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2,812,165

HEADER UNITS FOR PLATE TYPE HEAT EXCHANGER

Filed Feb. 6, 1953

2 Sheets-Sheet 1

Fig. 1

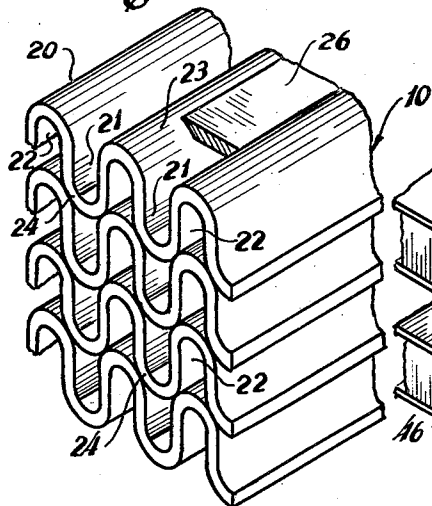


Fig. 2

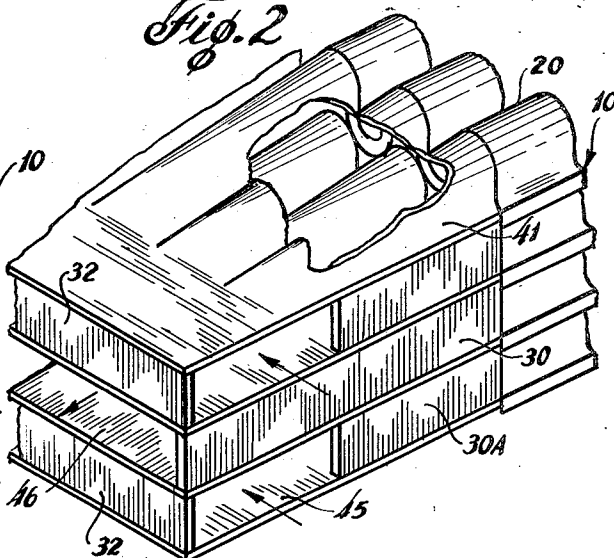


Fig. 3

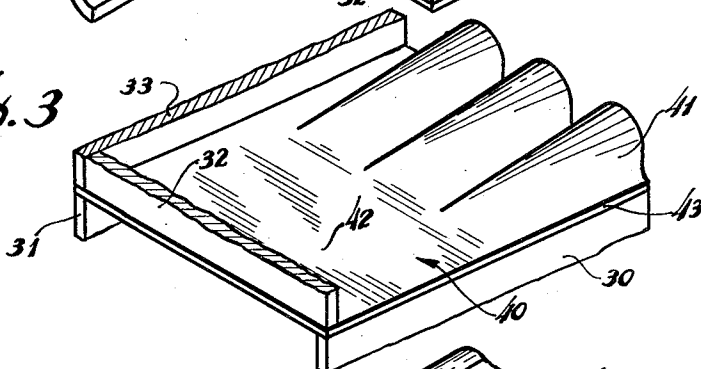
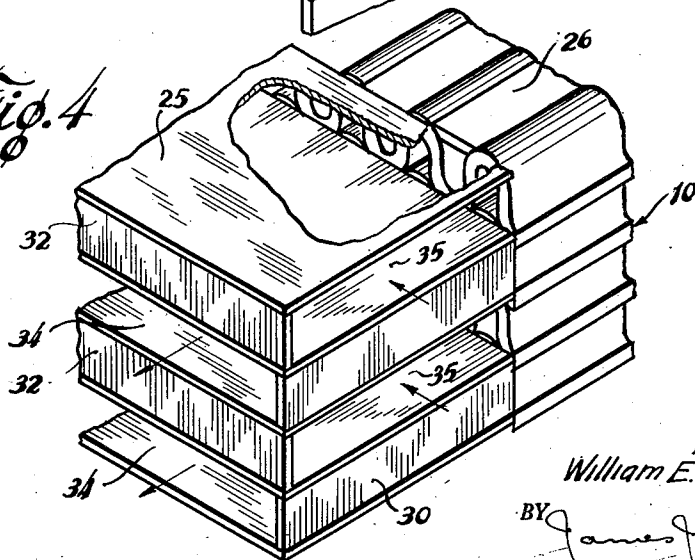


