HEAT EXCHANGER HAVING SNAP-ON BRACKET

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ABSTRACT

A heat exchanger includes a pair of manifolds, each of which has a plurality of axially spaced oblong slots, and each of which has at least two detents formed therein. A plurality of generally flat tubes extends between the manifolds and individually through the slots for providing fluid communication between the manifolds. A plurality of radiation fins extends between adjacent flat tubes. A plurality of brackets is provided for mounting the heat exchanger. Each of the brackets comprises a first member and a second member, and each of the first member and the second member including a curved portion and a flange portion. Each curved portion extends circumferentially around a portion of manifold and captures the manifold therein. Each curved portion has at least one protrusion which extends into one of the detents in the manifold. The flange portion connected to the curved portion. The flange portion of the first member and the flange portion of the second member are mechanically secured together to form a flange for mounting the heat exchanger.
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CROSS REFERENCE TO RELATED APPLICATION

[0001] This application is a continuation in part of application Ser. No. 09/020,448, filed Feb. 9, 1998.

BACKGROUND OF THE INVENTION

[0002] 1. Field of the Invention

[0003] This invention relates to a heat exchanger for use as a condenser or evaporator for an air conditioner, a radiator or a heater core for a motor vehicle or to other types of heat exchangers, and more particularly to the fabrication or manufacture of the brackets used to mount the heat exchanger.

[0004] 2. Description of the Prior Art

[0005] Heat exchangers generally include two cylindrical headers or manifolds which introduce a cooling medium into tubes and discharge it after it has circulated through the tubes. Heat exchangers of this type are used in automotive vehicles for several purposes, such as a radiator for cooling the engine and as a condenser for an air-conditioning coolant. The manifolds have often been formed each from a length of prefabricated pipe or from an extrusion. Alternatively, the manifolds can be made from a flat sheet of material and formed into a tubular shape in a progressive die operation using an interlocking side edge to hold the manifold together, as disclosed in patent application Ser. No. 09/020,448, of which this application is a continuation in part. The manifolds are finished to incorporate a plurality of spaced slots along one side for connection to the cooling tubes. These manifolds also have end caps on each end and connections for the introduction of the cooling medium. After assembly of the heat exchanger components, the assembly is usually brazed in an oven to join the elements together as assembled and provide a sealed vessel for the cooling medium.

[0006] Part of the heat exchanger design also involves a plurality of brackets which are secured to the heat exchanger at various locations. Each of the brackets usually has a flange which is used to mount the heat exchanger in place in its final application. Providing an inexpensive yet secure bracket has been a challenge in the design of heat exchangers, and several prior art designs have been proposed.

[0007] U.S. Pat. No. 5,205,349, issued to Nagao et al., shows several bracket designs, including one with a twolayer flange and some with engagement projections which help hold the flange to the manifold. However, many of these designs do not provide a means for accurately positioning the bracket longitudinally along the manifold. One design which does provide for longitudinal positioning of the bracket on the manifold requires large rectangular projections which must be first secured to the manifold before the bracket is installed. This does not provide for flexibility in easily re-positioning the bracket if such re-positioning is needed.

[0008] U.S. Pat. No. 5,069,275, issued to Suzuki et al., shows a bracket which includes a single projecting lug which engages a corresponding locking aperture on the manifold. However, the bracket does not otherwise snap around the manifold in any way, but relies solely upon a separate hooking portion which engages the cooling tubes.

[0009] None of the prior art designs provides the combination of a secure mounting of the bracket to the manifold and the capability of re-positioning the bracket longitudinally as needed, as well as providing a bracket which can snap onto the manifold during final assembly of the heat exchanger.

