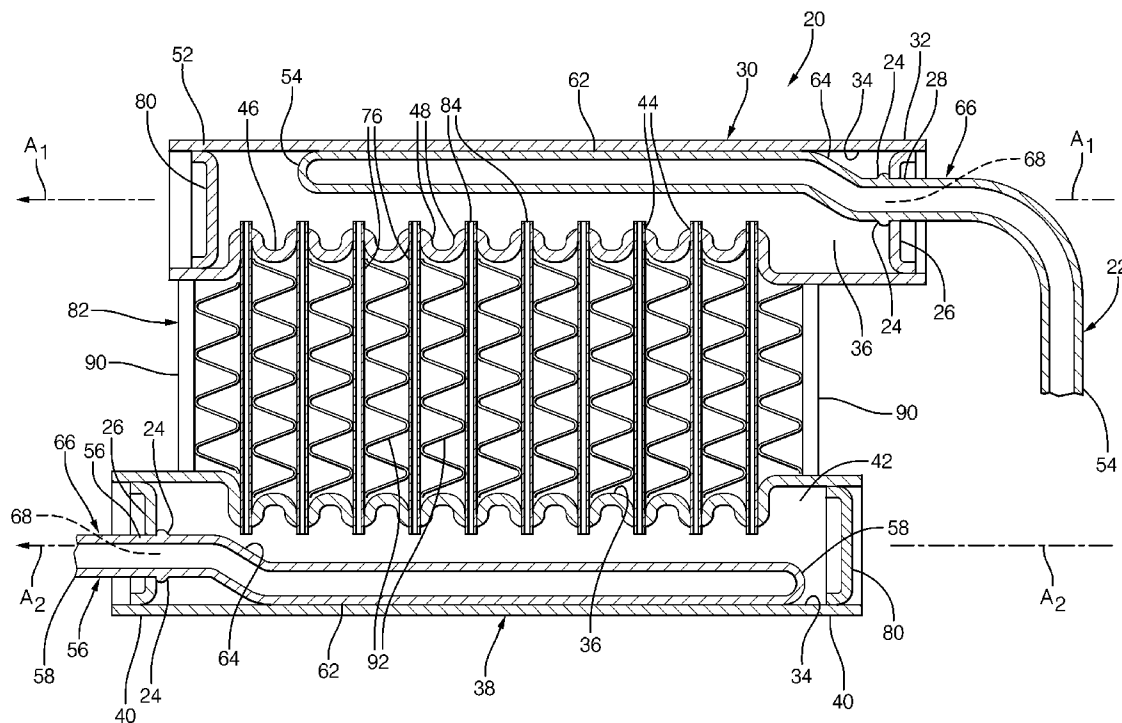




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Samuelson(10) **Pub. No.: US 2010/0300667 A1**(43) **Pub. Date: Dec. 2, 2010**(54) **DISTRIBUTOR TUBE AND END CAP
SUBASSEMBLY****Publication Classification**(75) Inventor: **David E. Samuelson**, Wheatfield,
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(52) **U.S. Cl.** **165/175; 165/181; 29/890.03**Correspondence Address:
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TROY, MI 48007 (US)**ABSTRACT**

A method for fabricating a heat exchanger assembly (20) includes pressing a pair of headers (30, 38) into refrigerant tubes (76). A notch (50) is cut axially into header ends (32, 40). An inner radial abutment (24) is formed in each of the refrigerant conduits (22, 56), which are then each inserted through an open end cap (26). An outer radial abutment (28) is formed in each of the refrigerant conduits (22, 56) so that the open end caps (26) are retained in position between the radial abutments (24, 28). The radial abutments (24, 28) can comprise a bead, a radially inwardly extending shoulder, an outwardly extending shoulder, or an expansion beneath the open end caps (26). A tool presses each subassembly into the corresponding headers (30, 38) until the tool reaches the corresponding notch bottom (52).

(73) Assignee: **Delphi Technologies, Inc.**, Troy,
MI (US)(21) Appl. No.: **12/475,859**(22) Filed: **Jun. 1, 2009**

