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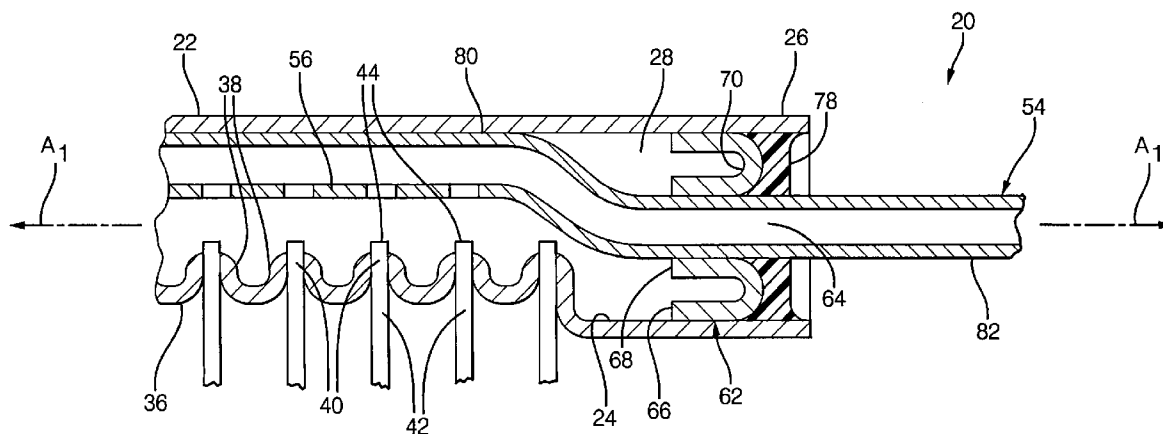
(19) **United States**(12) **Patent Application Publication**
Beamer et al.(10) **Pub. No.: US 2009/0173482 A1**(43) **Pub. Date: Jul. 9, 2009**(54) **DISTRIBUTOR TUBE SUBASSEMBLY****Publication Classification**(76) Inventors: **Henry E. Beamer**, Middleport, NY (US); **Thomas McGreevy**, Akron, NY (US); **Robert M. Runk**, Lockport, NY (US); **Douglas C. Wintersteen**, Burt, NY (US); **David E. Samuelson**, Wheatfield, NY (US)(51) **Int. Cl.**
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(52) **U.S. Cl.** **165/173; 29/890.03**(57) **ABSTRACT**

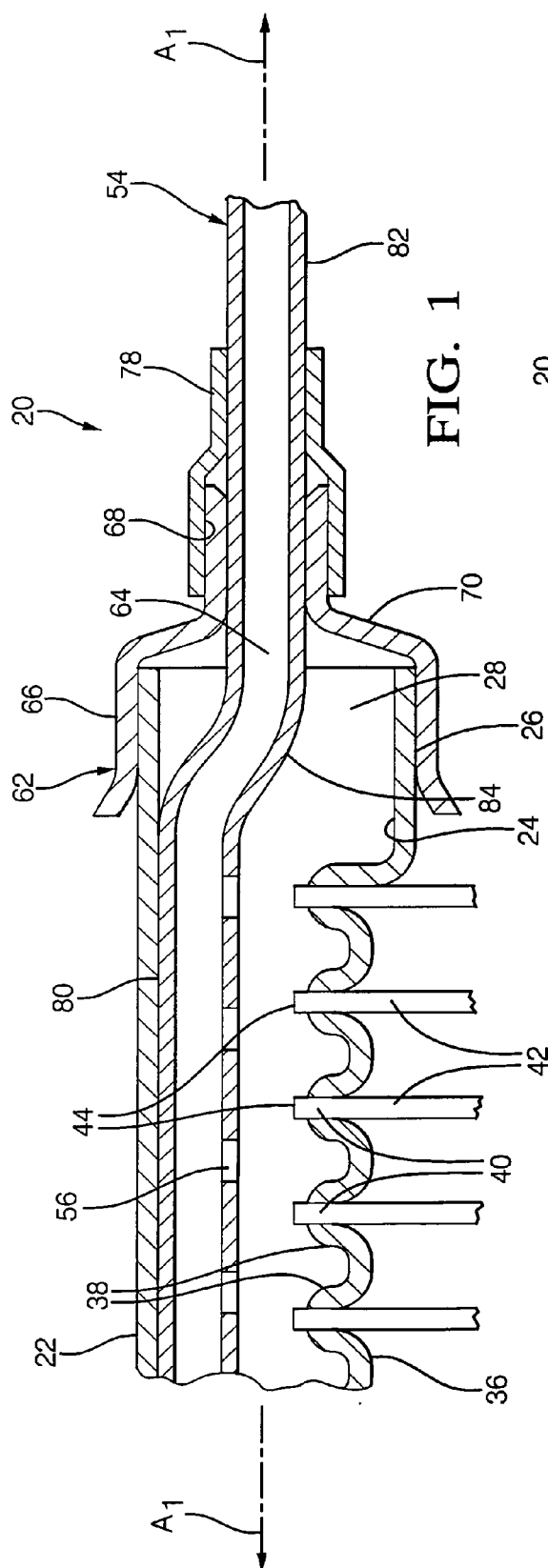
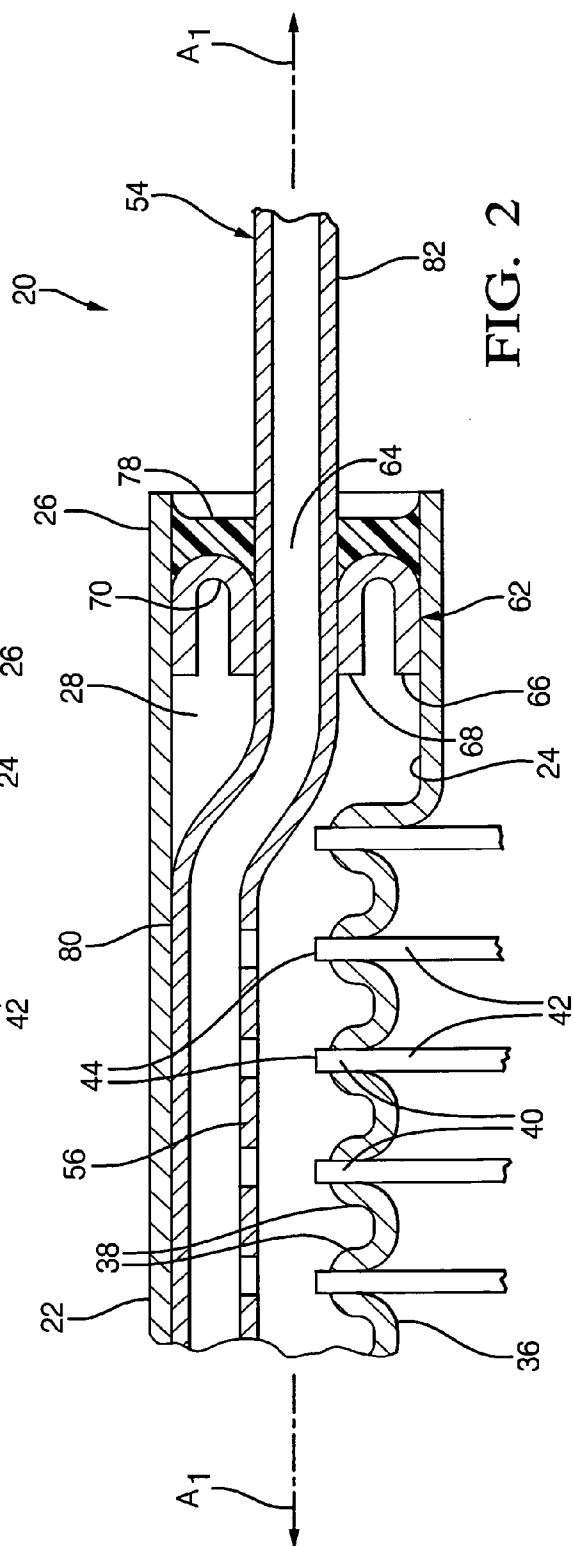
A heat exchanger assembly includes an outlet header extending along an outlet axis to define an outlet cavity and an inlet header defining an inlet cavity. A plurality of refrigerant tubes extends from the inlet header through the outlet header and into the outlet cavity. A collector conduit is disposed in the outlet header and includes a conduit body portion and at least one conduit end portion interconnected by a conduit transition portion with the conduit body portion being offset from the conduit end portion. The conduit body portion is engaged to an interior surface of the outlet header to space the conduit body portion from the refrigerant tubes extending into the outlet header and the conduit end portion is coaxial with the outlet header axis to provide a central outlet for the refrigerant vapor.