SUMMARY OF THE INVENTION

[0010] The present invention overcomes the disadvantages of the prior art and provides a heat exchanger having a unique snap-on bracket which simplifies the design and fabrication of heat exchangers. In accordance with the present invention, the bracket is formed of a two-piece design which includes a two-piece flange portion providing a spring-like action to the curved portions of the bracket which engage the manifold, allowing the bracket to easily snap onto the manifold at the desired location. The bracket further has at least two protrusions on the curved portions which engage corresponding detents formed on the exterior of the manifold. The combination of the curved portions that are urged together by the spring-like action of the flange portions, together with the engagement of the protrusions on the bracket with the detents on the manifold, provides for secure mounting of the bracket onto the manifold prior to brazing.

[0011] The preferred bracket is made of a flat brazing sheet. From this sheet, the two bracket members are formed, each of which has a flange portion and a curved portion. The two flange portions are mechanically attached together, preferably by the formation of tabs on the periphery of the flange portion of one of the members which tabs are cammed or coined over the edges of the flange portion of the other member to hold the members together. Each of the flange portions is connected to one of the curved portions, but the curved portions are not otherwise held together. This allows the curved portions to flexibly widen when the flange is snapped into place on the manifold. The curved portions are then urged back together by the spring-like action of the flange portions to help secure the flange in place. The securement of the bracket is enhanced by the engagement of the protrusions on the curved portions of the bracket with the detents on the exterior of the manifold, providing a more secure mounting of the of the brackets on the manifold than would be provided by either the resilient curved portions or the protrusions alone.

[0012] The present invention thus provides a unique combination of features not present in the prior art and which together provide a heat exchanger having a brackets which is easier to assemble and more flexible in design than those of the prior art.

[0013] These and other advantages are provided by the present invention a heat exchanger comprising a pair of manifolds, a plurality of generally flat tubes, a plurality of radiation fins, and a plurality of brackets. Each of the manifolds has a plurality of axially spaced oblong slots, and each of the manifolds has at least two detents formed therein. The plurality of generally flat tubes extends between the manifolds and individually through the slots for providing fluid communication between the manifolds. The plurality of radiation fins extends between adjacent flat tubes.
The plurality of brackets is for mounting the heat exchanger. Each of the brackets comprises a first member and a second member. Each of the first member and the second member includes a curved portion and a flange portion. Each curved portion extends circumferentially around a portion of manifold and captures the manifold therein. Each curved portion has at least one protrusion which extends into one of the detents in the manifold. The flange portion connected to the curved portion. The flange portion of the first member and the flange portion of the second member are mechanically secured together to form a flange for mounting the heat exchanger.

**BRIEF DESCRIPTION OF THE DRAWINGS**

**[0014]** FIG. 1 is a perspective view of a heat exchanger according to the present invention.

**[0015]** FIG. 2 is a perspective view of a portion of the heat exchanger of FIG. 1 showing the brackets removed.

**[0016]** FIG. 3 is an elevational view of one of the manifolds of the heat exchanger of FIG. 1.

**[0017]** FIG. 4 is another elevational view of the manifold taken along line 4-4 of FIG. 2.

**[0018]** FIG. 5 is an end sectional view of a portion of the manifold of FIGS. 3 and 4 showing one of the baffles or end caps.

**[0019]** FIG. 6 is a side elevational view of the baffle or end cap taken along line 6-6 of FIG. 5.

**[0020]** FIG. 7 is a sectional view of the baffle or end cap taken along line 7-7 of FIG. 5.

**[0021]** FIG. 8 is a detailed enlarged view of a portion of FIG. 7 showing the groove on the baffle or end cap.

**[0022]** FIG. 9 is a side elevational view of a portion of the assembled manifold showing the bracket of the present invention.

**[0023]** FIG. 10 is an end sectional view taken along line 10-10 of FIG. 9.

**[0024]** FIG. 11 is an end elevational view of the bracket similar to FIG. 10 showing the two bracket members separated.