Fig. 4



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2 Sheets-Sheet 2

Fig. 7

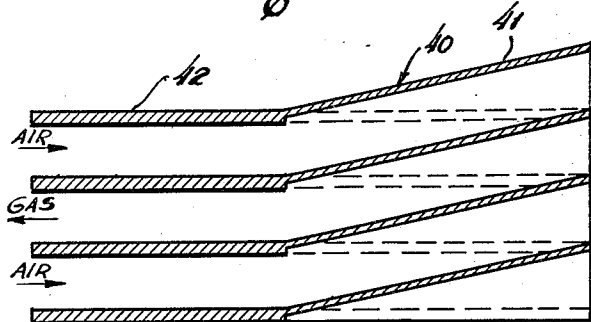


Fig. 8

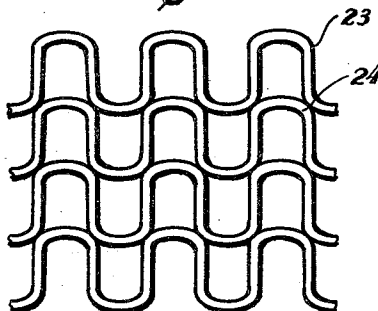


Fig. 5

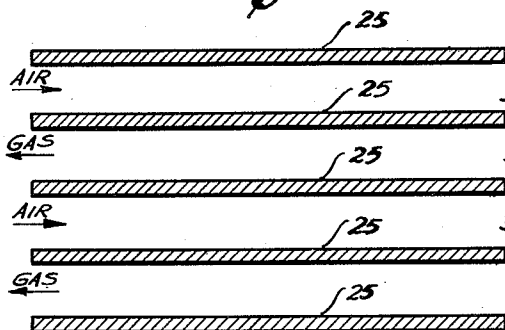
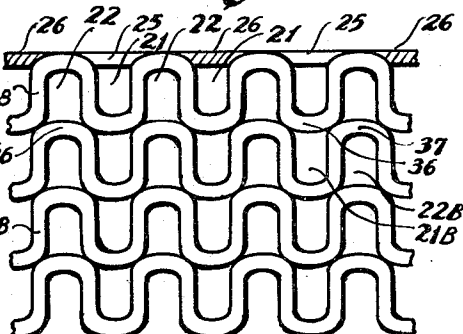


Fig. 6



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2,812,165

HEADER UNITS FOR PLATE TYPE HEAT EXCHANGER

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Application February 6, 1953, Serial No. 335,480

2 Claims. (Cl. 257—245)

The present invention relates to improvements in plate type heat exchangers of the type particularly adapted for the transfer of heat between two confined fluids.

This invention has for its principal object a heat exchanger assembly which is produced by stacking a series of corrugated sheets one upon another and bonding them together at their points of contact so as to form an integral matrix of heat exchanger elements. The open ends of the stacked sheets are made integral with a particular header arrangement which directs a relatively hot fluid and a fluid to be heated to separated passageways between corrugated sheets. The invention will best be understood upon consideration of the following detailed description when read in connection with the accompanying drawings in which:

Figure 1 is a perspective view of a core assembly utilizing corrugated sheet type elements in a stacked arrangement.

Figure 2 is a perspective view of a header arrangement used in conjunction with the corrugated sheet type element.

Figure 3 is a perspective view of another form of header used in conjunction with a core section of stacked corrugated sheets.

Figure 4 is a perspective view of one of formed header plates used in the header of Figure 3, to provide a transition between the passages constituted by the corrugations and a box like manifold.

Figure 5 is a sectional elevation of a header comprising the flat plates of Figure 4.

Figure 6 diagrammatically illustrates flow passageways within a heat exchanger core utilizing the flat plate header of Figure 2.

Figure 7 is a sectional elevation of the header illustrated in Figure 3.

Figure 8 diagrammatically illustrates the flow passageways within a core utilizing the formed plate header of Figure 3.

The heat exchanger elements of Figure 1 which comprise the heating surface core 10 of this novel heat exchanger are essentially a series of transversely superimposed corrugated sheets 20 each of which is formed from a plane surfaced metallic sheet having good heat transfer qualities; and which is otherwise suitable for fabrication into an integral heat exchanger core by means such as brazing. When stacked one upon another, these corrugated sheets form a series of parallel passageways 21, 22 suitable for containing a plurality of fluids flowing therethrough in a heat exchange relation one with another, the passages 21 for one fluid opening from the upper face of the sheet 20 while those 22 for the other fluid open from the underside of the sheet. The corrugations 23 of the sheets 20 are so formed in size and contour that when a plurality of said sheets are superimposed they do not "telescope" or "nest" one within another but only index themselves until they contact along lines tangent to the crest 24 of each corrugation 23. The outer diametral dimension of each corrugation being greater than the spacing

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of the corrugations or legs of the U-folds therein. The sheets may in this manner be joined together into an integral block-like heat exchanger core 10 as shown in Figure 1.

Figure 4 illustrates a form of header suitable for application to the disclosed corrugated plate type core 10. This header assembly essentially comprises a series of parallel plates 2 which abut and are joined end to end with the open ends of the corrugated sheet core. As is shown in Figure 4, one of the parallel plates is joined to each end face portion of the core which is defined by the lower loops or troughs of one corrugated sheet and the upper loops or crests of the next lower corrugated sheet. In addition, one such flat plate is joined to the upper loops of the uppermost corrugated sheet and a similar plate is joined to the lower loops of the lowermost corrugated sheet. To fully enclose the spaces between corrugations, metallic strips 2 are placed along the troughs of both the uppermost and lowermost corrugated plates so as to fully enclose the spaces between vertical legs of the corrugations. These enclosed spaces lead to and communicate with the interior of the headers in the same manner as those spaces which lie between the corrugated sheets and are closed by the crests of corrugations in adjacent sheets 20.

