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(54) **A CORE OF A HEAT EXCHANGER COMPRISING CORRUGATED FINS**

(57) The invention relates to a core (2) of a heat exchanger (1), comprising oblate/flat pipes (4) for the flow of a heating medium and corrugated fins (5) located in contact with and between each pair of neighbouring pipes (4). The fins (5) comprise ridges (6) having a width (W) and forming channels for the flow of the heated medium. Each ridge (6) of a fin (5) is bent at least in one place along its width (W) in the direction transverse to its width (W) thus forming an offset (9) dividing the ridge (6) into two sections (20, 30) which are disposed one after the other in the width direction (W) of the ridge (6) and are translated in parallel to each other in the length direction (L) of the core (2) at a distance  $\Delta L$  which is defined as a distance between the central planes (a, b) of the neighbouring sections (20, 30) of that ridge (6), wherein the central planes (a, b) of the sections (20, 30) are defined as planes through the centre of a crest (7) and at equal distances from the centres of troughs (8) of individual sections (20,30) of the ridge (6), and the distance  $\Delta L$  of the parallel translation of the neighbouring sections (20, 30) relative to each other fulfils the following condition:  $0 < \Delta L \leq fp/4$  where  $fp$  is the pitch of a corrugated fin (5) defined as a distance between troughs (8) of one ridge (6).

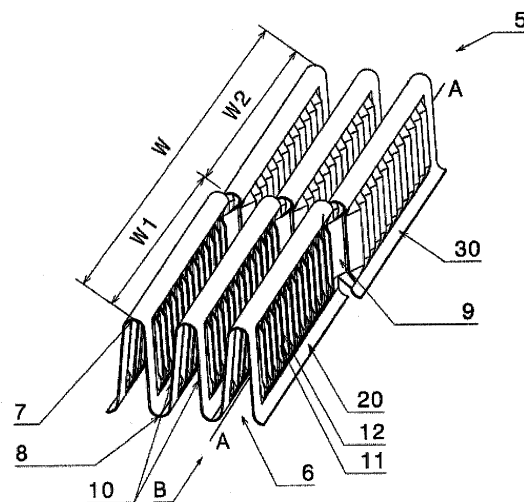


FIG. 2

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**Description**

THE FIELD OF THE INVENTION

5 **[0001]** The invention relates to a core of heat exchanger comprising corrugated fins, and in particular it relates to the shape of a corrugated fin.

THE STATE OF THE ART

10 **[0002]** Heat exchangers are well known in the state of the art, for example, in the automotive industry. Heat exchangers usually comprise a core consisting of a plurality of oblate pipes for leading a heating medium, i.e. flow of liquid or gas, and corrugated fins located between the oblate pipes along the whole length of the pipes. The ends of the pipes are connected with manifolds and tanks for, respectively, supplying to the pipes and leading away, the medium circulating in heat exchanger pipes. Each corrugated fin is usually shaped from sheet metal and has wavelike ridges disposed transversely to the core length. In the spaces between individual ridges of a fin there are defined channels for leading the second medium, i.e. flow of another gas, for example air, participating in heat exchange. The fin ridges are heated as a result of their contact with pipes wherein a heating medium flows, i.e. hot liquid or gas, whereas the second medium flowing through the channels is heated by contact with the heated fin ridges.

15 **[0003]** In order to increase heat exchange between the heating medium and the heated medium attempts are being made to construct fins that have various shapes and are placed in various position relative to the pipes.

20 **[0004]** The publication of US 2005/0199378 A1 discloses a core of a heat exchanger which comprises corrugated fins as described above located in contact with and between each pair of neighbouring oblate pipes, and each fin consists of ridges having flanks forming channels for the flow of a heated medium between the inlet thereof on the front surface of the core and the outlet on the rear surface of the core. The ridges extend obliquely to the front and rear surface of the core and consequently for a particular channel the inlet of the heated medium is displaced relative to the outlet of the heated medium relative to the line perpendicular to the front and rear surface of the core as a result of which the flow of the heated medium, being supplied in the direction perpendicular to the front surface of the core, hits the surfaces of the ridge flanks and intensifies the absorption of heat by the heated medium.

