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(54) **Heating device**

(57) Heating device comprising:
- a primary fire chamber (2) for burning a fuel (F), such as wood, the primary chamber having an air inlet (7) and a flame outlet (14);
- a secondary fire chamber (3) with a flame inlet (10) at the top of the chamber and a flue gas outlet (14);
- air circulation means (18) for feeding air into the air inlet of the primary fire chamber

wherein the secondary fire chamber is below the primary fire chamber with respect to the direction of gravity, wherein the flue gas outlet is arranged at a distance from the bottom (12) of the secondary fire chamber such that an ash (11) collection space is provided between the bottom of the secondary fire chamber and the flue gas outlet.

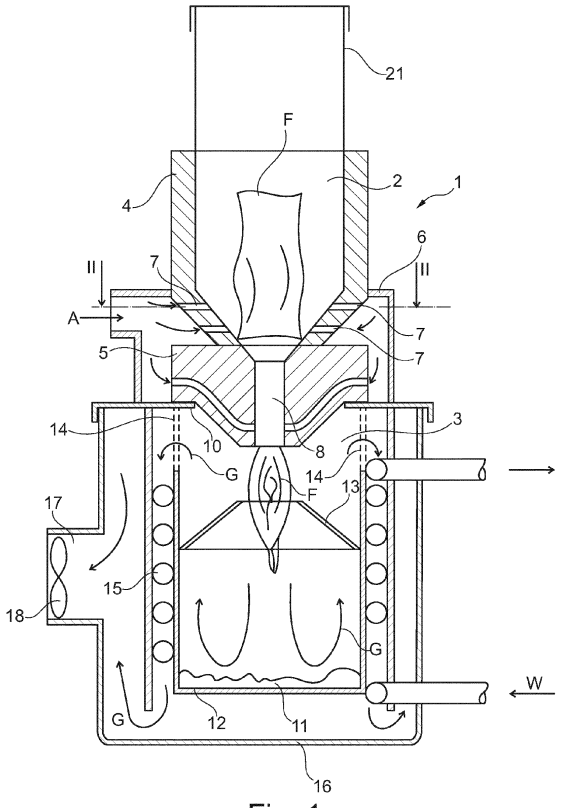

Fig. 1

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Description

[0001] The invention relates to a heating device comprising:

- a primary fire chamber for burning a fuel, such as wood, the primary chamber having a flame outlet;
- a secondary fire chamber with a flame inlet at the top of the chamber and a flue gas outlet;
- air circulation means for feeding air into the air inlet of the primary fire chamber

wherein the secondary fire chamber is below the primary fire chamber with respect to the direction of gravity.

[0002] Such a heating device is for example known from EP 0124945.

[0003] In the primary fire chamber a fuel, in particular wood or biomass or the like, is burned. The combustion gasses and flames are urged by the flow of the feeding air to the flame outlet of the primary fire chamber and to the flame inlet of the secondary fire chamber. The hot flue gasses are then fed from the secondary chamber to a heat exchanger, where the hot flue gasses can heat a secondary fluid, such as water, or make steam.

[0004] This type of heat exchanger according to the prior art has a relative effective burning process of the fuel. However still a lot of ash is taken along with the flue gasses into the heat exchanger and the chimney. These ashes clog the heat exchanger reducing the effectiveness of the heat exchanger.

[0005] Also due to the flue gas flow from the secondary fire chamber along the bottom towards the flue gas outlet a lot of ashes is transported outside of the fire chamber, while the ashes still contain fuel.

[0006] It is an object of the invention to further improve the heating device according to the prior art.

[0007] This object is achieved with a heating device according to the preamble, which is **characterized in that** the flue gas outlet is arranged at a distance from the bottom of the secondary fire chamber such that an ash collection space is provided between the bottom of the secondary fire chamber and the flue gas outlet.

