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(54) Joint structure of header tank and connector in heat exchanger, and method of joining thereof

(57) A joint structure of a header tank and a connector in a heat exchanger includes a header tank (1) including a plate wall (1c) formed with a first communication hole (1a). The joint structure includes a block-shaped connector (2) having a second communication hole (2b) positioned to the first communication hole (1a) and joined to the header tank (1). The first communication hole (1a) is smaller than the second communication hole (2b). The first communication hole (1a) has therearound a periphery (1b) caulked and fixed on an inner peripheral surface of the second communication hole (2a) by burring formation.

FIG.1A

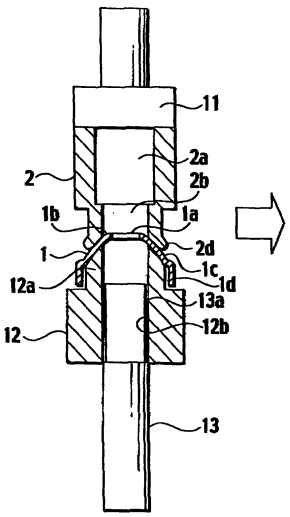


FIG.1B

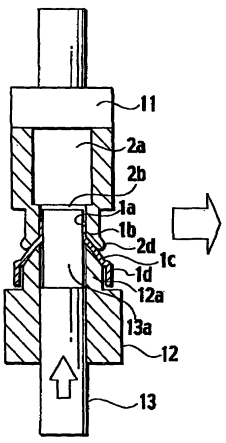
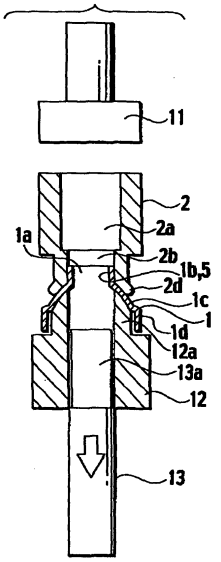


FIG.1C



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Description

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application is based upon and claims the benefit of priority from Japanese Patent Application No. 2004-303250 filed on October 18, 2004; the entire contents of which are incorporated herein by reference.

BACKGROUND OF THE INVENTION

[0002] The invention relates to a joint structure of a header tank and a connector in a heat exchanger, and a method of joining thereof.

[0003] Ordinary heat exchangers have a plurality of tubes in which fluid flows, fins arranged between the tubes, and header tanks for distribution and confluence joined at both ends of the tubes. The header tank is joined with a block-shaped connector for external pipe connection. Joining of the header tank and the connector is generally performed by brazing simultaneously when the tubes, fins, and the header tanks are brazed together.

[0004] When the header tank and the connector are brazed, they must be placed in a brazing furnace in such a state that they have been positioned and temporarily fixed in advance. In the related art, such a method is adopted that positioning and temporary fixing are performed utilizing a positioning unit provided, or positioning and temporary fixing is conducted by welding (for example, see Japanese Patent Applications Laid-open Nos. H6-229696 and H10-238987).

SUMMARY OF THE INVENTION

[0005] The positioning and temporary fixing method according to the related art, however, requires a complicated structure or takes man-hours, or it is difficult to conduct reliable positioning and temporary fixing, which may cause variations of the positioning and temporary fixing and further increases in cost.

[0006] The invention is directed to provide a joint structure of a header tank and a connector in a heat exchanger and a joining method thereof, which allows reliable positioning and temporary fixing with a simple constitution and allows constant-quality brazing at a low cost.

[0007] The first aspect of the invention provides a joint structure of a header tank and a connector in a heat exchanger. The joint structure includes a header tank (1) including a plate wall (1c) formed with a first communication hole (1a). The joint structure includes a block-shaped connector (2) having a second communication hole (2b) positioned to the first communication hole (1a) and joined to the header tank (1). The first communication hole (1a) is smaller than the second communication hole (2b). The first communication hole (1a) has therearound a periphery (1b) caulked and fixed on an inner peripheral surface of the second communication hole (2a) by burring formation.

