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(54) Heat exchanger provided with a fitting block

(57) Heat exchanger (10) comprising a collector box (16) and at least one longitudinal row (R1, R2) of heat exchange tube portions (12) through which a first fluid can flow and around which a second fluid can flow, wherein the collector box (16) is made up of stacked plates (20, 22, 24) including an upper plate (20) and a lower plate (24), said plates (20, 22, 24) comprising slots (30, 32, 34) and openings (36, 38) for distribution of the first fluid in all the tube portions (12), wherein at least one of the stacked plates (20, 24) is provided at its side edges with at least two parallel lateral flanges (40, 42) being crimped over the other plate (20, 24) for clinching the plates (20, 22, 24) together, wherein at least one fitting block (62) is connected to the collector box (16) for plumbing the heat exchanger (10) in at least one external pipe (70, 72), characterized in that said fitting block (62) is clinched between said lateral flanges (40, 42).

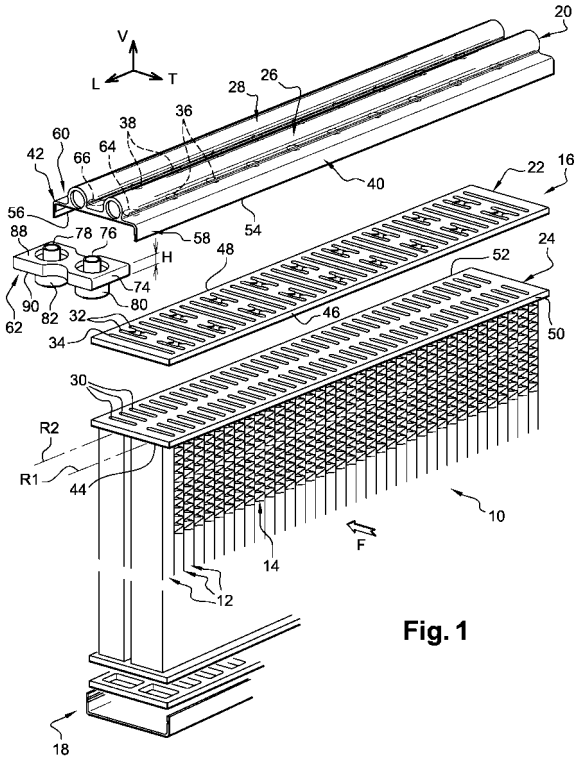

Fig. 1

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Description

TECHNICAL FIELD

[0001] The present invention relates generally to heat exchangers for motor vehicles.

BACKGROUND OF THE INVENTION

[0002] The present invention relates more particularly to heat exchangers which are suitable for use a gas coolers or evaporators of supercritical refrigeration cycles wherein a supercritical refrigerant, such as CO2 (carbon dioxide) refrigerant, is used.

[0003] Typically, the heat exchanger comprises a collector box, or header tank, and two longitudinal rows of heat exchange tube portions through which a first fluid such as a refrigerant fluid can flow and around which a second fluid such as air can flow, said tube portions being connected to the bottom face of the collector box. The collector box is made up of stacked plates including an upper plate and a lower plate, said plates comprising slots and openings for distribution of the first fluid in all the tube portions. At least one of the stacked plates comprises two parallel lateral flanges extending longitudinally and being crimped over the other plates for clinching the plates together. At least one fitting block is connected to the collector box for plumbing the heat exchanger in at least one external pipe.

[0004] Such a heat exchanger is disclosed for example in document WO 2005/100900 where the fitting block comprises a refrigerant inflow channel and a refrigerant outflow channel communicating respectively with an inlet and an outlet provided in one end portion of the collector box. The fitting block looks like a box which is fitted onto the end portion of the collector box and then it is brazed to the collector box. The fitting block is aimed to be connected to external pipes such as bended pipes for connection to an air conditioning fluid circuit.

[0005] Such a heat exchanger needs a fitting block of large dimensions to be able to fit onto the collector box which can be a problem when it is required to realize a compact side plumbing connection on the heat exchanger since the available space in the automotive body or the like object is very limited. Moreover, it requires a collector box with specific end portion for the mounting of the fitting block, which makes the design of the collector box more complex. Also, sealing is not easy to implement in such an arrangement.

SUMMARY OF THE INVENTION

[0006] Therefore, it is an object of the present invention to provide a heat exchanger wherein mounting and connection of the fitting block to the collector box can be made more easily in a more efficient manner.

