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(54) **A FLAT TUBE FOR A HEAT EXCHANGER AND A HEAT EXCHANGER**

FLACHROHR FÜR EINEN WÄRMETAUSCHER SOWIE WÄRMETAUSCHER

TUBE PLAT POUR ÉCHANGEUR DE CHALEUR ET ÉCHANGEUR DE CHALEUR

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(56) References cited:

EP-A1- 3 096 102

WO-A1-98/44306

WO-A2-2007/084984

DE-A1- 19 753 724

DE-A1-102006 016 711

US-A1- 2009 019 695

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Description

[0001] The object of the invention is a flat tube for a heat exchanger and a heat exchanger.

[0002] There are known in the art tubes for heat exchangers, for example condensers, which are used to guide a fluid and enable its cooling.

[0003] Such heat exchangers can be implemented in vehicles, e.g. cars. These vehicles are directly exposed to debris such as stones or other objects, either when they are moving or when they are stationary. The stones can travel at significant speed and can impact the heat exchanger, which in most cases is situated in front of the car and is at least partly exposed or can be reached after passing through the radiator grill. Impact of such objects can cause damage to the elements of the heat exchanger, which may lead to leaks of the fluid flowing through them and/or to deterioration of their performance. Documents [DE102006016711 A1], [WO9844306 A1], [US2009019695 AA], [EP3096102 A1] disclose the exemplary heat exchangers according to the preamble of claim 1.

[0004] It is thus desirable to provide an improved tube for a heat exchanger, which would be more resistant to debris and consequently which would reduce a chance of leakage and/or decrease in performance.

[0005] The object of invention is a flat tube for a heat exchanger, with two open ends defining its longitudinal direction, comprising a first wall and a second wall which are flat and parallel to each other, thereby delimiting the inner space of the tube, wherein one of the lateral sides of the first wall forms a multilayer nose by means of consecutive folds compounded towards the second wall, the lateral side of the second wall being bent to cover said multilayer nose, wherein the folds are at least partially displaced laterally towards the inner side of the tube with respect to the first bending point of said lateral side of the first wall.

[0006] Preferably, the inner facing arched portions of the folds laterally precede the first bending point of the multilayer nose.

[0007] Preferably, the lateral side of the second wall, bent over the multilayer nose, is also double walled.

[0008] Preferably, the lateral side of the second wall, bent over the multilayer nose, consists of one layer.

[0009] Preferably, the thickness of the reinforced tube nose in lateral direction is in the range $[0.5 \times \text{tube height} ; 1.5 \times \text{tube height}]$ and preferentially in the range $[0.5 \times \text{tube height} ; \text{tube height}]$.

[0010] Another object of the invention is a heat exchanger comprising a described tube.

[0011] The object of the invention has been presented by means of a drawing, in which:

Fig. 1 shows a general shape of a flat tube,

Fig. 2 presents a tube according to a first example,

Fig. 3 presents a tube according to a second example.

[0012] Fig. 1 presents a general shape of a flat tube which is an object of the invention. The invention specifically regards tube nose, which is depicted in detail in the following figures. The tube is defined by reference to general directions: longitudinal and lateral. These are presented in Fig. 1, as y axis and x axis, respectively. The reinforced tube nose can be located on the front area of the heat exchanger (e.g. condenser), e.g. facing the road.

[0013] Fig. 2 shows a first example of the flat tube. The tube comprises a first wall 1 and a second wall 2, which are flat and parallel to each other. Together they delimit the inner space of the tube. The tube has two opened ends, which define a longitudinal direction of the tube and a general path for the fluid flow. The tube can further comprise an inner fin. The fin is however optional. One of the lateral sides of the first wall 1 forms a multilayer nose 4 by means of consecutive folds compounded towards the second wall 2. The lateral side 6 of the second wall 2 is bent to cover said multilayer nose 4. The folds are at least partially displaced laterally towards the inner side of the tube with respect to the first bending point 20 of said lateral side of the first wall 1. This means that there is at least one cross-section of the tube in which the multilayer nose is constituted by flat portions of first and second walls 1, 2 and multiple layers of the multilayer nose 4. Preferably, the inner facing arched portions 10 of the folds laterally precede the first bending point 20 of the multilayer nose 4.

