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(54) **HEAT EXCHANGER**

(57) A heat exchanger (100) comprises a first manifold (102), a second manifold (104), and a plurality of tubes (106) extending between the first and second manifolds (102, 104). The first manifold (102) comprises a tank member (108) comprising a first and second channel (110A, 110B), and a header plate (112) comprising a first set of slots (114A) in conjunction with the first channel (110A) defining an inlet manifold (122), and a second set of slots (114B) in conjunction with the second channel (110B) defining an outlet manifold (124). The first manifold (102) extends beyond an outline of the tubes (106) and comprises at least two aperture (116A, 116B) in fluid communication with the inlet and outlet manifolds (122, 124), respectively. A first and second conduits (118, 120) are directly fixed to the first and second apertures (116A, 116B), respectively, for introduction of heat exchange fluid into the heat exchanger (100).

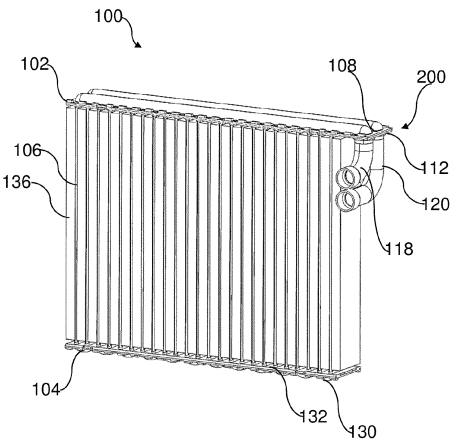


FIG. 3

## Description

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

**[0002]** Generally, a vehicle heat exchanger, such as for example, intercondenser is intended to be traversed by a fluid under high pressure, particularly, a refrigerant fluid, for example, R1234yf refrigerant. The heat exchanger includes header-tank assemblies configuring a first manifold and a second manifold disposed on opposite sides of a heat exchanger core defined by tubular elements separated by fins. The tubular elements configure fluid communication between the first manifold and the second manifold. Separate connection conduits connected to the first manifold and the second manifold respectively supply heat exchange fluid to and collect heat exchange fluid therefrom. However, such configuration of the heat exchanger with connection conduits faces packaging, connection, routing issues, as the connection conduits are disposed on both sides of the heat exchanger.

**[0003]** To address the above issues, prior art suggests a heat exchanger 1, for example, a condenser for a vehicle that includes a header tank assembly, a heat exchanger core 4 and a connecting arrangement 6 as illustrated in FIG. 1 and FIG. 2. The header tank assembly includes a tank cover 2 and a header 3. The tank cover 2 includes channels 2A, 2B formed thereon and longitudinally extending along length thereof. The header 3 includes portions with apertures formed thereon. The tank cover 2 and the header 3 are assembled together by crimping and brazing so that the channels 2A, 2B of the tank cover 2 aligned to and in conjunction with the corresponding header portions define a first manifold, particularly, an inlet manifold and a second manifold, particularly, an outlet manifold. The first manifold and the second manifold are disposed on same side of the heat exchanger core 4. The heat exchanger core 4 includes tubular elements 9 separated by fins 5. Further, the tubular elements 9 are divided into a first set of tubular elements and a second set of tubular elements that are disposed adjacent to each other. The first set of tubular elements and the second set of tubular element are interconnected and in fluid communication with each other via an intermediate manifold 2C to define a first pass and a second pass, respectively. A first heat exchange fluid flows from an inlet port 6A of the connecting arrangement 6 via an inlet conduit 7A to the inlet manifold. Further, the first heat exchange fluid flows through the first set of tubular elements extending from the inlet manifold toward the intermediate manifold 2C, and then reverses the direction of flow through the second set of tubes to reach the outlet manifold. A second heat exchange fluid, for example, air, flows around the tubular elements 9 and across the fins 5. The first heat exchange fluid and the second heat exchange fluid are in heat exchange configuration.

**[0004]** Also, the connecting arrangement 6 with the in-

let port 6A and the outlet port 6B is disposed proximal to the first and second manifolds. Accordingly, shorter lengths of inlet and outlet conduits 7A, 7B can be used for configuring fluid communication between the inlet port 6A and the first manifold, and between the second manifold and the outlet port 6B, respectively. The first manifold distributes the heat exchange fluid received thereby to the first set of tubular elements. The first heat exchange fluid undergoes heat exchange with the second heat exchange fluid, particularly, air around the first set of tubular elements as the first heat exchange fluid flows through the first set of tubular elements. The second set of tubular elements receive the first heat exchange fluid from the first set of tubular elements via the intermediate manifold 2C. The second heat exchange fluid further undergoes heat exchange as it passes through the second set of tubular elements. The second manifold collects the first heat exchange fluid from the second tubular elements, after the first heat exchange fluid had rejected heat to the air flowing across the tubular elements 9 as it passes through the tubular elements 9. The second manifold delivers the first heat exchange fluid collected thereby to the outlet conduit 7B for egress of the first heat exchange fluid from the heat exchanger 1 via the outlet port 6B.

**[0005]** The connecting arrangement 6 with the inlet port 6A and the outlet port 6B for ingress and egress of fluid with respect to the heat exchanger 1 is generally mounted on a vehicle frame proximal to the first and second manifolds. The inlet and outlet conduits 7A, 7B configures fluid communication between the inlet port 6A and the first manifold, and between the second manifold and the outlet port 6B, respectively. However, use of inlet and outlet conduits 7A, 7B involves routing of the connecting inlet and outlet conduits 7A, 7B in limited space, particularly, in areas proximal to the lateral side of the heat exchanger 1. Moreover, the inlet and outlet conduits 7A, 7B inherently cause an unutilized space "X" along lateral side of the heat exchanger 1. The inlet and outlet conduits 7A, 7B and connections thereof with manifolds on one side and with the connecting arrangement 6 on the other side cause packaging issues and pressure losses due to length of the inlet and outlet conduits 7A, 7B and bends in the inlet and outlet conduits 7A, 7B. In addition, the connecting arrangement 6 requires a number of mounting members 8A, 8B for sturdy mount of the inlet and outlet conduits 7A, 7B to the first manifold. Due to the excessive number of parts, this arrangement involves high material cost and manufacturing cost.

**[0006]** Accordingly, there is a need for a connecting arrangement for a heat exchanger that renders the heat exchanger compact and addresses the packaging issues, particularly, along lateral sides of the heat exchanger and longitudinal direction of the first and second manifolds. Further, there is a need for a connecting arrangement for a heat exchanger that reduces the number of parts, thereby reducing maintenance and enhancing reliability of the heat exchanger.

**[0007]** In the present description, some elements or

parameters may be indexed, such as a first element and a second element. In this case, unless stated otherwise, this indexation is only meant to differentiate and name elements which are similar but not identical. No idea of priority should be inferred from such indexation, as these terms may be switched without betraying the invention. Additionally, this indexation does not imply any order in mounting or use of the elements of the invention.

