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(54) HEAT EXCHANGER AND ASSEMBLY OF A HEAT EXCHANGER AND A BURNER

WÄRMEÜBERTRAGER UND ANORDNUNG EINES WÄRMETAUSCHERS UND EINES BRENNERS

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Description

[0001] The invention relates to a heat exchanger, comprising:

- a casing, comprising:
  - a substantially U-shaped body as seen in cross-section and extending in a longitudinal direction, wherein a base of the U-shape body comprises a gas outlet opening and wherein an open end, opposite to the base, of the U-shape body comprises a receiving space for receiving a burner, and
  - two end plates arranged at the two longitudinal end zones of said U-shape body;
- a plurality of pipes arranged within said casing and connected to said end plates, through which pipes in use a liquid can flow;
- a plurality of connecting means for providing a liquid through flow connection between at least two pipes at each longitudinal end zone of said U-shape body, such that liquid flowing through a first pipe of the at least two pipes is directed to the other pipe of the at least two pipes

  wherein a first part of the pipes is arranged in a first pattern defining two legs of a substantially U-shape as seen in cross-section, said first pattern being arranged substantially parallel to legs of said U-shape body, and
  wherein a second part of said pipes are arranged within a space at least partly bounded by said first pattern.

[0002] Such a heat exchanger is known from European patent EP-B1-0687870 in the name of the same applicant. It is an object to improve the heat exchanger described in EP-B1-0687870.

[0003] A heat exchanger is also known from EP 1 243 866 A1. This document discloses in a condensation boiler of the type comprising a plurality of pipes defining a water flow path between a return section from a heating plant to a delivery section to the heating plant, at least two covers mounted at an end of the plurality of pipes and provided internally with dividing walls that realize connecting chambers between the pipes and define the conformation of the water flow path. The connecting chambers also serve the function of front wall of a wet combustion chamber.

[0004] In an embodiment of the heat exchanger according to the invention said receiving space is arranged between at least a part of the pipes of the first pattern located near the open end of the U-shape body in such a manner that in use at least a part of the pipes of the first pattern surround a flame provided by said burner.

[0005] An advantage of this embodiment is that the casing is protected from the heat of the flame by said pipes of the first pattern that surround said flame. In the heat exchanger described in EP-B1-0687870 the flame was present in an area not bounded by pipes. Practically the heat exchanger therefore had a sealing arranged to protect the casing from the heat, which sealing is quite expensive. An advantage of this embodiment is therefore that no or less sealing is required, thereby reducing the costs of the heat exchanger.

[0006] In the heat exchanger according to the invention a distance between all pairs of adjacent pipes of each leg of the first pattern is maximally 0.1 mm.

[0007] It is noted that said distance is defined as the distance between the adjacent outer surfaces of each pair of adjacent pipes. An advantage of such small distances between adjacent pipes of the legs of the first pattern is that the mass flow of flue gas that will flow through the spaces between adjacent pipes to an area between the pipes of the legs of the first pattern and the casing is restricted, such that the flue gas that will enter this area will be cooled down by the liquid in the pipes to such an extent that the flue gas will have a relatively low temperature that is more or less similar to or slightly higher than the temperature of the walls of these pipes. As a result the casing will only be exposed to this relatively low temperature, such that no or less sealing of the casing is required, thereby reducing the costs of the heat exchanger.

[0008] It is noted that in the heat exchanger described in EP-B1-0687870 a distance between at least some pairs of adjacent pipes was larger than the above described maximum distances, such that more flue gas could enter the area, which flue gas entering the area therefore could have a higher temperature, and such that the U-shaped body required a substantially U-shape sealing covering said U-shape body to protect it from the heat. Such a relatively large sealing is quite expensive.

[0009] In another embodiment of the heat exchanger according to the invention said heat exchanger comprises a sealing arranged between the outer surface of the pipes arranged at a first end of each leg of the first pattern near the open end of the U-shape body and the substantially U-shaped body.

[0010] An advantage of this sealing that hot flue gas is prevented from flowing in the area between the pipes of the first pattern and the casing via a space present between the pipes arranged at the first ends of each leg of the first pattern and the U-shaped body, because this space is sealed off by said sealing. This way a relatively small amount of sealing is required for protecting the casing from being exposed to hot temperatures, at relatively low costs.

[0011] In another embodiment of the heat exchanger according to the invention the distance between the legs of the U-shape body and the pipes of the first pattern is maximally 1.0 mm, preferably maximally 0.4 mm.

[0012] It is noted that said distance is defined as the

distance between the outer surfaces of the pipes of the first pattern that are facing the U-shape body and the legs of the U-shape body. An advantage of such a relatively small distance is that the volume of the area between the pipes and the U-shape body is relatively small, thereby also contributing to the restriction of the mass flow of flue gas into this area and thereby contributing to the reduction in temperature to which the casing is exposed.

[0013] The second part of the pipes may be arranged such that a formula:

$$v_g = \frac{F_g}{A} = C$$

is substantially fulfilled, wherein:

v_g is the velocity of flue gases flowing from said burner in the direction of the base of said U-shape body in m/s in use of the heat exchanger;
F_g is the flow rate of flue gases flowing from said burner in the direction of the base of said U-shape body in m^3/s in use of the heat exchanger;
A is the surface area between adjacent pipes of the second part of the pipes;
C is a substantially constant value of maximally 12 m/s.

[0014] Relatively hot flue gas has a relatively large volume and vice versa. As such, as seen in a flow direction of the flue gas, the flue gas coming from the burner has a relatively large flow rate as the flue gas is relatively hot, thereby requiring a relatively large surface area between adjacent pipes arranged near the burner space in order to have the velocity of the flue gas being maximally said value C. The pipes arranged near the outlet opening however require a smaller surface area there between in order to have the velocity of the flue gas being maximally said value C, as the flue gas is already cooled down to some extent by the heat exchanger and the flow rate is relatively small. An advantage of a substantially constant velocity of the flue gas throughout the heat exchanger is that such a substantially constant velocity reduces the pressure drop. It is therefore an advantage of this embodiment to arrange said second part of the pipes such that this formula is fulfilled.

[0015] It is noted that in particular at low loads C may be less than said maximum value of 12 m/s.

[0016] The connecting means may be arranged to provide a liquid through flow connection between groups of at least two determined pipes at each longitudinal end zone of said U-shape body in such a manner that a second formula:

$$\frac{Q}{A_{eff} \cdot v_l} = k$$

is substantially fulfilled, wherein:

Q is the quantity of heat transferred to the liquid flowing in each pipe in kJ in use of the heat exchanger;
A_{eff} is the effective heat transferring surface of each pipe in m^2 in use of the heat exchanger; v_l is the velocity of the liquid flowing in each pipe in m/s in use of the heat exchanger, and k is a maximum value of 170 kJ/m^3.

[0017] An advantage of this embodiment is that the heat exchanger is designed such that the distribution of the liquid flow over determined groups of pipes is chosen such that the quantity of heat Q discharged from the flue gas and transferred to the liquid flowing in each pipe is substantially constant anywhere in the heat exchanger. As a result thereof, the pipes are exposed to less thermal stresses as the pipes are exposed to more or less similar heat transfer. Furthermore, the liquid flow through the pipes is optimized with respect to pressure drop and blockage of the pipes due to lime scale deposition is prevented by preventing the pipes from becoming too hot. This is especially advantageous in heat exchangers where a relatively large number of pipes with a relatively small throughflow area is used.

[0018] In another embodiment of the heat exchanger according to the invention at least one of the connecting means comprises a liquid distributor for substantially equally distributing liquid over pipes being connected to said connecting means.

