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(54) SCRUBBER APPARATUS HAVING INTEGRATED VENTURI

SCHEUERVORRICHTUNG MIT INTEGRIERTEM VENTURIROHR

APPAREIL D'ÉPURATEUR AYANT UN VENTURI INTÉGRÉ

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Description

[Technical Field]

[0001] The present invention relates to a scrubber apparatus for collecting and removing harmful substances contained in exhaust gas of a vessel engine, and more particularly, to a venturi-integrated scrubber apparatus in which a venturi structure is integrally installed inside a scrubber main body, and the scrubber main body is configured to be installed or disassembled in multiple stages, thereby reducing a size, volume and weight of the entire scrubber apparatus, so that the transportability, installation, spatial applicability or the like are improved and engines having various sizes are effectively applied thereto.

[Background Art]

[0002] In general, a vessel is operated after installing a main engine configured to drive a propeller for propelling a vessel, and a plurality of power generation engines configured to supply power to various equipment or annexes mounted on the vessel.

[0003] Since an exhaust gas discharged after combustion from a diesel engine of the vessel contains a plurality of suspended particulates, such as dust or fine dust and contains a plurality of harmful gaseous substances such as nitrogen oxide NOx and sulfur oxide SOx, the exhaust gas is regarded as a factor causing the environmental pollution.

[0004] In order to reduce the discharge of the environmental pollutants, the emissions are regulated through environmental regulations in countries around the world. In addition, since the International Maritime Organization (IMO) has a tendency to more strictly regulate the emission control of harmful substances in international waters as well as in ports, the removal of harmful substances contained in exhaust gas of a vessel engine has emerged as an important issue in vessel operations.

[0005] Accordingly, in order to satisfy the environmental regulations, people actively respond to the environmental regulations on the exhaust gas, especially for the vessel engine, by installing and operating, as one of a harmful substances dust collecting apparatus, a selective catalytic reduction (SCR) apparatus for removing nitrogen oxides, a scrubber apparatus for reducing sulfur oxides (SOx removal), or a diesel particulate filter (DPF) apparatus for removing particulate substances in an exhaust line of the engine.

[0006] Among the harmful substances dust collecting apparatuses as described above, the scrubber apparatus, as an apparatus for removing foreign substances in the exhaust gas through the contact and aggregation effect between gas and liquid, is an apparatus serving to purify the exhaust gas by collecting and removing gaseous substances such as sulfur oxides SOx in the exhaust gas and suspended particulates such as dust and fine dust.

[0007] Hereinafter, the conventional scrubber apparatus will be briefly described with reference to FIGS. 1 and 2.

[0008] Herein, FIG. 1 is a schematic diagram showing a scrubber module system for removing harmful substances in exhaust gas of a conventional vessel engine. FIG. 2 is a schematic diagram showing a conventional general scrubber.

[0009] As shown in FIG. 1, the scrubber module system for removing harmful substances in the exhaust gas of a vessel engine is configured to form one module system by connecting a scrubber, a vessel main engine MAIN ENGINE, and a gas and seawater monitoring system GAS & SEA WATER MONITORING SYSTEM for inspecting exhaust gas discharged after scrubbing and sea water introduced to or discharged from the scrubber to each other.

[0010] The scrubber is configured as an OUTSIDE VENTURI TYPE, and a venturi pipe is separately mounted to a side of a scrubber main body as shown in the drawing.

[0011] Accordingly, the exhaust gas discharged from the exhaust line of the main engine is introduced to a lower portion of the scrubber main body via the venturi pipe, scrubbed while moving upward along the inside of the scrubber main body, and discharged to the top of the scrubber main body.

[0012] As shown in FIG. 2, the above-described conventional general scrubber includes a scrubber main body 100 and a venturi pipe 150, and the venturi pipe 150 is installed to be connected to a lower portion of the scrubber main body 100.

[0013] Meanwhile, the scrubber main body 100 is installed therein with dust collection layers 110 in two stages, and provided with a plurality of spraying pipes 120 for spraying moisture to the exhaust gas introduced into the scrubber main body 100 and the dust collection layers 110.

[0014] The dust collection layer 110 refers to a portion filled with packing balls, pall-rings or the like having a plurality of pores through which the exhaust gas passes.

[0015] Accordingly, as indicated using an arrow, the exhaust gas EXHAUST GAS of the main engine introduced from an upper side of the venturi pipe 150 is inputted to a lower side of the scrubber main body 100 via the venturi pipe 150. At this time, the exhaust gas is diffused and expanded by the Venturi effect and moved upward from the lower portion of the scrubber main body 100.

[0016] In the above process, the exhaust gas is scrubbed, in which the gaseous particles such as sulfur oxides and particulates such as dust or fine dust, which are contained therein, come into contact with and aggregate with the moisture particles to fall downward. In addition, after the harmful substances are also collected and removed from the dust collection layer 110, the exhaust gas is discharged upward from the scrubber main body 100.

[0017] The conventional scrubber has been variously proposed according to properties of exhaust gas. As a related art document, Patent Document 1 (Korean Unexamined Patent Publication No. 10-2018-0038420, and Patent Document 2 (Korean registered Patent Publication No. 10-1549560 discloses a scrubber including an external venturi pipe, a dust collection layer, a spraying nozzle, and so on, like the above-described conventional scrubber.

[0018] However, the conventional scrubber as described above has the following problems.

[0019] First, since the venturi pipe capable of diffusing and expanding the exhaust gas is separately mounted to the outside of the scrubber main body, thereby increasing a size, volume, or weight of the entire scrubber, so that the installation cost and time increases significantly. In addition, there are a lot of restrictions on securing a space for installation due to the lack of space caused by the nature of a vessel having a spatial restriction.

[0020] Second, since the scrubber main body is manufactured to have an integrated cylindrical structure, transported and installed, the transportability or installation is significantly deteriorated due to the nature of a heavy-duty vessel engine scrubber of generally about 30 tons and maintenance costs are increased.

[0021] Third, the structural feature of the cylindrical venturi pipe may cause a venturi hole to be easily blocked, due to changes in characteristics such as temperature, flow rate and moisture content of the exhaust gas, or due to the occurrence of scale caused by property changes in particle size distribution, density or the like of a particulate substance required to be removed. Accordingly, the stability of operation is deteriorated.

[0022] Fourth, since it is difficult to expand the conduit of the cylindrical venturi pipe when the amount of exhaust gas to be treated increases, the venturi pipe itself is required to be replaced to have a larger capacity, or a separate venturi pipe is required to be installed. Thus, production costs increases and engines having various sizes are not effectively applicable.

[0023] Fifth, the exhaust gas moving inside the scrubber main body receives a back pressure due to structural obstruction of an internal material such as a scrubber packing, a moisture collector (demister) or the like, and due to cleaning water sprayed in a reverse direction with respect to a flowing direction of the exhaust gas. Accordingly, side effects such as increased engine load and reduced power are generated.

[0024] In order to prevent the back pressure, a separate power-driven forced draft fan has been installed in the related art. In this case, installation costs due to the installation of the additional forced draft fan and the operation costs due to additional power consumption are increased.

[0025] KR 2016 0049782 A discloses a venturi-integrated scrubber apparatus according to the preamble of claim 1.

[0026] KR 101 804 418 B1 discloses another venturi-integrated scrubber apparatus.

[Disclosure]

[Technical Problem]

[0027] The present invention is disclosed to solve the above problems. An object of the present invention is to integrally install a venturi unit inside a scrubber main body, so that an overall size, volume, or weight of the scrubber apparatus is significantly reduced, thereby implementing a miniaturized and compact feature.

[0028] In addition, the work convenience for storage, transportation, installation or the like is improved by configuring the scrubber main body to have a rectangular polyhedral shape and allowing the scrubber main body to be installed or disassembled after separated in multiple stages.

[0029] Another object of the present invention is to ensure the expandability of the venturi conduit by forming a plurality of narrow and long venturi conduits using a plurality of guide vanes.

[0030] In addition, venturi conduits are formed through guide vanes having arc shapes facing each other, and cleaning water spraying pipes are properly disposed along the inside of the scrubber main body as well as the venturi conduits, so that the fluidity of exhaust gas and the dust collection efficiency of harmful substances are improved.

[0031] Still another object of the present invention is to provide a venturi-integrated scrubber apparatus in which a plurality of spraying nozzles installed inside the scrubber main body are disposed in a forward direction to a flowing direction of the exhaust gas so as to add additional kinetic energy to the exhaust gas by using the self-propelled force of the sprayed cleaning water, so that a back pressure against the exhaust gas is effectively prevented from being generated.

[Technical Solution]

[0032] To implement the objects, the present invention includes: a scrubber main body formed in a lower portion thereof with a gas inlet through which exhaust gas is introduced, formed in an upper portion thereof with a gas outlet for discharging the exhaust gas to an outside, and having an empty inside to provide a main flow channel to allow the exhaust gas to move; at least one collection layer installed spaced apart inside the scrubber main body; a venturi unit installed at a lower inner portion of the scrubber main body and formed with at least one venturi conduit through which the exhaust gas passes so as to allow the gas inlet to communicate with the main flow channel; and a plurality of cleaning water spraying pipes installed along a movement path of the exhaust gas to multi-spraying cleaning water in the forward direction of the exhaust gas.

[0033] Accordingly, the venturi unit is integrally in-

stalled inside the scrubber main body, so that an overall size, volume, or weight of the scrubber apparatus may be significantly reduced, thereby implementing a miniaturized and compact feature.

[0034] In addition, the scrubber main body may be formed by connecting box-shaped tubular members having a rectangular polyhedral shape in multiple stages, and at least one drain hole for discharging the cleaning water to the outside may be installed at the lower portion thereof.

[0035] Accordingly, the installing or disassembling work of the scrubber may be easily performed, and costs for maintenance and repair may be reduced.

[0036] Meanwhile, the venturi unit of the present invention may include a partition wall horizontally installed to block a part of the main flow channel, and at least one guide member disposed at predetermined intervals between a lower side of the scrubber main body and the partition wall so that the venturi conduit is spaced apart.

