ABSTRACT: A plate-fin heat exchanger is provided in which the plate is a continuous convoluted sheet which separates the fluids between which heat is to be transferred. Corrugated fins are juxtaposed between the convolutions of the plate, and in heat-conducting contact therewith, the plate and fins thereby providing a high heat transfer surface area for efficient heat exchange. By providing a continuous convoluted plate, cross leakage between the fluids at any point along the plate surface is precluded.
3,552,488

PLATE-FIN HEAT EXCHANGER

This invention relates to plate-fin-type heat exchangers and more particularly to plate-fin heat exchangers in which the heat exchange plate is continuous and convoluted, with fins between the convolutions, and separates the hot and cold fluids, preventing cross leakage between the fluids at any point along its surface.

Plate-fin-type heat exchangers are well known in the heat transfer art. They are usually of the parallel or counterflow type, comprising a plurality of corrugated metal sheets known as fins, each separated by a metal sheet known as a plate. Separating and sealing means usually in the form of rectangular bars or channels of sheet material are then disposed between the ends of the plates, parallel to the corrugations of the fins, to form a plurality of heat exchanger elements having enclosed sides and having plates common to adjacent fins. The bars or channels are bonded to the plates to prevent cross leakage between the elements. The heat exchanger elements thus formed are usually packaged such that hot and cold fluids pass in a parallel or counterflow manner through adjacent elements, as shown in U.S. Pat. No. 3,305,010 to R. L. Campbell, et al. on Nov. 1, 1967. However, crossflow plate-fin heat exchangers are also known, as shown by Ladd in U.S. Patent No. 2,952,445, dated Sept. 13, 1960. The corrugated fins provide high surface area to conduct heat from the hot fluid to the plate, and from the plates to the cold fluid, thereby tending to equalize the temperature of both fluids, and accomplish the desired heat transfer. The plates separate the hot and cold fluids, and conduct heat from one fluid to the other.

Although the plate-fin heat exchangers of the prior art can be made to operate quite efficiently, due to the high surface area of the corrugated fins, their use is generally limited to low pressure systems, or to those systems where slight cross leakage between the hot and cold fluids is permissible. This is due to the fact that a construction of the type described above is prone to develop leakage at the bonded joints between the plates and the channels or bars, especially when the heat exchanger is employed in systems where there is a high differential pressure between the fluids. Since the effectiveness of the seal of each heat exchanger element is dependent upon the strength and continuity of the bond between the channels or bars and the plates, it is clear that any discontinuity in the bond therebetween can create a leakage path. This is particularly a problem where the heat exchanger comprises a great number of elements, and a correspondingly high number of bonded joints. Indeed, it is very difficult if not impossible to ensure a leakproof bond at all joints that will withstand a significant differential pressure between the fluids. Furthermore, if a cross leak between the fluids develops in use, its detection and repair are virtually impossible, especially if it occurs in the interior of the array of elements.

Attempts have been made to correct this deficiency in plate-fin heat exchangers. These efforts have been primarily directed towards the substitution of sealing means other than channels or bars, since each channel and bar must be bonded on two surfaces in order to enclose the elements. Improved sealing means are shown by Bauerfeind, et al., in U.S. Patent No. 2,912,749, dated Nov. 17, 1959, wherein they describe a method of forming and sealing heat exchanger elements whereby the ends of two heat exchanger plates enclosed a corrugated fin are folded in an interlocking manner, and crimped or swaged to form a fluid-tight seal on two sides, thereby reducing the number of joints at each end of the element to one, and thus providing a more efficient seal. However, this structure is such that a common plate between adjacent elements is included, since the entire length of each plate alternately up and down such that the ends of the folds of adjacent plates can be butted and bonded, thereby forming a crossflow plate-fin heat exchanger having common plates between the corrugated fins. Folding the plates in this manner requires the cutting of a right angle notch at each end of the plate. These notches are later sealed by bonding a right-angled closure at each corner. Although the seals on the sides of each element are an improvement over channel type closures, the bonding of the angled corner pieces introduces new potential leakage paths not heretofore present in plate-fin heat exchangers. Therefore, while Burton improves upon the heat transfer efficiency of Bauerfeind et al. Burton's device does not avoid the inherent cross leakage problem found in the plate-fin heat exchangers.