## SUMMARY OF THE INVENTION

**[0008]** The heat exchange comprises a first manifold, a second manifold, and a plurality of tubes. The first and second manifold comprises an axis of elongation. The first and second manifold extends substantially in parallel in a first direction. The first direction is parallel to the axis of elongation. The plurality of tubes extends substantially in perpendicular to the first direction between the first manifold and the second manifold. The tubes are arranged in two parallel stacks comprising a first stack of tubes and a second stack of tubes. The first manifold comprises a tank member comprising a first channel and a second channel, and a header plate configured to be fixed to the tank member. The tank member comprises a plurality of tabs extending from a peripheral portion of the tank member to provide a crimping connection with the header plate.

**[0009]** The header plate comprises a first set of slots configured to provide a fluidal communication between the first channel and the first stack of tubes. The header plate further comprises a second set of slots configured to provide a fluidal communication between the second channel and the second stack of tubes. The first set of slots align with the first channel and defines an inlet manifold, and the second set of slots align with the second channel and defines an outlet manifold.

**[0010]** The first manifold extends in the first direction beyond an outline of the plurality of tubes. The header plate comprises at least two apertures including a first aperture and a second aperture. The apertures are formed on the portion of the header plate that extends in the first direction beyond the outline of the plurality of tubes. The first aperture is in fluid communication with the inlet manifold and the second aperture is in fluid communication with the outlet manifold. In one embodiment, the apertures are coplanar to the slots of the header plate.

**[0011]** The heat exchanger further comprises a first conduit fixed directly to the first aperture and a second conduit fixed directly to the second aperture. The first aperture provides a fluidal communication between the first conduit and the inlet manifold. The second aperture provides a fluidal communication between the second conduit and the outlet manifold. The first and second apertures are coplanar with the slots of the header plate. In one embodiment, each of the conduit is a substantially L-shaped tubular member. In one embodiment, the first conduit and the second conduit comprise the same cross-sections. In another embodiment, the first conduit

and the second conduit comprise different cross-sections.

**[0012]** In one embodiment, each of the conduit comprises a first end portion, a second portion and a middle portion extending integrally between the first end portion and the second end portion. The first end portion and the middle portion of the conduit having a first inner diameter and the second end portion having a second inner diameter. In one embodiment, the first inner diameter is different from the second inner diameter. In another embodiment, the first inner diameter is smaller than the second inner diameter. In another embodiment, the first inner diameter is equal to the second inner diameter.

**[0013]** Further, the first end portion of the conduit having an outer diameter and the aperture having an inner diameter equal to the outer diameter of the first end portion of the conduit. Further, each of the aperture comprises a flange extending from a rim of the aperture. The first end portion of the conduit overlaps over the flange of the respective aperture.

## BRIEF DESCRIPTION OF DRAWINGS

**[0014]** Other characteristics, details and advantages of the invention can be inferred from the description of the invention hereunder. A more complete appreciation of the invention and many of the attendant advantages thereof will be readily obtained as the same becomes better understood by reference to the following detailed description when considered in connection with the accompanying figures, wherein:

FIG. 1 is a perspective view of a conventional heat exchanger;

FIG. 2 is a front view of the conventional heat exchanger of FIG. 1;

FIG. 3 exemplarily illustrates a perspective view of a heat exchanger, according to an embodiment of the present invention;

FIG. 4 exemplarily illustrates an exploded view of the heat exchanger of FIG. 3;

FIG. 5 exemplarily illustrates a perspective view of a tank member of a first manifold of the heat exchanger of FIG. 3;

FIG. 6 exemplarily illustrates a perspective view of a header plate of the first manifold of the heat exchanger of FIG. 3;

FIG. 7 exemplarily illustrates a perspective view of an inlet manifold and outlet manifold of the heat exchanger of FIG. 3;

FIG. 8 exemplarily illustrates an exploded view of a

connecting arrangement configured in the first manifold of the heat exchanger of FIG. 3, and

FIG. 9 exemplarily illustrates a cross-sectional view of the connecting arrangement configured in the first manifold of the heat exchanger of FIG. 3.

## DETAILED DESCRIPTION

**[0015]** The heat exchange comprises a first manifold, a second manifold, and a plurality of tubes. The first and second manifold extends substantially in parallel in a first direction. The plurality of tubes extends substantially in perpendicular to the first direction between the first manifold and the second manifold. The tubes are arranged in two parallel stacks comprising a first stack of tubes and a second stack of tubes. The first manifold comprises a tank member comprising a first channel and a second channel, and a header plate configured to be fixed to the tank member. The header plate comprises a first set of slots configured to provide a fluidal communication between the first channel and the first stack of tubes. The header plate further comprises a second set of slots configured to provide a fluidal communication between the second channel and the second stack of tubes. The first set of slots align with the first channel defining an inlet manifold, and the second set of slots align with the second channel defining an outlet manifold.

**[0016]** The first manifold extends in the first direction beyond an outline of the plurality of tubes. The header plate comprises at least two apertures including a first aperture and a second aperture. The apertures are formed on the portion of the header plate that extends in the first direction beyond the outline of the plurality of tubes. The apertures are coplanar to the slots of the header plate. The first aperture is in fluid communication with the inlet manifold and the second aperture is in fluid communication with the outlet manifold. The heat exchanger further comprises a first conduit fixed directly to the first aperture and a second conduit fixed directly to the second aperture for introduction of heat exchange fluid in the heat exchanger.

**[0017]** The provision of the apertures co-planar to the slots of the header plate and the conduits fixed to the apertures eliminates the space "X" formed in the conventional heat exchanger 1 of FIG. 1, and provides a compact heat exchanger. Further, the direct fixation of the conduits to the aperture without usage of additional components reduces the number of parts, thereby reducing maintenance and enhancing reliability of the heat exchanger.

**[0018]** Referring to FIG. 3 and FIG. 4, the heat exchanger 100 includes a first manifold 102, a plurality of tubes 106, a second manifold 104 and a connecting arrangement 200. The first manifold 102 may be an upper tank and the second manifold 104 may be a lower tank, and vice versa. The first manifold 102 includes an inlet manifold 122 and an outlet manifold 124 (shown in FIG.

7). The inlet manifold 122 and the outlet manifold 124 are disposed adjacent to each other and at the same side of the heat exchanger 100. Such configuration of the heat exchanger 100 with the inlet manifold 122 and the outlet manifold 124 disposed adjacent to each other and on the same side of the heat exchanger 100 provides certain advantages. For example, such configuration renders the heat exchanger 100 compact and addresses the packaging issues, connection issues and prevents clutter. Further, such configuration reduces the number of connection parts and hence reduces maintenance and improves reliability. The tubes 106 are also referred as heat exchange tubes 106 in this document.

**[0019]** Each of the manifold 102, 104 may comprise a tank member 108, 130 and a header plate 112, 132. The header plate 112, 132 may comprise a plurality of slots 114A, 114B, 134. The arrangement of plurality of slots 114A, 114B, 134 corresponds to the arrangement of the heat exchange tubes 106. The plurality of heat exchange tubes 106 may comprises a first end and an opposing second end. The first end of the heat exchange tubes 106 is received into corresponding slots 114A, 114B of header plate 112 of first manifold 102. The second end of the heat exchange tubes 106 is received into corresponding slots 134 of the header plate 132 of second manifold 104.

