

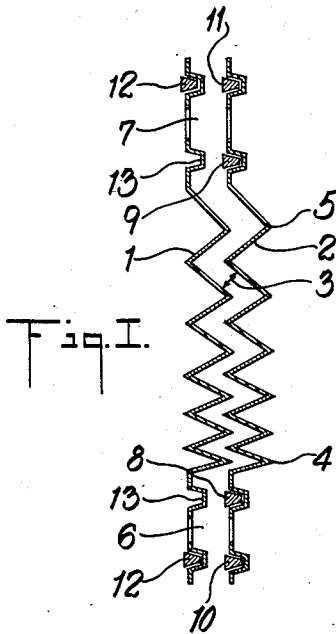
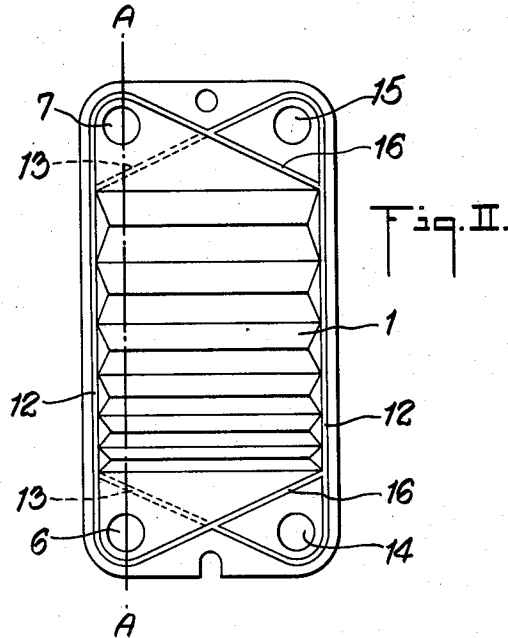
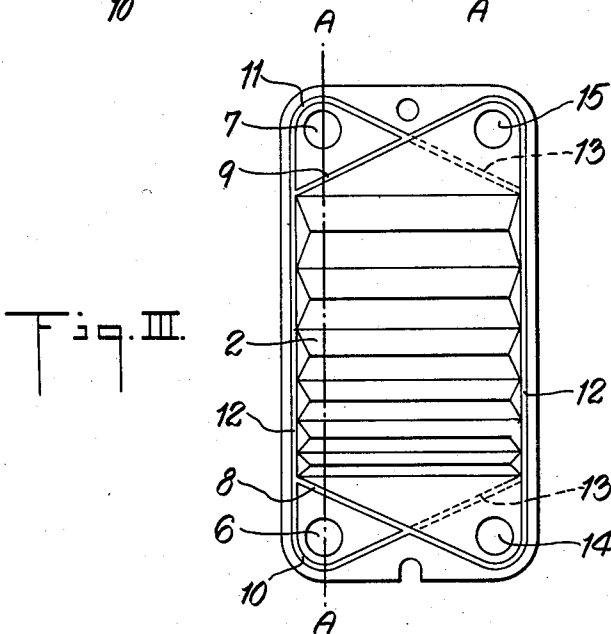
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PLATE TYPE HEAT EXCHANGER

2,872,165

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2 Sheets-Sheet 1



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Fig. IV.

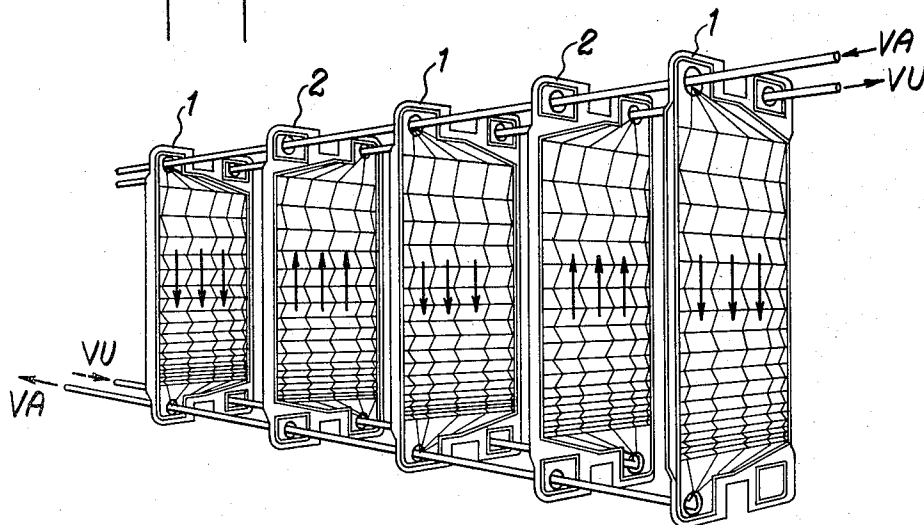
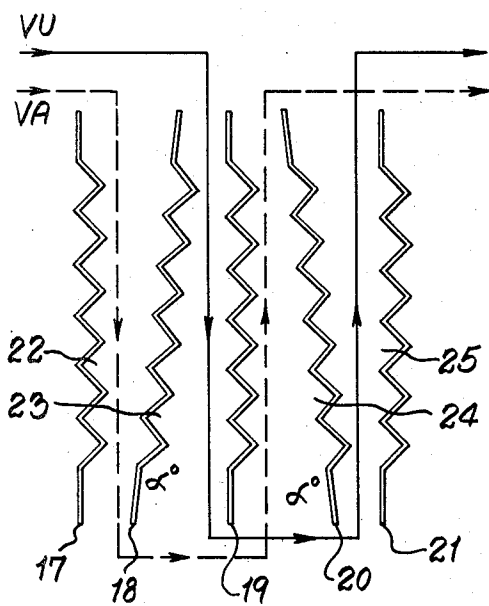