[0007] In order to achieve this object and other objects, it is provided, in accordance with the present invention, a heat exchanger comprising a collector box and at least one longitudinal row of heat exchange tube portions through which a first fluid such as a refrigerant fluid can flow and around which a second fluid such as air can flow, said tube portions being connected to the bottom face of the collector box, wherein the collector box is made up of stacked plates including an upper plate and a lower plate, said plates comprising slots and openings for distribution of the first fluid in all the tube portions, wherein at least one of the stacked plates is provided at its side edges with at least two parallel lateral flanges extending at least partially along the longitudinal edges of the plate and being crimped over the other plate for clinching the plates together, wherein at least one fitting block is connected to the collector box for plumbing the heat exchanger in at least one external pipe, **characterized in that** said fitting block is clinched between said lateral flanges.

[0008] Thanks to the invention, the overall size of the heat exchanger is limited which makes the implementation of the heat exchanger in a vehicle easier. Moreover, the fitting block is smaller and easier to be brazed. The clinching of the fitting block between lateral flanges allows maintaining easily the fitting block before brazing which guarantee a better fitting and a better brazing.

[0009] It has to be noted that the invention allows maintaining the fitting block onto the collector box without requiring further parts or a supplementary step in the assembly process.

[0010] Preferably, each lateral flange extends longitudinally beyond the last tube portion of the longitudinal row, forming cantilevered longitudinal end portions, and said fitting block is clinched between the end portions. The end portions may be made from the upper plate or from the lower plate.

[0011] Advantageously, the collector box comprises at least one manifold member extending on the upper plate. The upper plate extends longitudinally beyond the last tube portion of the longitudinal row. Said fitting block is connected to the manifold member through an opening made in the upper plate. Said manifold is made of one piece with the upper plate. Said fitting block comprises an inlet channel communicating with an inlet opening of the collector box and an outlet channel communicating with an outlet opening of the collector box.

[0012] According to another aspect of the present invention, said inlet and outlet channels extend substantially along a parallel direction to the tube portions, which allows the connection of external pipes to the collector box to be implemented more easily and which minimizes the space required for this connection.

[0013] Preferably, said fitting block is brazed with the stacked plates.

[0014] The present invention provides also a method of manufacturing for a collector box of a heat exchanger comprising the steps of:

- providing an upper plate and a lower plate, one of

the plates including two longitudinally parallel lateral flanges,
- stacking the plates,
- providing a fitting block of same transversal width than the stack of plates,
- arranging the fitting block between the lateral flanges,
- clinching the stack of plates together with the fitting block by crimping the lateral flanges over the stack of plates,
- brazing the stack of plates together with the fitting block.

[0015] Advantageously, the method further comprises the step of extruding the upper plate with the lateral flanges and with at least one manifold member to be connected to the fitting block, said manifold member extending above the upper plate, and the step of inserting vertically the internal port of the fitting block in the corresponding opening of the upper plate.

BRIEF DESCRIPTION OF THE DRAWINGS

[0016] The present invention is now described by way of example with reference to the accompanying drawings in which:

- figure 1 is an exploded perspective view showing an evaporator according to a first embodiment of the invention;
- figure 2 is a perspective view showing the evaporator of figure 1 assembled and connected to external pipes;
- figure 3a, 3b, and 3c are a perspective view showing from underneath the assembly step for the mounting of a fitting block onto the evaporator of figure 1;
- figure 4 is an exploded perspective view similar to the one of figure 1 showing a second embodiment of the invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0017] Figures 1 and 2 are perspective views showing the overall construction of a heat exchanger 10 according to a first embodiment of the invention for use as an evaporator 10 for a motor vehicle air-conditioning system which is operated with CO_2 as refrigerant. This evaporator 10 is designed as a two rows flat-tube evaporator and has a multiplicity of heat exchange tube portions constituted of flat tubes 12 arranged along two longitudinal rows R1, R2, a front row R1 on the front side of the evaporator 10 and a rear row R2 on the rear side of the evaporator 10. These flat tubes 12 can be designed as extruded multi-channel flat tubes, which have a multiplicity of flow passages. All the flat tubes 12 have the same length along a vertical axis V and the same depth D along a transverse axis T.

[0018] In the following description, for the purpose of better understanding, we will use an orientation along the vertical axis V, the longitudinal axis L, and the transverse axis T, as can be seen on figure 1.

[0019] Between the individual flat tubes 12 there are corrugated fins 14, which are acted on by ambient air in the direction of the arrow F, i.e. along a transverse axis.

[0020] The tubes 12 are fitted between an upper end member constituted of a collector box 16, or header tank, and a lower end member constituted of a diverter box 18.

[0021] According to an alternative embodiment, the diverter box 18 could be omitted by providing the heat exchanger 10 with U-tubes instead of pairs of straight tubes 12.