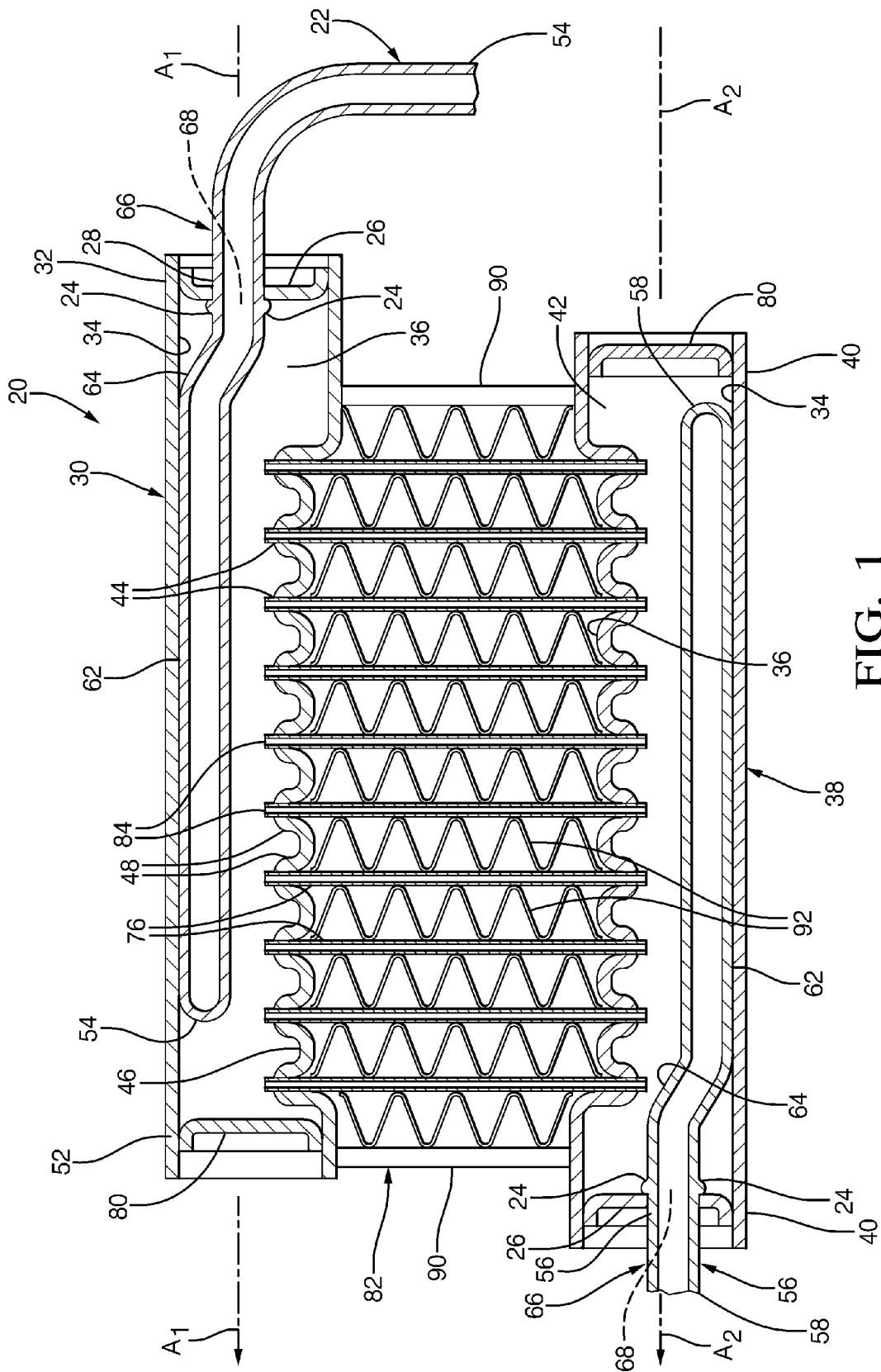
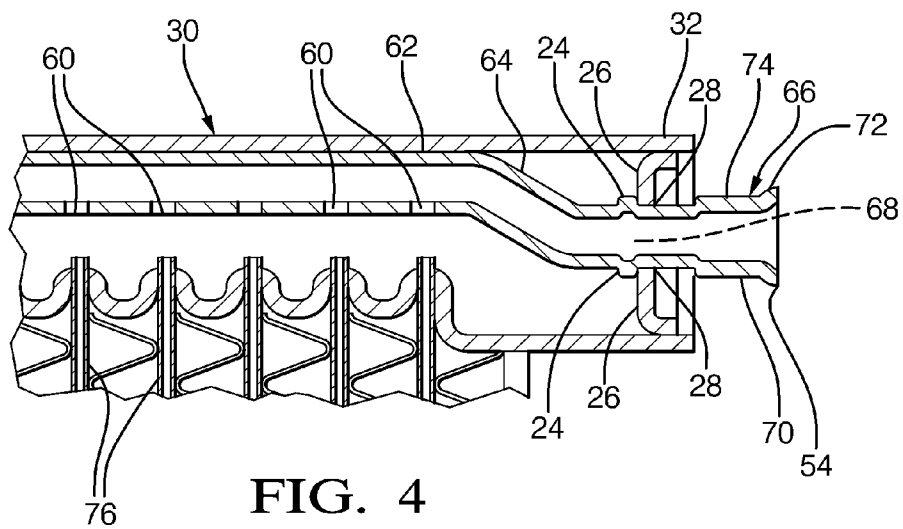
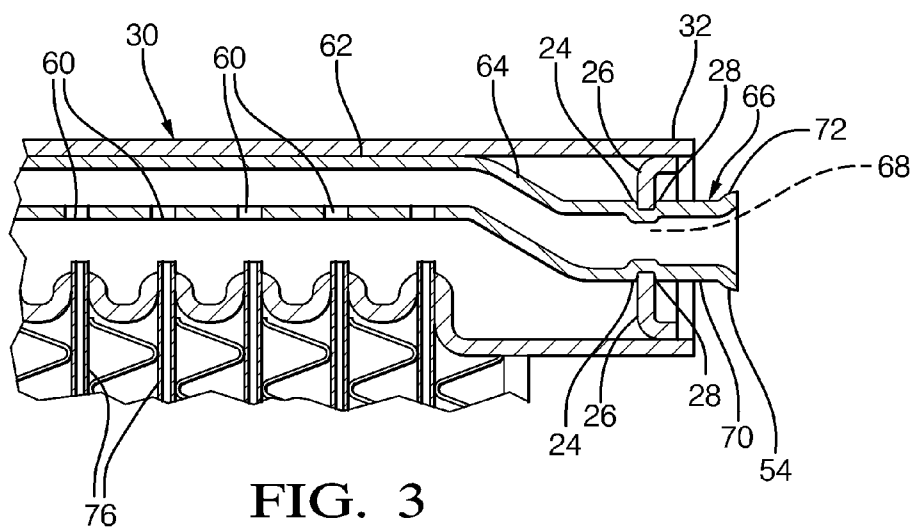
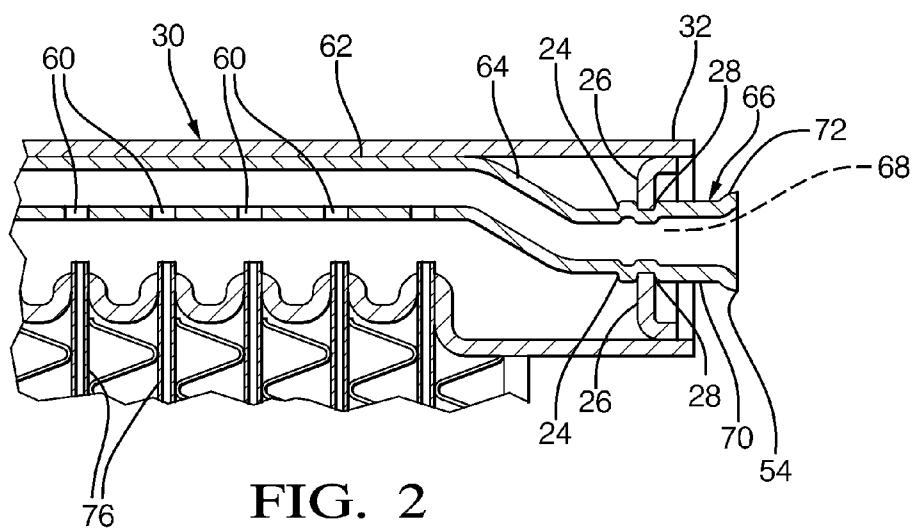


