said heat receiving medium.

[0023] In accordance with another one of the features of the present invention, there is provided an apparatus for recovering heat from an incinerator, in which a plurality of heat transfer tubes are arranged in a peripheral portion of a fluid layer of a fluid-bed type incinerator, and heat generated from combustion of an object to be incinerated in said fluid layer is recovered via a heat receiving medium flowing through said plurality of heat transfer tubes;

characterized in that:

each of said plurality of heat transfer tubes comprises a U-shaped heat transfer tube which has two vertical tube portions and a bent tube portion, both ends thereof communicating respectively with said vertical tube portions; and

said plurality of heat transfer tubes are removably arranged in said incinerator from a wall thereof in a vertical direction.

[0024] In the foregoing apparatus of the present invention for recovering heat from the incinerator, said plurality of

heat transfer tubes comprise unit heat transfer tubes.

[0025] In accordance with further another one of the features of the invention, there is provided a method for recovering heat from an incinerator and inhibiting production of dioxins, which comprises the steps of:

removably arranging, in a fluid-bed type incinerator having a fluid layer, a plurality of U-shaped heat transfer tubes each having two vertical tube portions and a bent tube portion in said incinerator from a wall thereof in a vertical direction so that said bent tube portion is immersed into said fluid layer;

passing a heat receiving medium sequentially through one of said vertical tube portions, said bent tube portion and the other of said vertical tube portions of each of said plurality of heat transfer tubes, thereby recovering heat generated from combustion of wastes in said fluid layer via said heat receiving media; and

supplying, when introducing a combustion waste gas produced from said combustion of said wastes into a dust collector through a flue to collect dust in said combustion waste gas, a calcium compound having a particle size of up to 500 μm into said incinerator to cause a reaction between said combustion waste gas discharged from said incinerator and said calcium compound in said flue running from said incinerator to said dust collector, thereby inhibiting resynthesis of dioxins, which occurs in said combustion waste gas flowing through said flue.

BRIEF DESCRIPTION OF THE DRAWINGS

[0026]

Fig. 1 is a schematic sectional view illustrating a first embodiment of an apparatus and a method of the present invention for recovering heat from a bluid-bed type incinerator;

Fig. 2 is a schematic sectional view illustrating a second embodiment of the apparatus and the method of the present invention for recovering heat from a fluid-bed type incinerator;

Fig. 3 is a schematic sectional view illustrating a third embodiment of the apparatus and the method of the present invention for recovering heat from a fluid-bed type incinerator;

Fig. 4 is a conceptural view illustrating a method of the present invention for inhibiting production of dioxins;

Fig. 5 is a schematic sectional view illustrating an example of a conventional apparatus for recovering heat from a fluid-bed type incinerator; and

Fig. 6 is a schematic sectional view illustrating another example of a conventional apparatus for recovering heat from a fluid-bed type incinerator.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

[0027] From the above-mentioned point of view, extensive studies were carried out to develop an apparatus and a method for recovering heat generated in a fluid-bed type incinerator during the incineration of combustible wastes such as industrial wastes in the incinerator, which apparatus and method permit the performance of replacement operation of a plurality of heat transfer tubes safely in a short period of time without causing incombustible matters in the wastes to cling to the heat transfer tubes, as well as a method for inhibiting the production of dioxins, which enables to inhibit the resynthesis of dioxins in a flue running from the incinerator to a dust collector, while a combustion waste gas discharged from a combustion waste gas discharge port of the incinerator, is introduced through the flue into the dust collector for dust collection.

[0028] As a result, the following findings were obtained: by vertically arranging a plurality of U-shaped heat transfer tubes each comprising two vertical tube portions and a bent tube portion in a peripheral portion of a fluid layer of a fluid-bed type incinerator so that the bent tube portion is immersed into the fluid layer, and the vertical tube portions are removably attached to an incinerator wall, it is possible to smoothly recover heat from the fluid layer while keeping the fluid layer in a satisfactory state. More specifically, since each of the heat transfer tubes in contact with the fluid layer containing incombustible matters does not have a horizontal portion except for the bent tube portion forming the lower portion of the heat transfer tube, the moving direction of a fluid medium moving only up and down agrees with the axial direction of the heat transfer tube, thus permitting prevention of incombustible matters from clinging to the heat transfer tubes.

[0029] Further, another findings were obtained: by supplying a calcium compound having a particles size of up to 500 μm into the incinerator, it is possible to inhibit the resynthesis of dioxins, occurring in a combustion waste gas flowing through a flue, under the effect of the reaction of the supplied calcium compound with the combustion waste gas discharged from the incinerator, in the flue running from the incinerator to the dust collector.

[0030] The present invention was made on the basis of the foregoing findings, and the method of the present invention for recovering heat from an incinerator comprises the steps of:

removably arranging, in a fluid-bed type incinerator having a fluid layer, a plurality of U-shaped heat transfer tubes each having two vertical tube portions and a bent tube portion in said incinerator from a wall thereof in a vertical direction so that said bent tube portion is immersed into said fluid layer; and

passing a heat receiving medium sequentially through one of said vertical tube portions, said bent tube portion and the other of said vertical tube portions of each of said plurality of heat transfer tubes, thereby recovering heat generated from combustion of wastes in said fluid layer via said heat receiving medium.

[0031] The apparatus of the present invention for recovering heat from an incinerator, in which a plurality of heat transfer tubes are arranged in a peripheral portion of a fluid layer of a fluid-bed type incinerator, and heat generated from combustion of an object to be incinerated in said fluid layer is recovered via a heat receiving medium flowing through said plurality of heat transfer tubes, is characterized in that:

each of said plurality of heat transfer tubes comprises a U-shaped heat transfer tube which has two vertical tube portions and a bent tube portion, both ends thereof communicating respectively with said vertical tube portions; and

said plurality of heat transfer tubes are removably arranged in said incinerator from a wall thereof in a vertical direction.

[0032] In the above-mentioned apparatus of the present invention for recovering heat from an incinerator, said plurality of heat transfer tubes comprise unit heat transfer tubes.

[0033] The method of the present invention for recovering heat from an incinerator and inhibiting production of dioxins, comprises the steps of:

removably arranging, in a fluid-bed type incinerator having a fluid layer, a plurality of U-shaped heat transfer tubes each having two vertical tube portions and a bent tube portion in said incinerator from a wall thereof in a vertical direction so that said bent tube portion is immersed into said fluid layer;

passing a heat receiving medium sequentially through one of said vertical tube portions, said bent tube portion and the other of said vertical tube portions of said heat transfer tube, thereby recovering heat generated from combustion of wastes in said fluid layer via said heat receiving media; and

supplying, when introducing a combustion waste gas produced from said combustion of said wastes into a dust collector through a flue to collect dust in said combustion waste gas, a calcium compound having a particle size of up to 500 μm into said incinerator to cause a reaction between said combustion waste gas discharged from said incinerator and said calcium compound in said flue running from said incinerator to said dust collector, thereby inhibiting resynthesis of dioxins, which occurs in said combustion waste gas flowing through said flue.

[0034] Now, the apparatus and the method of the invention will be described below in detail.