**[0020]** The plurality of tubes 106 includes a first stack of tubes 106A and a second stack of tubes 106B for facilitating flow of a first heat exchange fluid. The first stack of tubes 106A and the second stack of tubes 106B are arranged in at least two parallel stacks. The first stack of tubes 106A is fluidically connected to the second stack of tubes 106B through the second manifold 104 providing at least one U-turn for flow of the first heat exchange fluid. Precisely, the first heat exchange fluid flows through the first stack of tubes 106A extending from the inlet manifold 122 toward the second manifold 104, and then reverses the direction of flow through the second stack of tubes 106B to reach the outlet manifold 124, which defines a first fluid path.

**[0021]** The adjacent tubes of the first stack of tubes 106A are separated by fins 136. Similarly, the adjacent tubes of the second stack of tubes 106B are also separated by fins 136. A second heat exchange fluid flows around the tubes 106 and across the fins 136. The second heat exchange fluid may be air. The first heat exchange fluid and second heat exchange fluid are in heat exchange configuration. The fins 136 retard the flow of the second heat exchange fluid, particularly, the air outside the tubes 106 and to improve the heat exchange between the first heat exchange fluid flowing inside the tubes 106 and air flowing outside the tubes 106.

**[0022]** The connecting arrangement 200 may be configured to at least one of the manifolds (102, 104), for example, the first manifold 102 for the introduction of the first heat exchange fluid into the heat exchanger 100. The first manifold 102 extends in a first direction beyond the outline of the heat exchange tubes 106. The first manifold

102 including the tank member 108 and the header plate 112. The tank member 108 comprises a set of channels 110A, 110B, which extends along a length of the tank member 108 in the first direction. The elongation of the tank member 108 in the first direction defines the length of the tank member 108. The set of channels 110A, 110B includes a first channel 110A and a second channel 110B. The connecting arrangement 200 further includes at least two apertures 116A, 116B and at least two conduits 118, 120. The connecting arrangement 200 is explained in detail in further paragraphs.

**[0023]** Referring to FIG. 5, the tank member 108 further comprises an intermediate portion 138 between the first channel 110A and the second channel 110B, and a peripheral portion 128. The intermediate portion 138 and the peripheral portion 128 are planar regions, which separates the first channel 110A from the second channel 110B.

**[0024]** Referring to FIG. 6, the header plate 112 is configured to be fixed to the tank member 108. In an example, the header plate 112 comprises a plurality of tabs 126 extending from the peripheral portion 146 of the header plate 112. The plurality of tabs 126 are provided to form a crimping connection between the header plate 112 and the tank member 108. In another example, the header plate 112 and the tank member 108 may be secured to each other by brazing. In yet another example, the header plate 112 and the tank member 108 may be secured to each other by any other means that can form secure connection between the tank member 108 and the header plate 112. Referring to FIG. 7, on fixing the header plate 112 to the tank member 108, the first set of slots 114A aligns with the first channel 110A and defines the inlet manifold 122. The second set of slots 114B aligns with the second channel 110B and defines the outlet manifold 124.

**[0025]** Referring to FIG. 8 and FIG. 9, the connecting arrangement 200 including the first conduit 118 is in fluid communication with the inlet manifold 122 and the second conduit 120 is in fluid communication with the outlet manifold 124. In one embodiment, the first conduit 118 and the second conduit 120 are L-shaped tubular elements. A portion 140 of the header plate 112 that extends in the first direction includes the set of apertures 116A, 116B. The set of apertures 116A, 116B includes a first aperture 116A and a second aperture 116B. The set of apertures 116A, 116B are coplanar with the slots 114A, 114B on the header plate. 112 The first conduit 118 is directly fixed to the first aperture 116A and the second conduit 120 is directly fixed to the second aperture 116B. The first aperture 116A provides a fluidal communication between the first conduit 118 and the inlet manifold 122, and the second aperture 116B provides a fluidal communication between the second conduit 120 and the outlet manifold 124.

**[0026]** The configuration of apertures 116A, 116B on the portion 140 of the header plate 112 and connection of the conduits 118, 120 in a direction perpendicular to

the first direction reduces the space occupied by the conventional connecting arrangement 6. The reduction of space occupied by conventional connecting arrangement 6 could either be used to increase the number of tubes 106 to increase the heat transfer area or to provide a compact heat exchanger 100. Further, the direct attachment of the first conduit 118 and the second conduit 120 to the respective apertures 116A, 116B reduces the number of parts required for the configuration of the connecting arrangement 200, which reduces maintenance and enhances reliability of the heat exchanger 100.

**[0027]** The first conduit 118 defines a first fluid passage and the second conduit 120 defines a second fluid passage. In one embodiment, the first fluid passage and the second fluid passage comprise the same cross-sections. In another embodiment, the first fluid passage comprises a different cross-section than the second fluid passage.

**[0028]** In one embodiment, the first conduit 118 comprises a first end portion 118A, a second end portion 118B and a middle portion 118C extending integrally between the first end portion 118A and the second end portion 118B. The first end portion 118A is directly brazed to the first aperture 116A, thereby configuring a fluidal communication between the first conduit 118 and the inlet manifold 122. The first end portion 118A and the middle portion 118C of the first conduit 118 have a first inner diameter and the second end portion 118B have a second inner diameter. In one embodiment, the first inner diameter is different from the second inner diameter. In another embodiment, the first inner diameter is smaller than the second inner diameter. Further, the first end portion 118A of the first conduit 118 have a first outer diameter, and the first aperture 116A have a first inner diameter. In one embodiment, the first outer diameter of the first end portion 118A of the first conduit 118 is equal to the first inner diameter of the first aperture 116A, so that the first end portion 118A of the first conduit 118 fits within the first aperture 116A.

**[0029]** The first aperture 116A comprises a first flange 142A extends from a rim of the first aperture 116A. The first end portion 118A of the first conduit 118 is fixed to the first aperture 116A such that the first end portion 118A overlaps over an interior surface of the first flange 142A and the first aperture 116A. In another embodiment, the first outer diameter of the first conduit 118A is greater than the first inner diameter of the first aperture 116A. The first end portion 118A of the first conduit 118 is fixed to the first aperture 116A such that the first end portion 118A overlaps over an exterior surface of the first flange 142A and the first aperture 116A.

**[0030]** In one embodiment, the second conduit 120 comprises a first end portion 120A, a second end portion 120B and a middle portion 120C extending integrally between the first end portion 120A and the second end portion 120B. The first end portion 120A is directly brazed to the second aperture 116B, thereby configuring a fluidal communication between the second conduit 120 and the outlet manifold 124. The first end portion 120A and the

middle portion 120C of the second conduit 120 have a first inner diameter and the second end portion 120B have a second inner diameter. In one embodiment, the first inner diameter is different from the second inner diameter. In another embodiment, the first inner diameter is smaller than the second inner diameter.