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(21) Appl. No.: **12/229,123**(22) Filed: **Aug. 20, 2008****Related U.S. Application Data**

(60) Provisional application No. 61/020,040, filed on Jan. 9, 2008.





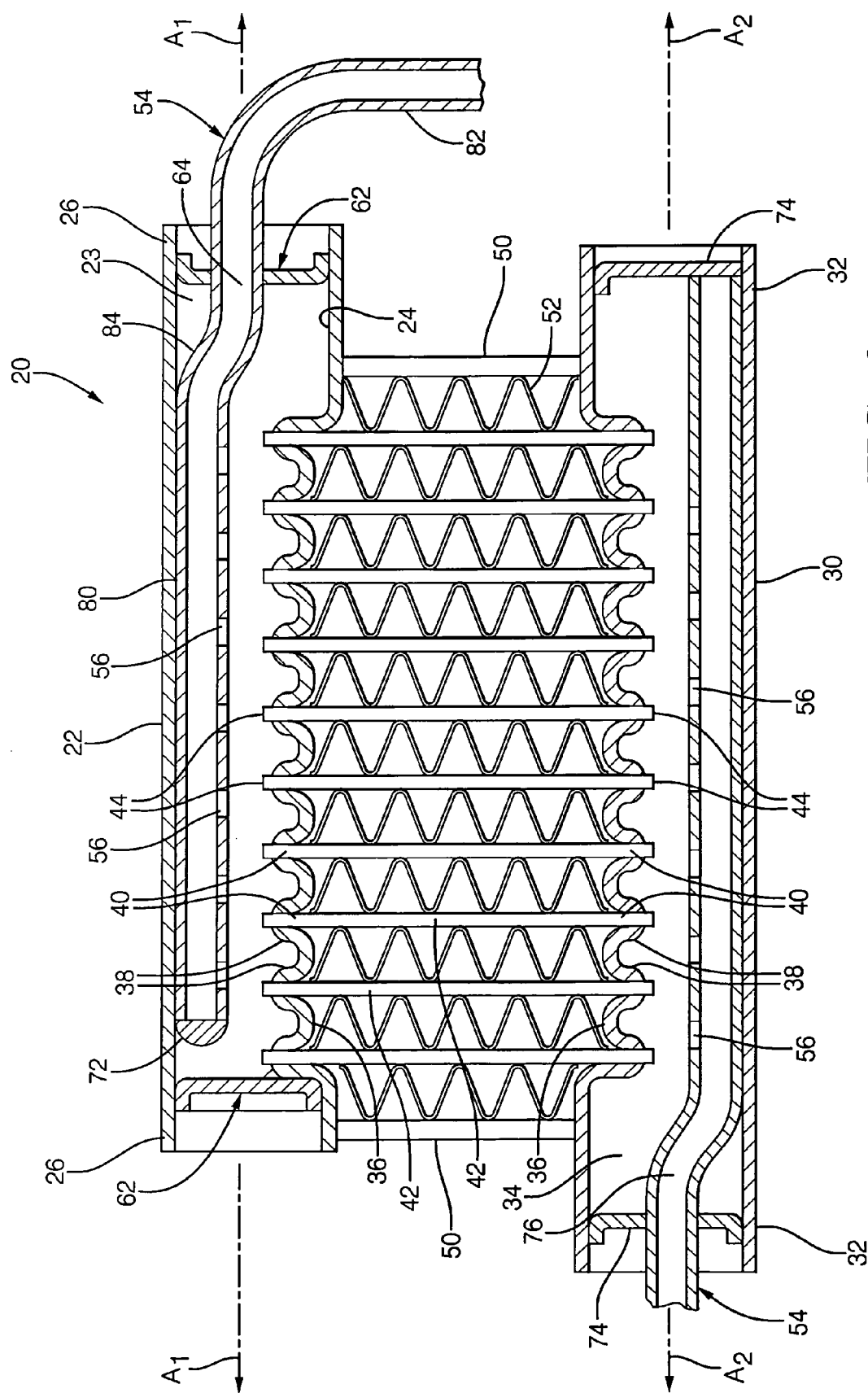
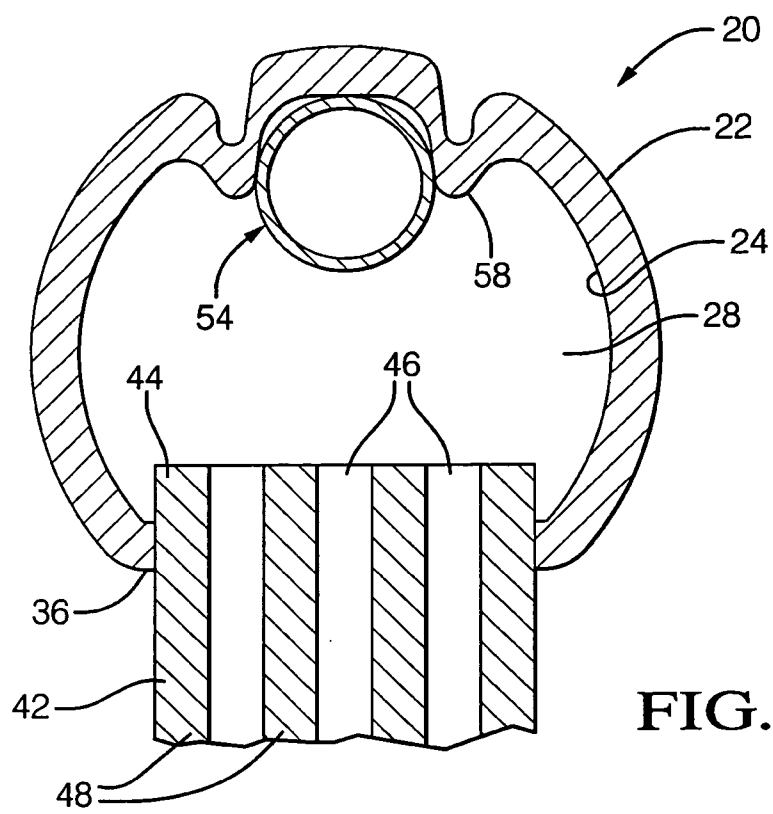
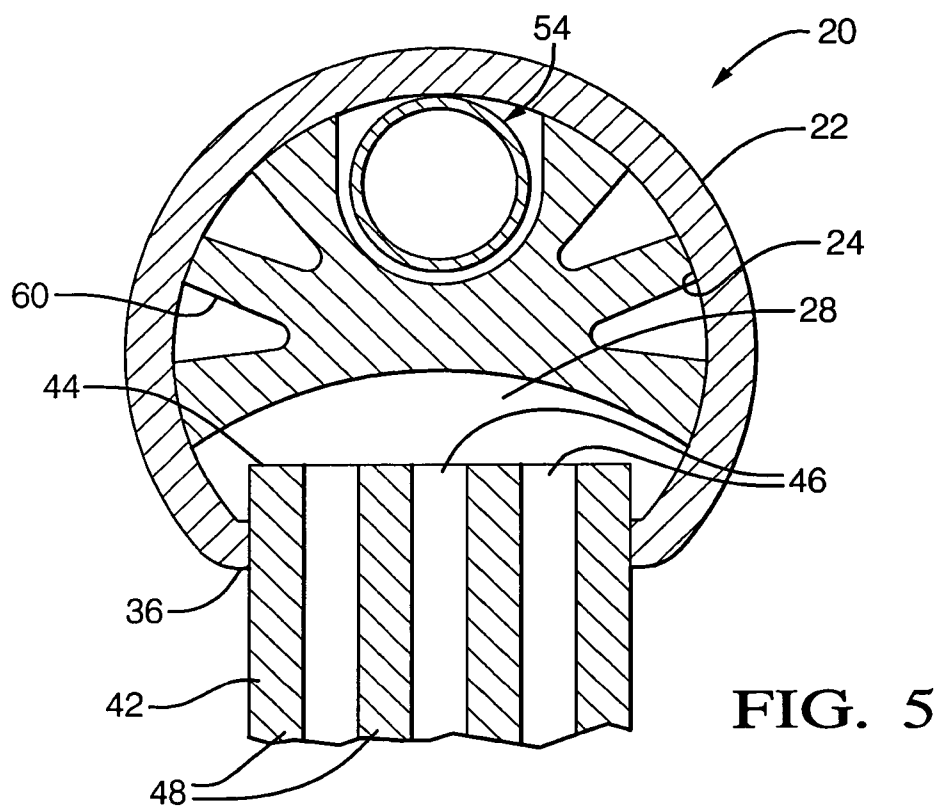


FIG. 3



DISTRIBUTOR TUBE SUBASSEMBLY**CROSS REFERENCE TO RELATED APPLICATION**

[0001] This application claims the benefit of application Ser. No. 61/020,040 filed on Jan. 9, 2008.

BACKGROUND OF THE INVENTION**[0002]** 1. Field of the Invention

[0003] The subject invention relates generally to a heat exchanger and method of fabricating the same, and, more specifically to a heat exchanger of the type including a plurality of refrigerant tubes extending between an inlet header and an outlet for transferring refrigerant from the inlet header to the outlet header.

[0004] 2. Description of the Prior Art

[0005] 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 defining fluid passages to interconnect 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. To improve refrigerant distribution, refrigerant conduits can be disposed in the headers. An example of such a heat exchanger is disclosed in U.S. Pat. No. 1,684,083 to S. C. Bloom.