25 **[0005]** The publication of US2009/0173477 discloses a heat exchanger comprising a core consisting of flat pipes and corrugated fins located in contact with and between said pipes. The fins are formed of a corrugated metal strip and the crests of such formed ridges extend in a direction transverse to the flat pipes and thus form channels for the flow of a heated medium between the inlet thereof on the front surface of the core and the outlet on the rear surface of the core. Each ridge has slits formed on the flanks thereof which change the direction of the heated medium flow through said channels to improve efficiency of heat exchange. Fin ridges may be bent in V-shaped form along their width, which additionally boosts heat exchange efficiency.

30 **[0006]** One problem connected with the use of corrugated fins known from the state of the art is that the pressure of a heated medium, usually air, drops as the medium flows between the front and the rear surface of a heat exchanger. The greater the drop in the heated medium pressure, the worse the efficiency of heat exchange in a heat exchanger.

35 **[0007]** The purpose of the present invention is to provide a heat exchanger core that would exhibit enhanced heat exchange efficiency and a smaller drop in the pressure of a heated medium led through the channels of a corrugated rib, and which would also be easy to manufacture and use.

SUMMARY OF THE INVENTION

40 **[0008]** The purpose of the invention is fulfilled by a heat exchanger core whose features are defined in the independent claim 1.

**[0009]** The remaining preferable features of the invention are presented in the dependent claims 2-7.

45 **[0010]** The use of the heat exchanger core according to the invention makes it possible to reduce pressure drop of the heated medium during its flow between the inlet thereof on the front surface of the heat exchanger and the outlet on the rear surface of the heat exchanger, which in consequence increases mass flow of a cooling medium. This fact may be used to boost efficiency of heat exchangers and makes it possible to reduce the power of fan system that generates a cooling medium stream.

BRIEF DESCRIPTION OF THE FIGURES

50 **[0011]** The invention is presented in the figures which are used for illustrative purposes only and are not intended to limit the scope of the invention.

Fig. 1 shows a front view of a heat exchanger comprising a core according to the present invention;

Fig. 2 shows an enlarged perspective view of a fragment of a corrugated fin of the core according to the invention;

5 Fig. 3 shows schematically the shape of one ridge of the corrugated fin in a cross-section A-A of Fig. 2;

Fig. 4 shows schematically the shape of one ridge of a fin in a view from direction B in Fig. 2.

DESCRIPTION OF AN EMBODIMENT OF THE INVENTION

10 [0012] The following description is only exemplary and it is not intended to limit the present invention or its application and use.

[0013] Fig. 1 presents a heat exchanger 1 comprising a core 2 according to the invention and a pair of manifolds 3 disposed on both flanks of the core 2. The core 2 comprises oblate pipes 4 disposed in the length direction L of the core 2. The pipes 4 are connected at their ends with manifolds 3 of the heat exchanger 1 for supplying and leading away a heating medium flowing through the pipes 4 and heating them. Between each pair of neighbouring pipes 4 there is disposed a corrugated fin 5 being in contact therewith. The corrugated fin 5 extends along the whole length L of the core 2 and of the pipes 4, and comprises a plurality of ridges 6 which have crests 7 and troughs 8. The ridges 6 extend in the transverse direction relative to the length L of the core 2, i.e. between the front surface 2a and the rear surface 2b of the core 2. Between individual ridges 6 of a rib 5 and external surfaces of the pipes 4 there are formed channels for the flow of a heated medium which is directed transversely to the length L of the core 2 between the front surface 2a of the core 2 defining the inlet of the heated medium and the rear surface 2b of the core 2 defining the outlet of the heated medium. The ridges 6 have a width W corresponding to the width of the core 2 (which can be more clearly seen in Fig. 2).

[0014] The ridges 6 of a fin 5 may be disposed perpendicularly to the front surface 2a and the rear surface 2b of the core 2, as shown in Fig. 1, or they can be disposed obliquely to said surfaces 2a, 2b to which intensify the heat exchange.

