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Heat Exchanger Tube to Header Plate Joints

Abstract:

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A liquid-to-air heat exchanger comprises a header plate 17, a plurality of liquid coolant tubes 13, each extending into a hole in the header plate, a primary load bearing welded joint 24 between the plate 17 and each tube which may be subject to the formation of leakage openings in the joint in use, and a thin sealant 25 sealing against leakage any leakage openings that may be present or that may occur.

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(54) Heat Exchanger Tube to Header Plate Joints

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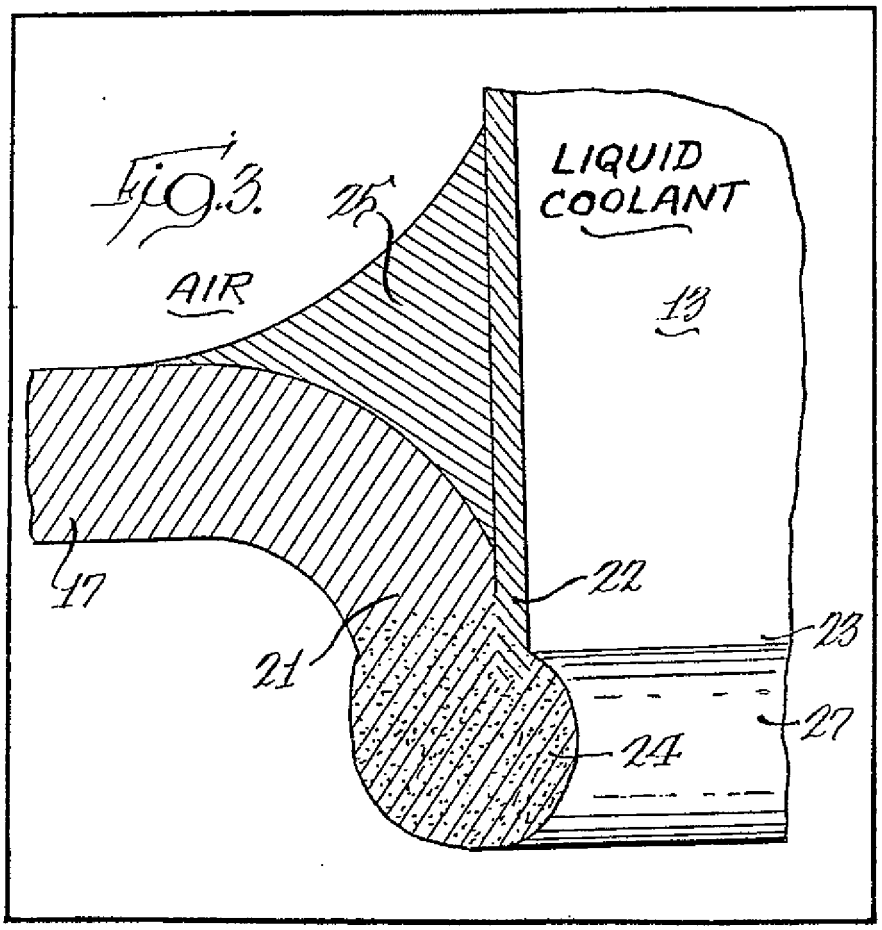

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Fig. 1.

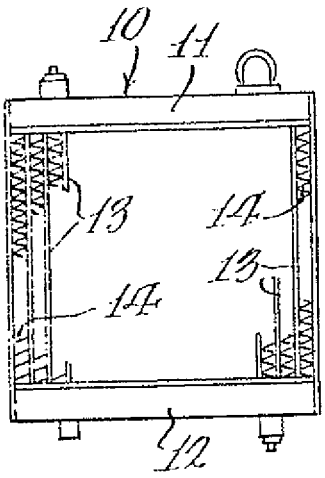


Fig. 2.