[0035] In the apparatus of the present invention for recovering heat from a fluid-bed type incinerator, each of the plurality of heat transfer tubes comprises a U-shaped heat transfer tube which has two vertical tube portions, and a bent tube portion having both ends thereof communicating with the respective vertical tube portions, and the plurality of heat transfer tubes are removably arranged in the vertical direction in the incinerator from a wall thereof. Further, the plurality of heat transfer tubes may comprise unit heat transfer tubes.

[0036] In the apparatus and the method of the present invention, a heat receiving medium flows downward from above an upper incinerator wall in one of the vertical tube portions, and after reaching the bent tube portion located in a fluid layer of the incinerator, flows upward in the other of the vertical tube portions. The heat receiving medium then flows out to above the upper incinerator wall. The heat receiving medium can therefore efficiently recover heat of the high-temperature fluid layer. Further, since each of the heat transfer tubes in contact with the fluid layer containing incombustible matters does not have a horizontal portion except for the bent tube portion forming the lower portion of the heat transfer tube, the moving direction of the fluid medium moving only up and down agrees with the axial direction

of the heat transfer tube. Therefore, except for very rare incombustible matters, the incombustible matters never cling to the heat transfer tubes, thus permitting smooth recovery of heat from the fluid layer while keeping the fluid layer in a satisfactory state. Further, there is present a very short horizontal portion in the bent tube portion of the heat transfer tube. However, because the gap between the downward vertical tube portion and the upward vertical tube portion is very small, the bent tube portion of the heat transfer tube is almost free from clogging of incombustible matters.

[0037] Since connecting portions of the plurality of heat transfer tubes provided on the incinerator wall are above the fluid layer (i.e., in the present invention, the heat transfer tubes are vertically attached and removed from the incinerator wall located above the fluid layer), it is not necessary to remove the fluid medium from the incinerator upon replacing the heat transfer tubes, thus permitting replacement of the heat transfer tubes in a short period of time. Even when the heat transfer tubes are removed from the incinerator wall, the replacing operation of the heat transfer tubes can be safely carried out without splash of the high-temperature fluid medium to outside the incinerator, because the connecting portions of the heat transfer tubes are located above the fluid layer as described above.

[0038] Furthermore, since the plurality of heat transfer tubes are replaced for each unit heat transfer tubes, the heat transfer tubes can be more efficiently replaced.

[0039] When removing the heat transfer tubes from the incinerator wall, there are produced a hole having a size corresponding to the cross-sectional area of the unit heat transfer tubes in the incinerator wall. As a result, even when a space between the heat transfer tubes is clogged off by unexpectedly large incombustible matters, it is easy to remove such large incombustible matters through the above-mentioned hole having a sufficiently large size produced in the incinerator wall.

[0040] When replacing the plurality of heat transfer tubes, it is possible to easily pull out the heat transfer tubes from the fluid layer or insert the heat transfer tubes into the fluid layer by blowing a fluidizing air into the fluid layer to reduce bulk density thereof.

[0041] Further, in the present invention, upon incinerating the wastes in the incinerator, the production of dioxins in the incinerator is inhibited by appropriately adjusting the combustion conditions, i.e., the combustion temperature, the gas staying time and the gas turbulence condition, as set forth in the Guideline established by the Ministry of Health and Welfare. In the present invention, furthermore, a calcium compound such as limestone ($CaCO_3$) and slaked lime ($Ca(OH)_2$) having a particle size of up to 500 μm is supplied into the incinerator.

[0042] The supplied calcium compound having a particle size of up to 500 μm is introduced into a flue from the incinerator together with a combustion waste gas, and convert hydrogen chloride (HCl) present in the combustion waste gas flowing through the flue and causing the production of dioxins, into innoxious calcium chloride ($CaCl_2$) through a reaction expressed by the following formulae:

$$CaCO_3 \rightarrow CaO + CO_2$$

$$Ca(OH)_2 \rightarrow CaO + H_2O$$

$$CaO + 2HCl \rightarrow CaCl_2 + H_2O$$

[0043] The innoxious calcium chloride ($CaCl_2$) produced from the foregoing reaction is collected in a dust collector and removed. During the time in which the combustion waste gas discharged from the incinerator passes through the flue and reaches the dust collector, therefore, resynthesis of dioxins is certainly inhibited.

[0044] With a particle size of the calcium compound supplied into the incinerator of over 500 μm, most of the supplied calcium compound particles stay in the incinerator and do not reach the flue running from the incinerator to the dust collector. The aforesaid reaction between the calcium compound and the combustion waste gas does not take place in the flue. The particle size of the calcium compound to be supplied into the incinerator should therefore be up to 500 μm. From the point of view of manufacture or handling, the particle size of the calcium compound should preferably be at least 100 μm.

[0045] The amount of supplied calcium compound should preferably be at least 2 in a molar ratio of Ca/(1/2 Cl). When sulfur (S) is contained in the wastes to be incinerated, the amount of supplied calcium compound should preferably be at least 2 in a molar ratio of Ca/(1/2 Cl + S), taking account of the amount of the calcium compound to be consumed in a reaction between sulfur and the calcium compound as represented by the following formula:

$$CaO + SO_2 \rightarrow CaSO_4$$

[0046] In any case, if the aforesaid molar ratio is too large, the amount of supplied calcium would be too large, resulting in an uneconomical operation. The molar ratio of Ca/(1/2 Cl) or Ca/(1/2 Cl + S) should therefore preferably be up to 10.

[0047] The calcium compound may previously be mixed in the wastes to be incinerated to supply same together with the wastes into the incinerator, or may be supplied separately from the wastes into the incinerator.

[0048] Now, the present invention will be described below further in detail by means of examples with reference to the drawings while comparing with examples for comparison.

Examples

Example 1

[0049] Fig. 1 is a schematic sectional view illustrating a first embodiment of the apparatus of the present invention for recovering heat from a fluid-bed type incinerator. By the use of a fluid-bed type incinerator 11 equipped with the apparatus of the first embodiment for recovering heat, the incineration of wastes, the recovery of heat and the replacement of a plurality of heat transfer tubes were carried out.

[0050] In the first embodiment of the apparatus of the present invention, as shown in Fig. 1, a horizontal incinerator wall 13 having holes (not shown) is formed on the incinerator wall surrounding a free board section 12 of the fluid-bed type incinerator 11, and a plurality of U-shaped heat transfer tubes 14 are vertically inserted into the incinerator 11 through the holes piercing the horizontal incinerator wall 13. The plurality of heat transfer tubes 14 are inserted into the incinerator 11 so that a bent tube portion 20 of each heat transfer tube 14 is immersed in a fluid layer 15 to be formed by a fluid medium such as sand particles. Each heat transfer tube 14 comprises two horizontal tube portions 18 connected respectively to an entry header 16 and an exit header 17, two vertical tube portions 19 extending vertically from the respective horizontal tube portions 18, and a U-shaped bent tube portion 20 having both ends thereof communicating with the respective vertical tube portions 19.

[0051] Steam as a heat receiving medium flowing through each heat transfer tube 14 flows, as shown by an arrow in Fig. 1, from the entry header 16 through one of the horizontal tube portions 18 outside the incinerator 11 into one of the vertical tube portions 19 in the incinerator 11, flows downward through the one of the vertical tube portions 19, flows upward through the other of the vertical tube portions 19 via the lowermost bent tube portion 20, and flows out into the exit header 17 through the other of the horizontal tube portions 18. In Fig. 1, 21 is an air dispersing plate; 22 is an air chamber partitioned into a plurality of cells; and 23 is an incombustible matter discharge port.