[0022] The collector box 16 comprises a stack of individual plates 20, 22, 24 bearing against one another and including successively an upper plate 20 called cover plate 20 at the top, an intermediate distribution plate 22, and a lower plate 24 called header plate 24 at the bottom. The collector box 16 comprises also an inlet manifold 26 and an outlet manifold 28 which extend along a longitudinal axis, in parallel to each other. According to the preferred embodiment, the manifolds 26, 28 are made tubular and are made of one piece with the cover plate 20. Preferably, the cover plate 20 and the manifolds 26, 28 are extruded.

[0023] In the drawings, the header plate 24 comprises two rows of mounting slots 30, each flat tube upper end being inserted into the header plate 24 through a mounting slot 30.

[0024] The distribution plate 22, or diverter plate, is arranged above the header plate 24 and has distribution slots 32 and diverter passages 34 for allowing the refrigerant to be distributed and to circulate in every flat tube 12.

[0025] The cover plate 20 includes, within the inlet manifold 26, a longitudinal row of refrigerant inlet apertures 36 and, within the outlet manifold 28, a longitudinal row of refrigerant outlet apertures 38 communicating respectively with the bottom part of the inlet and outlet manifolds 26, 28. These inlet 36 and outlet 38 apertures are provided for connecting the inlet 26 and outlet 28 manifolds 30 to corresponding distribution slots 32 of the distribution plate 22 underneath.

[0026] The cover plate 22 is integrally provided at each of its front and rear side edges with lateral flanges 40, 42 forming cover walls. Said lateral flanges 40, 42 are projecting downward to the bottom surface 44 of the header plate 24, covering the boundary between the header plate 24 and the distribution plate 22 over the entire length thereof, and are brazed to the front or rear side faces 46, 48, 50, 52 of the plates 22, 24. The projecting end 54, 56 of each flange 40, 42 is folded towards the opposite side of the cover plate 20, is engaged with the bottom surface 44 of the header plate 24, and is brazed to the header plate 24. Said flanges 40, 42 extend along the side faces 46, 48, 50, 52 of the distribution plate 22 and header plate 24, preferably along the entire length of the collector box 16.

[0027] According to an aspect of the present invention, said flanges 40, 42 extend beyond the last tube 12 of the rows R1, R2 forming cantilevered longitudinal end portions 58, 60. The entire cover plate 20 with the two manifolds 26, 28 extends beyond the last tube 12 of the rows R1, R2 so that a fitting block 62 could be connected to the manifolds 26, 28 from underneath. For this purpose, the cover plate 20 is provided with an inlet 64 and an outlet 66 openings which open into its bottom surface 44.

[0028] It should be noted that the manifold longitudinal extremities are closed with appropriate means such as a disc 68 made of metal which could be brazed at these extremities.

[0029] The fitting block 62 is mounted onto the collector box 16 for use as a fluid connecting element between respectively two external pipes 70, 72, shown on figure 2, and said manifolds 26, 28.

[0030] According to another aspect of the present invention, the fitting block 62 is clinched between said lateral flanges 40, 42.

[0031] Preferably, said fitting block 62 comprises a main block 74 substantially parallelepiped and ports 76, 78, 80, 82 forming an inlet 84 and an outlet 86 channels extending vertically through the main block 74. Said inlet 84 and outlet 86 channels communicate respectively with the inlet 64 and an outlet 66 openings for connection to the corresponding manifolds 26, 28. Each channel 84, 86 includes an internal port 76, 78 which is inserted in the corresponding inlet/outlet opening 64, 66 of the cover plate 20, and an external port 80, 82 for connection to the corresponding external pipe 70, 72. Said ports 76, 78, 80, 82 project vertically, respectively upward and downward, from the upper surface 88 and the bottom surface 90 of the main block 74.

[0032] Advantageously, said fitting block 62 has a transversal width W substantially similar to the transversal width of the two lower plates 22, 24, namely the distribution plate 22 and the header plate 24, and a vertical thickness H substantially similar to the vertical thickness of the two lower plates 22, 24 stacked together. Thanks to these advantageous features, the fitting block 62 can be clinched between the lateral flanges 40, 42 of the cover plate 20 together with the distribution plate 22 and the header plate 24.

[0033] The above-described individual parts of the evaporator 10 are assembled in the following way, according to the method of manufacturing of the invention, with reference to figures 3a to 3c.

[0034] The header plate 24 is fitted onto the flat-tube ends. Then, the distribution plate 22 and the cover plate 20 are stacked on top of the header plate 8. The fitting block 62 is moved upwardly towards the bottom surface 92 of the cover plate 20, as can be seen on figure 3a, until the internal ports 76, 78 of the fitting block 62 are inserted in the corresponding inlet/outlet opening 64, 66 of the cover plate 20.

