

Wet-scrubber for cleaning of polluted gas such as flue gas

Claims

1. Wet-scrubber (1) for cleaning flue gas, said wet scrubber (1) comprising:
 - a first end (2) comprising a first end wall and a second end (3) comprising a second end wall;
 - an annular wall (4) extending from the first end (2) and to the second end (3) so as to form a chamber (5) having a longitudinal axis, said annular wall (4) and said end walls having an inner surface (7) and an outer surface (8);
 - said chamber (5) comprising a gas inlet opening (9) and a gas outlet opening (10) for emitting the flue gas from the wet-scrubber (1), said openings being in fluid communication and defining a downstream direction from the inlet opening (9) to the outlet opening (10);
 - a liquid distribution system (11) comprising at least three liquid outlets (12) each comprising a spray nozzle ~~a number of spray nozzles~~ where the spray nozzles form a cone (17) of liquid for distributing a liquid film (18) on the inner surface (7) of the chamber (5);
 - means arranged to rotate the liquid film (18) on the inner surface (7) of the annular wall (4) relative to the annular wall (4), and
 - a liquid exit aperture (19) arranged in a wall of the chamber (5), characterised in that the second end (3) comprises the gas outlet opening (10) and is separated from the liquid exit aperture, where the at least three cones (17, 17', 17'') are positioned at different positions along the longitudinal axis of the chamber (5) where positioning of the cones (17, 17', 17'') creates chicanes in order to obstruct the path of the flue gas in a direction parallel to the longitudinal axis of the chamber (5) and creating an unobstructed path of an area where flue gas can easily pass around the liquid cones (17, 17', 17'') for the gas along the longitudinal axis of the chamber (5) so that the gas is adapted to firstly pass around the first cone (17) of liquid, subsequently to pass around the second cone (17') and subsequently to pass around the third cone (17''), and that where the liquid exit aperture (19) is arranged at the lowest point of the annular wall (4) of the chamber (5) in order to be able to withdraw liquid from the chamber (5).
2. Wet-scrubber (1) according to claim 1, wherein the liquid outlets (12) causes the liquid on the inner surface (7) of the chamber (5) to rotate in relation to the inner surface (7).

3. Wet-scrubber (1) according to any of the preceding claims, wherein the liquid distribution system (11) comprises a number of extension tubes (15) comprising:

- a first end (2) in fluid communication with the a central liquid conduit,
- a second end (3) arranged for emitting liquid, said first end (2) and second end (3) being in fluid communication.

4. Wet-scrubber (1) according to any of the preceding claims, wherein the wall of the chamber (5) comprises ~~at least~~ more than one liquid exit aperture.

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5. Wet-scrubber (1) according to claim 3 or 4, wherein the second end (3) of the extension tubes (15) comprises a tube outlet, where the axis of the tube outlet is arranged so as to point towards the inner wall of the chamber (5) in a downstream angle.

6. Wet-scrubber (1) according to any of the preceding claims, wherein the longitudinal axis of the chamber (5) is substantially horizontal.

7. Wet-scrubber (1) according to any of the preceding claims, wherein the ~~chamber and the longitudinal axis of the chamber (5) are formed in an angle~~ is arranged in a position different from a horizontal position.

8. Wet-scrubber (1) according to any of the preceding claims, wherein the liquid distribution system (11) comprises a substantially centrally arranged conduit in fluid communication with the nozzles inside the chamber (5) and a liquid supply.

9. Wet-scrubber (1) according to any of claims 1-8, wherein the chamber (5) comprises heat-exchanging means arranged to harvest energy from the gas in the chamber (5).

10. Wet-scrubber (1) according to any of claims 1-8, wherein the at least three liquid outlets (12) and spray nozzles are arranged at different angles.

11. Method of cleaning flue gas, the method comprising the steps:

- providing a wet-scrubber (1) according to ~~claims 1-9~~, comprising a first end (2) comprising a first end (2) wall and a second end (3) comprising a second end (3) wall; an annular wall (4) extending from the first end (2) and to the second end (3) so as to form a chamber (5) having a longitudinal axis, said annular wall (4) and said end walls having an inner surface (7) and an outer surface (8), said chamber (5) comprising a gas inlet opening (9) and a gas outlet opening (10) for emitting the flue gas from the wet-scrubber (1), said openings being in fluid communication and defining a downstream direction from the inlet opening (9) to the outlet opening (10), a liquid distribution system (11) comprising at least three liquid outlets (12, 17, 17', 17'') each comprising a spray nozzle, where the at least three cones are positioned at different positions along the longitudinal axis of the chamber (5), a liquid exit aperture (19) arranged at the lowest point of an annular wall (4) of the chamber (5), where the second end (3) comprises the gas outlet opening (10) and is separated from the liquid exit aperture,

- injecting liquid through the liquid distribution system (11) creating a cone (17) of liquid formed from the spray nozzles for distributing so as to form a liquid film (18) on the inner surface (7) of the chamber (5) where the liquid cone (17) provides an area where flue gas can easily pass around the liquid cones;

- causing rotating the liquid film (18) on to rotate relative to the inner surface (7) of the annular wall (4) relative to the annular wall (4) using the injected cone (17) of liquid chamber;

- providing contaminated flue gas into the chamber (5) via injecting contaminated gas to be cleaned through the inlet opening (9) forcing the gas into contact with the liquid,

- providing an unobstructed path for the gas along the longitudinal axis of the chamber (5) where the cones of liquid creates chicanes in order to obstruct the path of the flue gas in a direction parallel to the longitudinal axis of the chamber (5) forcing the gas into contact with the liquid, and;

- arranging the gas to pass around the first cone (17) of liquid, subsequently to pass around the second cone (17') and subsequently to pass around the third cone (17'') of liquid, and

- emitting the cleaned gas from the gas exit opening-outlet opening (10) of the chamber.

4412. Method of cleaning flue gas according to claim 10, wherein the method further comprises the step of:

~~—spraying liquid into the chamber in a manner so as to partly block linear path for the gas in the chamber,~~

~~- causing forcing the gas to follow a spiral path and/or a wiggling path along the~~
 5 ~~length of the chamber (5).~~

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10 ~~42~~13. Use of a wet-scrubber (1) according to claims 1-9 for cleaning flue gas.

~~43~~14. Use of wet-scrubber (1) according to claims 1 - 9 for cleaning exhaust from an engine of a ship, wherein the longitudinal axis of the chamber (5) is substantially parallel with the waterline of the ship.

15 ~~44~~15. A ship comprising a wet-scrubber (1) according to any of the claims 1-9 characterized in that the longitudinal axis of at least one chamber (5) of the wet-scrubber (1) is horizon-tally positioned.