[0008] The header tank (1) and the connector (2) caulked and fixed on each other by burring formation may be brazed to each other.

[0009] The connector (2) includes a first portion (2d) diverged in a concave form. The joint structure further includes a header-tank backup member (12) mating with the connector and having a second portion (12a) converged in a convex form. The diverged first portion and the converged second portion hold the plate wall (1c) therebetween.

[0010] The second aspect of the invention provides a method of joining a header tank and a connector in a heat exchanger. The method includes the step of forming, on a plate wall (1c) of a header tank (1) of a heat exchanger, a first communication hole (1a) smaller than a second communication hole (2b) of a block-shaped connector (2). The method includes the step of positioning the first and second communication holes (1a; 2b) to each other. The method includes the step of inserting a punch (13a) into the header tank (1) to burring form a periphery (1b) around the first communication hole (1a), with the first and second communication holes positioned to each other. The method includes the step of caulking and fixing the periphery (1b) around the first communication hole (1a) on an inner peripheral surface of the second communication hole (2b) by the punch (13a). The method includes the step of brazing the header tank (1) and the connector (2) caulked and fixed.

[0011] The method may include the step of applying a brazing material on an outer surface of the plate wall (1c) of a header tank (1) before the step of caulking and fixing by burring formation. The method may include the step of brazing the header tank (1) and the connector (2) to each other with the brazing material.

BRIEF DESCRIPTION OF THE ACCOMPANYING DRAWINGS

[0012] Figs. 1A to 1C are step diagrams illustrating a caulking process based upon a burring formation for obtaining a joint structure according to an embodiment of the invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0013] Embodiments of the invention will be described below with reference to the drawings.

[0014] Figs. 1A to 1C are step diagrams illustrating a caulking process based upon a burring formation. In Figs. 1A to 1C, a header tank 1, a connector 2, a connector backup member 11, a header tank backup member 12, a punch rod 13, and a punch 13a are illustrated.

[0015] The header tank 1 is of a two-separate type. Only a tank main unit in which a heat exchange fluid passage is formed is illustrated. The tank main unit is assembled with a header plate (not illustrated) joined to another tube, constituting an actual header tank.

[0016] The header tank 1 has a tubular base 1d extending straight. The header tank 1 has a semi-cylindrical plate wall 1c, and a central portion thereof in a transverse direction has a communication hole 1a communicating with a flow holes 2a and 2b. The semi-cylindrical plate wall 1c has, at the end, an oblique peripheral surface relative to the base 1d. The plate wall 1c extends from the base 1d to be converged. The flow holes 2a and 2b of the connector 2 constitute a stepped hole. The flow holes 2a and 2b have an enlarged diameter portion 2a connected to an external pipe and a reduced diameter portion 2b connected to the communication hole 1a of the header tank 1.

[0017] Prior to brazing, as illustrated in Fig. 1A, the diameter of the communication hole 1a of the header tank 1 is formed smaller than a diameter of the flow hole 2b of the connector 2 in advance. The connector 2 and the header tank 1 are supported by the backup members 11 and 12, respectively. The connector 2 and the plate wall 1c of the header tank 1 are caused to abut against each other, so that the communication hole 1a and the flow hole 2b are positioned to each other.

[0018] At this time, the plate wall 1c of the header tank 1 is supported from inside thereof by the semicircular column portion 12a of the backup member 12 on the side of the header tank 1. The semicircular column portion 12 a as a second portion has, at the end, a periphery converged to conform to the inner surface's shape of the semi-cylindrical plate wall 1c. The end face of the connector 2 is supported by the flat portion of the backup member 11 on the side of the connector 2. The abutting portion 2d of the connector 2 is caused to abut against the outer face of the plate wall 1c of the header tank 1. The abutting portion 2d as a first portion is shaped to conform to the oblique outer surface of the distal end of the plate wall 1c. The abutting portion 2d is diverged to conform to the converged outer surface of the plate wall 1c.