Heat exchangers wherein the hot and cold fluids are separated by a convoluted plate containing corrugations or ripples to increase the surface area are also known. This type of construction is shown by Murray, in U.S. Pat. No. 1,548,159, dated Aug. 4, 1925. Murray states that his heat exchanger is a "cellular structure formed of a corrugated plate bent back and forth in a sinuous or zigzag manner, so as to form a multiplicity of spaced walls." However, a careful examination of Murray's FIGS. 1 and 4 reveals that it is not possible to form the structure shown from a single plate unless seams are provided along the peaks of alternate convolutions, in which event it is quite possible for undetected interfluid leakage to develop at these seams.

Furthermore, in the Murray heat exchanger the fluid travels in a counterflow manner through each convolution, from its base to its peak, rather than lengthwise along the convolutions. To achieve this mode of flow, end closures must be bonded to both open ends of the convoluted plate. Due to the great number of junctions at the ends of the corrugated convolutions, it is extremely difficult to ensure leakproof end bonding. Therefore, a heat exchanger constructed in accordance with the Murray invention can develop many leaks along the joints between the end closures and the open ends of the convolutions, thereby resulting in the mixing of the hot and cold fluids. In addition, the Murray heat exchanger is merely of the plate type, and is therefore less efficient than a plate-fin heat exchanger of equal size, since a greater amount of heat transfer surface area is provided by the corrugated fins.

Another heat exchanger containing a corrugated convoluted plate is disclosed by Pall et al. in U.S. Patent No. 3,772,743, dated Mar. 12, 1973. The Pall et al. heat exchanger has proved to be quite satisfactory in general use. Unlike Murray, Pall et al. shows the use of corrugated separators to maintain the spacing between the corrugated convolutions and to increase the effective heat transfer surface area. The mode of flow is lengthwise within the passages created by the corrugated convolutions. However, the corrugated separators are juxtaposed between the convolutions of the plate such that the corrugations of the separators and the corrugations of the plate are at right angles to each other. This allows the fluids between which heat is to be exchanged to enter the passages between the corrugated convolutions of the plate where the inlet and outlet connections for each fluid are disposed at right angles to the fluid passages. However, when the fluid enters the device at right angles to the flow passages, end closures are required to seal off both open ends of the corrugated convoluted plate. To ensure that there is no cross leakage between the fluids, there must be a continuous bond between the edges of the corrugated convoluted plate and the end closures. If these edges are relatively long, effecting a continuous bond can be a time-consuming manual operation that is relatively costly to accomplish and becomes the bottleneck in a production run.

In accordance with the present invention, a parallel or counterflow heat exchanger of the plate-fin type is provided that substantially eliminates the problem of interfluid leakage across the plate, while maintaining efficient heat transfer. The plate-fin heat exchanger of this invention comprises, in combination, a housing; a corrugated continuous plate disposed in the housing in a manner so as to define separate flow passages
for the fluids between which heat is to be transferred; a plurality of corrugated fins juxtaposed between and in heat-conducting contact with the convolutions of the plate, in a manner such that the corrugations thereof run lengthwise of the convolutions of the plate; means for partially closing off both open ends of each flow passage to prevent the cross leakage of fluid while allowing the entrance and exit of the fluids, separating means adjacent to the closure means to direct the fluid to the proper flow passages so that flow will proceed along the entire surface of the convoluted plate; and openings in the housing for inflow and outflow of the fluids.