**[0025]** FIG. 12 is a perspective view of the bracket of FIGS. 9 and 10.

**[0026]** FIG. 13 is a sectional view taken along line 13-13 of FIG. 10.

**[0027]** FIG. 14 is an elevational view of a sheet used to form the manifold of FIG. 3 and 4.

**[0028]** FIG. 15 is a perspective view of the sheet of FIG. 14 partially formed into the manifold.

**DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT**

**[0029]** Referring more particularly to the drawings and initially to FIG. 1, there is shown a heat exchanger 10 according to the present invention. The preferred heat exchanger may be, for example, a condenser used in the air-conditioning system of an automobile, truck or other similar motor vehicle. The heat exchanger 10 includes a pair of manifolds 11 extending parallel to each other, with a plurality of cooling tubes 12 disposed between the manifolds and connected at each end to the manifolds. The manifolds 11 have a connection (not shown) for the introduction of a cooling medium into the heat exchanger. A plurality of radiation fins 13 is provided on the sides of the tubes 12, and a pair of reinforcement members 14 may be provided on the top and bottom of the radiation fins. The heat exchanger 10 is mounted in the vehicle or other location by means of brackets 15. As shown in FIG. 2, the brackets 15 are removable from each of the manifolds 11, and can be placed on the manifolds after assembly of the other members. The brackets 15 will be described in more detail below.

**[0030]** The manifold 11 is shown in more detail in FIGS. 3 and 4. The manifold 11 comprises a metal sheet formed into a tubular form with its sides joined together in a seam 19 to form a manifold tube. The seam 19 is generally zig-zag in shape because it is formed by a mechanical interlock which will be explained in detail below. A cap 20a is located on each end of the manifold 11 to enclose the manifold. The tube has a plurality of slots 21 along one side for connection to cooling tubes 12. A plurality of holes 22 are provided along the opposite side for the connection of a fitting which is used to introduce the cooling medium into the manifold, and a plurality of baffles 20b are mounted inside the manifold to divide the manifold into chambers to equalize the flow of cooling medium through the manifold.

**[0031]** The end caps 20a and the baffles 20b may be substantially identical, and are preferably of the construction of the baffle member 20 shown in FIGS. 4-7. The baffle member 20 includes a generally cup shaped with outer side portions 27 and an end portion 28. The outer side portions 27 of the baffle member are intended to fit circumferentially along the inside surface of the manifold 11, and the end portion 28 is intended to extend radially across the inside of the manifold to block the flow of the medium in the manifold. At one end of the side portions 27 is an outer rim 29 which also fits against the inside surface of the manifold 11. The outer rim 29 is preferably provided with a series of raised portions 30 which in between define recesses or channels 31 around the outer surface of the rim and extending parallel to the longitudinal axis of the tubular manifold. The channels 31 provide a path for flow to flow past the position of the baffle position during the brazing process. A groove 32 extends circumferentially around the baffle side portions 27 adjacent to the outer rim 29. The central portion of the end portion 28 is concave in shape when viewed from end of the baffle member opposite the rim 29 (when viewed from the right side as shown in FIGS. 6 and 7).

**[0032]** When the baffle member 20 is installed in the manifold, and especially when it is used as one of the end caps 20a, the concave end portion 28 assists in holding the baffle or end cap in place. When placed on the end of tubular manifold 11 with the concave end portion 28 facing the inside of the manifold, the pressure of the medium inside the manifold presses against the concave end portion 28, tending to increase the concavity which, in turn, causes the side portions 27 of the end cap to deform radially inwardly. Thus the pressure of the medium in the manifold is used to apply further force by the sides of the end cap upon the interior sidewalls of the manifold, helping the secure the end cap in place.
The groove 32 is used to locate and mount the baffle members 20 in place in the assembly process. When the baffle member 20 is used as one of the baffles 20b inside the manifold 11, it may be difficult to identify the location of the baffle and assure that it is properly located prior to brazing. During the assembly process, as will be explained more fully below, one or more crimps 35 may be placed in the outside of the manifold 11 at the position of the baffle 20b, and the crimps 35 will deform the manifold slightly to force a portion of the inside surface of the manifold into a portion of the groove 32. This serves to hold the baffle 20b in place during subsequent assembly and processing until the brazing operation is performed to secure the baffle. It also provides a visual indication on the outside of the manifold 11 of the position of the baffle 20b, which would otherwise be impossible to locate because it is completely hidden after the manifold has been assembled.

