US 20110155358A1

(19) **United States**

(12) **Patent Application Publication**

GALAHROUDI et al.

(10) **Pub. No.: US 2011/0155358 A1**

(43) **Pub. Date: Jun. 30, 2011**

(54) **HEAT EXCHANGER FOR A MOTOR VEHICLE**

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(21) Appl. No.: **12/979,227**

(22) Filed: **Dec. 27, 2010**

Related U.S. Application Data

(63) Continuation of application No. PCT/EP2009/004097, filed on Jun. 8, 2009.

(30) **Foreign Application Priority Data**

Jun. 26, 2008 (DE) 10 2008 029 958.8

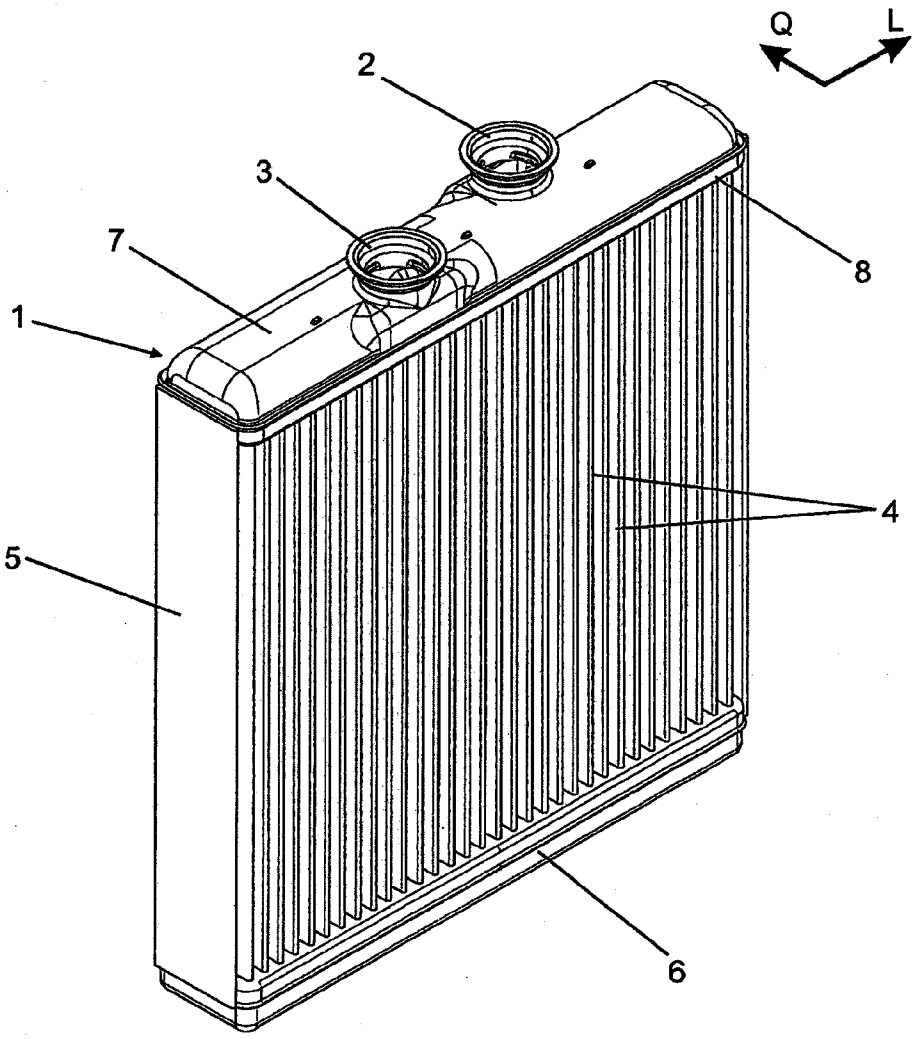
Publication Classification

(51) **Int. Cl.**
F28F 9/02 (2006.01)

(52) **U.S. Cl.** **165/173**

(57) **ABSTRACT**

A heat exchanger for a motor vehicle, the heat exchanger including a collector extending in a longitudinal direction and having a bottom and a collector box, at least two connections provided in the collector box for feeding and draining a fluid, a plurality of exchange tubes ending in the bottom of the collector, and a separator wall separating the collector into a first partial chamber on the inlet side and a second partial chamber on the outlet side, wherein the separating wall adjoins the bottom while dividing the bottom substantially symmetrically along a center line running in the longitudinal direction, and wherein the separating wall comprises a projection above the bottom, wherein at least one of the centers of the two connections has an offset relative to the center line.