The convolutions are arranged to define passages for flow of fluid along the surface of the heat exchanger plate, and the corrugated fins are arranged within the convolutions to provide maximum surface area to conduct heat from the hot fluid flowing therein to the plate. The corrugations of the fins and the convolutions of the plate together define a plurality of passages for the fluids which are interconnected at the open ends of the convolutions, so as collectively to form a passage extending substantially over the entire length and width of each convolution. For optimum heat transfer surface area, the convolutions are arranged to extend substantially the length and width of the housing in each direction, and the corrugated fins are also disposed between the end convolutions of the plate and the inside walls of the housing.

The plate-fin heat exchanger of this invention thus has high surface area for heat transfer, and the convolutions and corrugations define a plurality of passages for flow of the hot and cold fluids lengthwise along the heat exchanger plate, and prevent the leakage of fluid thereacross. This ensures effective heat exchange between the fluids along the entire length and width of the heat exchanger plate, without the danger of cross leakage.

The convolutions of the plate can have substantially parallel sides and right-angled corners. Generally this shape is preferred, since it is easier to fabricate, and provides a rectangular cross section which allows the use of fins having a uniform corrugation height corresponding to the spacing between the convolutions. This shape also readily permits the installation and sealing of simple closure means for the open ends of the convolutions, such as those described below. A plate having parallel convolutions of this form can be readily installed in a housing having a rectangular cross section formed from a channel of sheet material, the inner depth of which corresponds to the depth of the convolutions, and a flat closure which is bonded to the open side of the channel. By extending the bases of the two end convolutions of the plate, the flanges thus formed can be captured between the edges of the channel and the flat closure, and bonded along the entire length of the housing. This seals the plate to the housing, preventing external leakage, and also preventing interfluid leakage across the plate. Thus, an effective, accessible joint is provided, which serves the dual purpose of preventing both internal and external leakage. Naturally, other convolution forms, such as U-shaped and V-shaped of uniform or variable height, can also be provided with this type of sealing joint. Other shapes and forms will be obvious to those skilled in the art.

The shape of the corrugations of the fins can be in any convenient form. V-shaped or sinusoidal-shaped corrugations are generally preferred, since they are the easiest to form. The number of corrugations in each fin, the height of each corrugation, and the number of fins required must be determined by taking into consideration the flow characteristics and physical properties of the fluids between which heat is to be transferred.

In some instances, it is advantageous to provide a greater amount of fin area for one of the fluids than the other. In this case, the convolutions and the sides of each convolution in this fin, the height of each corrugation, and the number of fins required must be determined by taking into consideration the flow characteristics and physical properties of the fluids between which heat is to be transferred.

The corrugated fins can be set back slightly from the open ends of the convolutions of the plate, so that a means for partially closing the open ends thereof to prevent cross leakage of fluid, and for directing the hot and cold fluids to their respective flow passages, can be provided therein. Preferably, the closure means are a plurality of channels disposed across the open ends of each convolution, extending partially from the apex to some midpoint. By bonding the end portion of the channel to the apices of the convolutions, and the sides of the channels to the sides of the convolutions, alternate segments of each convolution are thereby sealed off. The closure means could also be any convenient shape that adequately closes and seals the ends of the convolutions. In many cases, it is desirable for the closure means to be used as a guide for the flow, to ensure proper distribution across the fin surfaces. One way of accomplishing this is to have a channel disposed at an angle to the ends of the fins.

A flat plate, perpendicular to the side edges of the convolutions of the plate, and extending across the housing, can be bonded to the plate of each closure means, thereby forming a separate entrance and exit channel for each fluid. The assembly thus formed can be connected to fluid lines in any suitable manner such that hot fluid enters and leaves on one side of the flat plate and the cold fluid enters and leaves on the other side thereof. The entrance and exit chambers are adjacent to the open ends of the convoluted plate, therefore, the flow of both fluids will pass over the entire surface of the plate on their respective sides. Illustrations of how this can be accomplished will be found in the drawings. Other means of closing the open ends of the convoluted plate to prevent cross leakage and to form separate entrance and exit chambers for the hot and cold fluid, such as individual channels for each convolution extending from apex to base and having a connecting line for the inflow or outflow of fluid, will be apparent to those skilled in the art.