An example of one of the brackets 15 are shown in more detail in FIGS. 9-13. The bracket 15 is comprised of a first member 40 and a second member 41. The first bracket member 40, shown in the right in FIG. 10, includes a curved portion 42 which extends circumferentially around a portion of the outside of the manifold 11 to a leading edge 42a, and a flange portion 43 which is substantially flat and extends from the curved portion in a generally outwardly radial direction relative to the manifold. The second bracket member 41, shown on the left in FIG. 10, also has a curved portion 44 which extends circumferentially around a portion of the outside of the manifold 11 to a leading edge 44a, and a flange portion 45 which is substantially flat and extends from the curved portion in a generally outwardly radial direction relative to the manifold. The curved portions each have ribs 46 extending circumferentially along the curved portions to provide structural support to the bracket 15.

The flange portions 43 and 45 are generally flat and extend in juxtaposition with each other to form together the mounting flange of the bracket 15. Concentric holes 47 and 48 are pierced in each of the flange portions for using the bracket 15 to mount the heat exchanger, such as by nut and bolt, or other suitable fastener. The holes 47 and 48 may be circular or oblong or any other desired shape. The flange portions 43 and 45 are affixed to each other, preferably by a mechanical interlock formed by the tabs 49 which are formed around the periphery of the flange portion 43. As shown in FIG. 12, the tabs 49 are coined over the periphery of the flange portion 45 of the second bracket member 41 to secure the flange portions 43 and 45 together, and thus secure the bracket members 40 and 41. Despite the fact that the flange portions are secured together, they are two separate members and are capable of a certain amount of movement relative to each other, so that they are capable of parting a small amount, particularly at the ends adjacent to the curved portions 42 and 44 to allow the bracket to be snapped into place onto the manifold.

As shown in FIGS. 10-12, the first bracket member 40 has at least one and preferably two protrusions 51 extending inwardly on the curved portion 42. The protrusions 51 are preferably located in the corners of the curved portion 42 spaced apart along the longitudinal axis of the manifold and near the leading edge 42a. The second bracket member 41 also has a protrusion 52 extending inwardly on the curved portion 44. The protrusion 52 is preferably located centrally along with width of the curved portion 44 but adjacent to the leading edge 44a. As shown in FIG. 2, corresponding holes or detents 53 are formed or punched on the manifold 11 at the desired position of the bracket 15. The detents 53 correspond to the position of the protrusions 51 and 52 on the bracket members 40 and 41. When the bracket 15 is mounted onto the manifold 11, the protrusions 51 and 52 are positioned in the corresponding detents 53 formed on the exterior side of the manifold 11. The correspondence of the protrusions 51 and 52 the corresponding hole or detent 53 in the manifold provides a means by which the bracket 15 is held in position on the manifold 11 during the initial assembly of the heat exchanger.

While the bracket 15 shown in FIGS. 10 and 11 includes curved portions 42 and 44 in which the curved portion 44 is more circumferentially extensive than the curved portion 42, the curved portions 42 and 44 can be made equally circumferentially extensive (so that the flange portions 43 and 45 extend radially from the manifold 11) or the curved portion 42 can be made more circumferentially extensive than the curved portion 44. The circumferential extent of each of the curved portions 42 and 44, and thus the location at which the flange portions 43 and 45 extend from the manifold 11, can be appropriately modified as necessary depending upon the mounting arrangement for the heat exchanger. However, the curved portions 42 and 44 together should define a circular cross section so that the manifold 11 is effectively captured between the curved portions and the manifold is held in place when the bracket is snapped in place on the manifold. In the preferred embodiment shown, the leading edges 42a and 44a each extend 7.5° beyond the plane which is perpendicular to the flange portions and which bisects the manifold, so that the inclusive angle between the leading edge 42a and the leading edge 44a relative to the central axis of the manifold is 195°, and this angle is more than 180°. Since the curved portions of the bracket do not extend much further than 180° around the outside circumference of the manifold, the brackets do not come close to the tubes 12 extending from the slots 21 on the other side of the manifold, and there is no problem of the bracket 15 providing an undesirable heat sink for the heat from the tubes 12 and fins 13 assembly process until it is securely fixed together by the subsequent brazing process.

