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Heat exchanger for a motor vehicle

Abstract

The main object of the invention is a heat exchanger including a first header plate of an inlet manifold, a second header plate of a distribution header and a heat exchange core bundle extending between the first header plate and the second header plate along a longitudinal direction, the heat exchange core bundle being defined by a shell and having a plurality of tubes arranged successively next to each other in a transverse direction, each tube being capable of cooperating with the header plates via through-holes formed in each plate. The shell has at least one longitudinal end with a straight edge configured to be in flat surface contact with at least one header plate in a contact area, the surface contact occurring mainly in a plane perpendicular to the longitudinal direction.

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Background/Summary

CROSS-REFERENCE TO RELATED APPLICATIONS
(1) This application is filed under 35 U.S.C. § 371 U.S. National Phase of International Application No. PCT/EP2021/056998 filed Mar. 18, 2021 (published as WO2021185987), which claims priority benefit to French Application No. 2002730 filed on Mar. 20, 2020, the disclosures of which are herein incorporated by reference in their entirety.
TECHNICAL FIELD
(2) The invention relates to a heat exchanger for a motor vehicle, and it relates more particularly to a heat exchanger liable to cool the supply air of the vehicle engine.
BACKGROUND OF THE INVENTION
(3) Such an exchanger may have an intake manifold and a distribution manifold framing a heat-exchange core that is able to channel fluids and that is configured to allow an exchange of heat between the fluids when they cross in the heat exchanger.
(4) The heat-exchange core comprises tubes in which a first fluid passing through the heat exchanger circulates, the second fluid being guided to circulate between the tubes. It is thus at these tubes that the gases are cooled, notably by an exchange of heat energy with a cooling fluid that is advantageously a heat-transfer fluid. In other words, the cooling fluid circulates through the heat-exchange core, between the tubes, and thus contributes to the cooling of the gases circulating in the tubes.
(5) The heat-exchange core thus has a sealed internal volume in which the cooling fluid circulates. It is known to delimit this internal volume by way of three groups of elements, namely by way of the intake and distribution manifolds, by way of a first and a last tube extending at ends of the heat-exchange core and by way of a shell surrounding the tubes of the heat exchanger.
BRIEF SUMMARY OF THE INVENTION
(6) In order to avoid any leakage zone of the cooling fluid, particular attention is given to the connecting zones between the various components that delimit the internal volume of the heat-exchange core, so as to notably prevent the cooling liquid from being able to leak out of the heat exchanger at these connecting zones.
(7) The invention lies within this context, and concerns a heat exchanger comprising a first header plate of an intake manifold, a second header plate of a distribution manifold and a heat-exchange core extending between the first header plate and the second header plate along a longitudinal direction, the heat-exchange core being delimited by a shell and comprising a plurality of tubes that are disposed successively next to one another in a transverse direction, each tube being able to cooperate with the header plates via through-orifices that are produced in each plate, characterized in that the shell has at least one longitudinal end with a straight edge configured to be in planar surface contact with at least one header plate in a contact zone, the surface contact being realized mainly in a plane perpendicular to the longitudinal direction.
(8) The invention thus relates to a heat exchanger whose function is to cool a first fluid notably by

