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(54) Heat exchanger.

(57) A heat exchanger having a tube plate (12) and parallel spaced tubes (15) extending through apertures in the tube plate (12) is provided with a supplementary reinforcing plate (20) which reinforces the tube (15) to tube plate (12) connection.

The reinforcing plate (20) is spaced from the tube plate (12) and has at its periphery a transverse portion (21) which is secured to the tube plate (12) to maintain a spacing between the tube plate (12) and the reinforcing plate (20).

Preferably the reinforcing plate (20) is rectangular and is located over the tubes (15) in the outer part of an array of tubes (15) and the tubes (15) extend through apertures in the reinforcing plate (20).

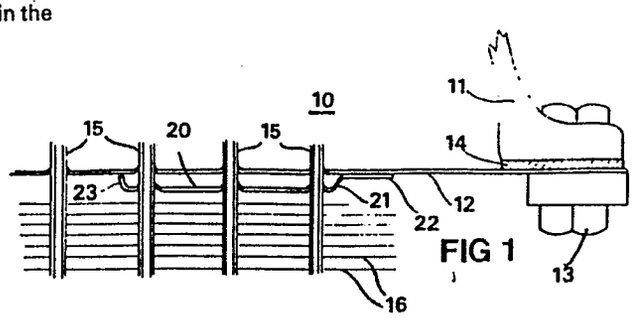

FIG 1

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Heat Exchanger

This invention relates to heat exchangers and, in particular, to heat exchangers having a plurality of parallel, spaced tubes for heat exchange fluid, the tubes being assembled into a unit using a tube plate having holes for receiving the tubes, and the plate extending transverse to the axes of the tubes.

It has been found that the joints between the tubes and the tube plate require strengthening to withstand the loads imposed during operation. Various methods have been employed for this purpose ranging from the provision of fillets of solder to those of British patents 622,421, 1344913, 1443725 and 1477323 in which two plates are employed in close proximity to one another.

An object of the invention is to provide an improved tube to tube plate assembly.

According to the invention a heat exchanger comprises parallel, spaced tubes, a tube plate apertured to receive the tubes and extending transverse to the axes of the tubes, and a supplementary plate apertured to receive at least one of the tubes, the supplementary plate having over a peripheral region a portion extending transversely of the plane of the plate and secured to the tube plate whereby the supplementary plate is spaced from and parallel to the tube plate and fits over the asscciated tube or tubes to reinforce the tube and tube plate connection.

Preferably the peripheral region of the supplementary plate includes a flange portion which lies parallel to the tube plate and is secured thereto by, for example, welding.

The apertures in the tube plate and in the supplementary plate are each conveniently formed with upstanding rims which project from the plates in the same direction as one another. The depths of the rims are preferably arranged to be less than the spacing between the tube plate and the supplementary plate.

The supplementary plate is conveniently of generally rectangular shape in plan view and the peripheral region extends over one or more edges of the plate.

Further features of the invention will appear from the following description of an embodiment of the invention given by way of example only and with reference to the drawings, in which:

Fig. 1 is a cross-section through a tube and tube plate assembly of a heat exchanger,

Fig. 2 is a plan view of part of an assembly similar to that of Fig. 1,

Fig. 3 is a side elevation of the assembly of Fig. 2,

Fig. 4 is a plan view of a supplementary reinforcing plate of the assembly of Figs. 2 and 3, and

Figs. 5 and 6 are side and end views of the plate of Fig. 4.

Referring to Fig. 1 part of a heat exchanger is shown which consists of a header tank 10 defined by a header member 11 (only part of which is shown) and a tube plate 12 secured thereto by bolts 13 and including a gasket 14.

Tubes 15 communicate with the tank space 10 and lie parallel to one another and at right angles to the tube

plate 12. The tubes 15 are in this case of flattened elongate form.

The tubes 15 pass through secondary heat exchange surfaces in the form of fins 16, in known manner.

The tube plate 12 is formed with a plurality of apertures through which the tubes 15 pass to enter into the space 10 and it is arranged that a fluid passes along the tubes between the header tank 10 at the upper ends of the tubes and a further tank (not shown) at the opposite, lower ends of the tubes. A further fluid with which heat is to be exchanged passes over the fins 16 and over the exterior of the tubes 15.

The apertures in the tube plate 12 are formed in a manner, for example by plunging, such that an upstanding lip is defined around each of the apertures.

