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(54) **Manifold for heat exchanger**

(57) The invention relates to a manifold for use in a heat exchanger comprising a manifold body comprising side walls and a base wall, the side walls having an edge region opposite to the base wall comprising an inwardly facing edge region, an outwardly facing edge region and a peripheral edge region and forming an aperture for receiving end portions of heat transfer tubes, wherein the manifold comprises a plastic insert plate comprising at

least one opening for receiving the end portions of the heat transfer tubes, the plastic insert plate being fastened to the side walls of the manifold body at or near the edge region. The invention also relates to a heat exchanger comprising the inventive manifold and to process for assembling the said manifold and heat exchanger.

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Description

[0001] The invention relates to a manifold for use in a heat exchanger, comprising a manifold body comprising side walls and a base wall, the side walls having an edge region comprising an inwardly facing edge region, an outwardly facing edge region and a peripheral edge region, opposite to the base wall, forming an aperture for receiving end portions of heat transfer tubes.

[0002] Such a manifold is known from US patent US-5,351,751. This patent describes heat exchangers of the type which are employed in automobiles, for example, as charged air coolers for turbochargers. Such a heat exchanger comprises a heat exchange core and manifolds in the form of separate tanks, also known as end-caps. Heat exchange cores are also known under the name of cooler body and are generally made of a light-weight heat conductive metal, such as aluminum. The heat exchange core comprises a header part and heat exchange tubes, also known as cooling pipes, cooling channels, and heat transfer tubes. The heat exchange tubes are connected at end portions thereof to the header part. In the heat exchanger in US-5,351,751, the manifold has side walls with an outwardly facing edge region and an outwardly facing edge region, which engage with the header part. The header part in heat exchange core comprises an upstanding side wall provided with crimping claws for joining the manifold body to the header part. The header part and the manifold body define together a manifold housing. The end portions of the heat exchange tubes through which tubes air or other medium, generally water or a water/glycol mixture, to be cooled is passed are received by the aperture in the manifold and extend into the manifold housing.

[0003] Such manifold housings are subject to expansions arising from elevated temperatures and pressures of the medium to be heated or cooled, which render them liable to mechanical failure of the heat exchanger. In particular pulsating pressures cause problems. Defects that can occur are, for example, cracks and bursts in the header part, opening of crimping claws, breakage of weld joints between the heat transfer tubes and the base plate in the header part. Conventionally, the manifolds or tank parts are reinforced to resist this expansion by the provision of increased wall thickness, the addition of internal and/or external ribbing, or the addition of internal tie bars which extend between inner walls of the tank. There are several means for fixing such tie bars, for example, casting together with the tank, or welding in position, or as in US-5,351,751 by sliding in a kind of T-slot. In the case of a plastic manifold the tie bar may also be molded integrally with the manifold. An increase in the header material gauge and the use of thicker crimping claws may also be employed as a means of reinforcement.

[0004] There are a number of problems with these means of strengthening as is also mentioned in US-5,351,751. Increase in the thickness of the crimping claws requires a larger force and bigger machines for

joining the manifold body and the header part, and also requires more space for heat exchanger in the car. The addition of extra material for strengthening adds weight and increases the cost of the manifold. It also complicates the tooling, designs, moulds etc., which are required. Where internal tie bars are welded into position within the tank there is a risk of catastrophic failure should a weld joint fail or a tie bar become dislodged. Where the tie bars are cast in position, this complicates the manufacture, and may require secondary operations to complete the casting, or the use of more than one sand core. Such casting procedures also require additional cleansing in order to remove residue created during this additional casting. Where the tie bars are molded integrally with the manifold, this complicates the manufacture. A further disadvantage of tie bars is that they only provide a local reinforcement, disturb the flow pattern inside the manifold housing, and in particular produce noise under use conditions of the heat exchanger.

[0005] The aim of the invention is to provide a manifold, which does not have the problems of the conventional heat exchangers, or to a lesser extent, more particularly to provide a manifold which allows for reduced sensitivity to mechanical failure in a heat exchanger, and which can be produced with limited extra costs and weight.

[0006] This aim has been achieved with the manifold according to the invention, wherein the manifold comprises a plastic insert plate comprising at least one opening for receiving the end portions of the heat transfer tubes, the plastic insert plate being fastened to the side walls of the manifold body at or near the edge region.