[0019] Without such a liquid distributor it is possible that the liquid is not equally distributed over the pipes connected to the connecting means. This way, some pipes with less liquid flowing there through can become too hot and thereby exposed to high thermal stresses. An advantage of the liquid distributor is therefore that the liquid is substantially equally distributed over pipes that are connected to said connecting means, thereby reducing the thermal stresses of the pipes.

[0020] In another embodiment of the heat exchanger according to the invention the second part of the pipes comprise at least three groups of pipes, wherein a first group located near the base of the U-shape body has a first, smallest diameter, wherein a second group located near the first group at a side of the first group opposite to the base of the U-shape has a second diameter, and wherein a third group located near the open end of the U-shape body has a third, largest diameter, which third group is located at a predetermined distance from the second group.

[0021] An advantage of this arrangement of the pipes is that the third group is arranged nearest to the burner space. The flue gas coming from the burner is cooled down relatively fast by this third group of pipes arranged near the burner with relatively large diameter and thereby relatively large liquid flow, such that the production of NOx is efficiently reduced. Between the third and second group said predetermined distance is present, such that over this distance the flue gas is substantially not cooled

down and a relatively large time period is provided for the conversion of CO into CO_2, such that the emission of CO is reduced and preferably prevented.

[0022] It is noted that said distance is preferably between 10 and 40mm, more preferably between 20 and 30mm. Said distance is defined between the outer surfaces of the row of pipes of the third group and the row of pipes of the second group arranged nearest to the third group and especially between the facing outer surfaces thereof.

[0023] In another embodiment of the heat exchanger according to the invention a part of the pipes of the first group is arranged at least partly between a part of the pipes of the second group.

[0024] An advantage of such an arrangement is that the flow of flue gas along substantially the whole outer surface of the pipes arranged upstream of said part of pipes of the second group as seen in the direction of the flow of flue gases is enhanced.

[0025] The invention also relates to an assembly of a heat exchanger according to any of the claims 1 - 7 and a burner, wherein the burner is arranged in said receiving space.

[0026] Such an assembly provides the advantages of the heat exchanger described above.

[0027] In an embodiment of the assembly according to the invention the assembly comprises the heat exchanger according to at least claim 2, wherein the burner is arranged in said receiving space in such a manner that in use at least a part of the pipes of the first pattern surround a flame provided by said burner.

[0028] As described above such an assembly provides the advantage that said part of the pipes of the first pattern protect the casing from heat of the flame of the burner.

[0029] In another embodiment of the assembly according to the invention said burner comprises a damper.

[0030] Such a (Panel Helmholtz resonance) damper efficiently dampens any noise of the heat exchanger.

[0031] Practically said burner comprises a burner plate that is connected to or is integrally formed with said damper.

[0032] An advantage of this embodiment is that the functions of the burner plate and the damper are combined in one integrally formed or connected element.

[0033] In another embodiment of the assembly said burner comprises a gas/air-mixture distribution plate that is connected to or integrally formed with said damper and/or burner plate.

[0034] An advantage of this embodiment is that the functions of the burner plate and/or the damper and/or the gas/air-mixture distribution plate are combined in one integrally formed or connected element.

[0035] In particular, said (Panel Helmholtz resonance) damper may be provided with through holes for distributing the gas/air-mixture, such that said damper functions also as said gas/air-mixture distribution plate.

[0036] Practically said assembly comprises a sealing that is provided between the casing and the gas/air-mixture distribution plate.

[0037] Said gas/air-mixture distribution plate is arranged upstream of the burner plate and distributes the gas/air-mixture prior to passing though the burner plate. As the gas/air-mixture distribution plate and the burner plate are connected or integrally formed in one element, the gas/air-mixture exiting the gas/air-mixture distribution plate cannot by-pass the burner plate. Said sealing prevents the gas/air-mixture from entering the burner room alongside said element comprising the gas/air-mixture distribution plate and the burner plate. The gas/air-mixture flowing through the gas/air chamber will cool down the gas/air chamber and the gas/air-mixture distribution plate/damper. The life time of the burner is hereby enhanced.

[0038] The invention is further elucidated with reference to figures shown in a drawing, in which:

Figures 1A and 1B show a heat exchanger according to the invention, respectively in an exploded perspective view and in a vertical cross sectional view;
Figure 2 schematically shows the distribution of the liquid flow through the pipes of the heat exchanger;
Figures 3A and 3B disclose the effect of liquid distributors according to the invention; and
Figure 4 is a perspective view of a burner according to the invention; and
Figure 5 is a perspective view of an assembly according to the invention.

[0039] Figures 1A and 1B show a heat exchanger 1. Said heat exchanger 1 comprises a casing with a substantially U-shaped body 2 as seen in cross-section and extending in a longitudinal direction L. The base 3 of the body 2 arranged at the lower end of the body 2 comprises a gas outlet opening (not shown). At the end opposite to the base 3, i.e. the upper end, the body 2 is open and comprises a receiving space 4 for receiving a burner (not shown). The flue gases from the burner flow downwards through the casing 1 and are discharged via said gas outlet opening. At each longitudinal end zone 5 of the body 2 the body 2 comprises an end plate 6. A plurality of pipes 9 is arranged within said casing and is connected to said end plates 6, in particular to holes in said end plates 6. In use of the heat exchanger 1 a liquid, practically water, flows though the pipes 9 for taking up heat from the flue gases, thereby heating the water and cooling the flue gases. Panels 7 are provided to cover the end plates 6. Each panel 7 comprises a plurality of hollow spaces 8, each hollow space 8 connecting at least two pipes 9 at each longitudinal end zone 5 of the body 2, such that liquid flowing through a first pipe 9 of the at least two pipes 9 is directed to the other pipe 9 of the at least two pipes 9. Liquid flowing through the pipes 9 thereby flows from the one longitudinal end zone 5 to the other longitudinal end zone 5 via the plurality of pipes 9 and hollow spaces 8. A water inlet 10 and a water outlet 11 are provided in one panel 7 at one longitudinal end zone 5, for feeding rela-

tively cold water to the pipes 9 via the water inlet 10 and for discharging relatively hot water from the pipes 9 via the water outlet 11. Said hot water may be used for central heating or tap water.

[0040] As is clearly shown in figure 1B, a first part of the pipes 9 is arranged in a first pattern 12 defining two legs of a substantially U-shape as seen in cross-section, said first pattern being arranged substantially parallel to legs of said U-shape body 2. The receiving space 4 for the burner is arranged between at least a part of the pipes 9 of the first pattern 12 located near the open end of the body 2 in such a manner that in use at least a part of the pipes 9 of the first pattern 12 surround a flame provided by said burner. This way, said part of the pipes 9 of the first pattern 12 protect the casing from the heat of the flame. A distance between all pairs of adjacent pipes 9 of each leg of the first pattern 12 is maximally 0.1 mm, thereby restricting the mass flow of flue gas that will flow through the spaces between adjacent pipes 9 to an area between the pipes of the legs of the first pattern 12 and the casing, such that the flue gas that will enter this area will be cooled down by the liquid in the pipes 9 to such an extent that the flue gas will have a relatively low temperature that is more or less similar to or slightly higher than the temperature of the walls of these pipes 9. The distance between the legs of the U-shape body 2 and the pipes 9 of the first pattern 12 is preferably maximally 1.0 mm, more preferably maximally 0.4 mm, thereby also contributing to the restriction of the mass flow of flue gas into this area and thereby contributing to the reduction in temperature to which the casing is exposed. A sealing 13 is arranged between the outer surface of the pipes 9 arranged at a first end of each leg of the first pattern 12 near the open end of the body 2 and the body 2, thereby sealing off the space there between and thereby preventing the flue gases from flowing in the area between the pipes 9 of the first pattern 12 and the casing via said space.

