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(54) Heat exchanger, set and method for forming the same

(57) Heat exchanger comprising a first heat exchanging body having a first end and an opposite second end, at least a flue gas channel and at least a water channel, a longitudinal direction of the first body extending between the first and second end thereof, and a second heat exchanging body, having a first end and an opposite second end, at least a flue gas channel and at least a water channel, a longitudinal direction of the second body extending between the first and second end thereof, wherein the first end of the second body is connected to the second end of the first body, wherein a burner chamber is provided at the first end of the first body.

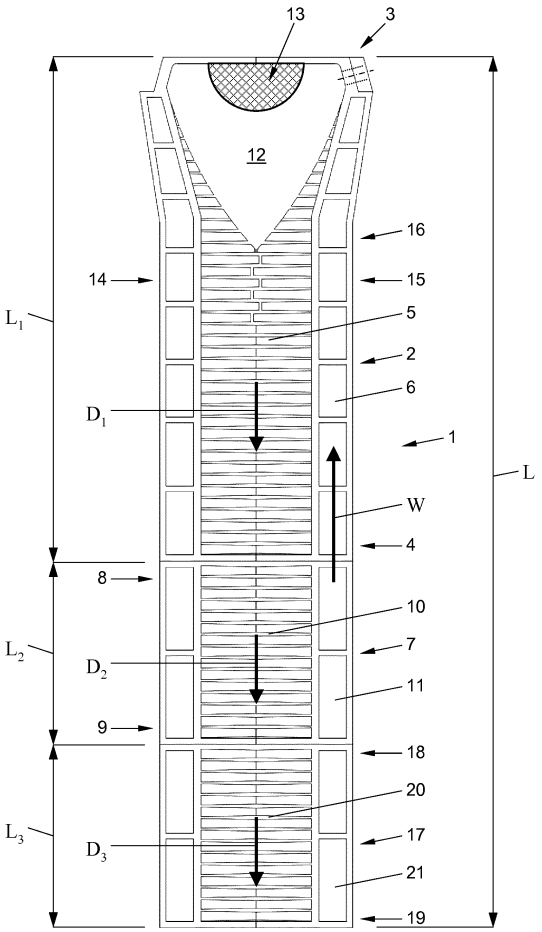


FIG. 1

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Description

[0001] The invention relates to a heat exchanger comprising a first heat exchanging body having a first end and an opposite second end, at least a flue gas channel and at least a water channel, a longitudinal direction of the first body extending between the first and second end thereof, and a second heat exchanging body, having a first end and an opposite second end, at least a flue gas channel and at least a water channel, a longitudinal direction of the second body extending between the first and second end thereof.

[0002] In such known heat exchanger the first and second heat exchanger bodies are substantially identical and are positioned side by side. Each of the first and second heat exchanger bodies has a burner space and a flue gas exhaust connecting element. In each burner space a burner is provided, wherein the burners are coupled to the same gas supply. The exhaust connecting elements of the first and second heat exchanging bodies are coupled to the same flue gas exhaust. The water channels of the first and second heat exchanger bodies are coupled in parallel to a common water supply and a common water exhaust.

[0003] In this known heat exchanger each of the exchanger bodies has the same capacity, each added heat exchanger body will increase the overall capacity with the same mount. Such heat exchanger is however complicated and expensive, especially since each added body requires an extra burner or a burner adapted to the extended width of the combined heat exchanger elements, whereas the flue gas exhaust and gas supply, as well as the connecting water ducts have to be adjusted for each number of heat exchanger bodies. Moreover the different numbers of heat exchanger bodies in a heat exchanger will require a different ground area.

[0004] An aim of the present disclosure is to provide an alternative heat exchanger. Moreover an aim is to provide for a heat exchanger which can relatively easily be amended for a different capacity. An aim of the present disclosure is to provide for a series of heat exchangers having different capacities but substantially the same ground plane.

[0005] In a first aspect a heat exchanger according to the disclosure can be characterized by comprising a first heat exchanging body having a first end and an opposite second end, at least a flue gas channel and at least a water channel, a longitudinal direction of the first body extending between the first and second end thereof, and a second heat exchanging body, having a first end and an opposite second end, at least a flue gas channel and at least a water channel, a longitudinal direction of the second body extending between the first and second end thereof. The first end of the second body is connected to the second end of the first body, wherein a burner chamber is provided at the first end of the first body.

[0006] The first and second heat exchanger bodies can be substantially the same, except for a length measured in the longitudinal direction thereof. In particular the longitudinal length of the second body can be smaller than the longitudinal length of the first body.

[0007] In an aspect a further second heat exchanger body can be connected to the second end of the second heat exchanger body connected to the first heat exchanger body. In an aspect a series of second heat exchanger bodies can be connected in series to the second end of the first heat exchanger body.

[0008] In an aspect a third heat exchanger body can be provided having a first end and an opposite second end, at least a flue gas channel and at least a water channel, a longitudinal direction of the third body extending between the first and second end thereof, wherein the first end of the third body is connected to the second end of the second body, wherein the at least one flue gas channel of the second body is connected to the at least one flue channel of the third body and the at least one water channel of the second body is connected to the at least one water channel of the third body. The third heat exchanger body can be substantially equal to the first and/or second heat exchanger body except for its longitudinal length between the opposite first and second end, which may be shorter of longer than the longitudinal length of the first and/or second heat exchanger bodies.