virtue of a second fluid. When the heat exchanger is put into position, the intake manifold receives the first fluid, this fluid then passes through the heat-exchange core to the distribution manifold. While passing through the heat-exchange core, the first fluid is cooled by a second fluid, the cooled first fluid then arriving at the distribution manifold.
(9) The second fluid is guided in circulation in the heat-exchange core by virtue of the shell of the heat-exchange core. This requires the heat exchanger to be sealed in order to prevent the second fluid from leaking out of the heat exchanger.
(10) Surface contact is understood to mean contact which extends at least in one plane, this plane in this case being a plane substantially perpendicular to the longitudinal direction.
(11) The shell is thus in contact with at least one of the manifolds, and advantageously both manifolds, in a plane perpendicular to the longitudinal direction. During the mounting of the header plate on the heat-exchange core, the end with a straight edge of the shell makes it possible to push the header plate all the way in as far as the stop and thus to ensure that the header plate is as close as possible to the shell before the brazing operation.
(12) According to an optional feature of the invention, the shell is also in planar surface contact with the at least one header plate in a plane parallel to the longitudinal direction.
(13) According to another optional feature of the invention, the tubes are disposed successively next to one another in the transverse direction and wherein the shell has at least one transverse wall which extends in this transverse direction while being in contact with each of the tubes, the surface contact between header plate and tube being formed at the longitudinal end of this transverse wall.
(14) According to another optional feature of the invention, the header plate has a perforated wall, in which the through-orifices are produced, and a frame arranged at the periphery of the perforated wall and configured to cooperate with the shell.
(15) According to various optional features of the invention, taken alone or in combination, it may be provided that: the perforated wall has, in the vicinity of each through-orifice, a clearance formed by a rounded edge or a chamfer, and wherein the at least one longitudinal end with a straight edge of the shell comprises at least one protuberance which extends the shell along the longitudinal direction and which has a shape and dimensions complementary to the clearance; each protuberance has a transverse dimension substantially equal to the transverse dimension of the tube disposed in the corresponding contact zone; each protuberance has a vertical dimension C smaller than the vertical dimension of the transverse wall; the plurality of tubes of the heat-exchange core comprises at least one first tube and a last tube that are disposed respectively at each transverse end of the plurality of tubes, the shell comprising at least one first protuberance in contact with the first tube and a second protuberance in contact with the last tube.
(16) A protuberance is understood to mean an extension of the shell from one of its longitudinal ends. The main function of the protuberance is to reinforce the sealing function of the shell, notably by positioning it in a space where the second fluid may leak. In this way, the protuberance is configured to be positioned at one of the contact zones of the shell with the intake and/or distribution manifold.
(17) The protuberance may be of one piece with the shell. The term “of one piece” is understood to mean that the protuberance and the shell can only be separated by destruction of one of the two elements.
(18) The protuberance at least partially extends one of the longitudinal ends of the shell along the longitudinal direction, but the protuberance may also extend along another direction. For example, the protuberance may extend along a direction parallel to the direction in which the plurality of tubes are aligned.
(19) According to an optional feature of the invention, the perforated wall is pressed locally, around each of the through-openings, so as to have a rolled end edge forming a border protruding from the perforated wall and to increase the contact surface with the tubes.
(20) According to an optional feature of the invention, the shell has a first longitudinal end with a

straight edge in contact with the first header plate at a first contact zone and a second longitudinal end with a straight edge in contact with the second header plate at a second contact zone.
(21) Each of the longitudinal ends of the shell is in contact with either the header plate associated with the intake manifold or the header plate associated with the distribution manifold, thus forming a first contact zone at the intake manifold and a second contact zone at the distribution manifold.
(22) As has been specified above, at least one of the contact zones of the shell is a surface contact in a plane perpendicular to the longitudinal direction. Thus, the first contact zone or the second contact zone reproduces a surface contact in a plane perpendicular to the longitudinal direction in accordance with the invention.
(23) Advantageously, each contact zone of the shell with the intake manifold and the distribution manifold is a surface contact in a plane perpendicular to the longitudinal direction.