The outwardly projecting end of the flange portion 43 may be bent to extend orthogonally to provide a perpendicular portion which is used to position the heat exchanger when the bracket 15 is used to mount the heat exchanger or to provide an additional mounting flange extending in the perpendicular direction. The perpendicular portion may be formed with a pair of wings, one extending from each side of the perpendicular portion and extending to the flange portion 43 to support the perpendicular portion when the bracket portion is assembled. The perpendicular portion may include an additional hole which also can be used to mount the heat exchanger. The perpendicular flange portion may be perpendicular or the entire flange can be made straight as with the bracket 15 or in any other desirable shape as required for the mounting of the heat exchanger.

As previously mentioned, the manifold 11 is made of a formed sheet material, the sides of the sheet are joined together at the seam 19 by an interlocking formation which will be explained in more detail with reference to the assembly of the manifold.
[0040] In making the heat exchanger assembly of the present invention, a brazing sheet 61 is prepared from an aluminum core sheet with a brazing substance on at least one surface. The sheet 61 is then formed into the manifold 11, preferably using a progressive die operation. The sheet 61 is first stamped or otherwise formed into the configuration shown in FIG. 15 in which a series of tabs and recesses is stamped on each side of the sheet. The detents 53 are preferably formed in sheet 61 at this time. Preferably, locator tabs 64 and 65 are also stamped on each end of the sheet 61 to provide a carrier for pilot holes which assist in locating the sheet at each station in the progressive die operation. The tabs and recesses on the sides of the sheet 61 form the interlocking formation which provides a mechanism which holds the sides of the sheet together to form the tubular manifold. The tabs include a plurality of positioning tabs 66 on one side of the sheet 61 (on the left side as shown in FIG. 15) which engage corresponding positioning recesses 67 on the other side of the sheet (on the right side as shown in FIG. 15). Between the positioning tabs 66 on the first side of the sheet 61 are two interlocking tabs 68 and 69 defined and separated by recesses 70, 71 and 72. On the opposite side of the sheet 61 between the positioning recesses 67 are two corresponding interlocking recesses 73 and 74 defined by tabs 75, 76 and 77. While the interlocking tabs 68 and 69 extend generally perpendicular to the sides of the sheet 61, the corresponding interlocking recesses 73 and 74 extend at an angle relative to the direction of the interlocking tabs 68 and 69. This angle may be between 5° and 45°, and it is preferably about 18°. The angle of the interlocking recesses 73 and 74 causes the interlocking tabs 68 and 69 to be deformed as the tabs are forced into the recesses during the forming operation, causing a secure mechanical attachment between the sides of the sheet, as will be explained in more detail below.

[0041] In a sequential progression of stamping and forming operations, the manifold develops into its tubular shape. First, the sheet 61 is formed into a semi-tubular shape, such that the middle portion 79 of the sheet is curved as shown in FIG. 16. The sheet 61 is then conveyed to a station in the progressive die operation in which the slots 21 are pierced or punched through the sheet. The pilot holes formed in the locator tabs 64 and 65 are used to assist in positioning the sheet at this station so that the slots are punched through the sheet at the precise desired locations. The slots 21 are formed with the middle portion 79 of the sheet already in a curved condition which approximates the final curved shape for the portion of the sheet. As a result, the slots 21 are formed with their side walls at the proper angle for the insertion of the ends of the tubes 12 into the finished tubular manifold. If the slots 21 were pierced or punched while the sheet 61 was entirely flat, the subsequent tubular forming operation would cause the shape of the slots to deform, making it more difficult to insert the tubes during the assembly operation. Also, the slots 21 are punched through the material from the inside of the manifold toward the outside, so that any residual material from the punching operation is formed on the outside of the manifold, not on the inside where it could contaminate the cooling medium and degrade the performance of the heat exchanger.