[0015] As shown in Fig. 2 and 3, according to the invention each ridge 6 of a fin 5 is bent along its width W in the direction perpendicular to its width W and forms an offset 9 dividing the ridge 6 into two sections 20, 30 which are disposed one after the other in the width direction W of the ridge 6 and are translated relative to each other in the length direction L of the core 2 at a distance ΔL (as shown in FIG. 3 and 4). The measure of the distance ΔL of the parallel translation of neighbouring sections 20, 30 of a ridge 6 is defined as the distance between central planes "a" and "b" of the neighbouring sections 20, 30 of a ridge 6 (as shown in FIG. 4). According to the invention the neighbouring sections 20, 30 are translated parallelly to each other at a distance ΔL which fulfils the following condition:

35 
$$0 < \Delta L \leq fp/4, \quad (1)$$

where fp is the pitch of a corrugated fin 5 defined as the distance between the troughs 8 of one ridge 6, and the central planes "a", "b" are defined as planes passing through the centre of a crest 7 and at even distances from the centres of troughs 8 of one given ridge 6.

40 [0016] The use of a corrugated fin 5 shaped according to the invention in a heat exchanger 1 makes it possible to reduce pressure drop in a heated medium as it flows between the inlet thereof on the front surface 2a of the core 2 and the outlet on the rear surface 2b of the core 2. It has been found that in the case of the heated medium flow rate of 2 m/s and the shape of ridges 6 with translation ΔL fulfilling the condition (1) the flow pressure drop may be reduced by 6% and the heat exchanger efficiency may be enhanced by 0.12% compared to the pressure drop and heat exchanger efficiency for the same flow rate of the heated medium in a conventional core. It has also been found that in the case of the heated medium flow rate of 5 m/s and the shape of ridges 6 with translation ΔL fulfilling the condition (1) the flow pressure drop may be reduced by 6% and the heat exchanger efficiency may be enhanced by 0.4% compared to the pressure drop and heat exchanger efficiency for the same flow rate of the heated medium in a conventional core.

[0017] Sections 20, 30 of a ridge 6 may have widths W1 and W2, respectively, which widths may be the same or different.

50 [0018] It should be noted that, although the drawing presents an embodiment wherein there is one bend and one offset 9 along the width W of a ridge 6, it has been envisaged that in the case of wider cores 2 of a heat exchanger 1 there may be more than one bend and more than one offset 9 along the width W, and more than two sections translated to each other in the length direction L of the core 2 may be formed. In such case the translation distance ΔL at the offset 9 between each pair of neighbouring sections fulfils the condition (1). In this case also the widths of the sections may be the same or may differ.

55 [0019] Each ridge 6 of a fin 5 has two flanks 10 which may be provided with slits 11 having deflected edges and forming louvers 12 for leading and directing a heated medium passing through the flanks 10 between the neighbouring channels

formed on both sides of a ridge 6. Preferably, the louvers 12 are arranged in the same direction in individual sections 20, 30 on both sides of the central planes "a", "b" thereof, and in the opposite directions in the neighbouring sections 20, 30, as it makes it possible to lead a heated medium through the heat exchanger core in both directions transverse to the core length while ensuring the same effects of heat exchange.

[0020] The core of a heat exchanger according to the invention may be used in heat exchangers of any type, such as an engine cooler, a condenser, an intercooler, and the like.

**Claims**

1. A core (2) of a heat exchanger (1), having a front surface (2a) defining an inlet of a heated medium and an opposite rear surface (2b) defining an outlet of the heated medium and comprising:

oblate pipes (4) for the flow of a heating medium disposed in the length direction (L) of the core (2);  
 corrugated fins (5) located in contact with and between each pair of neighbouring pipes (4) and comprising ridges (6); the ridges (6) having a width (W) and forming channels for the flow of the heated medium and extending transversely to the length (L) of the core (2) between the front surface (2a) and rear surface (2b) of the core (2),