[0009] In an aspect the disclosure can comprise a set of a first heat exchanger body and at least one second heat exchanger body, wherein the first heat exchanger body has first coupling elements at a lower end and the or each second heat exchanger has complementary second coupling elements at an upper end, such that the or each second heat exchanger body can be coupled to the first heat exchanger body or to a second heat exchanger body at a downstream position for flue gasses.

[0010] A heat exchanger according to the disclosure can be comprised in a boiler such as a central heating boiler or a tap water boiler or a combined central heating and tap water boiler. Such boiler can for example be a condensing boiler, a high efficiency boiler or a an improved efficiency boiler.

[0011] In an aspect the present disclosure can be directed to a method for forming a heat exchanger, wherein a first heat exchanger body is provided with a flue gas channel or part thereof having a main flue gas flow direction, wherein a second heat exchanger body comprising a flue gas channel or part thereof having a main flue gas flow direction, wherein the second heat exchanger body is connected at a downstream end of said first heat exchanger body.

[0012] In further elucidation of the present disclosure embodiments of a heat exchanger, set, heating boiler and method will be described, with reference to the drawings, which are only shown in elucidation and should not be understood as limiting the disclosure in any way. The drawings show:

Fig. 1 a heat exchanger comprising a first heat exchanger body and two further heat exchanger bod-

ies, in cross sectional side view;

Fig. 2 a heat exchanger comprising a first heat exchanger body and one further heat exchanger body, in cross sectional side view;

Fig. 2A the cross section along the line IIA - IIA;

Fig. 3 in cross sectional view a first and second heat exchanger body are shown, spaced apart from each other;

Fig. 4 in cross sectional side view a thing boiler comprising a heat exchanger according to fig. 1, connected to a heating circuit and a flue gas exhaust.

[0013] In this description different embodiments of heat exchangers and parts thereof, as well a heating circuit equipped therewith are disclosed and described by way of example only. In these embodiments the same or similar parts have the same or similar reference signs. Combinations of parts of the embodiments shown are also considered to have been disclosed herein. In this description a heat exchanger has to be understood as an exchanger for exchanging heat between heated flue gasses from a burner and water flowing through one or more water channels within said heat exchanger. Preferably a burner space is provided into which a burner can be inserted, such that said heated flue gasses are actively created, during use, within said heat exchanger. In an alternative the burner can be at least partly integrated in the heat exchanger, for example by extrusion, casting and/or machining. Such heat exchangers are especially, but not exclusively suitable in domestic and commercial heating systems such as boilers and central heating systems, such as for space heating and/or tap water heating systems.

[0014] In the following description molding or casting, possibly combined with machining of extruded parts, shall be described as an advantageous means for manufacturing parts of such heat exchanger. Nevertheless, some or all of these parts can also be made differently, such as but not limited to injection moulding, sand or otherwise lost core moulding or casting or the like, possibly combined with machining, such as but not limited to grinding, turning, milling, drilling and the like known machining methods. Parts of heat exchangers according to this disclosure can be made differently, for example by pressing, setting, folding, welding or any other suitable means known to skilled person.

[0015] In this disclosure embodiments of heat exchangers shall be disclosed by way of example only. In general terms an element of the present disclosure is that heat exchanger bodies can be connected in series in a longitudinal direction of the heat exchanger bodies, especially of a main flow direction of flue gasses through the heat exchanger bodies.

[0016] A heat exchanger 1 is shown in the embodiments comprising a first heat exchanging body 2 having a first end 3 and an opposite second end 4. At least a flue gas channel 5 is provided extending through the first heat exchanging body 2 and at least a water channel 6. The first heat exchanger body has a longitudinal direction L_1 extending between the first and second end 3, 4 thereof. A second heat exchanging body 7 is shown, having a first end 8 and an opposite second end 9, at least a flue gas channel 10 extending through the second heat exchanger body 7, and comprising at least a water channel 11. The second heat exchanger body 7 has a longitudinal direction L_2 of extending between the first and second end 8, 9 thereof. The first end 8 of the second body 7 is connected to the second end 4 of the first body 2. A burner chamber 12 is provided at the first end 3 of the first body 2. In the embodiments shown a burner 13 is shown extending at least partly into the burner space 12.

[0017] In the embodiments shown the at least one flue gas channel 5 of the first body 2 is connected to the at least one flue channel 10 of the second body 7 and the at least one water channel 6 of the first body 2 is connected to the at least one water channel 11 of the second body 7.

[0018] In embodiments shown the at least one flue channel 5 of the first body 2 has a main flue gas direction D_1 extending substantially parallel to the longitudinal direction L_1 of the first body 2. The at least one flue channel 10 of the second body 7 has a main flue gas direction D_2 extending substantially parallel to the longitudinal direction L_2 of the second body 7.

[0019] In the embodiments shown the first and second heat exchanger bodies 2, 7 can have a substantially block shaped outer configuration with substantially flat first and second ends 3, 4; 8, 9; 18, 19, substantially flat front 14 and back 15 and substantially flat sides 16 with a width W1 and a depth W2.

