(19) Europäisches Patentamt
European Patent Office
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(11) **EP 4 050 292 A1**

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
31.08.2022 Bulletin 2022/35

(21) Application number: **21159043.5**

(22) Date of filing: **24.02.2021**

(51) International Patent Classification (IPC):
F28D 1/053 *(2006.01)* ***F28F 9/02*** *(2006.01)*

(52) Cooperative Patent Classification (CPC):
F28D 1/05391; F28F 9/0214; F28F 9/028;
F28F 9/0224; F28F 9/0278; F28F 2250/06

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA ME
Designated Validation States:
KH MA MD TN

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(54) **A HEAT EXCHANGER**

(57) The object of the invention is, among others, a heat exchanger (1) for heat exchange between a first fluid and a second fluid, comprising: a first header- tank assembly (20) comprising: an inlet for the first fluid, an outlet for the first fluid a first header (21), a first cover (22), wherein the first header- tank assembly (20) forms two fluidly separated channels for the first fluid, a second header- tank assembly (30) comprising: a second header (31), a second cover (32), wherein the second header- tank assembly (30) forms two fluidly connected channels, plurality of tubes (40) forming a first pass (10) and a second pass (12) for the first fluid, wherein the tubes (40) are arranged in two parallel stacks between the first header- tank assembly (20) and the second header-tank assembly (30), characterised in that the second cover (32) is configured to control the flow of the fist fluid between the first pass (10) and the second pass (12) by the means of a bypass section (100), the bypass section (100) being formed by a plurality of communication channels, wherein the cross section range of the communication channels is between X_{min}=0.25 x Y and X_{max} 0.50 x Y, wherein X is the communication channel cross section dedicated to two tubes located within the same pass (10, 12) with cross section Y which equals to sum of doubled tube hydraulic cross section.

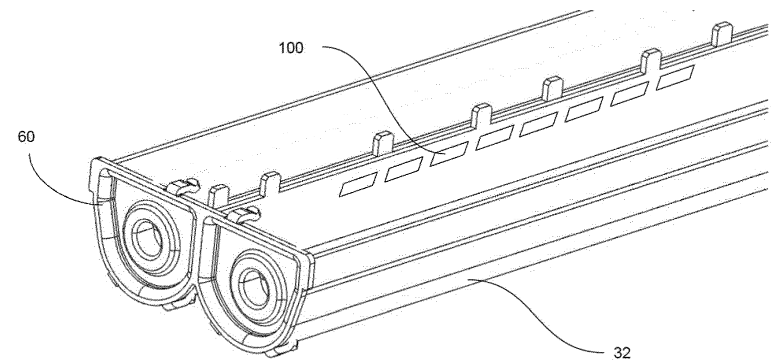

Fig. 4

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Description

FIELD OF THE INVENTION

[0001] The invention relates to a heat exchanger. In particular the invention relates to to the heat exchanger for a motor vehicle.

BACKGROUND OF THE INVENTION

[0002] Evaporators look like, and in fact are, similar to radiators, only thicker and smaller in overall size. Like radiators, evaporators consist of a series of internal tubes or flow paths with fins attached to them. Air can pass freely through the fins, just like a radiator. But unlike a radiator, where the internal tubes carry moving engine coolant, the passages in the evaporator carry moving refrigerant.

[0003] In an automotive air conditioning system (further referred to as A/C system), cold, low-pressure liquid refrigerant enters the evaporator. Warm air from the interior of the vehicle passes through the evaporator by action of the blower fan. Since it's a fact of nature that heat always travels from a warmer area to a cooler area, the cooler refrigerant flowing inside the evaporator's absorbs heat from the warm air. At the same time, humidity in the air condenses on the cool evaporator's surface, then eventually drips out of a drain tube to the outside. After the initially warmed refrigerant has completed its path through the evaporator, it moves on to the compressor.

[0004] Known evaporators usually comprise a first pass for the fluid and a second pass for the fluid, whereas the passes are fluidly communicated with each other. The fluid communication may be provided, for example, by the pipes connecting the tank of the first pass with the other tank of the second pass. However, such architecture leads to many disadvantages, starting from the pressure drop caused by the pipes themselves.