[0035] At this stage, which is shown on figure 3b, the projecting ends 54, 56 of the lateral flanges 40, 42 are still projecting vertically downward. The following step of the assembly process is to fold the two projecting ends 54, 56 towards each other until they engage with the bottom surface 44 of the header plate 24 and with the bottom surface 90 of the fitting block 62. Thus, the plates 20, 22, 24 are clinched together with the fitting block 62 by crimping the lateral flanges 40, 42 over the plates 20, 22, 24.

[0036] At this stage, which is shown on figure 3c, the fitting block 62 is maintained onto the collector box 16 with the stack of plates 20, 22, 24, and the fitting block 62 is connected to the manifolds 26, 28.

[0037] After the evaporator 10 has therefore been assembled, it is soldered, preferably brazed, to form a fixed block in a soldering furnace. During the soldering process, the plates 20, 22, 24 and the fitting block 62 are held in position with respect to one another the positive clamping action implemented by the lateral flanges 40, 42. However, it is also possible firstly to assemble the collector box 16, comprising the cover plate 20, the distribution plate 22, and the header plate 24, with the fitting block 62, and then to connect the collector box to flat tubes 12.

[0038] At one stage, the external pipes 70, 72 are inserted into the external ports 80, 82 of the fitting block 62, as can be seen on figure 2. They can be brazed to the fitting block 62.

[0039] The different plates constituting the diverter box 18 at the bottom of the evaporator are assembled in a similar way.

[0040] As an alternative embodiment, the distribution plate 22 could be integrated into the header plate 24 to save one plate.

[0041] According to a second embodiment of the invention, which is shown on figure 4, the lateral flanges 40, 42 are made integrally from the header plate 24 instead of the cover plate 20. Therefore, instead of projecting downwardly toward the bottom surface 44 of the header plate 24, the lateral flanges 40, 42 project upwardly toward the upper plane surface 94 of the cover plate 20 and the projecting ends 54, 56 of the lateral flanges 40, 42 are folded towards each other so that they engage with said upper plane surface 94.

[0042] Another difference, compared to the first embodiment, is that the header plate 24 comprises a cantilevered portion 96, corresponding to the cantilevered end portions 58, 60 of said flanges 40, 42, provided with a cut-out portion 98 for allowing the mounting of the fitting block 62 from underneath. The cover plate 20 still extends beyond the last tubes 12 of the rows R1, R2 in order to allow connection of the fitting block 62 in the inlet/outlet openings 64, 66.

[0043] The present invention has been described in part on the basis of the example of an evaporator 10. However, it should be noted that the heat exchanger 10 according to the invention is also suitable for other uses.

Claims

1. Heat exchanger (10), in particular for a motor vehicle, comprising a collector box (16) and at least one longitudinal row (R1, R2) of heat exchange tube portions (12) through which a first fluid such as a refrigerant fluid can flow and around which a second fluid such as air can flow, said tube portions (12) being connected to the bottom face of the collector box (16), wherein the collector box (16) is made up of stacked plates (20, 22, 24) including an upper plate (20) and a lower plate (24), said plates (20, 22, 24) comprising slots (30, 32, 34) and openings (36, 38) for distribution of the first fluid in all the tube portions (12), wherein at least one of the stacked plates (20, 24) is provided at its side edges with at least two parallel lateral flanges (40, 42) extending at least partially along the longitudinal edges of the plate (20, 24) and being crimped over the other plate (20, 24) for clinching the plates (20, 22, 24) together, wherein at least one fitting block (62) is connected to the collector box (16) for plumbing the heat exchanger (10) in at least one external pipe (70, 72),
characterized in that said fitting block (62) is clinched between said lateral flanges (40, 42).

2. Heat exchanger (10) according to claim 1, **characterized in that** each lateral flange (40, 42) extends longitudinally beyond the last tube portion (12) of the longitudinal row (R1, R2), forming cantilevered longitudinal end portions (58, 60), and **in that** said fitting block (62) is clinched between the end portions (58, 60).

3. Heat exchanger (10) according to claim 2, **characterized in that** the end portions (58, 60) are made from the upper plate (20).

4. Heat exchanger (10) according to claim 2, **characterized in that** the end portions (58, 60) are made from the lower plate (24).

5. Heat exchanger (10) according to anyone of claims 2 to 4, **characterized in that** the collector box (16) comprise at least one manifold member (26, 28) extending on the upper plate (20), **in that** the upper plate (20) extends longitudinally beyond the last tube portion (12) of the longitudinal row (R1, R2), and **in that** said fitting block (62) is connected to the manifold member (26, 28) through an opening (64, 66) made in the upper plate (24).