FIG. 1



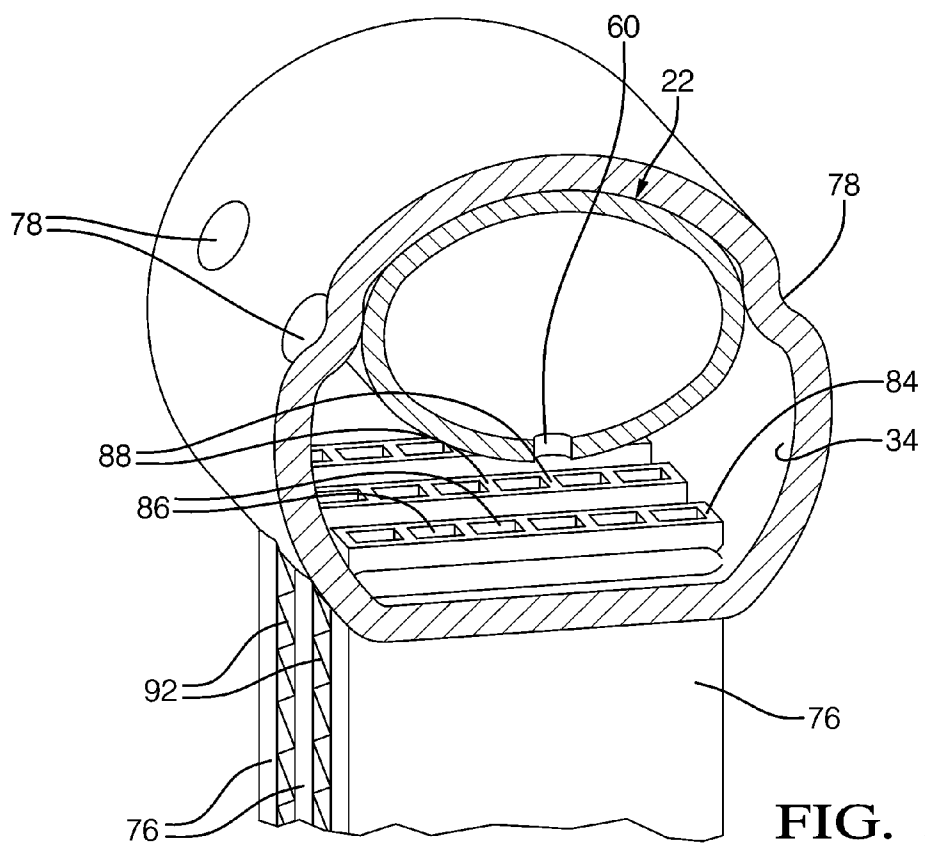


FIG. 5

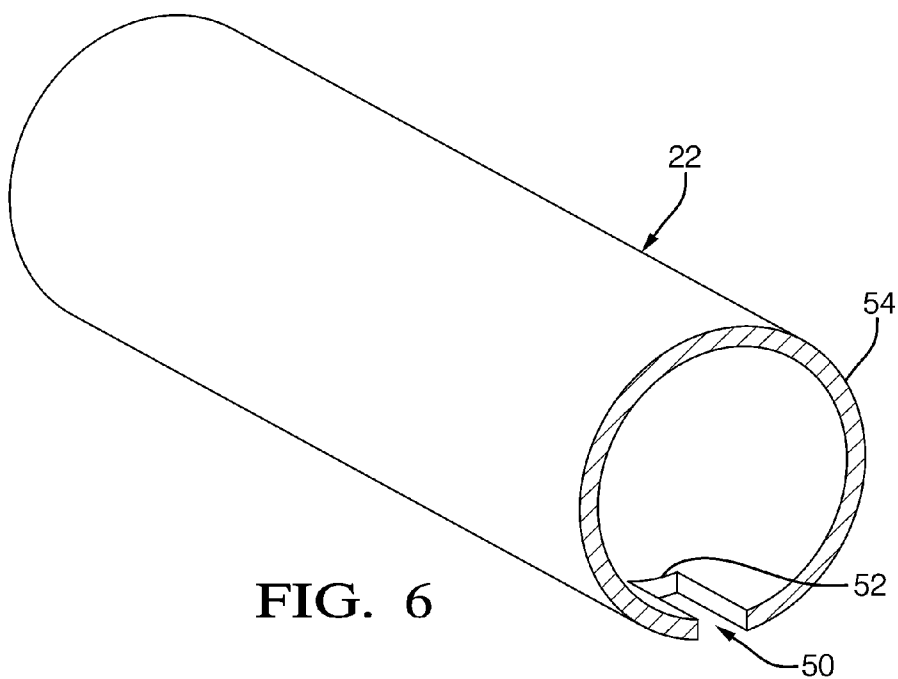


FIG. 6

DISTRIBUTOR TUBE AND END CAP SUBASSEMBLY

BACKGROUND OF THE INVENTION

[0001] 1. Field of the Invention

[0002] The subject invention relates to a heat exchanger and method of fabricating the same, and, more specifically to the method of fabricating a heat exchanger of the type including a plurality of refrigerant tubes extending between an inlet header and an outlet header for transferring a refrigerant from the inlet header to the outlet header and a refrigerant conduit disposed in at least one of the headers for uniformly distributing the refrigerant.

[0003] 2. Description of Related Art

[0004] Due to their high performance, automotive style brazed heat exchangers are being developed for residential air conditioning and heat pump applications. Automotive heat exchangers typically utilize a pair of headers with refrigerant tubes interconnecting the headers. Residential heat exchangers are typically larger than automotive heat exchangers and generally require headers that are two to five times longer than the typical automotive heat exchangers. In such heat exchangers, uniform refrigerant distribution is necessary for optimal performance. Refrigerant conduits can be disposed in the headers to improve refrigerant distribution. An example of such a heat exchanger is disclosed in U.S. Pat. No. 1,684,083 to S. C. Bloom.

[0005] The Bloom patent discloses a first header defining a first cavity and extending between a pair of first header ends and a second header defining a second cavity and extending between a pair of second header ends. The second header is an inlet header for receiving liquid refrigerant and the first header is an outlet header for outputting refrigerant vapor. A refrigerant conduit is disposed in each of the headers for conveying the refrigerant therethrough. The refrigerant conduits include a plurality of orifices in fluid communication with the corresponding cavities for transferring the refrigerant between the cavities and the refrigerant conduits. The refrigerant conduit disposed in the inlet header insures a uniform and even distribution of the refrigerant throughout the inlet header while the refrigerant conduit disposed in the outlet header insures only dry gas is withdrawn from the outlet header via the refrigerant conduit by a pump. A plurality of refrigerant tubes each defining a fluid passage extend between the first header and the second header for conveying the refrigerant from the first header to the second header.

[0006] Heat exchangers such as the type disclosed in the '083 patent to Bloom are typically manufactured by pressing a plurality of refrigerant tubes into the first header and into the second header so that the refrigerant tubes extend between the first header and the second header. A plurality of orifices can be punched in the refrigerant conduits, and the refrigerant conduits can be inserted into the headers at the header ends.

[0007] The method of manufacturing heat exchangers of this type oftentimes includes inserting a closed end cap into each of the headers at one of the header ends to seal the header, and inserting another open end cap defining an aperture at the other header ends. The refrigerant conduits can be inserted through the apertures of the corresponding open end caps. Ideally, the end caps and refrigerant conduits are disposed in a predetermined location relative to the refrigerant tubes. A furnace brazing process is typically used to secure the headers, end caps, and refrigerant conduits in the desired, predetermined location. An example of such an assembly and

method of manufacturing the same is disclosed in the U.S. Provisional Application No. 61/020,040 to the present inventor, D. E. Samuelson.