[0008] By having the flue gas outlet at a distance from the bottom of the secondary fire chamber, an ash collection space is created in which ashes will be collected. Because the flames and combustion gases will cause turbulence, ashes dropped in the collection space will be picked up and recycle into the flames, where the ashes will melt and burn further. If the ashes are light enough and thus small enough they could leave the secondary fire chamber along the flue gas outlet.

[0009] Preferably, in the heating device according to the invention the flue gas outlet is arranged near the top of the secondary fire chamber. This will ensure that a minimal amount of ashes or no ashes at all leave the chamber via the flue gas outlet.

[0010] A preferred embodiment of the heating device according to the invention further comprises deflector means arranged in the secondary fire chamber between the bottom and the flue gas outlet for recycling flue gas into the flame entering through the flame inlet.

[0011] With the deflector means it is possible to direct stirred up ashes from the ash collection space into the flames to ensure that the ashes are constantly recycled and to melt and burn completely.

[0012] Preferably, the deflector means comprise a truncated cone shaped metal sheet substantially concentrically arranged relative to the flame inlet.

[0013] The flames will initially blow the ashes into the secondary fire chamber. By having a deflector plate concentrically arranged, the plate will direct stirred up ashes back into the flames, creating a kind of whirlpool in which the ashes are recycled and further burned.

[0014] Another embodiment of the heating device according to the invention further comprises a heat exchanger with a primary circuit in fluid connection with the flue gas outlet and a secondary circuit, through which a heatable medium flows.

[0015] The heat exchanger is preferably of the counter flow type. As the heatable medium, typically water, is relative cold, condensation will occur in the flue gases on the heat exchanger. This has the advantage that small ash particles, which managed to escape the secondary fire chamber through the flue gas outlet, are captured by the condensation droplets, further cleaning the flue gases from any particles.

[0016] In the heating device according to the invention, the heat exchanger could comprise a coiled tube arranged around the secondary fire chamber and a peripheral wall, which is preferably removable, arranged around the coiled tube.

[0017] Such a coiled tube heat exchanger is robust and can be manufactured at low costs. If the secondary chamber and / or the peripheral wall can be taken away, the coiled tube heat exchanger can also be easily cleaned by brushing off the tube.

[0018] In yet another preferred embodiment of the heating device according to the invention, the primary fire chamber has a cylindrical wall and a plurality of air feed inlet channels are distributed over the cylindrical wall.

[0019] This plurality of air feed inlet channels ensure an even distribution of the air over the fuel, such that a uniform burning of the fuel can take place.

[0020] Preferably, the air feed inlet channels have a radial directional component at the exit into the primary fire chamber in order to urge the air into a vortex.

[0021] By urging the air into a vortex within the primary fire chamber, the air is evenly distributed, but also burning fuel portions are blown around, such that the fire bed is also uniform.

[0022] These and other features of the invention will be elucidated in conjunction with the accompanying drawings.

Figure 1 shows a cross sectional view of an embod-

iment of the heating device according to the invention.

Figure 2 shows a cross sectional view along the line II-II of figure 1 .

Figure 3 shows a cross sectional view of a variant of the secondary chamber as shown in figure 1.

Figure 4 shows a third embodiment of a secondary chamber of a heating device according to the invention.

Figure 5 shows a cross sectional view of a variant of the primary chamber as shown in figure 1.

[0023] Figure 1 shows an embodiment of a heating device 1 according to the invention. The heating device 1 has a primary fire chamber 2 and a secondary fire chamber 3.

[0024] The primary fire chamber is formed by ceramic two part element 4, 5. A cover 21 is arranged on the ceramic element 4 to close the primary fire chamber 2.

[0025] The ceramic element 4, 5 provides a holder for the fuel F and a guide element 6 for the air A. The upper ceramic element 4 is provided with air feed inlet channels 7, which feed air to the fuel F such that oxidation of the fuel can take place and combustible gases are produced. These combustible gases will be fed through the flame outlet 8 in the lower ceramic element 5 and ignite on the way resulting in a flame F. To further improve this burning process, additional air feed channels 9 are provided in the lower ceramic element 5.