[0006] The Bloom patent discloses a first header being at least in part generally cylindrical in cross-section to define a first cavity extending along a first header axis between a pair of first header end portions. A second header defining a second cavity extends along a second header axis between a pair of second header end portions. A plurality of refrigerant tubes each defining a fluid passage extends transversely to the header axes between the headers. The fluid passages of the refrigerant tubes are in fluid communication with the cavities for transferring refrigerant from one of the headers to the other of the headers. A refrigerant conduit having a conduit cross-section being circular is disposed in each of the cavities extending axially along the header axes parallel to the headers. The refrigerant conduits include a plurality of orifices in fluid communication with the corresponding cavities for transferring refrigerant between the refrigerant conduits and the corresponding cavities. One of the headers is an inlet header for receiving liquid refrigerant and the other of the headers is an outlet header for outputting refrigerant vapor. 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.

[0007] A heat exchanger as disclosed by the Bloom patent is typically made by puncturing a generally cylindrical first header defining a first cavity and a generally cylindrical second header defining a second cavity in predetermined spaced intervals axially along each header to define a plurality of header slots spaced axially along each header. A plurality of orifices is produced in a generally cylindrical refrigerant conduit, and the refrigerant conduit is inserted into the first cavity of the first header. The first and second headers are then placed in a stacker headering station fixture, and the headers

are pressed onto a plurality of refrigerant tubes each defining a fluid passage to fluidly communicate the cavities of the headers. The refrigerant tubes typically extend through the header slots and into the cavities of the headers.

[0008] Inserting a refrigerant conduit into a header without damaging the refrigerant tubes or the refrigerant conduit is often difficult in a residential heat exchanger because of the increased length. To alleviate this problem, heat exchangers including a refrigerant conduit disposed in a header and engaging an interior surface of the header have been produced as an alternative to the coaxial refrigerant conduit. Such heat exchangers provide efficient installation of a refrigerant conduit in a header by spacing the refrigerant conduit from the refrigerant tubes extending into the cavities. However, while such heat exchanger assemblies generally enhance the manufacturability of tube-in-tube heat exchanger assemblies, they generally are not compatible with traditional heat exchanger components and systems. There remains the need for a tube-in-tube heat exchanger assembly providing for efficient installation and which is also compatible with traditional heat exchanger components and systems.

SUMMARY OF THE INVENTION

[0009] The present invention provides such a heat exchanger assembly improved by the refrigerant conduit including a conduit body portion and at least one conduit end portion interconnected by a conduit transition portion with the conduit body portion being offset from the conduit end portion in the first cavity for spacing the conduit body portion from the refrigerant tubes and for positioning the conduit end portion centrally in the first cavity along the first header end portion.

[0010] The invention also provides an improved method of fabricating a heat exchanger including a refrigerant conduit having a conduit body portion and an offset conduit end portion interconnected by a conduit transition portion by offsetting the conduit end portion of the refrigerant conduit from the conduit body portion of the refrigerant conduit before inserting the refrigerant conduit into the first cavity.

[0011] Accordingly, the present invention provides efficient installation of a refrigerant conduit in a header and provides a heat exchanger which is also compatible with traditional heat exchanger components and systems. The conduit body portion of the refrigerant conduit is spaced from the refrigerant tubes for efficient installation and the conduit end portion is positioned centrally in the first cavity along the first header end portion to provide a central orifice for the refrigerant in accordance with traditional heat exchanger assemblies.

BRIEF DESCRIPTION OF THE DRAWINGS

[0012] Other advantages of the present invention will be readily appreciated, as the same becomes better understood by reference to the following detailed description when considered in connection with the accompanying drawings wherein:

[0013] FIG. 1 is a fragmentary and cross-sectional side view of an embodiment of a heat exchanger assembly including an external header end cap;

[0014] FIG. 2 is a fragmentary and cross-sectional side view of an embodiment of a heat exchanger assembly including an internal header end cap;

[0015] FIG. 3 is a cross-sectional side view of an embodiment of a heat exchanger assembly including a distributor conduit disposed in an inlet header and a collector conduit disposed in an outlet header;

[0016] FIG. 4 is a fragmentary and cross-sectional end view of a heat exchanger assembly including support projections; and

[0017] FIG. 5 is a fragmentary and cross-sectional end view of a heat exchanger assembly including a star clip.

DETAILED DESCRIPTION OF THE EXEMPLARY EMBODIMENT

[0018] Referring to the Figures, wherein like numerals indicate corresponding parts throughout the several views, a heat exchanger assembly 20 for dissipating heat is shown generally.

[0019] The heat exchanger assembly 20 comprises a first header 22, generally indicated, having an interior surface 24 and being generally circular in cross-section. The first header 22 extends along a first header axis A_1 between a pair of first header end portions 26 to define a first cavity 28. A second header 30 is generally indicated and generally circular in cross-section. The second header 30 extends along a second header axis A_2 between a pair of second header end portions 32 to define a second cavity 34. As shown in FIG. 3, the second header axis A_2 is preferably parallel to the first header axis A_1 .

[0020] Hereinafter, an exemplary embodiment of the heat exchanger assembly 20 is described wherein the first header 22 is an outlet header and the second header 30 is an inlet header 30. However, it is to be understood that in additional embodiments of the heat exchanger assembly 20 the first header 22 is an inlet header and the second header 30 is an outlet header. In the exemplary embodiment, the outlet header 22 further defines the first cavity 28 as an outlet cavity 28 extending along an outlet header axis A_1 between a pair of outlet header end portions 26 and the inlet header 30 further defines the second cavity 34 as an inlet cavity 34 extending along an inlet header axis A_2 between a pair of inlet header end portions 32. In the exemplary embodiment, the inlet header 30 is for receiving a refrigerant for liquid-to-vapor transformation and the outlet header 22 is for collecting refrigerant vapor.

[0021] Each header includes a lanced surface 36 being flat and extending parallel to the corresponding header axis A_1 , A_2 between the corresponding header end portions 26, 32. As shown in FIG. 3, each lanced surface 36 includes a plurality of truncated projections 38 extending into the corresponding cavity. The truncated projections 38 are axially spaced from one another between the corresponding header end portions 26, 32 to define valleys between adjacent truncated projections 38. The truncated projections 38 define a plurality of header slots 40 extending transversely to the corresponding header axis A_1 , A_2 .