[0008] However, it is oftentimes difficult to dispose and align the end caps and refrigerant conduits at the desired location within the headers. It is especially difficult to determine whether the orifices of the refrigerant conduits are in the correct location relative to the refrigerant tubes. Even when the components are initially disposed in the correct location, prior to or during the furnace brazing process the refrigerant conduits oftentimes slide within the open end caps and become disposed outside of the desired location. Also, after the furnace brazing process, it is difficult to check for leakage at the joints between the refrigerant conduits and open end caps located inside the headers. There remains a great need for a heat exchanger assembly and efficient method of manufacturing the same providing for refrigerant conduits and end caps being disposed and remaining at the desired location within the headers upon installation, and throughout the furnace brazing operation.

SUMMARY OF THE INVENTION AND ADVANTAGES

[0009] The subject invention provides for such a heat exchanger assembly and an improved method of manufacturing such a heat exchanger assembly. The method includes forming an inner radial abutment in a first refrigerant conduit for abutting an open end cap, and then inserting the first refrigerant conduit through the open end cap. The method includes forming an outer radial abutment engaging the open end cap and spaced from the inner radial abutment by the open end cap. The open end cap is retained in position between the abutments. The first refrigerant conduit and the open end cap are inserted as a subassembly into the first header. The method includes disposing the first header and a second header in spaced and parallel relationship to one another. A plurality of refrigerant tubes each defining at least one fluid passage are inserted into the first header and the second header so that refrigerant tubes extend between the first header and the second header.

[0010] The open end cap and first refrigerant conduit are inserted simultaneously, which improves manufacturing efficiency and reduces manufacturing costs, thus making the heat exchanger assembly conducive to high volume production. The open end cap portion of the subassembly can provide a flat surface so that a tool can engage the flat surface and press the subassembly to the predetermined location relative to the refrigerant tubes extending into the first header.

[0011] In an elective or alternative embodiment, the method includes cutting a notch extending a predetermined distance axially to a notch bottom in a first header end of the first header. The tool can be used to press the subassembly into the first header until the tool engages the notch bottom, which insures the first refrigerant conduit is located at the desired predetermined location within the header and relative to the refrigerant tubes.

[0012] The radial abutments lock the first refrigerant conduit and corresponding open end cap securely in the desired location relative to one another. The radial abutments can prevent the first refrigerant conduit from sliding along the open end cap prior to and during a furnace brazing process. The open end cap and first refrigerant conduit are held in close contact, which creates the conditions necessary for capillary action to form a braze joint during the furnace brazing pro-

cess, creating a leak-free joint within the first header. As discussed above, the subject invention provides a simplified two-piece design, eliminating the leak susceptible internal joints associated with the three-piece design disclosed in the prior art.

BRIEF DESCRIPTION OF THE DRAWINGS

[0013] Advantages of the present invention will be readily appreciated as the same becomes better understood by reference to the following detailed description and the accompanying drawings that set forth an exemplary embodiment wherein:

[0014] FIG. 1 is a cross-sectional, side view of an embodiment of the heat exchanger assembly;

[0015] FIG. 2 is a cross-sectional, side view of an embodiment of the heat exchanger assembly showing a refrigerant conduit including an inner radial abutment defined as a bead, a conduit transition portion, and an outer radial abutment defined as an outwardly extending shoulder in the refrigerant conduit;

[0016] FIG. 3 is a cross-sectional, side view of an embodiment of the heat exchanger assembly showing an inner radial abutment defined as a radially inwardly extending shoulder in the refrigerant conduit and an outer radial abutment defined as an outwardly extending shoulder in the refrigerant conduit;

[0017] FIG. 4 is a cross-sectional, side view of an embodiment of the heat exchanger assembly showing a refrigerant conduit including an inner radial abutment defined as a bead, a conduit transition portion, and an outer radial abutment defined as a uniform expansion in the diameter of the refrigerant conduit beneath an open end cap and including a radially outwardly extending shoulder between the outer radial abutment and a uniform section of the first refrigerant conduit;

[0018] FIG. 5 is a fragmentary, cross sectional view taken along line 5-5 of FIG. 4; and

[0019] FIG. 6 is a perspective, partial view of a header including a notch.

DETAILED DESCRIPTION OF THE EXEMPLARY EMBODIMENTS

[0020] Referring to the Figures, a heat exchanger assembly 20 for dissipating heat is generally shown in FIG. 1. A method for fabricating a heat exchanger assembly 20 comprising a first refrigerant conduit 22 including an inner radial abutment 24 abutting an open end cap 26 and an outer radial abutment 28 spaced from the inner radial abutment 24 by the open end cap 26 for retaining the open end cap 26 in position between the abutments 24, 28 so that the refrigerant conduit and the open end cap 26 form a subassembly comprises cutting a first generally cylindrical tube to define a first header 30 extending along a first header axis A_1 between a pair of first header ends 32 and having an interior surface 34 defining a first cavity 36. The method includes cutting a second generally cylindrical tube to define a second header 38 extending along a second header axis A_2 between a pair of second header ends 40 and having an interior surface 34 defining a second cavity 42, as shown in FIG. 1. The headers 30, 38 are typically cut from an aluminum tube material having a generally uniform cross-section.

[0021] The method typically includes creating a plurality of header slots 44 extending radially into and at predetermined spaced intervals axially along each of the headers 30, 38. The

headers 30, 38 may include a lanced surface 46 being flat and extending parallel to the header axes A_1 , A_2 between the corresponding header ends 32, 40. The lanced surfaces 46 may include a plurality of truncated projections 48 disposed in predetermined spaced intervals axially along the corresponding headers 30, 38 and extending into the corresponding cavities 36, 42 to define the plurality of header slots 44, as shown in FIG. 1. The headers 30, 38 are typically punctured with a lancing punch to define the header slots 44, which prevents the production of slugs, provides easier bonding, and adds reinforcement. Alternatively, the header slots 44 can be drilled or punched into the headers 30, 38. In the exemplary embodiment, the second header 38 is an inlet header for receiving a refrigerant for liquid-to-vapor transformation, and the first header 30 is an outlet header for collecting a refrigerant vapor. The method typically includes cutting a notch 50, as shown in FIG. 6, extending axially into each of the header ends 32, 40 to a notch bottom 52 disposed at a predetermined distance axially into the corresponding headers 30, 38.