[0020] In the embodiment shown in fig. 1 a third heat exchanger body 17 is provided. It is shown substantially identical to the second heat exchanger body 7. It has a first end 18 and an opposite second end 19, at least a flue gas channel 20 and at least a water channel 21. It has a longitudinal direction L_3 extending between the first 18 and second end 19 thereof. The first end 18 of the third body 17 is connected to the second end 9 of the second body 7. At least one flue gas channel 10 of the second body 7 is connected to the at least one flue channel 20 of the third body 17 and the at least one water channel 11 of the second body 7 is connected to the at least one water channel 21 of the third body 17. Thus at least one continuous flue gas channel and at least one continuous water channel can be provided through the heat exchanger can be obtained.

[0021] The second and third heat exchanger bodies 7, 17 can be similar in shape and dimensions, preferably identical, but can also be different, for example have a longitudinal length L_2, L_3, which in turn may be different from the longitudinal length L_1 of the first heat exchanger body 2. In embodiments the ratio of the longitudinal lengths L_1 and L_2 of the first and second heat exchanger bodies 2, 7 can for example be about 2:1 or 3:1. The ratio of the longitudinal lengths L_2, L_3 of the second and third

heat exchanger bodies 7, 17 can for example be about 1:1 or 2:1. The ratio of the longitudinal lengths L_1, L_2, L_3 of the first, second and third heat exchanger bodies 2, 7, 17 can for example be 2:1:1, 3:2:1, 4:2:1 or 4:3:2 or any other suitable ratio. By choosing a suitable ratio between the longitudinal lengths L of the different bodies 2, 7 and/or 17 different heat exchangers with different heat capacities can be constructed using one, two or more of the first, second and/or third bodies. For example but not limited to a series of heat exchangers having a capacity of 60 kW, 90 kW and 120kW, 40, 60 and 80 kW or 80, 120 and 140kW.

[0022] In embodiments the burner space 12 is provided in the first heat exchanger body 2, which can form part of or comprise a burner 13. Depending on the capacity wanted the burner capacity and type can be chosen.

[0023] The heat exchanger bodies have been made from light metal, especially aluminum or aluminum alloy. Other suitable light metal can for example be magnesium or magnesium alloy. Light metal is considered to be non-ferro metal having a density of less than about 4500 kg/m^3. According to the invention for example aluminum or aluminum alloy can be used having a density of about 2800 kg/m^3 or less.

[0024] The or each water channel 6 in the first heat exchanger body 2 can have an increasing cross section in a main flow direction. In embodiments the or each water channel of at least one of the second and third heat exchanger body 7, 17 can have a substantially constant cross section.

[0025] In the embodiment shown in fig 1 the heat exchanger has a first and two second heat exchanger bodies 2, 7, 7. In the embodiment shown in fig. 2 the heat exchanger 1 has a first and a second heat exchanger body 2, 7. In an embodiment a heat exchanger can comprise only one heat exchanger body 2, for example only a first heat exchanger body 2. A series of three such heat exchangers could for example have capacities of 60, 90 and 120 kW, 60, 90 and 110 kW, 80, 120 and 160 kW or any other range. Also more or less heat exchangers can be comprises in such series built with the same bodies as modules.

[0026] Fig. 3 shows a set 25 of a first heat exchanger body 2 and two further heat exchanger bodies. Such set will preferably comprise at least a first heat exchanger body and at least one second heat exchanger body. The first heat exchanger body has first coupling elements at a lower end 4 and the or each second heat exchanger 7 has complementary second coupling elements at an upper end 8, such that the or each second heat exchanger body 7 can be coupled to the first heat exchanger body 2 or to a second heat exchanger body 7 at a downstream position for flue gasses.

[0027] A set 25 can further comprise a burner 13 and/or a burner lid 27 and an end piece 26 for connecting to a flue gas exhaust 28. An upper end 3 of the first heat exchanger body 2 and the burner 13 and/or the burner lid 27 can be provided with complementary coupling elements for connecting the burner 13 and/or the burner lid 27 to the upper end 3 of the first heat exchanger body 2 . The end piece 28 can be provided with second coupling elements complementary to the first coupling elements of the first heat exchanger body 2. The or each second heat exchanger body 7 can also be provided with first coupling elements, such that the end piece 28 can be coupled to either the lower end 4 of the first heat exchanger body 2 or the lower end 9 of a second heat exchanger body 7.

[0028] In embodiments the complementary first and second coupling means can for example be formed by adjacent ends 3, 4; 8, 9; 18, 19 of heat exchanger bodies 2, 7, 17, burner 13 or burner plate 27 and/or end piece 26, such that they can be adhere, for example glued to each other. Preferably a heat resistant, elastic bonding agent is used. By way of example only, bonding can for example be achieved by glue, for example but not limited to acrylic glue, two or more component glue, PLEXUS MA 420, PERMABOND ES 550 or DOW CORNING 7091. In alternative embodiments and/or additionally other coupling means can be provided, such as nuts and bolts, screws, clamps or the bodies can be welded to each other or in any other suitable way be interconnected.

[0029] The water channel 6, 11 and/or 21 through the heat exchanger 1 can have a main flow direction W contrary to the main flow direction D of flue gas through the flue gas channel 5, 10 and/or 20. This can for example be understood as that a water inlet 40 is provided at a lower end of the heat exchanger 1 and a water exit 41 is provided at an upper end of the heat exchanger 1, with the burner 13 provided at an upper end of the heat exchanger and a gas exhaust at the lower end of the heat exchanger.

