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(54) HEAT EXCHANGER

(57) A heat exchanger (100) comprises at least two manifolds (102, 104), and a plurality of tubes (106) extending between the manifolds (102, 104). The manifold (102) comprises a tank member (110) comprising a first set of channels (114A, 114B) terminating at a first free end (122) and a header plate (108) comprising a first set of slots (112A) in conjunction with the channel (114A) defining an inlet manifold (138), a second set of slots (112B) in conjunction with the channel (114B) defining an outlet manifold (140), and a second set of channels (116A, 116B) at a second free end (124). The channels (116A, 116B) aligns with the channels (114A, 114B) to form a first and second port (118, 120). A first and second conduits (126, 128) directly fixed to the first and second port (118, 120), respectively, for introduction of heat exchange fluid into the heat exchanger (100).

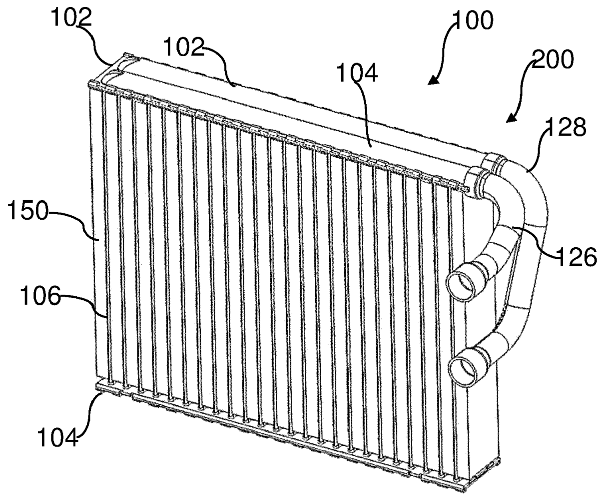

FIG. 3

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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, an air conditioning gas coolers, gas coolers or evaporators is intended to be traversed by a fluid under high pressure, particularly, a refrigerant fluid, such as for example, natural gases such as carbon dioxide, also known as CO2 or R744 in the supercritical state. 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 inlet 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 present invention discloses a heat exchanger comprising a first manifold, a second manifold and a plurality of tubes. Each of the manifolds comprises an axis of elongation. The plurality of tubes extending substantially in perpendicular to the axis of elongation between the first manifold and the second manifold. The tubes are arranged in two parallel stacks. The two parallel stacks comprises a first stack of tubes and a second stack of tubes. The first manifold comprises a tank member comprising a first set of channels, and a header plate configured to be fixed to the tank member.

[0009] The header plate comprises a first set of slots configured to provide a fluidal communication between at least one channel and the first stack of tubes. The header plate further comprises a second set of slots configured to provide a fluidal communication between at least one channel and the second stack of tubes.

[0010] The first set of channels terminating at a first free end of the tank member in the direction of the axis of elongation. The header plate further comprises a second set of channels at a second free end thereof. The second free end of the header plate being the same side as that of the first free end of the tank member. The second set of channels are configured to be aligned with the first set of channels at the first free end of the tank member to form a first port and a second port. The first set of channels comprises a first profile and the second set of channels comprises a second profile complementary to the first profile. In one example, the first set of channels comprises a first concave profile and the second set of channels comprises a second concave profile complementary to the first concave profile.

[0011] In one embodiment, the first port and the second port extends beyond the outline of the plurality of tubes. In one example, the first port has at least one of circular cross section and oval cross section. In one example, the second port has at least one of circular cross section and oval cross section. The heat exchanger further comprises a first conduit overlapping at least a portion of the first port, and a second conduit overlapping at least a portion of the second port. Further, the tank member comprises a first intermediate portion between the first set of channels and the header plate comprises a second intermediate portion between the second set of channels.

[0012] The tank member comprises a first peripheral portion, and the header plate comprises a second peripheral portion. A plurality of tabs extends from the second peripheral portion for configuring crimping connection with the first peripheral portion of the tank member. The first intermediate portion and the first peripheral portion of the tank member straddles over the second intermediate portion and the second peripheral portion of the header plate on assembly of the tank member to the header.

[0013] Further, each conduit comprises a first end portion, a second end portion and a middle portion extending integrally between the first end portion and the second end portion. The first end portion and the second end portion having a first inner diameter and the middle portion having a second inner diameter. The first inner diameter is different from the second inner diameter. In one example, the second inner diameter is smaller than the first inner diameter.

[0014] Further, each of the ports having an outer diameter equal to the first inner diameter of the corresponding conduit so that the first end portion of the corresponding conduit overlap over the corresponding port. The first end portion of the conduit comprises one or more notches to fit over the straddled planar portion and the peripheral portion of the tank member and the header plate as the conduit overlaps over the corresponding port.

BRIEF DESCRIPTION OF DRAWINGS

[0015] 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 first conduit in fluid communication with an inlet manifold via an inlet port of FIG. 3.

DETAILED DESCRIPTION

[0016] The heat exchanger comprises a first manifold, a second manifold and a plurality of tubes. Each of the manifolds comprises an axis of elongation. The plurality of tubes extending substantially in perpendicular to the axis of elongation between the first manifold and the second manifold. The tubes are arranged in two parallel stacks. The two parallel stacks comprises a first stack of tubes and a second stack of tubes. The first manifold comprises a tank member comprising a first set of channels, 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 at least one channel and the first stack of tubes. The header plate further comprises a second set of slots configured to provide a fluidal communication between at least one channel and the second stack of tubes.