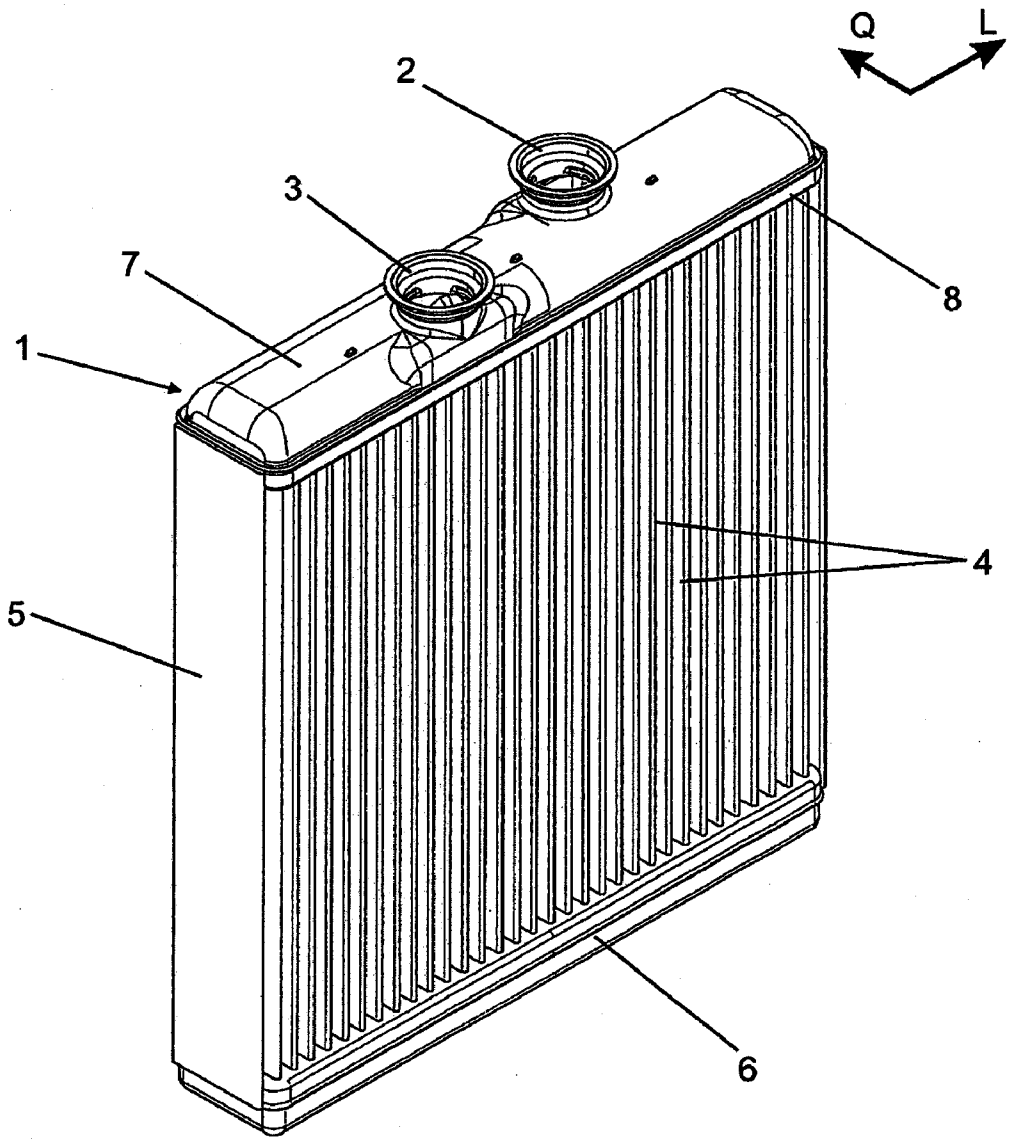


Fig. 1

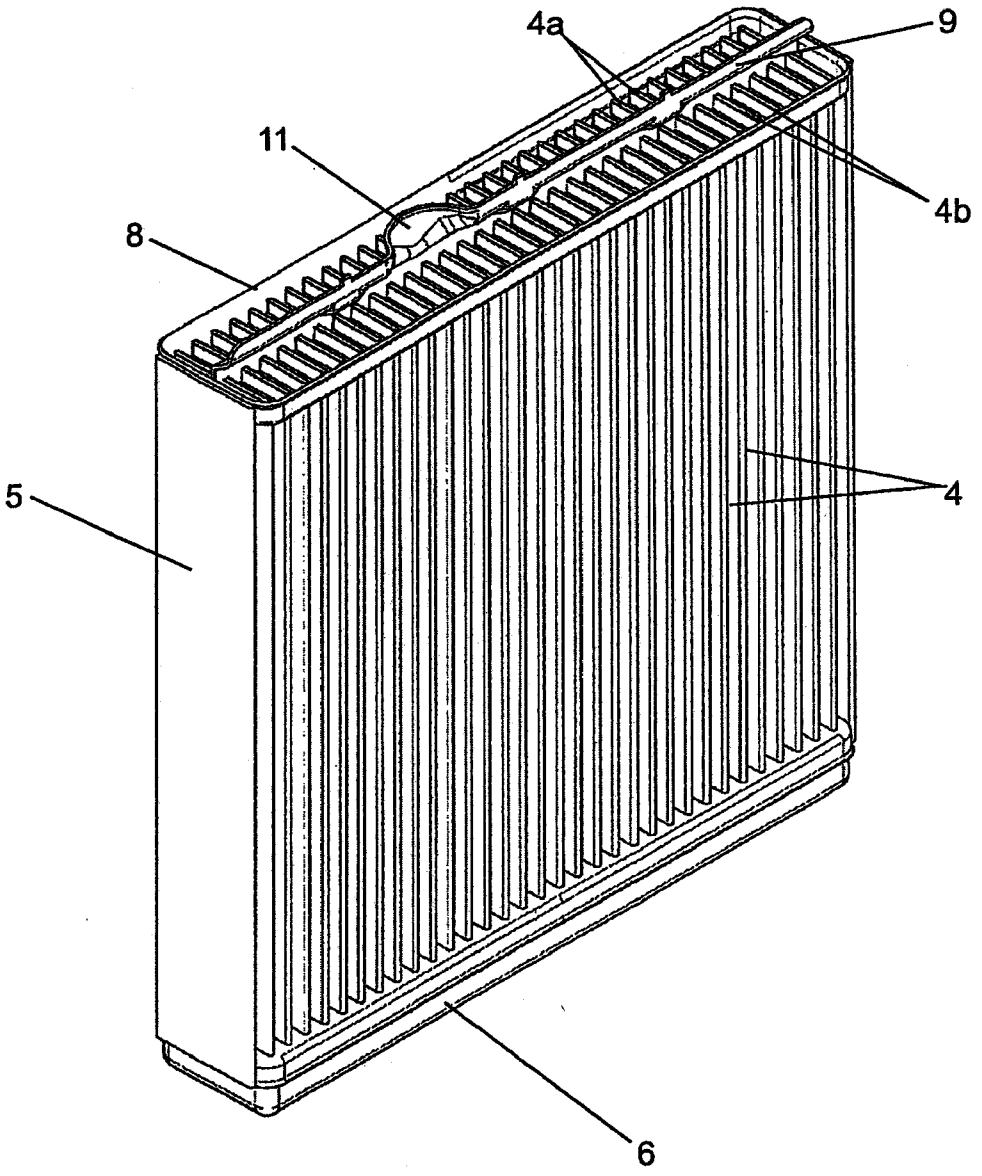


Fig. 2

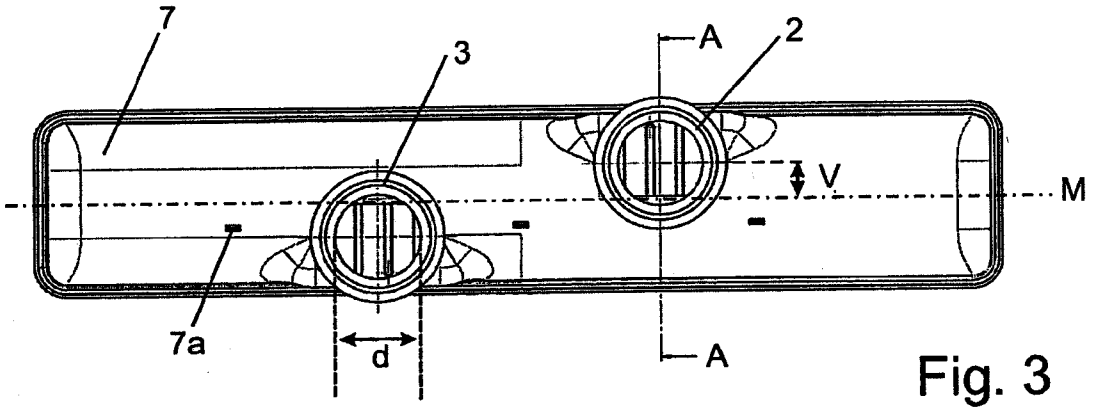


Fig. 3

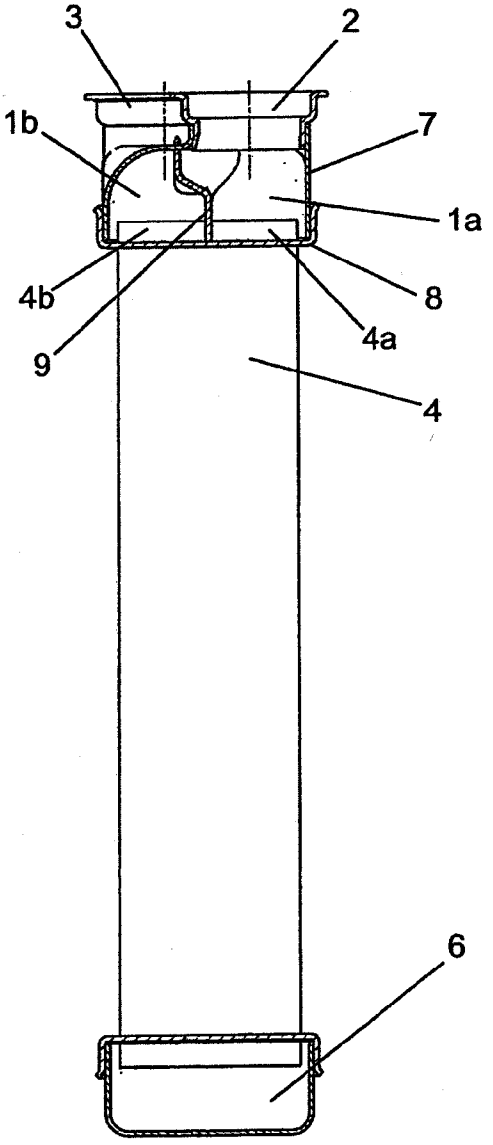


Fig. 4

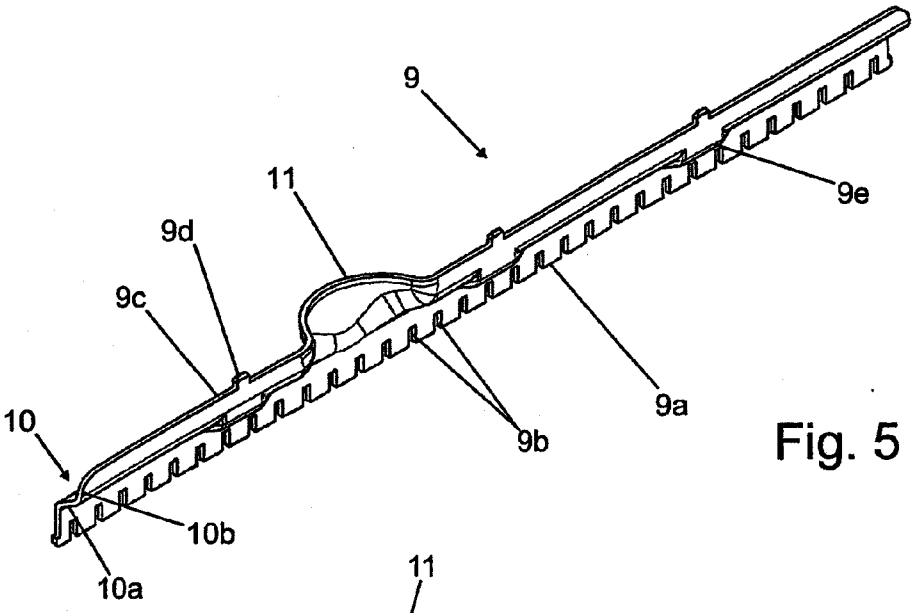


Fig. 5

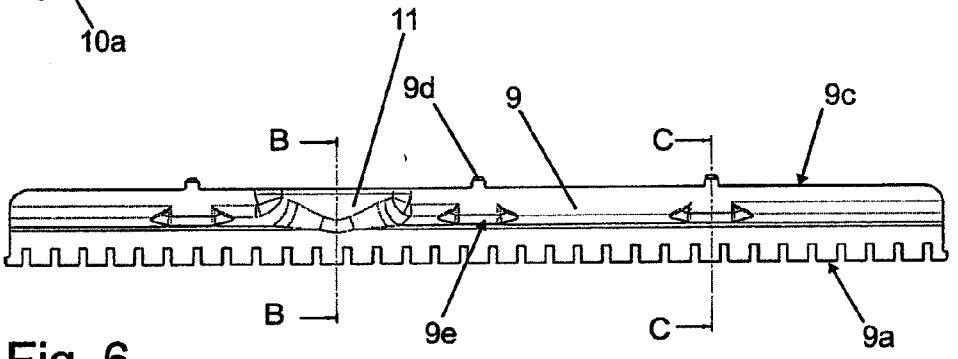


Fig. 6

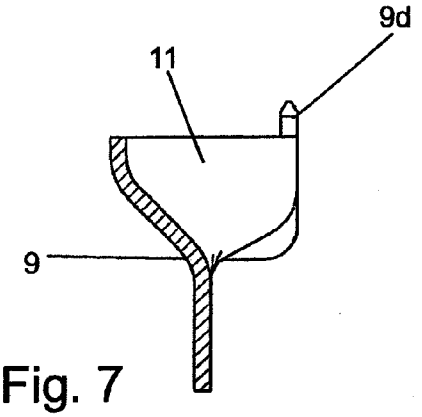


Fig. 7

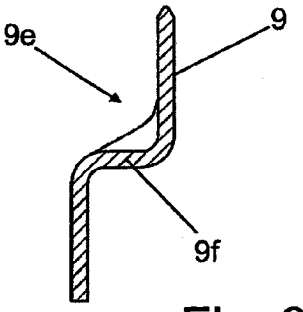


Fig. 8

HEAT EXCHANGER FOR A MOTOR VEHICLE

[0001] This nonprovisional application is a continuation of International Application No. PCT/EP2009/004097, which was filed on Jun. 8, 2009, and which claims priority to German Patent Application No. DE 10 2008 029 958.8, which was filed in Germany on Jun. 26, 2008, and which are both herein incorporated by reference.

BACKGROUND OF THE INVENTION

[0002] 1. Field of the Invention