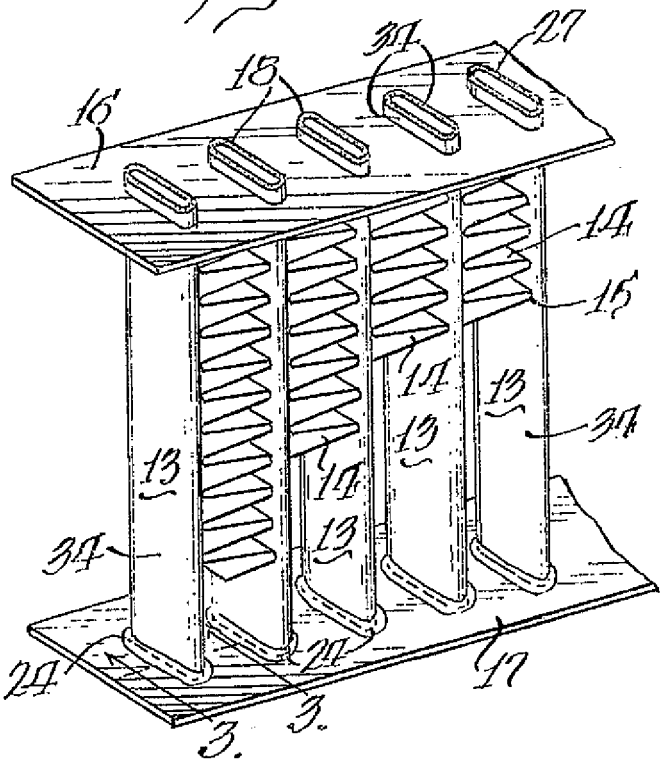
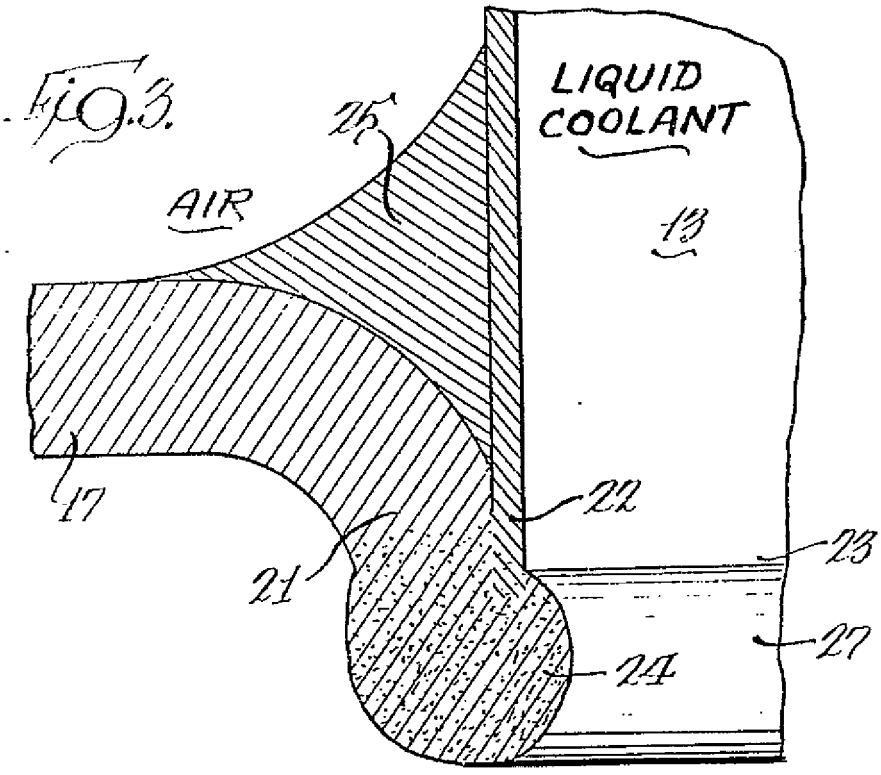


Fig. 3.



SPECIFICATION
Heat Exchanger

In heat exchangers of the type considered herein there is usually provided a pair of spaced header plates between which extend spaced tubes for conveying liquid between spaced tanks of which the header plates are parts. Air is then forced over and between the tubes and usually in contact with serpentine fins for cooling the liquid flowing through the tubes. An automotive radiator is a good example of such an exemplary heat exchanger.

Many of these heat exchangers particularly where the headers and tubes are constructed of brass and the interconnecting fins of copper are deficient in strength because the joints are customarily solder and have poor creep and fatigue properties. This invention both in structure and method avoids these difficulties by providing a primary load bearing joint such as weld metal joining the tubes to the headers at their areas of contact or of close proximity and then a thin sealant sealing against leakage any small leakage openings such as cracks, fissures, pin holes or the like that may be present.

The most pertinent prior art of which I am aware are the following U.S. patents: 2,270,864; 2,914,346; 3,078,551; 3,349,464; 3,496,629; 3,633,660; 3,689,941; 3,710,473; 3,750,747 and 3,763,536. Although many of these patents illustrate the problems of cracks, fissures and similar leaks in welded joints, none of them teach the solution to this problem of providing in the heat exchanger combination a thin sealant.

Figure 1 is a plan view of an automotive radiator embodying the invention.

Figure 2 is a fragmentary partial perspective view of the elements of the radiator of Figure 1.

Figure 3 is an enlarged fragmentary sectional view taken substantially along line 3—3 of Figure 2.

The radiator 10 as illustrated in Figure 1 comprises an upper tank 11, a lower tank 12 spaced therefrom, spaced tubes 13 of oval or flattened cross section spaced from each other with adjacent tubes being interconnected by serpentine fins 14 having their crests 15 attached to the tubes 13 in the customary manner as by welding, brazing, soldering or the like.