[0037] The guide member may include a support having both ends coupled to the both side walls of the scrubber main body, respectively, and guide vanes installed to face each other on upper and lower sides in a longitudinal direction of the support and provided to form an outwardly convex arc surface so that the venturi conduit formed between the guide members is narrowed.

[0038] Accordingly, the present invention may improve the expandability of the venturi conduit since the guide member for forming the venturi conduit is selected and applied at a proper length to correspond to a displacement of the engine.

[0039] In addition, the venturi vanes having long arc shapes facing each other are applied, so that the smooth flow of the exhaust gas is guided and the dust collection efficiency of harmful substances may be increased.

[0040] Meanwhile, the cleaning water spraying pipes of the present invention may include a venturi spraying pipe installed at a front side of the venturi conduit to spray the cleaning water toward the venturi conduit.

[0041] In addition, the cleaning water spraying pipes may include at least one reverse spraying pipe for spraying the cleaning water in a reverse direction with respect to a flowing direction of the exhaust gas in an upper portion of the main flow channel.

[0042] After the exhaust gas passes through the venturi portion, the reverse spraying pipe is disposed at an upper portion of the main flow channel after the velocity of the gas mixture is significantly lowered due to the rapid increase in the space volume, so that the back pressure may be prevented from being applied to the exhaust gas and the exhaust gas and the cleaning water may be mixed with each other more effectively.

[0043] Accordingly, the present invention may minimize the obstruction on the flow of the exhaust gas, so that the dust collection efficiency of harmful substances may be increased, and the back pressure may be prevented from being applied to the exhaust gas, thereby blocking the increased load or reduced power of the engine.

[0044] Meanwhile, a plurality of auxiliary spraying pipes for multi-spraying the cleaning water in the forward direction of the exhaust gas may be further provided at an inlet side of the venturi unit, in which the auxiliary spraying pipes may be disposed such that a plurality of spraying nozzles for spraying the cleaning water in the flowing direction of the exhaust gas form at least one row in the longitudinal direction.

[0045] When configured as described above, the exhaust gas entering the venturi unit after exiting the gas inlet is cooled and the volume is reduced, so that the back pressure is more effectively prevented from being applied to the exhaust gas.

[0046] Meanwhile, a guide plate may be installed in the main flow channel of the scrubber main body such that the exhaust gas discharged from the venturi unit and moving upward is diffused to a central portion of the scrubber main body.

[0047] In addition, the guide plate may be installed slantingly at a predetermined angle along a side wall inside the scrubber main body, and formed of a porous plate having a plurality of through-holes to allow the exhaust gas to pass therethrough, in which a plurality of drain grooves may be formed along a contact surface coming into contact with the side wall.

[0048] Accordingly, the exhaust gas moving upward along the side wall of the scrubber main body after exiting the venturi unit may be effectively diffused to the central portion of the scrubber main body, and the cleaning water may be discharged downward through the drain groove.

[Advantageous Effects]

[0049] As described above, the advantageous effects according to the present invention are as follows.

[0050] First, the scrubber becomes small and lightweight by selecting the scrubber having the venturi-integrated structure, so that the transportability or installation of the apparatus can be improved and the restriction of installation space can be minimized.

[0051] Second, the scrubber main body is configured to have a plurality of rectangular polyhedral so that the production can be facilitated, multiple stages can be separated from or coupled to each other so that the installing or disassembling work can be facilitated, and the cost for maintenance and repair can be reduced.

[0052] Third, the venturi conduit has the excellent expandability, so that vessel engines having various properties can be effectively applied, and the installation cost and the construction period can be reduced.

[0053] Fourth, a plurality of long venturi conduits are formed through guide vanes having arc shapes, so that the smooth flow of the exhaust gas can be guided, a cleaning work can be easily performed, and the stable operation can be ensured.

[0054] Fifth, the cleaning water is sprayed in the forward direction of the exhaust gas to block the back pres-

sure with respect to the exhaust gas, so that the engine can be stably operated and the fuel consumption can be reduced by preventing the increased load or decreased output of the engine.

[Description of Drawings]

[0055]

FIG. 1 is a schematic diagram of a scrubber module system for removing harmful substances in exhaust gas of a conventional vessel engine.

FIG. 2 is a schematic diagram of a conventional general scrubber.

FIG. 3 is a schematic diagram of a scrubber module system to which an example of a venturi-integrated scrubber apparatus of the present invention is applied.

FIG. 4 is a front view of one embodiment of the venturi-integrated scrubber apparatus according to the present invention.

FIG. 5 is an internal perspective view of the scrubber apparatus of FIG. 4 when viewed from the side thereof.

FIG. 6 is a front view of a scrubber main body in the venturi-integrated scrubber apparatus according to the present invention, in which a lower portion of the scrubber main body is incised in a state where only a partition wall and a guide member of a venturi unit are installed.

FIG. 7 is a front perspective view of the scrubber main body, in the venturi-integrated scrubber apparatus according to the present invention, in a state where only a collection layer and a plurality of cleaning water spraying pipes are installed inside the scrubber main body.

FIG. 8 is an enlarged view of an auxiliary spraying pipe installed in a lower portion inside the scrubber main body shown in FIG. 5 according to the present invention.

FIG. 9 is an explanatory diagram of operations of the venturi-integrated scrubber apparatus according to the present invention.

[Best Mode]

[Mode for Invention]

[0056] First, an example of a scrubber module system to which a venturi-integrated scrubber apparatus of the present invention is applied will be described with reference to FIG. 3.

[0057] Herein, FIG. 3 is a schematic diagram showing a scrubber module system to which an example of a venturi-integrated scrubber apparatus of the present invention is applied.

[0058] As shown in the drawing, the venturi-integrated scrubber apparatus in the scrubber module system of the present invention is connected to an exhaust line of a main engine of a vessel, thereby serving to remove gaseous substances such as sulfur oxides (SOx) and harmful particulate substances, such as dust or fine dust in an exhaust gas discharged from the engine, by contacting, aggregating and collecting the substances with cleaning water.

[0059] A gas monitoring system for inspecting the cleaned exhaust gas discharged after scrubbing is connected to the scrubber apparatus.

[0060] Meanwhile, since the scrubber apparatus of the present invention has an inside-venturi type integrated structure, the main engine of the vessel is directly connected to the scrubber main body as shown in the drawing.

[0061] In addition, since the venturi-integrated scrubber apparatus of the present invention is used in the vessel, sea water is used as the cleaning water, in which the sea water is supplied using a pump.

[0062] A sea water monitoring system for inspecting the adequacy of inputted seawater, and a discharge water monitoring system for inspecting the safety of seawater discharged after scrubbing are connected to the scrubber apparatus of the present invention.

[0063] Accordingly, the venturi-integrated scrubber apparatus of the present invention, as a component of the scrubber module system as described above, is configured to purify the exhaust gas of the engine.

[0064] Hereinafter, exemplary embodiments of the venturi-integrated scrubber apparatus of the present invention will be described in detail with reference to FIGS. 4 to 9.

[0065] First, FIG. 4 is a front view showing one embodiment of the venturi-integrated scrubber apparatus according to the present invention. FIG. 5 is an internal perspective view showing the scrubber apparatus of FIG. 4 when viewed from the side thereof.

[0066] As shown in the drawing, a venturi-integrated scrubber apparatus 1 of the present invention includes a scrubber main body 10, a collection layer 30, a venturi unit 50, and a cleaning water spraying pipe 80.

[0067] The scrubber main body 10 serves as a housing that provides a path through which the exhaust gas of the main engine moves, and is configured to have a box-shaped structure having an empty inside and a predetermined height.

[0068] Accordingly, the scrubber main body 10 is formed therein with a main flow channel 19 through which the exhaust gas moves upward during a scrubbing process.

[0069] The scrubber main body 10 is formed to have a rectangular box-shaped structure, and may be manufactured by combining box-shaped hollow members having a rectangular polyhedral shape in multiple stages.

[0070] The hollow members may be coupled to each other through a bolt or welding work by using a flange 17 structure.

[0071] Accordingly, since the scrubber apparatus 1 is

a heavy-duty facility having tens of tons, an installing or disassembling work may be easily performed by configuring the scrubber main body 10 in the multiple stages as described above, thereby improving storage and transportability, and facilitating a maintenance and repair work.

[0072] Meanwhile, the scrubber main body 10 is installed therein with at least one gas inlet 11 through which the exhaust gas of the engine is introduced, and a plurality of gas outlets 12 for discharging the scrubbed exhaust gas.

[0073] In the modular system shown in FIG. 3, the gas inlet 11 is connected to the main engine of the vessel, and installed in a front lower portion of the scrubber main body 10, and the gas outlet 12 is upwardly installed at the top.

[0074] As shown in FIG. 4, three gas inlet 11 and two gas outlet 12 are installed, respectively. However, these are shown as an example, and the size, number, or installation position may be selected and applied appropriately by comprehensively considering an environment in use or a type, size, displacement or the like of the engine to be connected.

[0075] Meanwhile, openings 15 and 16 are provided in a front upper portion and a rear lower portion of the scrubber main body 10.

[0076] The openings 15 and 16 are configured to be installed to observe the inside of the scrubber main body 10 or maintain and repair the cleaning water spraying pipe 80 or the like, and provided to be opened and closed using a door, in which a size, position or the like may be appropriately selected and applied in consideration of the use environment.

[0077] In addition, a plurality of drain holes 13 connected to the discharge water monitoring system shown in FIG. 3 is installed at the bottom of the scrubber main body 10.

[0078] When the cleaning water and the exhaust gas are mixed in contact with each other inside the scrubber main body 10, moisture particles of the cleaning water and particles of harmful substances in the exhaust gas aggregate together and fall downward. At this time, the harmful substances and moistures collected and accumulated on the lower surface of the scrubber main body 10 are discharged to the outside through the drain holes 13.

[0079] Meanwhile, at least one collection layer 30 is formed inside the scrubber main body 10.

[0080] As shown in the drawing, the collection layer 30 is horizontally installed and spaced in two stages at regular intervals in a vertical direction inside the scrubber main body 10.

[0081] The collection layer 30 may be formed of a demister that collects and removes moisture contained in the exhaust gas.

[0082] The demister functions as a filter for filtering the moisture contained in the exhaust gas, and is formed of fiber, plastic or metal.