Since the heat exchanger plate is convoluted and continuous, so as to form a continuous separation between the hot and cold fluids, cross leakage thereacross can occur only if a faulty bond exists or develops at the terminal ends of the convoluted plate where the closure means are disposed, or where the end convolutions are bonded to the housing. Leakage at these points, however, is visible and readily repairable, since they are located in accessible positions, toward or at the exterior of the heat exchanger. The plate-fin heat exchanger of this invention therefore provides a design which overcomes the inaccessible and irreparable leakage problem of prior plate-fin heat exchangers. Furthermore, since the hot and cold fluids are separated by a continuous convoluted plate, higher differential pressures between the fluids can be tolerated without adverse effects, such as leakage developing across a bonded joint, due to the fact that fewer joints are required. This construction also provides more efficient heat transfer, since a greater amount of heat transfer fin surface area can be enclosed in a given volume of heat exchanger, due to the elimination of the dead volume occupied by the sealing and separating means which are used to enclose the elements in prior plate-fin heat exchanger designs. Moreover, since the flow proceeds lengthwise along each convoluted fluid, the end to another, the entire heat transfer surface area is utilized.

Many heat exchangers and especially those of the plate-fin type contain brazed joints. By utilizing a convoluted heat exchanger plate, the heat exchanger of this invention requires significantly fewer brazed joints. Furthermore, all brazed connections are located at the outermost portions of the heat exchanger, thereby permitting visual detection of discontinuities, flaws or leakage paths which may develop in the brazed material, and allowing the repair thereof. Therefore, brazing of the plate-fin heat exchanger of this invention is quicker, more reliable, and less expensive than the brazing required for the plate-fin heat exchangers shown in the drawings.

The plates and fins of the heat exchanger of this invention can be formed of any material which is high in heat conductivity. The remainder of the heat exchanger can be constructed of the same or a different material, such as a material
of low heat conductivity. Metals have the desired rigidity and structural strength, in addition to affording good heat exchange characteristics, and accordingly are the preferred construction materials. Any of the metals commonly used in heat exchangers can be employed, for instance, iron, steel, stainless steel, aluminum, tin, titanium alloys, stainless alloys, bronze, brass, nickel and nickel alloys, zinc, cadmium, silver, copper alloys, nickel-chromium alloys, such as Nichrome and Monel, and magnesium. In some cases, a synthetic plastic or resinous material would be preferred because of its inertness to the fluids with which the heat exchanger will be used. Plastic materials which are satisfactory include polytetrafluoroethylene, polytrifluoroethylenen, polyethylene, polyethylene, polycarbonate resins, polynyl chloride, polystyrene, polyester resins, synthetic rubbers, such as butadiene-styrene, butadiene-acrylonitrile and butadiene-styrene-acrylonitrile copolymers, cellulose derivatives such as cellulose acetate, cellulose acetate propionate and cellulose butyrate, polyamides, such as nylon, and urea-formaldehyde, melamine formaldehyde and phenol-formaldehyde resins.

In many cases, the convoluted structure of the plate can be formed by molding a synthetic resinous material or by casting a metal. Usually, however, it will be found preferable to form a sheet or plate of the resinous material or metal into the desired convoluted configuration. Similarly, the corrugated fins (which can be made of the same material or of a different material) can be molded, cast or formed into the desired shape. The corrugated fins should be attached to the convoluted plate for structural rigidity, and to ensure that there is heat-conducting contact between all of the peaks of the corrugations and the walls of the plate. However, the peaks of the fins need not be attached to the plate in a leakproof manner, since the fins serve only to conduct heat from the fluid to the plate, and do not in any way seal off the two fluids.

Although the design of this heat exchanger is particularly well suited for dip brazing, any other bonding techniques, such as adhesive-bonding with epoxy resins, resistance welding, soldering or sintering, can be utilized to secure and seal the joints. Plastics can be heat or solvent-softened, and then fused together, to form a leaktight bond.