[0022] The method includes cutting another generally cylindrical tube to define a first refrigerant conduit 22 extending between a pair of first conduit ends 54. The method typically includes cutting a second refrigerant conduit 56 extending between a pair of second conduit ends 58, as shown in FIG. 1. The refrigerant conduits 22, 56 may comprise an aluminum material and they typically have a generally uniform cross-section. The cross-sectional area of the refrigerant conduits 22, 56 is less than the cross-sectional area of the headers 30, 38 so that the refrigerant conduits 22, 56 can be inserted into the headers 30, 38. The refrigerant conduits 22, 56 can also be made of copper, which has a higher strength and allows the refrigerant conduits 22, 56 to have a thinner gauge.

[0023] The method typically comprises creating a plurality of orifices 60 in each of the refrigerant conduits 22, 56. The orifices 60 may be located in a conduit body portion 62 of the refrigerant conduit, as shown in FIGS. 2-4, and they can be punched, drilled, or lanced into the refrigerant conduits 22, 56. The method may also include offsetting each of the refrigerant conduits 22, 56 adjacent to the conduit body portion 62 thereof to define a conduit transition portion 64 and a conduit outlet portion 66, as shown in FIGS. 1-4. The offset can be produced by any method known in the art. The method may comprise sealing the conduit ends 54, 58 opposite the corresponding conduit outlet portions 66 of the refrigerant conduits 22, 56 to close and those conduit ends 54, 58, as shown in FIG. 1. The conduit ends 54, 58 may be hermetically sealed, pinched, or substantially crimped shut.

[0024] The method comprises forming an inner radial abutment 24 about the circumference of at least one, but preferably both, of the refrigerant conduits 22, 56. The inner radial abutments 24 are typically formed at or about the conduit outlet portions 66, adjacent to the corresponding conduit transition portions 64, as shown in FIGS. 1-4. The inner radial abutments 24 may be formed at a predetermined location relative to the orifices 60 and the length of the refrigerant conduits 22, 56. The inner radial abutment 24 can be further defined as a bead adjacent to the transition portion extending upwardly from the refrigerant conduit 22, 56 and into the corresponding cavities 36, 42, as shown in FIGS. 1, 2 and 4, or as a radially inwardly extending shoulder in the refrigerant conduits 22, 56, as shown in FIG. 3.

[0025] The method includes inserting at least one, but preferably both, refrigerant conduits 22, 56 having the inner radial abutments 24 through an aperture 68 of an open end cap 26. The refrigerant conduits 22, 56 are typically inserted so that the corresponding open end caps 26 engage the conduit outlet portions 66 adjacent the conduit transition portions 64 and so that the open end caps 26 abut the corresponding inner radial abutments 24. The open end caps 26 typically comprise a symmetrically shape having a cross-sectional area equal to the cross-sectional area of the cavities 36, 42 of the headers 30, 38. The open end caps 26 may comprise a clad two-sided material.

[0026] Upon inserting the open end caps 26, the method comprises forming an outer radial abutment 28 about the circumference of at least one, but preferably both refrigerant conduits 22, 56 having the inner radial abutments 24. The outer radial abutments 28 are typically formed at or about the conduit outlet portions 66 and are spaced from the inner radial abutments 24 by the open end caps 26, as shown in FIGS. 1-4. The outer radial abutments 28 also abut the open end caps 26 and may capture and retain the open end caps 26 in the desired axial and longitudinal position. The outer radial abutments 28 may be an outwardly extending shoulder in the corresponding refrigerant conduits 22, 56, as shown in FIGS. 2 and 3. Alternatively, the outer radial abutments 28 may be formed by uniformly expanding the diameter of the refrigerant conduits 22, 56 beneath the corresponding open end caps 26, thereby locking the open end caps 26 to the corresponding refrigerant conduits 22, 56, as shown in FIG. 4. The radial abutments 24, 28 retain the open end cap 26 in position so that each of the refrigerant conduits 22, 56 and the corresponding open end caps 26 form a subassembly.

[0027] Upon forming the outer radial abutments 28, the method may include gradually expanding the diameter of the refrigerant conduits 22, 56 from a uniform section 70 disposed adjacent the corresponding outer radial abutments 28 to the corresponding conduit ends 54, 58 to define a flare 72 in the refrigerant conduits 22, 56, as shown in FIGS. 2-4. In regard to the embodiment comprising the uniform expansion of the refrigerant conduits 22, 56 beneath the open end caps 26, the method can also include forming a second radially outwardly extending shoulder 74 between the outer radial abutment 28 and the uniform section 70, as shown in FIG. 4.

[0028] The method comprises inserting each of the refrigerant conduits 22, 56 and the corresponding open end caps 26, i.e. the sub-assemblies, a predetermined distance into the corresponding headers 30, 38 so that the open end caps 26 are pressed into engagement with the interior surface 34 of the headers 30, 38, as shown in FIGS. 1-4. The open end cap 26 portion of the sub-assemblies are typically engaged with a tool and pressed into the corresponding headers 30, 38 by the tool until the tool engages the corresponding notch bottom 52. The open end caps 26 may provide a flat surface, as shown in FIGS. 1-4, that can be used to push the corresponding sub-assemblies the predetermined insertion distance and to a specific, desired location. Alternatively, the notch 50 may be used to orient the headers 30, 38 and the sub-assemblies relative to each other rotationally, and the sub-assemblies may be pressed to the predetermined distance using other tooling stops or a linear measurement device.

[0029] Each of the sub-assemblies may be disposed so that the corresponding conduit body portions 62 engage the interior surfaces 34 of the corresponding headers 30, 38, as shown in FIGS. 1-4. The predetermined location of the subassembly

in the headers 30, 38 can be adjusted, while maintaining the efficient method of the subject invention, by changing the insertion distance of the subassembly. The sub-assemblies can also be pressed so that the orifices 60 of the refrigerant conduits 22, 56 are disposed in a predetermined relationship relative to the header slots 44 and refrigerant tubes 76. The tight fit between the refrigerant conduits 22, 56 and the open end caps 26 prevent the refrigerant conduits 22, 56 from sliding outside of the predetermined desired location relative to the refrigerant tubes 76, prior to and during a furnace brazing process. The tool used to press the sub-assemblies into the headers 30, 38 can be any tool known in the art.

[0030] The method may comprise forming a plurality of indentations 78 spaced from one another and axially aligned in two rows in each of the headers 30, 38. The indentations 78 can extend into the corresponding cavities 36, 42 to contact the corresponding conduit body portions 62 for retaining the refrigerant conduits 22, 56 in position against the interior surfaces 34 of the corresponding headers 30, 38, as shown in FIG. 6. The method typically includes inserting a closed end cap 80 into each of the header ends 32, 40 opposite the corresponding open end cap 26 and adjacent to the corresponding conduit ends 54, 58 so that the closed end caps 80 are pressed into engagement with the corresponding interior surface 34 of the headers 30, 38, as shown in FIG. 1. The closed end caps 80 typically comprise a continuous sheet of metal, such as aluminum or copper.

