Sept. 19, 1967 G. W. GERSTUNG 3,341,925

METHOD OF MAKING SHEET METAL HEAT EXCHANGERS WITH AIR CENTERS

Filed June 26, 1963

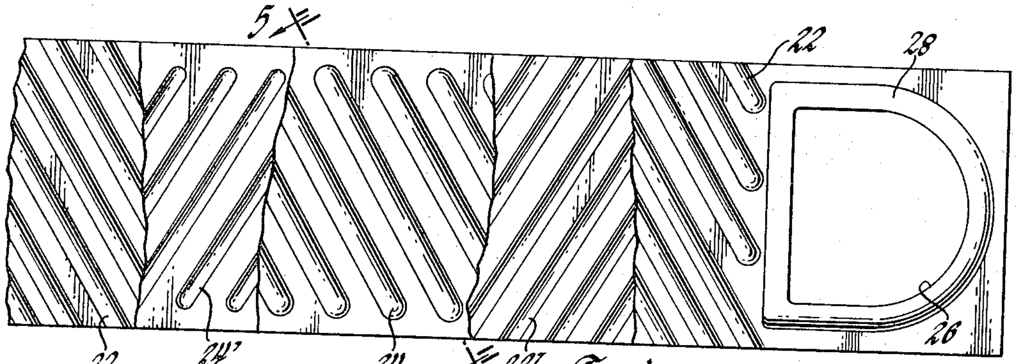

Fig. 1

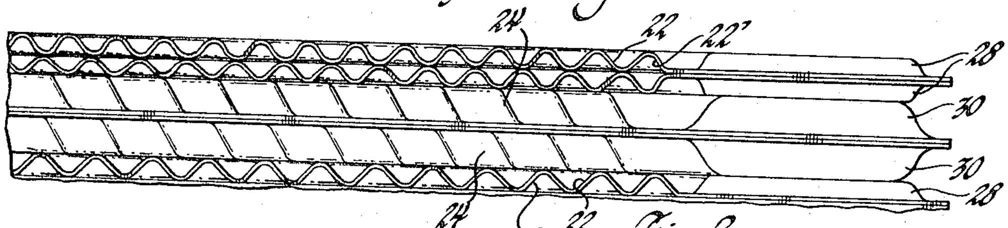

Fig. 2

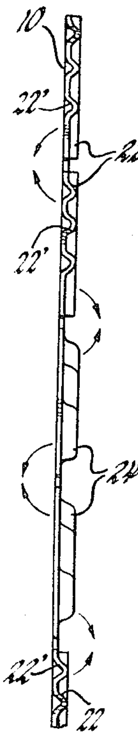

Fig. 3

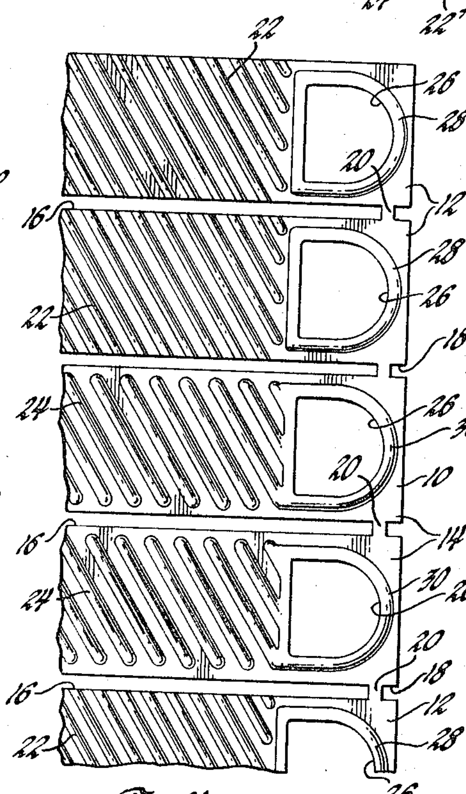

Fig. 4

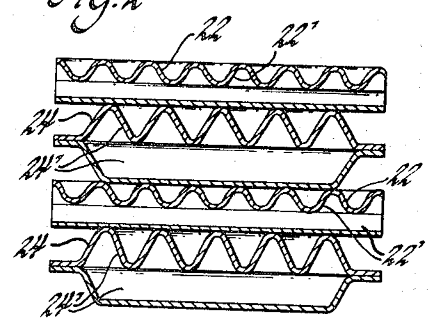

Fig. 5

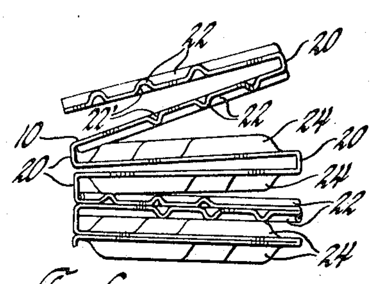

Fig 6

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METHOD OF MAKING SHEET METAL HEAT EXCHANGERS WITH AIR CENTERS

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4 Claims. (Cl. 29—157.3)

This invention relates to methods of making heat exchangers and more particularly to methods of making integral units of air center type heat exchangers from sheet metal by a folding technique.

A heat exchanger using no air centers and a method of making such an exchanger is disclosed in the United States application Ser. No. 194,594 filed May 14, 1962, now Patent No. 3,258,832 in the name of George W. Gerstung. The present application pertains to structures more suitable and capable of handling a greater amount of one fluid than of another in the heat interchange as in the case of automobile radiators through which air must pass in substantial volume as compared with the more limited volume of engine coolant.

An object of the present invention is to provide a high production method of making a sheet metal heat exchanger of low cost and lightweight construction and efficient for the transfer of heat from one fluid to another in situations wherein one of the fluids, such as air, is usually not as dense or capable of storing heat as the other fluid.

The object and important features of the invention will now be described in detail in the specification and then pointed out more particularly in the appended claims.

In the drawings:

FIGURE 1 is a plan view of part of a heat exchanger made in accordance with the present invention, portions in layers being broken away better to disclose the construction;

FIGURE 2 is a side view of the part of an exchanger shown in FIGURE 1;

FIGURE 3 is an end view of a part of a sheet of metal divided into alternating sets of air center portions and confined fluid portions preparatory to the step of folding those portions into a stack as shown in FIGURES 1, 2 and 5;

FIGURE 4 is an elevation view of the sheet, before folding, and as shown in FIGURE 3;

FIGURE 5 is a cross-sectional view looking in the direction of the arrows 5—5 in FIGURE 1;

FIGURE 6 is an end view of the sheet shown in FIGURES 3 and 4 being folded to form a stack.

In making the heat exchanger, a single sheet 10 of metal such as aluminum is formed into wide portions 12 and 14 by making slots 16 in narrow strips 18 separating the wide portions. There are two wide portions 12 alternating with sets of two wide portions 14 as indicated in FIGURE 4. Small hinge portions 20 of metal formed from the narrow strips 18 are left thereby to retain the integrity of the sheet 10. Ridges 22 are formed at an acute angle with the slots 16 in each of the portions 12. Each portion 14 is provided with ridges 24 of a greater height extending preferably, but not necessarily, at the same angle as the ridges 22. The ridges terminate at opposite parts of peripheral margins left in the flat on each wide portion 14. An opening 26 is formed in each end of each wide portion 12 and 14 with a defining raised flange 28 or 30 conforming with the ridges 22 or 24 as to height. It will be noted that all ridges and flanges extend from one side of the flat sheet 10. The product, being pressed from sheet metal, in presenting a ridge 22 or 24 on one of the sheets will provide a corresponding groove 22′ or 24′ on the other side.