Description

BRIEF DESCRIPTION OF THE DRAWINGS
(1) Further features, details and advantages of the invention will become more clearly apparent from reading the following description, and from a number of exemplary embodiments given by way of nonlimiting indication, with reference to the appended schematic drawings, in which:
(2) FIG. **1** is a perspective representation of a heat exchanger according to the invention;
(3) FIG. **2** is an exploded view of the various components of the heat exchanger in FIG. **1**;
(4) FIG. **3** is a longitudinal section of the heat exchanger in FIG. **1**;
(5) FIG. **4** is a detail of a longitudinal section of the heat exchanger in FIG. **1**, rendering a shell, a header plate and a tube of this exchanger more visible; and
(6) FIG. **5** is a perspective representation of a longitudinal end of a tube, rendering visible a longitudinal end edge of the shell and a protuberance in accordance with one aspect of the invention.
DETAILED DESCRIPTION OF THE INVENTION
(7) The features, variants and different embodiments of the invention may be combined with one another, in various combinations, as long as they are not mutually incompatible or mutually exclusive. In particular, variants of the invention can be contemplated that only comprise a selection of features that are described hereafter independently of the other features described, if this selection of features is sufficient to provide a technical advantage and/or to differentiate the invention from the prior art.
(8) FIG. **1** illustrates a heat exchanger **1** according to the invention, for a motor vehicle and which may notably constitute a cooling radiator of an engine or a heating radiator of the passenger compartment of this vehicle.
(9) The heat exchanger **1** adopts the overall shape of a rectangular parallelepiped and comprises at least one intake manifold (not shown here) able to be fixed to a first header plate **2**, a distribution manifold (not shown here) able to be fixed to a second header plate **4** and a heat-exchange core **6** extending between the intake manifold and the distribution manifold along a longitudinal direction A. The heat-exchange core **6** is notably configured to allow an exchange of heat between a first fluid and a second fluid.
(10) The first fluid may be, for example, the charge air intended to supply the engine of the vehicle, and the second fluid may be a cooling liquid or air depending on whether the heat exchanger is of the air-water type or of the air-air type.
(11) The first header plate **2** and the second header plate **4** each represent an opposite face of the rectangular parallelepiped, the heat-exchange core **6** being disposed between these header plates **2**, **4** and formed, as will be described below, by an external shell **38** and a plurality of tubes **24** that are arranged in parallel with one another inside this shell **38**. The heat-exchange core **6** is such that the

first fluid is made to circulate inside each of the tubes and the second fluid is made to circulate between the tubes, the heat exchange taking place from one fluid to the other at the tubes.
(12) With reference notably to FIGS. **1** and **2**, the first header plate **2** and the second header plate **4** are mutually symmetrical with respect to the heat-exchange core **6** and to the longitudinal direction A. In this way, a feature described for one header plate will also be applicable to the other header plate, whether the latter is intended to be secured to the intake manifold or to the distribution manifold. In addition, the general term "header plate **2**, **4**" will refer equally to the first header plate **2** and to the second header plate **4** in the rest of the description.
(13) The header plate **2**, **4** extends mainly in a plane perpendicular to the longitudinal direction A, the main dimension of the header plate **2**, **4** being measured along a transverse direction B perpendicular to the longitudinal direction A.
(14) The header plate **2**, **4** comprises a perforated wall **8** delimited at the periphery by a frame **10**. More particularly, the header plate **2**, **4** has a plurality of bars that are arranged parallel to one another, perpendicularly with respect to the transverse direction B, while extending between two opposite edges of the frame **10** so as to define a plurality of through-openings **12** through which a fluid, and notably the charge air intended to supply the engine of the vehicle, can circulate. These through-openings **12** are in this case represented with an elongated shape, such as a rectangle for example, the greatest dimension of which is measured along a vertical direction C perpendicular to the longitudinal A and transverse B directions. Each through-opening **12** is dimensioned so as to receive the end of one of the tubes **24** that form part of the heat-exchange core **6** and as will be described below. It is thus understood that the fluid made to pass through the manifold and the corresponding through-openings **12** originates from the tubes **24** or is directed inside the tubes **24**, depending on whether the manifold is an inlet or outlet manifold.
(15) The frame **10** forms an extension of the periphery of the perforated wall **8** along the longitudinal direction A, over the entire perimeter of this perforated wall **8**. More particularly, the frame **10** has a first portion **21** which directly extends the perforated wall **8** and which extends in the direction of the interior of the heat exchanger **1**, that is to say in the direction of the heat-exchange core **6**, while forming a bowl surrounding the perforated wall **8**, and it also comprises a second portion **22** which directly extends the first portion **21** and which extends longitudinally away from the heat-exchange core **6** while having a free end edge. The free end edge of the second portion **22** is configured to cooperate with the aforementioned supply circuit and/or the engine, whereas the first portion **21** is configured to be in contact with the heat-exchange core **6**.
(16) As illustrated more particularly in FIG. **2**, the heat-exchange core **6** of the heat exchanger **1** comprises at least a plurality of tubes **24** and a shell **38**.
(17) The tubes **24** are arranged parallel to one another, each of the tubes **24** extending longitudinally between the intake manifold and the first header plate **2** and the distribution manifold and the second header plate **4** through the heat-exchange core **6**. The tubes **24** are arranged successively next to one another such that it is possible to distinguish a first tube **26**, disposed at one transverse end of this plurality of tubes **24**, and a last tube **28**, disposed at the opposite transverse end of this plurality of tubes **24**.
(18) Each tube **24** extends longitudinally between a first end **30** and a second end **32** and is disposed in the heat-exchange core **6** such that the first end **30** is in contact with the first header plate **2** and the second end **32** is in contact with the second header plate **4**. Each end **30**, **32** of these tubes **24** goes beyond the corresponding through-opening **12** such that the tubes **24** thus open into the intake or distribution manifold and permit the passage of fluid between these manifolds and the heat-exchange core **6**. Three first ends **30** are visible in FIG. **1**, the other tubes **24** not having been represented so as to render the position of the tubes **24** through the header plate **2**, **4** visible.
(19) Each tube **24** extends along the longitudinal direction A, between the one through-opening **12** of the first header plate **2** and a corresponding through-opening **12** of the second header plate **4** of the distribution manifold.