[0014] Preferably, the folds of the multilayer nose 4 are substantially parallel to the first and second walls. In other words, planes of the folds are parallel to planes of the first wall 1 and the second wall 2.

[0015] The respective end of the second wall 2 is bent around the multilayer nose 4 so that it encompasses it. In this example, this end consists of a single layer. In other words, the lateral end of the second wall 2 forms a side wall 6, which covers the multilayer nose 4 of the first wall 1. This further strengthens the tube. At the same time it protects the multilayer nose 4 and enables the tube to have a unitary, unobtrusive shape.

[0016] Fig. 3 shows the second example of the tube. In this example, the side wall 6 is also double walled. This fold extends along the circumference of the multilayer nose 4.

[0017] The examples present folds of certain lateral length. The lateral length of folds of the multilayer nose 4 is dependent on the lateral length of the walls of the multilayer nose 4. The longer the folds, the more resistant the nose of the tube, as the thicknesses of the multilayer nose 4 and the side of the second wall 6 compound at longer distance.

[0018] The tube according to the invention may be a tube made of a single sheet of material. It can also be made of two sheets of material, constituting for example separately its first and second walls. Consequently, the

disclosed nose of the tube can be present on one lateral side of the tube, or both lateral sides of the tube. The thickness of the reinforced tube nose can be in the range [0.5 x tube height ; 1.5 x tube height] and preferentially in the range [0.5 x tube height ; tube height]. The tube height here is defined along an axis perpendicular to longitudinal and lateral directions.

[0019] These tubes can be produced by roll forming, similar to the process for currently known tubes with bends or folds.

Claims

1. A flat tube for a heat exchanger, with two open ends defining its longitudinal direction, comprising a first wall (1) and a second wall (2) which are flat and parallel to each other, thereby delimiting an inner space of the tube, wherein one of the lateral sides of the first wall (1) forms a multilayer nose (4) by means of consecutive folds compounded towards the second wall (2), the lateral side (6) of the second wall (2) being bent to cover said multilayer nose (4), **characterised in that** the folds are at least partially displaced laterally towards the inner space of the tube with respect to a first bending point (20) of said lateral side of the first wall (1).
2. The tube according to claim 1, wherein the inner facing arched portions (10) of the folds laterally precede the first bending point (20) of the multilayer nose (4).
3. The tube according to any preceding claim, wherein the lateral side of the second wall (2), bent over the multilayer nose (4), is also double walled.
4. The tube according to any of claims 1-2, wherein the lateral side of the second wall (2), bent over the multilayer nose (4), consists of one layer.
5. The tube according to any preceding claim, wherein the thickness of the reinforced tube nose in lateral direction is in the range [0.5 x tube height ; 1.5 x tube height] and preferentially in the range [0.5 x tube height ; tube height].
6. A heat exchanger comprising a tube according to any of claims 1-5.

Patentansprüche

1. Flachrohr für einen Wärmetauscher mit zwei offenen Enden, die seine Längsrichtung definieren, umfassend eine erste Wand (1) und eine zweite Wand (2), die flach sind und parallel zueinander verlaufen, wodurch ein Innenraum des Rohrs begrenzt wird, wobei eine der lateralen Seiten der ersten Wand (1) mittels

aufeinanderfolgender Falten, die zu der zweiten Wand (2) hin zusammengedrängt sind, eine mehrlagige Nase (4) bildet, wobei die laterale Seite (6) der zweiten Wand (2) gebogen ist, um die mehrlagige Nase (4) abzudecken, **dadurch gekennzeichnet, dass** die Falten bezüglich einer ersten Biegestelle (20) der lateralen Seite der ersten Wand (1) mindestens teilweise seitlich zu dem Innenraum des Rohrs hin verschoben sind.