[0041] A second part of said pipes 9 are arranged within a space 14 at least partly bounded by said first pattern 12. The second part of the pipes are arranged such that a formula:

$$v_g = \frac{F_g}{A} = C$$

is substantially fulfilled, wherein:

v_g is the velocity of flue gases flowing from said burner in the direction of the base of said U-shape body in m/s in use of the heat exchanger;

F_g is the flow rate of flue gases flowing from said burner in the direction of the base of said U-shape body in m^3/s in use of the heat exchanger;

A is the surface area between adjacent pipes of the second part of the pipes;

C is a substantially constant value of maximally 12 m/s.

[0042] Relatively hot flue gas has a relatively large volume and vice versa. As such, as seen in a flow direction of the flue gas, the flue gas coming from the burner arranged in the receiving space 4 has a relatively large flow rate as the flue gas is relatively hot, thereby requiring a relatively large surface area between adjacent pipes 9 arranged near the burner space in order to have the velocity of the flue gas being maximally said value C. The pipes 9 arranged near the outlet opening in the base 3 of the body 2 therefor require a smaller surface area there between in order to have the velocity of the flue gas being maximally said value C, as the flue gas is already cooled down to some extent by the heat exchanger and the flow rate is relatively small. This is shown in figure 1B, showing that the closer the pipes 9 are arranged to the burner arranged in the receiving space 4, the larger the surface area between the pipes 9.

[0043] As is further shown in figure 1B, the second part of the pipes comprises three groups of pipes 9, wherein a first group 15 located near the base 3 of the body 2 has a first, smallest diameter, wherein a second group 16 located near the first group 15 at a side of the first group 15 opposite to the base 3 of body 2 has a second, intermediate diameter, and wherein a third group 17 located near the open end of the body 2 has a third, largest diameter. As said third group 17 of pipes 9 has the largest diameter of the three groups, the flow rate of liquid flowing there through is also the largest of the three groups, thereby cooling down the flue gas coming from the burner relatively fast and efficiently reducing production of NO_x. Between the third group 17 and the second group 16 a certain distance of preferably between 10 and 40mm, more preferably between 20 and 30mm, is present, such that over this distance the flue gas is substantially not cooled down and a relatively large time period is provided for the conversion of CO into CO_2, such that the emission of CO is reduced and preferably prevented. The pipes 9 of the second group 16 have an intermediate diameter adapted to the amount of heat to be absorbed from the already partly cooled down flue gases, and the pipes 9 of the first group 15 have the smallest diameter adapted to absorb heat from the more cooled down flue gases. A part of the pipes 9 of the first group 15, in particular three pipes 9 thereof, is arranged at least partly between a part of the pipes 9 of the second group 16, wherein said part of the pipes 9 of the first group 15 and said part of the pipes 9 of the second group 16 are arranged alternately in a direction substantially orthogonal to the direction of the flow of the flue gases. As a result thereof, the flow of flue gas is directed along substantially the whole outer surface, in particular also along the lower surface, of the pipes 9 arranged directly upstream of said part of pipes 9 of the second group 16 as seen in the direction of the flow of flue gases.

[0044] Figure 2 schematically shows the distribution of the liquid flow through the pipes 9 of the heat exchanger. This shows that the pipes 9 are divided over in total twenty-two groups. Appointment of the pipes 9 to each

group is established with said hollow spaces 8 that connect any desired number of selected pipes 9 to a specific group. Liquid enters the first group I via the liquid inlet 10 that is in medium through flow connection with group I and exits the last group XX via liquid outlet 11 that is in medium through flow connection with group XX. The liquid flows alternatingly between the two end zones 5 via the groups in sequential order, thus via group I to group II, from group II to group III, etc. The number of pipes 9 belonging to each group and the selection of pipes 9 belonging to each group may be chosen as desired. Preferably, the selection and number of pipes 9 belonging to each group are chosen to fulfil a second formula:

$$\frac{Q}{A_{eff} \cdot v_l} = k$$

is substantially fulfilled, wherein:

Q is the quantity of heat transferred to the liquid flowing in each pipe in kJ in use of the heat exchanger;

A_{eff} is the effective heat transferring surface of each pipe in m^2 in use of the heat exchanger; v_l is the velocity of the liquid flowing in each pipe in m/s in use of the heat exchanger, and k is a maximum value of 170 kJ/m^3.

[0045] Using this formula the liquid flow is distributed such that the quantity of heat Q discharged from the flue gas and transferred to the liquid flowing in each pipe is substantially constant anywhere in the heat exchanger.

[0046] Figures 3A and 3B show the effect of liquid distributors according to the invention. Said liquid distributors may be provided in any desired hollow space 8 for distributing the liquid over the pipes 9 connecting to that hollow space 8. Figure 3A shows a plurality of three pipes 9 of a group that are connected via a hollow space 8 to three pipes 9 of a subsequent group. The liquid tends to follow the largest curvature and thereby to enter the most outer pipe 9 of the three pipes of the subsequent group. The middle pipe therefor receives less liquid and will therefor become relative hot and exposed to high thermal stresses. With use of the liquid distributors shown in figure 3B each pipe 9 of a group is connected to a pipe 9 of the subsequent group. The liquid is thereby evenly distributed over the pipes 9 belonging to a specific group, independent of the location of the pipe 9.

[0047] Figure 4 is a perspective view of a burner according to the invention. Said burner comprises a casing 18. In said casing 18 an element is provided comprising a ceramic burner plate 19 and a damper 21 that also functions as an aluminium gas/air mixture distribution plate and that is arranged upstream from the burner plate 19. An anorganic insulation material 20 is provided between the burner plate 19 and the damper/distribution plate 21. A sealing 22 is provided between the casing 18 and the damper/distribution plate 21, such that the gas/air-mixture is prevented from entering the burner room alongside said element comprising the damper/distribution plate 21and the burner plate 19. As the damper/distribution plate 21 and the burner plate 19 are combined in one element, the gas/air-mixture exiting the damper/distribution plate 21 cannot by-pass the burner plate 19. The gas/air-mixture flowing through the gas/air chamber will cool down the gas/air chamber and the gas/air-mixture distribution plate/damper 21. The life time of the burner is hereby enhanced.

[0048] Figure 5 shows an assembly of the heat exchanger of figures 1A, 1B and the burner of figure 4. The U-shape body 2 and the panels 7 of the heat exchanger are shown, as well as the casing 18 of the burner. The burner is arranged such in the receiving space of the body 2, that the flames coming from the burner plate are surrounded by the upper pipes 9 of the legs of the first pattern 12 of pipes 9.

[0049] It is noted that the invention is not limited to the shown embodiments but also extends to variants within the scope of the appended claims.

Claims

1. Heat exchanger (1), comprising:

- a casing (18), comprising:
  - a substantially U-shaped body (2) as seen in cross-section and extending in a longitudinal direction, wherein a base (3) of the U-shape body (2) comprises a gas outlet opening and wherein an open end, opposite to the base (3), of the U-shape body (2) comprises a receiving space (4) for receiving a burner, and
  - two end plates (6) arranged at the two longitudinal end zones (5) of said U-shape body (2);

- a plurality of pipes (9) arranged within said casing (18) and connected to said end plates (6), through which pipes (9) in use a liquid can flow;
- a plurality of connecting means for providing a liquid through flow connection between at least two pipes (9) at each longitudinal end zone (5) of said U-shape body (2), such that liquid flowing through a first pipe (9) of the at least two pipes (9) is directed to the other pipe (9) of the at least two pipes (9),

wherein a first part of the pipes (9) is arranged in a first pattern (12) defining two legs of a substantially U-shape as seen in cross-section, said first pattern (12) being arranged substantially parallel to legs of said U-shape body (2), and

wherein a second part of said pipes (9) are arranged within a space (14) at least partly bounded by said first pattern (12),
characterized in that a distance between all pairs of adjacent pipes (9) of each leg of the first pattern (12) is maximally 0.1 mm.