The porting and ducting of the housing to afford inflow and outflow of the fluids between which heat is to be exchanged can be effected in the conventional manner, to fit standard pipes. Illustrations of how this can be accomplished will be found in the drawings.

Preferred embodiments of the invention are shown in the drawings, in which:

FIG. 1 is a top plan view of a plate-fin heat exchanger in accordance with this invention;

FIG. 2 is a longitudinal section of the heat exchanger of FIG. 1, taken along the lines 2-2, and looking in the direction of the arrows;

FIG. 3 is another longitudinal section of the heat exchanger of FIG. 1, taken along the lines 3-3, and looking in the direction of the arrows;

FIG. 4 is a cross-sectional view of the heat exchanger of FIG. 1, taken along the lines 4-4, looking in the direction of the arrows;

FIG. 5 is a side plan view of another embodiment of a plate-fin heat exchanger in accordance with this invention; and

FIG. 6 is a cross-sectional view of the heat exchanger of FIG. 5, taken along the lines 6-6, and looking in the direction of the arrows.

The plate-fin heat exchanger of FIG. 1 through 4 comprises a convoluted plate 2, having parallel sides and right-angled corners, disposed within a channel-shaped housing 3, so as to separate the hot and cold fluids, and form passages 52 and 51 for the flow thereof. Juxtaposed between each convolution of the plate 2 on the cold fluid side are two corrugated fins 10 of sheet metal, having corrugations 40 running lengthwise of the convolutions of the plate 2, and extending substantially over the length and width of each cold fluid passage 51. The peaks 41 of each corrugation are in heat-conducting contact over their entire length with the plate 2. A separator plate 6 is disposed between the corrugated fins 10 to prevent interleafing of the corrugations. On the hot fluid side of the convoluted plate 2, corrugated fins 13 are juxtaposed between each convolution and between the end convolutions of the plate 2 and the walls of the housing 3. The fins 13 have corrugations 42 running lengthwise of the convolutions of the plate 2, and extending over substantially all of each hot fluid passage. The peaks 43 of each corrugation are in heat-conducting contact over their entire length with the plate 2. By arranging the plate and the fins in the manner described, the cross-sectional surface area of the heat exchanger is utilized, thereby providing quite efficient heat transfer between the hot and cold fluids.

Flanges 14 and 15 extending from the base of the end convolutions of the plate 2 are captured between the sides of the housing 3, and a flat rectangular shaped bottom closure 11. The joints thus formed are brazed along the entire length of the housing, thereby preventing external leakage of either fluid, and internal cross leakage of the fluids across the convoluted plate 2.

The corrugated fins 10 and 13 and the separator plate 6 located between the corrugated fins 10 are set back from both open ends of the convoluted plate 2, so that a means for closing the open ends of the convoluted plate to prevent the cross leakage of fluid and to disperse the heat across their respective flow passages can be provided therein. For this purpose, a plurality of channels 8 and 12 having angular cross sections as shown in FIGS. 2 and 3 are disposed within the open ends of the convolutions of the plate 2. The closure means 8 and 12 extend vertically along a portion of each convolution from the apex to some midpoint, with the open side of the channel facing outward, away from the corrugated fins 10 and 13, and the channel quickly dispersion the flow evenly over the cross section of the flow passages formed by each convolution of the plate 2. This is clearly illustrated by FIGS. 2 and 3. The flat sections of the closures 8 and 12 are brazed to the apices of each convolution of the plate 2, and the channelled sides of the closure means 8 and 12 are brazed to the sides of each convolution. Alternate segments of each convolution are thereby closed.