**[0031]** Further, the first end portion 120A of the second conduit 120 have a first outer diameter, and the second aperture 116B have a first inner diameter. In one embodiment, the first outer diameter of the first end portion 120A of the second conduit 120 is equal to the first inner diameter of the second aperture 116B, so that the first end portion 120A of the second conduit 120 fits within the second aperture 116B.

**[0032]** Furthermore, the second aperture 116B comprises a second flange 142B extends from a rim of the second aperture 116B. The first end portion 120A of the second conduit 120 is fixed to the second aperture 116B such that the first end portion 120A overlaps over an interior surface of the second flange 142B and the second aperture 116B. In another embodiment, the first outer diameter is greater than the first inner diameter of the second aperture 116B. The first end portion 120A of the second conduit 120 is fixed to the second aperture 116B such that the first end portion 120A overlaps over an exterior surface of the second flange 142B and the second aperture 116B.

**[0033]** During operation, the first heat exchange fluid flows from the first conduit 118 via the first aperture 116A to the inlet manifold 122. The inlet manifold 122 distributes the first heat exchange fluid received thereby to the first stack of tubes 106A. The first heat exchange fluid undergoes heat exchange with the second heat exchange fluid, particularly, air around the first stack of tubes 106A and fins 136 as the first heat exchange fluid flows through the first stack of tubes 106A. The second stack of tubes 106B receive the first heat exchange fluid from the first stack of tubes 106A via the second manifold 104 configuring fluid communication between the first and second stack of tubes 106A, 106B. The second heat exchange fluid further undergoes heat exchange as it passes through the second stack of tubes 106B. The outlet manifold 124 collects the first heat exchange fluid from the second stack of tubes 106B, after the first heat exchange fluid had rejected heat to the air flowing across the tubes 106 and fins 136 as it passes through the tubes 106. The outlet manifold 124 delivers the first heat exchange fluid collected thereby to the second conduit 120 for egress of the first heat exchange fluid from the heat exchanger 100.

**[0034]** In any case, the invention cannot and should not be limited to the embodiments specifically described in this document, as other embodiments might exist. The invention shall spread to any equivalent means and any technically operating combination of means.

## Claims

### 1. A heat exchanger (100), comprising:

a first manifold (102), and  
a second manifold (104), wherein each of the manifolds (102, 104) comprises an axis of elongation, wherein the manifolds (102, 104) extending substantially in parallel in a first direction, wherein the first direction is parallel to the axis of elongation;  
a plurality of tubes (106) extending substantially in perpendicular to the first direction between the first manifold (102) and the second manifold (104), wherein the tubes (106) are arranged in two parallel stacks (106A, 106B) comprising a first parallel stack (106A) and a second parallel stack (106B), wherein the first manifold (102) comprises a tank member (108) comprising a first channel (110A) and a second channel (110B), and a header plate (112) configured to be fixed to the tank member (108), wherein the header plate (112) comprises a first set of slots (114A) configured to provide a fluidal communication between the first channel (110A) and the first stack of tubes (106A), and a second set of slots (114B) configured to provide a fluidal communication between the second channel (110B) and the second stack of tubes (106B), wherein the first set of slots (114A) align with the first channel (110A) defining an inlet manifold (122), and the second set of slots (114B) align with the second channel (110B) defining an outlet manifold (124), wherein the header plate (112) comprises a first aperture (116A) and a second aperture (116B), **characterized in that**, the heat exchanger (100) further comprises a first conduit (118) fixed directly to the first aperture (116A), a second conduit (120) fixed directly to the second aperture (116B), wherein the header plate (112) comprises a portion (140) comprising said apertures (116A, 116B), wherein said portion (140) extends in the first direction beyond an outline of the plurality of tubes (106).

2. The heat exchanger (100) of claim 1, wherein the apertures (116A, 116B) are coplanar with the slots (114A, 114B).

3. The heat exchanger (100) of claim 1, wherein each of the conduit (118, 120) is a substantially L-shaped tubular member.

4. The heat exchanger (100) of claim 1, wherein each of the conduit (118, 120) comprises a first end portion (118A, 120A), a second end portion (118B, 120B) and a middle portion (118C, 120C) extending integrally between the first end portion (118A, 120A) and

the second end portion (118C, 120C).

5. The heat exchanger (100) of claim 4, wherein the first end portion (118A, 120A) and the middle portion (118C, 120C) of the conduit (118, 120) having a first inner diameter, and the second end portion (118B, 120B) having a second diameter. 5
6. The heat exchanger (100) of claim 5, wherein the first inner diameter is different from the second inner diameter. 10
7. The heat exchanger (100) of claim 5, wherein the first inner diameter is smaller than the second inner diameter. 15
8. The heat exchanger (100) of claim 5, wherein the first inner diameter is equal to the second inner diameter. 20
9. The heat exchanger (100) of claim 4, wherein the first end portion (118A, 120A) of the conduit (118, 120) having an outer diameter, and the aperture (116A, 116B) having an inner diameter equal to the outer diameter of the first end portion (118A, 120B) of the conduit (118, 120). 25
10. The heat exchanger (100) of claim 1, wherein each of the aperture (116A, 116B) comprises a flange (122A, 122B) extending from a rim of the aperture (116A, 116B). 30
11. The heat exchanger (100) of claim 9 and 10, wherein the first end portion (118A, 120A) of the conduit (118, 120) overlaps over the flange (122A, 122B) of the respective aperture (116A, 116B). 35
12. The heat exchanger (100) of claim 1, wherein the first manifold (102) extends in the first direction beyond an outline of the plurality of tubes (106). 40
13. The heat exchanger (100) of claim 1, wherein the first aperture (116A) provides a fluidal communication between the first conduit (118) and the inlet manifold (122), and the second aperture (116B) provides a fluidal communication between the second conduit (120) and the outlet manifold (124). 45
14. The heat exchanger (100) of claim 1, wherein the tank member (108) comprises a plurality of tabs (126) extending from a peripheral portion (128) of the tank member (108) to provide a crimping connection with the header plate (112). 50
15. The heat exchanger (100) of claim 1, wherein the first conduit (118) and the second conduit (120) comprise the same cross-sections. 55

16. The heat exchanger (100) of claim 1, wherein the first conduit (118) and the second conduit (120) comprise different cross-sections.