(20) To make the figures easier to understand, only four tubes of the plurality of tubes **24** are represented in this case in FIG. **2**, including the first tube **26** and the last tube **28**. However, the plurality of tubes **24** generally comprises as many tubes **24** as the number of through-openings **12** in the header plates **2**, **4**, each tube **24** connecting a through-opening **12** of the first header plate **2** to the corresponding through-opening **12** of the second header plate **4**.
(21) Each tube **24** has a shape similar to that of the other tubes **24**, namely the shape of a flat tube in this case, a section of each tube **24** corresponding to the section of a through-opening **12** of the header plates **2**, **4**. More specifically, the section of each tube **24** has a rectangular overall shape, the greatest dimension of which is measured along the vertical direction C. In this way, each tube **24** has two end faces **34** that are situated opposite to one another, in the vertical direction in this case, and two main faces **36** that connect the end faces **34**.
(22) The shell **38** is intended to surround the plurality of tubes **24** and to seal the zone defining the heat-exchange core **6**. More particularly, the shell **38** comprises two lateral walls **40**, only one of the two lateral walls **40** being visible in FIG. **2**, and two transverse walls **42**, **44** which each extend longitudinally between, on the one hand, the intake manifold and the first header plate **2** and, on the other hand, the distribution manifold and the second header plate **4**.
(23) Each of the lateral walls **40** extends in a plane parallel to the longitudinal A and vertical C directions, one of these lateral walls **40** being disposed on an external main face of the last tube **28** of the plurality of tubes **24**, whereas the other lateral wall **40** is disposed on an external main face of the first tube **26** of the plurality of tubes **24**. It is understood that the external main face of the first tube **26** and the external main face of the last tube **28** face away from one another, toward the outside of the heat-exchange core **6**, such that the lateral walls **40** of the shell **38** transversely frame the plurality of tubes **24**.
(24) The transverse walls **42**, **44** each extend in a plane parallel to the longitudinal A and transverse B directions. These transverse walls **42**, **44** extend between the header plates **2**, **4** along the longitudinal direction A and between the lateral walls **40** along the transverse direction B. The transverse walls **42**, **44** vertically frame the plurality of tubes **24**.
(25) Each transverse wall **42**, **44** comprises a planar portion intended to be placed against the end faces **34** of the tubes **24** and a pressed part **48** forming a fluid circulation molding which extends mainly perpendicularly with respect to the direction of elongation of the tubes **24**, namely the longitudinal direction in this case. This pressed part forms a part curved toward the outside of the heat-exchange core **6**, and it has a fluid inlet **52** or outlet **46** equipped with a circular orifice **50**, **56** through which the fluid enters or exits the fluid circulation molding. The pressed part **48**, **54** extends over the entire dimension of the corresponding transverse wall **42**, **44** along the transverse direction B, the fluid circulation molding **48** making it possible to distribute the fluid passing into the heat-exchange core **6** between each of the tubes **24** or to recover all of the fluid circulating between each of the tubes **24** depending on whether the transverse wall and its circulation molding are associated with a fluid inlet or a fluid outlet.
(26) The disposition of the lateral walls **40** and transverse walls **42**, **44** of the shell **38** delimits an internal volume of the heat-exchange core **6**, in which the plurality of tubes **24** extends and inside which the first fluid and the second fluid circulate, inside the tubes **24** and between the tubes **24**, respectively.
(27) The transverse walls **42**, **44** of the shell **38** have a first longitudinal end **60** liable to be in contact with the first portion **21** of the first header plate **2** and a second longitudinal end **62** liable to be in contact with the first portion **21** of the second header plate **4**.
(28) As can notably be seen in FIG. **3**, this contact between the longitudinal ends **60**, **62** of the transverse walls **42**, **44** of the shell **38** and the first portions **21** of the header plates **2**, **4** makes it possible to form contact zones **64** which seal the junction of the heat-exchange core **6** and the manifolds via the header plates **2**, **4** and which thus make it possible to seal the circulation of the second fluid between the tubes **24**.