[0019] In this state, as illustrated in Fig. 1B, the punch rod 13 is elevated from inside of the header tank 1, while being guided by a slide hole 12b of the backup member 12. The punch 13a at the distal end of the punch rod 13 burring-forms the periphery 1b around the communication hole 1a formed in the plate wall 1c of the header tank 1. The punch 13a caulks and fixes the periphery 1b (burring portion) of the communication hole 1a on the inner peripheral portion of the flow hole 2b. When caulking is conducted in this manner, the friction between the burring formation portion and the flow hole 2b of the connector 2 establishes fixing force.

[0020] The "burring formation" means that the punch 13a stretches and flanges the periphery 1b around the communication hole 1a. The punch 13a presses the periphery 1b burred against the inner peripheral surface of the flow hole 1b.

[0021] After caulking and fixing, as illustrated in Fig. 1C, the punch 13a moves down, the backup members 11 and 12 are removed, and the header tank 1 with the connector 2 temporarily fixed is transferred to a brazing step. The header tank 1 and the connector 2 are brazed to each other and the both are finally joined to each other, so that the joint structure is completed. During the formation, brazing material may be applied on the outer face of the plate wall 1c of the header tank 1 in advance. After caulking and fixing are performed in this state by the burring formation, the header tank 1 and the connector 2 are brazed to each other by the brazing material. This method establishes brazing with stable quality without supplying brazing material later.

[0022] According to the joint structure produced by the above method, brazing is performed in a state that the header tank 1 and the connector 2 have been positioned and temporarily fixed to each other reliably and firmly, so that products with stable quality are provided. Furthermore, the burring formation is conducted simply without taking man-hours, and the automation may be performed.

[0023] Although the invention has been described above by reference to certain embodiments of the invention, the invention is not limited to the embodiments described above. Modifications and variations of the embodiments described above will occur to those skilled in the art, in light of the above teachings. The scope of the invention is defined with reference to the following claims.

[0024] According to the invention, the first communication hole is smaller than the second communication hole, and the periphery around the first communication hole is burring formed. This method allows the periphery around the first communication hole to be caulking fixed on the inner peripheral surface, thus securely and firmly positioning and temporarily fixing the header tank and the connector to each other. Further, the burring formation allows for secure positioning and temporary fixing with a simple structure without taking man-hours, thus achieving brazing with a constant quality at a lower production cost.

[0025] With the header tank and the connector caulked and fixed by burring formation, the header tank and the connector are brazed to each other, thus securely joining the header tank and the connector to each other.

[0026] A brazing material is applied on the outer surface of the plate wall before the step of caulking and fixing by burring formation, and the header tank and the connector are brazed to each other. This method achieves brazing with a stable quality without feeding a brazing material later.

Claims

1. A joint structure of a header tank and a connector in a heat exchanger comprising:

   a header tank including a plate wall formed with a first communication hole; and

   a block-shaped connector having a second

communication hole positioned to the first communication hole and joined to the header tank,
wherein the first communication hole is smaller than the second communication hole,
wherein the first communication hole has therearound a periphery caulked and fixed on an inner peripheral surface of the second communication hole by burring formation.

2. The joint structure according to claim 1,
wherein the header tank and the connector caulked and fixed on each other by burring formation are brazed to each other.

3. The joint structure according to claim 1,
wherein the connector comprises a first portion diverged in a concave form,
wherein the joint structure further comprises a header-tank backup member mating with the connector and having a second portion converged in a convex form,
wherein the diverged first portion and the converged second portion hold the plate wall therebetween.

4. A method of joining a header tank and a connector in a heat exchanger, comprising:

forming, on a plate wall of a header tank of a heat exchanger, a first communication hole smaller than a second communication hole of a block-shaped connector;
positioning the first and second communication holes to each other;
inserting a punch into the header tank to burring form a periphery around the first communication hole, with the first and second communication holes positioned to each other;
caulking and fixing the periphery around the first communication hole on an inner peripheral surface of the second communication hole by the punch; and
brazing the header tank and the connector caulked and fixed.

5. The method according to claim 4, further comprising:

applying a brazing material on an outer surface of the plate wall of a header tank before the step of caulking and fixing by burring formation; and
brazing the header tank and the connector to each other with the brazing material.