[0005] Further, due to the fact that the pipes are usually made of thin material, they may be exposed to corrosive environment what makes them prone to damage.

[0006] One way to mitigate the upper-mentioned disadvantages is providing a specific architecture of the evaporator in which two passes are arranged parallelly with respect to each other. Further, the fluidal communication between the passes may be provided by the bypass section between the tanks of respective passes. The bypass section may be in a form of communication channels communication channels directly connecting both abutting tanks.

[0007] Such architecture requires specific bypass configuration which would provide sufficient efficiency of the heat exchanger.

[0008] It would be desired to provide a bypass section between the tanks which would improve the efficiency of the heat exchanger.

SUMMARY OF THE INVENTION

[0009] The object of the invention is, among others, a heat exchanger for heat exchange between a first fluid and a second fluid, comprising: a first header- tank assembly comprising: an inlet for the first fluid, an outlet for the first fluid a first header, a first cover, wherein the first header- tank assembly forms two fluidly separated channels for the first fluid, a second header- tank assembly comprising: a second header, a second cover, wherein the second header- tank assembly forms two fluidly connected channels, plurality of tubes forming a first pass and a second pass for the first fluid, wherein the tubes are arranged in two parallel stacks between the first header- tank assembly and the second header- tank assembly, characterised in that the second cover is configured to control the flow of the fist fluid between the first pass and the second pass by the means of a bypass section , the bypass section being formed by a plurality of orifices, wherein the cross section range of the bypass is between X_{min}=0.25 x Y and X_{max} 0.50 x Y, wherein X is the bypass cross section dedicated to two tubes with cross section Y which equals to sum of doubled tube hydraulic cross section.

[0010] Advantageously, the communication channels communication channels comprise essentially cuboidal cross-section.

[0011] Advantageously, the communication channels communication channels comprise essentially rectangular cross section.

[0012] Advantageously, the communication channels communication channels comprise smooth corners.

[0013] Advantageously, the communication channels communication channels comprise essentially circular cross- section.

[0014] Advantageously, the communication channels communication channels comprise essentially oblong cross- section.

[0015] Advantageously, the bypass section comprises communication channels communication channels of different cross-section.

[0016] Advantageously, the bypass section comprises communication channels communication channels of the same cross- section.

[0017] Advantageously, the assembly comprises two baffles forming respectively two end walls of the fluid channel located respectively at two opposite ends of the header.

[0018] Advantageously, at least one baffle has an opening to form an inlet or an outlet for the channel.

[0019] Advantageously, one baffle is configured to close an end of the fluid channel.

[0020] Advantageously, the header comprises at least one side wall protruding in perpendicular with respect to the general plane of the header, the side wall further comprising notches configured to immobilize at least one side of the cover.

[0021] Advantageously, the header comprises at least one distribution device located between the baffles.

BRIEF DESCRITPTION OF DRAWINGS

[0022] Examples of the invention will be apparent from and described in detail with reference to the accompanying drawings, in which:

Fig. 1 shows a perspective view of header- tank assembly comprising two stacks of tubes.

Fig. 2 shows a perspective view of the first header.

Fig. 3 shows a perspective view of the second header.

Fig. 4 shows a cross- sectional view of the second header- tank assembly comprising bypass section.

DETAILED DESCRIPTION OF EMBODIMENTS

[0023] The invention refers to a heat exchanger for a motor vehicle such as evaporator. The main sub-components of the evaporator are depicted by Fig. 1 and briefly described by further paragraphs.

[0024] Fig. 1 shows the perspective view of a heat exchanger 1 comprising main sub-components, i.e. plurality of tubes 40 comprising open ends, wherein the plurality of tubes 40 may form a first pass 10 and a second pass 12 for the first fluid, and a header-tank assemblies 20, 30 located on each side of the open ends of the tubes 40. The header- tank assemblies 20, 30 may comprise minor differences, depending on what role does each one of them play for the heat exchanger 1.

[0025] The heat exchanger 1 enables the heat exchange between two fluids, wherein one fluid (e.g. refrigerant) is encapsulated and circulates within the heat exchanger 1 and the other (e.g. air) flows across the sub-components of the heat exchanger 1.