Fig. V.

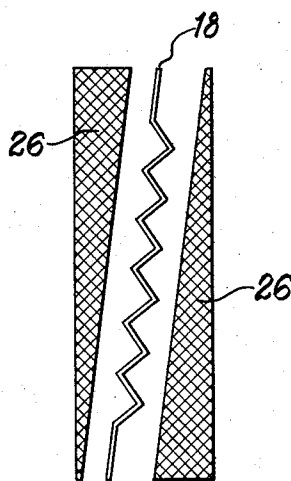


Fig. VI.

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PLATE TYPE HEAT EXCHANGER

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5 Claims. (Cl. 257—245)

This invention relates to plate type heat exchangers in which the media to be heated or cooled are led through flow channels formed between heat exchange plates which are compressed into packs. The invention has particular reference to an improved heat exchanger of the above-mentioned type wherein each channel is provided with a cross-sectional area which progressively increases or decreases in the flow direction while the width of the channel, as measured in the plane of the plate at a right angle to the flow direction is constant throughout the plate.

By means of the present invention, a maximum portion of the surfaces of the installed heat exchanging plates is used for heat transmission between the heat-emitting and the heat-absorbing media, while a progressively increasing or decreasing cross-sectional (through-flow) area is obtained in the flow channels between the plates. This form of the flow channels is particularly advantageous when the heat-absorbing medium, by heat transmission through the plates, is to be brought to boil in the flow channels between the plates, the volume of the heat-absorbing medium being increased considerably when flowing in the channels.

By arranging the heat exchanger so that the cross-sectional area in the channels for the heat-absorbing medium increases progressively, the flow velocity of the medium is prevented from decreasing as a result of counter-pressure arising in the channels, as the volume of the heat-absorbing medium is increased by supply of heat. The form of the channels thus obtained for the heat-emitting medium (generally steam), being of a progressively decreasing cross-sectional area, also entails an advantage. The heat-emitting medium is introduced into the channels where their cross-sectional area is largest in size, so that the flow resistance of the heat-emitting medium is as small as possible in the channel inlet, where the heat-emitting medium has its largest volume. The subsequent decrease in the flow velocity of the heat-emitting medium, as it continues through the channel, is an advantage. The risk of the heat-absorbing medium becoming scorched or burning onto these hottest parts of the plates is reduced in a corresponding degree, because the lower the velocity of the heat-emitting medium, the less the heat-transmission obtained. The further the heat-emitting medium enters into the channels, the larger becomes the condensed part of this medium and such condensed part takes on a smaller volume. Consequently, the fact that the channel cross-sectional area for the heat-emitting medium successively decreases does not entail a disadvantage. On the contrary, the best heat-transmission is obtained in those parts of the plates where the temperature of the heat-absorbing medium is low, because there the flow velocity of the condensed, heat-emitting medium increases.

For a better understanding of the invention, reference may be had to the accompanying drawings in which:

Fig. I is a sectional view of two parallel heat-exchange plates separated somewhat from their normal assembled positions but adapted when assembled together to form

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a flow channel which gradually decreases in cross-sectional area from its top part to its bottom part;

Fig. II is a face view of the left-hand plate in Fig. I, as seen from the left;

Fig. III is a face view of the right-hand plate in Fig. I, as seen from the left;

Fig. IV is a perspective view of a group of the plates showing how they are coupled together when the inter-plate flow channels for the heat-emitting and the heat-absorbing medium, respectively, are connected in parallel;

Fig. V is a diagrammatic view of a series of the heat exchange plates arranged at a certain angle in relation to each other, showing the flow paths of the media between the plates, and

Fig. VI is a similar view of one of the plates illustrated in Fig. V, showing wedge-like packing for sealing or tightening between the plates.