[0052] Sand particles serving as the fluid medium are fluidized by means of air ejected from the air chamber 22 through the air dispersing plate 21 provided on the bottom of the incinerator 11 to form the fluid layer 15. Combustible wastes such as city garbage, waste plastics and industrial wastes are charged into the thus formed fluid layer 15 to incinerate the wastes.

[0053] The plurality of heat transfer tubes 14 are vertically inserted into the incinerator 11 from the horizontal incinerator wall 13 above the fluid layer 15 as described above. Steam serving as the heat receiving medium first flows downward toward the lowermost portion of each heat transfer tube from the horizontal incinerator wall 13, and after reaching the lowermost bent tube portion 20, flows again upward to flow out from the horizontal incinerator wall 13. Since the sand particles serving as the fluid layer 15, into which each heat transfer tube 14 is inserted, move, on the other hand, only up and down, incombustible matters mixed in the fluid layer 15 are gradually transferred to the center portion of the incinerator 11 by means of the fluidizing sand particles, and discharged to outside the incinerator 11 through the incombustible matter discharge port 23 provided at the center of the bottom wall of the incinerator 11.

[0054] In the apparatus of the present invention, as described above, the plurality of heat transfer tubes 14 are immersed vertically into the fluid layer 15. Motion of the sand particles as the fluid medium moving up and down is therefore never prevented. As a result, a satisfactory fluidized state of the fluid layer 15 could be maintained. Further, incombustible matters in the fluid layer 15 never clinged to the heat transfer tubes 14.

[0055] Replacement of the plurality of heat transfer tubes 14 could easily be accomplished, by releasing the joint between the horizontal incinerator wall 13 of the incinerator 11 and the heat transfer tubes 14, pulling out the heat transfer tubes 14 upward from the incinerator 11, and inserting new heat transfer tubes into the incinerator 11.

[0056] According to the above-mentioned first embodiment of the apparatus of the present invention, heat could efficiently recovered from the fluid layer 15 of the incinerator 11. Further, upon replacing the plurality of heat transfer tubes 14, it was not necessary to discharge the sand particles as the fluid medium to outside the incinerator 11. Even after the completion of the replacing operation of the heat transfer tubes 14, therefore, the fluid layer 15 kept a sufficient temperature necessary for burning combustible wastes. As a result, after the completion of the replacing operation of the heat transfer tubes 14, the operation of the incinerator 11 could immediately be restarted.

Example 2

[0057] Fig. 2 is a schematic sectional view illustrating a second embodiment of the apparatus of the present invention for recovering heat from a fluid-bed type incinerator. By the use of a fluid-bed type incinerator 11 equipped with the apparatus of the second embodiment for recovering heat, the incineration of wastes, the recovery of heat and the replacement of the plurality of heat transfer tubes were carried out.

[0058] In the second embodiment of the apparatus of the present invention, unit heat transfer tubes 25 are used . The unit heat transfer tubes 25 comprise a connector 24, of which the interior is partitioned into prescribed shapes, and a plurality of U-shaped heat transfer tubes 14, of which the both ends communicate with the connector 24. In other words, in the unit heat transfer tubes 25, the plurality of heat transfer tubes 14 are integrated into one by means of the connector 24.

[0059] Steam as a heat receiving medium flowing through each heat transfer tube 14 flows, as shown by an arrow in Fig. 2, from the connector 24 into one of the vertical tube portions 19 in the incinerator 11, flows downward through the one of the vertical tube portion 19, flows upward through the other of the vertical tube portions 19, via the lowermost bent tube portion, and flows out into the connector 24.

[0060] In Fig. 2, 12 is a free board section; 21 is an air dispersing plate; 22 is an air chamber partitioned into a plurality of cells, and 23 is an incombustible matter discharge port.

[0061] Because the unit heat transfer tubes 14 are immersed vertically into the fluid layer 15 as in the Example 1, motion of the sand particles as the fluid medium moving up and down is never prevented. As a result, a satisfactory fluidized state of the fluid layer 15 could be maintained. Further, incombustible matters in the fluid layer 15 never clinged to the heat transfer tubes 14.

[0062] Replacement of the unit heat transfer tubes 25 formed as described above could easily and rapidly be accomplished, by releasing the joint between the horizontal incinerator wall 13 of the incinerator 11 and the unit heat transfer tubes 25, pulling out the unit heat transfer tubes 25 upward from the incinerator 11, and inserting new unit heat transfer tubes 25 into the incinerator 11, thus permitting a easy replacement of a plurality of heat transfer tube in a lump.

[0063] The number of the heat transfer tubes 14 in the unit heat transfer tubes 25 is determined within a range of from two to several hundred in an incinerator having a capacity within a range of from 24 to 300 tons/day, in response to a heat quantity to be recovered from the fluid layer 15 of the incinerator 11, and a position for insertion of the unit heat transfer tubes 25.

[0064] According to the above-mentioned second embodiment of the apparatus of the present invention, heat could efficiently be recovered from the fluid layer 15 of the incinerator 11. Further, upon replacing the unit heat transfer tubes 25, it was not necessary to discharge the sand particles serving as the fluid medium to outside the incinerator 11. As a result, even after the completion of the replacing operation of the unit heat transfer tubes 25, the fluid layer 15 kept a sufficient temperature necessary for burning combustible wastes. After the completion of the replacing operation of the unit heat transfer tubes 25, therefore, the incinerator 11 could immediately be restarted.

Example 3

[0065] Fig. 3 is a schematic sectional view illustrating a third embodiment of the apparatus of the present invention for recovering heat from a fluid-bed type incinerator. By the use of a fluid-bed type incinerator 11 equipped with the apparatus of the third embodiment for recovering heat, the incineration of wastes, the recovery of heat and the replacement of the plurality of heat transfer tubes were carried out.

[0066] The apparatus of the third embodiment has substantially the same fundamental structure as that of the apparatus of the second embodiment shown in Fig. 2 except that a slant incinerator wall 26 is adopted in place of the horizontal incinerator wall 13 in the second embodiment.

[0067] More specifically, in the third embodiment of the apparatus of the present invention, a slant incinerator wall 26 is provided above the fluid layer 15 of the incinerator 11, as shown in Fig. 3. The reason is as follows: when combustible wastes are burnt in the fluid layer 15 with the lowest possible oxygen concentration for the purpose of controlling the oxidized atmosphere and the reduced atmosphere in the incinerator 11 upon burning wastes in the fluid layer 15, unburnt gases having a high calorific value are produced in a large quantity from the fluid layer 15. By providing the slant incinerator wall 26 above the fluid layer 15, it is possible to allow the safe operation of the incinerator 11 while preventing the aforesaid unburnt gases from staying above the fluid layer 15.

[0068] The inclination angle of the slant incinerator wall 26 can be varied between the horizontal and 45° . With an inclination angle of over 45°, the number of heat transfer tubes 14 capable of being inserted into the fluid layer 15 decreases, so that it becomes difficult to sufficiently recover heat from the fluid layer 15. When it suffices for the quantity of recovered heat to be small, however, the inclination angle may be over 45° .