[0031] The method also typically comprises placing the first header 30 and the second header 38 in a stacker headering station fixture so that the open end cap 26 engaging the first header end 32 is disposed opposite from the open end cap 26 engaging the second header end 40. The method also typically includes creating a core structure 82 and then transferring the core structure 82 to the stacker headering station. The creation of the core structure 82 includes arranging a plurality of refrigerant tubes 76 in spaced and parallel relationship to one another. Each of the refrigerant tubes 76 extend between refrigerant tube ends 84 and include at least one fluid passage 86. The refrigerant tubes 76 typically have a rectangular cross-section and include at least one divider 88 defining a plurality of fluid passages 86, as shown in FIG. 5. A pair of core reinforcements 90 can be disposed outwards of the refrigerant tubes 76. The core reinforcements 90 extend between the headers 30, 38 in spaced and parallel relationship to the refrigerant tubes 76 to protect the refrigerant tubes 76 and to define the core structure 82. The method may include interleaving cooling fins 92 between adjacent refrigerant tubes 76 and between the core reinforcements 90 and the refrigerant tubes 76 adjacent to the core reinforcements 90, as shown in FIG. 1, for transferring heat away from the refrigerant tubes 76.

[0032] Upon transferring the core structure 82 to the stacker headering station, the method comprises inserting the refrigerant tubes 76 into of each of the headers 30, 38, typically by pressing the refrigerant tube ends 84 into the header slots 44 so that the fluid passages 86 of the refrigerant tubes 76 are in fluid communication with the corresponding header cavities 36, 42. Each of the refrigerant tube ends 84 extend through one of the header slots 44 of the corresponding headers 30, 38, as shown in FIGS. 1-4. The refrigerant tubes 76 may be pressed a predetermined distance into the headers 30, 38 so that the refrigerant tubes 76 are spaced from the refrigerant conduits 22, 56 in the corresponding cavities 36, 42, as shown in FIGS. 1-4. As discussed above, the refrigerant tubes

76 can be disposed in a predetermined location relative to the orifices 60 of the refrigerant conduits 22, 56.

[0033] The method typically comprises furnace brazing the headers 30, 38, end caps 26, 80, refrigerant conduits 22, 56, and core structure 82. The refrigerant conduits 22, 56 are held in close contact with the open end caps 26, as described above, which creates the conditions necessary for capillary action to form a braze joint during the furnace brazing operation. The method finally comprises leak testing the end caps 26, 80 about the header ends 32, 40 to ensure a leak-free heat exchanger assembly 20.

[0034] While the invention has been described with reference to an exemplary embodiment, it will be understood by those skilled in the art that various changes may be made and equivalents may be substituted for elements thereof without departing from the scope of the invention. In addition, many modifications may be made to adapt a particular situation or material to the teachings of the invention without departing from the essential scope thereof. Therefore, it is intended that the invention not be limited to the particular embodiment disclosed as the best mode contemplated for carrying out this invention, but that the invention will include all embodiments falling within the scope of the appended claims.

What is claimed is:

1. A heat exchanger assembly of the type including a plurality of refrigerant tubes extending between an inlet header and outlet header and a refrigerant conduit disposed in at least one of the headers for uniformly distributing a refrigerant comprising:

- a first header for collecting a refrigerant;
- a second header for receiving said refrigerant;
- a first refrigerant conduit disposed in said first header for conveying said refrigerant therethrough;
- an open end cap encompassing said first refrigerant conduit and engaging said first header;
- a plurality of refrigerant tubes each defining at least one fluid passage extending between said first header and said second header for conveying said refrigerant between said headers; and
- said first refrigerant conduit including an inner radial abutment abutting said open end cap and an outer radial abutment spaced from said inner radial abutment by said open end cap for retaining said open end cap in position between said abutments so that said first refrigerant conduit and said open end cap form a subassembly.

2. A heat exchanger assembly as set forth in claim 1 wherein said inner radial abutment is further defined as a bead extending upwardly into said first header.

3. A heat exchanger assembly as set forth in claim 1 wherein said inner radial abutment is further defined as a radially inwardly extending shoulder in said first refrigerant conduit.

4. A heat exchanger assembly as set forth in claim 1 wherein said outer radial abutment is further defined as a first radially outwardly extending shoulder in said first refrigerant conduit.

5. A heat exchanger assembly as set forth in claim 1 wherein said outer radial abutment is further defined as a uniform expansion in the diameter of said first refrigerant conduit beneath said open end cap thereby locking said open end cap to said first refrigerant conduit.

6. A heat exchanger assembly as set forth in claim 1 wherein said first header extends between a pair of first header ends; and

said first header includes a notch extending a predetermined distance axially from each of said first header ends to a notch bottom.

7. A heat exchanger assembly as set forth in claim 1 wherein said first refrigerant conduit extends between a pair of first conduit ends; and

said first refrigerant conduit includes a conduit body portion and a conduit outlet portion interconnected by a conduit transition portion with said conduit body portion being offset from said conduit outlet portion for spacing said conduit body portion from said refrigerant tubes and for positioning said conduit outlet portion centrally in said first header.

8. A heat exchanger assembly as set forth in claim 7 wherein said conduit outlet portion includes a uniform section adjacent said outer radial abutment; and

said first refrigerant conduits includes a flare defined by a gradual increase in the diameter of said first refrigerant conduit extending from said uniform section to said corresponding first conduit end.

9. A heat exchanger assembly as set forth in claim 8 including a second radially outwardly extending shoulder between said outer radial abutment and said uniform section of said first refrigerant conduit.

10. A heat exchanger assembly as set forth in claim 7 wherein said first conduit end opposite said corresponding conduit outlet portion is sealed.

11. A heat exchanger assembly as set forth in claim 7 wherein said first header includes a plurality of indentations extending between said first header ends and contacting said conduit body portion of said first refrigerant conduit for retaining said first refrigerant conduit against said first header.

12. A heat exchanger assembly as set forth in claim 1 wherein said first refrigerant conduit includes a plurality of orifices for transferring said refrigerant therethrough.

13. A heat exchanger assembly as set forth in claim 1 wherein said first header includes a lanced surface being flat and including a plurality of truncated projections disposed in spaced intervals axially along said first header to define a plurality of header slots.

14. A heat exchanger assembly as set forth in claim 13 wherein said first header extends between a pair of first header ends; and

said open end cap is disposed between said plurality of truncated projections and said corresponding first header end.

