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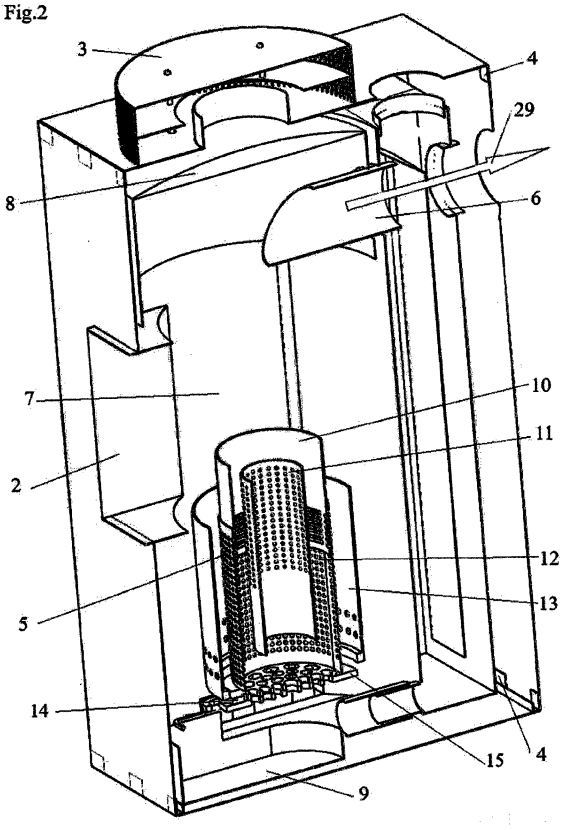
(54) **FIREPLACE INTENDED FOR SOLID FUELS WITH MULTI-FUEL DEVICE ARRANGED INTO ITS BURNING PLACE**

(57) A fireplace (1) intended for solid fuels, into the burning space of which fireplace is arranged a multi-fuel device (10-13) for burning several solid fuels, such as chopped wood, briquettes or biomasses, said multi-fuel device comprising a grate pair which consists of a bottom grate (15) and a top grate (14), a burning cylinder (10), a perforated cylinder (12), a fire tube (11) and a control system for conducting primary and secondary air into burning. The grate pair is adjustable and the perforated cylinder (12) is replaceable when changing the used fuel into another one and the multi-fuel device is located at least for its most part below the bottom-edge level of a fireplace door (2).

Fig.2



EP 4 227 580 A1

Description

[0001] The invention relates to a fireplace intended for solid fuels, such as a furnace, into the burning space of which fireplace is arranged a multi-fuel device for burning several solid fuels, such as chopped wood, briquettes or biomasses, said multi-fuel device comprising a grate pair, a burning cylinder, a perforated cylinder, a fire tube and a control system for conducting primary and secondary air into burning.

[0002] From specification EP1402217 is previously known a burner of solid fuel which contains a tank for the solid fuel to be burned and into which space for solid fuel is arranged a possibility for gas flow. Inside the tank, there is at least one fire tube through the wall of which fire tube is arranged a possibility for gas flow.

[0003] Furthermore, a burning device is known from Finnish specification FI109723 intended particularly for burning briquettes, comprising a dish-like section for placing burnable briquettes or equivalents. The device also includes a second bottomless and coverless dish section coming inside the dish-like section and supported on the top surface of the briquettes, whereby each of the sections contain holes on their casing surface. Each of the sections are cylinder-like and telescopically within each other. The lower section advantageously contains a perforated grate section in an elevated position from the bottom edge of said section.

[0004] Previously is known from Finnish specification FI123850 a grate used in a burning device which is formed of two grate plates on top of each other which both include holes in a circular form, and the sizes of holes going through the grates can be changed by turning the mutual position of the grate plates.

[0005] A disadvantage of the above fireplaces and burning means is their limited possibility to use different fuels in the same or slightly modified burner device.

[0006] To eliminate this above disadvantage, a novel multi-fuel device arrangeable into a fireplace, provided with a grate pair and its special positioning in the fireplace, which device eliminates the above drawbacks and disadvantages. The present invention is characterised by the grate pair being adjustable and the perforated cylinder being removable/addable when changing the used fuel into another one and that the multi-fuel device is located at least for its most part below the bottom-edge level of the fireplace door.

[0007] An advantage of the multi-fuel device arranged into a fireplace according to the invention is its suitability for several different fuels, such as wood chips, briquettes, chopped wood and biofuels. The structure of the multi-fuel device is additionally arranged with special controls of burning air and selections of burning points to implement burning such that very little particulate emissions and sootiness are created.