(29) To ensure the sealing of the internal volume of the heat-exchange core **6**, each header plate **2**, **4** comprises, at its first portion **21**, a recess **82** with a shape which is complementary to that of a longitudinal end **60**, **62** of the transverse walls **42**, **44** of the shell **38**.
(30) Each contact zone **64** between one of the longitudinal ends **60**, **62** of the shell **38** and one of the first portions **21** of the header plates **2**, **4**, at a recess **82**, is similar, that is to say that the contact is realized in an identical manner. Thus, a feature described for one of these contact zones **64** is applicable to the other contact zones **64**. In addition, the term "longitudinal end **60**, **62**" will be used to refer equally to the first and second longitudinal ends **60**, **62** of each transverse wall **42**, **44** of the shell **38** of the heat-exchange core **6** in the rest of the description.
(31) A contact zone **64** between the recess **82** defined in the first portion **21** of a header plate **2**, **4** and a longitudinal end **60**, **62** of the shell **38** of the heat-exchange core **6** will now be described more particularly.
(32) With reference to FIG. **4**, the first portion **21** is formed successively by an external wall **68**, which extends in the longitudinal extension of the second portion **22**, by a bottom wall **70**, which forms the bottom of the aforementioned cavity while extending the external wall **68** in a substantially perpendicular manner in the direction of the interior of the header plate **2**, **4**, namely toward the perforated wall **8**, and finally by a fold-over wall **72**, which extends the bottom wall **70** in a perpendicular manner, facing the external wall **68** and as far as the perforated wall **8**.
(33) As illustrated in FIG. **4**, the perforated wall **8** is pressed locally, around each of the through-openings **12**, so as to have an end edge rolled toward the interior of the corresponding header plate **2**, **4**, that is to say in the direction of the second portion **22**. In other words, the perforated wall **8** has, at the perimeter of each through-opening, a border **83** which forms a protrusion of the perforated wall **8** and which elongates the contact surface with the tubes **24** inside the corresponding header plate. This results in a corresponding clearance **85** on the opposite face of the perforated wall **8**, that is to say an internal face **76** of the perforated wall **8** facing toward the heat-exchange core **6**, this clearance **85** notably making it easier to insert the tube in the corresponding through-opening.
(34) The recess **82**, which is dimensioned to receive the corresponding longitudinal end **60**, **62**, is formed between the end faces **34** of the tubes **24**, the internal face **74** of the fold-over wall **72** and the internal face **76** of the perforated wall **8**, said internal faces facing toward the heat-exchange core **6**.
(35) The transverse wall **42**, **44** intended to be positioned in the recess **82** is configured, according to the invention, to be in contact with the corresponding header plate **2**, **4**, in a planar surface contact produced in a plane perpendicular to the longitudinal direction A. To this end, the transverse wall **42**, **44** has a straight edge at each longitudinal end **60**, **62**, that is to say an edge perpendicular to the main, in this case longitudinal and transverse, plane of elongation of the transverse wall **42**, **44**. As will be described below, an inclined plane forming a ramp may be locally provided at this straight edge, but it should be noted that the major part of the longitudinal end has the form of this straight edge, that is to say extending in a plane perpendicular to the main plane of elongation of the transverse wall **42**, **44**.
(36) More specifically, the longitudinal end **60**, **62** of one of the transverse walls **42**, **44** of the shell **38**, once it has been positioned in the recess **82**, is in contact at least with the internal face **76** of the perforated wall **8**, this contact being produced at least in a plane parallel to the transverse B and vertical C directions. The longitudinal end **60**, **62** and the perforated wall **8** thus define a contact zone **64**, the latter extending continuously along the transverse direction B between the first tube **26** and the last tube **28**. This contact zone **64** contributes to sealing the internal volume of the heat-exchange core **6**, at least at the transverse walls **42**, **44** of the shell **38** and the individual header plates **2**, **4** for admitting and distributing fluid.
(37) The sealing is notably ensured by a brazing operation carried out in a suitable furnace, which tends to ensure the contact between the straight edge of the longitudinal ends of the transverse