[0069] In the third embodiment of the apparatus of the present invention as well, unit heat transfer tube 25 are used as in the second embodiment. More specifically, the unit heat transfer tubes 25 comprise a connector 24, of which the

interior is partitioned into prescribed shapes, and a plurality of U-shaped heat transfer tubes 14 of which the both ends communicate with the connector 24. That is, in the unit heat transfer tubes 25, the plurality of heat transfer tubes 14 are integrated into one by means of the connector 24.

[0070] While the U-shaped heat transfer tube has so far been described above, a W-shaped heat transfer tube is also applicable.

[0071] In Fig. 3, 12 is a free board section; 21 is an air dispersing plate; 22 is an air chamber partitioned into a plurality of cells; and 23 is an incombustible matter discharge port.

[0072] According to the above-mentioned third embodiment of the apparatus of the present invention, replacement of the unit heat transfer tubes 25 could easily and rapidly be accomplished. Further, heat could efficiently be recovered from the fluid layer 15 of the incinerator 11. In addition, upon replacing the unit heat transfer tubes 25, it was not necessary to discharge the sand particles serving as the fluid medium to outside the incinerator 11. As a result, even after the completion of the replacing operation of the unit heat transfer tube 25, the fluid layer 15 kept a sufficient temperature necessary for burning combustible wastes. After the completion of the replacing operation of the unit heat transfer tube 25, therefore, the incinerator 11 could immediately be restarted.

Example 4

[0073] The method for recovering heat from a fluid-bed type incinerator and for inhibiting the production of dioxins by the use of the apparatuses for recovering heat of the above-mentioned first to third embodiments of the present invention, will be described below by means of an example with reference to the drawing.

[0074] Fig. 4 is a conceptural view illustrating a method of the present invention for inhibiting production of dioxins in a fluid-bed type incinerator. Silica sand particles serving as a fluid medium are placed on an air dispersing plate 32 provided in a fluid-bed type incinerator 31. The silica sand particles are fluidized by means of air blown upward from below the air dispersing plate 32 into the incinerator 31. In Fig. 4, 33 is waste charger into the incinerator 31, and 34 is a calcium compound supplier into the incinerator 31.

[0075] The wastes charged into the incinerator 31 by the waste charger 33 are stirred, dried and burnt by means of the fluid medium in the fluid layer, which have previously been heated to a prescribed temperature by the use of a heater (not shown). The combustion waste gas is discharged from a combustion waste gas discharge port 35 into a flue 36, and flows into a bag filter 37 serving as a dust collector through a waste gas inlet 38. The combustion waste gas of which dust has been removed by means of the bag filter 37 is released to the open air from a waste gas outlet 39.

[0076] The wastes were charged from the waste charger 33 into the above-mentioned incinerator 31, and the wastes were incinerated under the foregoing combustion conditions for inhibiting the production of dioxins. At the same time, limestone as the calcium compound having a particle size of up to 500 μm within the scope of the present invention in an amount of 5 in a molar ratio of Ca/(1/2 Cl + S) within the scope of the present invention, was supplied from the calcium compound supplier 34 into the incinerator 31 (hereinafter referred to as the "example of the invention No. 1"). Then, values of toxic equivalent quantity of dioxins at the combustion waste gas discharge port 35 of the incinerator 31, and the waste gas inlet 38 and the waste gas outlet 39 of the bag filter 37 were measured. The results are shown in Table 1.

[0077] For comparison purposes, values of toxic equivalent quantity of dioxins at the combustion waste gas discharge port 35 of the incinerator 31, and the waste gas inlet 38 and the waste gas outlet 39 of the bag filter 37 were measured for a case where limestone having a particle size within a range of from 1,000 to 2,000 μm outside the scope of the present invention was supplied (hereinafter referred to as the "example for comparison No. 1") and for a case where no calcium compound was supplied (hereinafter referred to as the "example for comparison No. 2"). The results are shown also in Table 1.

Table 1

Particle size of limestone (μm)	Toxic equivalent quantity of dioxins (ng)			Concentration of hydrogen chloride (ppm)	Remarks
	Combustion waste gas discharge port of incinerator	Waste gas inlet of bag filter	Waste gas outlet of bag filter	Combustion waste gas discharge port of incinerator	
≦ 500	1.0	2.4	0.12	250	Example of the invention No. 1

Table 1 (continued)

Particle size of limestone (μm)	Toxic equivalent quantity of dioxins (ng)			Concentration of hydrogen chloride (ppm)	Remarks
	Combustion waste gas discharge port of incinerator	Waste gas inlet of bag filter	Waste gas outlet of bag filter	Combustion waste gas discharge port of incinerator	
1,000 ~ 2,000	0.9	28.0	1.4	220	Example for comparison No. 1
-	2.2	32.0	1.6	360	Example for comparison No. 2

[0078] As is clear from Table 1, in the example of the invention No. 1, in which limestone as the calcium compound having a particles size of up to 500 μm within the scope of the present invention was supplied into the incinerator 31 in accordance with the method of the present invention, values of toxic equivalent quantity of dioxins were remarkably low at the waste gas inlet 38 and the waste gas outlet 39 of the bag filter 37, suggesting that resynthesis of dioxins in the flue 36 running from the incinerator 31 to the bag filter 37 could effectively be inhibited.

[0079] In contrast, in the example for comparison No. 1, in which limestone as the calcium compound having a particle size of from 1,000 to 2,000 μm outside the scope of the present invention was supplied into the incinerator 31, and in the example for comparison No. 2, in which no calcium compound was supplied, the values of toxic equivalent quantity of dioxins were high at the waste gas inlet 38 and the waste gas outlet 39 of the bag filter 37, suggesting that resynthesis of dioxins occurred in the combustion waste gas discharged from the combustion waste gas discharge port 35 of the incinerator 31 in the flue 36 running from the incinerator 31 to the bag filter 37.

[0080] The concentration of hydrogen chloride in the combustion waste gas at the combustion waste gas discharge port 35 of the incinerator 31 was higher in the example of the invention No. 1, in which limestone as the calcium compound having a particle size of up to 500 μm within the scope of the present invention was supplied, than in the example for comparison No. 1, in which limestone having a particle size of from 1,000 to 2,000 μm outside the scope of the present invention was supplied into the incinerator 31. This fact suggested that there was not necessarily a correlation between the concentration of hydrogen chloride at the combustion waste gas discharge port 35 of the incinerator 31 and the concentration of dioxins in the flue 36 running from the incinerator 31 to the dust collector 37.

[0081] According to the method and the apparatus of the present invention, as described above in detail, it is possible to recover heat generated when incinerating wastes in a fluid-bed type incinerator, and carry out the replacing operation of the heat transfer tubes safely in a short period of time without causing incombustible matters in the wastes to cling to the heat transfer tubes. Further, according to the method and the apparatus of the present invention, resynthesis of dioxins is inhibited in the flue running from the incinerator to the dust collector, while the combustion waste gas discharged from the combustion waste gas discharge port of the incinerator is introduced through the flue into the dust collector for collecting dust, thus permitting reduction of the concentration of dioxins, thereby bringing about industrially useful effects.