6. Heat exchanger (10) according to claim 5, **characterized in that** said manifold member (26, 28) is made of one piece with the upper plate (20).

7. Heat exchanger (10) according to anyone of the preceding claims, **characterized in that** said fitting block (62) comprises an inlet channel (84) communicating with an inlet opening (64) of the collector box (16) and an outlet channel (86) communicating with an outlet opening (66) of the collector box (16).

8. Heat exchanger (10) according to claim 7, **characterized in that** said inlet and outlet channels (84, 86) extend substantially along a parallel direction to the tube portions (12).

9. Heat exchanger (10) according to anyone of the preceding claims, **characterized in that** said fitting block (62) is brazed with the stacked plates (20, 22,24).

10. Method of manufacturing for a collector box (16) of a heat exchanger (10) comprising the steps of:

    - providing an upper plate (20) and a lower plate (24), one of the plates (20, 24) including two longitudinally parallel lateral flanges (40, 42),
    - stacking the plates (20, 22, 24),
    - providing a fitting block (62) of same transversal width than the stack of plates (20, 22, 24),
    - arranging the fitting block (62) between the lateral flanges (40, 42),
    - clinching the stack of plates (20, 22, 24) together with the fitting block (62) by crimping the lateral flanges (40, 42) over the stack of plates (20, 22, 24),
    - brazing the stack of plates (20, 22, 24) together with the fitting block (62).

11. Method according to claim 10 further comprising the step of extruding the upper plate (20) with the lateral flanges (40, 42) and with at least one manifold member (26, 28) to be connected to the fitting block (62), said manifold member (26, 28) extending above the upper plate (20).

12. Method according to claim 10, wherein the fitting block (62) is provided with at least one internal port (76, 78) to be fitted in an opening (64, 66) pierced in the bottom surface (92) of the upper plate (20) for the purpose of connecting the fitting block (62) to the manifold member (26, 28), further comprising the step of inserting vertically said internal port (76, 78) in said opening (64, 66).

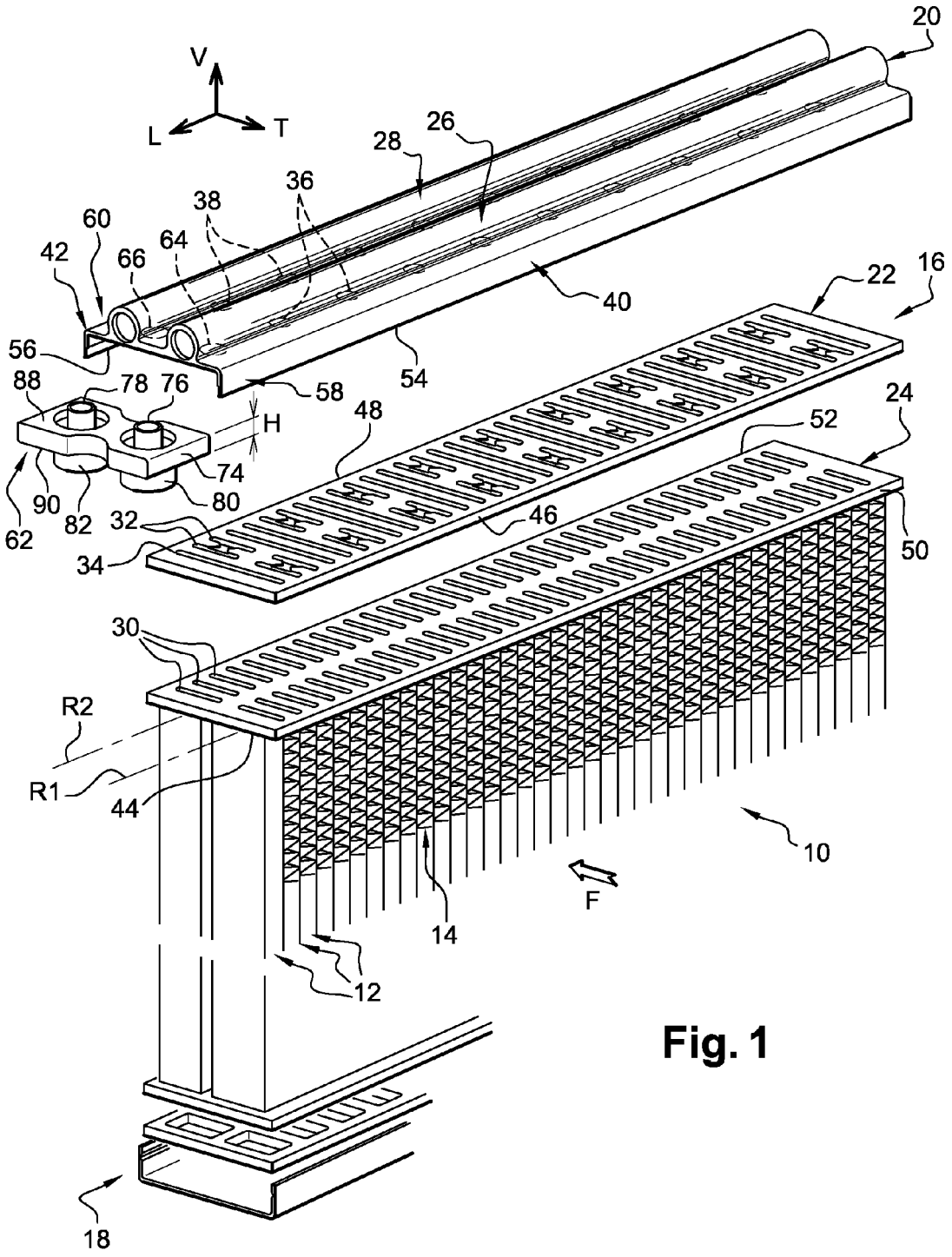
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Fig. 1