[0083] The demister applied to the present invention, as shown in FIG. 6, is applied with a chevron type formed of plastic or metal, and has a large number of 'V'-shaped or zigzag micro-channels through which the exhaust gas passes.

[0084] Accordingly, while the exhaust gas passes through the many micro-channels formed in the demister as described above, a surface area thereof is widened, the speed is lowered, and the area and time of contact with a wall surface of the micro-channel are increased. Accordingly, the moisture contained in the exhaust gas is effectively attached to the wall surface of the micro-channel, so that the moisture is removed.

[0085] The collection layer 30 may be provided by applying various demisters of generally used products, so further detailed description will be omitted.

[0086] Meanwhile, the collection layer 30 in the present invention has been described as a demister for removing moisture, but also may be configured as a conventional dust collector having a dust collecting function capable of collecting and removing dust or the like in the exhaust gas.

[0087] The dust collector is filled with packing balls or pall-rings having a plurality of pores through which gas passes, so that particulate substances such as dust or the like in the exhaust gas are adsorbed and removed.

[0088] Accordingly, the collection layer 30 of the present invention may be composed of a demister or a dust collector by considering features of the engine, using environments or the like, or may be composed of a combination thereof.

[0089] Hereinafter, the venturi unit and the guide member applied to the venturi-integrated scrubber apparatus of the present invention will be described in detail with reference to FIGS. 5 and 6.

[0090] FIG. 6 is a front view showing a scrubber main body, in the venturi-integrated scrubber apparatus according to the present invention, in which a lower portion of the scrubber main body is incised in a state where only a partition wall and a guide member of a venturi unit are installed.

[0091] FIG. 6 shows a state in which only the venturi unit 50 is installed inside the scrubber main body without installing the cleaning water spraying pipe 80 and an auxiliary spraying pipe 90 for the convenience of description.

[0092] The venturi unit 50 is provided with a venturi conduit 53 that has a relatively small sectional area of a flow channel to increase the flow rate of the exhaust gas passing through the venturi conduit 53, and induce diffusion and expansion together with a pressure decrease of the exhaust gas after passing through the venturi conduit 53, so that a contact area between the exhaust gas and the cleaning water is increased and a uniform mixing is induced, thereby effectively agglomerating the moisture particles of the cleaning water with the harmful substance particles contained in the exhaust gas.

[0093] The venturi unit 50 of the present invention is installed at a lower inner side of the scrubber main body

10 to allow the gas inlet 11 installed in the scrubber main body 10 to communicate with the main flow channel 19 formed inside the scrubber main body 10, and installed in a position corresponding to the gas inlet 11 so as to be provided such that the exhaust gas passing through the gas inlet 11 directly enters the venturi unit 50.

[0094] The venturi unit 50 is formed with at least one venturi conduit 53 through which the exhaust gas introduced from the gas inlet 11 passes.

[0095] The venturi unit 50 includes a partition wall 51 and a guide member 55.

[0096] The partition wall 51 is configured to form an upper wall of the venturi unit 50, has a rectangular plate structure, and horizontally installed spaced upward at a predetermined distance from an inner lower side of the scrubber main body 10.

[0097] The partition wall 51 is fixed to an inner wall of the scrubber main body 10, and installed to block only a part of the main flow channel 19 as shown in FIG. 5.

[0098] Accordingly, after the exhaust gas passing through the venturi unit 50 hits a rear wall of the scrubber main body 10, the exhaust gas may move upward along the main flow channel 19 through an opening between a front end surface of the partition wall 51 and the rear wall of the scrubber main body 10.

[0099] Meanwhile, a plurality of guide members 55 are provided between the lower side of the scrubber main body 10 and the partition wall 51.

[0100] The guide member 55 is horizontally installed to be spaced at a predetermined distance in the vertical direction between the partition wall 51 and the lower side of the scrubber main body 10, in which both end surfaces are fixed to both side walls of the scrubber main body 10, respectively, as shown in FIG. 6.

[0101] The guide member 55 includes a support 57 having both ends coupled to the both side walls of the scrubber main body 10, respectively, and two guide vanes 58 coupled to the support 57.

[0102] The support 57 has a long plate structure having a predetermined thickness and width, and the guide vanes 58 are symmetrically installed to face the upper and lower sides of the support 57.

[0103] The guide vanes 58 are installed in the longitudinal direction of the support 57, and provided to form convex arc surfaces toward outsides of the support 57, respectively, so that a venturi conduit 53 having a relatively narrow vertical width and a long length is horizontally formed between the guide members 55 as shown in FIG. 6.

[0104] Meanwhile, a guide vane 58 is provided on the lower side of the front end portion of the partition 51 to correspond to an upper guide vane 58 of the guide member 55 positioned at the uppermost side.

[0105] Accordingly, the guide vane 58 installed on the partition wall 51 and the guide member 55 exerts a venturi effect to the exhaust gas passing therethrough by forming a plurality of venturi conduits 53 in the vertical direction in a rear portion of the venturi unit 50 as shown in FIG. 5.

[0106] The partition 51, the guide member 55, the guide vane 58 and the like of the venturi unit 50 may be fixed to the scrubber main body 10 by welding or the like.

[0107] Meanwhile, as shown in FIGS. 5 and 6, a guide plate 20 is installed on an inner rear wall of the scrubber main body 10.

[0108] The guide plate 20 is installed in the main flow channel 19 slightly above the venturi unit 50, and serves to change a flowing direction of the exhaust gas so that the exhaust gas moving upward along the rear wall of the scrubber main body 10 after discharged from the venturi unit 50 is diffused and moved to a central portion of the scrubber main body 10.

[0109] The guide plate 20 may be formed of a porous plate formed with a plurality of through-holes 21 so that some of the upwardly moving exhaust gas pass through.

[0110] The guide plate 20, as shown in FIG. 5, is installed on the rear wall inside the scrubber main body 10, and installed slantingly upward at a predetermined angle not to exert an impact to the flow of the exhaust gas.

[0111] Accordingly, some of the exhaust gas moving upward pass through the through-holes 21 of the guide plate 20 and move upward, and the remaining of the exhaust gas flows along a lower surface of the guide plate 20, thereby moving to even the central portion of the main flow channel 19.

[0112] Meanwhile, in the guide plate 20, a plurality of drain grooves 25 are formed along a surface coming into contact with a rear side wall of the scrubber main body 10.

[0113] The drain grooves 25 are spaced and separated apart at predetermined lengths along a rear end surface of the guide plate 20, so that a plurality of drain holes may be formed at regular intervals along the coupled surface when the guide plate 20 is coupled to the rear side wall of the scrubber main body 10 through welding or the like.

[0114] Accordingly, the cleaning water falling from the top above the guide plate 20 may pass through the drain holes defined by the drain groove 25 and move to the lower portion of the scrubber main body 10.

[0115] Hereinafter, the cleaning water spraying pipe provided in the present invention will be described in detail with reference to FIGS. 5 and 7.

[0116] FIG. 7 is a front perspective view showing the scrubber main body, in the venturi-integrated scrubber apparatus according to the present invention, in a state where only a collection layer and a plurality of cleaning water spraying pipes are installed inside the scrubber main body.

[0117] FIG. 7 shows a state in which the cleaning water spraying pipes are installed in a state in which the venturi unit 50 is removed for the convenience of description.

[0118] The cleaning water spraying pipe 80 is installed along the path through which the exhaust gas introduced through the gas inlet 11 of the scrubber main body 10 moves, and functions to mix the cleaning water with the exhaust gas by spraying the cleaning water in the flowing direction, that is, in the forward direction of the exhaust

gas.

[0119] Accordingly, since the cleaning water sprayed from the cleaning water spraying pipe 80 is sprayed in the forward direction of the exhaust gas, a self-propulsion force may be added to kinetic energy of the exhaust gas, so that an unnecessary back pressure is prevented from being applied to the exhaust gas.

[0120] As shown in FIG. 5, three cleaning water spraying pipes 80 are installed spaced apart from each other in the vertical direction between the guide member 55 of the venturi unit 50 and the rear side wall of the scrubber main body 10, and four cleaning water spraying pipes 80 are also installed on the main flow channel 19 at the lower portion of each collection layer 30.

[0121] In addition, the cleaning water spraying pipe 80 may include four venturi spraying pipes 85 installed in a front portion of the venturi conduit 53 of the venturi unit 50.

[0122] The cleaning water spraying pipe 80 includes a spraying pipe body 81 horizontally installed in a horizontal direction of the main flow channel 19, and a plurality of spraying nozzles 83 installed spaced apart from each other along the spraying pipe body 81.

[0123] The spraying pipe body 81, as shown in FIG. 7, is configured to have a pipe structure having an empty inside to which the cleaning water moves, and have both ends coupled to the both side walls of the scrubber main body 10 and horizontally fixed.

[0124] As shown in FIG. 7, the cleaning water spraying pipe 80 is provided with a cleaning water inlet 82 protruding to one side wall of the scrubber main body 10.

[0125] Meanwhile, as shown in FIG. 7, a plurality of spraying nozzles 83 are installed spaced apart from each other at predetermined distances along the spraying pipe body 81.

[0126] The injection nozzle 83 may be installed to spray the cleaning water in the flowing direction of the exhaust gas.

[0127] Meanwhile, a plurality of spraying nozzle 86 of the venturi spraying pipe 85 (shown in FIG. 5) are horizontally installed to be spaced apart from each other along the venturi conduit 53 so as to spray the cleaning water toward the venturi conduit 53, and the spraying nozzles 83 of the three cleaning water spraying pipes 80 installed adjacent to the lower rear side wall of the scrubber main body 10 in the vertical direction are installed to be directed upward.

[0128] Since the cleaning water spraying pipe 80 sprays the cleaning water in the same forward direction as the flowing direction of the exhaust gas, moisture is effectively contacted and mixed with the exhaust gas, and the back pressure is prevented from being applied to the exhaust gas, so that side effects such as increased engine load or reduced power may be prevented.