The ends of the closure means 8 and 12 terminate at the same position on the open ends of the convolutions of the plate 2, thereby forming a straight line extending perpendicularly across the convolutions. A flat plate 9 is brazed to the terminal points of the closure means 8 and 12, at both open ends of the plate, and to the walls of the housing 3, thereby forming an entrance chamber 31 and an exit chamber 33 for the cold fluid, and an entrance chamber 34 and an exit chamber 32 for the hot fluid. Fluid entering via chamber 31 and leaving via chamber 33 will flow through the fluid passages 51 formed by the convolutions closed off by the closure means 8, while fluid entering via chamber 34 and leaving via chamber 32 will flow through the fluid passages 52 formed by the convolutions closed off by the closure means 12. In the embodiment illustrated by FIGS. 1 through 4, the housing 3 extends beyond the open end of the convolutions of the plate 2 on one side only, such that the chambers 31 and 32 are larger than the chambers 33 and 34. This is purely for illustration; the chambers can be arranged in any convenient manner, to suit the particular system in which the device is to be installed.

A flange 7 containing a plurality of mounting holes 5 is brazed to the outer side of the outer periphery of the flat plate 9. This allows the installation of the device into a duct system wherein the cold fluid is contained on the one side of the plate 9 and the hot fluid is contained on the other side of the plate 9. Fairings 4 are brazed to the ends of the convolutions of the plate 2 forming the cold passage 51, and are located within the hot fluid exit chamber 32 to provide a smoothing effect for the exhaust flow of hot fluid. This reduces the pressure loss across the device.
It should be noted that cross leakage between the hot and cold fluids at any point along the interior portions of the heat exchanger shown herein is precluded by the fact that the plate forms a continuous convoluted sheet. Unlike the plate-fin heat exchangers of the prior art, there are no brazed joints at the interior portions of the device. This significantly simplifies the brazing operation, which in most cases can be accomplished in a single pass, using dip-brazing techniques. Therefore, the brazed joints of this device are more reliable, and less likely to develop leaks than the brazed joints of the plate-fin heat exchangers of the prior art. Furthermore, should a leak develop, its detection and repair are facilitated by the fact that most of the brazed joints are located at the outermost portions of the device.

The embodiment shown in FIGS. 5 and 6 of the plate-fin heat exchanger of this invention, comprises a convoluted plate 26 having parallel sides, right-angled corners, and equal spacing on both the hot and cold sides. Flanges 27 and 28, extending from the end convolutions of the plate 26 are captured between the sides of the housing 29 and the closure 30, and brazed thereto along the entire length of the heat exchanger. Corrugated fins 34 are juxtaposed between the convolutions of the plate 26 and between the end convolutions of the plate and the housing 29. The peaks of the corrugations of the fins are brazed to the sides of the convolutions of the plate to give added rigidity to the structure and provide intimate heat-conducting contact between the plates and fins, to ensure efficient heat transfer. Channel-shaped closure means 21 are brazed to the open ends of each convolution and extend from the apex of each convolution to some midpoint, thereby closing off alternate segments of each convolution. This is clearly seen in FIG. 6. Flat plates 20, which extend across the housing 29 perpendicularly to the ends of the convolutions of the plate 26, are brazed to the terminal point of the channelled closure means at both ends of the convoluted plate 26 and to the walls of the housing 29. End covers 22 are brazed to the open ends of the housing and to the plates 20, thereby forming chambers 36 and 37 for the entrance and exit of the cold fluids, and chambers 38 and 35 for the entrance and exit of the hot fluid. Connecting tubes 18 and 19 are brazed to the end covers 22 to provide communication from the cold fluid line into the entrance chamber 36 and from the exit chamber 37 back to the cold fluid line. Similarly, connecting tubes 16 and 17 are provided for the hot fluid line and are also brazed to the end covers 22.

Although preferred embodiments have been shown herein, other methods for connecting the plate-fin heat exchanger of this invention to the fluid lines and for separating the hot and cold fluids are possible and within the skill of those in the art. Likewise, although the drawings show the device in particular horizontal and vertical positions, it should be noted that the plate-fin heat exchanger of this invention is in no way position sensitive, nor is it limited to use in the positions shown. These positions are shown merely for descriptive purposes, and have no bearing on the operation of the device. Similarly, the spacings between the convolutions of the plate can be designed to suit the particular fluid and system in which the device is to be utilized, and hot and cold fluids can be directed to either side of the convoluted plate.

