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(71) Applicant: **Synertec Sp. z o.o.**
25-608 Kielce (PL)

(72) Inventors:
- **Stepien, Andrzej**
  26-600 Radom (PL)
- **Zarski, Kazimierz**
  89-530 Sliwice (PL)

(74) Representative: **Garstka, Antoni Czeslaw**
Tumlin-Wegle 87
26-050 Zagnansk (PL)

(54) Light-walled plate heat exchanger

(57) The light-walled plate heat exchanger, according to the invention, is characteristic in that it comprises non-planar, favourably corrugated lengthwise and / or broadwise plates (1' and 2') stacked alternately with a non-parallel favourably perpendicular orientation of the corrugation, whereby the plates are in contact or are permanently connected and create flow channels (1 and 2) for the two heat carriers (I and II), which ensure with their shape an induction of uniaxial or biaxial turbulences of the heat carriers (I and II).

Fig. 1a

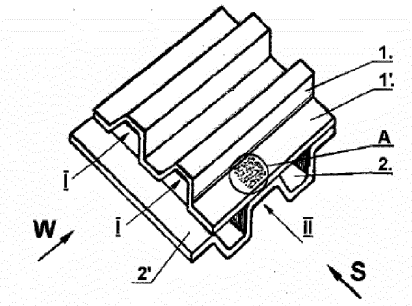


Fig. 1b

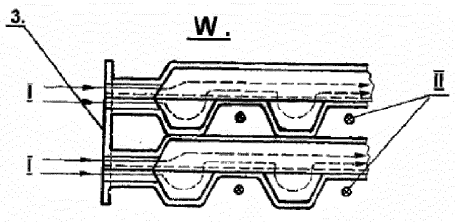


Fig. 1c

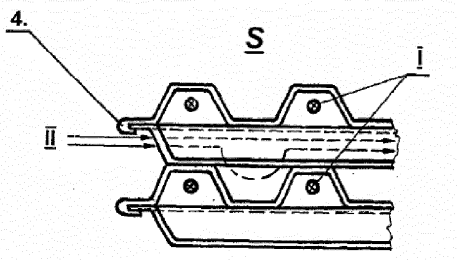


Fig. 1

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Description

[0001] The present invention is a light-walled plate heat exchanger, characteristic for its high efficiency and low production costs, suitable for mass production.

[0002] Known plate exchangers, with the module (the distance between the plates) of 1.5 to 4 mm, are characteristic for a laminar motion of the heat carriers present therein. In a laminar motion, the heat transfer coefficient is dependent on the Reynolds number to the power of circa 0.3-0.35. The mechanism of the heat transfer is limited to conduction of heat within the carrier.

[0003] The light-walled plate heat exchanger, according to the invention, is characteristic for that it comprises non-planar plates, favourably corrugated broadwise and/or longwise, stacked alternately on each other with a non-parallel, favourably perpendicular orientation of the corrugation. The plates are either in contact or are permanently joined together and create the flow channels for the two heat carriers, ensuring with their shape an induction of uniaxial or biaxial turbulences of the heat carriers.

[0004] The advantage of the light-walled plate heat exchanger, according to the invention, is the shape of its plates, which ensures the turbulent nature of motion of the heat carriers. In a turbulent motion, the heat transfer coefficient is proportional to the Reynolds number to the power of 0.8. Transverse to the axis of flow, the motion of the particles of liquid causes intense transfer of heat, thus the heat exchange surface - as compared to the conventional plate heat exchangers - is much smaller.

[0005] Furthermore, the heat exchanger, according to the invention, is lightweight and small-sized yet maintains a large heat exchange surface, and has high efficiency achieved from the unit volume of the exchanger. The force exerted as a result of difference in the pressure of the agent flowing on both sides of the heat transfer surfaces affects the small-length structural components, thus the tensions are much smaller than in case of large-sized flat plates. In the invention thinner wall plates are used, along with materials of lower durability, while the entire structure of the heat exchanger is rigid. It is possible to connect the plates permanently in order to increase the rigidity of the structure. Shape of the plates (outer sides of the flow channels form the thresholds) and a zigzag axis of flow along the channel entail that both agents are subject to biaxial movement disorders. The result is a wild (turbulent) motion of the heat carriers, which results in a higher efficiency and significant reduction of the heat transfer surface.