[0007] Fastening of the plastic insert plate to the side walls of the manifold body at or near the edge region of the side walls allows the manifold to be joined to the heat exchange core of a heat exchanger in such a way that the end portions of the heat transfer tubes of the heat exchanger are received by the at least one opening of the plastic insert plate. The effect of the plastic insert plate fastened to the side walls of the manifold at or near the edge region the side walls in the manifold according to the invention is that when the manifold used in a heat exchanger, occurrence of mechanical failure of the heat exchanger is reduced, while at the same time the flow pattern of the air or other medium used inside the manifold housing is hardly influenced, if any. Also the noise produced due to the plastic insert plate is very low, if any at all. Due to the reduced sensitivity for mechanical failure, the increment in dimensions of other parts of the manifold or the header part for reinforcement reasons can be less, in specific cases the dimensions of such other parts may even be reduced or even completely omitted. Furthermore, to obtain the manifold according to the invention, the plastic insert plate itself can be light weighted, and can be simply produced and assembled with the manifold body.

[0008] Preferably the plastic insert plate is fastened to the side walls in such a way that the plastic insert plate has full contact, or nearly so, with the side walls.

With full contact is herein understood that the plastic insert plate is in contact with the side walls along a closed line. In other words there is no opening between the plastic insert plate and the manifold. The advantage of this preferred manifold, wherein the plastic insert plate has full contact with the side walls is that the sensitivity to mechanical failure of the heat exchanger is further reduced and, for example, the dimensions of crimping claws, if used, can be reduced.

[0009] Such a full contact can be achieved, for example, with a plastic insert plate having a planar cross section in plane with the plastic insert plate having an outer circumference similar to or identical to an inner circumference of a planar cross section of the manifold at or near the edge region of the side walls of the manifold. Where the said outer circumference of the plastic insert plate is identical to the said inner circumference of the manifold the full contact can be accomplished, for example by insertion and clamping of the plastic insert plate in the manifold or by welding of the plastic insert plate onto the manifold. Where the said outer circumference of the plastic insert plate is similar to the said inner circumference of the manifold the full contact can be accomplished, for example by fastening of the plastic insert plate to the manifold body by clamping and completing the full contact with the use of an adhesive.

[0010] In a preferred embodiment of the manifold according to the invention, the plastic insert plate has a plurality of openings for individually receiving one heat transfer tube. Such a plastic insert plate has the advantage that the stiffness of the manifold is further increased and the sensitivity to mechanical failure is further reduced thus allowing a further reduction in dimensions of reinforcements in other parts of the manifold or of the header part of the heat exchanger.

[0011] More preferably, the size of the openings of the plurality of openings is such that the openings fit closely around the heat transfer tubes to be received by the openings. For that purpose the openings have a smallest inner circumference identical or similar to the outer circumference of a cross section of the end portions of the heat transfer tubes. An advantage of the plastic insert plate with such closely fitting openings is that the heat transfer tubes are better fixed in their positions and mechanical failure due to the heat transfer tubes breaking loose out of their positions is reduced. A further advantage is that the plastic insert plate can be joined to the header part by fixing the plastic insert plate to the end portions of the heat transfer tubes, for example by placing the plate over the end portions of the heat transfer tubes, extending the end portions of the heat transfer tubes through the openings in the plate and bending the ends of the heat transfer tubes outwardly, thus providing for an even stronger construction of the heat exchanger.

[0012] Also preferably, the openings of the plurality of openings have an at least partially tapered shape, such that the openings get wider when viewed in the direction of the base wall. The openings with said tapered shape

have the advantage that the flow of the incoming or outgoing medium to be heated or cooled is even less disturbed, thus allowing for an even less disturbed flow pattern of the medium to be cooled inside the manifold housing.

[0013] The tapered shape may be any shape with which the openings get wider when viewed in the direction of the base wall. The tapered shape suitably is, for example, a shape with a linear slope having a fixed inclination or a curved shape having a variable inclination or a combination thereof. The openings having an at least tapered shape preferably have an inner side with a fixed or variable inclination between 5 and 80°, more preferably between 20 and 70°, or 30 and 60°, most preferably around 45°.