walls **42**, **44** and the internal face **76** of the perforated wall **8**.
(38) The brazing operation also makes it possible to secure the transverse walls **42**, **44** of the shell **38** to the end faces **34** of at least the first and the last tube **26**, **28** of the plurality of tubes **24**, the contact extending substantially along the longitudinal direction A between each of the longitudinal ends **60**, **62** of the transverse walls **42**, **44**, so as to again ensure the sealing of the internal volume of the heat-exchange core **6**.
(39) According to an alternative embodiment, the end faces **34** of other tubes **24** of the plurality of tubes **24** may also be in contact with the transverse walls **42**, **44** of the shell **38**, these contacts contributing to the delimitation of partially enclosed spaces of the internal volume of the heat-exchange core **6**.
(40) Furthermore, the brazing operation may also make it possible to secure the longitudinal end **60**, **62** of the transverse wall **42**, **44** to the fold-over wall **72** of the header plate **2**, **4**, the contact being produced at least in a plane parallel to the longitudinal A and transverse B directions.
(41) According to the invention, the shapes and the dimensions of the recess **82** and also of the longitudinal end **60**, **62** of the transverse wall **42**, **44** make it possible to insert the transverse wall **42**, **44** in the recess until the surface contact between longitudinal end and perforated wall **8** is effective and forms a stop with respect to the movement. It is thus ensured that the transverse wall **42**, **44** is inserted correctly before the brazing operation, that is to say that the transverse wall **42**, **44** is close enough to the perforated wall **8** that the brazing operation is effective and makes it possible to ensure the sealing of the heat-exchange surface.
(42) According to the invention, and as can be seen in FIGS. **4** and **5**, the shell **38** comprises at least one protuberance **84** which locally extends the shell **38** along the longitudinal direction A. More specifically, each protuberance **84** locally extends a longitudinal end **60**, **62** of a transverse wall **40**, **42** of the shell **38**, it being understood that this longitudinal end **60**, **62** retains a shape that is predominantly planar and perpendicular to the main plane of elongation of the transverse wall **42**, **44**.
(43) The at least one protuberance **84** protrudes from the longitudinal end **60**, **62** and is configured to fill the clearance **85** present between the perforated wall **8** and the corresponding tube **24**. As has been specified above, the border of the perforated wall **8** contributing to the delimitation of a through-opening **12** is bent such that a pressing radius contributes to the delimitation of a clearance **85** forming, between the tube **24** and the longitudinal end **60**, **62** of the shell **38**, a leakage space. Hence, the protuberance **84** of the longitudinal end **60**, **62** is accommodated in this leakage space by exhibiting a structural complementarity with each of the components delimiting this space.
(44) An internal surface **410** of the transverse wall **42**, **44** is defined as the surface that is situated opposite to the tubes **24** on which the planar portion of the transverse wall **42**, **44** comes to rest, and an external surface **412** of the transverse wall **42**, **44** is defined as the opposite surface. According to the invention, and as illustrated in FIG. **5**, the longitudinal end **60**, **62** of the transverse wall **42**, **44** predominantly has a straight edge, and the protuberance **84**, which partially extends the longitudinal end **60**, **62** of the shell **38** along the longitudinal direction A, locally extends in the extension of the internal surface **410**, that is to say as close as possible to the internal volume of the heat-exchange core **6** so as to be able to be in contact with the tube **24**. In other words, the thickness, or dimension in the vertical direction C, of the protuberance **84** is smaller than the thickness, or corresponding dimension in the same vertical direction, of the transverse wall **42**, **44**. As illustrated, the protuberance **84** may notably have a thickness whose value is substantially equal to 10 to 20% of the value of the thickness of the transverse wall **42**, **44**.
(45) Each protuberance **84** provided in the extension of the transverse wall **42**, **44** of the shell **38** extends along the transverse direction B over a distance substantially equal to the transverse dimension of the tube **24** with which this protuberance **84** is intended to be in contact.
(46) As illustrated in FIG. **5**, the protuberance **84** is arranged on the shell **38** so as to be in contact with the first tube **26** or the last tube **28** of the plurality of tubes **24**, at least two protuberances **84**