[0026] The flame F enters the secondary fire chamber 3 through the flame inlet 10, in which the lower ceramic element 5 with the flame outlet 8 protrudes.

[0027] The flame F will take along non burnt fuel or ashes 11. These particles 11 will fall to the bottom 12 of the secondary chamber 5. The force of the flame F and the flue gases G will take along the ashes 11 from the bottom 12 and stir them up, creating a cloud of ashes inside of the secondary chamber 5. The deflector plate 13, which is concentrically arranged around the flame F and the flame inlet 10 ensures that the stirred up particles have to travel through the flame F, such that these particles 11 are burnt further. The flame F will urge the particles back to the bottom 12 and substantially flue gas G will escape from the secondary fire chamber 3 through the flue gas outlet 14.

[0028] A coiled tube 15 is arranged on the outside of the secondary fire chamber 3 through which water W is transported in counter flow with the flue gases G exiting through the flue gas outlet 14. Due to the counter flow arrangement, heat of the flue gas G can be exchanged efficiently with relative cold water W.

[0029] The flue gases G pass a number of sections of the coiled tube 15 and exit into a surrounding housing 16, which has an outlet 17 in which a ventilator 18 is arranged. This ventilator 18 provides low pressure in the surrounding housing 16 such that flue gases are sucked from the secondary fire chamber 3 along the coiled tube 15. The ventilator 18 also ensures as a result of the generated low pressure that the air A is sucked into the primary fire chamber 2 and mixes with the fuel F to generate combustible gases for creating the flame F.

[0030] Figure 2 shows a cross sectional view of the upper ceramic element 4 creating part of the primary fire chamber 2. The wall of the ceramic element 4 is provided with a plurality of air feed channels 7.

[0031] It is clear from this figure, that the air feed channels 7 have a radial directional component at the exit into the primary fire chamber 2. Because all the air feed channels 7 have a corresponding radial direction component, the sucked in air A, will be urged into a vortex, which improves the uniform burning of the fuel F.

[0032] Figure 3 shows a variant of the secondary chamber 3 as shown in figure 1. Similarly to figure 1, a coiled tube 15 is arranged on the outside of the secondary fire chamber 3 through which water W is transported in counter flow with the flue gases G exiting through the flue gas outlet 14. The flue gases G passes a number of sections of the coiled tube 15 and exit into a collecting housing 16, which has an outlet 17 in which a ventilator 18 is arranged. This ventilator 18 provides low pressure in the collecting housing 16 such that flue gases are sucked from the secondary fire chamber 3 along the coiled tube 15.

[0033] A water screen 20 is arranged around the outside of the coiled tube 15. This water could be in fluid communication with the water in the coiled tube 15. The water screen 20 prevents heat to be radiated from the secondary chamber 3 between the coiled tube 15 to the outlet 17. Any heat radiation is captured by the water in the water screen 20 and combined with the heat captures in the coiled tube 15.

[0034] Figure 4 shows a third embodiment of a secondary chamber 30 of a heating device according to the invention. This secondary chamber can also be used as a standalone heat exchanger without the need of a primary chamber according to the invention.

[0035] The secondary chamber 30 has at the bottom an inlet 31, through which hot flue gas is inputted. The secondary chamber 30 is enveloped by a water screen 32, which picks up part of the heat in the hot flue gas G.

[0036] At the top of the secondary chamber 30, the flue gas is directed downwards along the outside of the water screen 32 and along a coiled tube 33. The coiled tube 33 is provided with water from a supply pipe 34. This water is heated in the coiled tube 33 by the flue gases and is then fed to the water screen 32, where it is further heated and finally exits through outlet pipe 35.

[0037] A fan 36 is provided to urge the hot flue gases G along the correct path.