[0014] In the manifold according to the invention, the plastic insert plate may be fastened to the side walls by any means that are suitable for fixing a plate-like body to a plastic body with a hollow-shape body. Suitable means are, for example, mechanical bonds, such as clamping and snapping, for example by use of a snap fit or a click mechanism using undercuts, or other seal mechanism, and chemical bonds, such as an adhesive bond, with the use of an adhesive or using a weld line, for example applied by vibration welding or laser welding, or any combination thereof.

[0015] Preferably, a combination of a mechanical bond and a chemical bond is used. The advantage thereof is that the manifold is even stronger and can withstand larger pressure variations.

[0016] The mechanical bonds and/or chemical bonds are optionally combined with a sealing body or a sealing agent to provide for an even better seal of the bonds.

[0017] The plastic insert plate in the manifold according to the invention, preferably has a peripherally located elevated circumferential rim protruding in the direction of the base wall. The advantage of the said rim is that manifold gets stiffer near the edge regions of the manifold body and the heat exchanger wherein the manifold is used becomes less sensitive for mechanical failure. With the term "peripherally located" is understood herein that the rim is located near or at the edge of the plastic insert plate.

[0018] The plastic insert plate with the said rim may be fastened to the side walls of the manifold body for example, through contact of the said with the peripheral edge region of the side walls. In this embodiment the rim forms an extension of the side walls of the manifold body. In fact, the height of the rim may be about as high or even higher than the height of the side walls. The plastic insert plate with such a high rim can be visualized as having a trough shape. In a particular situation the height of the rim may be such that the height of the side walls can be reduced by large, while maintaining sufficient volume for the manifold housing. In the extreme form thereof, the manifold has the form of a box, wherein the plastic insert plate with the rim forms the base part with bottom and walls and the manifold body having side walls the height

of which is reduced to the minimum, forms the lid of the box. The advantage of this embodiment, in particular where the height of the rim is larger, is that the sensitivity of the heat exchanger for mechanical failure is reduced, likewise because bonding side between plastic insert plate and manifold body is located further away from the heating core.

[0019] Alternative either the rim is received by and abutted against the inwardly facing edge regions of the side walls of the manifold body, or the side walls of the manifold body are received by the rim and the rim is abutted against the outwardly facing edge regions of the side walls. Preferably, the side walls of the manifold body are received by the rim and the rim is abutted against the outwardly facing edge regions of the side walls. The advantage thereof is that the heat exchanger can withstand higher pressure.

[0020] Optimally a combination of these embodiments is applied. This can be achieved with the plastic insert plate having the said rim, wherein the rim has a peripheral edge region with an inwardly or outwardly facing cut out for receiving the edge region of the side walls of the manifold body and abutting to respectively the outwardly or inwardly edge region of the side walls. Alternatively, or in combination therewith, the side walls have a peripheral edge region with an inwardly or outwardly facing cut out for receiving the edge region of the rim.

[0021] Optionally, in addition an adhesive and/or a weld is used for better engagement of the plastic insert plate with the manifold body. Also optionally, the said rim may be provided with ripple marks or other surface modifications for better engagement of the plastic insert plate with the manifold body.

[0022] In the manifold according to the invention, the plastic insert plate and manifold body can be made of various materials. The plastic insert plate and the manifold body may be made of the same material, although these parts may also be made of different materials.

[0023] The plastic insert plate may be made of a thermoset polymer composition or a thermoplastic polymer composition, preferably a thermoplastic polymer composition. The material from which the manifold body is made may be a plastic material of the same polymer composition as the plastic insert plate or of a different polymer composition, or of another material, in particular a metal, for example, aluminum. The manifold body is also preferably made of a thermoplastic polymer composition.

[0024] The thermoplastic polymer composition from which the plastic insert plate and/or the manifold body are made comprises at least one thermoplastic polymer. Suitable thermoplastic polymers, that can be used in the thermoplastic polymer composition, are, for example, polyamides. Examples of suitable polyamides are aliphatic polyamides, such as polyamide-6, polyamide-6,6 and polyamide-4,6 and semi-aromatic polyamides like polyamide-6,T, polyamide-9,T, and blends and copolyamides of these polyamides, such as polyamide-6,6/T.