[0129] Meanwhile, since a residual exhaust gas, which has not yet been mixed, is easily mixed in a state in which the velocity of the gas mixture rapidly having increased in a space volume is significantly lowered after passing through the venturi unit 50, the cleaning water spraying pipe 80 installed at the lower portion of the collection layer 30 may include a reverse spraying pipe capable of spraying the cleaning water in a reverse direction of the flowing direction of exhaust gas.

[0130] Accordingly, as shown in FIGS. 5 and 7, among the four cleaning water spraying pipes 80 disposed at the lower portion of the collection layer 30, the lower two cleaning water spraying pipes 80 are configured as reverse spraying pipes that spray the cleaning water in the reverse direction of the exhaust gas.

[0131] In other words, among the four cleaning water spraying pipes 80 under the collection layer 30, the upper two cleaning water spraying pipes 80 upwardly spray the cleaning water in the forward direction of the exhaust gas toward the upper collection layer 30, and the lower two reverse spraying pipes downwardly spray the cleaning water spray.

[0132] Although the two reverse spraying pipes installed under the collection layer 30 spray the cleaning water in the reverse direction of the exhaust gas, the two reverse spraying pipes are positioned at the upper portion of the main flow channel 19, and the velocity of the gas mixture is significantly lowered due to the rapid increase in the space volume after the exhaust gas passes through the venturi unit 50, so that the back pressure is prevented from being applied to the exhaust gas, and the moisture of the cleaning water and the harmful substance particles in the exhaust gas more effectively contact and mix with each other.

[0133] In addition, the number, arrangement or the like of the cleaning water spraying pipe 80 may be appropriately selected and applied in consideration of the engine output, displacement, and use environment, and the number of the spraying nozzles 83 and 86 may also be appropriately selected and applied in consideration of the processing capacity of the scrubber apparatus 1.

[0134] Hereinafter, the auxiliary spraying pipe 90 will be described with reference to FIGS. 5 and 8.

[0135] FIG. 8 is an enlarged view showing the auxiliary spraying pipe installed in a lower portion inside the scrubber main body shown in FIG. 5 according to the present invention.

[0136] The auxiliary spraying pipe 90, as shown in FIG. 5, is installed to a rear of the gas inlet 11, that is, an inlet side of the venturi unit 50, and installed to spray the cleaning water in the flowing direction of the exhaust gas.

[0137] The auxiliary spraying pipe 90 is configured to spray the cleaning water in the forward direction to the exhaust gas entering the venturi unit 50 after exiting the gas inlet 11 to mix the cleaning water with the exhaust gas, in which two auxiliary spraying pipes may be installed spaced apart in the vertical direction.

[0138] In general, since the exhaust gas is a high-temperature gas of about 250°C, the auxiliary spraying pipe 90 mixes the relatively cold cleaning water with the high-temperature exhaust gas entering the venturi unit 50 to quickly cool the exhaust gas, thereby reducing the volume, so that the back pressure is prevented from being

applied to the exhaust gas due to the venturi unit 50.

[0139] The auxiliary spraying pipe 90, like the cleaning water spraying pipe 80, includes a spray pipe body 91 for moving the cleaning water and a spraying nozzles 92 and 93.

[0140] The spraying pipe body 91 has both ends coupled to both inner side walls of the scrubber main body 10, thereby being installed in a transverse direction inside the scrubber main body 10, like the cleaning water spraying pipe 80, in which a plurality of spraying nozzles 92 and 93 are spaced apart along the spraying pipe body 91.

[0141] The spraying nozzles 92 and 93, as shown in FIG. 8, may be provided in three rows to include central portion side spraying nozzles 92 installed spaced apart along the spraying pipe body 91, and both sides spraying nozzles 93 protruding in the vertical direction of the spraying pipe body 91 to spray the cleaning water toward the rear side (the flowing direction of the exhaust gas).

[0142] Accordingly, the auxiliary spraying pipe 90 mixes the cleaning water with the exhaust gas more effectively, so that a rapid cooling effect can be obtained.

[0143] Hereinafter, an operating process of the venturi-integrated scrubber apparatus of the present invention will be described with reference to FIG. 9.

[0144] FIG. 9 is an explanatory diagram showing operations of the venturi-integrated scrubber apparatus according to the present invention, in which the cleaning water sprayed from the cleaning water spraying pipe 80 and the auxiliary spraying pipe 90 are indicated by dotted lines.

[0145] First, since the gas inlet 11 is connected to the exhaust line of the engine, the exhaust gas discharged to the engine enters the gas inlet 11 of the scrubber main body 10 as shown by an arrow 200.

[0146] The exhaust gas exiting after passing through the gas inlet 11 is cooled after mixed with the cleaning water sprayed in the forward direction from the auxiliary spraying pipe 90, thereby entering each venturi conduit 53 of the venturi unit 50 while having reduced volume.

[0147] The exhaust gas is mixed with the cleaning water sprayed from the venturi spraying pipe 85 installed in the front portion of the venturi conduit 53 at the same time entering the venturi conduit 53, and then passes through the venturi conduit 53.

[0148] As the exhaust gas passes through the venturi conduit 53, the flow rate increases. Then, the exhaust gas exiting the venturi conduit 53 has a reduced pressure and is diffused and expanded due to the venturi effect, thereby hitting the rear wall of the scrubber main body 10 and moving upward.

[0149] After mixed with the cleaning water sprayed from the three cleaning water spraying pipes 80 installed on a discharge portion side of the venturi unit 50 and moving upward, some pass through the through-hole 21 of the guide plate 20 and move upward as it is, and some move to a central portion of the main flow channel 19 along a lower surface of the guide plate 20.

[0150] The exhaust gas moved to the central portion of the main flow channel 19 is mixed with the cleaning water sprayed upward and downward from the four cleaning water spraying pipes installed below the collection layer 30, thereby moving to the collection layer 30.

[0151] After the exhaust gas is introduced from the gas inlet 11 as described above, the gaseous particles such as sulfur oxides and particulates such as dust or fine dust contained therein are brought into contact with and aggregated with the moisture particles of the cleaning water to fall downward in the process of passing through the venturi unit 50 and moving upward along the main flow channel 19, so that harmful substances are removed.

[0152] Meanwhile, since the exhaust gas contains a lot of water particles after mixed with the cleaning water, the flow rate is decreased and the surface area is increased while passing through the demister of a first collection layer 30, and thus the moisture particles present therein are attached to the wall surfaces of micro-channels of the collection layer 30 and collected, thereby removing the moisture and then the exhaust gas moves upward.

[0153] After the exhaust gas is mixed with the cleaning water sprayed by the cleaning water spraying pipe 80 above the first collection layer 30, the moisture is removed once again from a second collection layer 30, thereby being discharged to the outside through the gas outlet 12.

[0154] The exhaust gas is discharged to the outside through the gas outlet 12 in a state in which the harmful substances and the moisture particles contained therein are removed.

[0155] Accordingly, the present invention adopts the scrubber main body 10 having the multi-stage structure, so that an installing or disassembling work is easily performed, and the transportability and the storage are improved. In addition, the venturi unit 50 is integrally installed inside the scrubber main body 10, so that an overall size, volume, or weight of the scrubber apparatus 1 is significantly reduced, thereby implementing a miniaturized and compact feature, and improving the dust collection efficiency.

[0156] In addition, since the venturi unit 50 may be easily expanded according to using environments, effectively applied to various engine characteristics or using environments, and since the cleaning water is sprayed in the forward direction with respect to the flowing direction of the exhaust gas, the back pressure is prevented from generated to the exhaust gas, so that the increased engine load or reduced power is prevented, and additional facilities, such as a separate power-assisting forced draft fan, are unnecessary.

[0157] The above-described embodiment is merely described as an example for convenience of description and thus the claims are not limited, and various modifications may be made within the technical scope of the present invention.

[0158] For example, the position or number of the gas inlet 11, gas outlet 12, cleaning water spraying pipe 80,

or the like is not limited to the drawings, and may be selected and applied in various ways according to the using environments. In addition, the demister or the dust collector as the collection layer 30 may be appropriately selected and applied.

[0159] In addition, although the scrubber apparatus 1 of the present invention has been described as a structure installed to be erected, the scrubber apparatus 1 may also be applied to horizontally installed environments.

[Industrial Applicability]

[0160] The above-described venturi-integrated scrubber apparatus of the present invention may be connected to various engine facilities such as a main engine, a power generation engine, or a boiler of a vessel so as to be used to reduce harmful substances in the exhaust gas.

Claims

1. A venturi-integrated scrubber apparatus (1) comprising:

   a scrubber body (10) formed in a lower portion thereof with a gas inlet (11) for introducing exhaust gas, formed in an upper portion thereof with a gas outlet (12) for discharging the exhaust gas to an outside, and having an inside empty to provide a main flow channel (19) to allow the exhaust gas to move;
   at least one collection layer (30) installed inside the scrubber body (10);
   a venturi unit (50) installed at a lower inner portion of the scrubber main body (10) to allow the gas inlet (11) to communicate with the main flow channel (19) and provided with at least one venturi conduit (53) through which the exhaust gas passes; and
   a plurality of cleaning water spraying pipes (80) installed along a movement path of the exhaust gas to multi-spray cleaning water in a forward direction of the exhaust gas, wherein
   the scrubber body (10) is configured by connecting box-shaped tubular members having a rectangular polyhedral shape in multiple stages, and installed at the lower portion thereof with at least one drain hole (13) for discharging the cleaning water to the outside, and
   the venturi unit (50) includes a partition wall (51) horizontally installed to block a part of the main flow channel (19), and at least one guide member (55) disposed between a lower side of the scrubber body (10) and the partition wall (51) so that the venturi conduit (53) is spaced apart, in which
   the guide member (55) includes a support (57) having both ends coupled to the both side walls of the scrubber body, respectively,
   characterized in that the guide member (55) includes guide vanes (58) installed to face each other on upper and lower sides in a longitudinal direction of the support (57) and provided to form an outwardly convex arc surface so that the venturi conduit (53) formed between the guide members (55) is narrowed.

2. The venturi-integrated scrubber apparatus (1) of claim 1, wherein the cleaning water spraying pipes includes a venturi spraying pipe installed at a front side of the venturi conduit to spray the cleaning water toward the venturi conduit.