2. Heat exchanger (1) according to claim 1, wherein said receiving space (4) is arranged between at least a part of the pipes (9) of the first pattern (12) located near the open end of the U-shape body (2) in such a manner that in use at least a part of the pipes (9) of the first pattern (12) surround a flame provided by said burner.

3. Heat exchanger (1) according to any of the preceding claims, comprising a sealing (13) arranged between the outer surface of the pipes (9) arranged at a first end of each leg of the first pattern (12) near the open end of the U-shape body (2) and the substantially U-shaped body (2).

4. Heat exchanger (1) according to any of the preceding claims, wherein the distance between the legs of the U-shape body (2) and the pipes (9) of the first pattern (12) is maximally 1.0 mm, preferably maximally 0.4 mm.

5. Heat exchanger (1) according to any of the preceding claims, wherein at least one of the connecting means comprises a liquid distributor for substantially equally distributing liquid over pipes (9) being connected to said connecting means.

6. Heat exchanger (1) according to any of the preceding claims, wherein the second part of the pipes (9) comprise at least three groups of pipes (9), wherein a first group (15) located near the base (3) of the U-shape body (2) has a first, smallest diameter, wherein a second group (16) located near the first group (15) at a side of the first group (15) opposite to the base (3) of the U-shape body (2) has a second diameter, and wherein a third group (17) located near the open end of the U-shape body (2) has a third, largest diameter, which third group (17) is located at a predetermined distance from the second group (16).

7. Heat exchanger (1) according to claim 6, wherein a part of the pipes (9) of the first group (15) is arranged at least partly between a part of the pipes (9) of the second group (16).

8. Assembly of a heat exchanger (1) according to any of the claims 1 - 7 and a burner, wherein the burner is arranged in said receiving space (4).

9. Assembly according to claim 8, wherein the assembly comprises the heat exchanger (1) according to at least claim 2, and wherein the burner is arranged in said receiving space (4) in such a manner that in use at least a part of the pipes (9) of the first pattern (12) surround a flame provided by said burner.

10. Assembly according to claim 8 or 9, wherein said burner comprises a damper (21).

11. Assembly according to claim 10, wherein said burner comprises a burner plate (19) that is connected to or integrally formed with said damper (21).

12. Assembly according to claim 10 or 11, wherein said burner comprises a gas/air-mixture distribution plate that is connected to or integrally formed with said damper (21) and/or burner plate (19).

13. Assembly according to claim 12, comprising a sealing (22) that is provided between the casing (18) and the gas/air-mixture distribution plate.

Patentansprüche

1. Wärmetauscher (1), umfassend:

- ein Gehäuse (18), umfassend:

- einen im Wesentlichen U-förmigen Körper (2), wie im Querschnitt gesehen, und der sich in einer Längsrichtung erstreckt, wobei eine Basis (3) des U-förmigen Körpers (2) eine Gasauslassöffnung umfasst und wobei ein offenes Ende, gegenüber der Basis (3), des U-förmigen Körpers (2) einen Aufnahmeraum (4) zum Aufnehmen eines Brenners umfasst, und
- zwei Endplatten (6), die an den zwei Längsendzonen (5) des U-förmigen Körpers (2) eingerichtet sind;
- eine Vielzahl von Rohren (9), die innerhalb des Gehäuses (18) eingerichtet und mit den Endplatten (6) verbunden sind, wobei, in Verwendung, eine Flüssigkeit durch die Rohre (9) fließen kann;
- eine Vielzahl von Verbindungsmitteln zum derartigen Bereitstellen einer Flüssigkeitsdurchflussverbindung zwischen mindestens zwei Rohren (9) an jeder Längsendzone (5) des U-förmigen Körpers (2), dass Flüssigkeit, die durch ein erstes Rohr (9) der mindestens zwei Rohre (9) fließt, zu dem anderen Rohr (9) der mindestens zwei Rohre (9) geleitet wird,

wobei ein erster Teil der Rohre (9) in einem ersten Muster (12) eingerichtet

ist, das zwei Schenkel einer im Wesentlichen U-Form definiert, wie im Querschnitt gesehen, wobei das erste Muster (12) im Wesentlichen parallel zu Schenkeln des U-förmigen Körpers (2) eingerichtet ist, und
wobei ein zweiter Teil der Rohre (9) innerhalb eines Raums (14) eingerichtet ist, der mindestens teilweise durch das erste Muster (12) begrenzt ist,
dadurch gekennzeichnet, dass ein Abstand zwischen allen Paaren von angrenzenden Rohren (9) jedes Schenkels des ersten Musters (12) maximal 0,1 mm beträgt.

2. Wärmetauscher (1) nach Anspruch 1, wobei der Aufnahmeraum (4) zwischen mindestens einem Teil der Rohre (9) des ersten Musters (12) eingerichtet ist, nahe dem offenen Ende des U-förmigen Körpers (2) in einer derartigen Weise gelegen, dass, in Verwendung, mindestens ein Teil der Rohre (9) des ersten Musters (12) eine Flamme umgibt, die durch den Brenner bereitgestellt wird.

3. Wärmetauscher (1) nach einem der vorstehenden Ansprüche, umfassend eine Dichtung (13), die zwischen der Außenoberfläche der Rohre (9), die an einem ersten Ende jedes Schenkels des ersten Musters (12) nahe dem offenen Ende des U-förmigen Körpers (2) eingerichtet sind, und dem im Wesentlichen U-förmigen Körper (2) eingerichtet ist.

4. Wärmetauscher (1) nach einem der vorstehenden Ansprüche, wobei der Abstand zwischen den Schenkeln des U-förmigen Körpers (2) und den Rohren (9) des ersten Musters (12) maximal 1,0 mm, vorzugsweise maximal 0,4 mm, beträgt.

5. Wärmetauscher (1) nach einem der vorstehenden Ansprüche, wobei mindestens eines der Verbindungsmittel einen Flüssigkeitsverteiler zum im Wesentlichen gleichmäßigen Verteilen von Flüssigkeit über Rohre (9) umfasst, die mit den Verbindungsmitteln verbunden sind.

6. Wärmetauscher (1) nach einem der vorstehenden Ansprüche, wobei der zweite Teil der Rohre (9) mindestens drei Gruppen von Rohren (9) umfasst, wobei eine erste Gruppe (15), nahe der Basis (3) des U-förmigen Körpers (2) gelegen, einen ersten, kleinsten Durchmesser aufweist, wobei eine zweite Gruppe (16), nahe der ersten Gruppe (15) auf einer Seite der ersten Gruppe (15) gelegen, die der Basis (3) des U-förmigen Körpers (2) gegenüberliegt, einen zweiten Durchmesser aufweist, und wobei eine dritte Gruppe (17), nahe des offenen Endes des U-förmigen Körpers (2) gelegen, einen dritten, größten Durchmesser aufweist, wobei die dritte Gruppe (17) in einem zuvor bestimmten Abstand von der zweiten Gruppe (16) gelegen ist.