[0006] The present invention is visualised as an exemplification in a drawing, in which Fig. 1 shows an axonometric view on a fragment of the heat exchanger, according to the invention, and shows and explains the principle of induction of a turbulent flow of the two heat carriers, whereas the symbols appearing in Fig. 1 represent: I- first heat carrier, II - second heat carrier, 1 - flow channel of the first heat carrier shaped within the barrier plate, 1' - first plate of the barrier, 2 - flow channel of the second heat carrier shaped within the barrier plate, 2' - second plate of the barrier, 3 and 4 - joints of the barrier plates 1' and 2', A - contact point of the channels (as a joint of the plates). Fig. 1 shows the flow of the heat carriers I and II along the flow channels 1 and 2. Fig. 1a, Fig. 1b and Fig. 1c illustrate the way the disturbances-turbulences occur, explaining that if a heat carrier flows along the channel 1, then channel 2 constitutes an obstacle through the influence of its outer side. Vice versa, for the second heat carrier II, channel 1 becomes an obstacle. Fig. 1 also indicates the contact point of the barriers 1' and 2'.

[0007] Fig. 2 shows an axonometric view of the two barriers (Fig. 2a and Fig. 2b), which are assembled together with their embossed flow channels facing each other at a right angle. Made into a package they form an inset of the heat exchanger (Fig. 2c), which for this version of the structure does not require connecting of the barrier plates. The flow of the two carriers is structurally separated. The sheets are formed by pressing and then stacked alternately into a package. The rectilinear shape of the channels along the flow axis somewhat simplifies the structure, but causes uniaxial disruption, which can be partly changed by intersecting the rectilinear channels differently than at a right angle.

[0008] Fig. 3 shows and explains the structure of the heat exchanger according to the invention, which allows for a biaxial disturbance of flow of the heat carriers through zigzag shaping of the flow channels of the heat carriers, wherein: I - first heat carrier; II - second heat carrier, 1 - flow channel of the first heat carrier shaped within the barrier plate, 1' - first plate of the barrier, 2 - flow channel of the second heat carrier shaped within the barrier plate, A - contact point of the channels (as a joint of the plates).

[0009] The light-walled plate heat exchanger, according to the invention, allows to take into account diverse properties of the heat carriers by differentiating the depth of the flow channels (for first and second barrier) and varying the cross-sections of the flow channels (the cross-section may be in particular: trapezoidal, sinusoidal, rectangular, semi-circular, etc.). The plates can be made especially of metals, such as steel, copper and its alloys, aluminium and its alloys, or ceramics.

[0010] Utilisation of such different materials is linked with a variety of heat carriers used and their parameters, which in turn allows to connect the inset of the heat exchanger (barrier plates) with one another by different methods, in particular: adhesive bonding, soldering (hard and soft), braze welding, welding, fusion welding. However, for several solutions there is no need for connecting, and it is sufficient to stack the plates into packets.

[0011] The solution according to the invention allows for a modular construction of the heat exchangers from the same basic elements as barrier plates.

Claims

1. The light-walled plate heat exchanger, **characteristic in that** it comprises non-planar, favourably corrugated lengthwise and / or broadwise plates (1' and 2') stacked alternately with a non-parallel favourably perpendicular orientation of the corrugation, whereby the plates are in contact or are permanently connected and create flow channels (1 and 2) for the two heat carriers (I and II), which ensure with their shape an induction of uniaxial or biaxial turbulences of the heat carriers (I and II).