3. The venturi-integrated scrubber apparatus (1) of claim 2, wherein the cleaning water spraying pipe (80) includes at least one reverse spraying pipe for spraying the cleaning water in a reverse direction with respect to a flowing direction of the exhaust gas in an upper portion of the main flow channel (19).

4. The venturi-integrated scrubber apparatus (1) of claim 3, wherein a plurality of auxiliary spraying pipes (90) for multi-spraying the cleaning water in the forward direction of the exhaust gas are further provided to an inlet side of the venturi unit (50), in which the auxiliary spraying pipes (90) are disposed such that a plurality of spraying nozzles (92, 93) for spraying the cleaning water in the flowing direction of the exhaust gas form at least one row in the longitudinal direction.

5. The venturi-integrated scrubber apparatus (1) of claim 1, wherein a guide plate (20) is installed in the main flow channel (19) of the scrubber body (10), such that the exhaust gas moving upward after discharged from the venturi unit (50) is diffused to a central portion of the scrubber body (10).

6. The venturi-integrated scrubber apparatus (1) of claim 5, wherein the guide plate (20) is installed slantingly at a predetermined angle along a side wall inside the scrubber body (10), and formed of a porous plate having a plurality of through-holes (21) to allow the exhaust gas to pass therethrough, in which a plurality of drain grooves (25) are formed along a contact surface coming into contact with the side wall.

Patentansprüche

1. Venturiintegrierte Wäschervorrichtung (1), umfassend:

   einen Wäscherkörper (10), der in seinem unte-

ren Teil mit einem Gaseinlass (11) zum Einleiten von Abgas ausgebildet ist, der in seinem oberen Teil mit einem Gasauslass (12) zum Ableiten des Abgases nach außen ausgebildet ist und der ein leeres Inneres aufweist, um einen Hauptströmungskanal (19) bereitzustellen, damit sich das Abgas bewegen kann;
mindestens eine Sammelschicht (30), die im Inneren des Wäscherkörpers (10) installiert ist;
eine Venturieinheit (50), die an einem unteren inneren Abschnitt des Wäscherkörpers (10) installiert ist, damit der Gaseinlass (11) mit dem Hauptströmungskanal (19) in Verbindung steht, und die mit mindestens einer Venturileitung (53) versehen ist, durch die das Abgas strömt; und
eine Vielzahl von Reinigungswasser-Sprührohren (80), die entlang eines Bewegungspfades des Abgases installiert sind, um Reinigungswasser mehrfach in einer Vorwärtsrichtung des Abgases zu versprühen, wobei der Wäscherkörper (10) durch Verbinden kastenförmiger röhrenartiger Elemente mit einer rechteckigen polyedrischen Form in mehreren Stufen konfiguriert ist und an seinem unteren Abschnitt mit mindestens einem Abflussloch (13) zum Ablassen des Reinigungswassers nach außen installiert ist, und
die Venturieinheit (50) eine Trennwand (51), die horizontal installiert ist, um einen Teil des Hauptströmungskanals (19) zu blockieren, und mindestens ein Leitelement (55) aufweist, das zwischen einer unteren Seite des Wäscherkörpers (10) und der Trennwand (51) angeordnet ist, so dass die Venturileitung (53) beabstandet ist, wobei
das Leitselement (55) eine Stütze (57) aufweist, deren beide Enden jeweils mit den beiden Seitenwänden des Wäscherkörpers verbunden sind,
dadurch gekennzeichnet, dass das Leitelement (55) Leitschaufeln (58) aufweist, die so installiert sind, dass sie einander auf der oberen und unteren Seite in einer Längsrichtung des Trägers (57) gegenüberliegen, und die so vorgesehen sind, dass sie eine nach außen konvexe Bogenfläche bilden, so dass die zwischen den Leitelementen (55) gebildete Venturileitung (53) verengt wird.

2. Venturiintegrierte Wäschervorrichtung (1) nach Anspruch 1, wobei die Reinigungswassersprührohre ein Venturisprührohr umfassen, das an einer Vorderseite der Venturileitung installiert ist, um das Reinigungswasser in Richtung der Venturileitung zu sprühen.

3. Venturiintegrierte Wäschervorrichtung (1) nach Anspruch 2, wobei das Reinigungswassersprührohr (80) mindestens ein Rückwärtssprührohr zum Sprühen des Reinigungswassers in einer umgekehrten Richtung in Bezug auf eine Strömungsrichtung des Abgases in einem oberen Abschnitt des Hauptströmungskanals (19) umfasst.

4. Venturiintegrierte Wäschervorrichtung (1) nach Anspruch 3, wobei mehrere Hilfssprührohre (90) zum Mehrfachsprühen des Reinigungswassers in Vorwärtsrichtung des Abgases an einer Einlassseite der Venturieinheit (50) vorgesehen sind, bei der die Hilfssprührohre (90) so angeordnet sind, dass eine Vielzahl von Sprühdüsen (92, 93) zum Sprühen des Reinigungswassers in Strömungsrichtung des Abgases mindestens eine Reihe in Längsrichtung bilden.

5. Venturiintegrierte Wäschervorrichtung (1) nach Anspruch 1, wobei eine Leitplatte (20) in den Hauptströmungskanal (19) des Wäscherkörpers (10) eingebaut ist, so dass das Abgas, das sich nach dem Austritt aus der Venturieinheit (50) nach oben bewegt, zu einem zentralen Abschnitt des Wäscherkörpers (10) geleitet wird.

6. Venturiintegrierte Wäschervorrichtung (1) nach Anspruch 5, wobei die Leitplatte (20) schräg in einem vorbestimmten Winkel entlang einer Seitenwand im Inneren des Wäscherkörpers (10) installiert ist und aus einer porösen Platte mit einer Vielzahl von Durchgangslöchern (21) gebildet ist, um den Durchtritt des Abgases zu ermöglichen, in der eine Vielzahl von Abflussrillen (25) entlang einer Kontaktoberfläche, die mit der Seitenwand in Kontakt kommt, ausgebildet ist.

Revendications

1. Un appareil d'épurateur (1) à venturi intégré comprenant :

un corps d'épurateur (10) avec, formée dans une partie inférieure de celui-ci, une entrée de gaz (11) destinée à introduire des gaz d'échappement, avec, formée dans une partie supérieure de celui-ci, une sortie de gaz (12) destinée à décharger les gaz d'échappement vers un extérieur et présentant un intérieur vide pour assurer une voie d'écoulement principale (19) pour permettre aux gaz d'échappement de se déplacer ;
au moins une couche de collecte (30) installée à l'intérieur du corps d'épurateur (10) ;
une unité venturi (50) installée dans une partie intérieure inférieure du corps principal d'épurateur (10) pour permettre à l'entrée de gaz (11) de communiquer avec la voie d'écoulement

principale (19) et munie d'au moins un conduit venturi (53) à travers lequel passent les gaz d'échappement ; et
une pluralité de tuyaux de pulvérisation d'eau de nettoyage (80) installés le long d'un trajet de déplacement des gaz d'échappement pour réaliser des pulvérisations multiples d'eau de nettoyage dans une direction avant des gaz d'échappement, dans lequel
le corps d'épurateur (10) est conçu en reliant des éléments tubulaires en forme de boîte présentant une forme polyédrique rectangulaire en plusieurs étages, et avec, installé dans la partie inférieure de celui-ci, au moins un orifice d'évacuation (13) pour décharger l'eau de nettoyage vers l'extérieur, et
l'unité venturi (50) comporte une paroi séparatrice (51) installée horizontalement pour bloquer une partie de la voie d'écoulement principale (19) et au moins un élément de guidage (55) disposé entre un côté inférieur du corps d'épurateur (10) et la paroi séparatrice (51) de telle sorte que le conduit venturi (53) est espacé, dans lequel l'élément de guidage (55) comporte un support (57) dont les deux extrémités sont respectivement accouplées aux deux parois latérales du corps d'épurateur,
caractérisé en ce que l'élément de guidage (55) comporte des ailettes de guidage (58) installées en vis-à-vis sur des côtés supérieur et inférieur dans une direction longitudinale du support (57) et prévues pour former une surface courbe convexe vers l'extérieur de telle sorte que le conduit venturi (53) formé entre les éléments de guidage (55) est resserré.

2. L'appareil d'épurateur (1) à venturi intégré selon la revendication 1, dans lequel les tuyaux de pulvérisation d'eau de nettoyage comportent un tuyau de pulvérisation venturi installé sur une face avant du conduit venturi pour pulvériser de l'eau de nettoyage vers le conduit venturi.

3. L'appareil d'épurateur (1) à venturi intégré selon la revendication 2, dans lequel le tuyau de pulvérisation d'eau de nettoyage (80) comporte au moins un tuyau de pulvérisation inverse pour pulvériser l'eau de nettoyage dans une direction inverse par rapport à la direction d'écoulement des gaz d'échappement dans une partie supérieure de la voie d'écoulement principale (19).

4. L'appareil d'épurateur (1) à venturi intégré selon la revendication 3, dans lequel une pluralité de tuyaux de pulvérisation auxiliaires (90) destinés à réaliser des pulvérisations multiples de l'eau de nettoyage dans la direction avant des gaz d'échappement sont prévus en outre sur un côté entrée de l'unité venturi (50), dans lequel
les tuyaux de pulvérisation auxiliaires (90) sont disposés de telle manière qu'une pluralité de buses de pulvérisation (92, 93), destinées à pulvériser l'eau de nettoyage dans la direction d'écoulement des gaz d'échappement, forment au moins une rangée dans la direction longitudinale.

5. L'appareil d'épurateur (1) à venturi intégré selon la revendication 1, dans lequel une plaque de guidage (20) est installée dans la voie d'écoulement principale (19) du corps d'épurateur (10), de telle sorte que les gaz d'échappement se déplaçant vers le haut après avoir été déchargés de l'unité venturi (50) se diffusent dans une partie centrale du corps d'épurateur (10).

6. L'appareil d'épurateur (1) à venturi intégré selon la revendication 5, dans lequel la plaque de guidage (20) est installée de manière inclinée à un angle prédéfini le long d'une paroi latérale à l'intérieur du corps d'épurateur (10) et constituée d'une plaque poreuse présentant une pluralité de trous traversants (21) pour permettre aux gaz d'échappement de passer à travers celle-ci, une pluralité de rainures de drainage (25) étant formées le long d'une surface de contact venant en contact avec la paroi latérale.