The tanks 11 and 12 have as component parts upper 16 and lower 17 header plates through which the tube ends 18 extend as shown in relation to the upper plate 16 of Figure 2. The plates 16 and 17 each are provided with an outwardly extending flange as illustrated at 21 in Figure 3 as a part of the lower plate 17. These flanges 21 describe a hole 22 into which the tube end 23 extends.

This tube end 23 is attached to the plate flange 21 by a primary load bearing joint 24. This joint is in two parts with the first part being the welded joint 24 and the second part being a solder coating 25 on the air side between the tube 13 and flange 21.

Where the heat exchanger is constructed of metal the load bearing joint 24 is preferably of welded construction. The term "weld" is used in its broadest sense and is usually formed with metal parts by heating and allowing metals to flow together. Where the parts are of plastic, and this heat exchanger can be constructed of strong plastic parts, these parts are united in a similar manner by heating to form the weld.

After the primary load bearing joint 24 is formed there is added the second part of the joint: the solder coating or layer 25.

The main part of the load between the headers 16 and 17 and the tubes 13 is taken up by the primary load bearing joint 24. The sealant 25, particularly where it is solder or brazing on a welded joint, also has a load bearing function. However, its main purpose is to seal up and close leakage openings such as fissures, cracks, pin points and the like that occur either during the manufacturing process or in subsequent use. In any event, although the primary purpose of the sealant 25 is to prevent immediate or after developed leakage problems, it does function to distribute some of the forces between the tubes 13 and the header plates 16 and 17 and particularly those caused by internal pressure and temperature changes of the liquid on the interior 33 of the tubes.

With the usual flattened tubes 13 of the customary automotive radiator, and especially when these tubes comprise brass, internal pressure changes of the coolant, normally water, within the tubes causes the sides 34 of the tubes to tend to expand away from each other under internal pressure and contract back toward each other to the position shown in Figure 2, for example, under these internal pressure as well as temperature changes. The primary joint 24 successfully absorbs these loads caused by pressure and temperature expansion and contraction.

Although this invention is most useful in conjunction with heat exchangers made of metal parts, it is also useful in heat exchangers made of reinforced plastic; and these are coming into increasing use. Whether of plastic or metal, the joint 24 is a primary load bearing joint. The sealant 25 in all these embodiments functions mainly as a sealant but is also, secondarily, a load distributing member.

Having described my invention as related to the embodiment shown in the accompanying drawings, it is my intention that the invention be not limited by any of the details of description, unless otherwise specified, but rather be construed broadly within its spirit and scope as set out in the appended claims.

Claims

1. A liquid-to-air heat exchanger, comprising: a header plate containing a plurality of spaced tube receiving holes; a liquid coolant tube extending into each said hole; a primary load bearing joint subject to the formation of leakage openings

therein joining each said tube to said plate at its said opening, an air side of said joint being exposed to said air; and a thin sealant on said air side sealing against leakage any said leakage openings that may be present.

2. The heat exchanger of claim 1 wherein said primary load bearing joint comprises a first weld metal and said sealant coating comprises a second weld metal.

3. The heat exchanger of claim 2 wherein said second weld metal has a melting point less than that of the first weld metal.

4. The heat exchanger of claim 2 wherein said first weld metal coprises brazing metal.

5. The heat exchanger of claim 4 wherein said second weld metal comprises solder.

6. The heat exchanger of claim 1 wherein there are provided a pair of said header plates spaced apart with said tubes extending between them, each tube having an end extending into a said hole in the corresponding plate, said tubes being of oval cross section arranged parallel to each other with the sides of adjacent tubes spaced apart and interconnected by serpentine fins attached to the sides of said tubes.

7. The heat exchanger of claim 6 wherein said primary load bearing joint comprises a first weld metal and said sealant comprises a second weld metal.

8. The heat exchanger of claim 7 wherein said header plates and tubes comprise brass and said fins comprise copper.

9. The method of making a liquid-to-air heat exchanger, comprising: providing a header plate containing a plurality of spaced tube receiving holes; inserting a liquid coolant tube into each said hole; providing a primary load bearing joint subject to the formation of leakage openings therein joining each said tube to said plate at its said opening, an air side of said joint being exposed to said air; and applying a thin sealant on said air side sealing against leakage any said leakage openings that may be present.

10. The method of claim 9 wherein said primary load bearing joint comprises a first weld metal and said sealant comprises a second weld metal.

11. The method of claim 10 wherein said sealant of said second weld metal is applied to the air side of said joint.

12. The method of claim 10 wherein said second weld metal has a melting point less than that of the first weld metal.

13. The method of claim 10 wherein said first weld metal comprises brazing metal.

14. The method of claim 13 wherein said second weld metal comprises solder.

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