[0022] A plurality of refrigerant tubes 42, each having a pair of refrigerant tube ends 44, extends in a spaced and parallel relationship and transversely to the header axes A_1 , A_2 between the headers 22, 30. Each of the refrigerant tubes 42 generally has a rectangular cross-section and defines a fluid passage 46 extending between the refrigerant tube ends 44. In additional embodiments of the assembly 20, the refrigerant tubes 42 have an oval cross-section or a circular cross-section. Each fluid passage 46 is in fluid communication with the cavities 28, 34 for transferring refrigerant from the inlet

cavity 34 to the outlet cavity 28. As shown in FIG. 4, each refrigerant tube 42 preferably includes at least one divider 48 defining a plurality of the fluid passages 46 extending between the refrigerant tube ends 44 and being in fluid communication with the cavities 28, 34. The dividers 48 add structural support for supporting the refrigerant tube 42 during extreme pressures. As shown in FIG. 3, the refrigerant tube ends 44 of each refrigerant tube 42 generally extend through one of the header slots 40 of each header and into the corresponding cavity 28, 34.

[0023] In an embodiment of the assembly 20, as shown in FIG. 3, a pair of core reinforcements 50 are disposed outwards of the refrigerant tubes 42 and extend between the headers 22, 30 in a parallel and spaced relationship to the refrigerant tubes 42 and are connected to the headers 22, 30 for protecting the refrigerant tubes 42. The core reinforcements 50 add structural support to the heat exchanger assembly 20 and protect a plurality of cooling fins 52.

[0024] The plurality of cooling fins 52 are disposed between adjacent refrigerant tubes 42 and between each core reinforcement 50 and the next adjacent of the refrigerant tubes 42, as shown in FIG. 3, for transferring heat from the refrigerant tubes 42. The cooling fins 52 may be serpentine fins or any other cooling fins commonly known in the art.

[0025] A refrigerant conduit 54 is generally indicated and preferably has a generally uniform cross-section. In the exemplary embodiment, the refrigerant conduit 54 is disposed in the outlet cavity 28 and extends along the outlet header axis A_1 . In such an exemplary embodiment, the refrigerant conduit 54 is a collector conduit 54. However, it is to be understood that in additional embodiments, the refrigerant conduit 54 is disposed in the inlet header 30 defining the refrigerant conduit 54 as a distributor conduit. In further embodiments, a refrigerant conduit 54 is disposed in each header 22, 30 as shown in FIG. 3. The collector conduit 54 is preferably generally circular in cross-section.

[0026] The collector conduit 54 includes a plurality of orifices 56 in fluid communication with the outlet cavity 28 for transferring the refrigerant vapor from the outlet cavity 28 to the collector conduit 54 to flow the refrigerant vapor along the collector conduit 54. In additional embodiments of the assembly 20 wherein the assembly 20 includes a distributor conduit disposed in the inlet header 30, the distributor conduit includes a plurality of orifices 56 in fluid communication with the inlet cavity 34 for transferring refrigerant from the distributor conduit to the inlet cavity 34.

[0027] As shown in FIG. 4, the outlet header 22 preferably includes a plurality of support projections 58 extending into the outlet cavity 28 under the collector conduit 54 for positioning the collector conduit 54. In an embodiment of such an assembly 20, the support projections 58 are spaced from one another and aligned in two rows each parallel to the outlet header axis A_1 . In an additional embodiment of such an assembly 20, each support projection 58 extends axially along the outlet header 22 parallel to the outlet header axis A_1 . In alternative embodiments of the heat exchanger assembly 20, clips 60 are disposed in the outlet cavity 28 in lieu of, or in addition to, the support projections 58 for supporting the collector conduit 54. As shown in FIG. 5, the clips 60 can be "star" clips, however, it is to be understood that in additional embodiments of the assembly 20, the clips 60 can be "wing" clips, "s" clips, or any other type of clip or other support commonly known in the art.

[0028] Each of a pair of first end caps 62 is generally indicated and is engaged and hermetically sealed to one of the outlet header end portions 26. At least one of the first end caps 62 defines a first aperture 64 for receiving the collector conduit 54. In the exemplary embodiment, the first end caps 62 are outlet end caps 62 and the first aperture 64 is an outlet aperture 64. The outlet aperture 64 is generally hermetically sealed about the collector conduit 54 as shown in FIGS. 1-3. In an embodiment of the assembly 20, as shown in FIGS. 1-3, the collector conduit 54 extends through the outlet aperture 64 and outward of the outlet cavity 28 and the outlet header end portion 26 for venting the refrigerant vapor. In other embodiments of the assembly 20, the collector conduit 54 extends to the outlet aperture 64, and the outlet end cap 62 is configured for receiving an outlet pipe for venting the refrigerant vapor.

[0029] In an embodiment of the assembly 20, as shown in FIG. 3, at least one of the outlet end caps 62 is ring shaped and disposed circumferentially about the outlet header axis A_1 in the outlet cavity 28 in one of the outlet header end portions 26 to define the outlet aperture 64. In additional embodiment of the assembly 20, as shown in FIGS. 1 and 2, at least one of the outlet end caps 62 includes a header engaging portion 66 and a conduit engaging portion 68 interconnected by an end cap transition portion 70. In such embodiments, the header engaging portion 66 is generally circular in cross-section and engaged and hermetically sealed to the outlet header end portion 26, the end cap transition portion 70 is generally circular in cross-section and is disposed circumferentially about the outlet header axis A_1 , and the conduit engaging portion 68 is generally circular in cross-section to define the outlet aperture 64 and is engaged and hermetically sealed about the collector conduit 54. In an embodiment of such an assembly 20, as shown in FIG. 1, the header engaging portion 66 is engaged and hermetically sealed about the outlet header end portion 26. In an alternative embodiment of such an assembly 20, as shown in FIG. 2, the header engaging portion 66 is disposed in the outlet cavity 28 and engaged and hermetically sealed to the interior surface 24 of the outlet header 22. In another embodiment of such an assembly 20, as shown in FIG. 1, the end cap transition portion 70 is tapered. In an alternative embodiment of such an assembly 20, as shown in FIG. 2, the end cap transition portion 70 extends perpendicularly to the outlet header axis A_1 . In another embodiment of such an assembly 20, as shown in FIG. 1, the conduit engaging portion 68 extends from the end cap transition portion 70 and away from the outlet cavity 28 and along the collector conduit 54. In an alternative embodiment of such an assembly 20, as shown in FIG. 2, the conduit engaging portion 68 extends from the end cap transition portion 70 and toward the outlet cavity 28 and along the collector conduit 54. In the Figures, the conduit engaging portion 68 is shown as being disposed circumferentially about the outlet header axis A_1 and concentrically with the outlet header end portions 26, however, those skilled in the art appreciate the conduit engaging portion 68 is offset from the outlet header axis A_1 in additional embodiments of the assembly 20.