**characterized in that**

each ridge (6) of a fin (5) is bent at least in one place along its width (W) in the direction transverse to its width (W) thus forming an offset (9) dividing the ridge (6) into two sections (20, 30);  
 the sections (20,30) are disposed one after the other in the width direction (W) of the ridge (6) and are translated in parallel to each other in the length direction (L) of the core (2) at a distance  $\Delta L$ ;  
 the distance  $\Delta L$  is defined as a distance between central planes (a, b) of the neighbouring sections (20, 30) of that ridge (6), wherein the central planes (a, b) are defined as planes passing through the centre of a crest (7) and at equal distances from the centres of troughs (8) of individual sections (20,30) of the ridge (6); and  
 the distance  $\Delta L$  of the parallel translation of the neighbouring sections (20, 30) relative to each other fulfils the following condition:

$$0 < \Delta L \leq fp/4$$

where fp is the pitch of a corrugated fin (5) defined as a distance between troughs (8) of one ridge (6).

2. The core of a heat exchanger according to claim 1, wherein sections (20, 30) of a ridge (6) have widths W1, W2, respectively, which are equal.
3. The core of a heat exchanger according to claim 1, wherein sections (20,30) of a ridge (6) have widths W1, W2, respectively, which are different.
4. The core of a heat exchanger according to claim 1, wherein each ridge (6) has two flanks (10) which are provided with slits (11) having deflected edges forming louvers (12) for leading and directing a heated medium through the flanks (10) between neighbouring channels formed by the ridges (6).
5. The core of a heat exchanger according to claim 4, wherein the louvers (12) are disposed in the same direction in individual sections (20, 30) on both sides of their central planes (a, b) and in opposite directions in the neighbouring sections (20, 30).
6. The core of a heat exchanger according to claims 1-5, wherein the ridges (6) of the fins (5) are disposed transversely to the front surface (2a) and the rear surface (2b) of the core (2).
7. The core of a heat exchanger according to claims 1-5, wherein the ridges (6) of the fins (5) are disposed perpendicularly to the front surface (2a) and the rear surface (2b) of the core (2).