7. Wärmetauscher (1) nach Anspruch 6, wobei ein Teil der Rohre (9) der ersten Gruppe (15) mindestens teilweise zwischen einem Teil der Rohre (9) der zweiten Gruppe (16) eingerichtet ist.

8. Anordnung eines Wärmetauschers (1) nach einem der Ansprüche 1 bis 7 und eines Brenners, wobei der Brenner in dem Aufnahmeraum (4) eingerichtet ist.

9. Anordnung nach Anspruch 8, wobei die Anordnung den Wärmetauscher (1) nach mindestens Anspruch 2 umfasst und wobei der Brenner in dem Aufnahmeraum (4) in einer derartigen Weise eingerichtet ist, dass, in Verwendung, mindestens ein Teil der Rohre (9) des ersten Musters (12) eine Flamme umgibt, die durch den Brenner bereitgestellt wird.

10. Anordnung nach Anspruch 8 oder 9, wobei der Brenner eine Klappe (21) umfasst.

11. Anordnung nach Anspruch 10, wobei der Brenner eine Brennerplatte (19) umfasst, die mit der Klappe (21) verbunden oder integral damit ausgebildet ist.

12. Anordnung nach Anspruch 10 oder 11, wobei der Brenner eine Gas-/Luftgemisch-Verteilungsplatte aufweist, die mit der Klappe (21) und/oder der Brennerplatte (19) verbunden oder integral damit ausgebildet ist.

13. Anordnung nach Anspruch 12, umfassend eine Dichtung (22), die zwischen dem Gehäuse (18) und der Gas-/Luftgemisch-Verteilungsplatte bereitgestellt ist.

Revendications

1. Échangeur de chaleur (1), comprenant:

- un carter (18), comprenant:

  - un corps sensiblement en forme de U (2) vu en coupe transversale et s'étendant dans une direction longitudinale, dans lequel une base (3) du corps en forme de U (2) comprend une ouverture de sortie de gaz et dans lequel une extrémité ouverte, opposée à la base (3), du corps en forme de U (2) comprend un espace de réception (4) destiné à recevoir un brûleur, et
  - deux plaques d'extrémité (6) agencées au niveau des deux zones d'extrémité longitudinales (5) dudit corps en forme de U (2);

- une pluralité de tuyaux (9) agencés à l'intérieur dudit carter (18) et reliés aux plaques d'extrémité (6), à travers lesquels les tuyaux (9), lors de l'utilisation, peuvent laisser s'écouler un liquide;
- une pluralité de moyens de raccordement pour fournir un liquide à travers un raccordement d'écoulement entre au moins deux tuyaux (9) au niveau de chaque zone d'extrémité longitudinale (5) dudit corps en forme de U (2), de telle sorte que le liquide s'écoulant à travers un premier tuyau (9) des au moins deux tuyaux (9) est dirigé vers l'autre tuyau (9) des au moins deux tuyaux (9),

dans lequel une première partie des tuyaux (9) est agencée selon un premier modèle (12) définissant deux pattes d'une forme sensiblement en U vue en coupe transversale, ledit premier modèle (12) étant agencé sensiblement parallèlement aux pattes dudit corps en forme de U (2), et
dans lequel une seconde partie des tuyaux (9) est agencée à l'intérieur d'un espace (14) au moins partiellement délimité par le premier modèle (12),
caractérisé en ce qu'une distance entre toutes les paires de tuyaux adjacents (9) de chaque patte du premier modèle (12) est au maximum de 0,1 mm.

2. Échangeur de chaleur (1) selon la revendication 1, dans lequel ledit espace de réception (4) est agencé entre au moins une partie des tuyaux (9) du premier modèle (12) situés près de l'extrémité ouverte du corps en forme de U (2) de manière que, lors de l'utilisation, au moins une partie des tuyaux (9) du premier modèle (12) entoure une flamme fournie par ledit brûleur.

3. Échangeur de chaleur (1) selon l'une quelconque des revendications précédentes, comprenant un joint d'étanchéité (13) agencé entre la surface extérieure des tuyaux (9) agencés au niveau d'une première extrémité de chaque patte du premier modèle (12) près de l'extrémité ouverte du corps en forme de U (2) et le corps en forme de U (2).

4. Échangeur de chaleur (1) selon l'une quelconque des revendications précédentes, dans lequel la distance entre les pattes du corps en forme de U (2) et les tuyaux (9) du premier modèle (12) est au maximum de 1,0 mm, de préférence au maximum de 0,4 mm.

5. Échangeur de chaleur (1) selon l'une quelconque des revendications précédentes, dans lequel au moins l'un parmi les moyens de raccordement comprend un distributeur de liquide pour distribuer de manière sensiblement égale le liquide sur des tuyaux (9) raccordés auxdits moyens de raccordement.

6. Échangeur de chaleur (1) selon l'une quelconque des revendications précédentes, dans lequel la seconde partie des tuyaux (9) comprend au moins trois groupes de tuyaux (9), dans lequel un premier groupe (15) situé près de la base (3) du corps en forme de U (2) présente un premier diamètre, le plus petit, dans lequel un deuxième groupe (16) situé près du premier groupe (15) sur un côté du premier groupe (15) opposé à la base (3) du corps en forme de U (2) présente un deuxième diamètre, et dans lequel un troisième groupe (17) situé près de l'extrémité ouverte du corps en forme de U (2) présente un troisième diamètre, le plus grand, ce troisième groupe (17) étant situé à une distance prédéterminée du deuxième groupe (16).

7. Échangeur de chaleur (1) selon la revendication 6, dans lequel une partie des tuyaux (9) du premier groupe (15) est agencée, au moins en partie, entre une partie des tuyaux (9) du deuxième groupe (16).

8. Assemblage d'un échangeur de chaleur (1) selon l'une quelconque des revendications 1 à 7 et d'un brûleur, dans lequel le brûleur est agencé dans ledit espace de réception (4).

9. Assemblage selon la revendication 8, dans lequel l'assemblage comprend l'échangeur de chaleur (1) selon au moins la revendication 2, et dans lequel le brûleur est agencé dans ledit espace de réception (4) de manière que, lors de l'utilisation, au moins une partie des tuyaux (9) du premier modèle (12) entoure une flamme fournie par ledit brûleur.

10. Assemblage selon la revendication 8 ou 9, dans lequel ledit brûleur comprend un amortisseur (21).

11. Assemblage selon la revendication 10, dans lequel ledit brûleur comprend une plaque de brûleur (19) qui est reliée audit amortisseur (21) ou formée d'une seule pièce avec celui-ci.

12. Assemblage selon la revendication 10 ou 11, dans lequel ledit brûleur comprend une plaque de distribution du mélange gaz/air qui est reliée audit amortisseur (21) et/ou à ladite plaque de brûleur (19) ou formée d'une seule pièce avec ceux-ci.

13. Assemblage selon la revendication 12, comprenant un joint d'étanchéité (22) placé entre le carter (18) et

la plaque de distribution du mélange gaz/air.