[0038] An isolation layer 37 is arranged around the coiled tube 33 and the secondary chamber 30 to ensure that no heat escapes. The isolation layer 37 could for example comprise a metal liner directed to the coiled tube, such that the isolation layer 37 is not affected by the heat. The isolation layer 36 is preferably removable, such that easy access is provided to the coiled tube 33

for easy cleaning.

[0039] Figure 5 shows a cross sectional view of a variant of the primary chamber 2 of figure 1.

[0040] In this variant the primary chamber 40 is also composed out of two ceramic elements 41, 42 stacked on top of each other. An air guiding housing 43 is arranged around the ceramic elements 41, 42. This housing 43 has two separate spaces 44, 45 which can be supplied with air through respective inlets 46, 47. The ceramic elements 41, 42 have corresponding channels 48, 49, 50 to feed the air to a respective location inside of the primary chamber 40.

[0041] Because the housing 43 is split, it is possible in this embodiment to control the amount of air, which is fed to the upper part of the chamber 40 and the lower part. Especially, with loose fuel, such as pellets or wood chips 51, it is desirable to control the air flow to have an optimal burning.

[0042] A grating 52, 53 is arranged inside of the primary chamber 40 to support the fuel 51 and prevent the ashes and fuel to clog the flame outlet 54.

[0043] The grating 52, 53 has a ring shaped base 52 from which elongate pins 53 protrude. The length, angle and spacing of the pins 53 could be designed for a specific fuel.

Claims

1. Heating device comprising:

- a primary fire chamber for burning a fuel, such as wood, the primary chamber having an air inlet and a flame outlet;
- a secondary fire chamber with a flame inlet at the top of the chamber and a flue gas outlet;
- air circulation means for feeding air into the air inlet of the primary fire chamber

wherein the secondary fire chamber is below the primary fire chamber with respect to the direction of gravity, **characterized in that**

- the flue gas outlet is arranged at a distance from the bottom of the secondary fire chamber such that an ash collection space is provided between the bottom of the secondary fire chamber and the flue gas outlet.

2. Heating device according to claim 1, wherein the flue gas outlet is arranged near the top of the secondary fire chamber

3. Heating device according to claim 1 or 2, further comprising deflector means arranged in the secondary fire chamber between the bottom and the flue gas outlet for recyclinging flue gas into the flame entering through the flame inlet.

4. Heating device according to claim 3, wherein the deflector means comprise a truncated cone shaped metal sheet substantially concentrically arranged relative to the flame inlet.

5. Heating device according to any of the preceding claims further comprising a heat exchanger with a primary circuit in fluid connection with the flue gas outlet and a secondary circuit, through which a heatable medium flows.

6. Heating device according to claim 5, wherein the heat exchanger comprises a coiled tube arranged around the secondary fire chamber and a peripheral wall arranged around the coiled tube.

7. Heating device according to any of the preceding claims, wherein the primary fire chamber has a cylindrical wall and wherein a plurality of air feed inlet channels are distributed over the cylindrical wall.

8. Heating device according to claim 7, wherein the air feed inlet channels have a radial directional component at the exit into the primary fire chamber in order to urge the air into a vortex resulting in a complete pyrolising of the fuel.