[0008] The invention will now be described with reference to the accompanying drawings in which

Fig. 1 shows an oblique view of a fireplace.

Fig. 2 shows a cut view of the fireplace of Fig. 1 along line A-A.

Fig. 3 shows an oblique bottom view of a multi-fuel device.

Fig. 4 shows a cut exploded view of the multi-fuel device of Fig. 3.

Fig. 5 shows a cut view of a multi-fuel device of dry biomasses.

[0009] Fig. 1 shows a fireplace 1 into which is installed a multi-fuel device 10-13 according to the invention. The structure of the fireplace 1 can be e.g. sheet-metal shelled, masonry or element-structured from which heat is conveyed to a room from openings 4 by means of air flows, such as is shown in Fig. 1. Also via side surfaces and an air distributor 3 on top of the fireplace. The fireplace 1 includes a door 2 (not shown in the figure) from which fuel is added to the multi-fuel device 10-13, the top part of which device is shown via the door 2. A multi-burner 5 is located at least for the most part below the bottom-edge level of the door 2. The fireplace operates without electricity and blowing and the fuel can be selected from various dry and solid fuels, such as chopped wood, wood briquettes, wood chips, wood coal, various farming waste, such as maize straw briquettes, fruit scales and other non-sintering dry particles, pressed if necessary. The burning event aims at as clean as possible burning, i.e., the minimization of particle emissions.

[0010] Fig. 2 shows the fireplace 1 of Fig. 1 cut along line A-A, whereby interior parts of a fireplace solution are better visible. The main parts of the fireplace 1 are the following:

A smoke flue 6 from which flue gases of the burning event are controlled out by means of underpressure created by a chimney.

[0011] A burning space 7 is a limited space above the multi-burner 5 in which fuel gases burn cleanly in a high temperature. The burning space 7 is limited by a fire cover 8 above.

[0012] An ash pan 9 is in the bottom part of the fireplace 1 to which pan unburned particles fall. In some cases, the firing of the fuel is performed via the ash pan 9, burning air is conveyed to the multi-fuel device 10-13 and secondary air to afterburning.

[0013] A burning cylinder 10 distributes burning air to burning gases above the fuel and follows the surface of the burning fuel for the time of burning. The burning cylinder 10 is an optional part and it is not required in connection with all fuels.

[0014] A fire tube 11 operates as a collection space for carbon monoxide when its burning is ensured in the multi-burner 5. The fire tube 11 is an optional part when changing the fuel.

[0015] A perforated cylinder 12 forms a space for a fuel batch. It allows flow-throughs of gases and flows of burning air to the burning cylinder 10. The perforated cylinder 12 is an optional part with a cylinder 13 when changing

the fuel to another one.

[0016] The cylinder 13 is used as the space for the fuel batch typically when burning chopped wood.

[0017] The burning of various dry and solid fuels targetedly cleanly requires that the burning air is controlled to the forming point of carbon monoxide or immediately after it. For that purpose, the fireplace contains an operational and overlapping grate pair. A bottom grate 15 stays in place and a top grate 14 moves into its open position for removing the grate pair for cleaning and into its more or less open position when adjusting the burning position for different fuels.

[0018] Through the grate pair 14, 15, firing, burning air and afterburning are controlled by electric logics when aiming at targeted burning for different fuels.

[0019] Fig. 3 shows a multi-fuel device 10-13 to be located in the fireplace 1 which shows a cylinder collar 16, the cylinder 13 and holes 17 of the cylinder 13. When burning chopped wood, the cylinder 13 limits a space inside of it for the required batch. Chopped wood can be added via the door 2. Of the grate pair, the holes of the lowest bottom grate 15 are shown. A part of them includes firing tubes 19 and a part air tubes 18. The openings of the operating grate pair are adjusted to the position required by targeted burning.

[0020] Through the grate pair 14-15 flows burning air to the fire. Arrows 29 show the course of the air flows. The holes 17 of the cylinder assists in the convection of burning air to the fuel.

[0021] Via the air tubes 18 of the grate pair 14-15, it is possible to convey burning air for burning using electric logics and, via the firing tubes 19, firing air for firing, as controlled by electric logics and as optional. Chopped wood burns freely without electricity and blowing on top of the grate pair 14-15 into targeted cleanness. The collar 16 of the cylinder limits the by-pass flow of oxygen and adjusts air for the fire.