[0017] The first set of channels terminating at a first free end of the tank member in the direction of the axis of elongation. The header plate further comprises a second set of channels at a second free end thereof. The second free end of the header plate being the same side as that of the first free end of the tank member. The second set of channels are configured to be aligned with the first set of channels at the first free end of the tank member to form a first port and a second port. The configuration of ports on the manifold and the conduits fixed directly to the ports substantially reduces 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 includes an inlet manifold 138 and an outlet manifold 140 (shown in FIG. 7). The inlet manifold 138 and the outlet manifold 140 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 138 and the outlet manifold 140 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 110, 142 and a header plate 108, 146. The header plate 108, 146 may comprise a plurality of slots 112A, 112B, 148A, 148B. The arrangement of plurality of slots 112A, 112B, 148A, 148B 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 112A, 112B of header plate 108 of first manifold 102. The second end of the heat exchange tubes 106 is received into corresponding slots 148A, 148B of the header plate 146 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 138 toward the second manifold 104, and then reverses the direction of flow through the second stack of tubes 106B to reach the outlet manifold 140, which defines a first fluid path.

[0021] The adjacent tubes of the first stack of tubes 106A are separated by fins 150. Similarly, the adjacent tubes of the second stack of tubes 106B are also separated by fins 150. A second heat exchange fluid flows around the tubes 106 and across the fins 150. 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 150 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. 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. Each of the manifold 102, 104 comprises an axis of elongation.

[0022] The first manifold 102 extends in a first direction beyond the outline of the heat exchange tubes 106. The first direction is parallel to the axis of elongation. The first manifold 102 including the tank member 110 and the header plate 108. The tank member 110 comprises a first set of channels 114A, 114B, which extends along a length of the tank member 110 in the first direction. Further, the first set of channels 114A, 114B terminates at a first free end 122 of the tank member 110 in the direction of the axis of elongation. The elongation of the tank member 110 in the first direction defines the length of the tank member 110. The connecting arrangement 200 further comprises a second set of channels 116A, 116B at a second free end 124 of the header plate 108. The second free end 124 being the same side as that of the first free end 122 of the tank member 110. The second set of channels 116A, 116B are configured to be aligned with the first set of channels 114A, 114B to form a first port 118 and a second port 120. The connecting arrangement 200 is explained in detail in further paragraphs.

[0023] Referring to FIG. 5, the tank member 110 further comprises a first intermediate portion 110A between the first set of channels 114A, 114B, and a first peripheral portion 110B. The first intermediate portion 110A and the first peripheral edge portion 110B are planar regions, which separates the first set of channels 114A, 114B from one another. Referring to FIG. 6, the header plate 108 is configured to be fixed to the tank member 110. The header plate further comprises a second intermediate portion 108A between the first set of slots 112A, 112B, and a second peripheral portion 108B. The second intermediate portion 108A and the second peripheral portion 108B are planar regions, which separates the second set of channels 116A, 116B. The first set of channels 114A, 114B comprises a first profile and the second set of channels 116A, 116B comprises a second profile complementary to the first profile. In one example, the first set of channels 114A, 114B comprises a first concave profile and the second set of channels 116A, 116B comprises a second concave profile complementary to the first concave profile.

[0024] The header plate 108 further comprises a plurality of tabs 130 extending from the second peripheral portion 108B of the header plate 108. The plurality of tabs 130 are provided to form a crimping connection between the header plate 108 and the tank member 110. In one example, the header plate 108 and the tank member 110 may be secured to each other by brazing. In another example, the header plate 108 and the tank member 110 may be secured to each other by any other means that can form secure connection between the tank member 110 and the header plate 108. Referring to FIG. 7, on fixing the header plate 108 to the tank member 110, the first set of slots 112A aligns with the channel 114A of the first set of channels 114A, 114B and defines the inlet manifold 138. The second set of slots 112B aligns with the channel 114B of the first set of channels 114A, 114B and defines the outlet manifold 140.

[0025] Further, the second set of channels 116A, 116B at the second free end 124 of the header plate 108 aligns with the first set of channels 114A, 114B at the first free end 122 of the tank member 110 to form a first port 118 and a second port 120. In one embodiment, the first port 118 and the second port 120 extends beyond the outline of the plurality of tubes 106. In one example, the first port 118 has at least one of circular cross section and oval cross section. In one example, the second port 120 has at least one of circular cross section and oval cross section. Further, the first intermediate portion 110A and first peripheral portion 110B of the tank member 110 straddles over the second intermediate portion 108A and the second peripheral portion 108B of the header plate 108 on assembly of the tank member 110 to the header plate 108. The first end portion 126A, 128A of the conduit 126, 128 comprises one or more notches 136, shown in FIG. 8, to fit over the straddled intermediate portion 110A, 108A and the periphery portion 110B, 108B of the tank member 110 and the header plate 108 as the conduit 126, 128 overlaps over the corresponding port 118, 120.

