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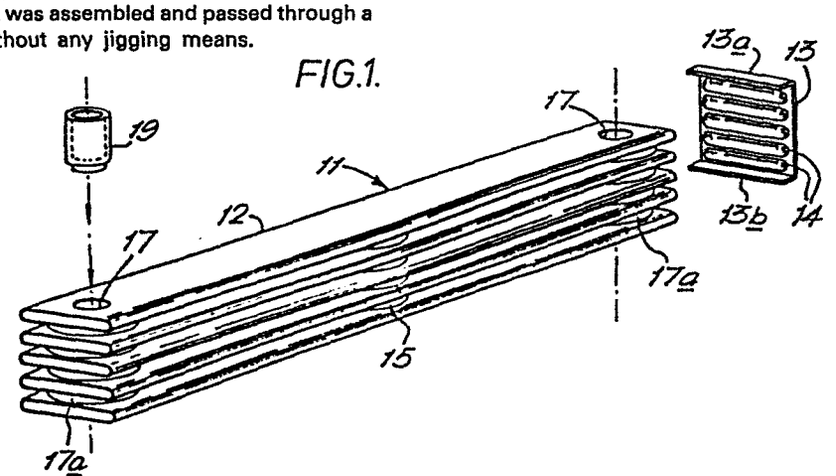
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(54) **Heat exchanger.**

(57) A heat exchanger such as an oil cooler consists of flat tubes 12 spaced apart in an array. A connector 19 feeds a header and another header is provided at the other end of the tubes. The tubes are closed at the ends by an end plate 13 which has channel-shaped depressions 13 over the region where it contacts the tubes, and arms 13*a*, 13*b*. The depressions 13 and arms 13*a*, 13*b* hold the oil cooler tubes together after assembly so that the oil cooler can be removed from the jig in which it was assembled and passed through a brazing apparatus without any jigging means.

FIG.1.



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HEAT EXCHANGER

P1492

This invention relates to a heat exchanger. It is particularly concerned with both a form of exchanger and a method of fabricating it.

The present invention provides a heat exchanger comprising: a stack of tubes maintained in co-extensive space array; two headers communicating with the tubes; and an end plate for each end of the stack which close the tubes and locate the tubes in the spaced array.

The location of the tubes by the end plates facilitates transfer of the heat exchanger to a brazing apparatus during manufacture.

In a preferred form of the invention the heat exchanger has tubes of flattened section. The end plate preferably has channel-shaped depressions over the region where it engages the tubes, the walls of the depressions contacting the end portions of the outside of the tubes. The tubes fit in the channel-shaped depressions, which complement the shape of the tubes, providing closure for the tubes, assistance in location of the tubes, and a good contact area between the ends of the tubes and the end plate which facilitates good sealing of the ends of the tubes during brazing.

The end plate is advantageously secured by brazing.

The invention also provides a method of fabricating a heat exchanger comprising the steps of assembling the stack and end plates in a jig, removing it from the jig, and undertaking a single brazing operation to unite the assembly.

The invention will now be described by way of example with reference to the accompanying drawing, in which :

Figure 1 is a partially exploded view of an oil cooler;
Figure 2 is a section through an end plate on the oil cooler.

Figure 1 shows a spaced array or stack 11 of flat walled tubes typically tube 12. The tubes are both closed at each end and spaced apart by end plates 13 of which only one is shown. A section of the end plate 13 is shown in Figure 2 located at the end of stack 11. The end plate 13 is provided with a series of channel-shaped dimples 14 each of which correspond in shape to the end of the tube which they serve both to close and to locate in the stack. If the end plate was flat, the tubes would only be contacted over their end faces, which could cause sealing problems. The channel-shaped depressions are in interference fit with the flat end portions of the tubes as well as contacting their end faces, and this promotes good liquid tight sealing after brazing has been undertaken, and assists in

holding the assembly together during brazing.

The end plate terminates in arms 13c, 13b which engage the top and bottom of the stack.

In view of the length of the tubes in the array additional spacers 15 are provided along the length of the stack.

To enable liquid to be circulated through the stack 11 a connector 19 engages hole 17 and is brazed in place on assembly to provide an externally liquid tight joint between the connector 19 and the top tube. The connector feeds a header defined by apertures in the tubes (except of course on the lower face of the lower tube) and apertured washers 17a between the tubes. A similar connector (not shown) connects to an identical header at the other end of the stack. The connectors allow hoses or other couplings to be secured to the oil cooler.