[0022] The size of the cylinder 13 and its grates can be changed to match required power. The cylinder 13 is suitable for traditional and new fireplaces.

[0023] The parts in Fig. 4 are not in their places but they have been lifted up, similar to an exploded view, out of the way of parts at the back. The cylinder 13 also limits the volume of a briquette storage when using them as the burning batch. Inside the cylinder 13, there can be a required number of the fire tubes 11. A cover 20 guides surface gases from the briquette layer to the fire tube 11 to burn cleanly. Hot secondary air is guided along the outer surface of the cylinder 13 to the fire in the burning space. Chopped wood is fired in the cylinder 13 normally from the top or by means of electric logics from the firing tubes 19.

[0024] For example, when burning briquettes, carbon monoxide is released from the briquettes when firing them in the fire tube 11 from the effect of the heat of the firing briquette. For burning gases, a sufficient amount of air in the limited space is conveyed by the fire tube 11. The burning event is adjusted by adjusting burning air. Burning continues in the burning space 7, into which, burning air is conveyed to achieve the targeted burning level.

[0025] The adjustable grate pair 14-15 is supported by its bracket 23. By rotating one of the grates, the holes 21, 22 of the grate pair can be aligned, whereby they are in the emptying position of the grate. During burning, the holes 21, 22 of the grates are usually partially aligned as the result of adjustment. The burning can be repeated when the previous briquettes have burned and the ashes have been dropped via the holes of the grate pair into the ash pan. From the air tubes 18 and the firing tubes 19 of the grate pair 14-15, it is possible to optionally convey burning air and firing air to the briquettes e.g. by means of electric-logic adjustment. The briquettes burn without electricity and mechanical blowing solely with the smoke flue suction and free draught according to the target. The burning power and burning time are adjusted by repeating the burning, the size of the cylinder 13, the area of the fire tubes 11 and the supply of burning air.

[0026] Fig. 5 particularly shows a burning device of various dry biomasses by means of cylinder burning. Then, the perforated cylinder 12 is the batch burning storage. The bottom of the storage consists of the operable grate pair, the bottom grate 14 and the top grate 15, which have an emptying position and a burning position. The firing tube 19 is in the middle and almost extends on the surface of the fuel. To the firing tube 19 is conveyed hot air produced electrically by a ceramic resistor which air fires the dry biomass starting from the surface. Next, the firing tube 19 operates in adjusting burning air to the fire making the burning targeted in terms of power, burning time and cleanness.

[0027] The biomass fired by the flow in the firing tube 19 or, when filling normally, fired from the surface is burned inside the perforated cylinder 12 in the burning cylinder 10 being on top of the fuel layer using free draught without electricity and blowing and aiming at the targeted cleanness of burning gases.

[0028] The perforated cylinder 12, including holes 24, follows downwards the diminishing burning mass and distributes burning air to the fire keeping carbon monoxide in the burning state and the fire hot enough for burning fine particles in the fire. Hot secondary air is guided to the fire in the burning space from the gap of a collar 25 of the perforated cylinder and the perforated cylinder 12 in accordance with the arrows 29. An inner tube 26 provided with holes 28 distributes air inside the perforated cylinder 12.

[0029] The hot secondary air increases the temperature in the burning space and fine particles burn away before their access to the smoke flue 6. In this way and by conveying burning air to different biomasses, the targeted burning results are also obtainable with various waste burnings.

[0030] The fireplace is made in accordance with an existing need and its burning method is selected to burn with the correct power targetedly. Only some of the about

billion people burning waste and biomass daily know chopped wood as a fuel. Hence, a simple multi-fuel bio-burner is needed for all dry biomass, to burn targetedly, in all homes, even ones without electricity, and in times of various upheavals using the so-called locally-available fuels.

Claims

1. A fireplace (1) intended for solid fuels and provided with a burning space (7), into the burning space of which fireplace is arranged a multi-fuel device (10-13) for burning several solid fuels, such as chopped wood, briquettes or biomasses, said multi-fuel device (10-13) comprising a grate pair which consists of a bottom grate (15) and a top grate (14) and further a burning cylinder (10), a perforated cylinder (12), a fire tube (11) and a control system for conducting primary and secondary air into the burning cylinder (10), **characterised in that** the grate pair (14, 15) is adjustable by moving them in relation to each other and the perforated cylinder (12) is changeable when changing the used fuel to another one and that the multi-fuel device (10-13) is located at least for the most part below the bottom-edge level of a door (2).

2. A fireplace (1) according to claim 1, **characterised in that** the grate pair (14, 15) comprises two perforated plates on top of each other and part of the flues of the grate pair has been formed as firing flues.