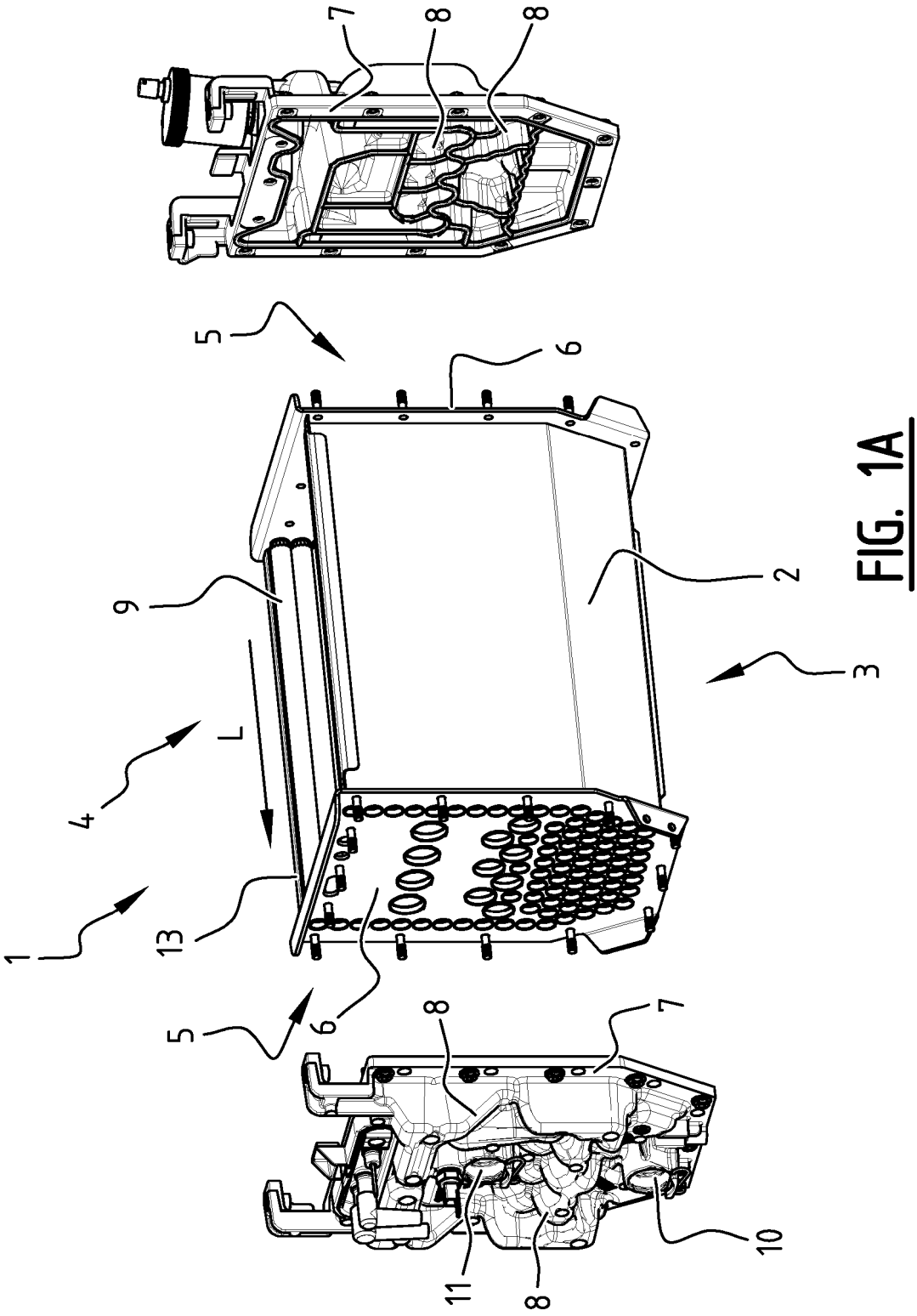

FIG. 1A

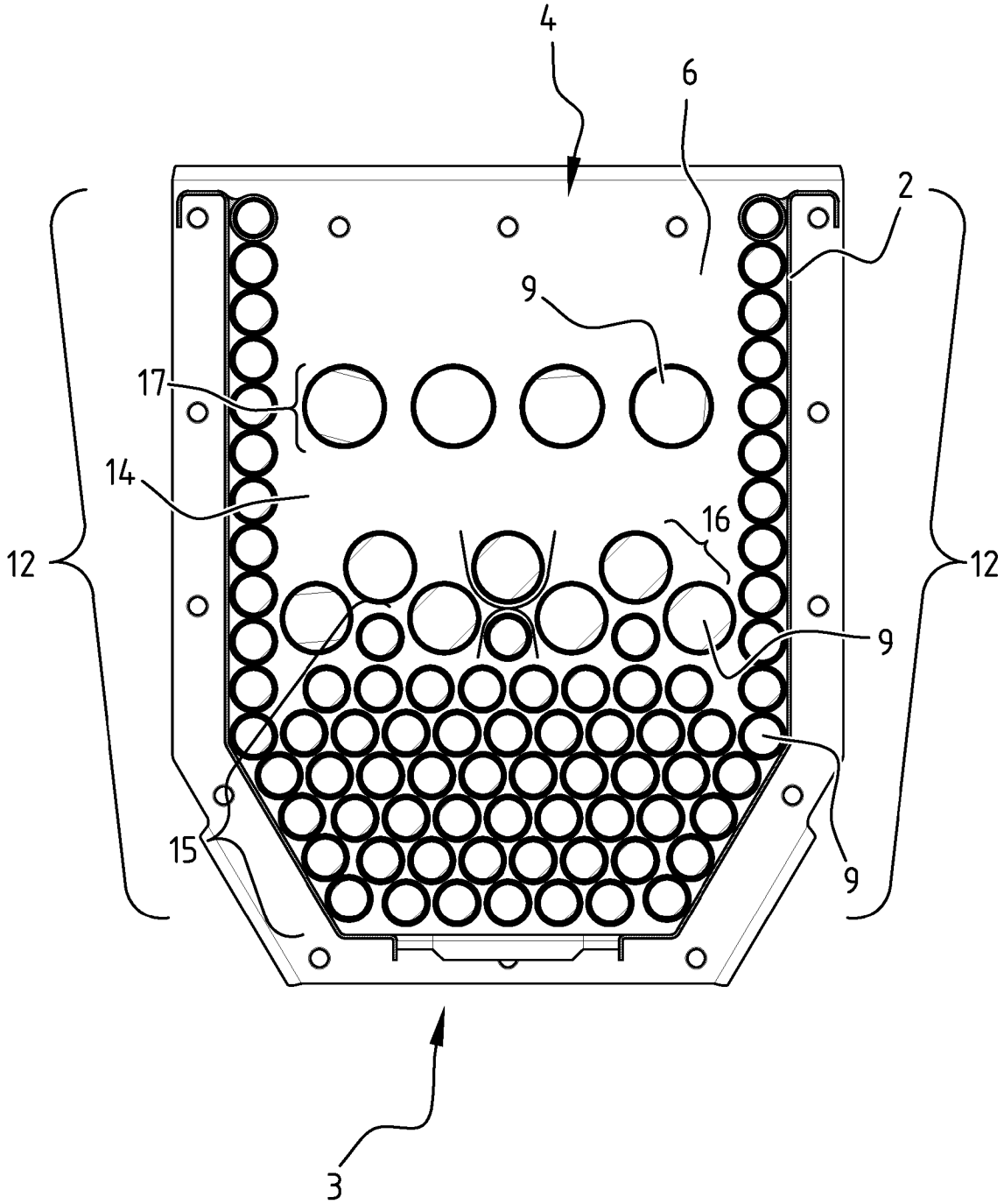

FIG. 1B

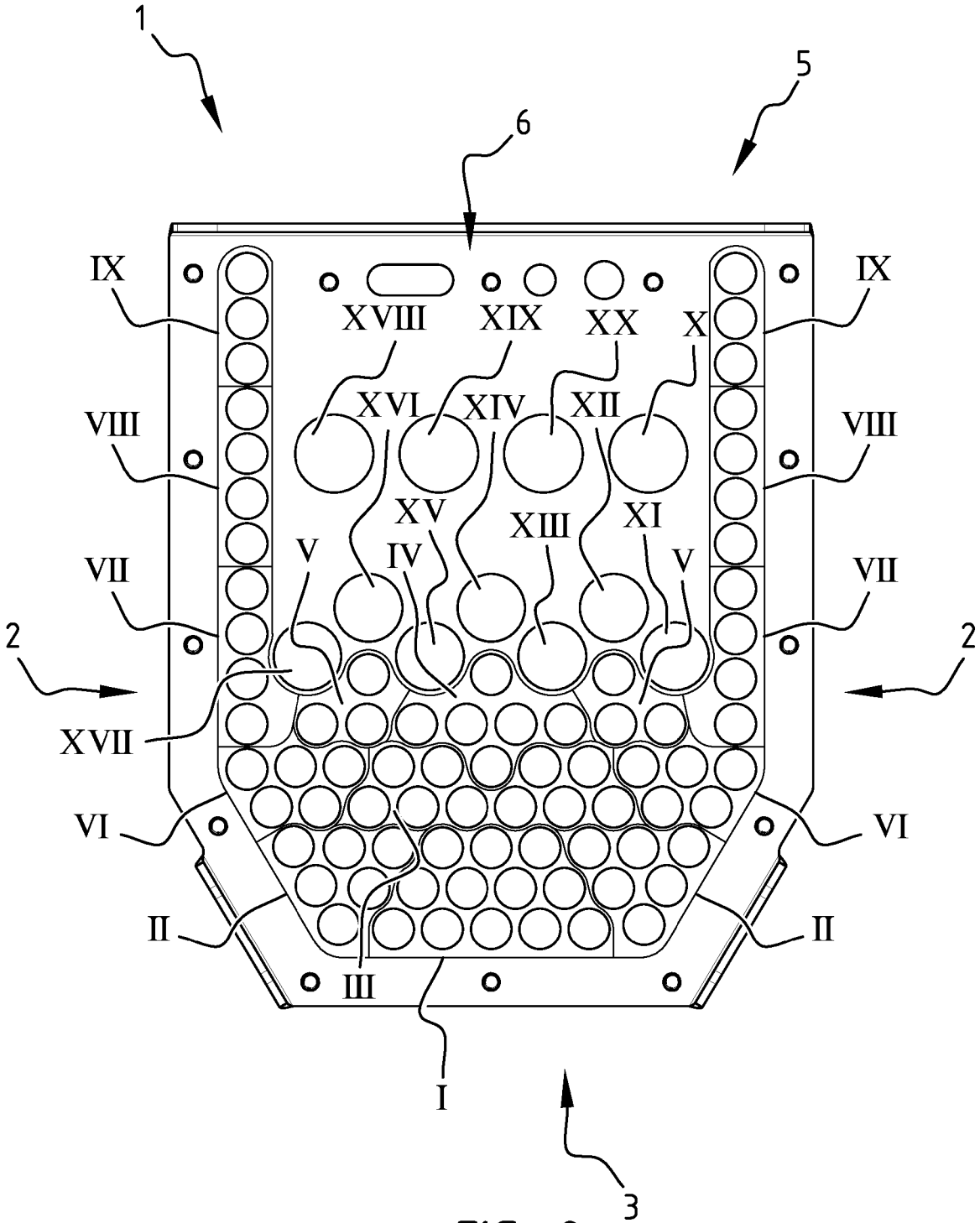
1
5
6
IX
IX
XVIII
XIX
XX
X
VIII
VIII
XVI
XIV
XII
XV
XIII
XI
V
IV
V
VII
VII
2
2
XVII
VI
VI
II
II
III
I
3