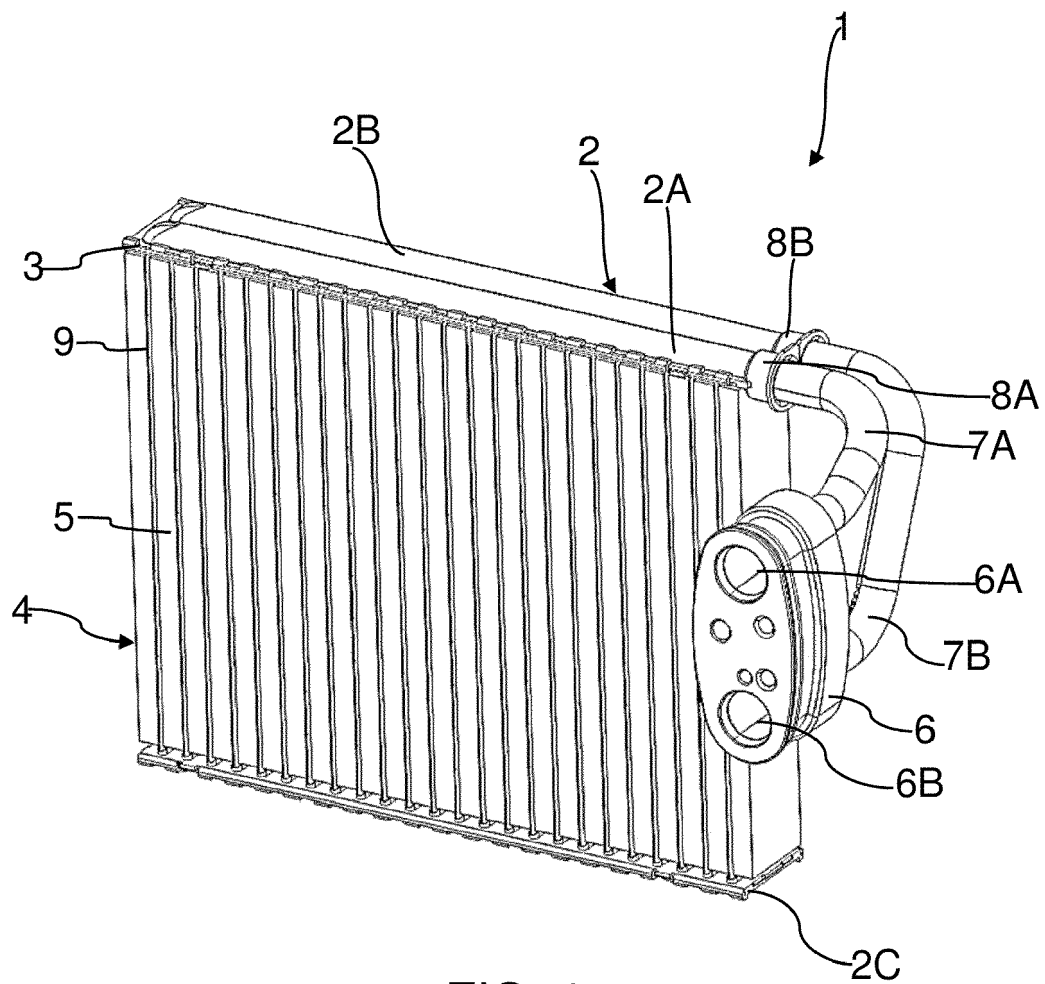


FIG. 1  
(PRIOR ART)

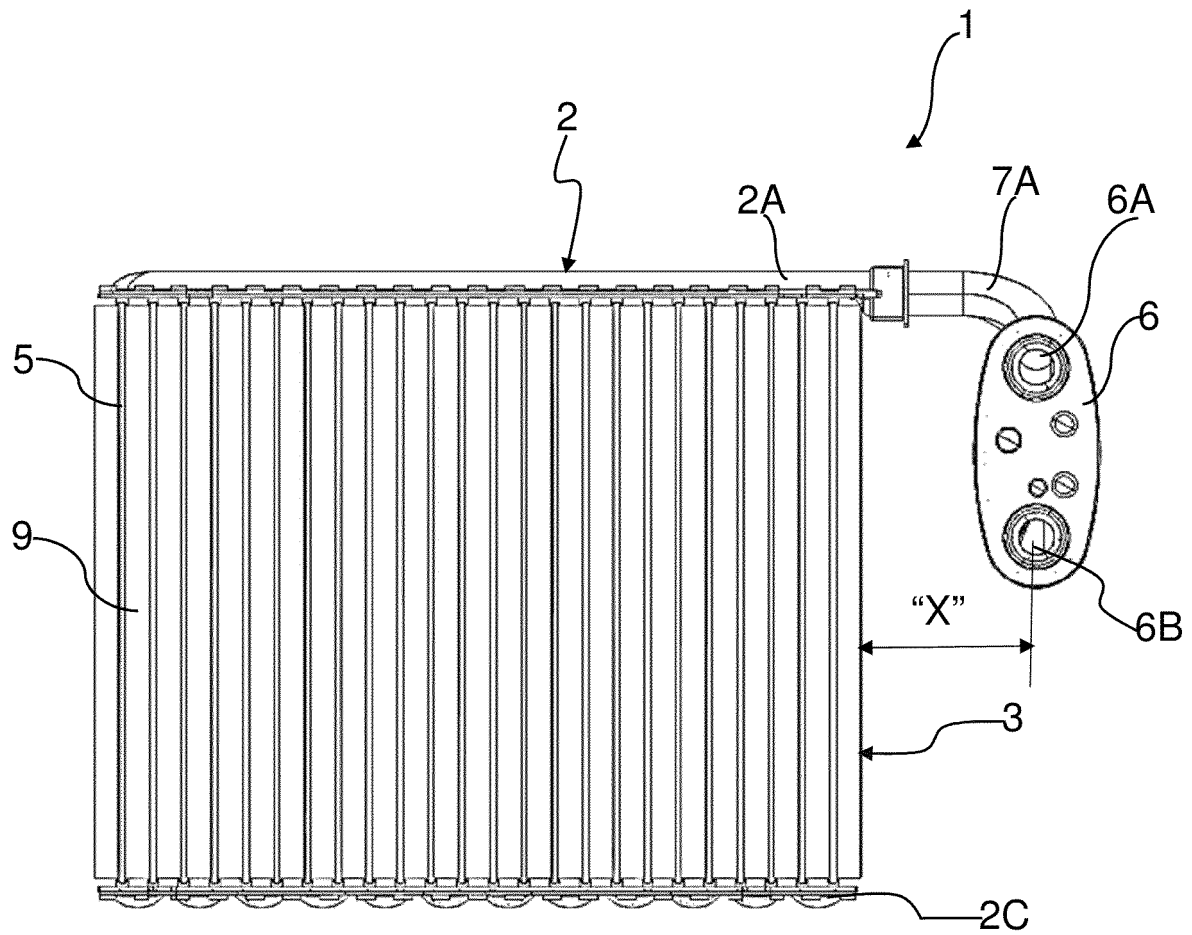


FIG. 2  
(PRIOR ART)