We claim:

1. A heat exchanger of the plate-fin type comprising, in combination, a housing; a convoluted plate disposed in the housing in a manner so as to define separate flow passages between convolutions for the fluids between which heat is to be transferred; a plurality of corrugated fins juxtaposed between and in heat conducting contact with the convolutions of the plate in a manner such that the corrugations thereof run lengthwise of the convolutions of the plate; means for partially closing off both ends of each flow passage to prevent cross leakage of the fluids, while allowing the entrance and exit of the fluids at the ends of the passages; separating means adjacent to the closure means to direct the fluids to the proper flow passages so that flow will proceed along the entire surface of the convoluted plate; and openings in the housing for inflow and outflow of the fluids.

2. A plate-fin heat exchanger in accordance with claim 1, in which corrugated fins are disposed between the end convolutions of the plate and the walls of the housing, to provide additional heat transfer surface area.

3. A plate-fin heat exchanger in accordance with claim 1, in which the corrugations of the fins and the convolutions of the plate together define a plurality of flow passages which are interconnected so as collectively to form a passage extending substantially over the entire length and width of each convolution.

4. A plate-fin heat exchanger in accordance with claim 1, in which the convolutions of the plate have substantially parallel sides and right-angled corners.

5. A plate-fin heat exchanger in accordance with claim 1, in which the peaks of the corrugations of the fins are bonded to the sides of the convolutions of the plate to provide structural rigidity and ensure complete heat-conducting contact between the plate and the fins.

6. A plate-fin heat exchanger in accordance with claim 1, in which the convolutions of the plate are spaced wider apart on one side, to allow the installation of greater fin surface area for one fluid.

7. A plate-fin heat exchanger in accordance with claim 1, in which the convolutions of the plate are spaced equally on both sides.

8. A plate-fin heat exchanger comprising, in combination, a channel-shaped housing; a convoluted plate disposed within the housing so as to separate the fluids between which heat is to be transferred, and define flow passages therefor between the convolutions; corrugated fins juxtaposed between and in heat conducting contact with the convolutions of the plate, and between the end convolutions of the plate and the walls of the housing; said fins being set back from the open ends of the convolutions of the plate; channel-like closure means at the apex of each convolution, to partially close off both ends of each flow passage; flanges extending from the end convolutions of the said plate captured between the sides of the said channel-shaped housing and a flat bottom closure, and bonded thereto along the entire length of the housing, to prevent external leakage and cross leakage of the fluid; a flat separator plate parallel to the bottom closure, extending across both open ends of the housing and bonded to the ends of each channel-like closure means, separating the fluids between which heat is to be transferred, and directing the fluid to the proper flow passage, such that the hot fluid will enter and leave on one side of the separator plate, and cold fluid will enter and leave on the other side thereof, and a flange containing mounting holes bonded to the outer periphery of the separator plate for connection to the fluid lines.

9. A plate-fin heat exchanger in accordance with claim 8, in which the channel-like closure means for sealing the open ends of each flow passage are a plurality of channels having an angled cross section extending along a portion of the convolutions from the apex to some midpoint with the open side of the channel facing away from the corrugated fins; the top portions of the said closure means being bonded to the apices of the convolutions of the plate, and the sides of the angled portions of the said closure means being bonded to the sides of the convolutions, so that alternate segments of each convolution are thereby closed off.

10. A plate-fin heat exchanger in accordance with claim 8, in which all joints are brazed.

11. A plate-fin heat exchanger in accordance with claim 8, in which the separator plate disposed within the housing forms separate chambers for the entrance and exit of each fluid at both ends of the convoluted plate, so that flow will proceed along the entire surface of the convoluted plate.

12. A plate-fin heat exchanger in accordance with claim 11, in which separate tubes communicate with each chamber, and provide a means for connection to the fluid lines.