[0003] The present invention relates to a heat exchanger for a motor vehicle.

[0004] 2. Description of the Background Art

[0005] DE 199 42 458 A1 describes a heat exchanger for a motor vehicle air conditioning system, in which, to achieve a potentially narrow design, a supplying connection and a discharging connection are disposed in a central location on a collector which is separated by a partition wall into two partial chambers on a central axis of symmetry of the heat exchanger running in the longitudinal direction. For this purpose, a partition wall dividing the collector into two partial chambers has two bent-out sections running in opposite directions via which the first connection, which is centrally disposed in one end region of the collector, is connected to only the first partial chamber, and the other connection, which is centrally disposed in the other end region, is connected only to the other partial chamber. On the whole, this limits the flexibility in disposing the connections and makes the heat exchanger assembly complex and susceptible to errors due to the bent-out formation of the partition wall.

SUMMARY OF THE INVENTION

[0006] It is therefore an object of the invention to provide a heat exchanger for a motor vehicle, in which it is possible to dispose connections in a particularly flexible and space-optimized manner.

[0007] Due to the fact that at least one of the center points of the two connections has an offset relative to the center line, it is possible to lay supplying and discharging pipes in such a way that they do not, or only slightly, protrude laterally over the heat exchanger. In addition, a component is provided for designing the projections of the partition wall while optimizing assembly and process reliability.

[0008] In an embodiment, at least one of the connections is disposed on the collector box in such a way that its free opening spans the center line, due to the projection. A particularly compact heat exchanger is thus achieved.

[0009] In an embodiment of the invention, a connecting line of the center points of the connections form an angle of at least approximately five degrees with the center line, which provides a particularly large offset of at least one of the center points of the connections relative to the center line. Due to the connections which are offset relative to each other, the tubes may be laid side by side flush with the collector box, thereby saving space.