2. Rohr nach Anspruch 1, wobei die nach innen weisenden gebogenen Abschnitte (10) der Falten der ersten Biegestelle (20) der mehrlagigen Nase (4) seitlich vorhergehen.
3. Rohr nach einem der vorhergehenden Ansprüche, wobei die laterale Seite der zweiten Wand (2), die über die mehrlagige Nase (4) gebogen ist, auch doppelwandig ist.
4. Rohr nach einem der Ansprüche 1 - 2, wobei die laterale Seite der zweiten Wand (2), die über die mehrlagige Nase (4) gebogen ist, aus einer Lage besteht.
5. Rohr nach einem der vorhergehenden Ansprüche, wobei die Dicke der verstärkten Rohnase in der seitlichen Richtung im Bereich [0,5 x Rohrhöhe; 1,5 x Rohrhöhe] und vorzugsweise im Bereich [0,5 x Rohrhöhe; Rohrhöhe] liegt.
6. Wärmetauscher, umfassend ein Rohr nach einem der Ansprüche 1 - 5.

Revendications

1. Tube plat pour un échangeur thermique, comportant deux extrémités ouvertes définissant une direction longitudinale, comprenant une première paroi (1) et une seconde paroi (2) qui sont plates et parallèles l'une à l'autre, délimitant ainsi un espace intérieur du tube, l'un des côtés latéraux de la première paroi (1) formant un nez multicouche (4) par le biais de plis successifs combinés en direction de la seconde paroi (2), le côté latéral (6) de la seconde paroi (2) étant courbé de façon à couvrir ledit nez multicouche (4), **caractérisé en ce que** les plis sont au moins partiellement décalés latéralement en direction de l'espace intérieur du tube par rapport à un premier point de courbure (20) dudit côté latéral de la première paroi (1).
2. Tube selon la revendication 1, dans lequel les parties arquées orientées vers l'intérieur (10) des plis précèdent latéralement le premier point de courbure (20) du nez multicouche (4).

3. Tube selon l'une quelconque des revendications précédentes, dans lequel le côté latéral de la seconde paroi (2), recourbé sur le nez multicouche (4), est également doublé.
- 5
4. Tube selon l'une quelconque des revendications 1 et 2, dans lequel le côté latéral de la seconde paroi (2), recourbé sur le nez multicouche (4), est constitué d'une seule couche.
- 10
5. Tube selon l'une quelconque des revendications précédentes, dans lequel l'épaisseur du nez de tube renforcé dans la direction latérale est comprise dans la plage $[0,5 \times \text{hauteur du tube} ; 1,5 \times \text{hauteur du tube}]$ et, de préférence, dans la plage $[0,5 \times \text{hauteur du tube} ; \text{hauteur du tube}]$.
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6. Échangeur thermique comprenant un tube selon l'une quelconque des revendications 1 à 5.
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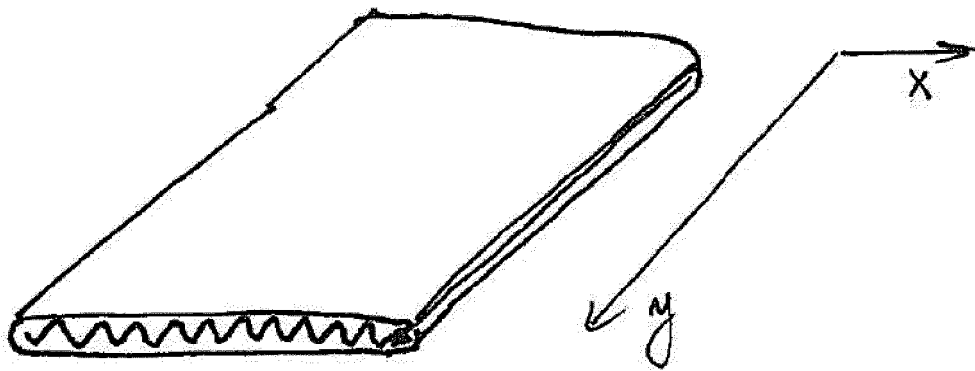