In the embodiment of the invention illustrated in Fig. I, two heat exchange plates 1 and 2 are arranged in parallel, closely adjacent relation and appear as seen along the section lines A—A in Figs. II and III, respectively. The surfaces of the plates are corrugated to form transverse corrugations, the ridges of which extend at right angles to the flow direction of the heat-absorbing and heat-emitting media. The corrugation ridges may, if desired, be arranged differently than as illustrated. The plates 1 and 2 form between them a flow channel 3, the cross-sectional area of which increases from the bottom transverse corrugation 4 to the top transverse corrugation 5 on each plate. More particularly, each plate 1 and 2 has transverse corrugations arranged side by side and the widths of which (as measured in the flow direction of the medium flowing in the channel 3 parallel to the plane of the plate) increase successively from the lowermost to the uppermost corrugation, while the heights of the corrugations (as measured at a right angle to the plane of the plate) are equal. The increase in width of the corrugations is stepwise and is obtained by varying the inclination of the corrugation flanks toward the plane of the plate, so that this inclination of the flanks of each corrugation is less than that of the flanks of the next lower corrugation. Alternatively, the cross-sectional area of channel 3 may be made to enlarge gradually in the upward direction by successively reducing the heights of the transverse corrugations along the plates from bottom to top.

By means of elastic sealing or tightening ribs 8 and 9, the flow channel 3 is isolated from communication passages or holes 6 and 7 in the bottom and top parts, respectively, of the plates 1 and 2, the passages 6 and 7 affording communication between flow channels at the left side of plate 1 and the right side of plate 2 (Fig. I). The communication passages 6, 7 are in their turn provided with outer ribs 10 and 11 for sealing against the surrounding air outside the plate pack. The flow channel 3 is sealed against the surrounding air by means of marginal packing or tightening ribs 12. The sealing ribs 8—12 are held in grooves 13 in the plate surfaces, these grooves, however, being without tightening ribs at certain points, as shown in Figs. II and III.

In Fig. II is illustrated a face view of the plate 1 in Fig. I, showing the passages 6 and 7 affording communication with the flow channel formed at the left-hand side of the plate 1 (Fig. I). Other communication passages 14 and 15 in the bottom and top parts, respectively, of the plate 1 are, however, isolated from this flow channel by means of inner sealing ribs 16. These communication passages 14 and 15 are connected, as is shown in Fig. III, with the flow channel 3 across the recesses 13 in the bottom and top parts, respectively, of the plate 2. The plate 2 is formed as a reflected image of the plate 1.

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Referring now to Fig. IV, the heat exchanger comprises a series of the plates 1 and 2, these plates being arranged alternately and side by side as a pack. The heat-absorbing medium VU and the heat-emitting medium VA are fed as shown in Fig. IV. The plates 1 and 2 are arranged so that the flow channels between the plates for the various media are coupled separately in parallel, the media being led between the plates in flows directed in opposite directions to each other. The plates arranged in this manner constitute a counter-flow heat exchanger.

In the embodiment of the invention shown in Fig. V, the flow channels formed between the plates 17-21 are provided with gradually changing cross-sectional areas by arranging the planes of the plates at a certain angle to each other. Wedge-like flow channels 22-25 are thus obtained. The surfaces of the plates are corrugated to form transverse corrugations, the ridges of which extend at a right angle to the flow direction of the media flowing between the plates. The widths of the transverse corrugations, as measured in the flow direction parallel to the plane of the plate, are here formed so as to be of equal size, although they may be successively increased in size as in the embodiment of the invention previously described. Fig. V also shows the paths of the heat-emitting medium VA and heat-absorbing medium VU between the plates, these media flowing in the same direction through each pair of adjacent channels between the plates forming the pack. The plates 17-21 arranged in this way form a parallel-flow heat exchanger, the flow channels for each medium being series-connected. Wedge-like packings 26 (Fig. VI) are arranged between the plates 17-21 in order to seal the flow channels 22-25 against air surrounding the plates.

I claim:

1. In a plate type heat exchanger, a pack of heat exchange plates defining a plurality of flow channels between adjacent plates of the pack and arranged to accommodate flow through said channels longitudinally of the plates, the plates being of uniform width and the

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channels being of a width substantially equal to the width of the plates, each channel extending substantially from end to end of the adjacent plates defining the channel, the plates each having a series of transverse corrugations extending transversely of said flow and partly defining each channel adjacent the plate, the corrugation adjacent one end of each plate being of greater width than the corrugation adjacent the opposite end of the plate, said corrugation width being measured in the longitudinal direction of the plate, the corrugations of each series increasing in width from one end of the plate to the other end, whereby each channel has a cross-sectional area which increases from one end to the other end of the adjacent plates.

2. A pack of heat exchange plates according to claim 1, in which the transverse corrugations of each plate are of uniform height measured at right angles to the plane of the plate.

3. A pack of heat exchange plates according to claim 1, in which said increase in the width of the corrugations of each series is stepwise.

4. A pack of heat exchange plates according to claim 1, in which the planes of said plates are parallel to each other.

5. A pack of heat exchange plates according to claim 1, in which the plates have throughflow channels for the heat absorbing and the heat emitting media, said throughflow channels being coupled in parallel to cause the media to flow in opposite directions in adjacent channels, thereby forming a countercurrent heat exchanger.

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