being provided, opposite to one another in the transverse direction B, at the same longitudinal end **60**, **62** so as to cooperate with the first tube **26** and the last tube **28**, respectively. Thus, the first tube **26**, the last tube **28**, the protuberances **84**, the header plates **2**, **4** and the transverse walls **42**, **44** of the shell **38** delimit an airtight space for circulation of a fluid, notably after a brazing operation that is made possible by the proximity of the material of each of the components mentioned above before passing into the brazing furnace. Specifically, each of the specified elements contributes to guiding the circulation of a fluid between the tubes **24** from the first transverse wall **42** of the shell **38** to the second transverse wall **44** of the shell **38**.

(47) According to an alternative embodiment, the shell **38** may comprise a protuberance **84** at each contact zone **64** close to a tube **24**, in addition to those provided to be in contact with the first and last tubes **26**, **28**. In this way, the protuberances **84** delimit various airtight circulation spaces in the internal volume of the heat-exchange core **6**, the number of airtight circulation spaces thus being correlated with the number of protuberances **84** of the shell **38**.

(48) The protuberance **84** is produced in one piece with the corresponding transverse wall **40**, **42**, so as to advantageously form an assembly of one piece with the shell **38**. This feature facilitates the manufacture and the mounting of the heat exchanger **1**, but it should be noted that a protuberance **84** forming an entity that is produced separately from the shell **38** and that is attached thereto would not depart from the scope of the invention.

(49) The protuberance **84** is composed of a material similar to the shell **38** and to the header plates **2**, **4**. Specifically, as mentioned above, during the mounting of the heat exchanger **1**, the perforated wall **8** at the contact zone **64** and the longitudinal end **60**, **62** are at least partially secured to one another by brazing, and the filler material necessary for the brazing operation should be chemically secured to the protuberance **84**, the longitudinal end **60**, **62** and the header plate **2**, **4**.

(50) To make the invention easier to understand, the operation of the heat exchanger **1**, and notably of the circulation of the various fluids passing through it, will now be described.

(51) As a reminder, the function of the heat exchanger **1** is to cool gases circulating through the latter.

(52) The intake manifold receives the gases from the supply circuit of the engine and then guides them, via the first header plate **2**, to the heat-exchange core **6** through the plurality of tubes **24** in which they are cooled, increasing their oxygen concentration. The cooled gases are then guided to the distribution manifold **4** and to the engine.