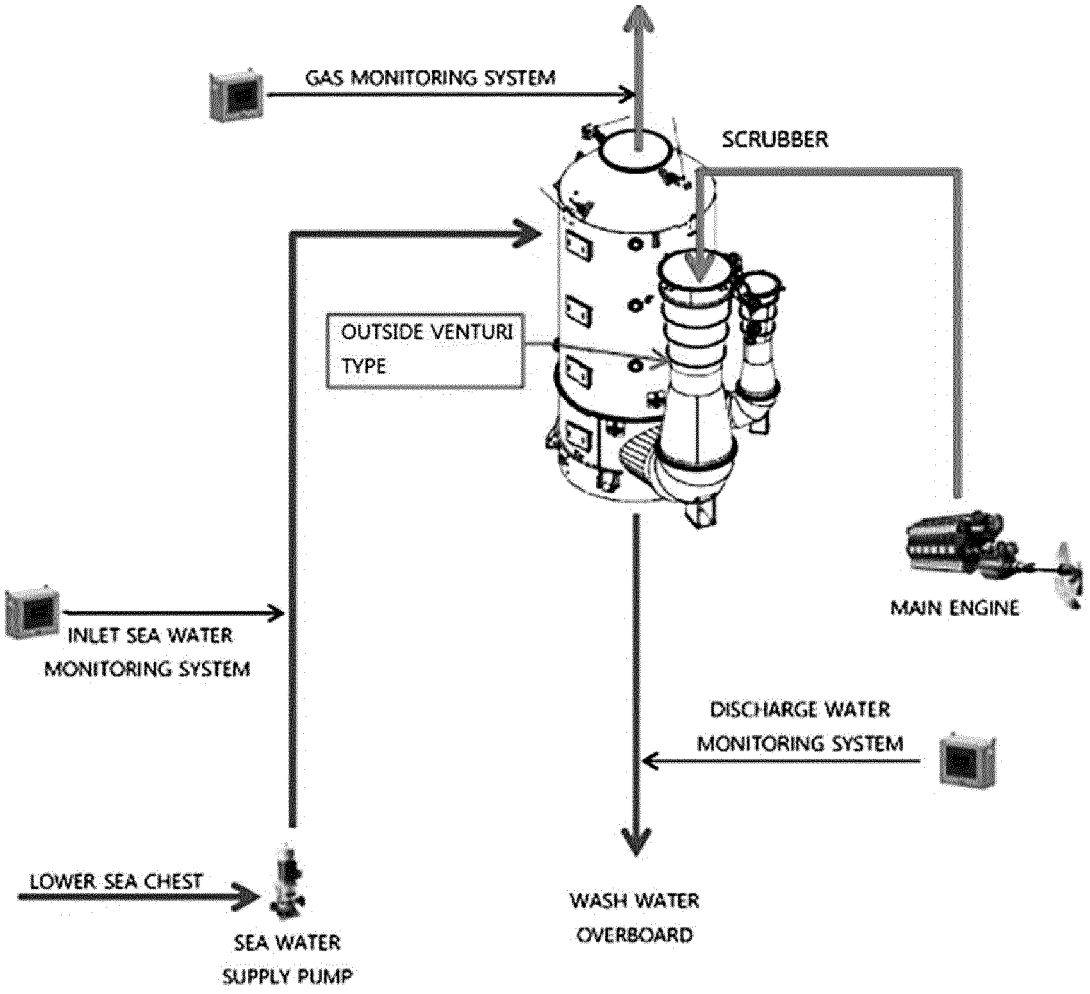

GAS MONITORING SYSTEM
SCRUBBER
OUTSIDE VENTURI TYPE
MAIN ENGINE
INLET SEA WATER MONITORING SYSTEM
DISCHARGE WATER MONITORING SYSTEM
LOWER SEA CHEST
SEA WATER SUPPLY PUMP
WASH WATER OVERBOARD

FIG 1.

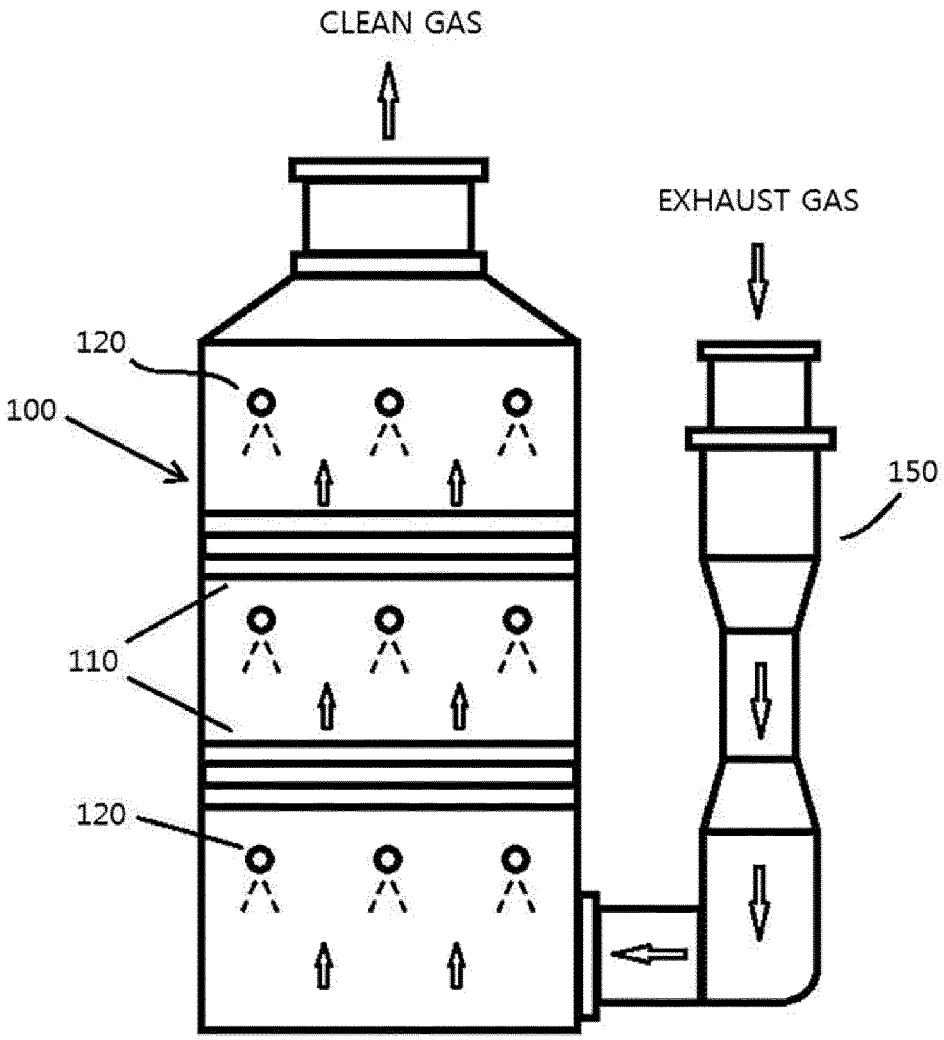


FIG 2.

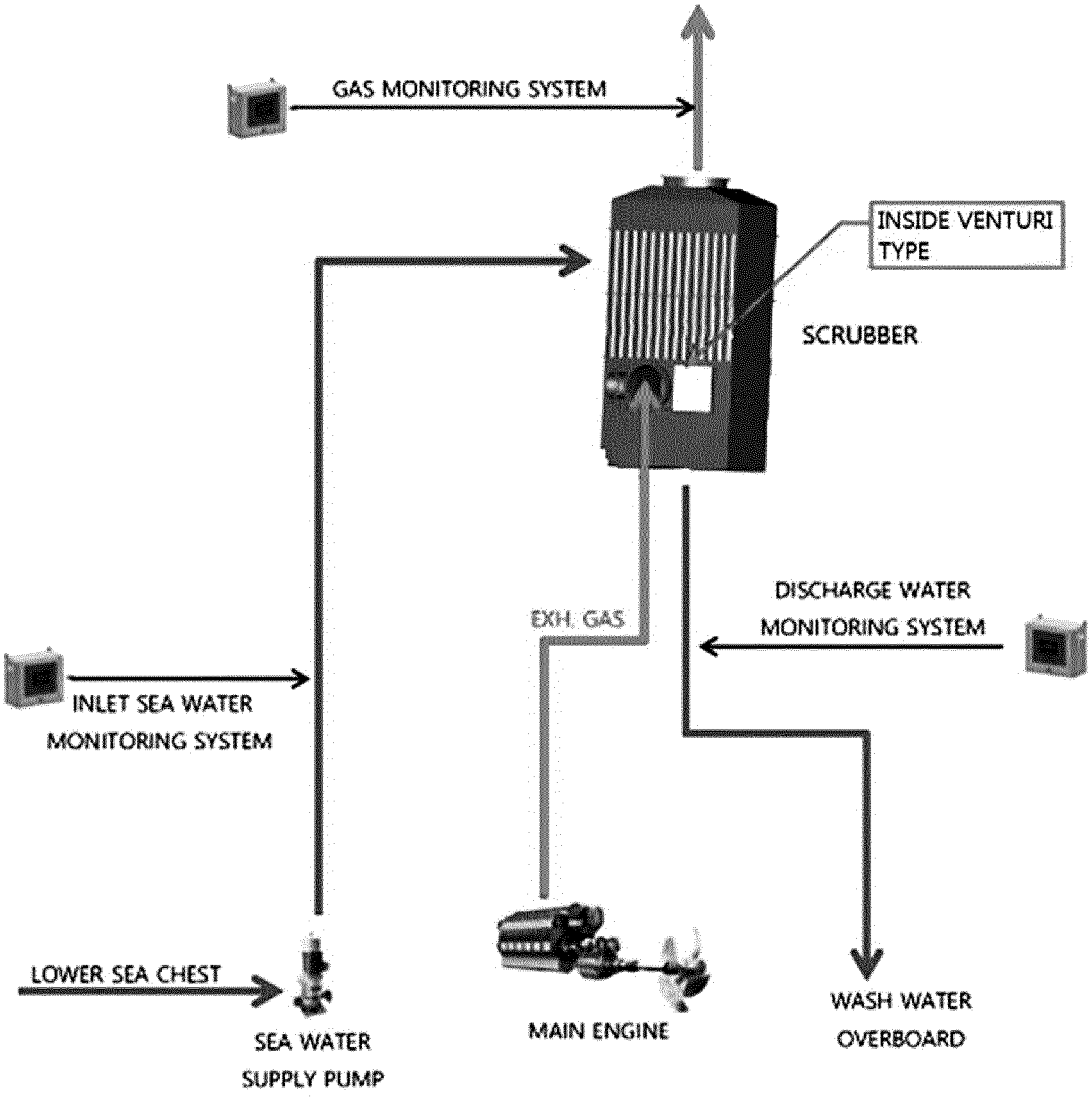

GAS MONITORING SYSTEM
INSIDE VENTURI TYPE
SCRUBBER
DISCHARGE WATER MONITORING SYSTEM
EXH. GAS
INLET SEA WATER MONITORING SYSTEM
LOWER SEA CHEST
SEA WATER SUPPLY PUMP
MAIN ENGINE
WASH WATER OVERBOARD

FIG 3.