[0025] More preferably, the polyamide is a semicrystalline (aliphatic or semi-aromatic) polyamide with a melt temperature (T_m) of at least 230°C, or an amorphous semi-aromatic polyamide with a glass transition temperature (T_g) of at least 230°C. Preferably the said T_m or T_g is at least 240 °C, more preferably at least 260°C, or even 280°C, and may be as high as 330°C or even higher.

[0026] The thermoplastic polymer composition may comprise, next to the at least one thermoplastic polymer, one or more additives. Additives that can be used may be any additives known in the art that is suitable for use in thermoplastic polymer compositions used for manifolds. Suitable additives include, for examples, inorganic fillers, reinforcing agents, such as glass fibres, nucleating agents, stabilizers, processing aids, pigments, etc. The optimal amount of additive or combinations thereof can in principle be determined experimentally by a person skilled in the art through systematic research. Preferably, the amount of the additives is such that the added additive or additives do not adversely affect the molding properties of the polymer.

[0027] The plastic insert plate as well as the manifold body is also preferably made of a thermoplastic polymer composition with a heat distortion temperature (HDT) of at least 240°C. Preferably the HDT is at least 250 °C, more preferably at least 270°C, or even 290°C.

[0028] The thermoplastic polymer composition also preferably is a laser-weldable composition. In this respect it is preferred that the plastic insert plate is made of a thermoplastic polymer composition with a softening point that is higher than the material used to form the manifold body. This has the advantage that the manifold according to the invention can be made by inserting the plastic insert plate into the manifold body and then fastening of the plastic insert plate to the manifold body by laser welding.

[0029] The invention also relates to a process for making a manifold according to the invention. The process according to the invention comprises an assembly step wherein the plastic insert plate is fastened to the side walls of the manifold body. The advantage of this process, apart from the effects for the manifold described above, is that it is less complicated than processes wherein a tie bar is welded into position and also the risk of dislodging of the reinforcing element is reduced. The fastening may be carried out by any process that is suitable for that purpose, for example, by clamping, snapping, adhesive bonding or welding, or any combination thereof.

[0030] In a preferred embodiment of the process according to the invention, first (i) the manifold body is made by injection moulding at elevated temperature and demoulded, and then (ii) the plastic insert plate is fastened to the side walls of the moulded manifold body obtained by step (i) before the moulded manifold body is cooled to room temperature. This preferred embodiment has the advantage that falling of the side walls or warpage of the complete manifold body upon cooling is reduced, thereby allowing for better dimension stability of the man-

ifold body during the mounting procedure and better fitting of the manifold body to the header part of the heat exchanger.

[0031] The invention also relates to a heat exchanger. A heat exchanger generally comprises a heat exchange core, comprising a header part comprising a plurality of heat transfer tubes, and a manifold joined to the header part of the heat exchange core. In the heat exchanger according to the invention, the manifold is a manifold according to the present invention described above as well as according to all the preferred embodiments thereof.

[0032] The heat exchanger may be an air cooler such as a charged air cooler for turbo engines. The heat exchanger may also be any other type of heat exchanger comprising other media to be heated or to be cooled.

[0033] In the heat exchanger according to the invention the manifold may be an inlet manifold, also known as introduction tank, as well as an outlet manifold, also known as discharge tank. Preferably, the manifold is part of a charged air cooler with the manifold being an air inlet manifold and/or an air outlet manifold.

[0034] In a preferred embodiment of the heat exchanger according to the invention, the header part comprises a header base plate and the plastic insert plate is fastened to the base plate. Such a header base plate is also known as end plate or seat. This embodiment has the advantage that the manifold body is joined to the heat exchange core via the plastic insert plate, and allows further reduction of the dimensions of fastening elements, such as crimping claws, needed for joining the manifold body to the heat exchange, while maintaining sufficient mechanical integrity of the whole heat exchanger.

[0035] The fastening may be accomplished by any method that is suitable for fixing a plastic plate to a metal plate, and include, for example, the use of nuts and bolts and the use of an adhesive. Optionally the fastening is combined with the use of a sealing body or sealing agent applied between the plastic insert plate and the base plate. Suitably, the sealing body is a gasket, for example a rubber gasket.