FIG.1C

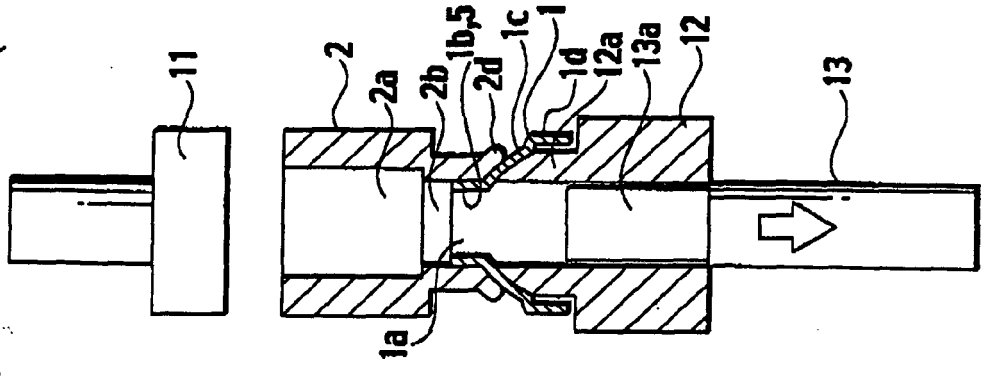


FIG.1B

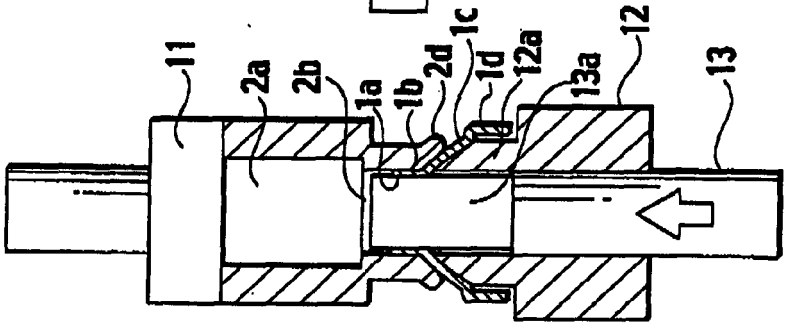
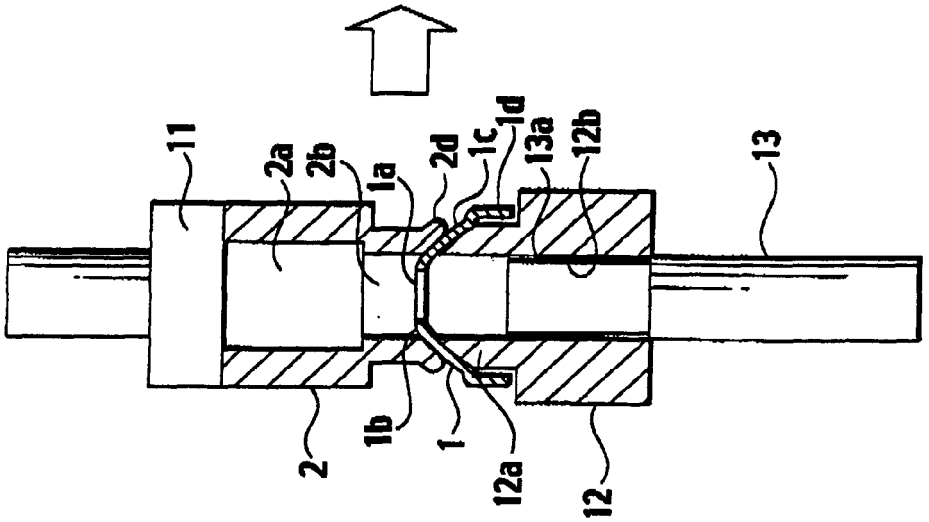


FIG.1A



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Application Number
EP 05 02 2521

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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	23 February 2006	Mellado Ramirez, J

CATEGORY OF CITED DOCUMENTS

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