[0026] Referring to FIG. 8 and FIG. 9, the connecting arrangement 200 including the first conduit 126 is in fluid communication with the inlet manifold 138 and the second conduit 128 is in fluid communication with the outlet manifold 140. The first conduit 126 is directly fixed to the first port 118, shown in FIG. 9 and the second conduit 128 is directly fixed to the second port 120. The cross-section of second conduit 128 fixed to second port 120 is identical to the illustration of FIG. 9 and hence not illustrated to avoid repetition of Figures. The integration of the first port 118 and the second port 120 on the first manifold 102 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 126 and the second conduit 128 to the respective ports 118, 120 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 126 defines a first fluid passage and the second conduit 128 defines a second fluid passage. In one embodiment, the first fluid passage and the second fluid passage comprises a same cross-section. In another embodiment, the first fluid passage comprises a different cross-section than the second fluid passage. In yet another embodiment, the first fluid passage and the second fluid passage comprises a variable cross section. In one embodiment, the first conduit 126 comprises a first end portion 126A, a second end portion 126C and a middle portion 126B extending integrally between the first end portion 126A and the second end portion 126C. The first end portion 126A is directly brazed to the first port 118, thereby configuring a fluidal communication between the first conduit 126 and the inlet manifold 138. The first end portion 126A and the second end portion 126C having a first inner diameter and the middle portion 126B having a second inner diameter. The first inner diameter is different from the second inner diameter. In one example, the second inner diameter is smaller than the first inner diameter.

[0028] Further, the first port 118 have a first outer diameter equal to the first inner diameter of the first end portion 126A of the first conduit 126, so that the first end portion 126A of the conduit 126 overlaps the first port 118. In another example, the first port 118 have a first inner diameter and the first end portion 126A of the first conduit 126 have a first outer diameter. The first outer diameter of the first end portion 126A is equal to the first inner diameter so that the first end portion 126A fits within the first port 118. In one embodiment, the second conduit 128 comprises a first end portion128A, a second end portion 128C and a middle portion 128B extending integrally between the first end portion 128A and the second end portion 128C. The first end portion 128A is directly brazed to the second port 120, thereby configuring a fluidal communication between the second conduit 128 and the outlet manifold 140.

[0029] The first end portion 128A and the second end portion 128C having a first inner diameter and the middle portion 128B having a second inner diameter. The first inner diameter is different from the second inner diameter. In one example, the second inner diameter is smaller than the first inner diameter. Further, the second port 120 have a first outer diameter equal to the first inner diameter of the first end portion 128A of the second conduit 128, so that the first end portion 128A of the conduit 128 overlaps the second port 120. In another example, the second port 120 have a first inner diameter and the first end portion 128A of the second conduit 128 have a first outer diameter. The first outer diameter of the first end portion 128A is equal to the first inner diameter so that the first end portion 128A fits within the second port 120.

[0030] During operation, the first heat exchange fluid flows from the first conduit 126 via the first port 118 to the inlet manifold 138. The inlet manifold 138 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 150 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 106B 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 140 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 150 as it passes through the tubes 106. The outlet manifold 140 delivers the first heat exchange fluid collected thereby to the second conduit 128 for egress of the first heat exchange fluid from the heat exchanger 100.

[0031] 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);
   a second manifold (104), wherein each of the manifolds (102, 104) comprises an axis of elongation, and
   a plurality of tubes (106) extending substantially in perpendicular to the axis of elongation 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 stack of tubes (106A) and a second stack of tubes (106B), wherein the first manifold (102) comprises a tank member (110) comprising a first set of channels (114A, 114B), and a header plate (108) configured to be fixed to the tank member (110), wherein the header plate (108) comprises a first set of slots (112A) configured to provide a fluidal communication between the channel (114A) and the first stack of tubes (106A) ,and a second set of slots (112B) configured to provide a fluidal communication between the channel (114B) and the second stack of tubes (106B), **characterized in that**,
   the first set of channels (114A, 114B) terminating at a first free end (122) of the tank member (110) in the direction of the axis of elongation;
   the header plate (108) comprising a second set of channels (116A, 116B) at a second free end (124) thereof, the second free end (124) being the same side as that of the first free end (122) of the tank member (110), wherein the second set of channels (116A, 116B) are configured to be aligned with the first set of channels (114A, 114B) at the first free end (122) of the tank member (110) to form a first port (118) and a second port (120);
   a first conduit (126) overlapping at least a portion of the first port (118), and
   a second conduit (128) overlapping at least a portion of the second port (120).

2. The heat exchanger (100) of claim 1, wherein the first port (118) and the second port (120) extends beyond an outline of the plurality of tubes (106).

3. The heat exchanger (100) of claim 1, wherein the tank member (110) comprises a first intermediate portion (110A) between the first set of channels (114A, 114B).

4. The heat exchanger (100) of claim 1, wherein the header plate (108) comprises a second intermediate

portion (108A) between the second set of channels (116A, 116B).

5. The heat exchanger (100) of claim 1, wherein the tank member (110) comprises a first peripheral portion (110B), and the header plate (108) comprises a second peripheral portion (108B) and a plurality of tabs (130) extends from the second peripheral portion (108B) for configuring crimping connection with the first peripheral portion (110B) of the tank member (110).

6. The heat exchanger (100) of claim 1, wherein each of the conduits (126, 128) comprises a first end portion (126A, 128A), a second end portion (126C, 128C) and a middle portion (126B, 128B) extending integrally between the first end portion (126A, 128A) and the second end portion (126C, 128C).

7. The heat exchanger (100) of claim 6, wherein the first end portion (126A, 128B) and the second end portion (126C, 128C) having a first inner diameter and the middle portion (126B, 128B) having a second inner diameter, wherein the first inner diameter is different from the second inner diameter.

8. The heat exchanger (100) of claim 7, wherein the second inner diameter is smaller than the first inner diameter.

9. The heat exchanger (100) of claim 1, wherein the first port (118) has at least one of circular cross section and oval cross section.

10. The heat exchanger (100) of claim 1, wherein the second port (120) has at least one of circular cross section and oval cross section.

11. The heat exchanger (100) of claim 1 and 7, wherein each of the ports (118, 120) having an outer diameter equal to the first inner diameter of the corresponding conduit (126, 128) so that the first end portion (126A, 128A) of the corresponding conduit (126, 128) overlap over the corresponding port (118, 120).