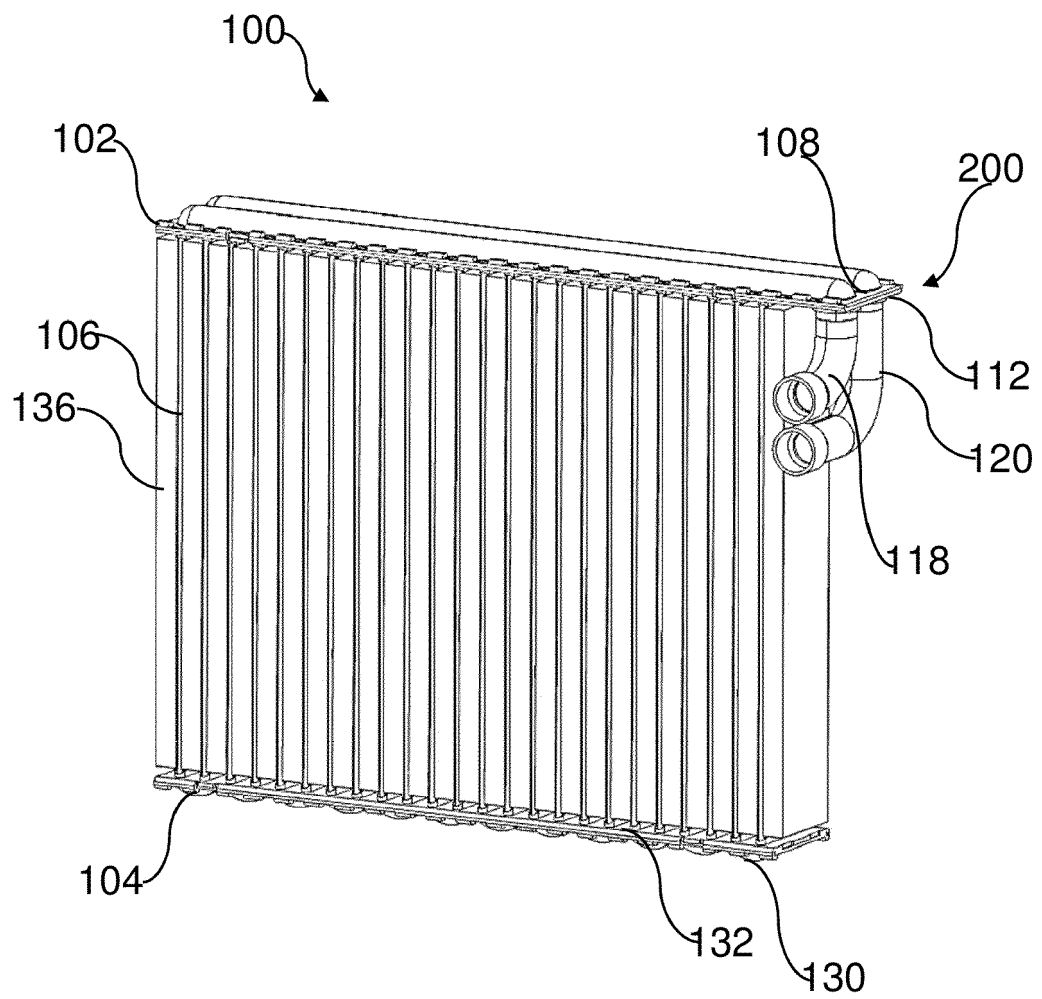


FIG. 3

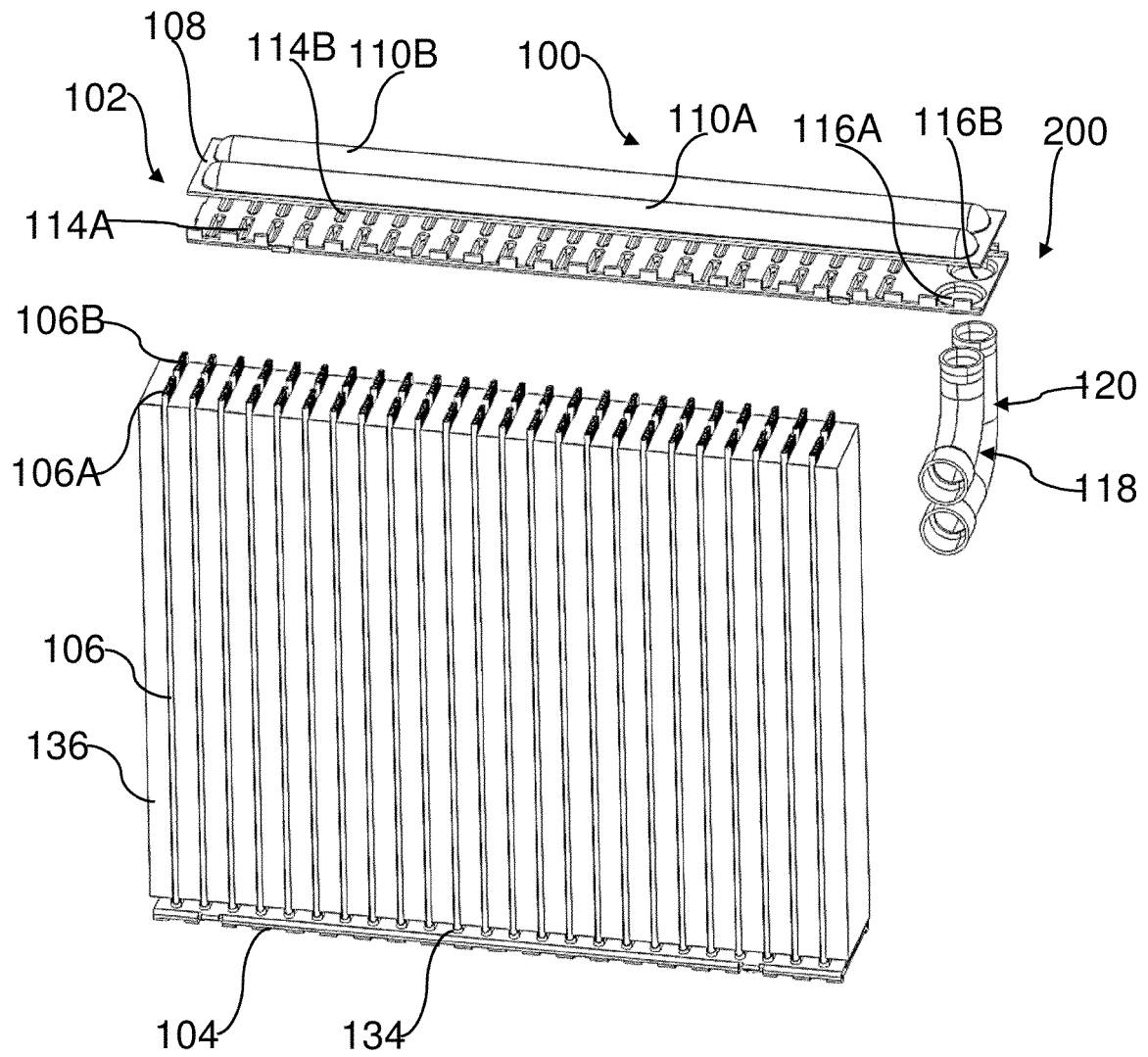
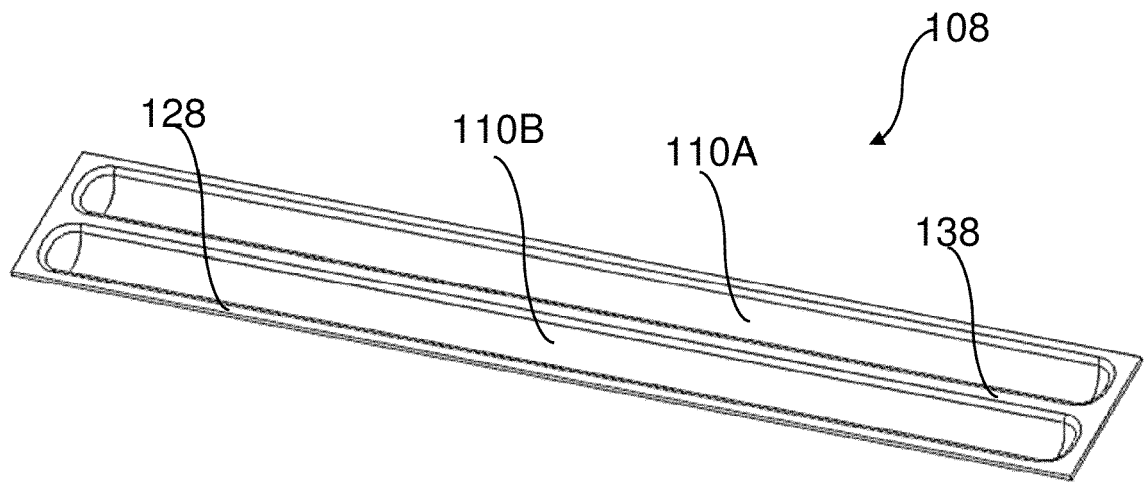