[0026] The tubes 40 may be in form of elongated, flattened channels stacked between two header- tank assemblies 20, 30, wherein all tubes 40 are oriented in the same direction, so that the fluid (e.g. air) may flow through the stack. The tubes 40 may provide a fluidal communication between the header- tank assemblies 20, 30. The tubes 40 actively participate in the heat transfer process, so the flattened shape of the tubes 40 not only enables the fluid to flow through the stack, but also increases the heat transfer surface. However, the specific dimensions of the tubes 40 should be calculated respecting the characteristics of other sub-components.

[0027] In order to further facilitate the heat transfer process, the tubes 40 may be interlaced with so-called fins. Fins may be in a form of corrugated sheet of material of relatively high thermal conductivity, e.g. aluminum. The corrugations form ridges which may be in contact with the surface of two adjacent tubes 40. Usually, the fins are initially squeezed to increase the number of possible corrugations and then brazed to the surface of the tubes 40, so that the fins are immobilized with respect to the tubes 40. Depending on the operational mode of the heat exchanger 1, the fins along with the tubes 40 may receive the heat from the fluid e.g. refrigerant circulating through the tubes 40 in order to facilitate cooling it down. This phenomena may be used in heat exchange devices such as radiators or condensers.

[0028] Alternatively, the fins and the tubes 40 receive the heat from the other fluid, e.g. hot air, in order to receive the heat therefrom, so that the other fluid, e.g. hot air, is cooled down. This phenomena may be used in heat exchange devices such as evaporators.

[0029] The tubes 40 may be formed, for example, in the process of extrusion. This process enables to create the tubes 40 comprising one, or many channels within the single tube 2. Alternatively, the tubes 40 may be made of out of single, folded sheet of metal.

[0030] Fig. 1 further shows the heat exchanger 1 comprising two the header- tank assemblies 20, 30, wherein each of these comprises a single at least two channels for the fluid. This allows to arrange the fluid flow in several ways.

[0031] The first arrangement may include the first header- tank assembly 20 comprising an inlet configured to deliver the fluid thereto. The first header- tank assembly 20 may further comprise a first header 21 and a first cover 22 which are arranged together to form two fluidly separated channels for the fluid. The fluid fills completely the channel fluidly connected to the inlet and it is directed into the tubes 40. The tubes 40 are fluidly connected with a second header- tank assembly 30.

[0032] The second header- tank assembly 30 may comprise, inter alia, a second header 31 and a second cover 32 which are arranged together to form two fluidly connected channels for the fluid.

[0033] One of the possible architectures for the heat exchanger 1 may include an arrangement in which the header- tank assemblies 20, 30 along with the tubes 40 form two passes 10, 12 for the fluid.
In such arrangement, the first header- tank assembly 20 comprises both inlet and outlet, so it is configured to deliver and collect the fluid from the heat exchanger 1. The first header 21 and the first cover 22 may form continuous channels for the for the fluid. In other words, there may be no baffles located within the channels formed by the first header- tank assembly 20 so that the fluid is delivered along the main axis of elongation of the channels up to the end portion of the first header- tank assembly 20. Similarly, the second header 31 and the first cover 32 may form continuous channels for the for the fluid. This allows to form two passes 10, 12 for the fluid, wherein one channel of the first header- tank assembly 20 is fluidly connected with one channel of the second header-tank assembly 30 via one stack of tubes 40, and the other channel of the first header- tank assembly 20 is fluidly connected with the other channel of the second header-tank assembly 30 via the other stack of tubes 40. The U-

turn of the fluid is formed between the adjacent channels of the second header- tank assembly 30.

[0034] Alternatively, the header- tank assemblies 20, 30 may comprise at least one baffle configured to redirect flow of the fluid within the channel. This allows to arrange more than two passes 10, 12 within the heat exchanger 1. However, further paragraphs will refer mainly to the heat exchanger 1 comprising two passes 10, 12.