Claims

1. A method for recovering heat from an incinerator, which comprises the steps of:

removably arranging, in a fluid-bed type incinerator having a fluid layer, a plurality of U-shaped heat transfer tubes each having two vertical tube portions and a bent tube portion in said incinerator from a wall thereof in a vertical direction so that said bent tube portion is immersed into said fluid layer; and

passing a heat receiving medium sequentially through one of said vertical tube portions, said bent tube portion and the other of said vertical tube portions of each of said plurality of heat transfer tubes, thereby recovering heat generated from combustion of wastes in said fluid layer via said heat receiving medium.

2. An apparatus for recovering heat from an incinerator in which a plurality of heat transfer tubes are arranged in a peripheral portion of a fluid layer of a fluid-bed type incinerator, and heat generated from combustion of an object to be incinerated in said fluid layer is recovered via a heat receiving medium flowing through said plurality of heat transfer tubes;
characterized in that:

each of said plurality of heat transfer tubes comprises a U-shaped heat transfer tube which has two vertical tube portions and a bent tube portion, both ends thereof communicating respectively with said vertical tube portions; and

said plurality of heat transfer tubes are removably arranged in said incinerator from a wall thereof in a vertical direction.

3. An apparatus as claimed in Claim 2, wherein:

said plurality of heat transfer tubes comprise unit heat transfer tubes.

4. A method for recovering heat from an incinerator and inhibiting production of dioxins, which comprises the steps of:

removably arranging, in a fluid-bed type incinerator having a fluid layer, a plurality of U-shaped heat transfer tubes each having two vertical tube portions and a bent tube portion in said incinerator from a wall thereof in a vertical direction so that said bent tube potion is immersed into said fluid layer;

passing a heat receiving medium sequentially through one of said vertical tube portions, said bent tube portion and the other of said vertical tube portions of each of said plurality of heat transfer tubes, thereby recovering heat generated from combustion of wastes in said fluid layer via said heat receiving medium; and

supplying, when introducing a combustion waste gas produced from said combustion of said wastes into a dust collector through a flue to collect dust in said combustion waste gas, a calcium compound having a particle size of up to 500 μm into said incinerator to cause a reaction between said combustion waste gas discharged from said incinerator and said calcium compound in said flue running from said incinerator to said dust collector, thereby inhibiting resynthesis of dioxins which occurs in said combustion waste gas flowing through said flue.

5. A method as claimed in Claim 4, wherein:

said calcium compound has a particles size within a range of from 100 to 500 μm.

6. A method as claimed in Claim 4 or 5, wherein:

said calcium compound is supplied in an amount within a range of from 2 to 10 in a molar ratio of Ca/(1/2 Cl) or Ca/(1/2 Cl + S).

Patentansprüche

1. Verfahren zum Rückgewinnen von Wärme aus einem Verbrennungsofen, das folgende Schritte umfaßt:

herausnehmbares Anordnen, in einem Wirbelschicht-Verbrennungsofen mit einer Fluidschicht, von mehreren U-förmigen Wärmeübertragungsrohren, von denen jedes zwei vertikale Rohrabschnitte und einen gebogenen Rohrabschnitt aufweist, in dem Verbrennungsofen von einer Wand desselben in einer Vertikalrichtung, so daß der gebogene Rohrabschnitt in die Fluidschicht eingetaucht ist, und
sequentielles Passierenlassen eines Wärmeaufnahmemediums durch einen der vertikalen Rohrabschnitte, den gebogenen Rohrabschnitt und den anderen der vertikalen Rohrabschnitte jedes der mehreren Wärmeübertragungsrohre, wodurch bei der Verbrennung von Abfall bzw. Müll in der Fluidschicht erzeugte Wärme über das Wärmeaufnahmemedium zurückgewonnen wird.

2. Vorrichtung zum Rückgewinnen von Wärme aus einem Verbrennungsofen, in der mehrere Wärmeübertragungsrohre in einem Umfangsabschnitt einer Fluidschicht eines Wirbelsschicht-Verbrennungsofens angeordnet sind,

und bei der Verbrennung eines zu verbrennenden Gegenstands in der Fluidschicht erzeugte Wärme über ein Wärmeaufnahmemedium, das durch die mehreren Wärmeübertragungsrohre strömt, rückgewonnen wird,
dadurch gekennzeichnet, daß:

jedes der mehreren Wärmeübertragungsrohre ein U-förmiges Wärmeübertragungsrohr umfaßt, das zwei vertikale Rohrabschnitte und einen gebogenen Rohrabschnitt aufweist, wobei beide Enden desselben jeweils mit den vertikalen Rohrabschnitten in Verbindung stehen, und
die mehreren Wärmeübertragungsrohre in dem Verbrennungsofen von einer Wand desselben in einer Vertikalrichtung herausnehmbar angeordnet sind.

3. Vorrichtung nach Anspruch 2, wobei:

die mehreren Wärmeübertragungsrohre Einheits-Wärmeübertragungsrohre umfassen.

4. Verfahren zum Rückgewinnen von Wärme aus einem Verbrennungsofen und zum Verhindern der Erzeugung von Dioxinen, welches folgende Schritte umfaßt:

herausnehmbares Anordnen in einem Wirbelschicht-Verbrennungsofen mit einer Fluidschicht, von mehreren U-förmigen Wärmeübertragungsrohren, von denen jedes zwei vertikale Rohrabschnitte und einen gebogenen Rohrabschnitt aufweist, in dem Verbrennungsofen von einer Wand desselben in einer Vertikalrichtung, so daß der gebogene Rohrabschnitt in die Fluidschicht eingetaucht ist,
sequentielles Passierenlassen eines Wärmeaufnahmemediums durch einen der vertikalen Rohrabschnitte, den gebogenen Rohrabschnitt und den anderen der vertikalen Rohrabschnitte jedes der mehreren Wärmeübertragungsrohre, wodurch bei der Verbrennung von Abfällen bzw. Müll in der Fluidschicht erzeugte Wärme über das Wärmeaufnahmemedium zurückgewonnen wird, und
Zuführen, bei der Einleitung eines Verbrennungsabgases, das bei der Verbrennung des Mülls bzw. der Abfälle erzeugt wird, in einen Staubsammler durch einen Rauchabzug, um Staub in dem Verbrennungsabgas zu sammeln, einer Kalziumverbindung mit einer Partikelgröße von bis zu 500 μm in den Verbrennungsofen, um eine Reaktion zwischen dem aus dem Verbrennungsofen ausgetragenen Verbrennungsabgas und der Kalziumverbindung in dem Rauchabzug, der von dem Verbrennungsofen zum Staubsammler verläuft, zu bewirken, wodurch eine Resynthese von Dioxinen, die in dem durch den Rauchabzug strömenden Verbrennungsabgas auftritt, verhindert wird.

5. Verfahren nach Anspruch 4, wobei:

die Kalziumverbindung eine Partikelgröße in einein Bereich von 100 bis 500 μm aufweist.

6. Verfahren nach Anspruch 4 oder 5, wobei:

die Kalziumverbindung in einer Menge in einem Bereich von 2 bis 10 in einem molaren Verhältnis von Ca/(1/2 Cl) oder Ca/(1/2 Cl + S) zugeführt wird.