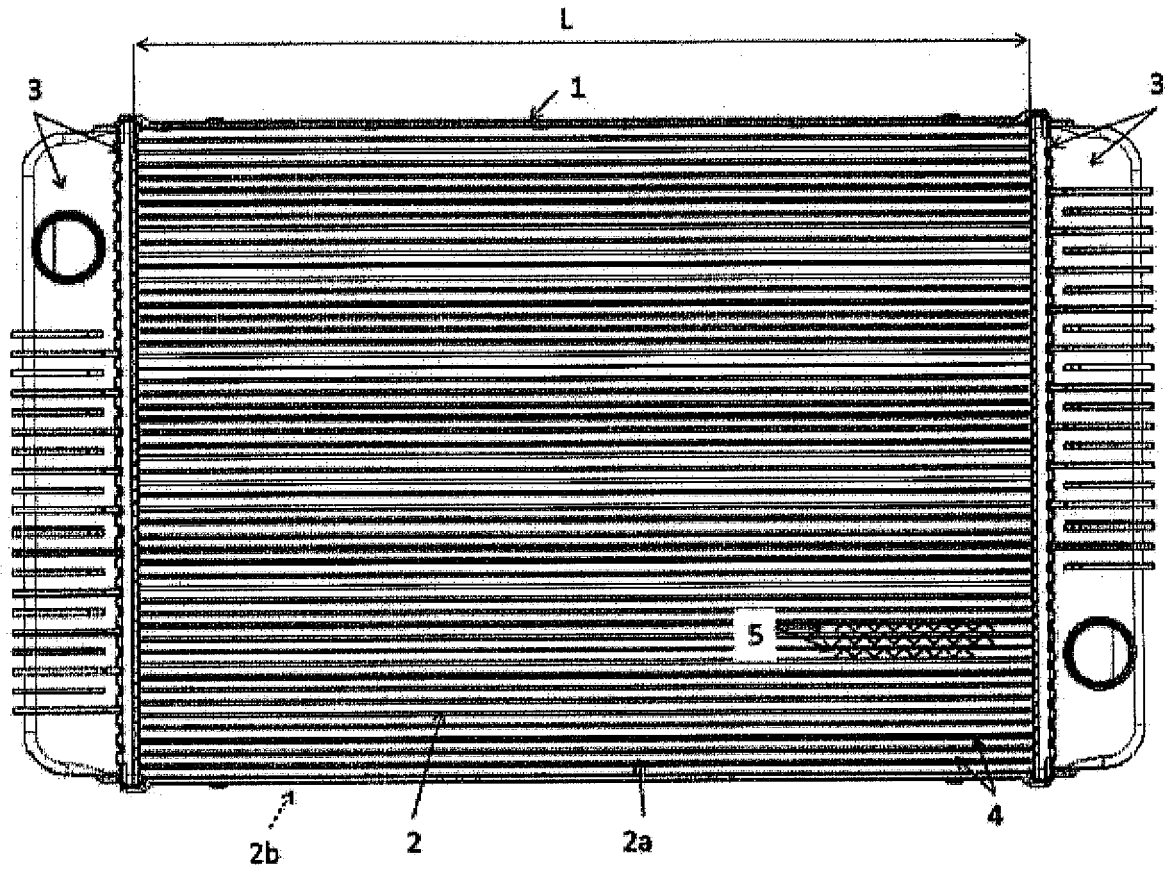


FIG. 1

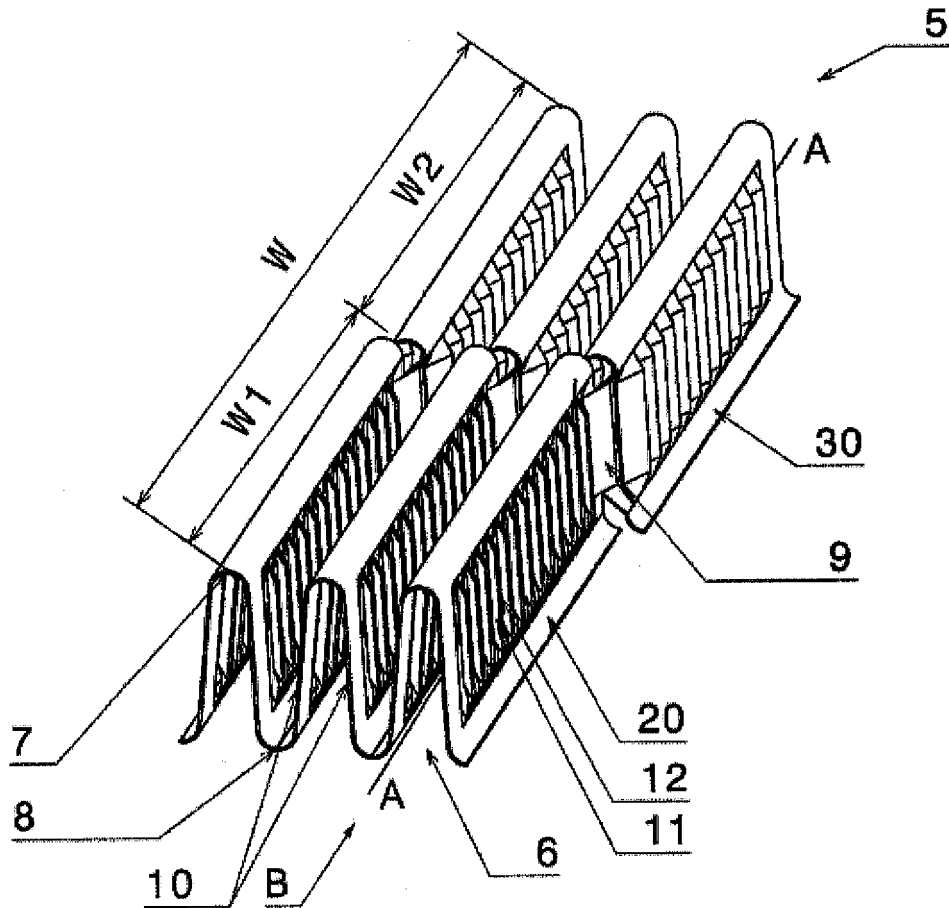


FIG. 2

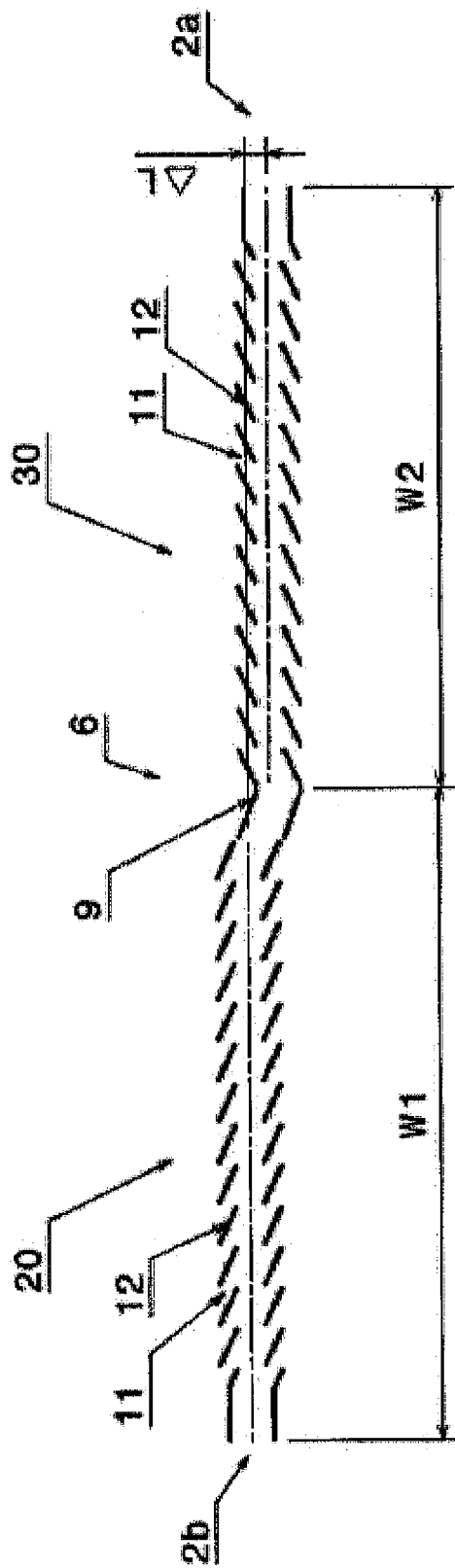


FIG. 3