FIG. 2

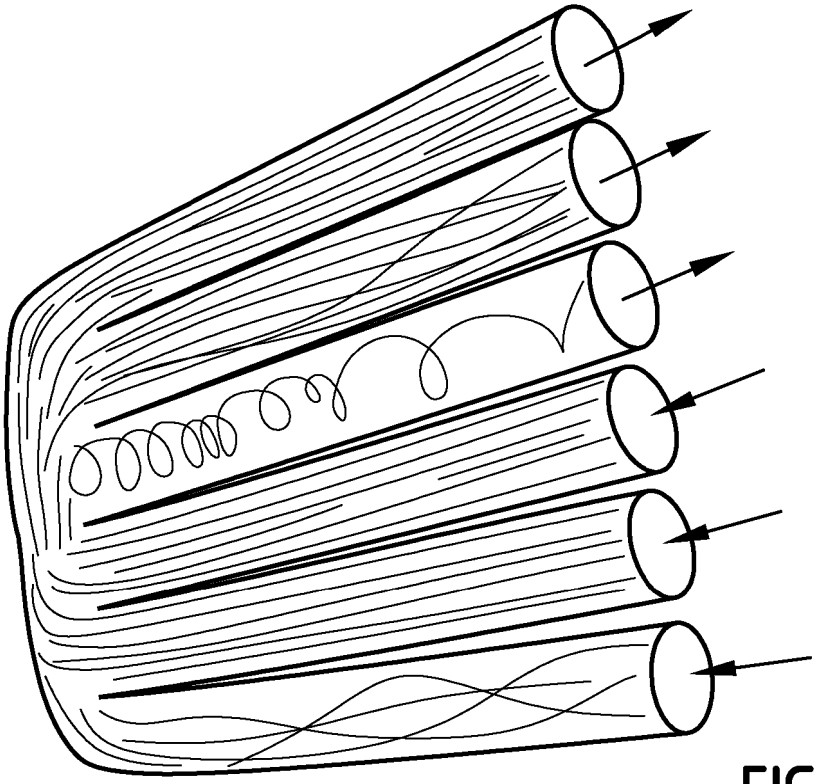

FIG. 3A

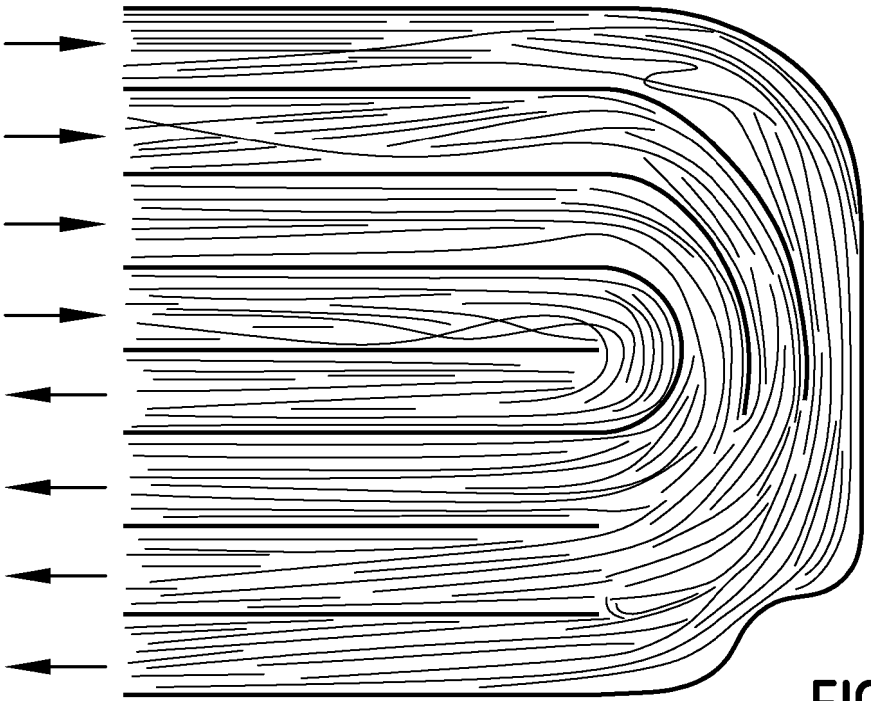

FIG. 3B

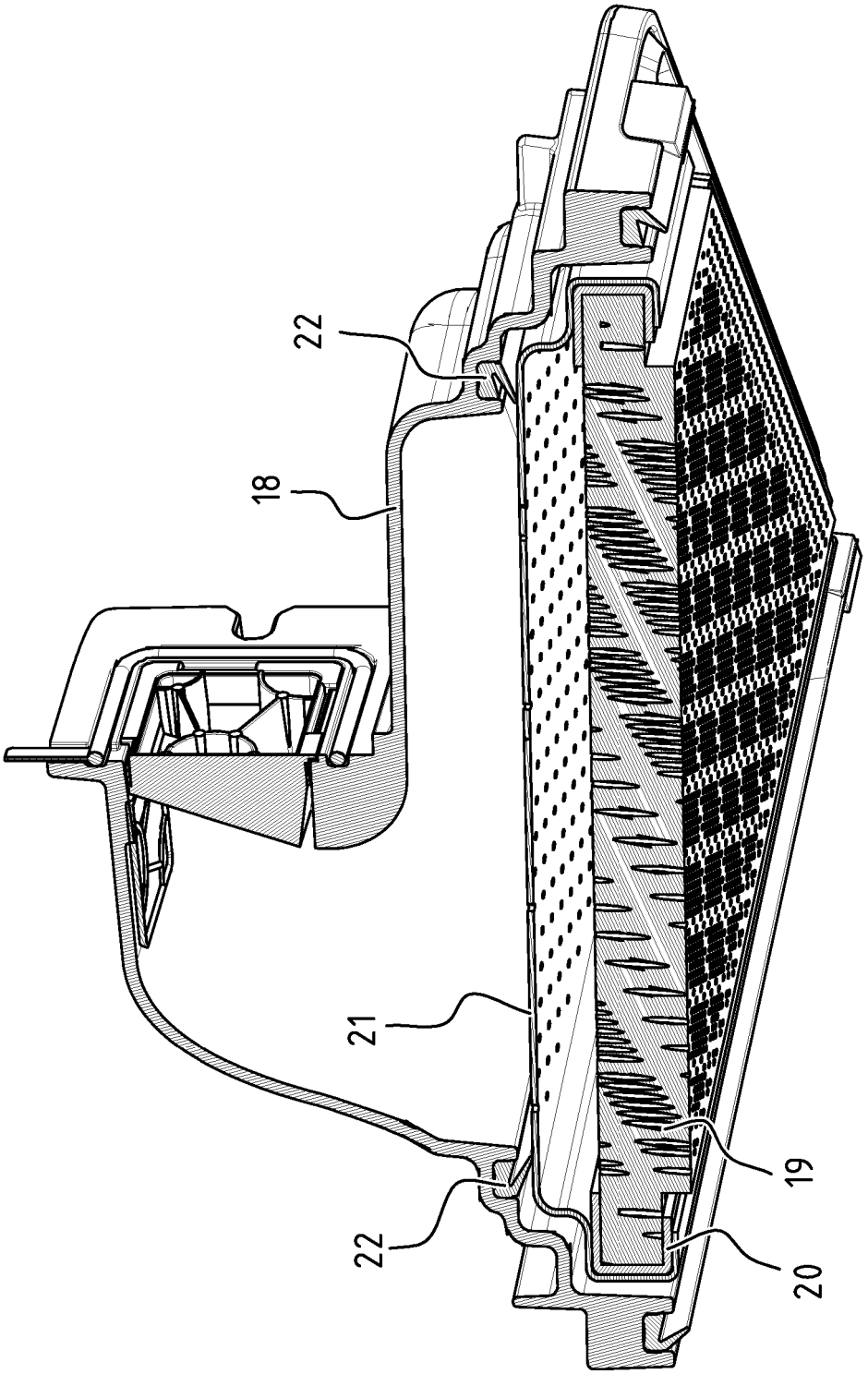

FIG. 4

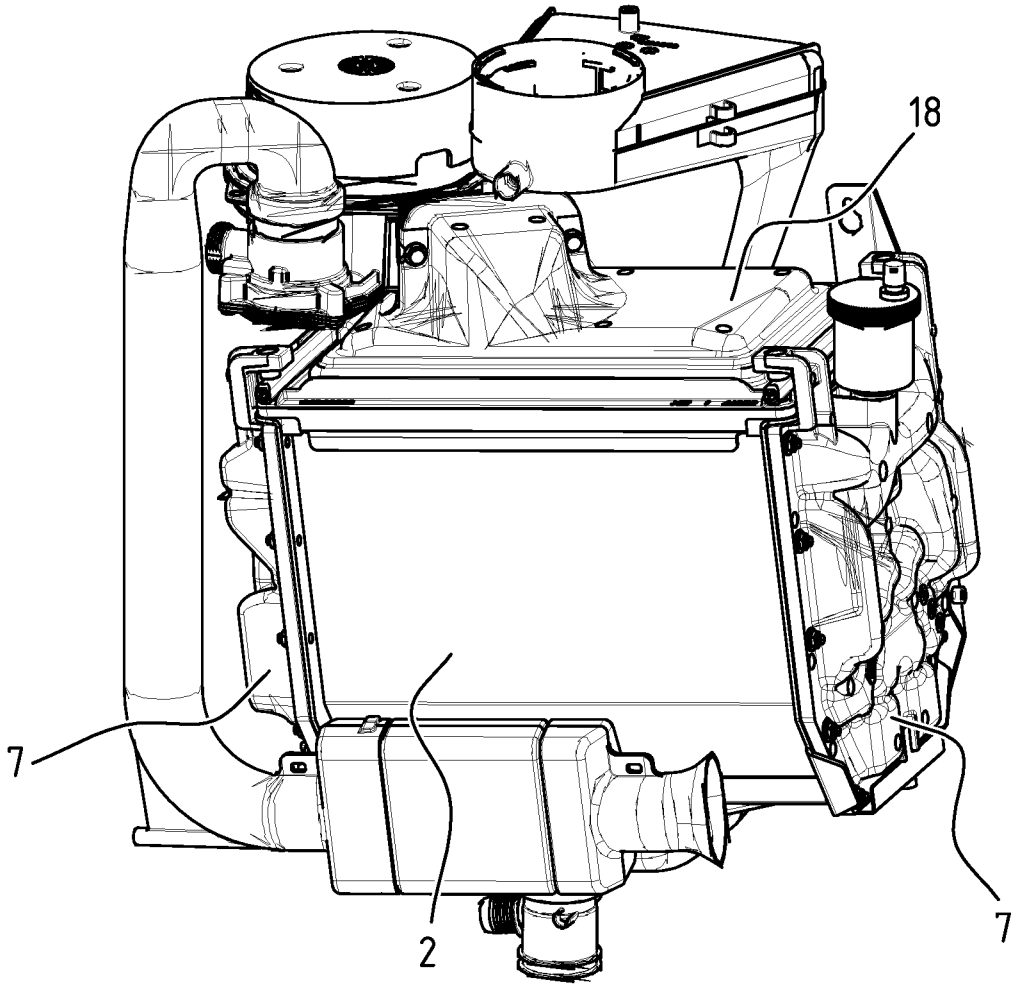

FIG. 5

REFERENCES CITED IN THE DESCRIPTION

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- EP 1243866 A1 **[0003]**