Revendications

1. Procédé pour la récupération de chaleur dans un incinérateur, qui comprend les étapes de :

aménagement de manière amovible, dans un incinérateur de type à lit fluidisé comportant une couche fluidisée, d'une pluralité de tubes de transfert de chaleur en forme de U, chaque tube comportant deux parties de tube verticales et une partie de tube recourbée dans ledit incinérateur à partir d'une paroi de celui-ci dans une direction verticale de sorte que ladite partie de tube recourbée est immergée dans ladite couche fluidisée ; et passage en séquence d'un milieu récepteur de chaleur au travers de l'une desdites parties de tube verticales, de ladite partie de tube recourbée et de l'autre desdites parties de tube verticales de chacun de ladite pluralité de tubes de transfert de chaleur, permettant la récupération de la chaleur générée par la combustion de déchets dans ladite couche fluidisée par l'intermédiaire dudit milieu récepteur de chaleur.

2. Appareil pour la récupération de chaleur dans un incinérateur dans lequel une pluralité de tubes de transfert de chaleur est aménagée dans une partie périphérique d'une couche fluidisée d'un incinérateur de type à lit fluidisé,

et la chaleur générée par la combustion d'un objet à incinérer dans ladite couche fluidisée est récupérée par l'intermédiaire d'un milieu récepteur de chaleur passant au travers de ladite pluralité de tubes de transfert de chaleur ;
caractérisé en ce que :

chaque tube de ladite pluralité de tubes de transfert de chaleur comprend un tube de transfert de chaleur en forme de U qui comporte deux parties de tube verticales et une partie de tube recourbée, les deux extrémités de celle-ci étant respectivement en communication avec lesdites parties de tube verticales ; et
ladite pluralité de tubes de transfert de chaleur est aménagée de manière amovible dans ledit incinérateur à partir d'une paroi de celui-ci dans une direction verticale.

3. Appareil selon la revendication 2, dans lequel ladite pluralité de tubes de transfert de chaleur comprend un ensemble de tubes de transfert de chaleur.

4. Procédé pour la récupération de chaleur dans un incinérateur et pour empêcher la formation de dioxines qui comprend les étapes de :

aménagement de manière amovible, dans un incinérateur de type à lit fluidisé comportant une couche fluidisée, d'une pluralité de tubes de transfert de chaleur en forme de U, chaque tube comportant deux parties de tube verticales et une partie de tube recourbée dans ledit incinérateur à partir d'une paroi de celui-ci dans une direction verticale de sorte que ladite partie de tube recourbée est immergée dans ladite couche fluidisée ;
passage en séquence d'un milieu récepteur de chaleur au travers de l'une desdites parties de tube verticales, de ladite partie de tube recourbée et de l'autre desdites parties de tube verticales de chacun de ladite pluralité de tubes de transfert de chaleur, permettant la récupération de la chaleur générée par la combustion de déchets dans ladite couche fluidisée par l'intermédiaire dudit milieu récepteur de chaleur ; et
fourniture, lors de l'apparition de gaz de combustion perdus produits par ladite combustion desdits déchets à l'intérieur d'un collecteur de poussière par un carneau destiné à recueillir la poussière se trouvant dans lesdits gaz de combustion perdus, d'un composé calcique ayant une dimension de particule allant jusqu'à 500 μm à l'intérieur dudit incinérateur afin de provoquer une réaction entre lesdits gaz de combustion perdus libérés par ledit incinérateur et ledit composé calcique dans ledit carneau allant dudit incinérateur au dit collecteur de poussière, empêchant ainsi la synthèse de dioxines qui se produit dans lesdits gaz de combustion perdus qui passent au travers dudit carneau.

5. Procédé selon la revendication 4, dans lequel ledit composé calcique a une dimension de particule dans une plage située entre 100 et 500 μm.

6. Procédé selon la revendication 4 ou la revendication 5, dans lequel ledit composé calcique est fourni en une quantité située dans une plage de 2 à 10 dans un rapport molaire de Ca / (1/2 Cl) ou Ca / (1/2 Cl + S).