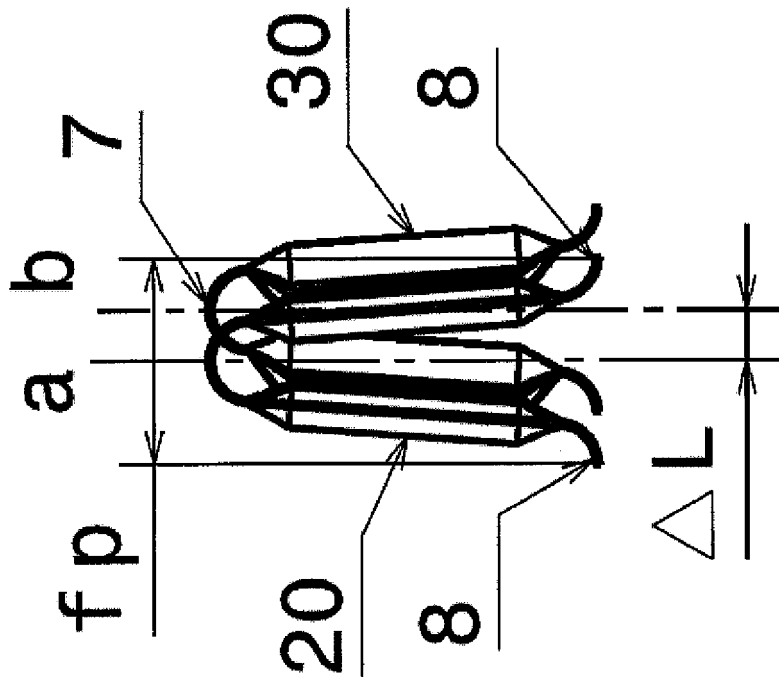


FIG. 4



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Application Number  
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