[0010] In a further embodiment, the selected offset can be equal to at least approximately one fourth of a diameter of the free opening of the connection for the same reason. The free opening of the connection is understood to be the smallest diameter of the circle over the course of the connection, at least in the case of a circular connection opening.

[0011] It is generally advantageous if a diameter of the free opening of the at least one connection is greater than a maximum width of the partial chamber connected thereto. This also makes it possible to select a sufficiently large opening cross section, in particular if the free opening has a circular shape, in order to ensure a sufficient mass flow of the fluid for flowing through the heat exchanger. It is important to take into account the fact that heat exchangers of a very long build and limited installation space in the transverse direction, in particular, are problematic when it comes to sufficiently dimensioning the connections, in particular if a circular shape is desired. Due to the projection of the partition wall and the associated ability to dimension the connection to have a free opening that is larger than the with of a partial chamber, a sufficient fluid mass flow may be provided. This applies, for example, to a typical application in which the heat exchanger is designed as a heating element of a vehicle air conditioning system through which hot water flows.

[0012] The projection of the partition wall can include a bend around the longitudinal axis which is largely uniform over this area. A bend of this type may be easily and precisely produced from a sheet metal part, it being possible for the connection to easily overlap a center plane. In order to design the other connection of a similar or equal size, it is suitably provided that the projection has a convex portion oriented in the opposite direction from the bend in the area of the other connection. In particular, the other connection may also extend beyond a center line of the collector box via the convex portion oriented in the opposite direction.

[0013] The entire bend can run over at least half the length of the partition wall in the longitudinal direction, providing the partition wall with a dimensionally stable and easily assembled design.

[0014] In an embodiment, the partition wall can have a uniform cross sectional shape, in particular in the form of a bend, in the area of an abutment against each of opposite end faces of the collector box. When mechanically assembling the heat exchanger, this promotes a non-torsional press-fit stemming of the partition wall with the collector box and the base prior to introduction into a soldering furnace, thereby ensuring a secure and low-failure solder joint.

[0015] The partition wall can have a plurality of notches in the area of its abutment with the base for surrounding protrusions of the heat exchanger tubes, which provides a defined stop for assembling the heat exchanger and at the same time ensures a more secure and tighter clamping of the heat exchanger tubes following soldering. At the same time, the partition wall is held precisely and securely in position in the area of the base.

[0016] In an embodiment, the partition wall can have at least one, in particular multiple, tabs for attachment to the collector box in the area of its abutment with the collector box opposite the base. The partition wall particularly preferably has a projection below the at least one tab for plastic press-fit stemming of the partition wall during assembly, the projection having a section which is largely perpendicular to an assembly direction of the partition wall in an even further preferred detail design. These alternative or additional measures make it possible to ensure a particularly secure and position-accurate preassembly of the partition wall between the collector box and the base, thereby ensuring that the

individual components are soldered in a soldering furnace to form a sealing and low-failure solder joint.

[0017] The exchanger tubes of a heat exchanger according to the invention can be designed as flat tubes, each having a forward-directed section connected to a first partial chamber and a backward-directed section connected to the second partial chamber, the number of separate exchanger tubes being easily reduced thereby. In a simple and suitable detail design, a second collector is provided for deflecting the fluid from the first section of the flat tubes to the second section of the flat tubes. In principle, however, a second collector may be dispensed with, for example in that the two sections of the flat tubes are each connected to each other in a lower end area of the flat tubes.

[0018] In the interest of cost-effective mass production of a heat exchanger according to the present invention, it can be provided that at least the collector box, the connections, the base, the partition wall and the flat tubes are soldered together in a common method step or in multiple method steps in a soldering furnace. These components may suitably be each made of sheets of an aluminum alloy which are entirely or partially brazed to the individual component during the soldering process, depending on the requirements.

[0019] Further scope of applicability of the present invention will become apparent from the detailed description given hereinafter. However, it should be understood that the detailed description and specific examples, while indicating preferred embodiments of the invention, are given by way of illustration only, since various changes and modifications within the spirit and scope of the invention will become apparent to those skilled in the art from this detailed description.