3. A fireplace (1) according to claim 1, **characterised in that** the burning cylinder (10) is provided with a cover (20).

4. A fireplace (1) according to claim 4, **characterised in that** the burning cylinder (10) together with its cover (20) are arranged due to their wall sections to control the burning event in accordance with each selected fuel.

5. A fireplace (1) according to claim 1, **characterised in that** the diameter of the fire tube (11) included inside the cylinder (13) of the multi-fuel device (10-13) is selectable different for various fuels.

6. A fireplace (1) according to claim 1, **characterised in that** inside the burning cylinder (10) are addable parts intended for conveying primary air and/or flue gases when changing the fuel from chopped wood to e.g. wood chips, wood briquettes or dry biomass granules.

7. A fireplace (1) according to claim 1, **characterised in that** through the grate pair are arranged to go air tubes (18) for conveying burning air to the fuel layer.

8. A fireplace (1) according to claim 2, **characterised in that** the cleaning of the separate grates (14), (15) is arranged to be performed by the mutual motion of the grates.

9. A fireplace (1) according to claim 1, **characterised in that**, in order to fire the fuel by means of heated burning air, the fireplace (1) includes an electric heater of burning air, such as a ceramic heater, and conveying the heated air into connection with the fuel.

10. A fireplace (1) according to claim 1, **characterised in that** the multi-fuel device (10-13) is located in relation to the door (2) such that the fuel can be batched and the parts of the multi-burner (5) can be replaced via said door (2).

11. A fireplace (1) according to claim 1, **characterised in that** the holes (21) or (22) of at least one of the grates (14) or (15) are elongated openings.

12. A fireplace (1) according to claim 1, **characterised in that** the multi-fuel device (10-13) is cylindrical and formed of cylindrical parts supported on the structure of the grate pair (14, 15).