[0036] In another preferred embodiment of the heat exchanger according to the invention, the plastic insert plate has a plurality of openings the number of which openings is identical to the number of the heat transfer tubes comprised by the heat exchange core, end portions of the heat transfer tubes are received by and extend through the openings of the plastic insert plate and extreme parts of the end portions of the heat transfer tubes have been bended outwardly. The advantage of this embodiment is that the manifold body is joined to the heat exchange core via the plastic insert plate, and that this joint is so strong that the dimensions of fastening elements, such as crimping claws, needed for joining the manifold body to the heat exchanger, can be further reduced or even eliminated while maintaining sufficient mechanical integrity of the whole heat exchanger.

[0037] A further advantage of bending the heat transfer

tubes outwardly is that the joint is so strong that it can withstand higher internal pressure, thus reducing the risks of loss of pressure related to mechanical failure of crimping claws and/or of the base plate of the header part. This advantage can be achieved with the plastic insert plate having closed contact with the manifold body. It can also be achieved when there is no closed contact with the manifold body but a sealing body between the plastic insert plate and the base plate is used. If under such circumstances a crack in the base plate underneath the plastic insert plate within the area enclosed by the sealing body, the heat exchanger can still withstand a higher internal pressure.

[0038] It is noted that the effect of the increased pressure can already be obtained with outwardly bending of the extreme parts with relative short end portions, as are used in conventional heat exchangers, for example 1-2 mm. However, it may be preferred to use longer end portions, for example 3-10, preferably 4-5 mm long, to obtain a better sealing and fastening of the plastic insert plate to the header base plate.

[0039] The effect of outwardly bended end portions of the heat transfer tubes allowing higher internal pressure, can be further enhanced with the embodiment, wherein the openings have an inner surface and the end portions of the heat transfer tubes have an outer surface and the plastic insert plate is sealed with a sealing agent applied between the inner surface and the outer surface. This embodiment has the advantage that an even higher internal pressure can be applied.

[0040] In a particularly preferred embodiment of the invention, the manifold is joined to the heat exchange core primarily or even only through fastening of the plastic insert plate to the manifold body. The advantage of this embodiment is that the header part of the heat exchange core can be refrained from any crimping claws, thus reducing dimensions of the heat exchanger and saving space in the automobile.

[0041] The effect of the higher internal pressure, which the heat exchanger can still withstand, can also be achieved with a conventional heat exchange core comprising a header part comprising a plurality of heat transfer tubes, and a manifold joined to the header part of the heat exchange core, wherein the heat exchanger comprises a plastic insert plate having a plurality of openings the number of which openings is identical to the number of heat transfer tubes, and wherein end portions of the heat transfer tubes extend through the openings of the insert plate and extreme parts of the end portions of the heat transfer tubes have been bended outwardly.

[0042] The invention also relates to processes for making a heat exchanger. The first of these inventive processes comprises process steps comprising first (i) fastening a plastic insert plate, having at least one opening for receiving end portions of heat transfer tubes, to the side walls of a manifold body at or near the edge region of the side walls, and then (ii) joining the manifold obtained by step (i) to the header part of a heat exchange

core. Joining of the manifold to the header part may be performed by conventional means, for example with the use of crimping claws. An advantage of this process is that the sensitivity of the header part of the heat exchanger obtained by this process is reduced and that optionally the dimensions of the means for joining of the manifold to the header part can be reduced.

[0043] The other inventive process comprises first (i) joining a plastic insert plate having at least one opening for receiving the heat transfer tubes to the header part of the heat exchange core, and then (ii) fastening the plastic insert plate to the side walls of a manifold body at or near the edge region of the side walls.

[0044] This process has the advantage that first an optimal a pressure tight joint between plastic insert plate and header part can be made, e.g. by outwardly bending extreme parts of end portions of heat transfer tubes, optionally using a sealing agent and or a sealing body

[0045] In a preferred embodiment of the latter process the plastic insert plate has a plurality of openings for individually receiving one heat transfer tube, the number of openings is identical to the number of the heat transfer tubes in the heat exchange core, and the plastic insert plate is fastened to the header part by extending the end portions of the heat transfer tubes through the openings of the insert plate followed by outwardly bending of extreme parts of the end portions of the heat transfer tubes. The outward bending may be performed, for example with a thorn.