Turbulators in the form of corrugated inserts are provided along the length of each tube, in order to cause turbulence in the flow along the tubes to improve heat transfer and to provide resistance to crushing of the flat tubes.

The washer 17a each have a raised rim at their inner diameter on both sides which fits into the apertures in the tubes, in order to locate the washers prior to brazing. In addition, because the end plates are so shaped that they clamp the ends of the stack together when

fitted on, when the parts have been assembled in a jig, the whole assembly stays together and can be lifted in one piece from the jig, to be passed through a brazing apparatus.

The self jigging nature of the assembled oil cooler is a particular advantage, since the need for a combined assembly and brazing jig is avoided.

The parts of the oil cooler are of aluminium, and the end plates are of clad aluminium which means that the cladding of lower melting aluminium melts during the brazing operation. The brazing operation may be carried out in an inert gas.

The oil cooler is particularly suited because of its shape to being water-cooled by insertion in a header tank of a radiator. Of course, the oil cooler is equally well suited to being air cooled and, to this end, may incorporate corrugated fin material between the spacers 15 and the washers 17a.

Various modifications may of course be made without departing from the scope of the invention. Thus, for example, instead of providing washers 17a with a raised internal rim for locating washers, flat washers may be used and a tubular insert may be inserted through the header apertures, the inset having holes registering with each flat tube to allow feed and return of liquid.

CLAIMS

1 A heat exchanger comprising: a stack of tubes maintained in co-extensive spaced array; two headers communicating with the tubes; and an end plate for each end of the stack which close and locate the tubes the tubes in the spaced array.

2 A heat exchanger as claimed in claim 1, wherein the tubes are of flattened section.

3 A heat exchanger as claimed in claim 2, wherein the end plate has channel-shaped depressions over the region where it engages the tubes, the walls of the depressions contacting the end portions of the outside of the tubes.

4 A heat exchanger as claimed in claim 3, wherein the end plate is pressed to form the depressions.

5 A heat excahnger as claimed in claim 3 or claim 4, wherein the end plate has arms which extend at right angles to the plate and which engage the top and bottom surfaces of the stack.

6 A heat exchanger as claimed in any of claims 1 to 5, wherein spacer members are located in the stack at a point intermediate the tube ends.

7 A heat exchanger as claimed in any one of claims 1 to 6, wherein the headers are defined by apertures in the tubes and washers between the tubes.

8 A heat exchanger as claimed in claim 7, wherein an inner rim of the washers is raised to engage the apertures in the tubes.

9 A heat exchanger as claimed in any one of claims 1 to 8, wherein the end plate is secured by brazing.

10 A heat exchanger substantially as hereinbefore described with reference to the accompanying drawings.

11 A method of fabricating a heat exchanger as claimed in any one of claims 1 to 10, comrising the steps of assembling the stack, and end plates in a jig, removing it from the jig, and undertaking a single brazing operation to unite the assembly.

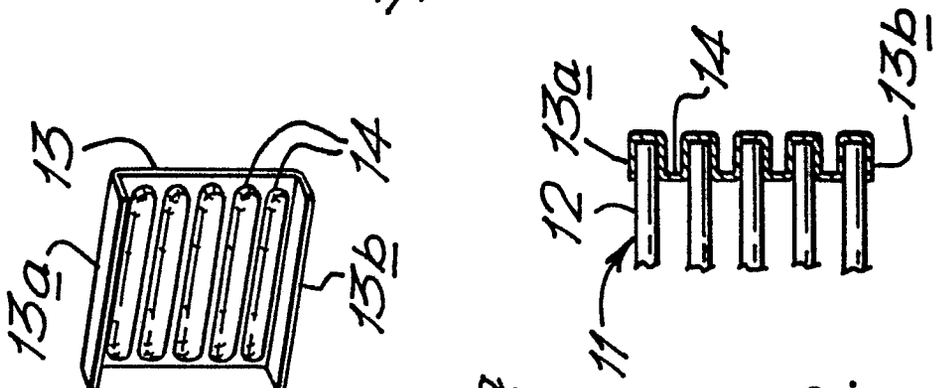


FIG.2.

