Serpentined heat exchanger

Preferably, a cooling fluid enters header 12 through inlet 13 and passes through serpentined heat exchange tube 14 and is collected in header 16 and discharged through outlet 17. Hot gas, preferably, enters header 18 through inlet 19 and passes countercurrent to the cooling fluid through plate type corrugated heat exchange fins 20 to outlet header 22 from whence it is discharged through outlet 23.

Corrugated fin members 29 of the plate type and serpentinened tubes 14 are constructed from aluminum, preferably, because aluminum provides a non-corrosive and light weight heat exchanger. Obviously though, stainless steel fin members or tubes could be used. If higher tensile strength is necessary aluminum alloys also could be employed. Other materials and combinations thereof can be employed, if desired.

In the preferred form, heat exchanger 10 is constructed of a series of heat exchange sections 24 brazed or welded together. Parting sheets 26 are employed between each heat exchange section 24 to form a unitary structure. These parting sheets 26 may be brazed or welded to the respective heat exchange sections.

Each heat exchange section 24 basically consists of two corrugated fin members 20, a serpentinened heat exchange tube 14 between the fins 20, and a parting sheet 28 between the fins 20 brazed or welded to the tubes 14 and the fin members 20. Channel sections 30 and block off bars 31 are provided to prevent leakage of gas to the outside and provide structural strength to the heat exchanger.

Each fin member 20 has at least three sections, namely 32, 34, and 36. Additional sections 34 may be employed depending on the width or length of heat exchanger desired. The particular length and width of sections 32 and 36 are not considered part of the invention.

Each fin member section 34 has a plurality of recesses 37 formed therein to accommodate half the diameter of the straight portion 38 of the serpentinened heat exchange tube 14. These recesses are formed in the manner shown and described in my Patent No. 2,820,617, filed November 7, 1955, and issued January 21, 1958.

Fin member sections 32 and 36 are formed with U-bend recesses 40 to accommodate the U-bend sections 42 of serpentined heat exchange tube 14. The portion of the sections 32 and 36 where the serpentinened tubes 14 are headered are formed with recesses 44 like those of fin member section 34.

In construction, a parting sheet 26 is first put down. Then a corrugated fin member consisting of sections 32, 34, and 36 is laid on the parting sheet with the recesses facing upward. A serpentinened heat exchange tube 14 is placed on the fin member 20 with the straight portions 38 of serpentined tube in the recesses 37 and 44 and the U-bends in the recesses 49. Parting sheets 46 and 48 or 50 and 52 are then placed on the fin members 20 with the projections 54 extending between the U-portions of the serpentined tube. A second fin member 20 is then placed upon the tube 14 and the first fin member 20, so that the fin portions of the first fin member and the second fin member surround and engage tube 14. A second parting sheet 26 is placed on top of the second fin member 20 and channel sections 39 are placed adjacent the end of the corrugated fin member 20. The whole assembly is then temporarily held together by any suitable means such as clamping and is brazed or welded by any suitable process.

In actual practice, the heat exchanger 10 will be built up to the appropriate length, width, and depth and brazed as an unit instead of individual brazing of heat exchange sections 24 and then the appropriate headers such as 12, 16, 18, and 22 are brazed on.

Particular notice should be taken of FIGURES 6 and 7.
which show two forms of parting sheets which are used with my heat exchanger depending on whether the serpentinized tubes 14 enter and exit on the same side of the heat exchanger or on opposite sides of the heat exchanger.

FIGURE 6 shows the parting sheets 46 and 48 which are used between fin members 20 when the serpentinized tube 14 enters and exits on the same side of the heat exchanger.

FIGURE 7 shows the parting sheets 50 and 52 which are employed when the serpentinized tubes 14 enter one side of the heat exchanger and exit from the other side.

Looking now to the modification of FIGURES 8–10, the heat exchanger 10 is shown composed of a series of corrugated fins 20 spaced one upon the other with serpentinized heat exchange tubes 14 disposed between each corrugated fin member. The fin member, as in the embodiment of FIGURES 1–7, has at least three sections 32, 34, and 36 with recesses 37, 40, and 44 therein to accommodate the serpentinized tubes 14. The recesses are so formed as to surround and engage the tube 14. Parting sheets 28 like those of FIGURES 6 and 7 are employed between the fin members 20 and parting sheets 26 are employed on the top and bottom of the heat exchange section.

In FIGURE 8, the section 33 of the top heat exchange section 18 has been removed to show the offset relationship of the serpentinized heat exchange tubes. As shown in FIGURES 8 and 9 the heat exchange tubes between adjacent fin members 20 are offset in relation to one another. This is necessary due to manufacturing reasons since the forming of recesses on both sides of the heat exchange members with one recess on top of the other would weaken the fin member and be very difficult to form.

For the sake of disclosure only three fin members 20 are shown but obviously the number of fin members and tubes therebetween is dependent only on the heat exchange function of the particular heat exchanger manufactured.