12. The heat exchanger (100) of claim 5, wherein the first intermediate portion (110A) and first peripheral portion (110B) of the tank member (110) straddles over the second intermediate portion (108A) and the second peripheral portion (108B) of the header plate (108) on assembly of the tank member (110) to the header plate (108).

13. The heat exchanger (100) of claim 12, wherein the first end portion (126A, 128A) of the conduit (126, 128) comprises one or more notches (136) to fit over the straddled intermediate portion (110A, 108A) and the periphery portion (110B, 108B) of the tank member (110) and the header plate (108) as the conduit (126, 128) overlaps over the corresponding port (118, 120).

14. The heat exchanger (100) of claim 1, wherein the first set of channels (114A, 114B) comprises a first profile and the second set of channels (116A, 116B) comprises a second profile complementary to the first profile.

15. The heat exchanger (100) of claim 1, wherein the first set of channels (114A, 114B) comprises a first concave profile and the second set of channels (116A, 116B) comprises a second concave profile complementary to the first concave profile.

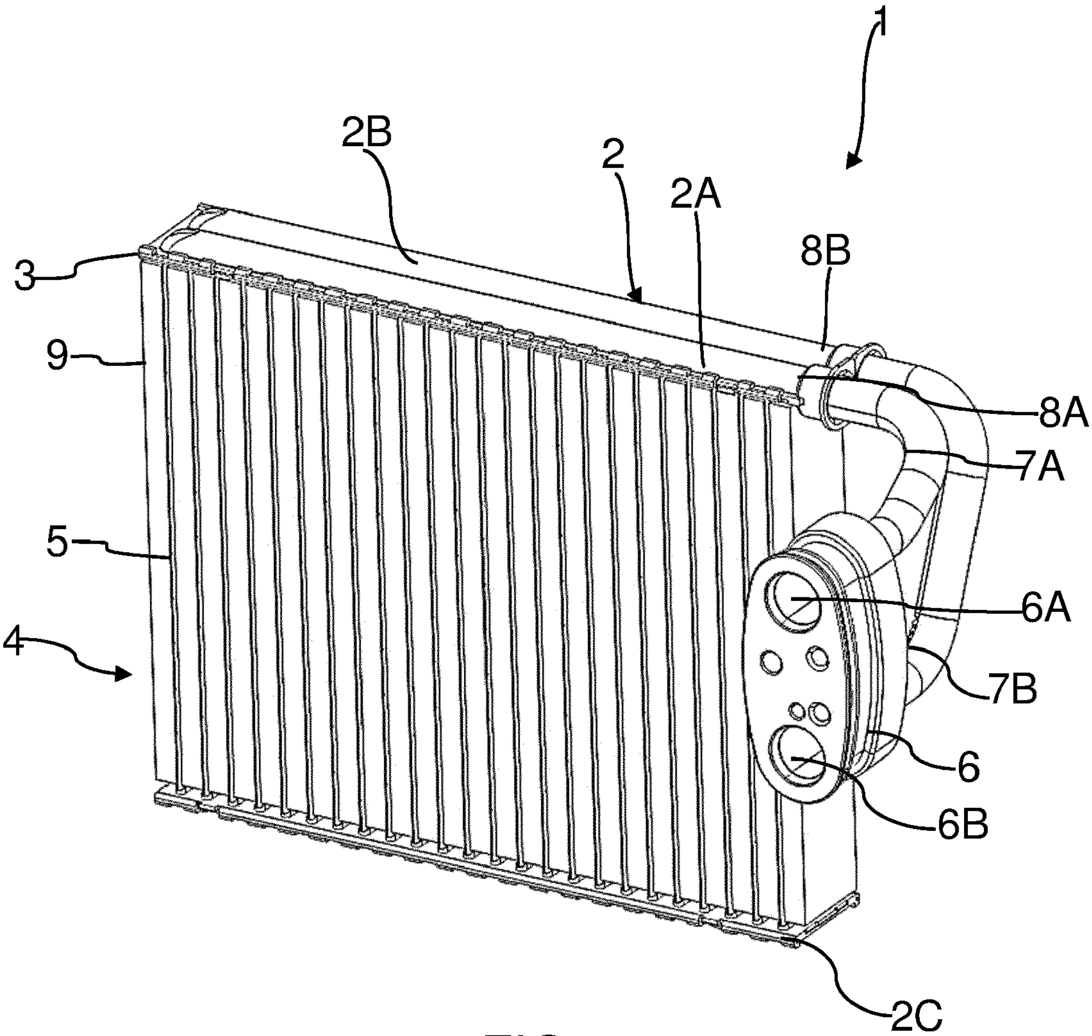

FIG. 1

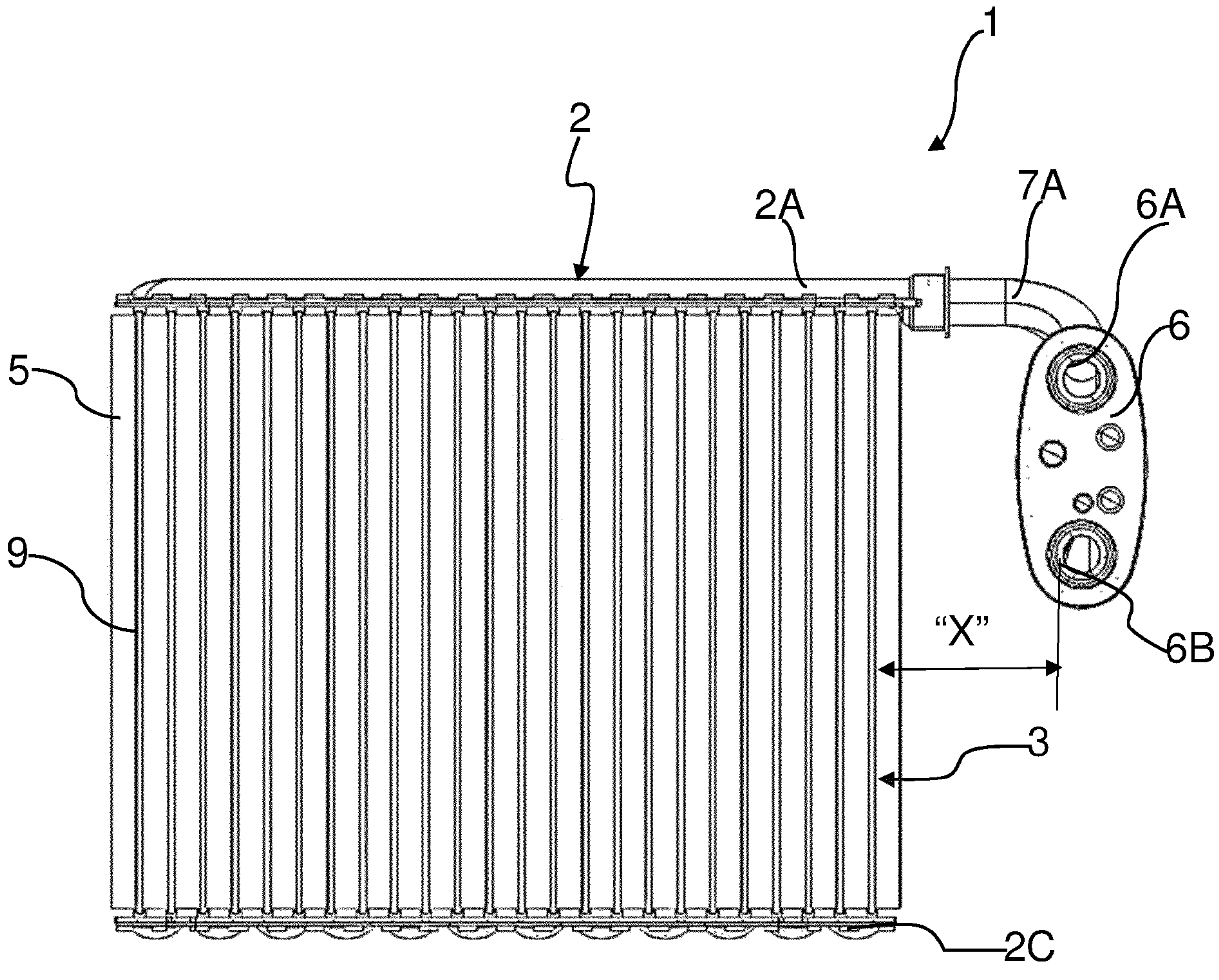

FIG. 2

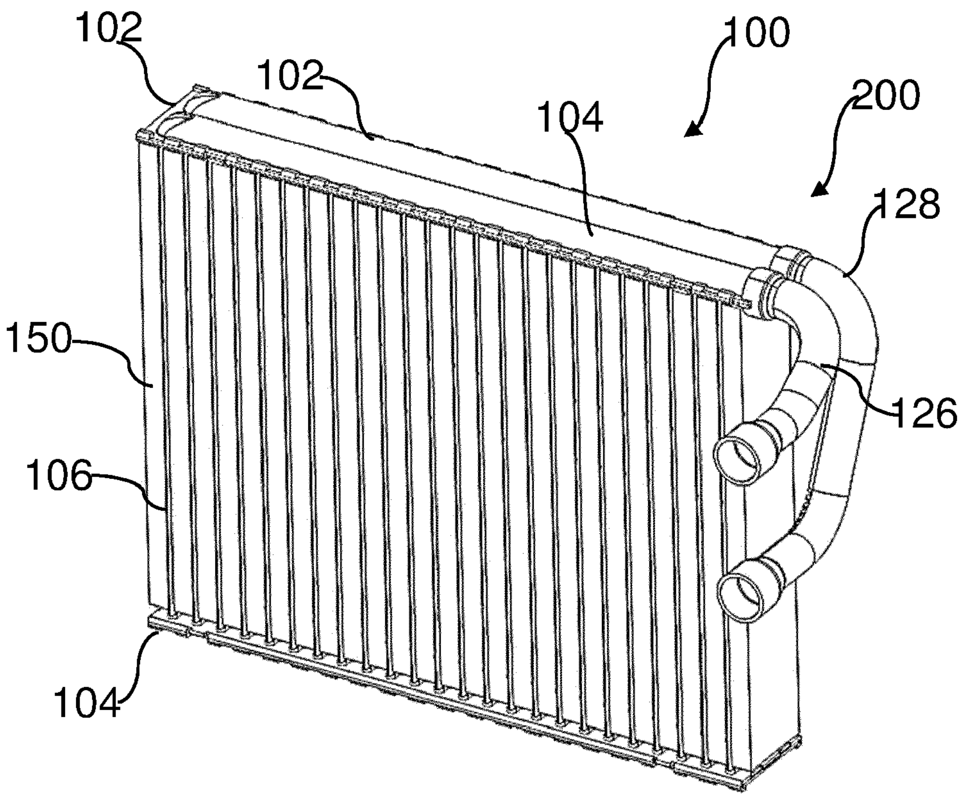

FIG. 3

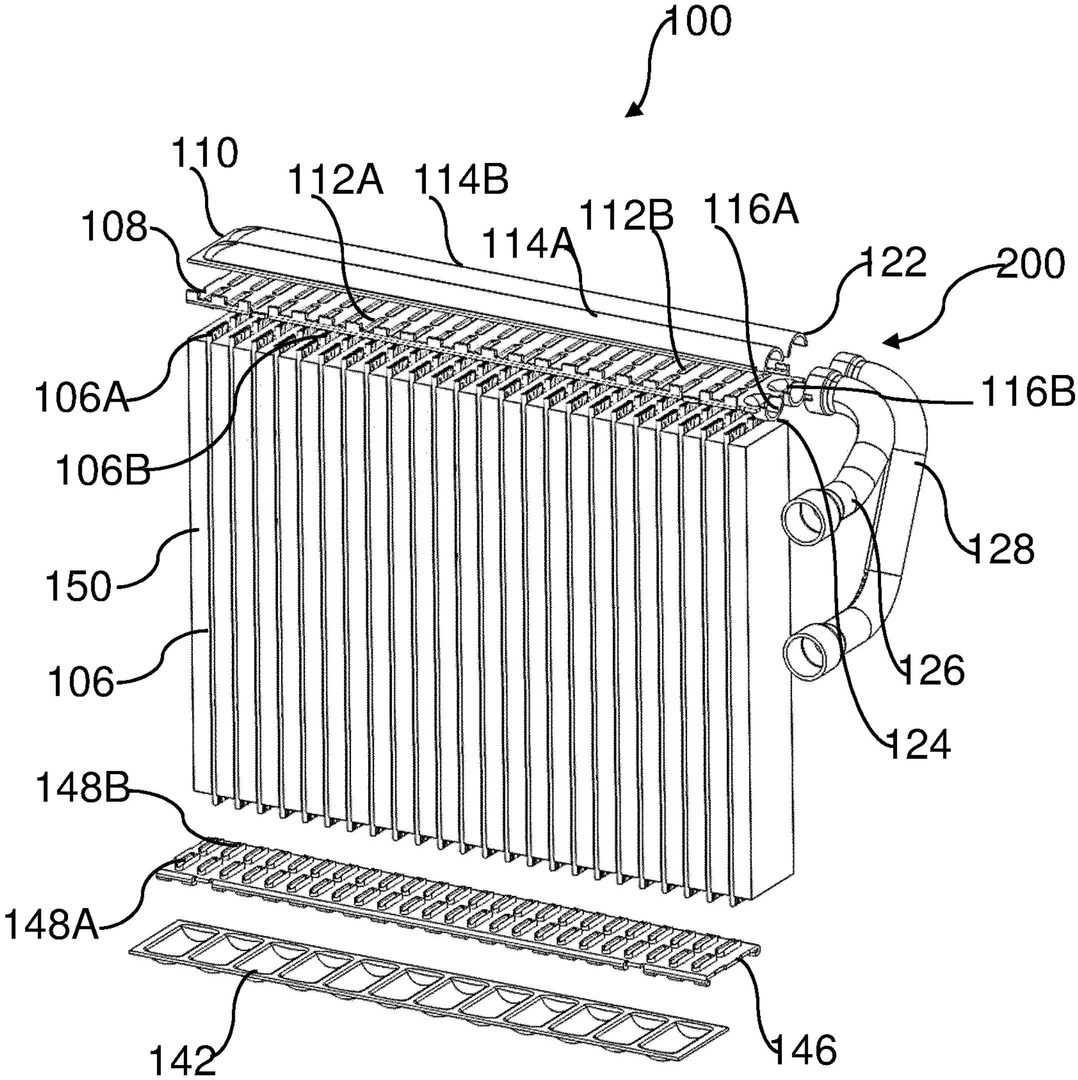
100
110
112A
114B
114A
112B
116A
108
122
200
106A
116B
106B
128
150
126
106
124
148B
148A
146
142