[0046] This process has the advantage a pressure tight joint between plastic insert plate and header part is obtained. Optionally, this process is combined with the use of a sealing agent and or a sealing body

[0047] In a preferred embodiment of any of the two inventive processes, the plastic insert plate is fastened to the side walls of the manifold body by clamping, snapping, adhesive bonding or welding, or a combination thereof.

[0048] The invention is further elucidated with the following examples.

Preparation of the materials.

[0049] For the experiments use was made of a heat exchange core of a commercial type of heat exchanger, which in its standard form comprises a sealing edge of 3.6 mm wide and crimping claws of 6.5 mm wide. Without further changing the construction of the heat exchange core, two central parts and were taken out of the heat exchange core comprising three heat transfer tubes, two intermittent layers of cooling fins, and two small parts of base plate, one at each end of the tubes. The size of the cut-out parts of base plate was about 45 x 45 mm. The heat transfer tubes had end portions of about 2 - 2.5 mm length extending out from the parts of base plate.

[0050] Four plastic insert plates were prepared by starting with plastic plates, each 80 x 80 mm and 2 mm thick. The plastic of which the plates were made was

Stanyl TW200F6, a polyamide-4,6 moulding composition of DSM, The Netherlands. In each of the plates three slit like openings with the dimensions of the heat transfer tubes were made. The openings were tapered circumferentially with a slope of 45°.

[0051] Furthermore, four aluminum plates, each 80 x 80 mm and 2 mm thick, were used. Two of these aluminum plates were provided with a centrally placed valve for connection to a pressure unit. The aluminium plates are used here as a model shape for the manifold body.

Preparation of the models

Experiment 1

[0052] Two of the plates with the tapered openings were slid over the ends of the heat transfer tubes of one of the two heat exchange core parts and positioned against the parts of base plate, one plate at each side of the part, thus forming a first assembly. This first assembly was placed in an oven at 200 °C for 30 minutes. After that the heat transfer tubes were provided with a flange by bending outwardly the extreme ends of the pipes. Against the outer side of the plastic insert plates aluminum plates, one with and one without a valve were fixed with small bolts and nuts and some sealant in the outer regions. The resulting part is herein below indicated as assembly A.

Experiment 2

[0053] The whole procedure of Experiment 1 was repeated with the second heat exchange core part, except that between the base plate and the plastic insert plate a adhesive was applied prior to the positioning of the plastic insert plate against the base plate. The adhesive that was used was Loctite 5366, a silicon based adhesive of the Henkel Group, USA. The resulting part from this procedure is herein below indicated as assembly B.

Pressure tests

[0054] Assemblies A and B were subjected to two different pressure tests, first to a nitrogen pressure test, then to a water pressure tests. For these tests the valves on the aluminum plates were connected to a nitrogen pump, respectively to a water pump. The pressure in each of the tests was gradually increased and the assemblies were inspected on leakage and other forms of damages. With assembly A, the nitrogen pressure could be raised up to 2.8 bar without any problem. At 2.8 bar some leakages occurred, but the construction of the assembly itself remained intact.

[0055] With assembly B, the nitrogen pressure could be raised up to 3 without any problem. For safety reasons, the test was continued with water pressure. The water pressure could be raised without a problem to 6 bar. At 6 bar some leakages occurred, but the construction of

the assembly itself remained intact.

[0056] The results for these model experiment show that manifold comprising the model shape for the manifold body fixed to a plastic insert plate and the a plastic insert plate itself fixed to a heat exchange core part, wherein the plastic insert plate is only fixed by means of outwardly bending of the ends of the heat transfer tubes and without using crimping claws or other further means for fixing of the manifold body to the heat exchange core, already high working pressures can be attained, while maintaining the integrity of the construction. It is furthermore shown that by using a sealing agent the working pressures can be further enhanced substantially.