[0030] In an embodiment of the assembly 20 wherein one of the outlet end caps 62 does not define an outlet aperture 64, the collector conduit 54 is engaged and hermetically sealed to the outlet end cap 62 for sealing the collector conduit 54 about the outlet end cap 62. In such an embodiment, the outlet end cap 62 can include an indentation or a projection or another form of indication for locating the collector conduit 54. In such an embodiment, the outlet end cap 62 can also include a

support structure for contacting and supporting the collector conduit 54. In an alternative embodiment of the assembly 20 wherein one of the outlet end caps 62 does not define an outlet aperture 64, the collector conduit 54 is engaged and hermetically sealed about the interior surface 24 of the outlet header 22 instead of being engaged and hermetically sealed to the outlet end cap 62. In another alternative embodiment of such an assembly 20 wherein one of the outlet end caps 62 does not define an outlet aperture 64, the collector conduit 54 is engaged and hermetically sealed with a forming operation instead of being engaged and hermetically sealed to the outlet end cap 62. In another alternative embodiment of such an assembly 20 wherein one of the outlet end caps 62 does not define an outlet aperture 64, as shown in FIG. 3, a plug 72 is disposed in and engaged and hermetically sealed to the collector conduit 54 instead of having the collector conduit 54 engaged and hermetically sealed to the outlet end cap 62.

[0031] Each of a pair of second end caps 74 is engaged and hermetically sealed to one of the inlet header end portions 32 with at least one of the second end caps 74 defining a second aperture 76 in fluid communication with the inlet cavity 34. In the exemplary embodiment, the second end caps 74 are inlet end caps 74 and the second aperture 76 is an inlet aperture 76 for receiving the refrigerant. While various configurations of the outlet end caps 62 are described above, it is to be understood that various embodiments of the assembly 20 include the inlet end caps 74 having such configurations. However, it is also to be understood that the inlet and outlet end caps 74, 62 are not limited to the configurations as described above. Any of the various shapes and types of end caps commonly known in the art can be used in conjunction with the assembly 20.

[0032] In an embodiment of the assembly 20, an encapsulant 78 is disposed about the collector conduit 54 extending through the outlet aperture 64 as shown in FIGS. 1-2. The encapsulant 78 is preferably engaged to the collector conduit 54 and the outlet end cap 62 for shielding the collector conduit 54 and the outlet end cap 62 from corrosion. The encapsulant 78 is preferably included in embodiments of the assembly 20 wherein the collector conduit 54 and the outlet end cap 62 are composed of dissimilar materials, however, those skilled in the art appreciate an encapsulant can be included in additional embodiments of the assembly 20.

[0033] The heat exchanger assembly 20 is distinguished by the refrigerant conduit 54 including a conduit body portion 80 and at least one conduit end portion 82 interconnected by a conduit transition portion 84 wherein the conduit body portion 80 is offset from the conduit end portion 82 in the outlet cavity 28 to space the conduit body portion 80 from the refrigerant tubes 42 and to provide a central outlet for the refrigerant vapor. The conduit body portion 80 is preferably engaged to the interior surface 24 of the cylindrical first header 22 and the conduit end portion 26, 82 is preferably coaxial with the outlet header axis A_1 . The offset between the axis the conduit body portion 80 extends along and the axis the conduit end portion 82 extends along is preferably the distance between the interior surface 24 of the outlet header 22 and the conduit end portion 26, 82. The conduit body portion 80 and the conduit transition portion 84 generally extend between the outlet header end portions 26 and the conduit end portion 82 is generally disposed in one of the outlet header end portions 26.

[0034] A method for fabricating a heat exchanger assembly 20 including a refrigerant conduit 54 having a conduit body

portion **80** and an offset conduit end portion **82** interconnected by a conduit transition portion **84** comprises the steps of cutting a generally cylindrical tube having a generally uniform cross-section to define the refrigerant conduit **54**. The refrigerant conduit **54** is generally cut from welded or folded tubing. The refrigerant conduit **54** is generally made of copper or aluminum. The higher strength of copper provides for a refrigerant conduit **54** of a thinner gauge. This in turn allows for a refrigerant conduit **54** having a smaller cross-sectional area for easier insertion into a first header **22**.

[0035] A plurality of orifices **56** is produced in the refrigerant conduit **54**. The orifices **56** are generally produced in the conduit body portion **80** of the refrigerant conduit **54** and are generally punched, drilled, or lanced, or any other method commonly known in the art.

[0036] The method includes the step of engaging one of a pair of first end caps **62** to one of a pair of first header end portions **26** of a first header **22** having an interior surface **24** and defining a first cavity **28** and extending along a first header axis A_1 to seal the first header **22** about the corresponding first header end portion **26**. The first end cap **62** can be an internal or external end cap. An internal first end cap **62** offers a higher burst strength relative to an external first end cap **62** due to a smaller area exposed to the internal refrigerant pressure. An internal first end cap **62** design is preferably generally symmetrical due to forming and space limitations. It is also generally preferable for an internal first end cap **62** and a refrigerant conduit **54** to both be made of copper. It is generally preferable for an external first end cap **62** to be made of aluminum in conjunction with a refrigerant conduit **54** made of either aluminum or copper. The higher coefficient of thermal expansion/contraction of aluminum causes the aluminum to shrink into either an aluminum or a copper refrigerant conduit **54** as the joint cools from the joining operation. Additionally, an external joint between a copper first end cap **62** and an aluminum first header **22** is difficult to shield from corrosion. Corrosion shielding of an aluminum first end cap **62** and copper refrigerant conduit **54** joint can be obtained with an encapsulant **78**. However, a higher material gage is required for an aluminum external first end cap **62** relative to the material gage required for an internal first end cap **62** due to the increased pressure area and aluminum material. A dome shaped external first end cap **62** is generally preferred due to higher burst strength and reduced refrigerant conduit **54** and first end cap **62** deformation under pressure.