FIG. 4

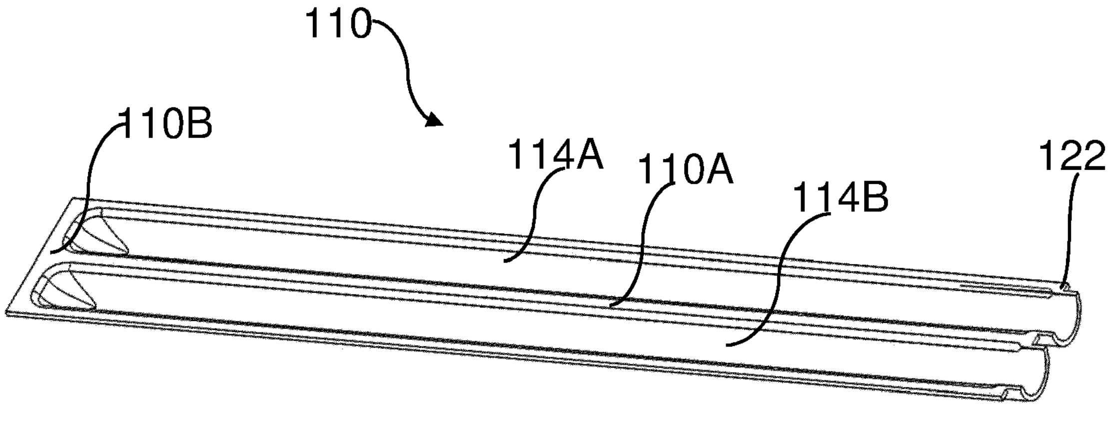
110
110B
114A
110A
114B
122

FIG. 5

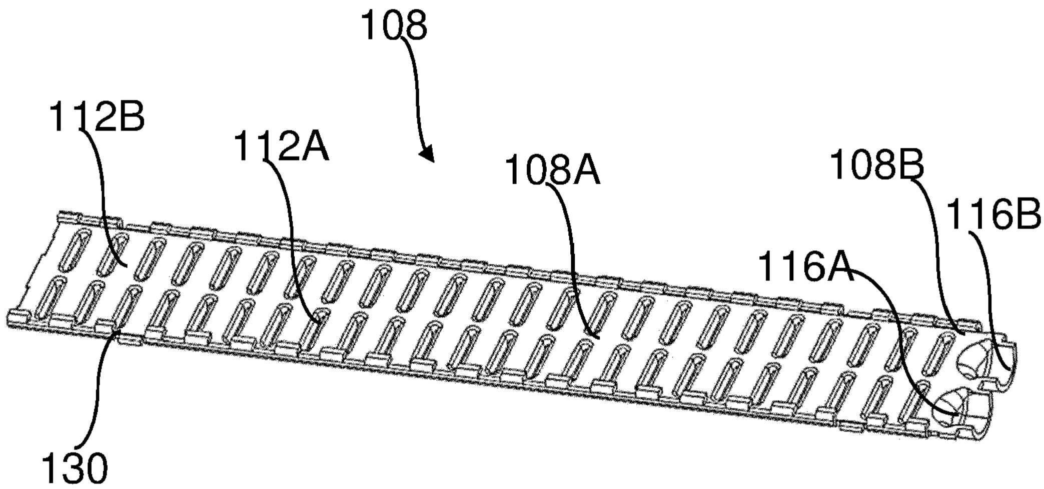
108
112B
112A
108A
108B
116B
116A
130

FIG. 6

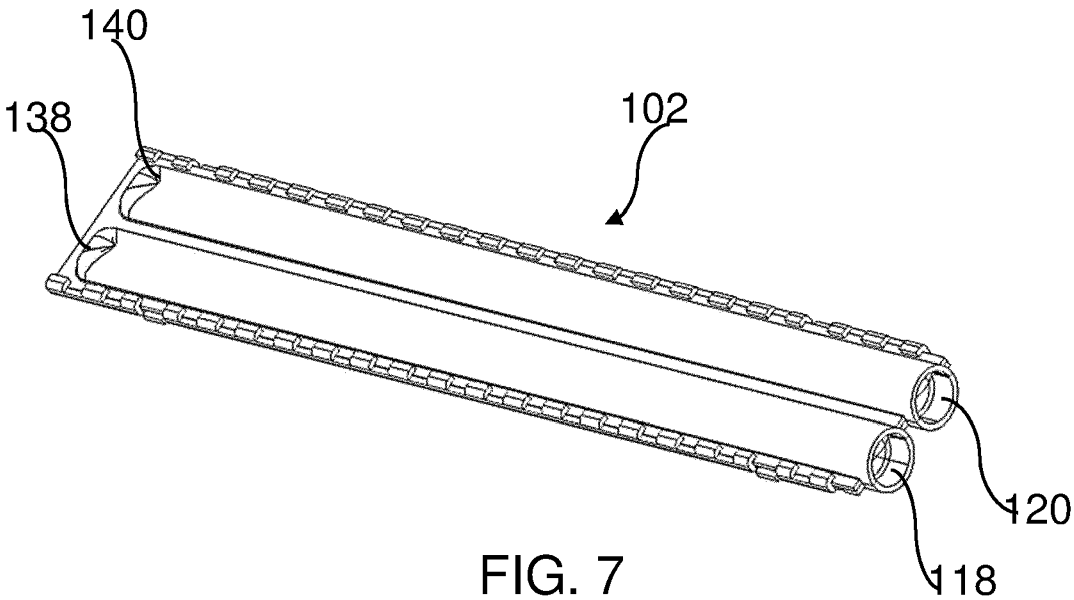
140
138
102
120
118

FIG. 7

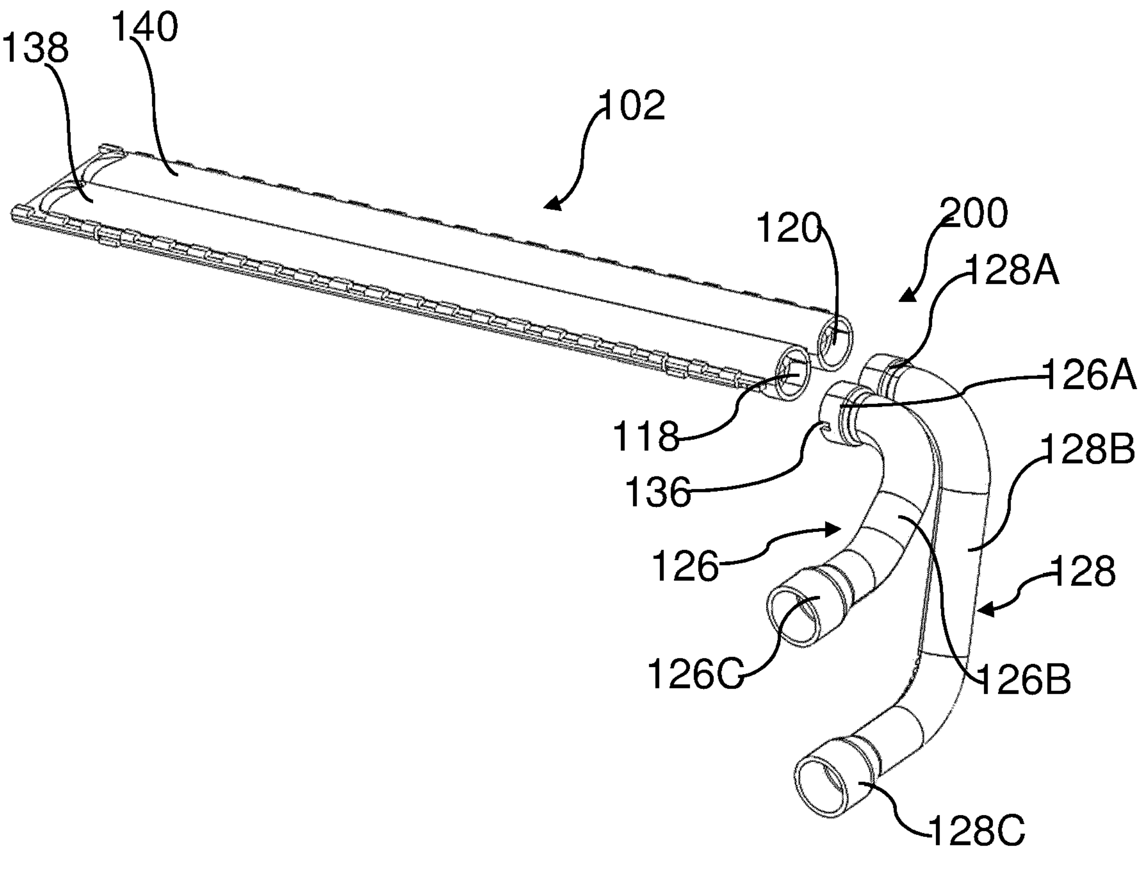
138
140
102
120
200
128A
126A
118
136
128B
126
128
126C
126B
128C

FIG. 8