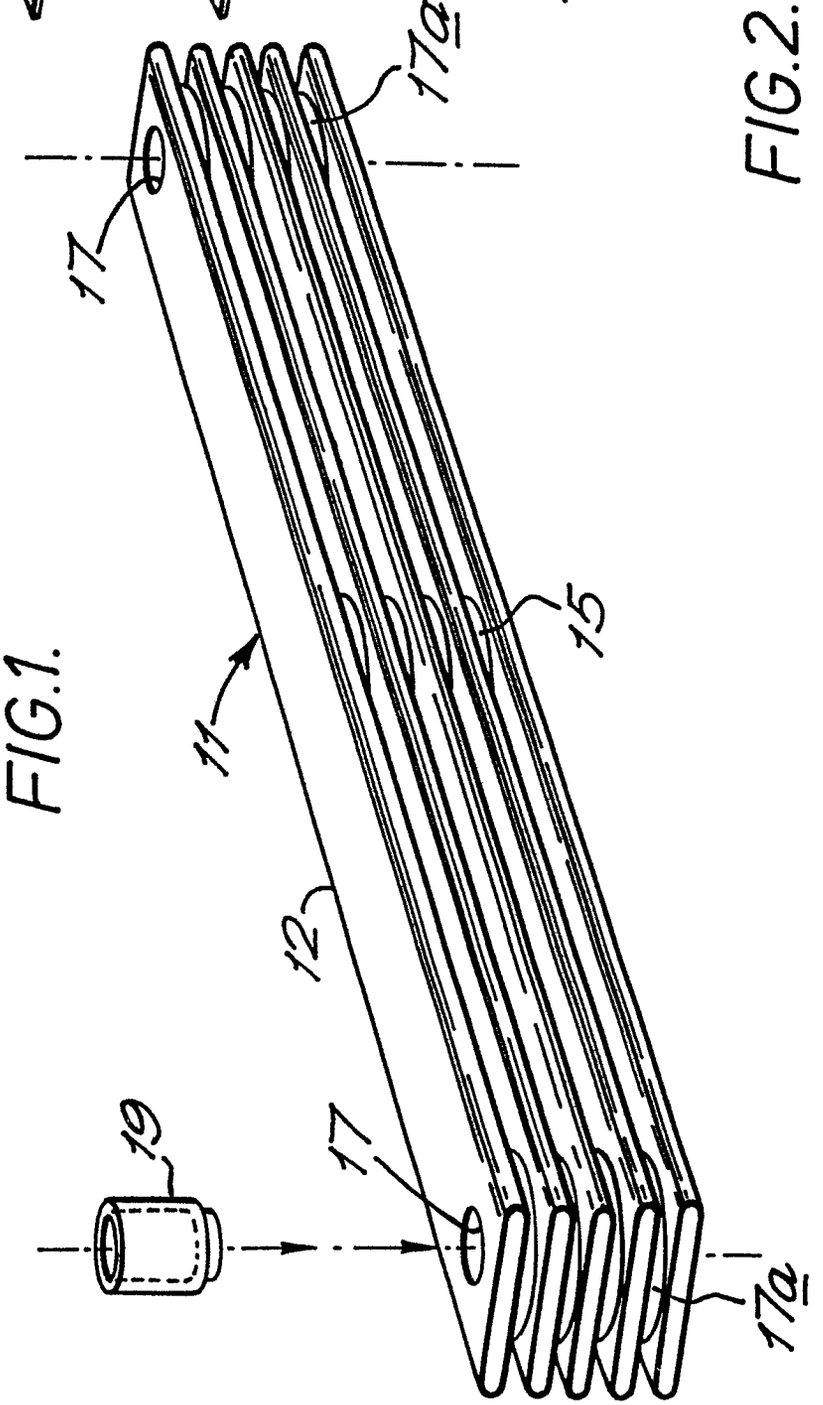


FIG.1.

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EUROPEAN SEARCH REPORT

Application number

EP 83 30 5075

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl. ³)
Y	GB-A- 859 837 (BUCKMAN) * Whole document *	1,2,7, 8,10, 11	F 28 F 3/08 F 28 F 1/02
Y	US-A-2 816 740 (HUET) * Column 2, line 23 - column 4, line 43; figures 1,2,8 *	1-3,7, 10,11	
A	US-A-1 831 533 (HUBBARD) * Figures 3,4 *	3,5	
A	US-A-3 430 694 (CARDELL) * Figure 1 *	6	
A	FR-A-2 428 809 (IPRA)		TECHNICAL FIELDS SEARCHED (Int. Cl. ³)
A	US-A-4 011 905 (MILLARD)		F 28 F F 28 D

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	16-12-1983	SCHOUFOUR F.L.

CATEGORY OF CITED DOCUMENTS

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