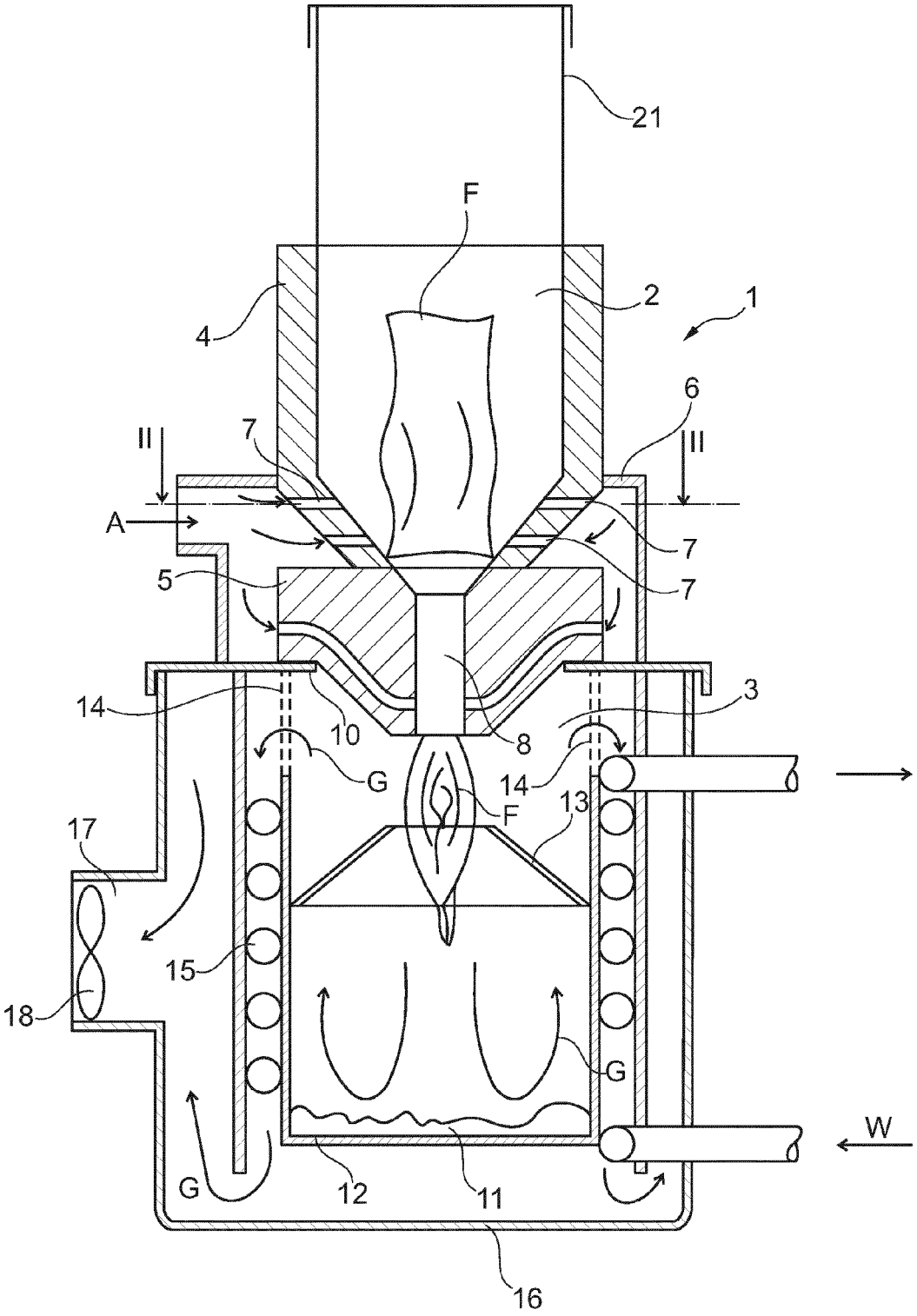

Fig. 1

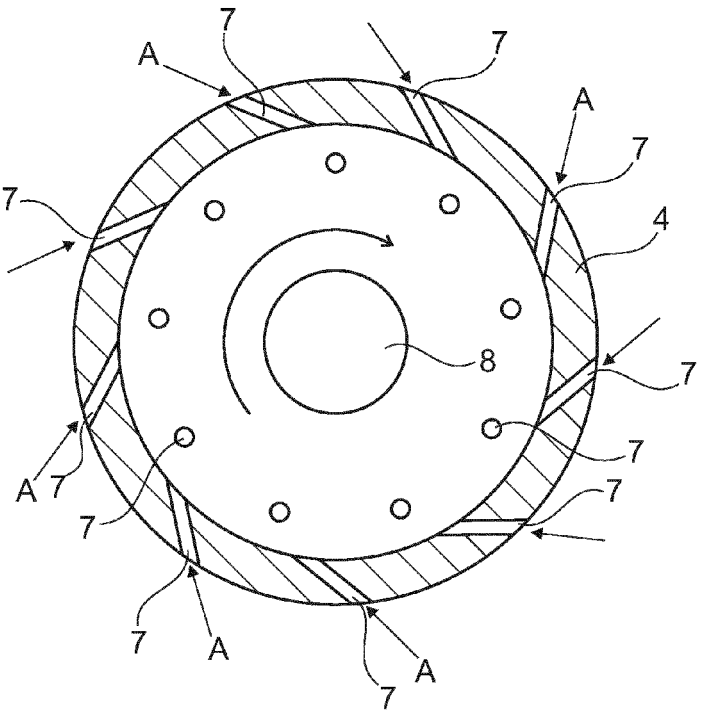

Fig. 2

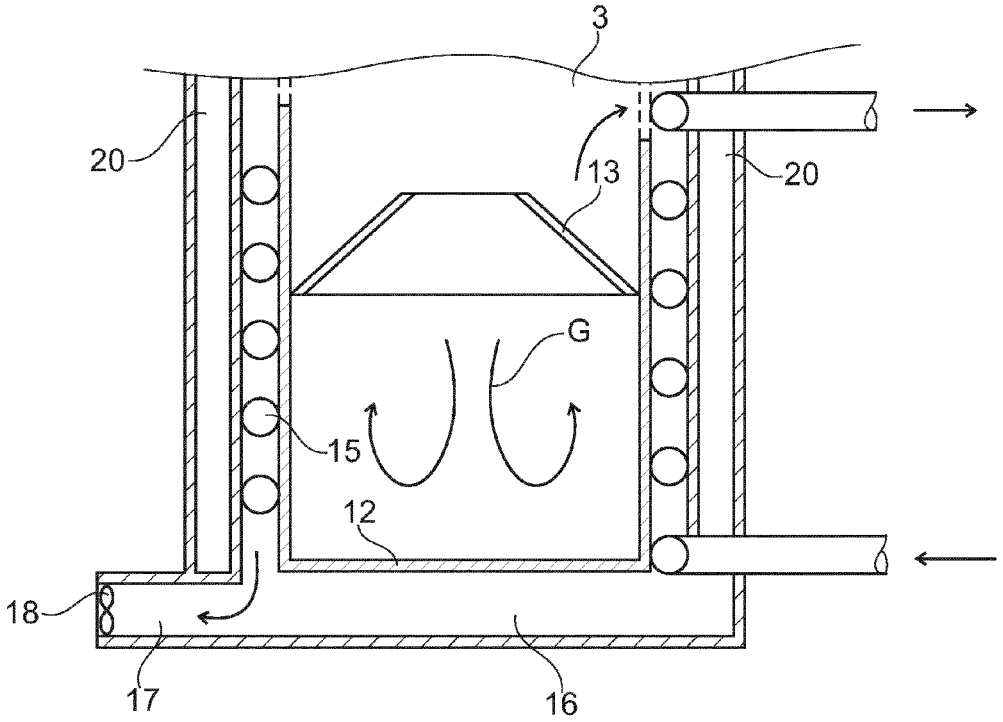

Fig. 3

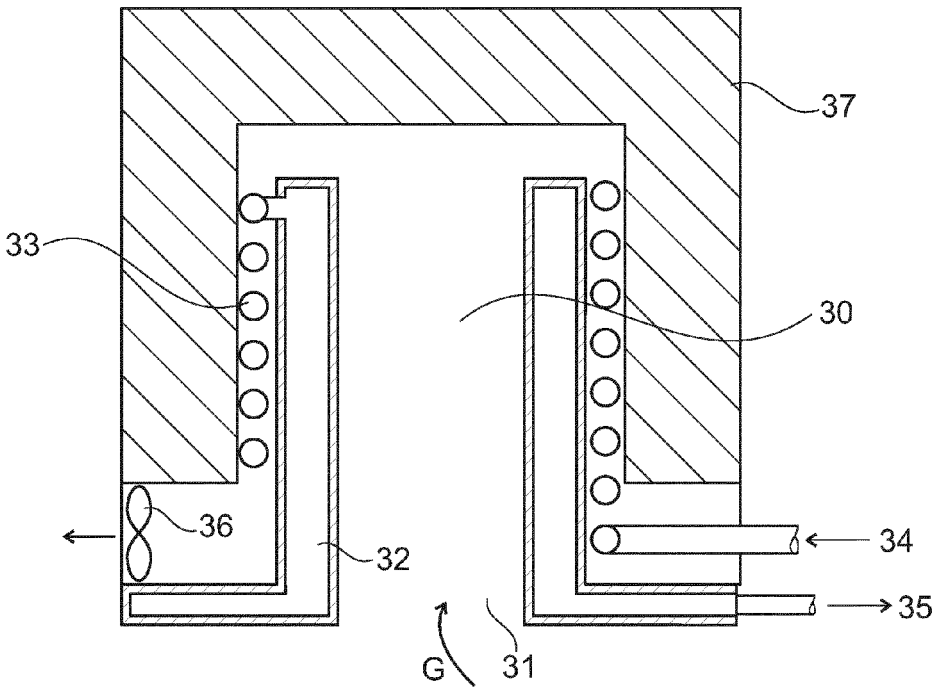

Fig. 4

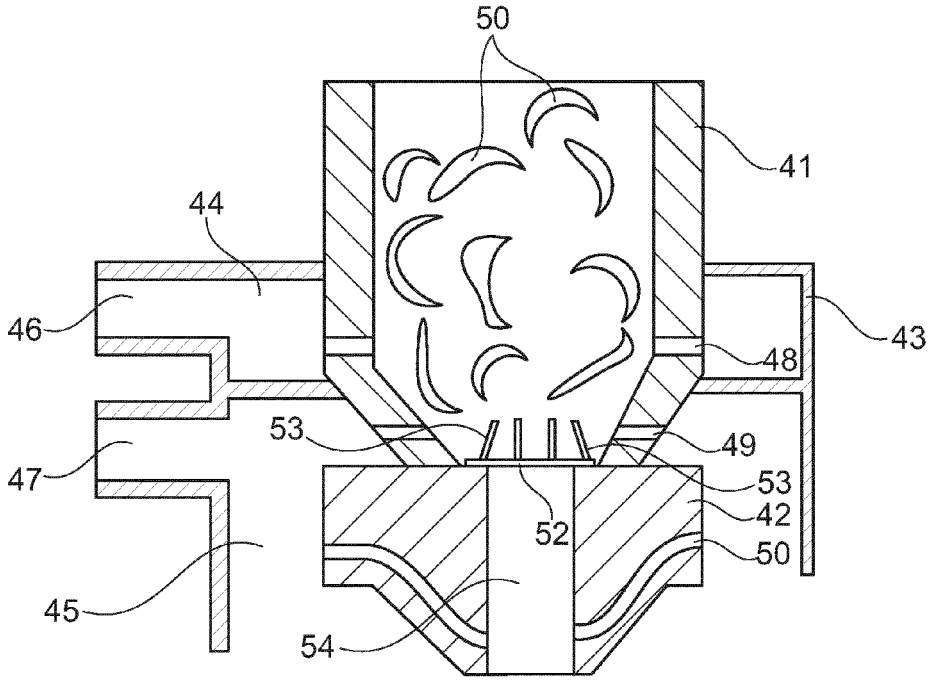

Fig. 5

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EUROPEAN SEARCH REPORT

Application Number
EP 12 15 1204

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TECHNICAL FIELDS SEARCHED (IPC)
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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	16 October 2012	Coli, Enrico

CATEGORY OF CITED DOCUMENTS

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ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 12 15 1204

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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

REFERENCES CITED IN THE DESCRIPTION

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