(53) The gases are cooled in the plurality of tubes **24** by an exchange of heat with another fluid, through the wall of each tube **24** of the plurality of tubes **24**. The second fluid circulates between the plurality of tubes **24** in the internal volume of the heat-exchange core **6** from the circular orifice **50** of the first transverse wall **42** to the circular orifice **50** of the second transverse wall **44**.

(54) The second fluid may, for example, be a heat-transfer fluid, which cools the gases circulating in the plurality of tubes **24**.

(55) As mentioned above, the contact zone **64** between the longitudinal end **60**, **62**, the protuberance **84** and the perforated wall **8** and its clearance **85**, and also the contact between the transverse walls **42**, **44** and the first and last tubes **26**, **28**, contribute to sealing the heat-exchange core **6** so as to limit the possibility of the other fluid circulating in the internal volume of the heat-exchange core **6** leaking.

(56) The invention is not, however, limited to the means and configurations described and illustrated here, but also extends to any equivalent means or configuration described and illustrated here, and also extends to any equivalent means or configuration and to any technically operational combination of such means. In particular, the internal volume of the heat-exchange core **6** may be passed through by at least two fluids, the transverse walls **42**, **44** then comprising two fluid inlets, two distribution bearings, two receiving bearings and two fluid outlets, a protuberance **84** being positioned at each contact zone close to the tube **24** of the plurality of tubes **24** delimiting the two circulation spaces of the fluids.

Claims

1. A heat exchanger comprising a first header plate, a second header plate and a heat-exchange core extending between the first header plate and the second header plate along a longitudinal direction, the heat-exchange core being delimited by a shell and including a plurality of tubes that are disposed successively next to one another in a transverse direction, each tube being able to cooperate with the first and second header plates via through-orifices that are produced in each of the first and second header plates, wherein the shell has at least one longitudinal end configured to be in planar surface contact with at least one of the first and second header plates in a contact zone, the planar surface contact being realized in a plane perpendicular to the longitudinal direction wherein at least one of the first and second header plates has a perforated wall, in which the through-orifices are produced, and a frame arranged at the periphery of the perforated wall and configured to cooperate with the shell, wherein the perforated wall has, in the vicinity of each through-orifice, a clearance formed by a rounded edge or a chamfer, and wherein the at least one longitudinal end of the shell includes at least one protuberance which extends the shell along the longitudinal direction and which has a shape and dimensions complementary to the clearance, wherein the at least one protuberance has, along the whole extension length thereof, a vertical dimension smaller than the vertical dimension of a transverse wall of the shell that extends in the transverse direction while being in contact with each of the plurality of tubes, the vertical dimension being measured in a vertical direction that is perpendicular to the longitudinal direction and the transverse direction.
2. The heat exchanger as claimed in claim 1, wherein the shell is also in planar surface contact with the at least one of the first and second header plates in a plane parallel to the longitudinal direction.
3. The heat exchanger as claimed in claim 1, wherein the plurality of tubes is disposed successively next to one another in the transverse direction, the surface contact between at least one of the first and second header plates and each of the plurality tubes being formed at the longitudinal end of the at least one transverse wall.
4. The heat exchanger as claimed in claim 1, wherein the at least one protuberance has a transverse dimension substantially equal to the transverse dimension of the tube disposed in the corresponding contact zone.
5. The heat exchanger as claimed in claim 1, wherein the plurality of tubes of the heat-exchange core includes a first tube and a last tube that are disposed respectively at each transverse end of the plurality of tubes, the shell including a first protuberance in contact with the first tube and a second protuberance in contact with the last tube.
6. The heat exchanger as claimed in claim 1, wherein the perforated wall is pressed locally, around each of the through-openings, so as to have a rolled end edge forming a border protruding from the perforated wall and to increase the contact surface with the plurality of tubes.
7. The heat exchanger as claimed in claim 1, wherein the least one longitudinal end of the shell includes a first longitudinal end in contact with the first header plate at a first contact zone and a second longitudinal end in contact with the second header plate at a second contact zone.