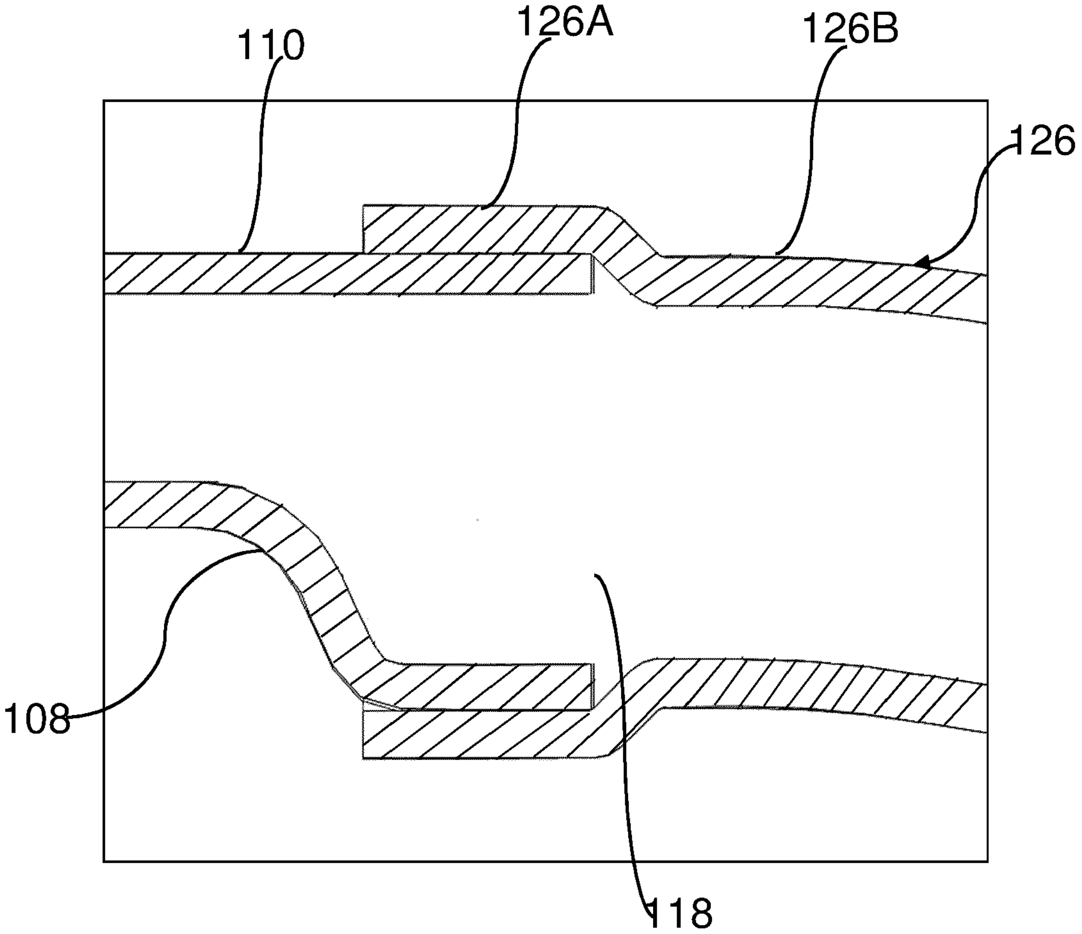

FIG. 9

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EUROPEAN SEARCH REPORT

Application Number
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F28D
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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	23 January 2023	Bain, David

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