Fig. 1a

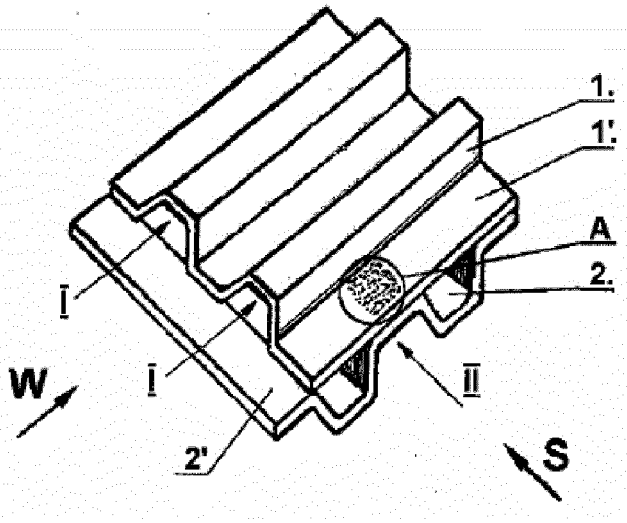


Fig. 1b

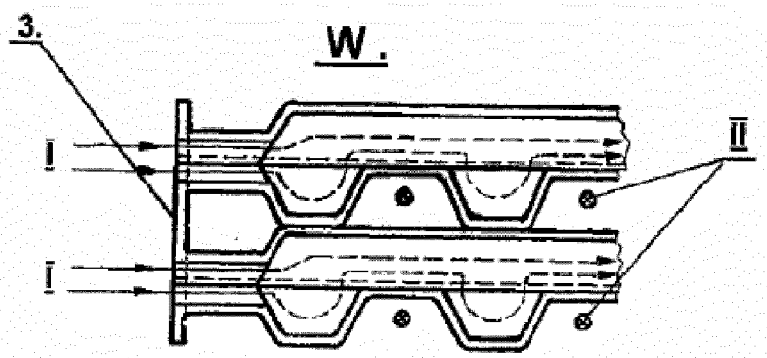


Fig. 1c

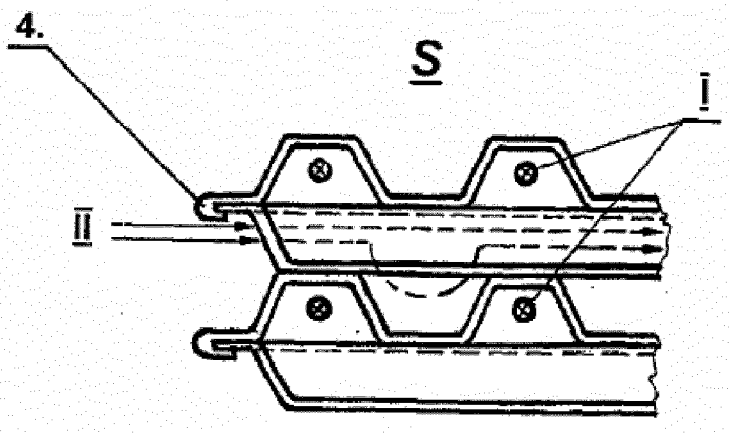


Fig. 1

Fig. 2a

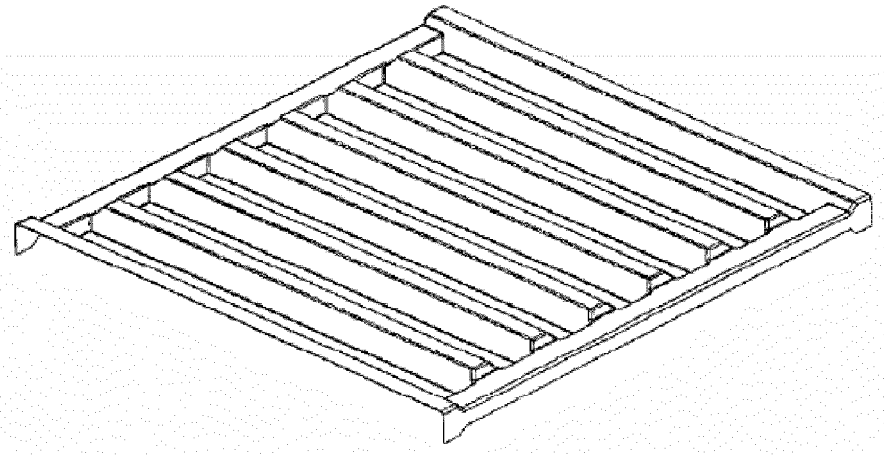


Fig. 2b

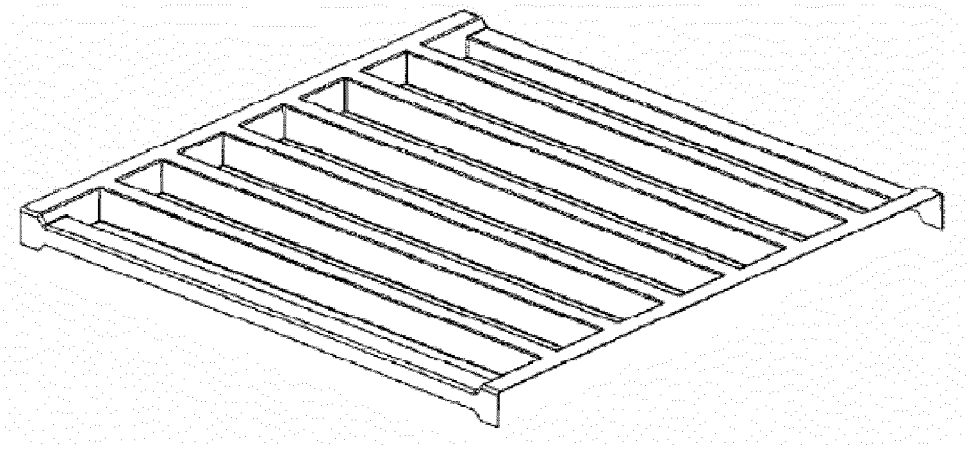


Fig. 2c

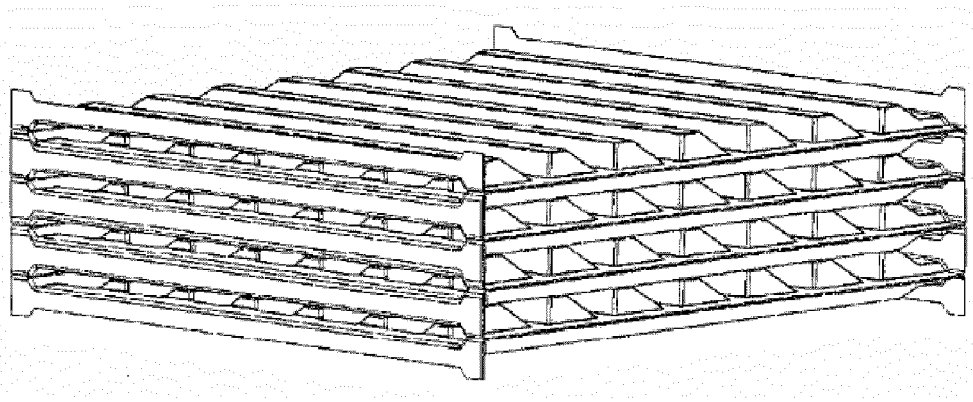


Fig. 2

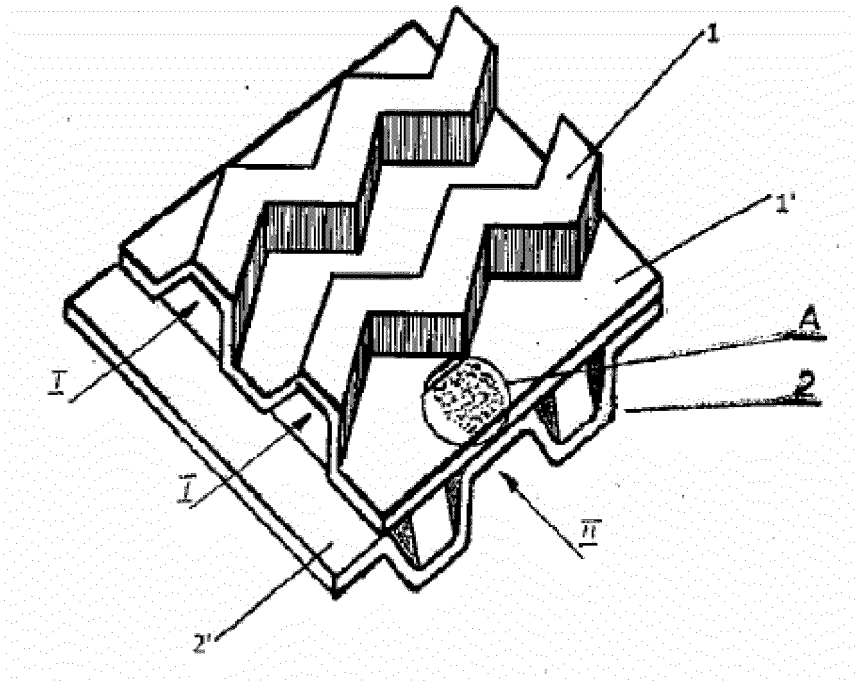


Fig. 3

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EUROPEAN SEARCH REPORT

Application Number
EP 13 46 1554

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X	EP 2 202 476 A1 (ALFA LAVAL VICARB [FR]; ALFA LAVAL CORP AB [SE]) 30 June 2010 (2010-06-30) * paragraph [0025] - paragraph [0031]; figures 1,2 *	1	INV. F28F3/04 F28D9/00
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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	14 March 2014	Delval, Stéphane

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