[0037] The first header **22** and a second header **30** defining a second cavity **34** are punctured in predetermined spaced intervals axially along each of the headers **22**, **30** to define a plurality of header slots **40** spaced axially along each of the headers **22**, **30**. In the preferred embodiment, the headers **22**, **30** are punctured with a lancing punch to define the header slots **40** to prevent the production of slugs, to provide easier bonding, and to add reinforcement. In additional embodiments, the headers **22**, **30** can be drilled or punched to define the header slots **40**.

[0038] The refrigerant conduit **54** is inserted into the first cavity **28** defined by the first header **22**. The refrigerant conduit **54** is generally positioned with one end of the refrigerant conduit **54** abutting the first end cap **62** engaged to the first header end portion **26**.

[0039] The method preferably includes the step of producing a plurality of support projections **58** spaced from one another and aligned in two rows on the first header **22** and extending into the first cavity **28** to contact the conduit body

portion **80** of the refrigerant conduit **54** for positioning the refrigerant conduit **54**. In alternative embodiments of the method, the support projections **58** are produced extending into the first cavity **28** and along the first header axis A_1 . In further embodiments of the assembly **20**, the method includes the step of engaging a plurality of clips **60** to the refrigerant conduit **54** before inserting the refrigerant conduit **54** into the first cavity **28** in addition to, or in lieu of, the step of producing a plurality of support projections **58**.

[0040] A first aperture **64** defined by the other of the pair of first end caps **62** is placed about the conduit end portion **82** of the refrigerant conduit **54**. The other of the pair of first end caps **62** is engaged to the other of the pair of first header end portions **26** of the first header **22** to seal the first header **22** about the other of the first header end portions **26**. The other of the pair of first end caps **62** can be an internal or external end cap. The method also includes the step of engaging the first aperture **64** of the other of the pair of first end caps **62** to the conduit end portion **82** to seal the other of the pair of first end caps **62** about the conduit end portion **82**. In an alternate embodiment of the assembly **20**, the other of the pair of first end caps **62** and the refrigerant conduit **54** are combined into a subassembly before inserting the refrigerant conduit **54** into the first cavity **28** defined by the first header **22**. Generally, if the other of the pair of first end caps **62** and the refrigerant conduit **54** are composed of aluminum, it is preferable to assemble the other of the pair of first end caps **62** and the refrigerant conduit **54** before inserting the refrigerant conduit **54** into the first cavity **28** defined by the first header **22** so that all joints are formed in the brazing operation. In alternative embodiments of the assembly **20**, wherein either the other of the pair of first end caps **62** or the refrigerant conduit **54** are composed of copper, the assembly **20** is preferably brazed before engaging the other of the pair of first end caps **62** and the refrigerant conduit **54**. A subsequent joining operation must then be used to join the copper parts to the assembly.

[0041] In an embodiment of the method, an encapsulant **78** is disposed about the other of the pair of first end caps **62** and about the conduit end portion **82** for shielding the other of the pair of first end caps **62** and the conduit end portion **82** from corrosion.

[0042] The first header **22** and the second header **30** are placed in a stacker headering station fixture and a plurality of cooling fins **52** are interleaved between a plurality of refrigerant tubes **42** to define a fin matrix. The cooling fins **52** can be serpentine fins or any other cooling fins commonly known in the art. The method also preferably includes the step of disposing a pair of core reinforcements **50** outwards of the fin matrix to define a core assembly. The core reinforcements **50** protect the cooling fins **52** and provide structural support. The core assembly **20** is transferred to the stacker headering station and the headers **22**, **30** are pressed onto the cooling fin **52** and refrigerant tube **42** matrix with the refrigerant tubes **42** preferably extending through the header slots **40** defined by the headers **22**, **30**.

[0043] The method includes the step of furnace brazing the headers **22**, **30** and core assembly **20**. The core reinforcements **50** and the refrigerant tubes **42** are brazed to the headers **22**, **30** and the cooling fins **52** are brazed to the core reinforcements **50** and the refrigerant tubes **42**. In various embodiments of the method of fabricating a heat exchanger assembly **20**, the elements of the heat exchanger assembly **20** may consist of different materials depending upon the requirements of the heat exchanger assembly **20**. For brazed joints, it

is preferred to have an aluminum element over a copper element so that the aluminum will shrink into the copper as the joint cools due to its higher coefficient of thermal expansion. However, an aluminum to copper joint generally must be protected to provide corrosion shielding. This is best done in a controlled heat exchanger manufacturing process, as opposed to the variable environment associated with field installation. Alternatively, the typical brazing temperature of a copper to copper joint is significantly higher than the brazing temperature of a copper to aluminum joint. This protects a pre-brazed copper to copper sub-assembly joint during brazing of a copper to aluminum joint.

[0044] The method is distinguished by offsetting the conduit end portion 82 from the conduit body portion 80 before the inserting the refrigerant conduit 54 into the first cavity 28 step. The offset can be produced by forming the refrigerant conduit 54 or by any other method known in the art.

[0045] The method is further distinguished by the steps of positioning the conduit body portion 80 between the first header end portions 26 and in engagement with the interior surface 24 of the first header 22 and parallel to and offset from the first header axis A_1 after said inserting the refrigerant conduit 54 into the first cavity 28 step for spacing the conduit body portion 80 from the refrigerant tubes 42 and positioning the conduit end portion 82 coaxially along the first header axis A_1 in one of the first header end portions 26 after said inserting the refrigerant conduit 54 into the first cavity 28 step for providing a central opening for the refrigerant.