Claims

1. A manifold for use in a heat exchanger, comprising a manifold body comprising side walls and a base wall, the side walls having an edge region opposite to the base wall comprising an inwardly facing edge region, an outwardly facing edge region and a peripheral edge region and forming an aperture for receiving end portions of heat transfer tubes, **characterized in that** the manifold comprises a plastic insert plate comprising at least one opening for receiving the end portions of the heat transfer tubes, the plastic insert plate being fastened to the side walls of the manifold body at or near the edge region.
2. A manifold according to claim 1, wherein the plastic insert plate has a plurality of openings for individually receiving one heat transfer tube.
3. A manifold according to claim 2, wherein the openings have an at least partially tapered shape, such that the openings get wider when viewed in the direction of the base wall.
4. A manifold according to any of claims 1-3, wherein the plastic insert plate has been fastened to the side walls by a mechanical bond, a chemical bond or a combination thereof.
5. A manifold according to any of claims 1-4, wherein the plastic insert plate has a peripherally located elevated circumferential rim protruding in the direction of the base wall,
6. A manifold according to claim 5, wherein the rim is received by and abutted against the outwardly facing edge regions of the side walls of the manifold body.
7. A manifold according to any of claims 1-6, wherein the manifold body is made of a plastic material.
8. A manifold according to claim 7, wherein the plastic insert plate and the manifold body are made of laser

weldable plastic material.

9. A process for making a manifold according any of claims 1-8, comprising fastening a plastic insert plate to the side walls of a manifold body by clamping, snapping, adhesive bonding or welding, or a combination thereof.
10. A process according to claim 9, wherein first (i) the manifold body is made by injection moulding at elevated temperature and demoulded, and then (ii) the plastic insert plate is fastened to the side walls of the moulded manifold body obtained by step (i) before the moulded manifold body is cooled to room temperature.
11. A heat exchanger comprising a heat exchange core comprising a header part and a manifold, **characterized in that** the manifold is a manifold with an plastic insert plate according to claim 1.
12. A heat exchanger according to claim 11, wherein the manifold is an inlet manifold and/or an outlet manifold.
13. A heat exchanger according to claim 11 or 12, wherein the header part comprises a header base plate and the plastic insert plate is fastened to the base plate.
14. A heat exchanger according to any of claims 11-13, wherein the header part comprises a plurality of heat transfer tubes and the plastic insert plate has a plurality of openings the number of which openings is identical to the number of the heat transfer tubes comprised by the heat exchange core, end portions of the heat transfer tubes are received by and extend through the openings of the plastic insert plate and extreme parts of the end portions of the heat transfer tubes have been bended outwardly.
15. A heat exchanger according to claim 14 wherein the manifold body is joined to the heat exchange core primarily or only through fastening of the plastic insert plate to the manifold body.
16. A heat exchanger comprising a heat exchange core comprising a header part comprising a plurality of heat transfer tubes, and a manifold joined to the header part of the heat exchange core, wherein the heat exchanger comprises a plastic insert plate having a plurality of openings the number of which openings is identical to the number of heat transfer tubes, and wherein end portions of the heat transfer tubes extend through the openings of the insert plate and extreme parts of the end portions of the heat transfer tubes have been bended outwardly.

17. A process for making a heat exchanger according to claim 11-16, comprising first (i) fastening a plastic insert plate, having at least one opening for receiving end portions of heat transfer tubes, to the side walls of a manifold body at or near the edge region of the side walls, and then (ii) joining the manifold obtained by step (i) to the header part of a heat exchange core. 5
18. A process for making a heat exchanger according to claim 11-16, comprising first (i) joining a plastic insert plate having at least one opening for receiving the heat transfer tubes to the header part of the heat exchange core, and then (i) fastening the plastic insert plate to the side walls of a manifold body at or near the edge region of the side walls. 10 15
19. A process according to claim 18, wherein the plastic insert plate has a plurality of openings for individually receiving one heat transfer tube, the number of openings is identical to the number of the heat transfer tubes in the heat exchange core, and the plastic insert plate is fastened to the header part by extending the end portions of the heat transfer tubes through the openings of the insert plate followed by outwardly bending of extreme parts of the end portions of the heat transfer tubes. 20 25
20. A process according to any of claims 17-19. wherein the plastic insert plate is fastened to the manifold body by clamping, snapping, adhesive bonding or welding, or a combination thereof. 30

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European Patent
Office

EUROPEAN SEARCH REPORT

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DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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