[0030] Fig. 4 shows schematically a heating boiler comprising a heat exchanger according to the disclosure. The burner 13 is connected to a gas supply line 30. A flue gas exhaust 31 such as a chimney is connected to the end piece 28, and thus to the lower end of the flue gas channel. A water circuit 32, for example comprising at least a radiator 33 and/or a tap water heating system 34 such as a tap water boiler is connected between the water inlet 40 and the water outlet 41 of the water channel 6, 11 and/or 21.

[0031] As can be seen in fig. 1 - 4, heat transferring surface increasing elements 35 can be provided at least in part of the flue gas channels 5, 10, and/or 20. These elements 35 can for example be ribs, notches, pins or the like which can extend for example in rows and/or columns and can have a main height extending perpendicular to a main flow direction through the flue gas channel. In a burner space, if present, the height of the elements 35 can increase in the flow direction D of flue gasses, such that closest to the first end 3 the distance between facing free ends 36 of the pins on two opposite sides of the flue gas channel 6 is larger than further down the flue gas channel 6.

[0032] Since the heat exchanger bodies 2, 7, 17 in a

heat exchanger 1 according to the description are connected in series, one on top of the other, a surface area P occupied by the heat exchanger can be defined largely by the cross section of the heat exchangers, irrespective of the number of heat exchanger bodies forming the heat exchanger and thus irrespective of the capacity of the heat exchanger. Such cross section can for example be substantially perpendicular to the main direction of flow of flue gasses through the flue gas channel extending through the bodies 2, 7 and/or 17. Moreover only one burner 13 and one exhaust 31 are necessary.

[0033] In the disclosure each heat exchanger body 2, 7, 17 can be made integrally, for example by an appropriate lost core method such as but not limited to sand die casting, whereas they can alternatively be made of two or more pieces, connected to each other, for example again by gluing, welding, bonding, screwing or any such known and suitable means. In the drawings such embodiments are shown as examples. The water channels 6, 11, 21 preferably spiral around the flue gas channels 5, 10, 20, such that water can flow all around the heat exchanger bodies. Alternatively the water channels can be provided differently, for example on two opposite sides 14, 15 of each body 2, 7, 17, zig-zagging up or down. As can be seen the elements 35 can extend across the full width of the flue gas channel or such that a space is left between their ends 36.

[0034] The end piece 26 and the cap 27 can be made by any suitable means and from any suitable material, such as but not limited to cast or forged from metal, such as light metal.

[0035] According to a method for forming a heat exchanger, a first heat exchanger body is provided with a flue gas channel or part thereof having a main flue gas flow direction and a second heat exchanger body comprising a flue gas channel or part thereof having a main flue gas flow direction, wherein the second heat exchanger body is connected at a downstream end of said first heat exchanger body. If so desired further heat exchanger bodies can be coupled downstream from the second heat exchanger body, in series.

[0036] In designing a heat exchanger in embodiments a desired capacity of a heat exchanger or heating boiler is defined, wherein based on said capacity a first or first and second or a first and two or more further heat exchanger bodies are selected, for example tow or more second heat exchanger bodies. A burner is provided at a first end of the first heat exchange. In such method when only a first heat exchanger body is selected, an end piece 28 can be connected to the opposite second end 4 of the first heat exchanger body 2. When a first 2 and a second heat exchanger body 7 are selected, a first end 8 of the second heat exchanger body 7 is coupled to a second end 4 of the first heat exchanger body 2 and an end piece 28 is connected to a second end 9 of the second heat exchanger body 7. When a first 2 and at least two second heat exchanger bodies 7 are selected, a first end 8 of a first second heat exchanger body 7 is coupled to a second end 4 of the first heat exchanger body 2 and a first end 8 of a second second heat exchanger body 7 is connected to a second end 9 of the first second heat exchanger body 7. An end piece 28 can be provided for connecting to a second end 9 of the second second heat exchanger body 7. Obviously if more heat exchanger bodies are necessary they can be coupled similarly in series with the heat exchanger bodies 2, 7 as discussed.

[0037] The invention is by no means limited to the embodiments as shown and/or described in this description. Many variations thereof are possible within the scope of the claims, including at least all combinations of parts and elements of the embodiments and parts thereof shown, in any combination or permutation. For example the first and/or second and/or further heat exchanger can have other cross sections and can for example have different cross sections, as long as they can be connected to each other as indicated, for forming at least one continuing flue gas path through the heat exchanger. The bodies can be attached to each other using different means, such as screws, fasteners, clamps, welds or the like. Also other bonding agents can be used, for example two or more component agents. Moreover, an even thickness of the bonding layers and heat conducting properties through the connection thus formed can be achieved in another way, for example by gluing tools and moulds used for exact positioning of the parts during bonding, and/or by providing heat conducting elements connected to both parts, such as but not limited to pins, strips or similar, preferably metal elements inserted in between the bonded parts or to them, crossing said bonding connection. Shapes and dimensions, as well as positions of the different parts can be changed within the scope of the claims as pending.

[0038] These and other alterations and modifications are supposed to be disclosed within the scope of the claims.

Claims

1. Heat exchanger comprising a first heat exchanging body having a first end and an opposite second end, at least a flue gas channel and at least a water channel, a longitudinal direction of the first body extending between the first and second end thereof, and a second heat exchanging body, having a first end and an opposite second end, at least a flue gas channel and at least a water channel, a longitudinal direction of the second body extending between the first and second end thereof, wherein the first end of the second body is connected to the second end of the first body, wherein a burner chamber is provided at the first end of the first body.