Fig. 1

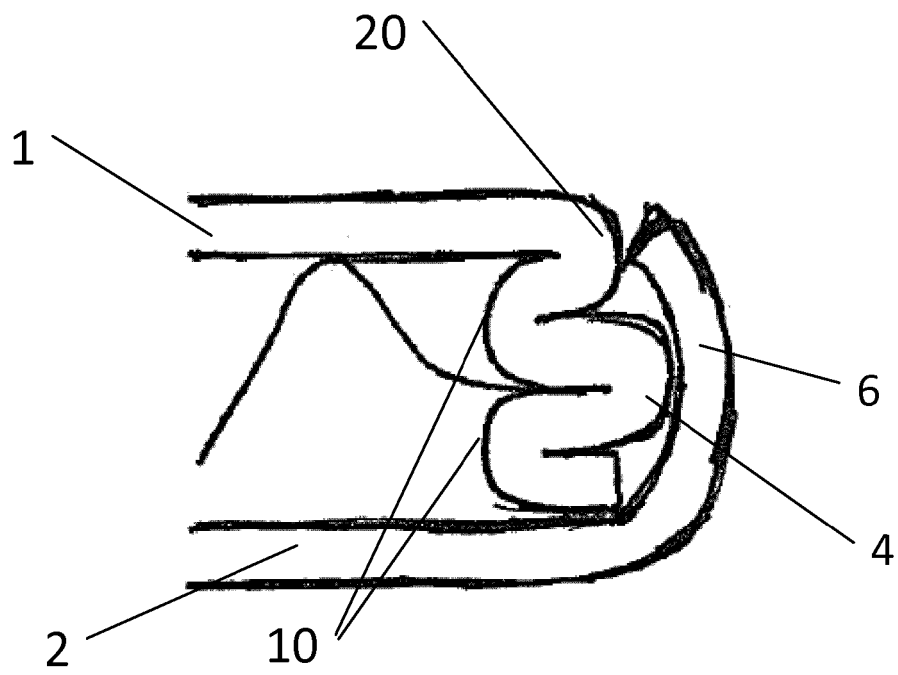


Fig. 2

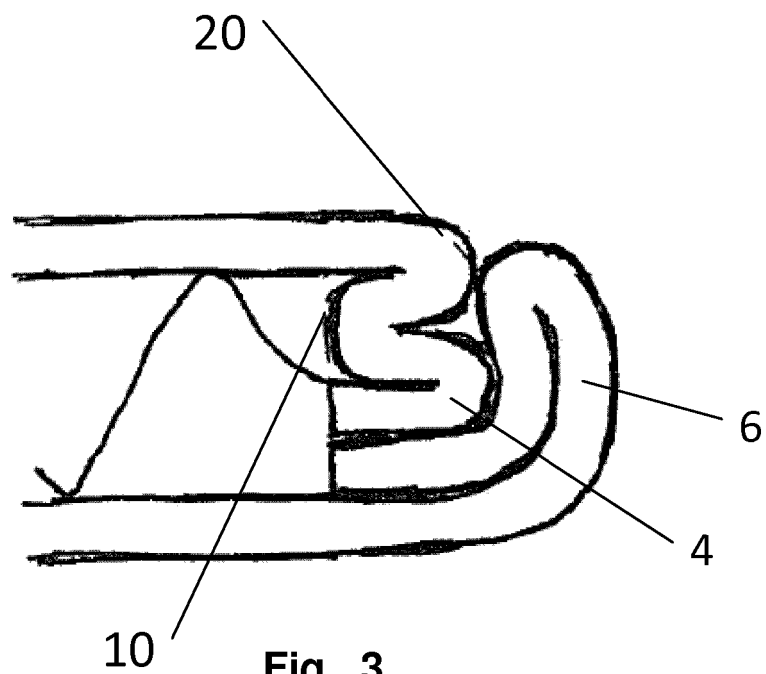


Fig. 3

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- DE 102006016711 A1 [0003]
- WO 9844306 A1 [0003]
- US 2009019695 AA [0003]
- EP 3096102 A1 [0003]