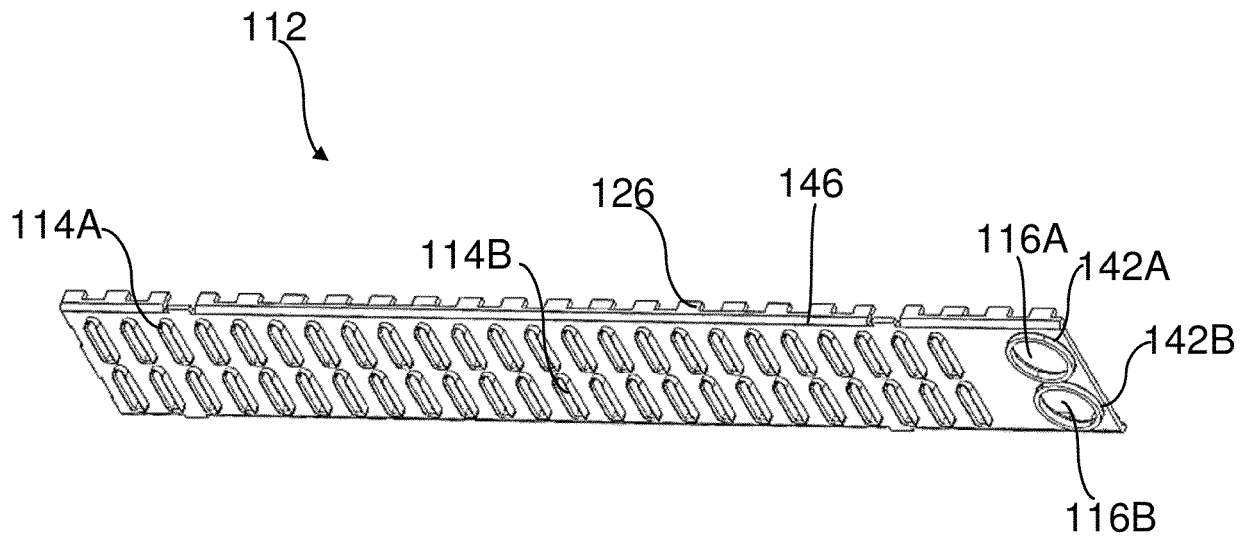


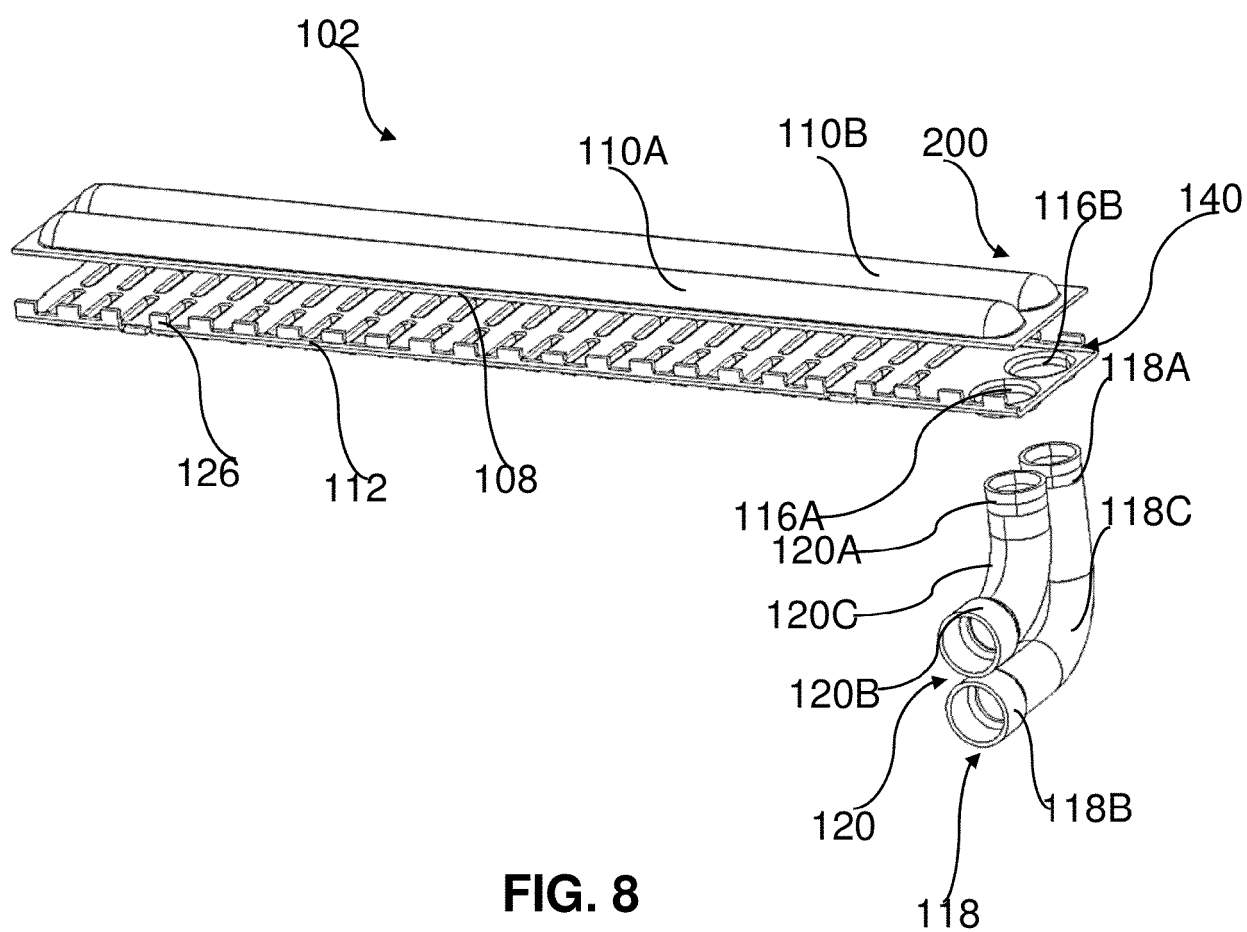
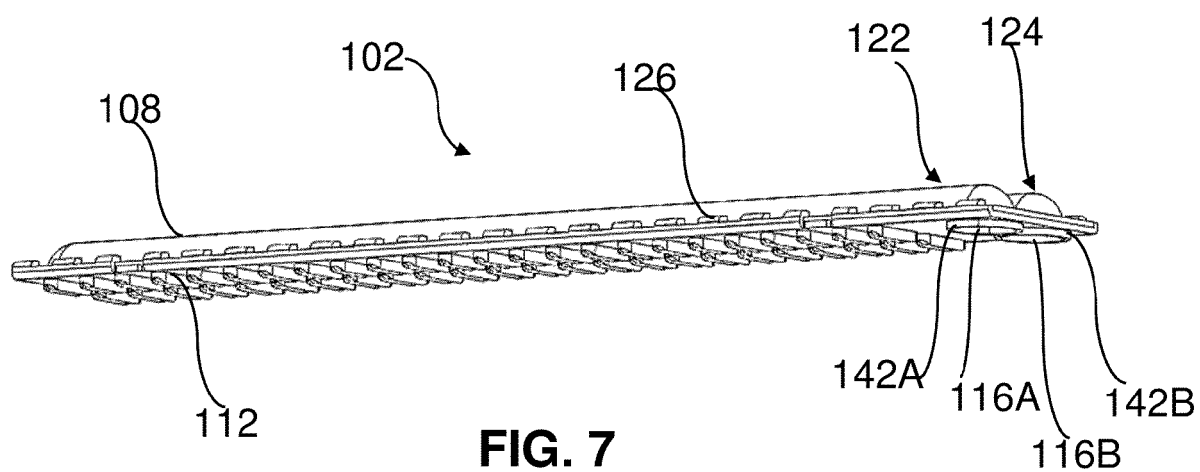
FIG. 4