It is obvious that the above described invention has many advantages not present in previous heat exchangers. Previous to my invention, heat exchangers which employed serpentinized heat exchange tubes had the U-bends extending outwardly from the heat exchanger where obviously this section of the tube was not useful for the purpose intended. Further, in brazing a heat exchanger this surface was lost as a brazing surface which inherently lowered the pressure at which the heat exchanger could operate. I have not only increased the efficiency of the heat exchanger by internally locating the complete serpentinized heat exchange tube but have provided a fin construction which allows complete and efficient use of the complete serpentinized heat exchange tube. I have also provided a heat exchanger construction which when brazed will withstand pressures up to 1800 p.s.i. without rupture. Further, as herein set forth, I have provided a heat exchanger which is readily assembled and can be made to perform numerous heat exchange functions by merely changing the header construction or the number of passes or both.

While the apparatus disclosed and described herein constitutes preferred forms of the invention, yet it will be understood that the apparatus is capable of alteration without departing from the spirit of the invention, and that all modifications which fall within the scope of the appended claims are intended to be included herein.

I claim as new and desire to secure by Letters Patent is:

1. A heat exchanger comprising: a first inlet header and a first outlet header, a plurality of pairs of corrugated plate type fin members extending between said first inlet header and said first outlet header and forming a passage for a first heat exchange fluid, each pair being superimposed and co-extensive with the other fin member of the pair, means forming a plurality of recesses in said fin members, said recesses being located to form a passage between said fin members in each pair to accommodate a serpentinized heat exchange tube located in said recesses with the U-bends of said heat exchange tube being confined within said fin members, and means communicating with said heat exchange tube to provide for passage heat exchange fluid into and out of said heat exchange tube.

2. The structure of claim 1 wherein a parting sheet is located between said fin members in each pair, said parting sheet being in at least two sections with one section abutting one side of said heat exchange tube and the other section abutting the other side of said heat exchange tube.

3. The structure of claim 2 wherein a piece parting sheet is provided between each pair of said fin members.

4. A heat exchanger comprising a first supply header, a first discharge header, means forming a fluid passage extending between said headers for a first heat exchange fluid, a plurality of pairs of plate type fin members in said fluid passage extending between said first supply header and first discharge header, a second supply header and a second discharge header, a plurality of serpentinized heat exchange tubes each communicating at one end to said second supply header and connected at the other end to said second discharge header whereby each header and a plurality of said serpentinized heat exchange tubes between and substantially within each pair of said fin members to internally locate the U-bends of said heat exchange tube whereby said U-bends are available as a heat transfer surface to increase the efficient use of said serpentinized heat exchange tube.

5. A heat exchanger comprising a first supply header, a first discharge header, means forming a fluid passage extending between said headers for a first heat exchange fluid, a pair of plate type fin members in said fluid passage extending between said first supply header and first discharge header, a second supply header and a second discharge header, at least one serpentinized heat exchange tube communicating at one end to said second supply header and connected at the other end to said second discharge header, means locating said serpentinized heat exchange tube between and substantially within said fin members to internally locate the U-bends of said heat exchange tube whereby said U-bends are available as a heat transfer surface to increase the efficient use of said serpentinized heat exchange tube, a parting sheet located between said fin members in said pair, said parting sheet being in two sections with one section abutting one side of said heat exchange tube and the other section abutting the other side of said heat exchange tube.

6. A heat exchanger comprising a first supply header, a first discharge header, means forming a fluid passage extending between said headers for a first heat exchange fluid, a plate type fin structure in said fluid passage extending between said first supply header and first discharge header, a second supply header and a second discharge header, at least one serpentinized heat exchange tube communicating at one end to said second supply header and connected at the other end to said second discharge header, means locating said serpentinized heat exchange tube within said fin structure and wholly within said heat exchanger to internally locate the U-bends of said heat exchange tube whereby said U-bends are available as a heat transfer surface to increase the efficient use of said serpentinized heat exchange tube, said fin structure being comprised of two or more serpentinized heat exchange tubes having recesses formed therein which accommodate the U-bend portions of said heat exchange tube, and the third section having recesses therein to accommodate the straight portions of said serpentinized heat exchange tube.

7. A heat exchanger comprising a first supply header, a first discharge header, means forming a fluid passage extending between said headers for a first heat exchange fluid, a plurality of plate type fin members in said fluid
passage extending between said first supply header and first discharge header, a second supply header and a second discharge header, a plurality of serpentinized heat exchange tubes each communicating at one end to said second supply header and connected at the other end to said second discharge header, means locating each one of said serpentinized heat exchange tubes between and substantially within pairs of said fin members to internally locate the U-bends of said heat exchange tubes whereby said U-bends are available as a heat transfer surface to increase the efficient use of said serpentinized heat exchange tube, and one of said heat exchange tubes being offset from the heat exchange tube between the next adjacent fin members.

References Cited in the file of this patent

UNITED STATES PATENTS

2,119,761 Wentworth ---------------- June 7, 1938
2,858,112 Gerstung ---------------- Oct. 28, 1958