15. A heat exchanger assembly as set forth in claim 13 wherein each of said refrigerant tubes extends through one of said header slots.

16. A heat exchanger assembly as set forth in claim 1 wherein said first refrigerant conduit comprises an aluminum material.

17. A heat exchanger assembly as set forth in claim 1 wherein said first header comprises an aluminum material.

18. A heat exchanger assembly as set forth in claim 1 wherein said open end cap comprises a clad two-sided material.

19. A heat exchanger assembly as set forth in claim 1 including a second refrigerant conduit disposed in said second header for conveying said refrigerant therethrough.

20. A heat exchanger assembly as set forth in claim 19 wherein said first header extends along a first header axis and said second header extends along a second header axis being parallel to said first header axis.

21. A heat exchanger assembly for dissipating heat comprising:

a first header having an interior surface and being generally circular in cross-section to define a first cavity for collecting a refrigerant vapor and extending along a first header axis between a pair of first header ends;

a second header having an interior surface and being generally circular in cross-section to define a second cavity for receiving a refrigerant liquid and extending along a second header axis between a pair of second header ends;

said second header axis being parallel to said first header axis;

said headers each including a lanced surface being flat and extending parallel to said header axes between said corresponding header ends;

each of said lanced surfaces including a plurality of truncated projections disposed in predetermined spaced intervals axially along said headers and extending into said corresponding cavities to define a plurality of header slots;

said header slots of said first header facing toward said header slots of said second header;

a first refrigerant conduit disposed in said first cavity and extending generally parallel to said first header axis between said first conduit ends for transferring said refrigerant vapor therethrough;

said first refrigerant conduit including a plurality of orifices in fluid communication with said first cavity for transferring said refrigerant vapor from said first cavity to said first refrigerant conduit;

a second refrigerant conduit disposed in said second cavity and extending generally parallel to said second header axis between said second conduit ends for transferring said refrigerant therethrough;

said second refrigerant conduit including a plurality of orifices in fluid communication with said second cavity for transferring said refrigerant from said second refrigerant conduit to said second cavity;

said refrigerant conduits each including a conduit body portion and a conduit outlet portion interconnected by a conduit transition portion with said conduit body portions being offset from said conduit outlet portions in said corresponding cavities for spacing said conduit body portions from said refrigerant tubes and for positioning said conduit outlet portions centrally in said corresponding cavities;

said refrigerant conduits each having a generally uniform cross-section throughout said conduit portions;

said conduit ends opposite said corresponding conduit outlet portions being sealed for closing one of said conduit ends of each of said refrigerant conduits;

said refrigerant conduits comprising an aluminum material;

said headers including a plurality of indentations extending into said corresponding cavities to contact said corresponding conduit body portions disposed in said cavities for positioning said refrigerant conduits against said interior surface of said corresponding headers;

said indentations being spaced from one another and axially aligned in two rows parallel to said header axes;

an open end cap engaging said interior surface of each of said headers at a predetermined axial position between said truncated projections and one of said corresponding

header ends and a closed end cap engaging said interior surface of each of said headers at a predetermined axial position between said truncated projections and the opposite one of said header ends;

said open end cap engaging said first header being adjacent the opposite one of said header ends from said open end cap engaging said second header;

said open end caps each defining an aperture encompassing and engaging said corresponding conduit outlet portions adjacent said conduit transition portions so that said refrigerant conduits extend through said apertures and outward of said header ends for conveying said refrigerant;

said closed end caps comprising a continuous sheet of metal;

said open end caps comprising a clad two-sided material;

a plurality of refrigerant tubes extending between refrigerant tube ends in spaced and parallel relationship to one another and transversely to said header axes between said headers;

each of said refrigerant tube ends extending through one of said header slots of said corresponding headers and into said corresponding cavities;

each of said refrigerant tubes having a generally rectangular cross-section and including at least one divider defining a plurality of fluid passages extending between said refrigerant tube ends and being in fluid communication with said cavities for transferring said refrigerant vapor from said second cavity to said first cavity;

a pair of core reinforcements disposed outwards of said refrigerant tubes and extending between said headers in a parallel and spaced relationship to said refrigerant tubes for protecting said refrigerant tubes and defining a core structure;

a plurality of cooling fins interleaved between adjacent refrigerant tubes and between said core reinforcements and said adjacent refrigerant tubes for transferring heat away from said refrigerant tubes;

each of said refrigerant conduits including an inner radial abutment disposed about the circumference of said conduit outlet portions adjacent said conduit transition portions of said refrigerant conduits and abutting said corresponding open end caps;

each of said refrigerant conduits including an outer radial abutment disposed about the circumference of said conduit outlet portions and spaced from said inner radial abutments by said open end caps and abutting said open end caps for retaining said open end caps in axial position for brazing said refrigerant conduits to said open end caps;

each of said headers including a notch extending a predetermined distance axially from each of said header ends to a notch bottom.

22. A heat exchanger assembly as set forth in claim 21 wherein said inner radial abutment being is further defined as a bead adjacent to the transition portion extending upwardly into said corresponding cavities.

23. A heat exchanger assembly as set forth in claim 21 wherein said inner radial abutment is further defined as a radially inwardly extending shoulder in said corresponding refrigerant conduits.

24. A heat exchanger assembly as set forth in claim **21** wherein said outer radial abutment is further defined as a first radially outwardly extending shoulder in said corresponding refrigerant conduits.

25. A heat exchanger assembly as set forth in claim **21** wherein said outer radial abutment is further defined as a uniform expansion in the diameter of said corresponding refrigerant conduits beneath said open end caps thereby locking said open end caps to said refrigerant conduits.

26. A heat exchanger assembly as set forth in claim **21** wherein each of said conduit outlet portions includes a uniform section adjacent said outer radial abutments and a flare defined by a gradual increase in the diameter of said refrigerant conduits extending from said uniform sections to said corresponding conduit ends.

27. A heat exchanger assembly as set forth in claim **26** including a second radially outwardly extending shoulder between said outer radial abutments and said uniform sections of said refrigerant conduits.

28. A method for fabricating a heat exchanger assembly of the type including a plurality of refrigerant tubes extending between an inlet header and outlet header and a refrigerant conduit disposed in at least one of the headers for uniformly distributing a refrigerant comprising the steps of:

inserting a first refrigerant conduit through an open end cap;

inserting the first refrigerant conduit and the open end cap into a first header;

disposing a second header in spaced and parallel relationship to the first header;

inserting a plurality of refrigerant tubes each defining at least one fluid passage into the first header and into the second header so that refrigerant tubes extend between the first header and the second header; and

forming an inner radial abutment for abutting the open end cap upon engaging the first refrigerant conduit to the open end cap and forming an outer radial abutment spaced from the inner radial abutment by the open end cap for retaining the open end cap in position between the abutments for inserting the first refrigerant conduit and the open end cap as a subassembly into the first header.