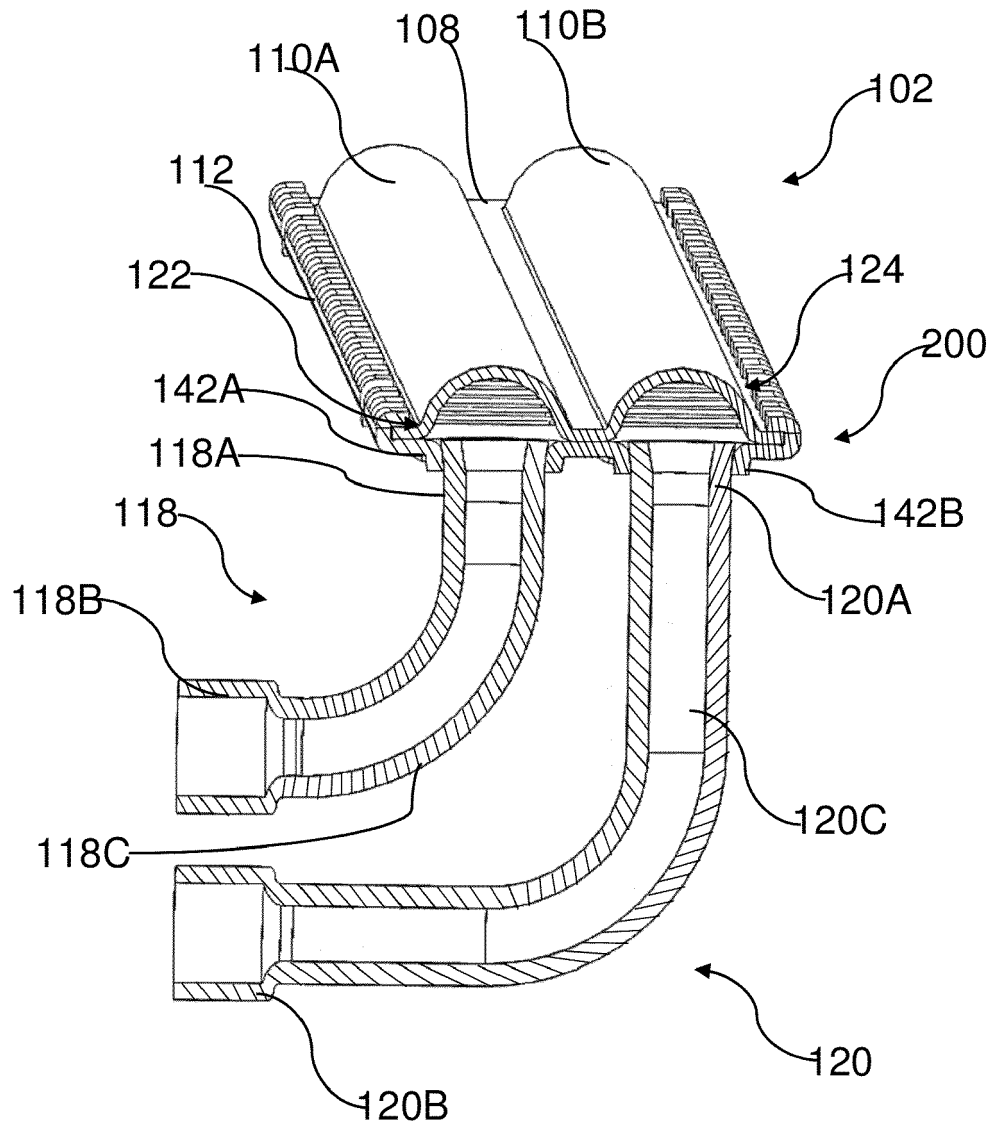


**FIG. 5**



**FIG. 6**





**FIG. 9**



## EUROPEAN SEARCH REPORT

Application Number

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| CATEGORY OF CITED DOCUMENTS<br>X : particularly relevant if taken alone<br>Y : particularly relevant if combined with another document of the same category<br>A : technological background<br>O : non-written disclosure<br>P : intermediate document |                                                                                                   | T : theory or principle underlying the invention<br>E : earlier patent document, but published on, or after the filing date<br>D : document cited in the application<br>L : document cited for other reasons<br>.....<br>& : member of the same patent family, corresponding document |                                         |

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