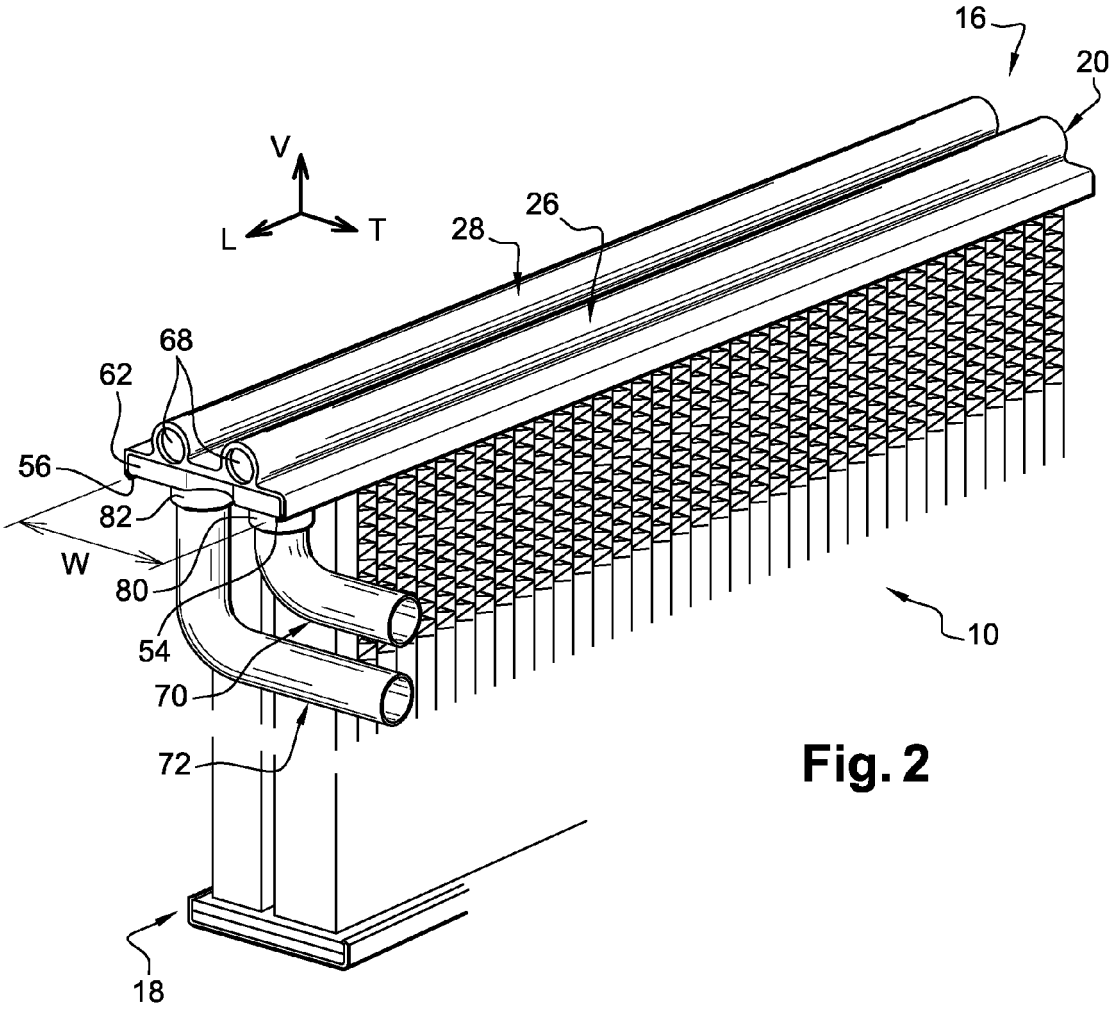
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Fig. 2