[0042] After punching the slots 21, the sheet is further formed into its finished tubular shape. As the sheet is formed in this second forming operation, the sides of the sheet come together in a circumferential direction, and the positioning tabs 66 engage the positioning recesses 67 so that the other tabs and recesses are properly oriented with respect to each other. As the sides of the sheet come together, the interlocking tabs 68 and 69 are forced into the angled interlocking recesses 73 and 74. As the interlocking tabs 68 and 69 engage the interlocking recesses 73 and 74, each interlocking tab is forced to deform to fit the angle of the interlocking recess. Since the interlocking tabs 68 and 69 are much narrower than the tabs 75, 76 and 77 on the opposite side of the sheet which form the interlocking recesses 73 and 74, the interlocking tabs 68 and 69 will deform before the tabs 75, 76 and 77 deform, and the interlocking tabs 68 and 69 are forced to assume the shape of the interlocking recess 73 and 74 into which they drive. Once the interlocking tabs 68 and 69 are so deformed, each pair of tabs is pinched together, and they are incapable of removal from the interlocking recesses 73 and 74 in the circumferential direction. A secure interlocking engagement is formed between the sides of the sheet, and the resulting tubular shape is secure from being forced part even at relatively high pressures.

[0043] It is noted that this interlocking operation occurs as the tabs and recesses on the sides of the sheet approach each other in the circumferential direction. No deformation of the sheet 61 in the radial direction is required in order to engage the interlocking mechanism. In this manner the interlocking mechanism can be put together in a conventional progressive die operation without the need for a more complicated deformation of the sheet material which would be commercially unfeasible. Furthermore, since the tabs are deformed by the interlocking operation, they are less likely to come apart when exposed to high pressures.

[0044] After the manifold 11 has been formed, the baffles 206 are inserted into the tubular manifold and located at their desired positions. Then crimps 35 are formed on the outside of the manifold 11 at the location of the baffle groove 32 to hold the baffle 206 in place and to provide a visual indication of the presence and position of the baffle. The end caps 20a are then attached at each end of the manifold 11 in a similar manner.

[0045] The brackets 15 are formed in two pieces as previously discussed. Each bracket member 40 and 41 is made of a brazing sheet, comprising a core aluminum sheet with brazing substance on one side. The sheet is then stamped and formed into the two bracket members 40 and 41, preferably using a progressive die operation. The bracket members are then secured together by coating the tabs 49 on the first bracket member 40 over the periphery of the flange portion 45 of the second bracket member 41, securing the flange portions 43 and 45 together. The position of the brackets 15 on the manifold 11 is determined by the detents 53 which have already been formed in the exterior surface of the manifold. If the detents 53 have not already been formed, or if the desired location of the brackets 15 has changed, detents can be placed in the manifold 11 with the arrangement of the detents 53 corresponding to the arrangement of the protrusions 51 and 52 on the bracket. The brackets 15 are then snapped in place on the manifold 11 at the preset location, each protrusion 51 or 52 on the bracket member 40 engaging the corresponding detent 53 on the outside of the manifold. If it is desired to change the location of the brackets 15 prior to brazing, for example to accommodate a different mounting arrangement for the heat exchanger, the brackets can be easily removed from the manifold, and new detents can be formed at the new position on the manifold, and the brackets can then be easily reattached at the new position.
The bracket flange is thus formed of two pieces, that is, the flange portions 43 and 45 of the two bracket members 40 and 41, and this two piece bracket flange configuration assists in allowing the bracket to be snapped into place on the manifold 11 and to be removed from the manifold prior to brazing. Since each bracket member 40 and 41 comprises a flange portion 43 or 45 and a curved portion 42 or 44, and since the two flange portions are connected to each other, a spring-like action is provided to the two curved portions. This spring-like action allows the distance between the leading edges 42a and 44a to widen as the bracket is snapped into place, allowing the bracket 15 to be installed on the manifold. Further, the spring-like action forces the distance between the leading edges 42a and 44a to return to its original configuration after the bracket is in place on the manifold with the protrusions located within the detents. With the bracket in place the spring-like action of the curved portions imparted by the two-piece flange, along with the positioning of the protrusions in the detents assures that the bracket is securely held in place at the desired location on the manifold. However, since the curved portions can be opened slightly in opposition to the spring-like action, the bracket can be removed from the manifold, if desired, prior to brazing.