[0035] Fig. 2 shows a perspective view of the standalone first header- tank assembly 20 comprising two channels for the fluid. The first header- tank assembly 20 may comprise, inter alia, the cover 22 which may form one or more than one channels for the fluid. The first cover 22 may be in a form of one or more half-cylindrical portions, depending on the desired number of channels to be formed. Further, the first cover 22 may be a unitary element or several elements which are connected to each other in such way, to ensure a fluid- tight connection (e.g. by brazing).

[0036] As shown in Fig. 2 the first channel may be formed by one part of the first cover 22, wherein the first channel is responsible for delivering fluid to the tubes 40 which are fluidly connected with the first header 21. The second channel may be formed by other part of the first cover 22, wherein the second channel may be responsible for collecting the fluid from the tubes 40 which are fluidly connected with the second header 21. In such embodiment, an inlet 71 which is usually responsible for delivering the fluid from the loop to the heat exchanger 1 may be fluidly connected with the first channel, and an outlet 72 which is usually responsible for collecting the fluid from the heat exchanger 1 may be fluidly connected with the second channel of the first header- tank assembly 20. As further shown in Fig. 2, the inlet 71 and/or the outlet 72 may be fixed to the same baffle 60, however, other deployment of these sub-components is also envisaged, depending on the flow arrangement through the heat exchanger 1.

[0037] The first cover 22 may be formed by two essentially U-shaped which may comprise projections located on at least one terminal portion forming U-shape. The first cover 22 may further comprises a plurality of U-shaped ribs arcading in series from one end of the cover to the other, in order to increase robustness of the first cover 22. Accordingly, the same features may be applied on the second cover 32.

[0038] The headers 21, 31 may comprise cavities adapted to partially receive the respective covers 22, 32, wherein the cavities are arranged alternately and in two parallel series between the two rows of slots 41. The projections located on the thanks 22, 32 may be configured to be introduced into corresponding cavities of the headers 21, 31.

[0039] The headers 21, 31 may further comprise at least one sidewall extending along the longer side thereof. Preferably, the headers 21, 31 may comprise a pair of sidewalls extending along both sides of the headers 21, 31. Two sidewalls are substantially parallel with respect to each other and perpendicular to the portion of the headers 21, 31 which comprises the slots 41. The sidewalls are formed by bending or stamping of the excessive material located on the longer sides of the headers 21, 31 and they are configured to receive the covers 22, 32 in order to form a fluid tight connection between an inner face of the sidewall and an outer face of the covers 22, 32.

[0040] Fig. 3 shows a perspective view of the second header- tank assembly 30 and Fig. 4 shows cross-sectional view thereof in the vicinity of a bypass section 100.

[0041] According to the embodiment of the invention, the first pass 10 and a second pass 12 for the first fluid are formed by plurality of tubes 40 arranged in two parallel stacks between the first header- tank assembly 20 and the second header- tank assembly 30.

[0042] The second cover 32 may be configured to control the flow of the fist fluid between the first pass 10 and the second pass 12 by the means of a bypass section 100. The bypass section 100 may be understood as any means which allow the fluidal communication between the channels of the second cover 32. As shown in Fig. 4, the bypass section 100 may be formed by a plurality of communication channels communication channels located subsequently along the second cover portion 32. It is to be noted that the cross section range of the bypass is between X_{min}=0.25 x Y and X_{max} 0.50 x Y. The "X" should be regarded as the bypass cross section dedicated to two tubes 40 with cross section Y which equals to sum of doubled tube hydraulic cross section. In other words, term "hydraulic cross section" is the cross-sectional area of the flow.
In one of the embodiments, the cross- section of the tube channel is equal 0,74mm.

[0043] The formula presented in previous paragraphs allows to provide homogenous refrigerant distribution in the heat exchanger 1. If the bypass cross- section is too low, the pressure within the heat exchanger may significantly increase so that the cooling power of the heat exchanger is decreased. If the bypass cross- section is too wide, the zones in which the non-homogenous fluid distribution may occur.

[0044] As shown in Fig. 4, the communication channels communication channels forming the bypasses of the bypass section 100 may be in a form of a rounded rectangle i.e. rectangle in which the corners do not form right angle but they are semi-circular. Other forms of openings are also envisaged as long as X_{min}=0.25 x Y and X_{max} 0.50 x Y. For example, the communication channels communication channels comprise essentially cuboidal cross-section.