The spaces between the parallel header plates 25 are further enclosed on two of the remaining three open sides by a combination of two side plates 30, 31 or by an end plate 32 and a single side plate 33. By alternating the enclosure arrangement it is possible that the open sides 34, 35 of the header boxes or manifolds may be alternately located at the outer end or at a side of the header.

When used with the flat plate header of Figure 4, the stretcher portions 36, 37 of the corrugated sheet core become in effect plates separating one fluid from another, and the legs 38 of the undulating portions of the corrugated sheets form continuous strip fins in the spaces between plates in the manner illustrated by Figure 6. Figure 5 illustrates the straight passageways between flat header plates which direct fluid flow to the core so as to achieve the pattern of flow illustrated by Figure 8.

In use, the combined core and header arrangement illustrated in Figure 4 may be connected into any two-fluid system wherein it is desired to effect a transfer of heat from one fluid to another. As one fluid enters through the side openings 35 it passes into the header where it is turned to flow through the passageways 21, 22 situated between the corrugated sheets 20. The fluid continues to flow to the second header where it is discharged from openings symmetrical with those at the entrance end. A second fluid is simultaneously supplied to the core through openings 34 situated in the second header. This second fluid then flows counter-current to the first fluid through the spaces 21B, 22B (Figure 6) between corrugated sheets and into the second outlet header where it is exhausted to the proper ducting connections.

Figure 2 discloses a core of stacked corrugated sheets 20 having a novel header construction in which formed transition plates 40 comprise separating plates whose corrugated end faces exactly abut the end faces of the individual corrugated sheets 20 which comprise the core 10. The corrugations 41 of the formed plates 40 taper to a flat plate section 42 that lies substantially midway between the ends of the plate and the two sides 43 of the plate adjacent the corrugations lie in the same plane as the flat end portion 42 of the plate so that the sides of said plate present flat surfaces readily adapted to joining together with the straight edges of closure plates 30, 31 and 33.

These closure plates enclose the space between formed sheets 40 except for a single opening which is maintained alternately at the outer end of the header or at one side

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thereof in the manner shown at 45 and 46 of Figure 2. Such openings allow a plurality of fluids to flow into and out of the header in a constantly spaced relation. Where the opening is at one side of the header, the end thereof is entirely closed off by a spacer plate 32, one side is completely closed off by a full length side plate 31 and the ported side is closed off by a shortened side plate 30A. Where the header opening is at the outer ends of the plates 40, two full length side plates 30, 31 are joined between the plates to fully enclose the sides.

In the assembly disclosed in Figure 2, the arrangement would be such that any one sheet would form an upper wall and the adjacent lower sheet would form a lower wall for a series of passageways located in "zig-zag" fashion between said two plates. Fluids traversing the heat exchanger would be completely separated by the corrugated sheets making up each layer of the core, and it would be impossible for one fluid to lead into a passageway being occupied by a second fluid. The fluids flow through each core section in a "checker-board" pattern as is clearly seen by reference to Figures 7 and 8. The heat transfer takes place between fluids in alternate passages so that the core becomes in effect a bundle of tubes, each tube of fluid being bounded on all four sides by a tube carrying a second fluid.

It may be desirable under certain conditions to fabricate the core sheet 20 and the matching header plate 40 from a single sheet of material. A plurality of sheets so formed could be superimposed so that the corrugations would index themselves to the proper point where they could be securely held until finally bonded together. The spacer plates 30, 31, 32 and 33 may then be welded into the required spaces, or in certain instances these spacer plates may be positioned at the time the corrugated sheets are stacked and the entire unit of corrugated sheets and spacer plates bonded together in a single operation.

What I claim is:

1. A plate type heat exchange apparatus arranged to

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direct the flow of hot and cold fluids in heat exchange relationship, the apparatus including a plurality of sinusoidally corrugated sheets stacked one upon another with a crest of one corrugation bridging the space between troughs of abutting corrugations to provide a series of parallel passageways therebetween; a header assembly adjacent open ends of the fluid passageways to direct hot and cold fluids to their respective passageways, said header assembly comprising a series of header plates corrugated at one end to coincide with the end faces of the corrugated sheets and planar at the remote end thereof to provide spaced walls which permit fluid flow therebetween; and closure means positioned between outer edges of adjacent header plates to enclose the space therebetween, said closure means having an opening for fluid whereby fluid flowing into the space between adjacent header plates is directed to diagonally adjacent passageways lying between abutting pairs of corrugated sheets.

2. A heat exchange apparatus as defined in claim 1 wherein the corrugated portion of said header assembly is formed entirely at one side of the plane in which the flat portion lies.

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