2. Heat exchanger according to claim 1, wherein the at least one flue gas channel of the first body is con-

nected to the at least one flue channel of the second body and the at least one water channel of the first body is connected to the at least one water channel of the second body.

3. Heat exchanger according to claim 1 or 2 wherein the at least one flue channel of the first body has a main flue gas direction extending substantially parallel to the longitudinal direction of the first body and wherein preferably the at least one flue channel of the second body has a main flue gas direction extending substantially parallel to the longitudinal direction of the second body.

4. Heat exchanger according to any one of the previous claims, wherein a third heat exchanger body is provided having a first end and an opposite second end, at least a flue gas channel and at least a water channel, a longitudinal direction of the third body extending between the first and second end thereof, wherein the first end of the third body is connected to the second end of the second body, wherein the at least one flue gas channel of the second body is connected to the at least one flue channel of the third body and the at least one water channel of the second body is connected to the at least one water channel of the third body.

5. Heat exchanger according to claim 4, wherein the second and third heat exchanger bodies are similar in shape and dimensions, preferably identical.

6. Heat exchanger according to any one of the previous claims, wherein the burner space is provided in the first heat exchanger body.

7. Heat exchanger according to any one of the previous claims, wherein the heat exchanger bodies have been made from light metal, especially aluminum or aluminum alloy.

8. Heat exchanger according to any one of the previous claims, wherein the or each water channel in the first heat exchanger has an increasing cross section in said main flow direction, wherein at least one of the second and third heat exchanger body preferably has a substantially constant cross section.

9. Set of a first heat exchanger body and at least one second heat exchanger body, wherein the first heat exchanger body has first coupling elements at a lower end and the or each second heat exchanger has complementary second coupling elements at an upper end, such that the or each second heat exchanger body can be coupled to the first heat exchanger body or to a second heat exchanger body at a downstream position for flue gasses.

10. Set according to claim 9, further comprising a burner and/or a burner lid and an end piece for connecting to a flue gas exhaust, wherein an upper end of the first heat exchanger body and the burner and/or the burner lid are provided with complementary coupling elements for connecting the burner and/or the burner lid to the upper end of the first heat exchanger body and wherein the end piece is provided with second coupling elements complementary to the first coupling elements of the first heat exchanger body and wherein preferably the or each second heat exchanger body is also provided with first coupling elements, such that the end piece can be coupled to either the lower end of the first heat exchanger body or the lower end of a second heat exchanger body.

11. Heating boiler comprising a heat exchanger according to any one of claims 1 - 8 or constructed using a set according to claim 9 or 10.

12. Method for forming a heat exchanger, wherein a first heat exchanger body is provided with a flue gas channel or part thereof having a main flue gas flow direction, wherein a second heat exchanger body comprising a flue gas channel or part thereof having a main flue gas flow direction, wherein the second heat exchanger body is connected at a downstream end of said first heat exchanger body.

13. Method according to claim 12, wherein a desired capacity is defined, and wherein based on said capacity a first a first and second or a first and two second heat exchanger bodies are selected, wherein a burner is provided at a first end of the first heat exchanger and:

- when only a first heat exchanger body is selected, an end piece is connected to the opposite second end of the first heat exchanger body; or
- when a first and a second heat exchanger body are selected, a first end of the second heat exchanger body is coupled to a second end of the first heat exchanger body and an end piece is connected to a second end of the second heat exchanger; or
- when a first and at least two second heat exchanger bodies are selected, a first end of a first second heat exchanger body is coupled to a second end of the first heat exchanger body and a first end of a second second heat exchanger body is connected to a second end of the first second heat exchanger, and wherein an end piece is provided for connecting to a second end of the second second heat exchanger body.