FIG. 1

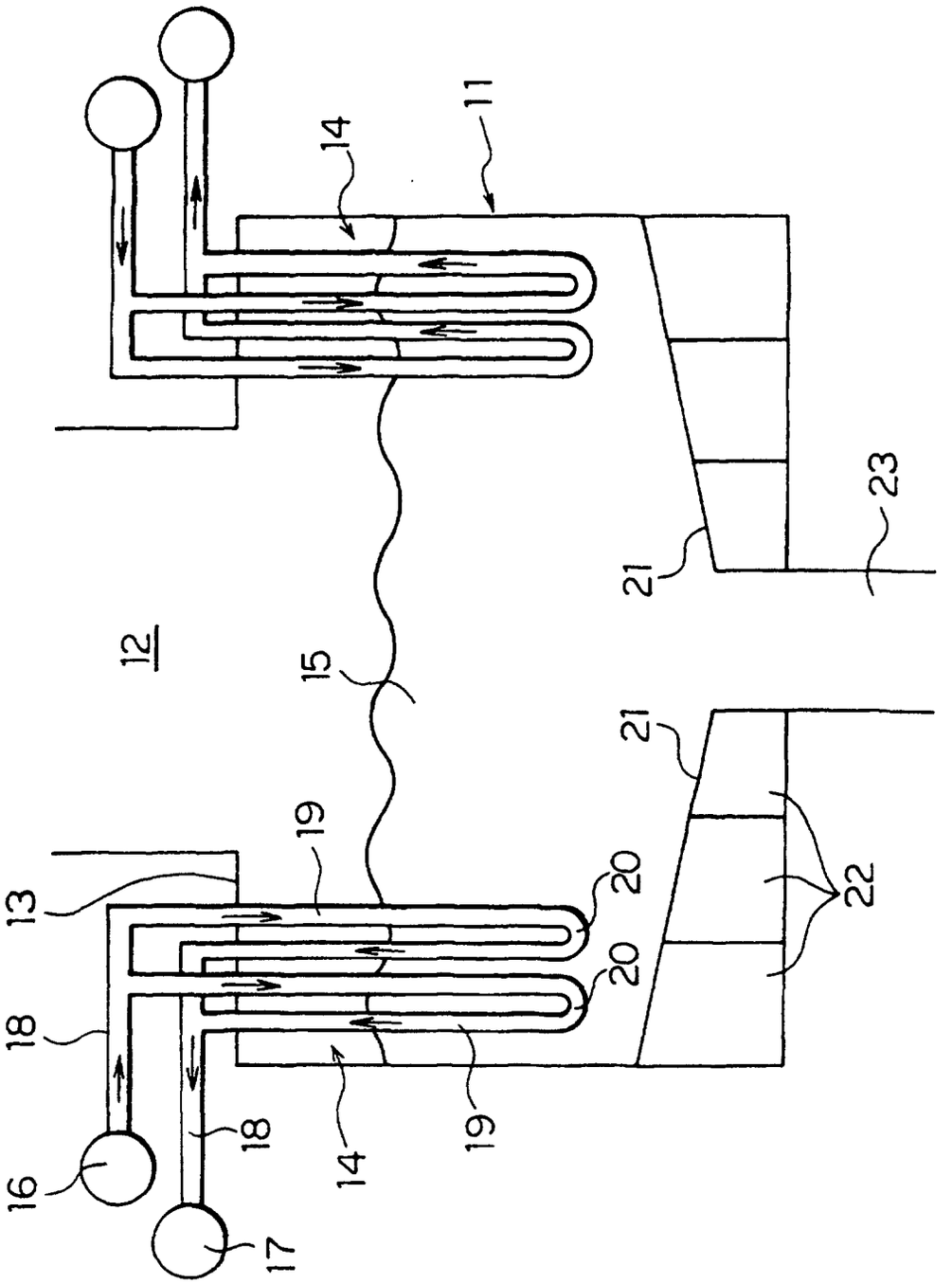

FIG. 2

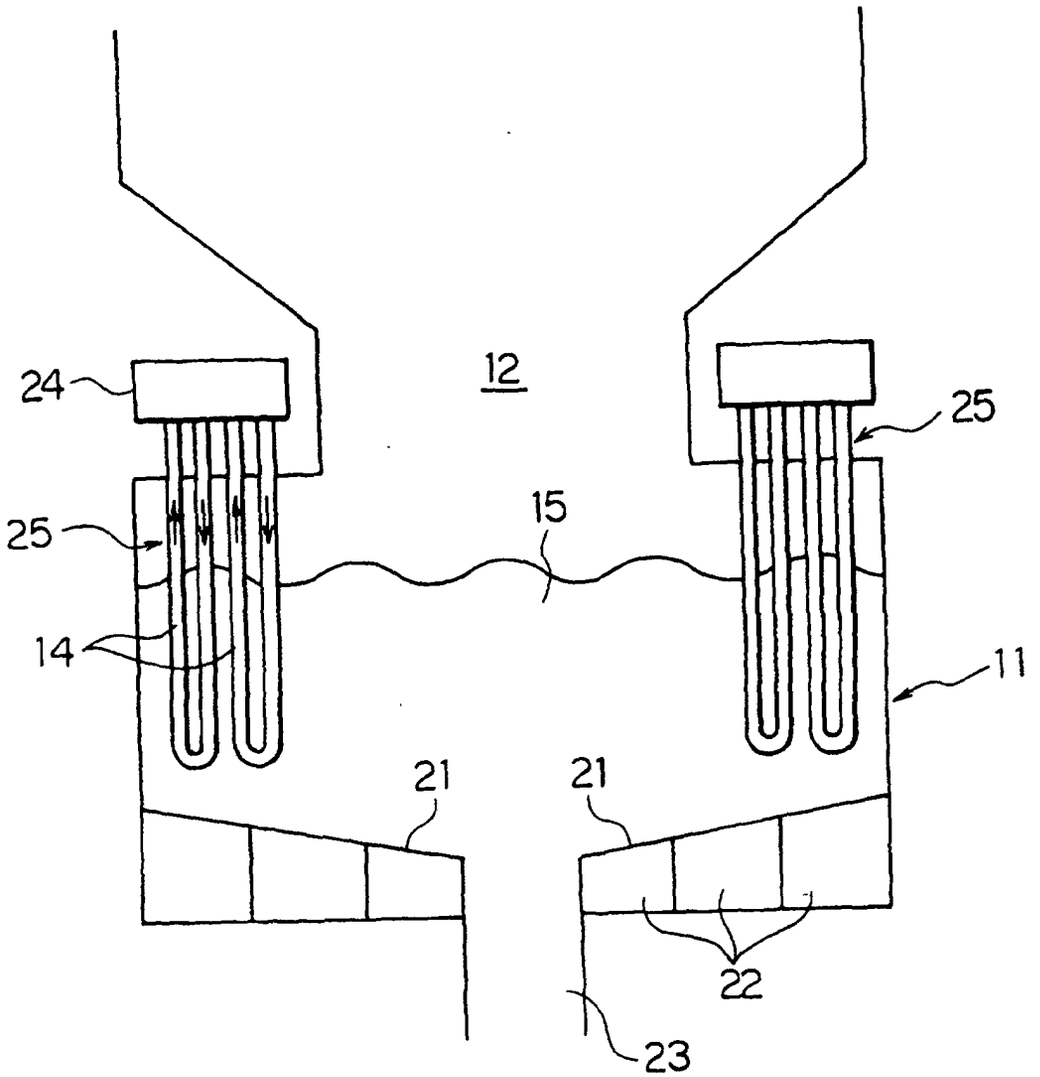

FIG. 3