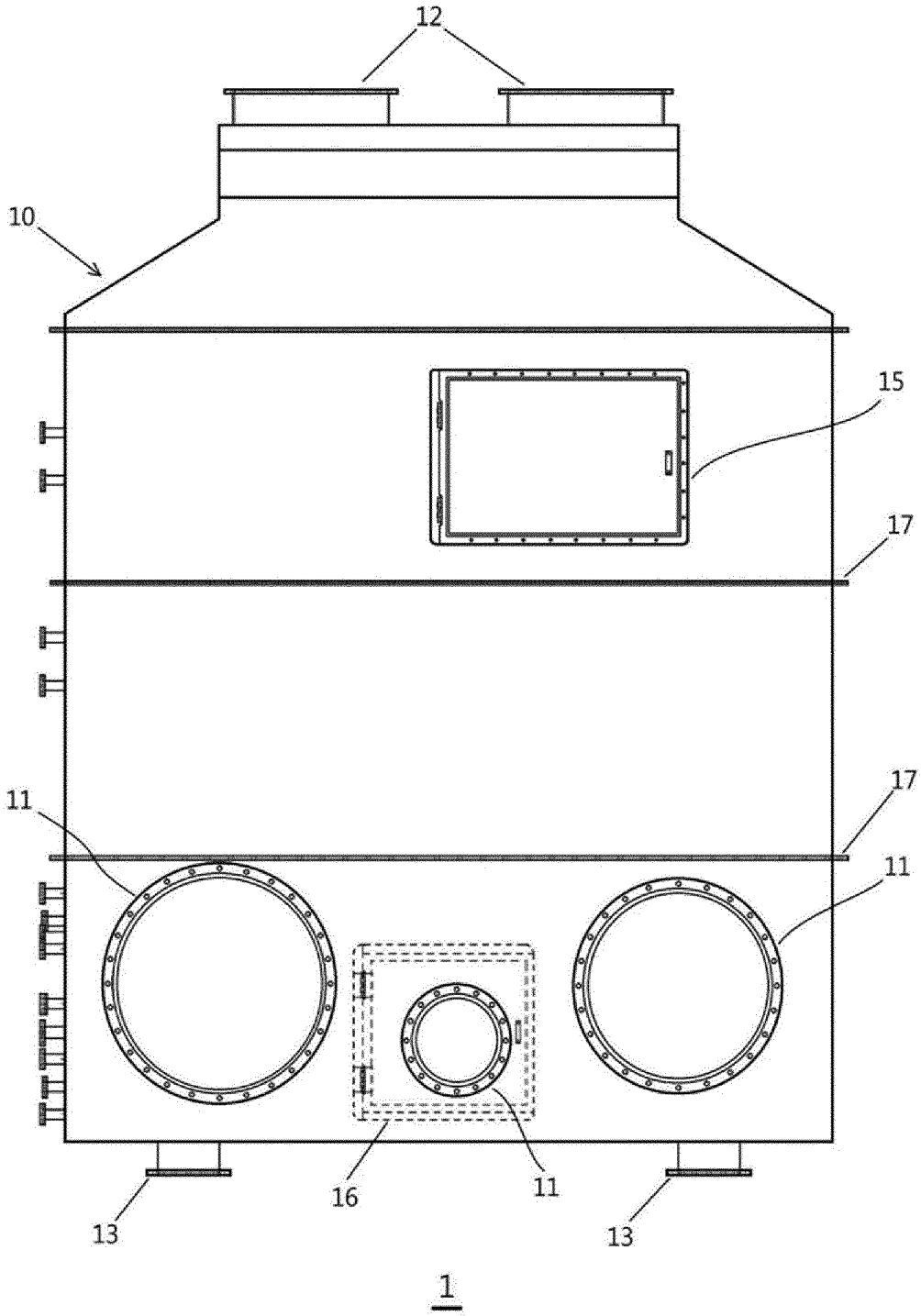
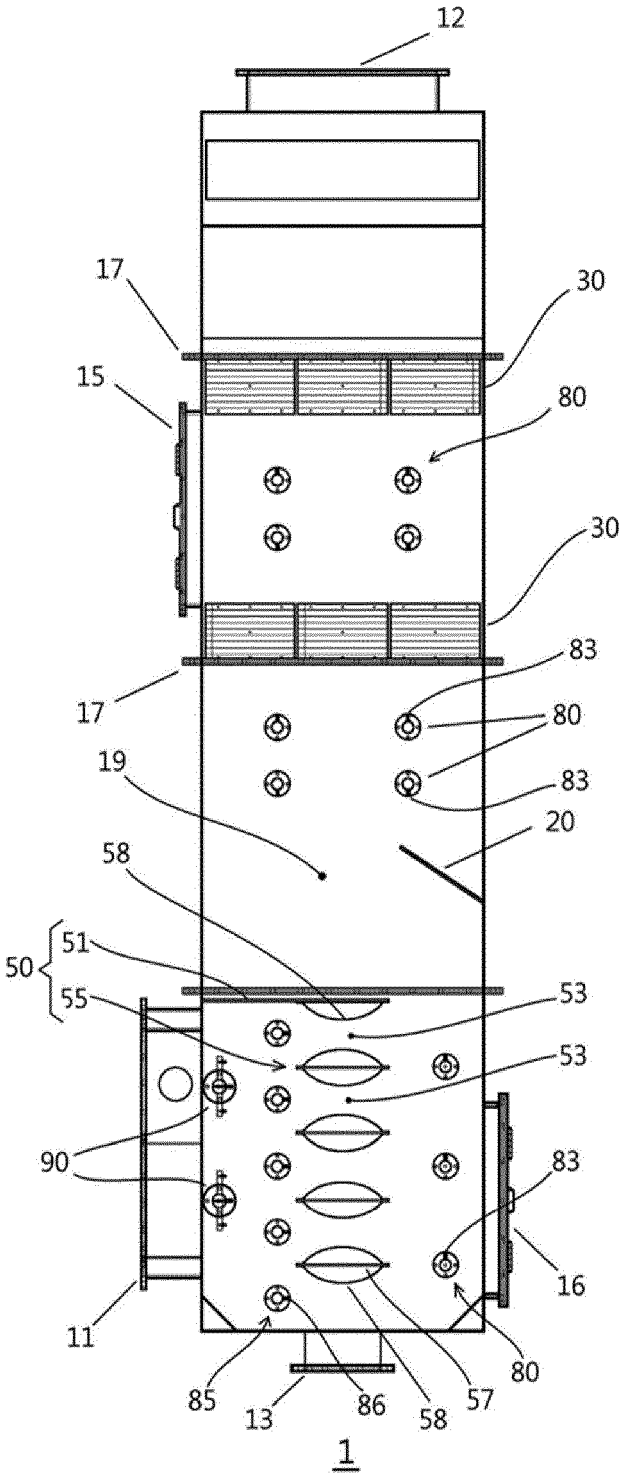


FIG 4.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1

FIG 5.