The remainder of the heat exchanger is then assembled in a conventional manner. The ends of the tubes 12 are inserted into the slots 21 of the manifold 11, and corrugated fins 13 may be sandwiched between the tubes. Suitable connections are attached to the manifolds 11 using the holes 22 provided for that purpose.

Other variations and modifications of the specific embodiments herein shown and described will be apparent to those skilled in the art, all within the intended spirit and scope of the invention. While the invention has been shown and described with respect to particular embodiments thereof, these are for the purpose of illustration rather than limitation. Accordingly, the patent is not to be limited in scope and effect to the specific embodiments herein shown and described nor in any other way that is inconsistent with the extent to which the progress in the art has been advanced by the invention.

What is claimed is:

1. A heat exchanger comprising:
   a pair of manifolds, each of the manifolds having a plurality of axially spaced oblong slots, at least one of the manifolds also having at least two detents formed therein;
   a plurality of generally flat tubes extending between the manifolds and individually through the slots for providing fluid communication between the manifolds;
   a plurality of radiation fins extending between adjacent flat tubes; and
   a plurality of brackets for mounting the heat exchanger, each of the brackets comprising a first member and a second member, each of the first member and the second member including
   a curved portion extending circumferentially around a portion of the manifold and capturing the manifold therein, each curved portion having at least one protrusion which extends into one of the detents in the manifold, and
   a flange portion connected to the curved portion, the flange portion of the first member and the flange portion of the second member being mechanically secured together to form a flange for mounting the heat exchanger.

2. A heat exchanger as defined in claim 1, wherein the first member and the second member are mechanically secured to each other by providing tabs on the periphery of one of the members, the tabs being coined over the periphery of the other of the members to hold the members together.

3. A heat exchanger as defined in claim 1, wherein the flange portions of the first and second members are mechanically secured together to provide spring means allowing the curved portions to open to be placed on the manifold and urging the curved portions together to secure the bracket on the manifold with the protrusions located in the detents.

4. A heat exchanger as defined in claim 1, wherein the curved portions of the brackets together extend circumferentially around a portion of the manifold.

5. A heat exchanger as defined in claim 1, wherein at least one of the manifolds comprises a single rectangular brazing sheet having connection portions on each side edge, each of the side edge connection portions including an interlocking formation comprising tabs and recesses, at least some of the tabs deformed as the side.

6. A process of making a heat exchanger, comprising the steps of:
   forming a tubular manifold with slots pierced therein;
   providing a tube for each slot, and inserting the tube into the corresponding slot of the manifold;
   placing fins between adjacent tubes;
   making detents on the exterior of the manifold at the desired position of mounting brackets;
   forming at least one bracket of two members, each of the members including a curved portion and a flange portion, the curved portions extending circumferentially around part of the manifold and capturing the manifold therein, each of the curved portions having at least one protrusion;
   mechanically securing the flange portions of the bracket members together to form a flange for mounting the heat exchanger;
   snapping the bracket onto the manifold at the desired location with the curved portions extending circumferentially around part of the manifold and capturing the manifold therein and the protrusions extending into the detents in the manifold; and
   brazing the manifold, tubes and fins together.

7. A method as defined in claim 6, wherein the bracket members are formed with a spring-like action provided by the flange portions, and the bracket is snapped onto the manifold by widening the curved portions to fit around the manifold and allowing the spring-like action of the flange portions to urge the curved portions back toward each other.

8. A method as defined in claim 7, wherein the bracket is snapped onto the manifold by allowing the spring-like action of the flange portions to urge the protrusions into the detents.