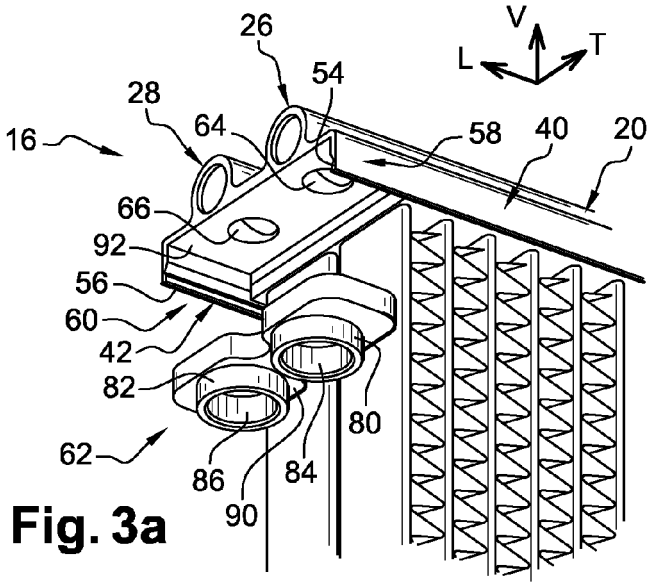
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Fig. 3a