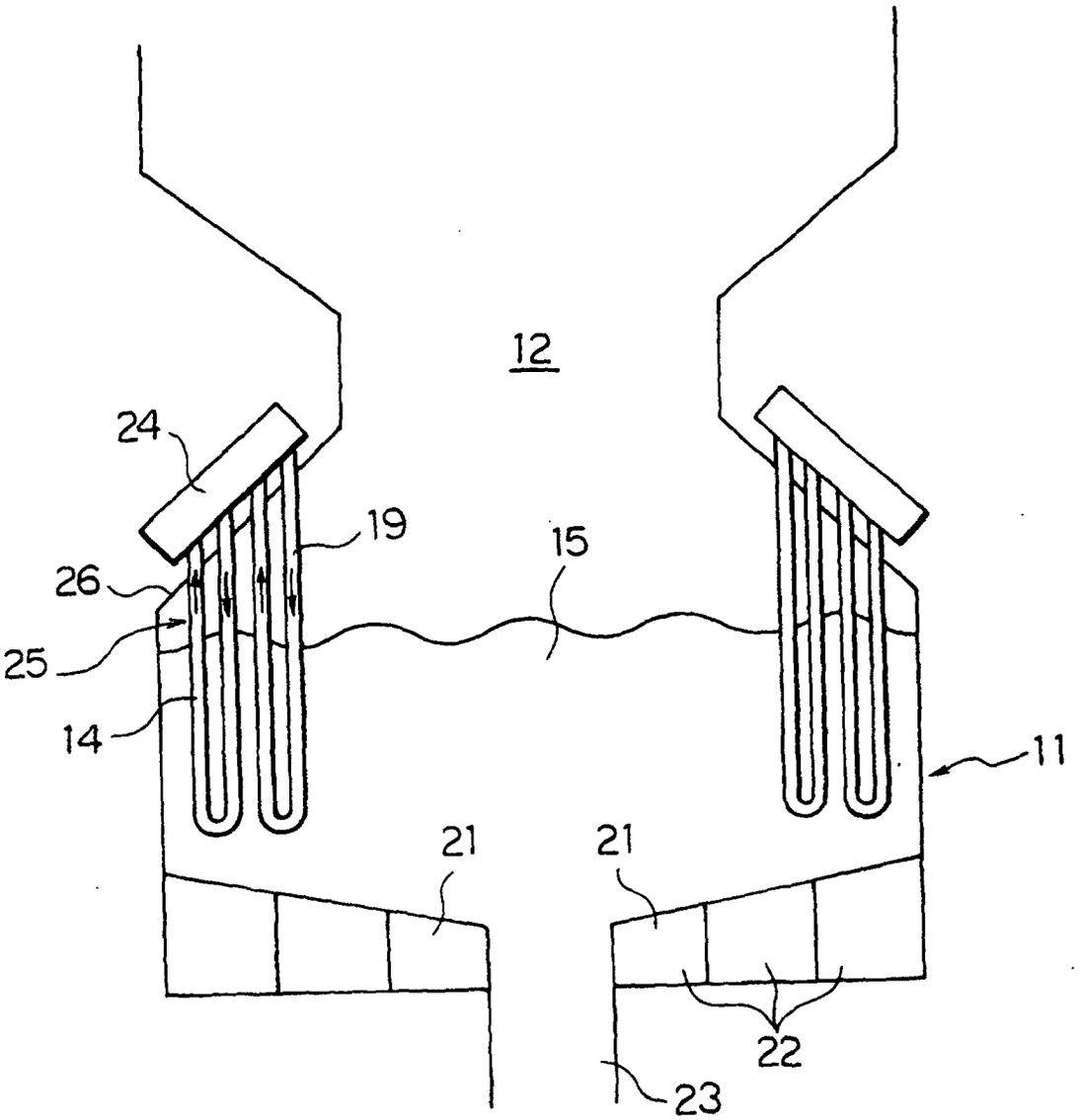

FIG. 4

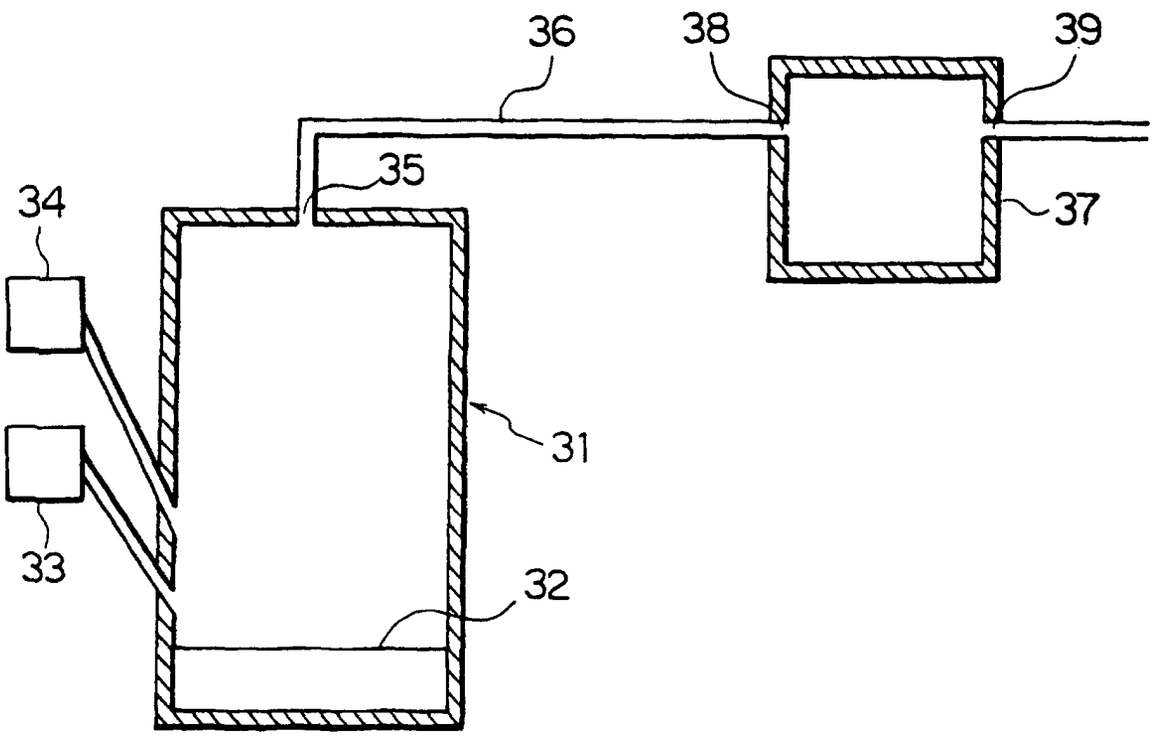

FIG. 5

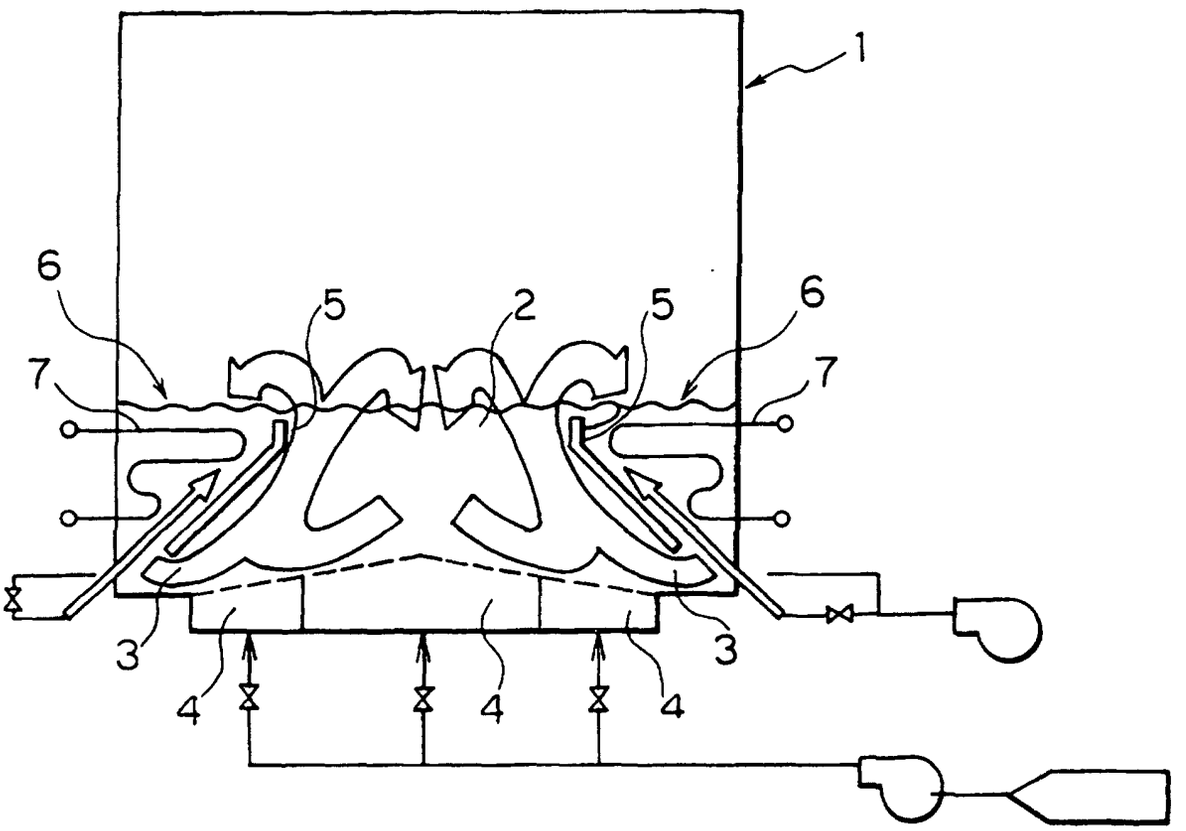

FIG. 6