29. A method as set forth in claim **28** further comprising cutting a notch extending axially from a first header end of the first header to a notch bottom disposed a predetermined distance axially into the header.

30. A method as set forth in claim **29** wherein said inserting the first refrigerant conduit and the open end cap into the first header is further defined by engaging the open end cap with a tool to push the open end cap into the header until the tool engages the notch bottom.

31. A method as set forth in claim **28** wherein said forming an inner radial abutment is further defined as forming a bead in the first refrigerant conduit adjacent to the transition portion extending upwardly into the first header.

32. A method as set forth in claim **28** wherein said forming an inner radial abutment is further defined as forming a radially inwardly extending shoulder in the first refrigerant conduit.

33. A method as set forth in claim **28** wherein said forming an outer radial abutment being further defined as forming a first radially outwardly extending shoulder in the first refrigerant conduits.

34. A method as set forth in claim **28** wherein said forming an outer radial abutment is further defined as expanding the diameter of the first refrigerant conduit beneath the open end cap thereby locking the open end cap to the corresponding first refrigerant conduit.

35. A method as set forth in claim **28** further comprising gradually expanding the diameter of the first refrigerant conduit from a uniform section disposed adjacent the outer radial abutment to a first conduit end to define a flare in the first refrigerant conduits upon forming the outer radial abutment.

36. A method as set forth in claim **35** further comprising forming a second radially outwardly extending shoulder between the outer radial abutment and the uniform section of the first refrigerant conduit.

37. A method for fabricating a heat exchanger assembly of the type including a plurality of refrigerant tubes extending between an inlet header and outlet header and a refrigerant conduit disposed in at least one of the headers for uniformly distributing a refrigerant comprising the steps of:

cutting a first generally cylindrical tube comprising an aluminum material and having a generally uniform cross-section to define a first header extending along a first header axis between a pair of first header ends and having an interior surface defining a first cavity;

cutting a second generally cylindrical tube comprising an aluminum material and having a generally uniform cross-section to define a second header extending along a second header axis between a pair of second header ends and having an interior surface defining a second cavity;

puncturing a plurality of header slots radially into and at predetermined spaced intervals axially along each of the headers;

cutting a first generally cylindrical tube comprising an aluminum material and having a generally uniform cross-section to define a first refrigerant conduit extending between a pair of first conduit ends;

cutting a second generally cylindrical tube comprising an aluminum material and having a generally uniform cross-section to define a second refrigerant conduit extending between a pair of second conduit ends;

puncturing a plurality of orifices in a conduit body portion in each of the refrigerant conduits;

offsetting each of the refrigerant conduits adjacent to the conduit body portion thereof to define a conduit transition portion and a conduit outlet portion;

sealing each of the conduit ends opposite the corresponding conduit outlet portions of each of the refrigerant conduits to close the corresponding conduit ends;

inserting each of the conduit outlet portions through an aperture of an open end cap so that the open end caps engages the conduit outlet portions adjacent the conduit transition portions;

inserting each of the refrigerant conduits and the corresponding open end caps into the corresponding headers so that the corresponding conduit body portion opposite the orifices engages the interior surface of the corresponding headers so that the orifices of the refrigerant conduits are disposed in a predetermined relation relative to the header slots and the open end caps are pressed into engagement with the interior surface of the headers;

forming a plurality of indentations spaced from one another and axially aligned in two rows in each of the headers and extending into the corresponding cavities to

contact the corresponding conduit body portion for positioning each of the refrigerant conduits against the interior surface of the adjacent one of the headers;

inserting a closed end cap into each of the header ends opposite the corresponding open end cap and adjacent to the corresponding conduit ends in each of the headers so that the closed end caps are pressed into engagement with the corresponding interior surface of the headers;

placing the first header and the second header in a stacker headering station fixture so that the open end cap engaging the first header end is disposed opposite from the open end cap engaging the second header end;

disposing a plurality of refrigerant tubes each including at least one fluid passage extending between refrigerant tube ends in spaced and parallel relationship with one another;

disposing a pair of core reinforcements outwards of the refrigerant tubes and cooling fins to define a core structure;

interleaving cooling fins between adjacent refrigerant tubes and between said core reinforcements and said adjacent refrigerant tubes for transferring heat away from said refrigerant tubes;

transferring the core structure to the stacker headering station;

inserting the refrigerant tubes into of each of the headers by pressing the refrigerant tube ends into the header slots so that the fluid passages of the refrigerant tubes are in fluid communication with the corresponding header cavities and the refrigerant tubes are spaced from the corresponding refrigerant conduits in the cavities;

furnace brazing the headers and the end caps and the refrigerant conduits and the core structure;

leak testing the end caps about the header ends;

forming an inner radial abutment about the circumference of the conduit outlet portions of each of the refrigerant conduits adjacent to the corresponding conduit transition portions for abutting the open end caps upon inserting the conduit outlet portions through the apertures of the open end caps;

forming an outer radial abutment about the circumference of the conduit outlet portions of each of the refrigerant

conduits and spaced from the inner radial abutments by the open end caps for abutting the open end caps and retaining the open end caps in position for inserting the refrigerant conduits and the open end caps into the corresponding headers;

cutting a notch extending axially into each of the header ends to a notch bottom disposed a predetermined distance axially into in the headers; and

wherein said pressing the end caps into the headers is further defined by engaging each of the end caps with a tool to push the end caps into the headers until the tool engages the notch bottom.

38. A method as set forth in claim 37 wherein said forming an inner radial abutment is further defined as forming a bead in each of the refrigerant conduits adjacent to the transition portion extending upwardly into the corresponding cavities.

39. A method as set forth in claim 37 wherein said forming an inner radial abutment is further defined as forming a radially inwardly extending shoulder in each of the refrigerant conduits.

40. A method as set forth in claim 37 wherein said forming an outer radial abutment being further defined as forming a first radially outwardly extending shoulder in each of the refrigerant conduits.

41. A method as set forth in claim 37 wherein said forming an outer radial abutment being further defined as expanding the diameter of each of the refrigerant conduits beneath the corresponding open end caps thereby locking the open end caps to the corresponding refrigerant conduits.

42. A method as set forth in claim 37 further comprising gradually expanding the diameter of each of the refrigerant conduits from a uniform section disposed adjacent the corresponding outer radial abutments to the corresponding conduit ends to define a flare in each of the refrigerant conduits upon forming the outer radial abutments.

43. A method as set forth in claim 42 further comprising forming a second radially outwardly extending shoulder between the outer radial abutments and the uniform sections in each of the refrigerant conduits.

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