[0045] Alternatively, the communication channels communication channels may comprise essentially rectangular cross section.

[0046] Alternatively, the communication channels may comprise smooth corners.

[0047] Alternatively, the communication channels may comprise essentially circular cross-section.

[0048] Alternatively, the communication channels may comprise essentially oblong cross-section.

[0049] The communication channels forming the bypasses of the bypass section 100 comprises communication channels of different cross-sections i.e. one bypass section 100 is different than the other.

[0050] Preferably, the communication channels forming the bypasses of the bypass section 100 comprises communication channels of different cross-sections i.e. one bypass section 100 are the same as the other.

[0051] Other variations to the disclosed embodiments can be understood and effected by those skilled in the art in practicing the claimed invention, from a study of drawings, the disclosure, and the appended claims. The mere fact that certain measures are recited in mutually different dependent claims does not indicate that a combination of these measures cannot be used to the advantage.

Claims

1. A heat exchanger (1) for heat exchange between a first fluid and a second fluid, comprising:

    - a first header- tank assembly (20) comprising:

        - an inlet for the first fluid
        - an outlet for the first fluid
        - a first header (21),
        - a first cover (22),

    wherein the first header- tank assembly (20) forms two fluidly separated channels for the first fluid
    - a second header- tank assembly (30) comprising:

        - a second header (31),
        - a second cover (32),

    wherein the second header- tank assembly (30) forms two fluidly connected channels,
    - plurality of tubes (40) forming a first pass (10) and a second pass (12) for the first fluid, wherein the tubes (40) are arranged in two parallel stacks between the first header- tank assembly (20) and the second header- tank assembly (30),

    characterised in that
    the second cover (32) is configured to control the flow of the fist fluid between the first pass (10) and the second pass (12) by the means of a bypass section (100), the bypass section (100) being formed by a plurality ofcommunication channels, wherein the cross section range of the communication channels is between X_{min}=0.25 x Y and X_{max} 0.50 x Y, wherein X is the communication channel cross section dedicated to two tubes located within the same pass (10, 12) with cross section Y which equals to sum of doubled tube hydraulic cross section.

2. The heat exchanger (1) according to claim 1, wherein the cross section of the tubes (40) of the first pass (10) is equal to the cross section of tubes (40) forming the second pass (12).

3. The heat exchanger (1) according to claim 1, wherein the cross section of the tubes (40) of the first pass (10) is different than the cross section of tubes forming the second pass (12).

4. The heat exchanger according to claim 1, wherein the communication channelscommunication channels comprise essentially cuboidal cross-section.

5. The heat exchanger according to claim 1, wherein the communication channelscommunication channels comprise essentially rectangular cross section.

6. The heat exchanger according to any of the preceding claims, wherein the communication channels-communication channels comprise smooth corners.

7. The heat exchanger according to claim 1, wherein the communication channelscommunication channels comprise essentially circular cross- section.

8. The heat exchanger according to claim 1, wherein the communication channelscommunication channels comprise essentially oblong cross- section.

9. The heat exchanger according to claims 4-7, wherein the communication channels comprise communication channels of different cross-section.

10. The heat exchanger according to claims 4-7, wherein the communication channels comprise communication channels of the same cross- section.

11. The header- tank assembly (30) according to any of the preceding claims, wherein the assembly (40) comprises two baffles (60) forming respectively two end walls of the fluid channel located respectively at two opposite ends of the header (40).

12. The header- tank assembly (30) according to any of the preceding claims, wherein at least one baffle (60) has an opening to form an inlet (71) or an outlet (72) for the channel.

13. The header- tank assembly (30) according to claims 1-10, wherein one baffle (60) is configured to close an end of the fluid channel.

14. The header- tank assembly (30) according to any of

the preceding claims, wherein the header (40) comprises at least one side wall protruding in perpendicular with respect to the general plane of the header (40), the side wall further comprising notches configured to immobilize at least one side of the cover (50).

15. The header- tank assembly (30) according to any of the preceding claims, wherein the header (40) comprises at least one distribution device located between the baffles (60).