Fig.1

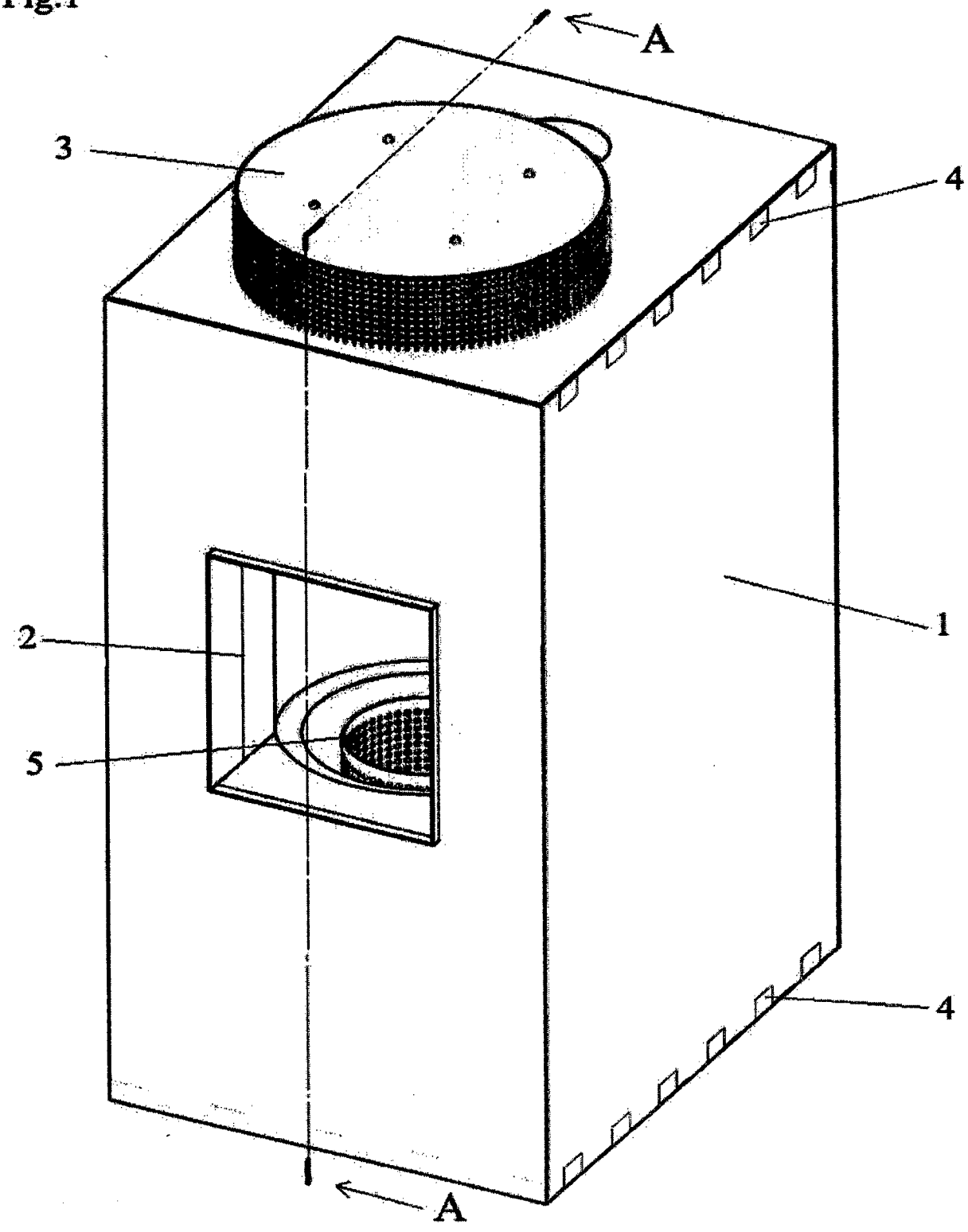


Fig.2

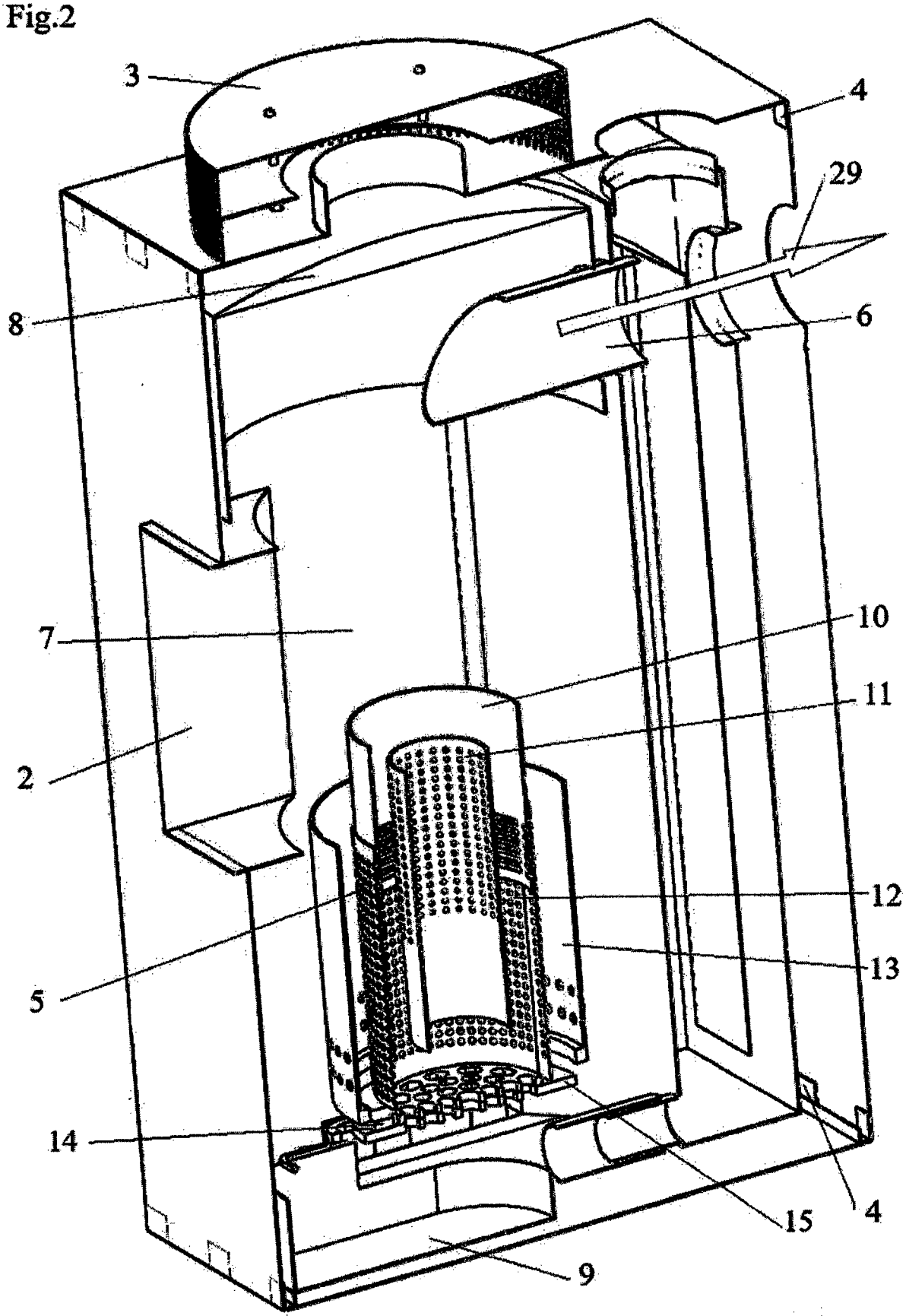


Fig.3

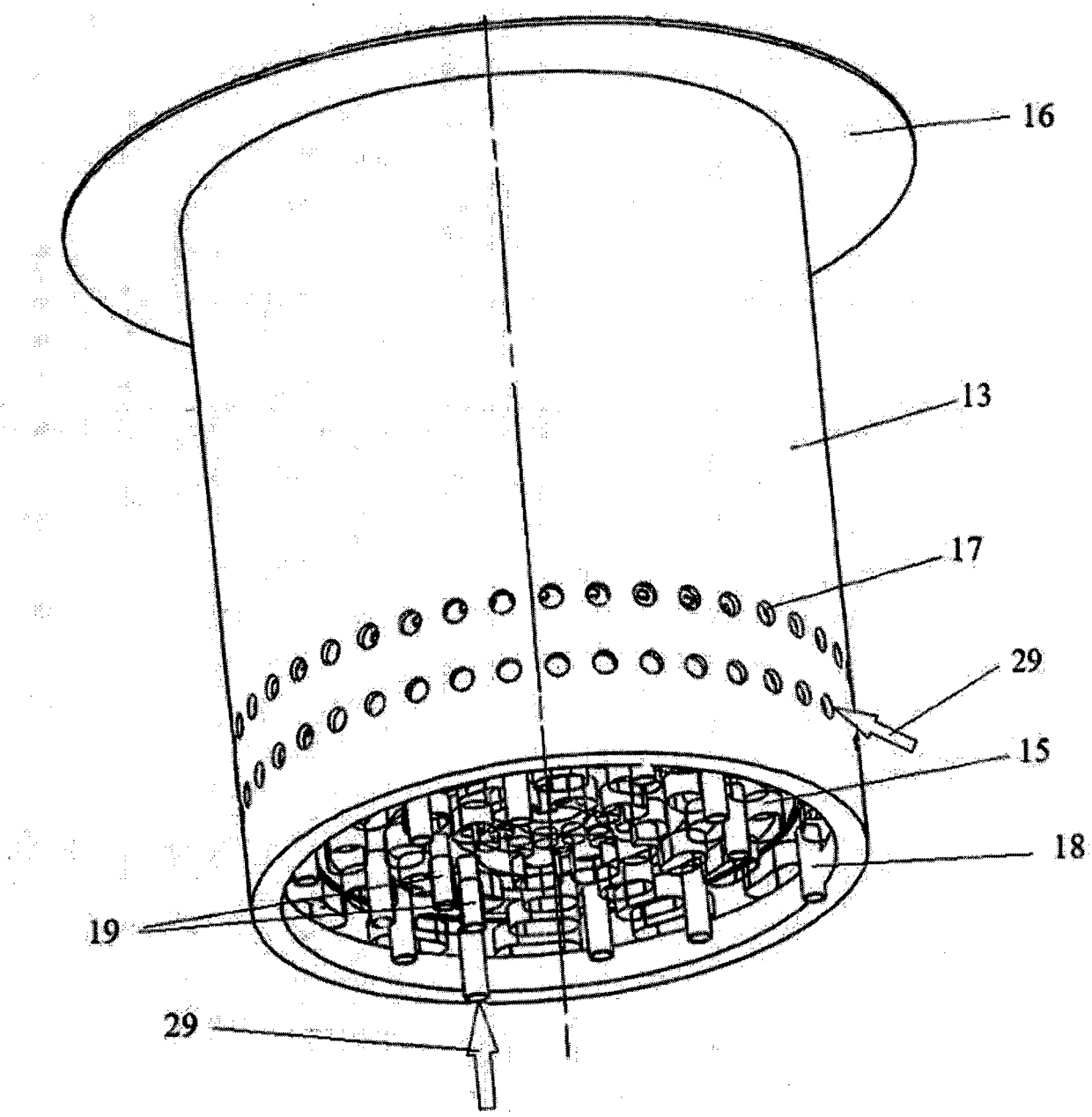


Fig.4

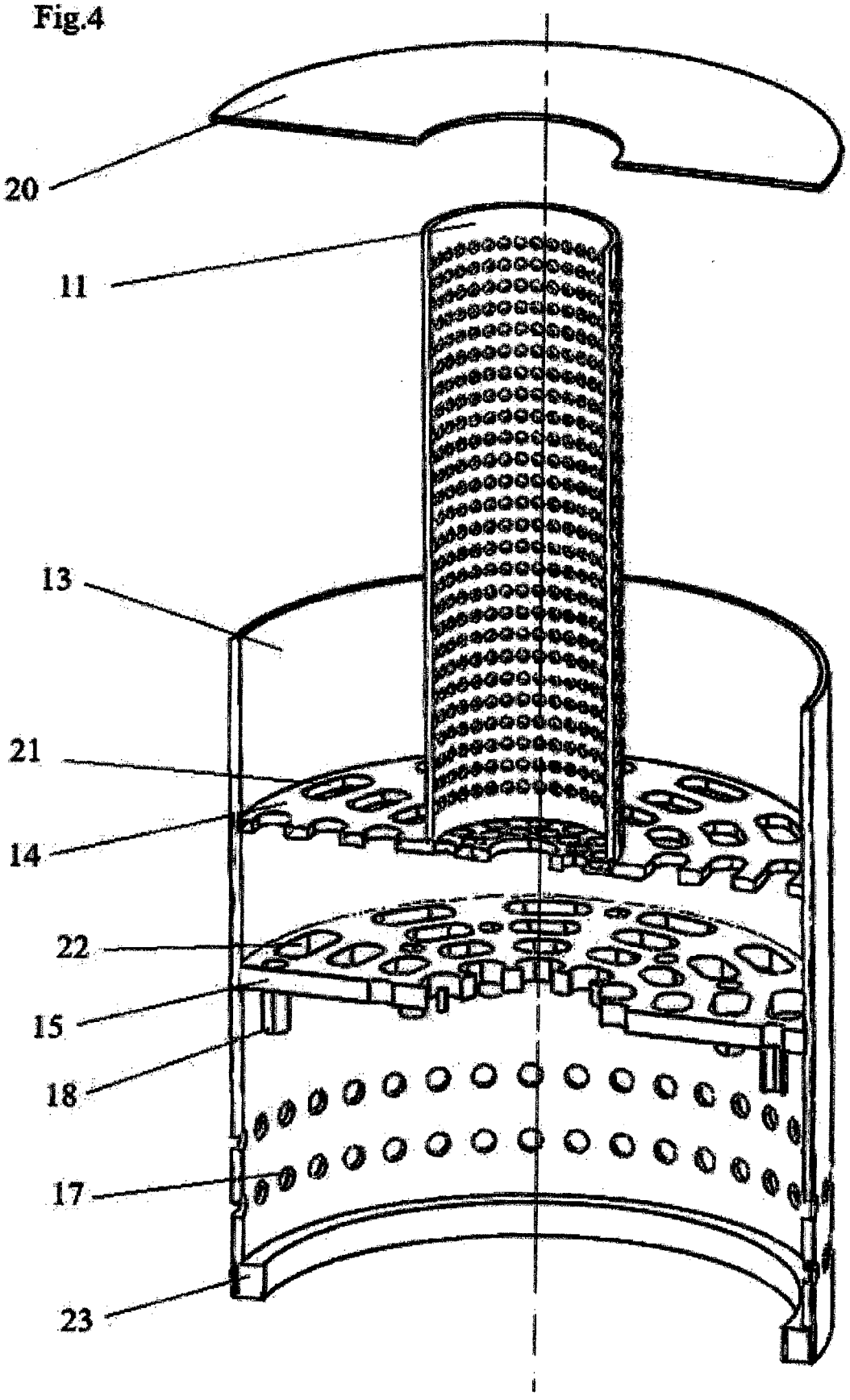
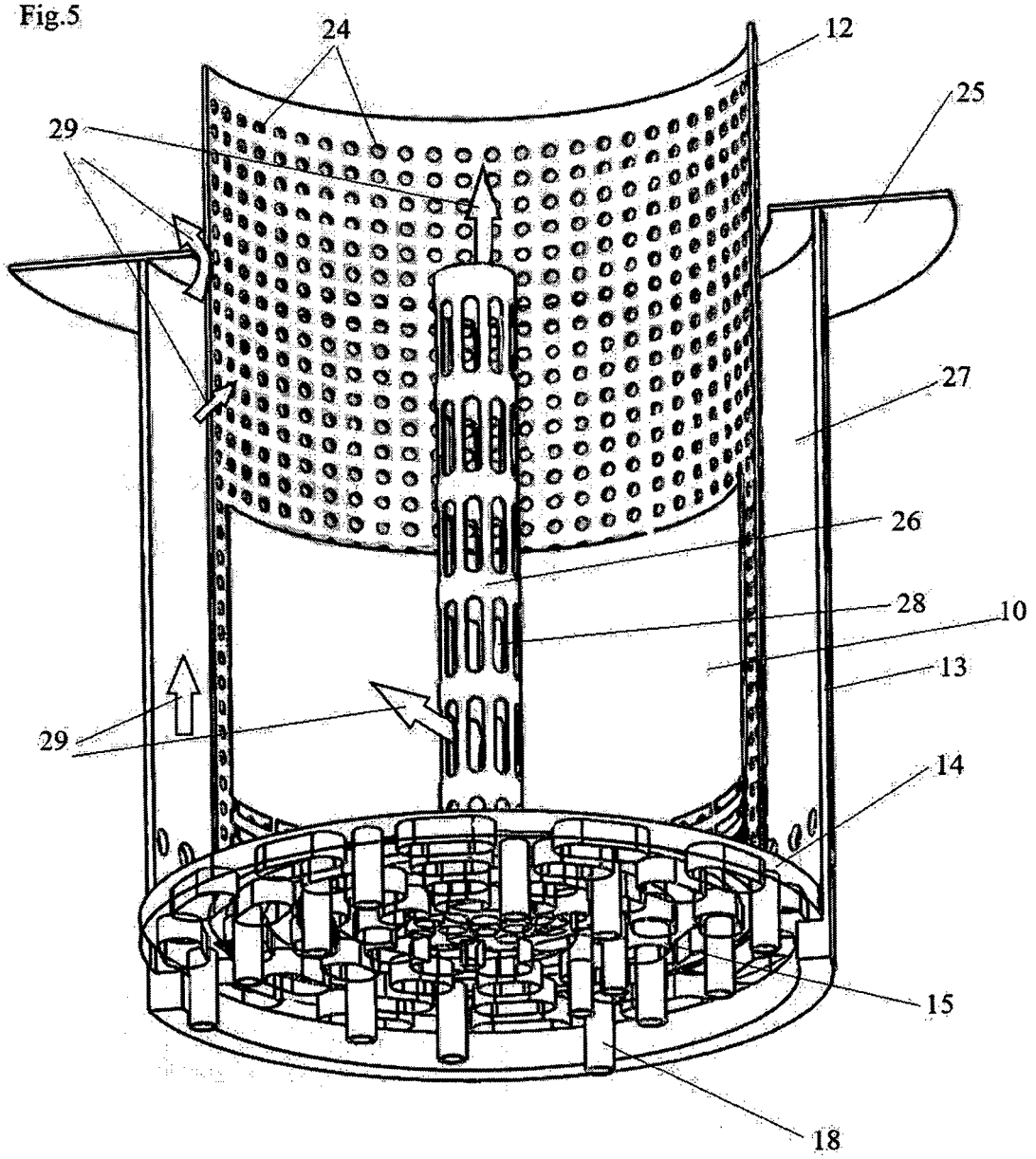


Fig.5



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EUROPEAN SEARCH REPORT

Application Number
EP 22 39 6001

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
Y	WO 2016/075646 A1 (LELLO DAVID ROYDON [ZA]) 19 May 2016 (2016-05-19) * figure 1a * * page 1, line 12 - page 1, line 14 * * figure 2 * * page 9, line 34 - page 10, line 9 * * figure 1c * * figure 10 * * page 10, line 25 - page 10, line 32 * * figure 3 *	1-12	INV. F24B1/193 F24B5/02
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Y	EP 1 983 262 A2 (PIETI PAULI [FI]) 22 October 2008 (2008-10-22) * paragraphs [0007], [0027]; claim 3; figures 1-2 *	1-12	
			TECHNICAL FIELDS SEARCHED (IPC) F24B F23B

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	30 June 2022	Jalal, Rashwan

CATEGORY OF CITED DOCUMENTS

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- FI 109723 **[0003]**
- FI 123850 **[0004]**