BRIEF DESCRIPTION OF THE DRAWINGS

[0020] The present invention will become more fully understood from the detailed description given hereinbelow and the accompanying drawings which are given by way of illustration only, and thus, are not limitive of the present invention, and wherein:

[0021] FIG. **1** shows a spatial overall view of a heat exchanger according to the invention;

[0022] FIG. **2** shows the heat exchanger from FIG. **1**, with the omission of a collector box;

[0023] FIG. **3** shows a top view of the heat exchanger from FIG. **1**, seen from above;

[0024] FIG. **4** shows a sectional view of the heat exchanger from FIG. **3** along line A-A;

[0025] FIG. **5** shows a spatial view of a partition wall of the heat exchanger from FIG. **1**;

[0026] FIG. **6** shows a top view of the partition wall from FIG. **5**, seen from the side;

[0027] FIG. **7** shows a sectional view of the partition wall from FIG. **6** along line B-B; and

[0028] FIG. **8** shows a sectional view of the partition wall from FIG. **6** along line C-C.

DETAILED DESCRIPTION

[0029] The heat exchanger shown in FIG. **1** is a heating element of an air conditioning system of a motor vehicle through which the coolant of an engine cooling system of the motor vehicle flows. The heat exchanger includes an upper collector **1** having a first connection **2** for supplying the fluid and a second connection **3** for discharging the fluid, both connections in this case having a rotationally symmetrical design and a minimum free opening of each connection having a circular cross section. A plurality of exchanger tubes **4**, which are disposed side-by-side in a stacked manner in a longitudinal direction L and whose long side surfaces extend in a transverse direction Q or a depth direction of the heat exchanger, empty into collector **1**. Exchanger tubes **4** are each divided into multiple separated channels (not illustrated). End plates **5** are provided at the end faces of the heat exchanger to form a closure of the stack of exchanger tubes **4**.

[0030] Opposite collector **2**, exchanger tubes **4** empty into a second collector **6**, via which the fluid is deflected from a forward-directed section **4***a* to a backward-directed section **4***b* of the exchanger tubes, forward-directed section **4***a* and backward-directed section **4***b* of an exchanger tube being disposed consecutively in the transverse direction.

[0031] Fins (not illustrated) for enlarging the surface for exchanging heat with the air flowing through the heat exchanger in the transverse direction are provided in the known manner between exchanger tubes **4**.

[0032] The heat exchanger is made entirely of partially brazed aluminum components which are mechanically preassembled and soldered together as a whole in a single method step or in multiple method steps in a soldering furnace. Prior to soldering, collector **1** largely includes the individual parts of connections **2**, **3** of a collector box **7** of a base **8** and a partition wall **9** extending between base **8** and collector box **7**. The collector chamber enclosed by collector box **7** and base **8** is divided by partition wall **9** into to partial chambers **1***a*, **1***b* (see FIG. **4**), one partial chamber **1***a* being connected to first connection **2** and first section **4***a* of the exchanger tubes, and second partial chamber **1***b* being connected only to second connection **3** and second section **4***b* of the exchanger tubes.

[0033] For this purpose, partition wall **9**, which extends in the longitudinal direction of the heat exchanger, adjoins base **8** by a base-side edge **9***a* along a center line M, so that collector **1** is divided precisely in half into partial chambers **1***a*, **1***b* in the area of the base of collector **1** (see FIG. **4**).

[0034] In the area of edge **9***a*, partition wall **9** also encompasses notches **9***b* with which flat tubes **4** inserted through openings in base **8** engage by their center areas, thereby ensuring a simple holding action, positioning and sealing solder joint.

[0035] Above base-side edge **9***a*, partition wall **9** includes a protection along most of its length, in the manner of a bend **10** around the longitudinal direction, a first folded edge **10***a* being formed at an approximately 45° angle in one direction and a second folded edge **10***b* being formed by approximately the same angle in the opposite direction, so that an edge **9***c* of the partition wall adjacent to collector box **7** and opposite base **8** is also positioned largely perpendicular to the surface of collector box **7**.

[0036] A total of three tabs **9***a*, which engage with corresponding openings **7***a* (see FIG. **3**) in collector box **7**, are provided on this edge **9***a*, so that a secure positioning and press-fit stemming or attachment of the partition wall is ensured during mechanical assembly of the heat exchanger. To further improve press-fit stemming, box-shaped projections **9***e*, which according to the sectional view in FIG. **8** have a section **9***f* perpendicular to the assembly direction of the partition wall, are provided beneath tabs **9***d* in the area of bend **10**.

[0037] One of the two connections **2** is positioned above bend **10** of partition wall **9**, a diameter d of its free opening being greater than the width of partial chambers **4***a*, **4***b* on the plane of the base of collector **1**. This is made possible by the fact that upper edge **9***c* of partition wall **9** on the collector box side adjoins collector box **7** in a manner which is laterally offset from the plane of symmetry, due to bend **10**.