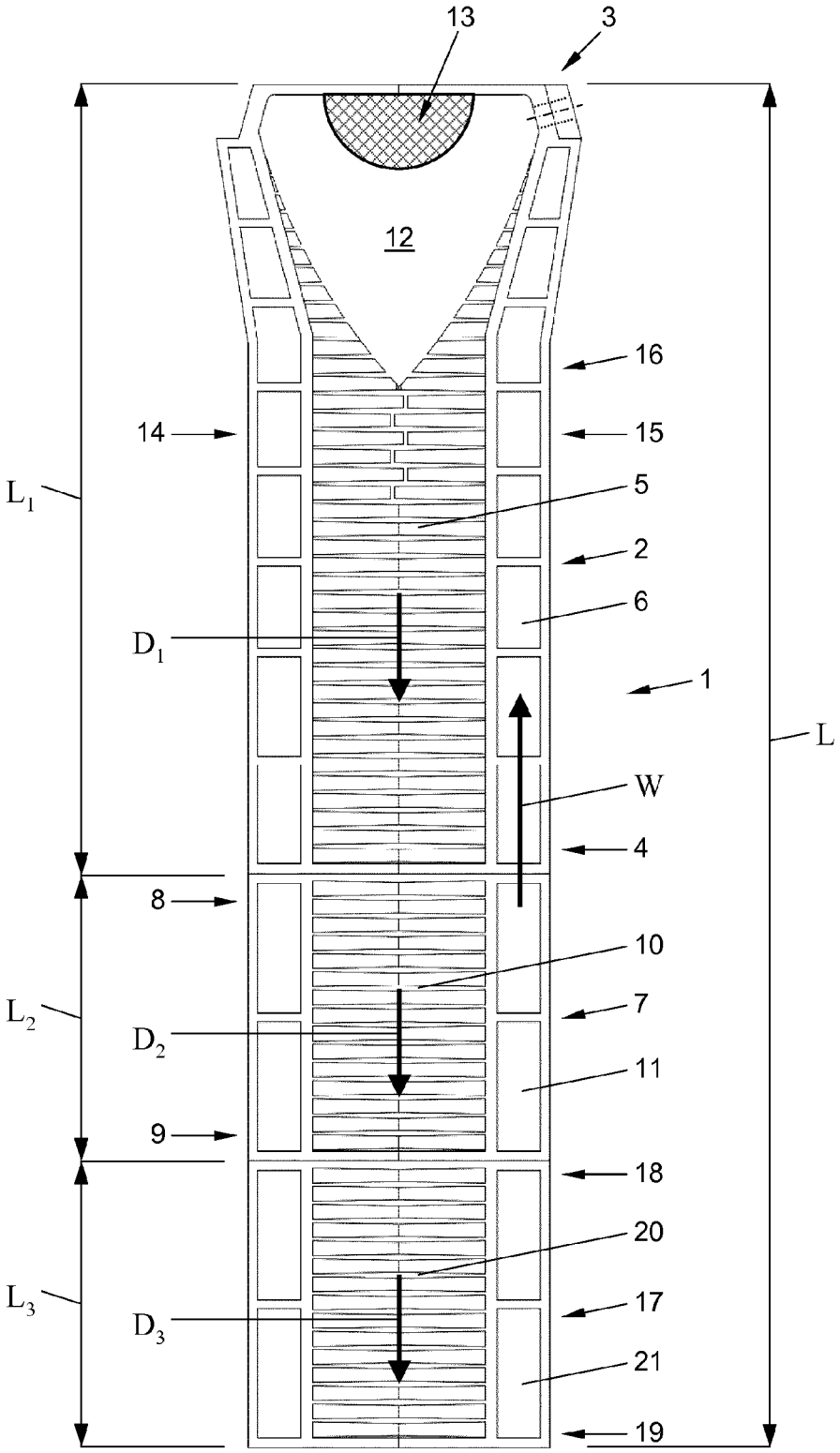


FIG. 1

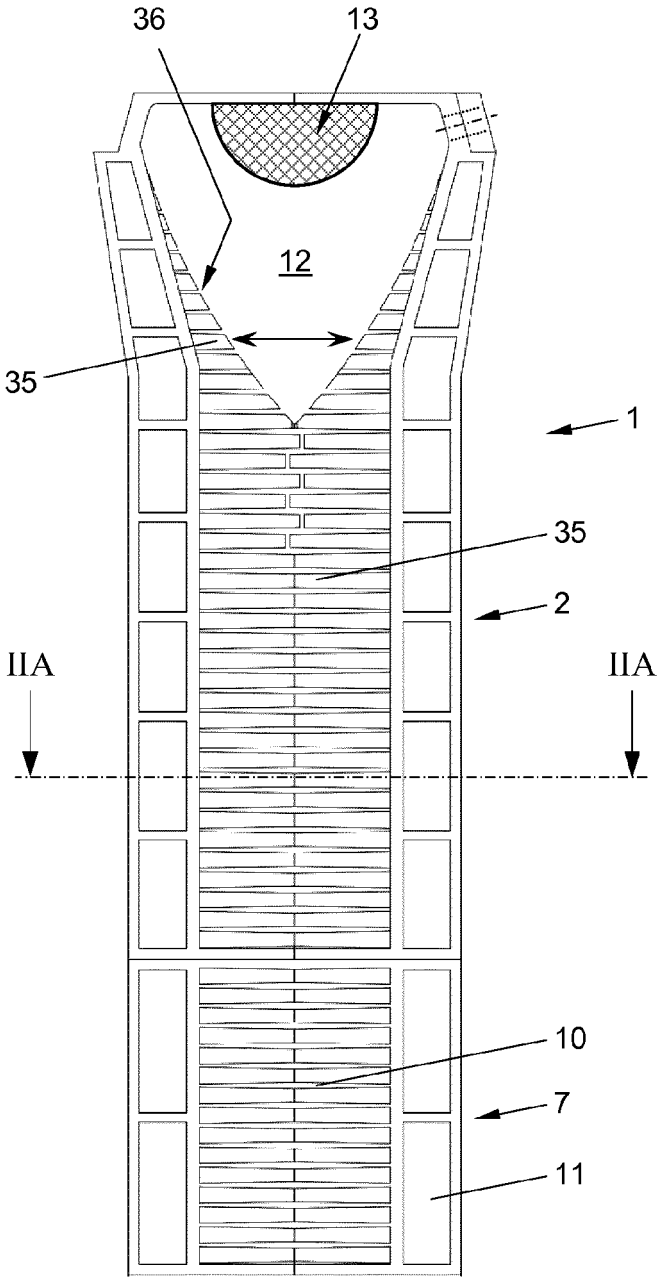


FIG. 2

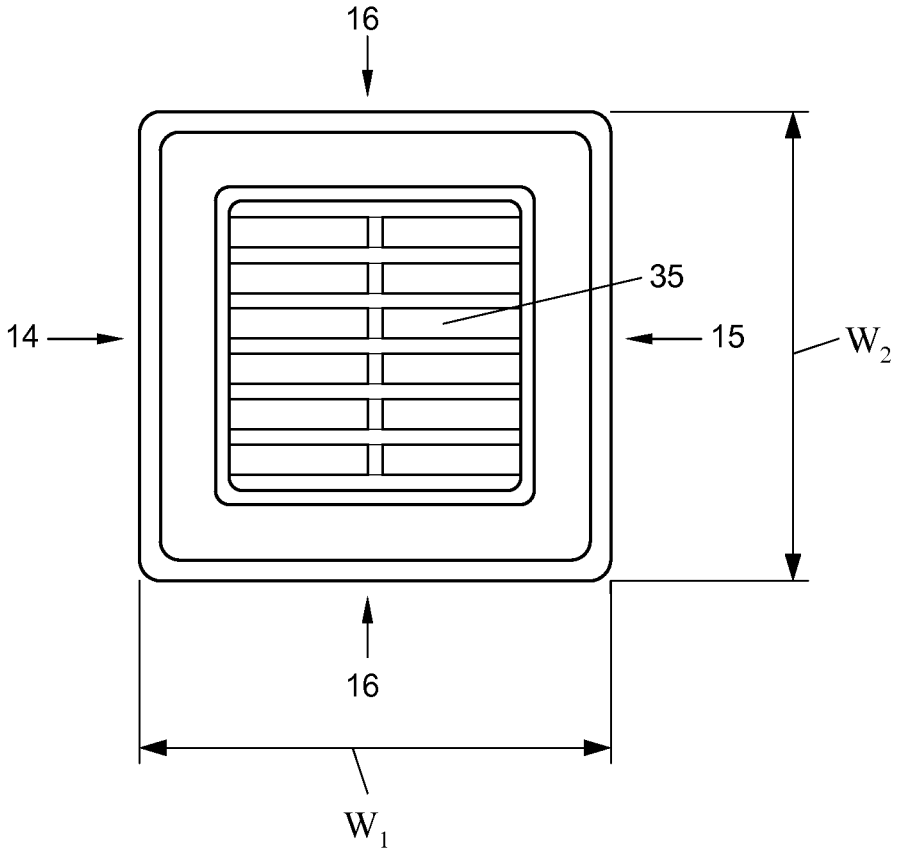


FIG. 2A

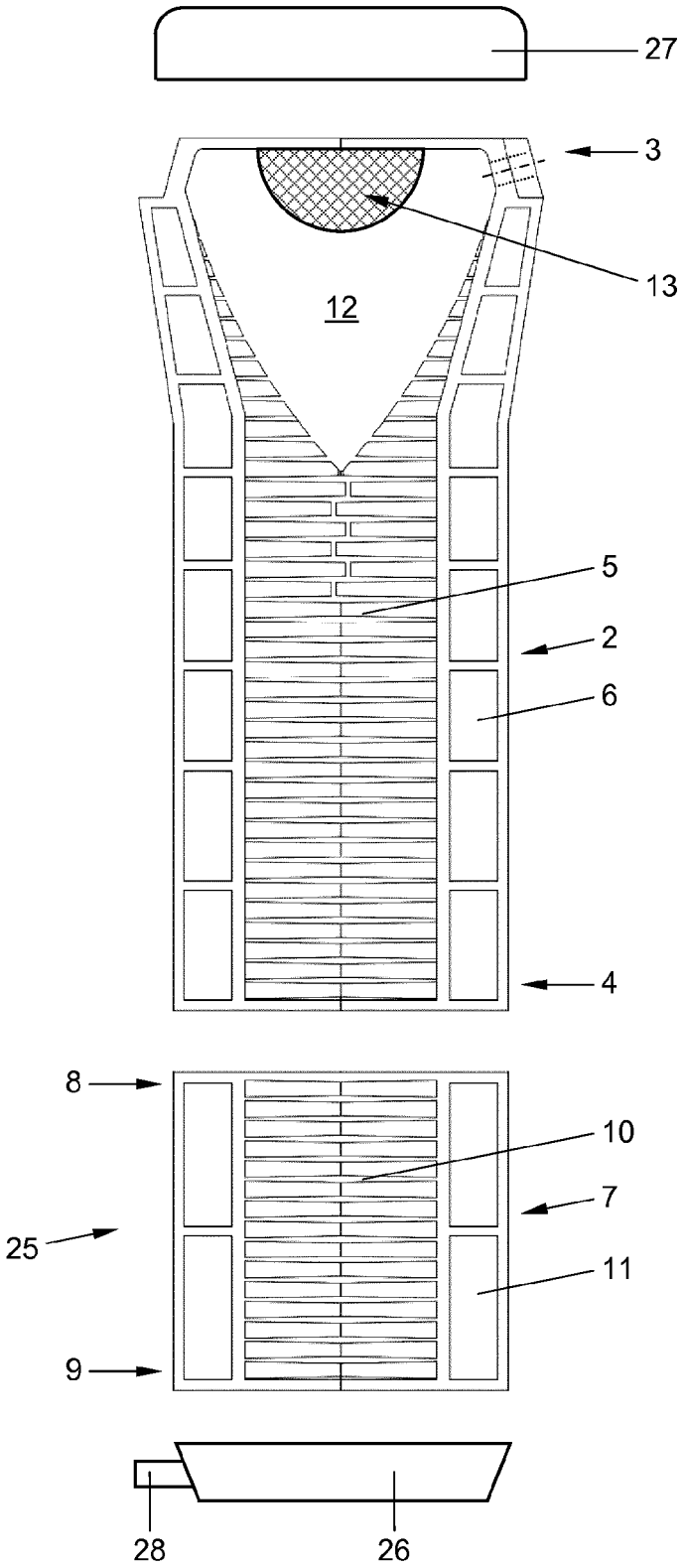


FIG. 3

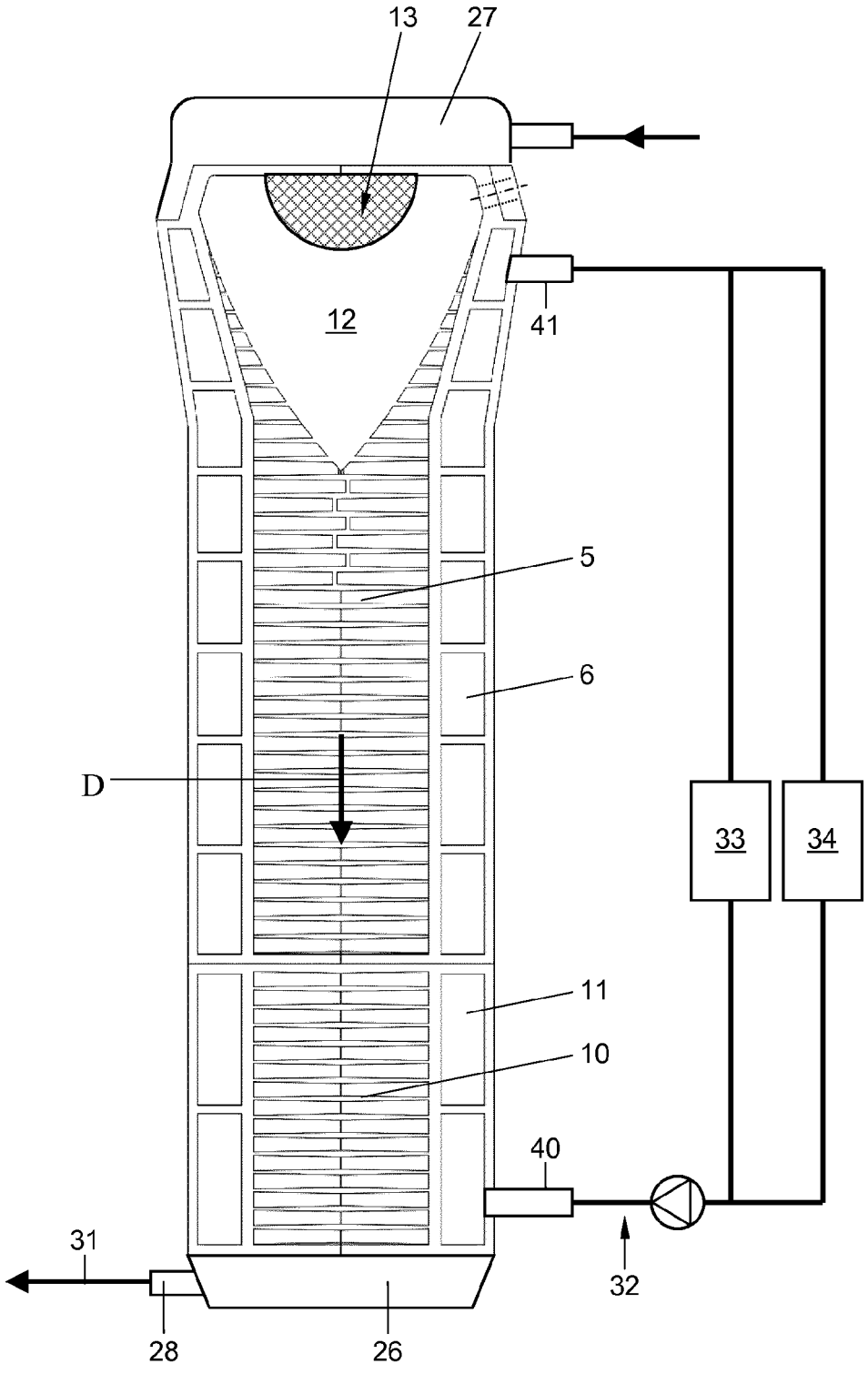


FIG. 4

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EUROPEAN SEARCH REPORT

Application Number
EP 14 18 9322

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X Y	NL 1 009 225 C1 (BRABANT ALUCAST PRODUCTS B V [NL]) 24 November 1999 (1999-11-24) * page 2, line 16 - page 4, line 14; figures 1,2 * * page 4, line 15 - page 5, line 32; figures 3,4 * -----	1-7,9-13 8	INV. F28F3/12 F28F7/02 F28F9/26 F28D9/00 F28F13/08 F24H1/26
Y	WO 2009/053247 A1 (BEKAERT COMBUST TECHNOL B V [NL]; GEELEN FRANK [NL]; THIJSSEN PAUL [NL]) 30 April 2009 (2009-04-30) * paragraph [0015] - paragraph [0016]; figure 2 * -----	8	F24H9/00

TECHNICAL FIELDS SEARCHED (IPC)

F28F
F28D

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	9 February 2015	Ast, Gabor

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