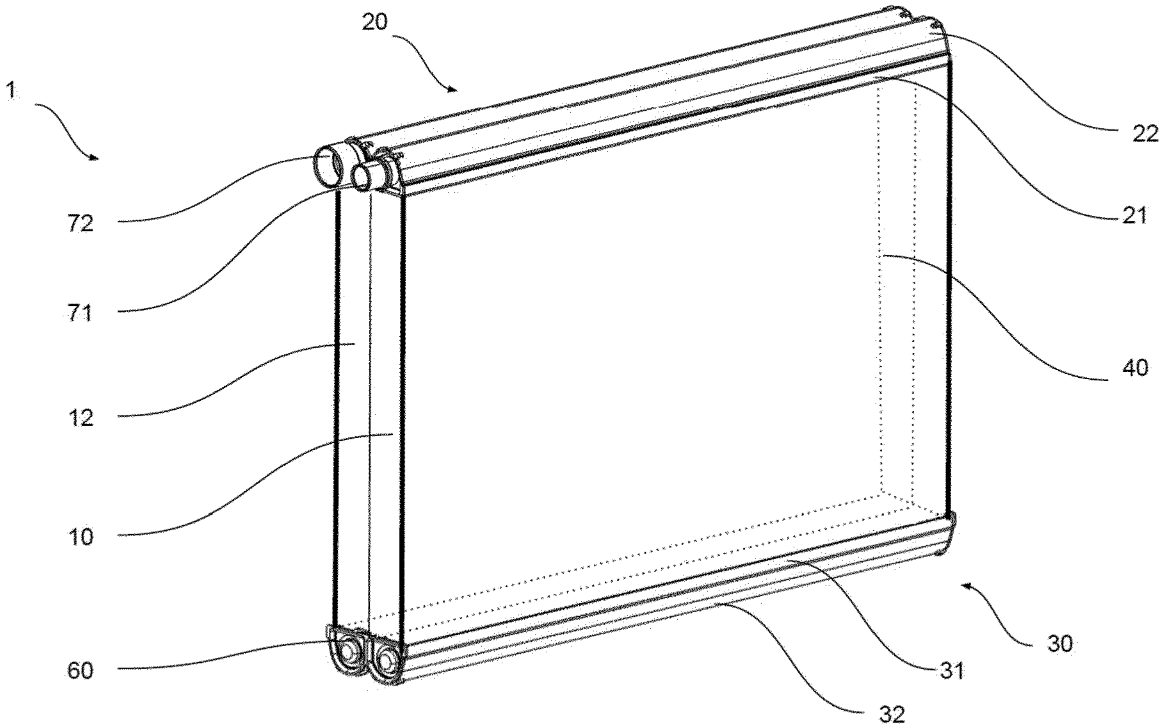

Fig. 1

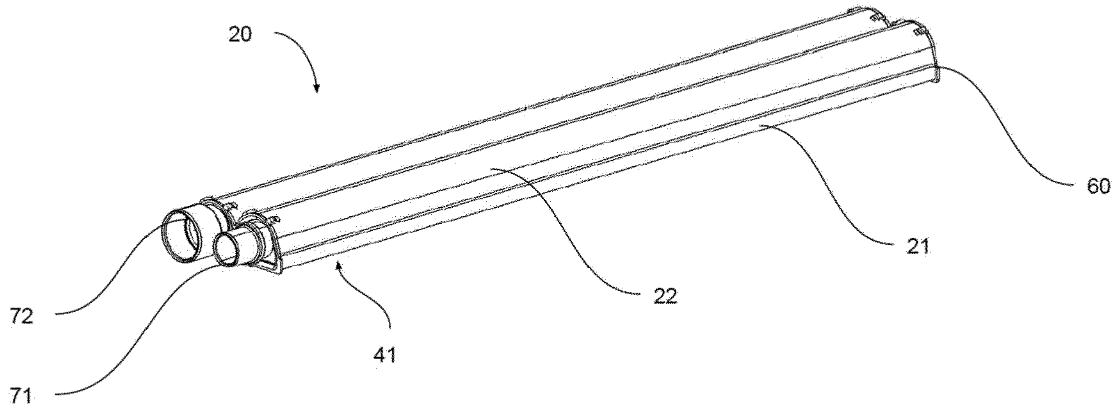

Fig. 2

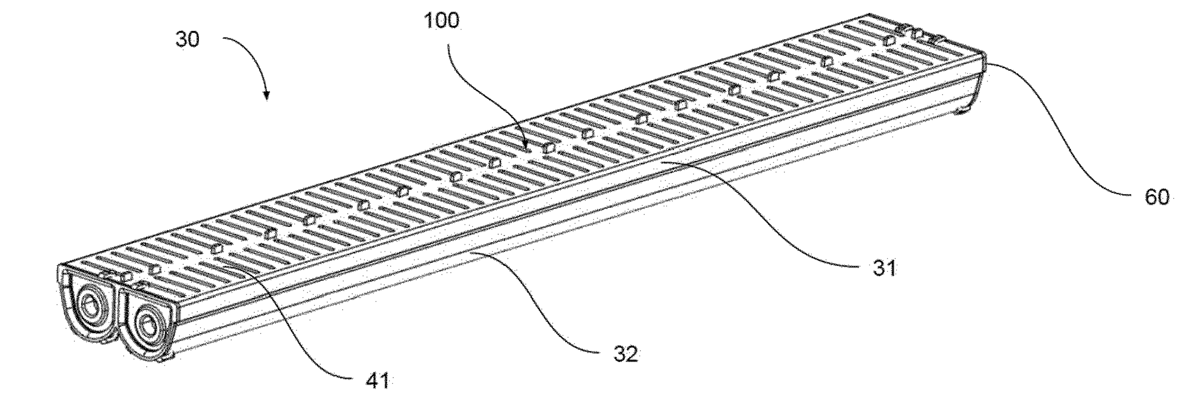

Fig. 3

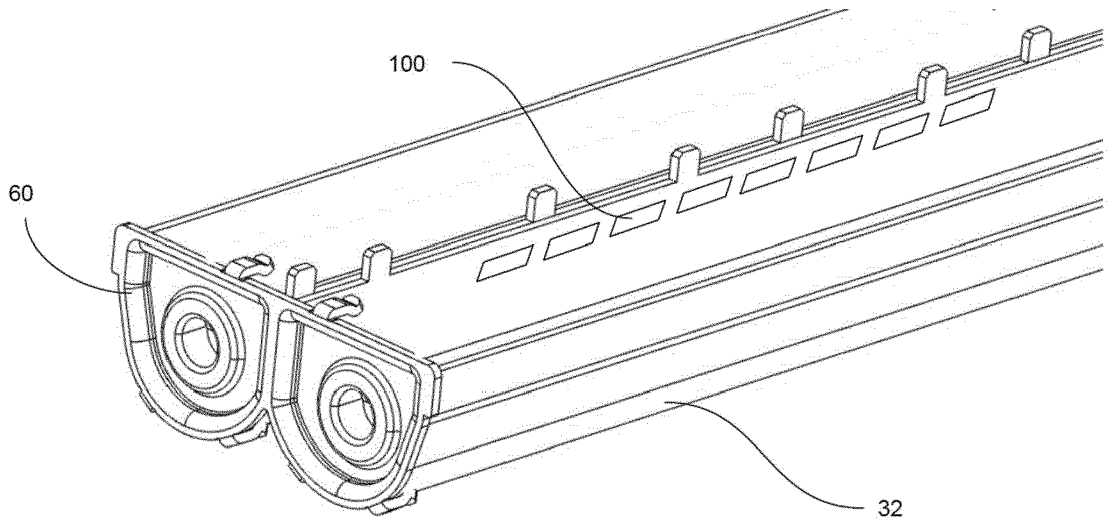

Fig. 4

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EUROPEAN SEARCH REPORT

Application Number
EP 21 15 9043

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The present search report has been drawn up for all claims

1

Place of search	Date of completion of the search	Examiner
Munich	11 August 2021	Vassoille, Bruno

CATEGORY OF CITED DOCUMENTS

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ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO.

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