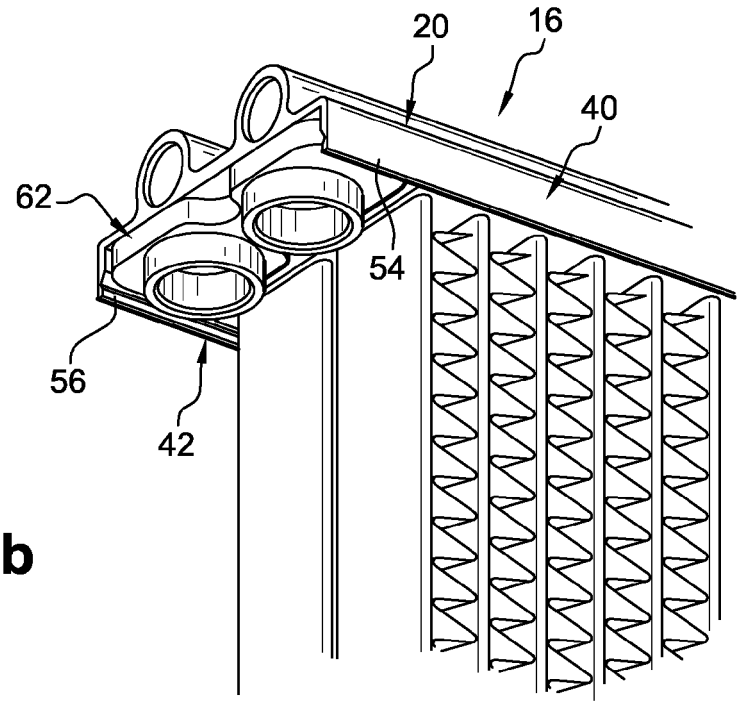

Fig. 3b

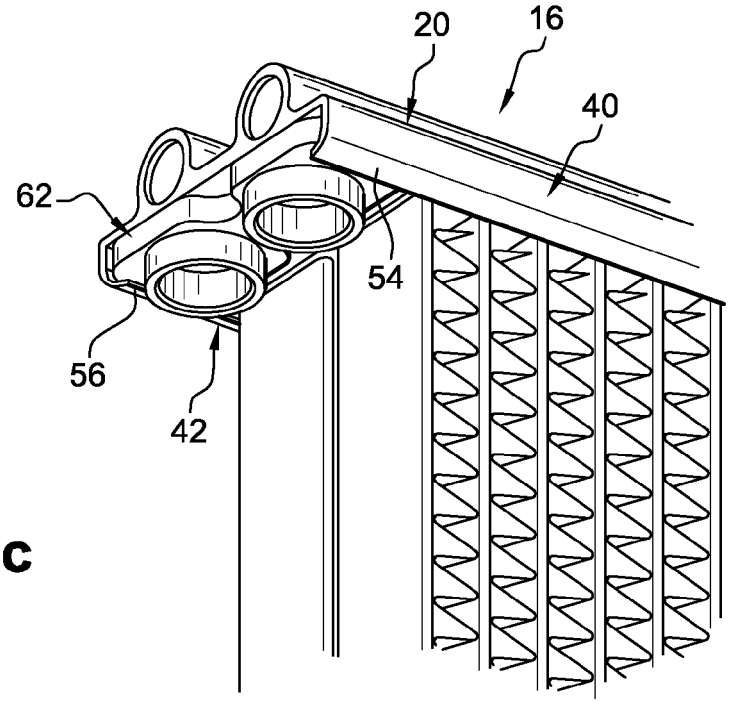

Fig. 3c

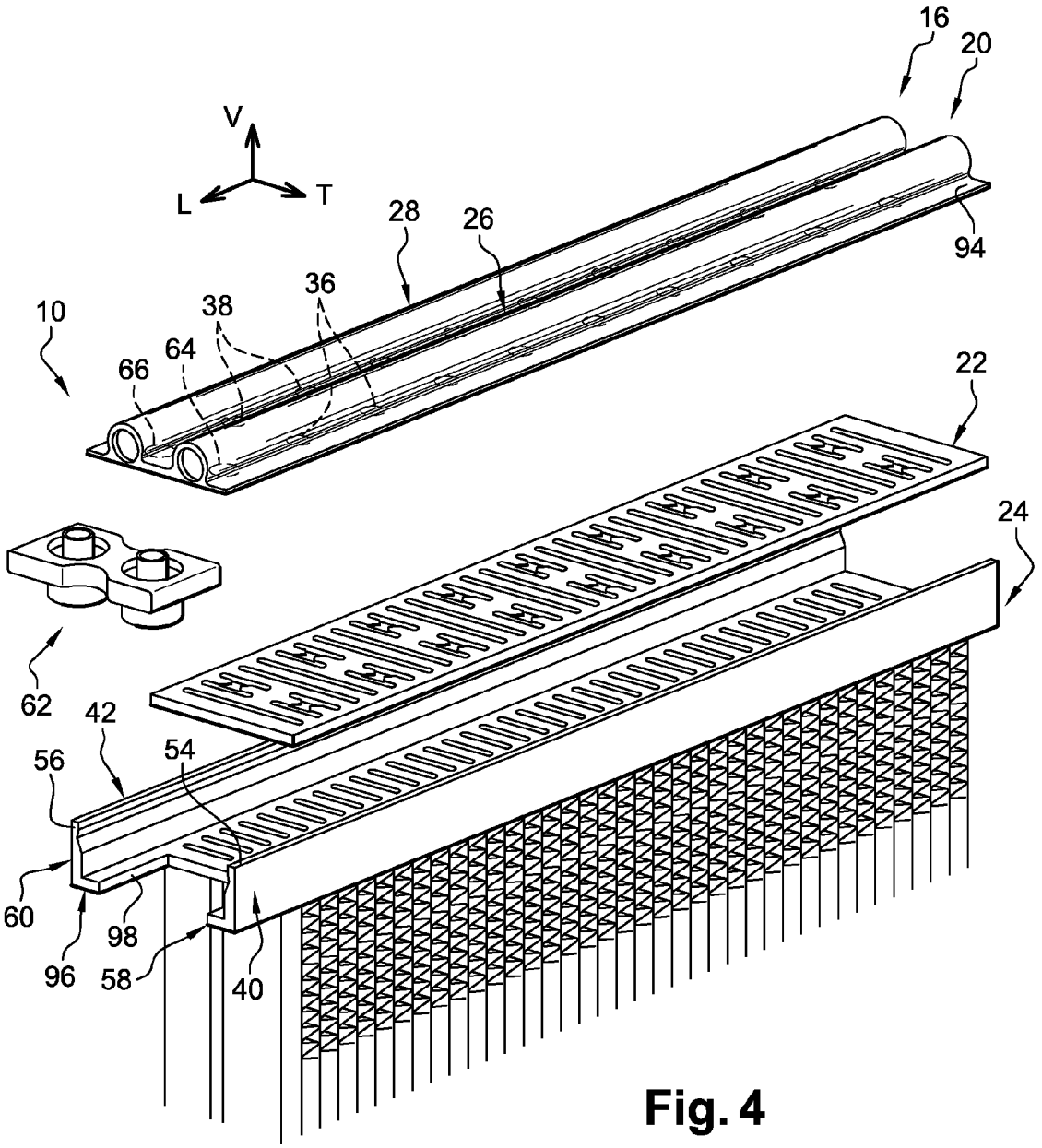

Fig. 4

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Application Number
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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
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CATEGORY OF CITED DOCUMENTS

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