[0046] 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 for dissipating heat comprising:

- a first header extending along a first header axis between a pair of first header end portions to define a first cavity;
- a second header extending along a second header axis between a pair of second header end portions to define a second cavity;
- each header defining a plurality of header slots;
- a plurality of refrigerant tubes each extending between said headers from one of said header slots of each header;
- each of said refrigerant tubes defining a refrigerant passage being in fluid communication with said cavities for transferring refrigerant from one of said cavities to the other of said cavities;
- a refrigerant conduit disposed in said first cavity and extending along said first header axis;
- said refrigerant conduit including a plurality of orifices in fluid communication with said first cavity; and
- said refrigerant conduit including a conduit body portion and at least one conduit end portion interconnected by a conduit transition portion with said conduit body portion being offset from said conduit end portion in said first cavity for spacing said conduit body portion from said

refrigerant tubes and for positioning said conduit end portion centrally in said first cavity in one of said first header end portions.

2. The assembly as set forth in claim 1 wherein said first header has an interior surface and said conduit body portion is engaged to said interior surface of said first header.

3. The assembly as set forth in claim 1 wherein said conduit end portion extends coaxially along said first header axis.

4. The assembly as set forth in claim 1 wherein said conduit body portion and said conduit transition portion extend between said first header end portions and said conduit end portion is disposed in one of said first header end portions.

5. The assembly as set forth in claim 1 including a pair first end caps each engaged and hermetically sealed to one of said first header end portions wherein at least one of said first end caps defines a first aperture being engaged and hermetically sealed about said conduit end portion.

6. The assembly as set forth in claim 5 wherein at least one of said first end caps is ring shaped and disposed circumferentially about said first header axis in said first cavity in one of said first header end portions to define said first aperture.

7. The assembly as set forth in claim 5 wherein;

at least one of said first end caps includes a header engaging portion and a conduit engaging portion interconnected by an end cap transition portion to define said first aperture;

said header engaging portion extends along one of said first header end portions and said first header axis and is engaged and hermetically sealed to said corresponding first header end portion;

said conduit engaging portion extends about and along said conduit end portion of said refrigerant conduit and is engaged and hermetically sealed about said conduit end portion; and

said end cap transition portion is disposed circumferentially about said first header axis and extends radially about said first header axis.

8. The assembly as set forth in claim 7 wherein said header engaging portion is engaged and hermetically sealed about said first header end portion.

9. The assembly as set forth in claim 7 wherein said first header has an interior surface and said header engaging portion is disposed in said first cavity and engaged and hermetically sealed to said interior surface of said first header.

10. The assembly as set forth in claim 7 wherein said conduit engaging portion extends along said first header axis from said end cap transition portion and away from said conduit body portion.

11. The assembly as set forth in claim 7 wherein said conduit engaging portion extends along said first header axis from said end cap transition portion and toward said conduit body portion.

12. The assembly as set forth in claim 7 wherein said end cap transition portion is tapered.

13. The assembly as set forth in claim 5 wherein said conduit body portion is engaged and hermetically sealed to one of said first end caps for sealing said refrigerant conduit about said corresponding first end cap.

14. The assembly as set forth in claim 1 including a plug disposed in and engaged and hermetically sealed to said conduit body portion of said refrigerant conduit for sealing said refrigerant conduit about said plug.

15. The assembly as set forth in claim 1 including a plurality of support projections extending into said first cavity

and engaging said refrigerant conduit for positioning said refrigerant conduit in said first cavity.

16. The assembly as set forth in claim **15** wherein said support projections are spaced from one another and aligned in two rows each parallel to said first header axis.

17. The assembly as set forth in claim **1** wherein said first header has an interior surface and including at least one clip disposed in said first cavity and engaging said interior surface of said first header and said refrigerant conduit for positioning said refrigerant conduit in said first cavity.

18. The assembly as set forth in claim **1** wherein;
each header includes a lanced surface extending parallel to said corresponding header axis between said corresponding header end portions,
each lanced surface includes a plurality of truncated projections extending into said corresponding cavity and being axially spaced from one another between said corresponding header end portions to define valleys between adjacent truncated projections, and
each truncated projection defines said header slots as being elongated and extending transversely to said header axis.

19. A method for fabricating a heat exchanger assembly comprising the steps of:

cutting a tube to define a refrigerant conduit having a conduit body portion and a conduit end portion interconnected by a conduit transition portion;
producing a plurality of orifices in the conduit body portion of the refrigerant conduit;
puncturing a first header having an interior surface and defining a first cavity and extending along a first header axis between a pair of first header end portions and a second header defining a second cavity and extending between a pair of second header end portions in predetermined spaced intervals axially along each of the headers to define a plurality of header slots spaced axially along each of the headers;
inserting the refrigerant conduit into the first cavity of the first header;
placing the first header and the second header in a stacker headering station fixture;

pressing the headers onto a plurality of refrigerant tubes with each refrigerant tube extending from one of the header slots of each header and being spaced from the conduit body portion of the refrigerant conduit; and offsetting the conduit end portion from the conduit body portion before said inserting the refrigerant conduit into the first cavity step.

20. The method as set forth in claim **19** including the step of positioning the conduit body portion between the first header end portions and in engagement with the interior surface of the first header and parallel to and offset from the first header axis after said inserting the refrigerant conduit into the first cavity step.

21. The method as set forth in claim **19** including the step of positioning the conduit end portion coaxially along the first header axis in one of the first header end portions after said inserting the refrigerant conduit into the first cavity step.

22. The method as set forth in claim **19** including the step of producing a plurality of support projections spaced from one another and aligned in two rows on the first header and extending into the first cavity to contact the conduit body portion of the refrigerant conduit for positioning the refrigerant conduit in the first cavity.

23. The method as set forth in claim **19** including the steps of;

engaging a first end cap to each of the first header end portions of the first header to seal the first header about the first header end portions;
aligning the conduit end portion of the refrigerant conduit with a first aperture defined by one of the first end caps; and
engaging the first aperture about the conduit end portion of the refrigerant conduit to seal the corresponding first end cap about the conduit end portion.

24. The method as set forth in claim **23** including the step of engaging the conduit body portion of the refrigerant conduit to one of the first end caps to seal an end of the refrigerant conduit.

25. The method as set forth in claim **19** including the step of inserting a plug into the conduit body portion of the refrigerant conduit to seal an end of the refrigerant conduit.

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