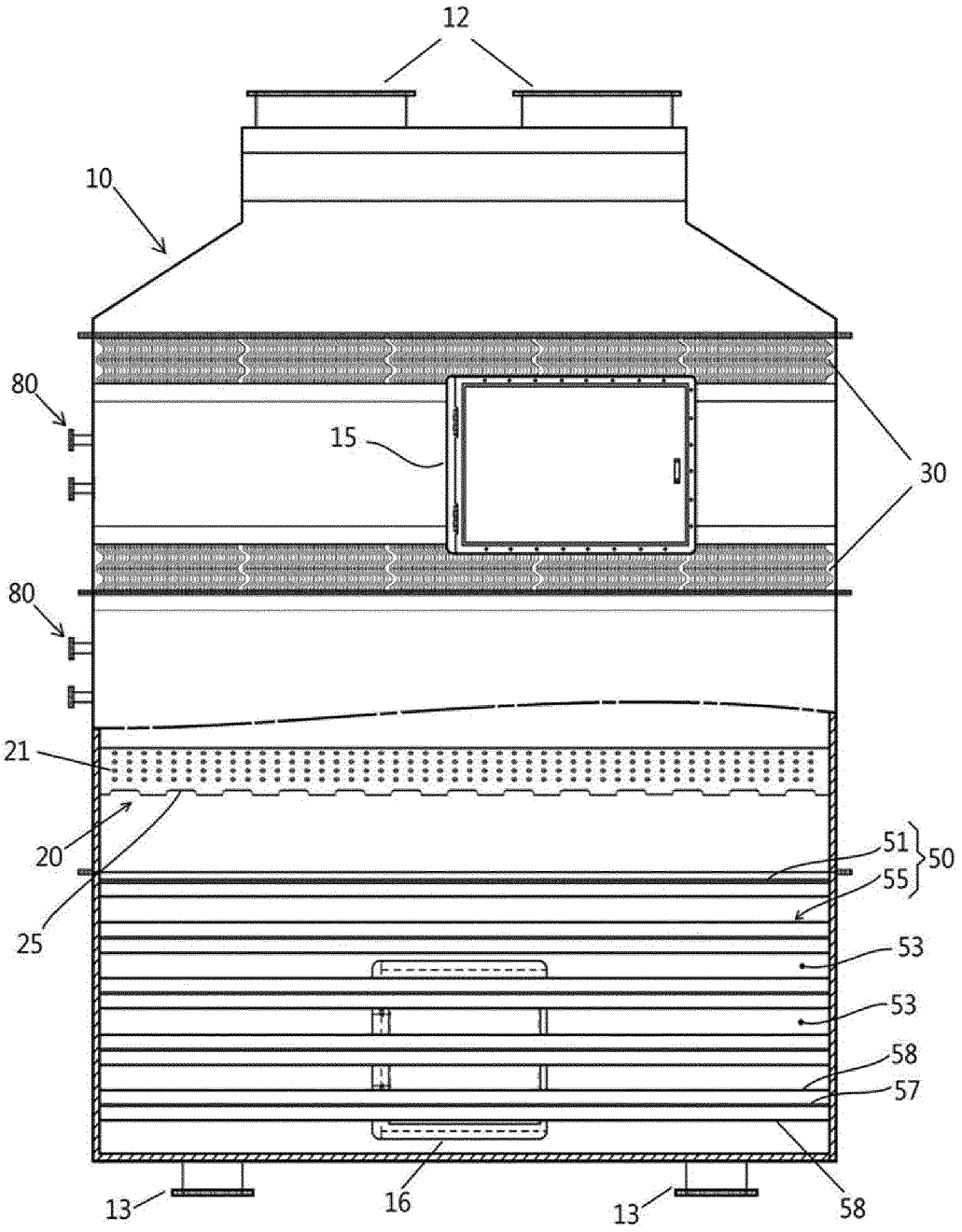


FIG 6.

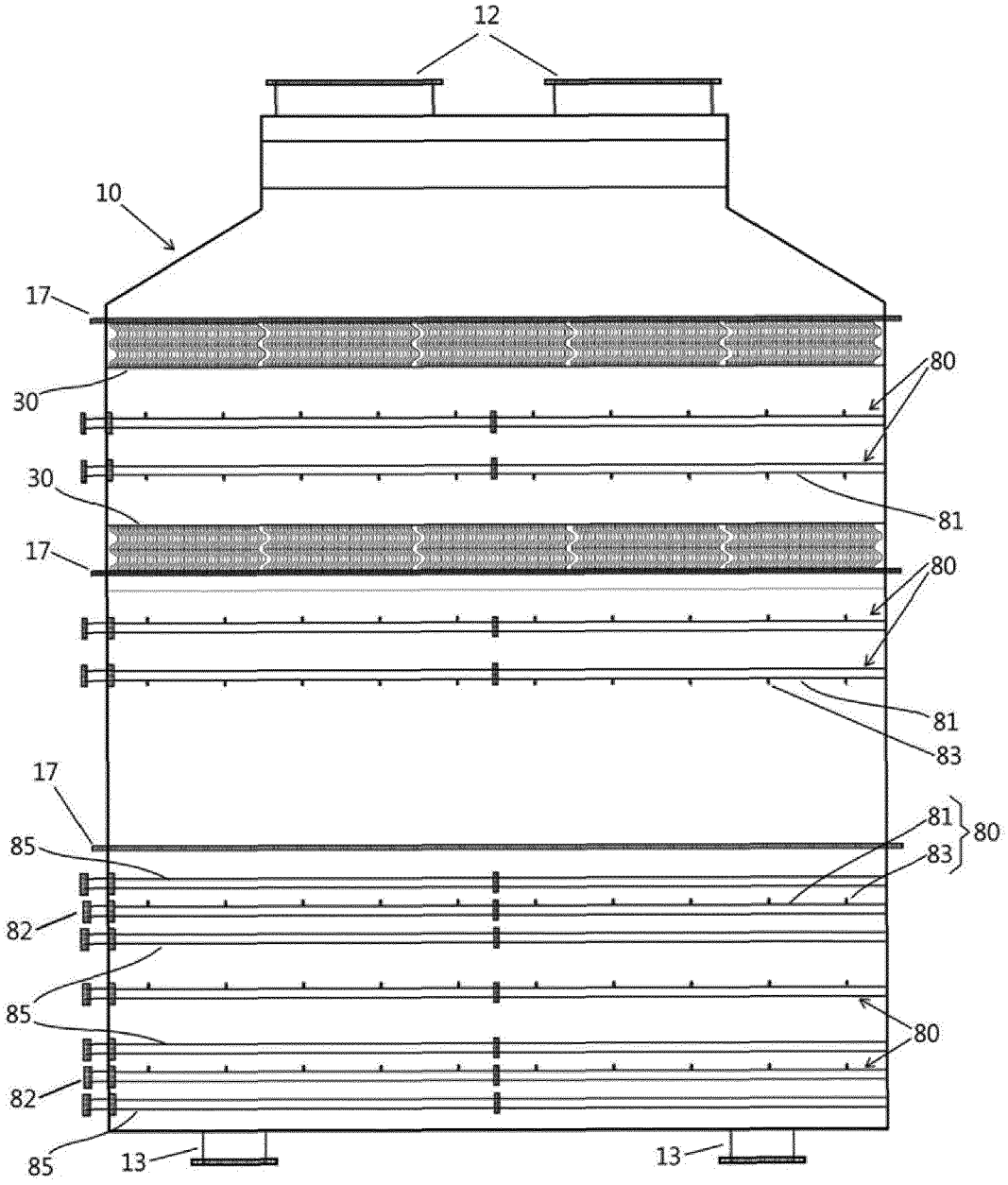


FIG 7.

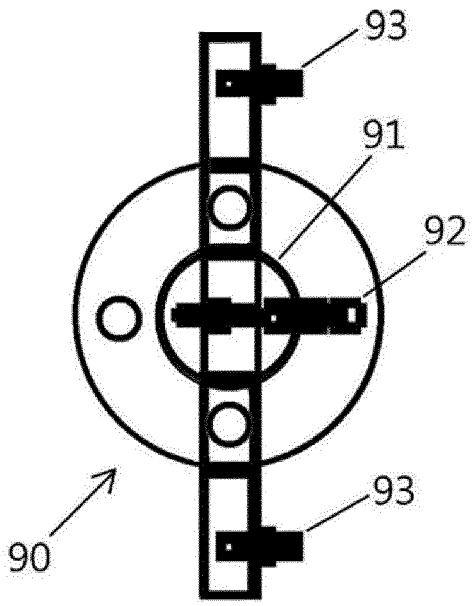
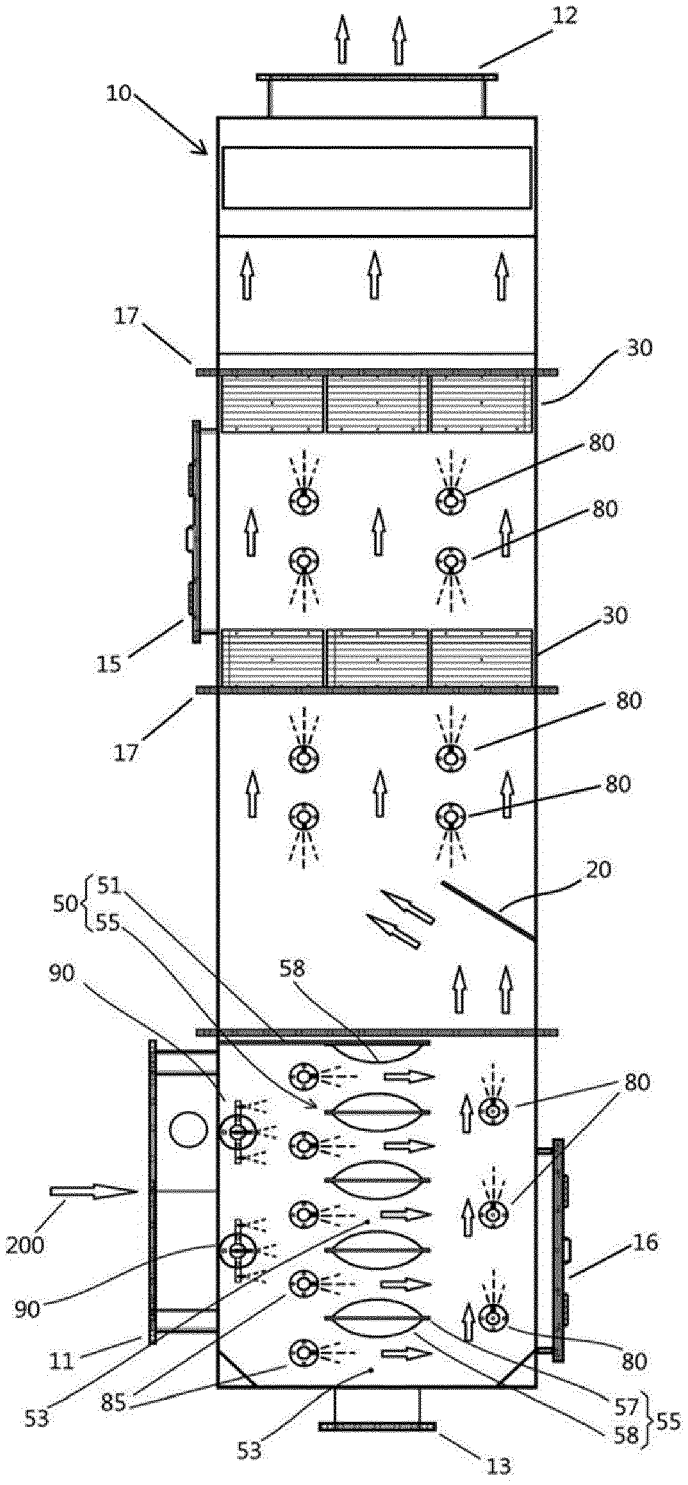


FIG 8.


12
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51
55
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58
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200
16
90
11
80
53
85
57
55
58
53
13

FIG 9.

REFERENCES CITED IN THE DESCRIPTION

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