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The sheet is then folded into a zigzag formation as indicated by the arrows in FIGURE 3 and the partially completed stack of FIGURE 6, the fold lines being confined to the narrow strips 18 or hinge portions 20 and with the open ended grooves 22′ of adjacent wide portions 12 in facing relation and with the closed grooves 24′ of adjacent wide portions 14 in facing relation. This places the series of flanges 28 and 30 in such relation that a continuous header is formed at each end of the stack. In making the stack, the peripheral margin of a portion 14 is forced into contact with the peripheral margin of the adjacent portion 14 so that closed end grooves 24′ of the two portions communicate and connect with the openings 26. It will be noted that the ridges 22 extend entirely across each wide portion 12—i.e.—terminate at a slot 16—but that the end ridges 22 stop short of the corresponding flange 28. Ridges 24, on the other hand, terminate short of the edges of each wide portion 14 or the slots 16 and the end ridges 24 join the corresponding flange 30. Because of this arrangement, all closed grooves 24′ are in communication with the headers and all grooves 22′ are cut off from them but open at their ends to the atmosphere.

The sheet material 10 is preferably supplied with a coating on both sides which when subsequently heated in the stack assembly will bond or metal fuse together the peripheral margins and facing ridges and flanges. Each header may constitute an inlet or an outlet for the liquid in the closed grooves 24′ to be heated or cooled by air passing through the open-ended grooves 22′. Commercially available aluminum brazing sheet may be used in making the stack into a unit but other materials may be employed in permanently joining the portions together. After the brazing operation, the hinge portions 20 may easily be removed. Obviously, only metal of the hinge portions 20 at the left side of FIGURE 6 need be removed to make the heat exchanger operative.

If engine coolant is admitted to one header, it will flow through the confined passages defined by the closed grooves 24′ of the wide portions 14 and be discharged from the other header. Air, in the meanwhile, may be forced by ram effect or otherwise through the open ended passage determined by the "air center" or ridges 22 defining the grooves 22′ in the wide portions 12 of the stack. The strong agitation of or turbulence imparted to both the air and the engine coolant promotes a very effective heat exchange between the two fluids.

I claim:

1. A method of making a heat exchanger having opposite sides for admitting and discharging a first fluid such as air, said method comprising forming wide portions alternating with narrow strips along a length of sheet metal, the said forming including holding peripheral margins of alternate pairs of said wide portions in the flat and pressing the metal enclosed by said margins of said alternate pairs into ridges protruding from one side of said sheet and into ridges also on said one side and extending entirely across the other pairs of said wide portions, forming openings defined by peripheral flanges in each of said wide portions, folding and compressing said sheet with fold lines within said narrow strips into zigzag formation with the ridges and peripheral flange of each wide portion of an alternate pair into facing relation with the ridges and peripheral flange of the adjacent wide portion of said alternate pair, securing the peripheral flanges of each pair of alternate wide portions together, and said method including the removal of sheet metal from each of said narrow strips connecting the wide portions of an alternate pair to an adjacent wide portion to open the grooves formed by corresponding ridges.

2. A method of making a heat exchanger comprising forming a length of sheet metal into alternate pairs of

wide portions with adjacent wide portions separated by narrow portions, said forming comprising making parallel ridges and grooves terminating at flat margins for each of alternate sets of said wide portions and parallel ridges and grooves extending the full width of the other sets of said wide portions, bending said length within the limits of each narrow portion to form a zigzag construction, pressing and securing the flat margins of each pair of alternate wide portions together, and removing metal from one of said narrow portions connecting a pair of alternate wide portions to an adjacent pair of said other wide portions so that the latter may be effective as air centers.

3. A method of making a heat exchanger comprising forming a length of sheet metal into wide portions with adjacent wide portions being separated by narrow portions, said forming comprising removing metal from said narrow portions to make openings through the sheet metal but leaving the length of sheet metal as an integral structure, said forming also including making ridges defining grooves in each of said wide portions with all ridges protruding from only one side of said sheet with the ridges in alternate pairs of said wide portions terminating short of the corresponding narrow portions to leave flat margins on said alternate pairs and with the ridges in the other pairs of said wide portions extending the full width of each of the latter, folding the remaining metal of said narrow portions so that said length of sheet material attains a zigzag arrangement, and pressing and securing the flat margins of each pair of alternate wide portions together and the apices of the ridges of each wide portion against the apices of an adjacent wide portion.

4. A method of making a heat exchanger as set forth in claim **3** wherein the step of securing comprises brazing said wide portions together to make a unitary structure defining separate paths for two fluids.

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