[0038] Opposite a center line M or the position of lower edge **9***a* of partition wall **9**, a center point of the free opening of connection **2** is disposed in a laterally offset manner by a variable V which, in the present exemplary embodiment, is approximately one third diameter d of the free opening.

[0039] The other connection **3** in the present example is disposed by same offset V from the center line and also spans the center line by its free opening. This is made possible by the fact that partition wall **9** has a convex portion **11** opposite bend **10** in the area of second connection **3** (see FIG. **5**). Convex portion **11** is limited to a short section of partition wall **9** and adjoins collector box **7** on the cover side largely in the form of a semicircle.

[0040] Due to bend **10**, which is present over most of the length of partition wall **9**, and convex portion **11**, which is positioned at only one location, connections **2**, **3** may be easily positioned in nearly any manner in the longitudinal direction of collector **1** by modifying the partition wall specifically illustrated. In the present example, the two connections **2**, **3** lie relatively close to each other in the central area of collector **1**, a connecting line of their center points with the longitudinal direction and the center line of the heat exchanger forming an angle of approximately 15°.

[0041] A further feature of partition wall **9** lies in the fact that partition wall **9** adjoins both end faces of collector box **7** by bend **10** formed in the same direction, so that a twisting or torsion of the partition wall is avoided during mechanical preassembly.

[0042] The invention being thus described, it will be obvious that the same may be varied in many ways. Such variations are not to be regarded as a departure from the spirit and scope of the invention, and all such modifications as would be obvious to one skilled in the art are to be included within the scope of the following claims.

What is claimed is:

1. A heat exchanger for a motor vehicle, comprising:

a collector extending in a longitudinal direction and having a base and a collector box;

at least two connections arranged in the collector box that are configured to supply and discharge a fluid;

a plurality of exchanger tubes emptying into the base of the collector; and

a partition wall configured to divide the collector into a first partial chamber on an inlet side and a second partial chamber on an outlet side, the partition wall adjoining the base, while dividing the base largely symmetrically along a center line running in the longitudinal direction, the partition wall having a projection arranged above the base,

wherein at least one of the center points of the two connections has an offset relative to the center line.

2. The heat exchanger according to claim **1**, wherein at least one of the connections is disposed on the collector box, a free opening thereof spanning the center line, due to the projection.

3. The heat exchanger according to claim **1**, wherein a connecting line of the center points of the connections forms an angle of at least five degrees with the center line.

4. The heat exchanger according to claim **1**, wherein the offset is at least one fourth of a diameter of a free opening of the connection.

5. The heat exchanger according to claim **1**, wherein a diameter of a free opening of the at least one connection is greater than a maximum width of the partial chamber connected thereto.

6. The heat exchanger according to claim **1**, wherein, in an area of one of the connections, the projection of the partition wall has a bend around the longitudinal axis which is substantially uniform over the area.

7. The heat exchanger according to claim **6**, wherein the projection has a convex portion oriented away from the bend in the area of the other connection.

8. The heat exchanger according to claim **6**, wherein the total bend runs along at least half the length of the partition wall.

9. The heat exchanger according to claim **1**, wherein the partition wall has a plurality of notches in an area of its abutment with the base for surrounding the protrusions of the exchanger tubes.

10. The heat exchanger according to claim **1**, wherein the partition wall has at least one tab or a plurality of tabs in an area of its abutment with the collector box opposite the base for attachment to the collector box.

11. The heat exchanger according to claim **10**, wherein the partition wall has a projection beneath the at least one tab for plastic press-fit stemming of the partition wall during an assembly.

12. The heat exchanger according to claim **11**, wherein the projection has a section that is substantially perpendicular to an assembly direction of the partition wall.

13. The heat exchanger according to claim **1**, wherein the exchanger tubes are designed as flat tubes, each having a forward-directed section connectable to the first partial chamber and a backward-directed section connectable to the second partial chamber.

14. The heat exchanger according to claim **13**, further comprising a second collector configured to deflect the fluid from the first section of the flat tubes to the second section of the flat tubes.

15. The heat exchanger according to claim **1**, wherein at least the collector box, the connections, the base, the partition wall, and the exchanger tubes are soldered to each other in a common method step or in multiple method steps in a soldering furnace.

* * * * *