Due to the forces on the heat exchanger induced during use, for example due to expansion and contraction of the tubes, the connection between the tubes 15 and tube plate 12 comes under stress, particularly towards the outermost tubes, i.e. the tubes closest to the outer edges of the header tank. This is believed to be due, at least in part, to the tube plate 12 acting as a diaphragm as the tubes expand and contract.

To counteract these stresses it has been found that adding a supplementary reinforcing plate 20, as shown, greatly reduces the tendency for the tube to tube plate connection to fail.

The reinforcing plate 20 is arranged to define apertures for receiving the outermost rows of tubes 15 in certain regions of the array of tubes and, over the apertured area

of the plate 20, the plate 20 is parallel to and spaced from the tube plate 12. The apertures in the plate 20 are formed in a similar manner to those in the tube plate 12 so that an upstanding lip is defined around each aperture, the lips being directed upwards and in the same direction as those of the tube plate 12.

The plate 20 is secured to the tube plate 12 along at least one of its peripheral edges by forming the edge with a transversely-directed bend 21 and a flange 22. The flange 22 lies in contact with the tube plate 12 and is secured thereto by welding, preferably by spot welding at spaced positions longitudinally of the flange. Along another edge or edges of the plate 20 a turned-over portion 23 has its free end closely adjacent the surface of the tube plate 12.

Figs. 2 and 3 shows a specific form of tube plate 12', tubes 15' and reinforcing plates 20A' and 20B'. In this case lateral rows P of tubes 15', four in each row, lie at right angles to the sides of a rectangular tube plate 12'. The tubes 15' also lie in longitudinal rows R lying parallel to said sides, and at opposite ends of the rows R are arranged the reinforcing plates 20A' and 20B'. In Fig. 2 only one end of the assembly is shown.

The plates 20A' and 20B' take similar forms and each receive six of the rows P of tubes 15' through apertures aligned with apertures in the tube plate 12'. The plates 20A' and 20B' together receive all the tubes across the longitudinal rows R over said six lateral rows P.

Each plate 20A' and 20B' is of generally rectangular shape and has a transverse bend 21' and flange 22' along two

of its peripheral edges, the flanges 22' being secured to the tube plate 12' by welding as described in relation to Fig. 1. The plates each have a turned over portion 23' along another peripheral edge, the portions 23' lying closely adjacent one another.

Figs. 4, 5 and 6 show a reinforcing plate 20' of Figs. 2 and 3 as a separate element before assembly with the tube plate 12'.

In each case the connections of the tubes to the tube plate and to the reinforcing plate are enhanced by soldering, for example by dipping the assembled unit into solder.

It will be appreciated that with different arrays of tubes the tube to tube plate connection may be reinforced with different configurations of reinforcing plate. Generally it is advantageous to provide such reinforcement of the outermost tubes of the array but in some circumstances the reinforcement plate may receive all the tubes in an array.

In the arrangement of Figs. 2-6 the tubes 15' are in rows P of which alternate rows are staggered. In an alternative arrangement in which the rows are not staggered relative to one another it may be advantageous to form each reinforcing plate 20' with one or more V-shaped grooves or corrugations, the apex of the V being in contact with the tube plate 12' when assembled. Each corrugation extends between two or more of the rows P and serves to additionally reinforce and support the tube to tube plate connection.

Claims

1. A heat exchanger which comprises parallel, spaced tubes 15, a tube plate 12 apertured to receive the tubes and extending transverse to the axes of the tubes, and a supplementary plate 20 apertured to receive at least one of the tubes 15, characterised in that the supplementary plate 20 has over a peripheral region a portion 21 : 23 extending transversely of the plane of the supplementary plate 20 and secured to the tube plate 12 whereby the supplementary plate is spaced from and parallel to the tube plate and fits over the associated tube or tubes to reinforce the tube and tube plate connection.

2. A heat exchanger according to claim 1 characterised in that the peripheral region of the supplementary plate 20 includes a flange portion 22 integral with the transverse portion and which lies parallel to the tube plate 12 and is secured thereto.

3. A heat exchanger according to claim 2 characterised in that the flange portion 22 is secured to the tube plate 12 by welding.

4. A heat exchanger according to any one of the preceding claims characterised in that the apertures in the tube plate 12 and the supplementary plate 20 are each formed with upstanding lips which project from the plates 12 and 20 in the same direction as one another.

5. A heat exchanger according to claim 4 characterised in that the depths of the lips are less than the spacing between the tube plate 12 and the supplementary plate 20.

6. A heat exchanger according to any one of the preceding claims characterised in that the supplementary plate 20 is of generally rectangular shape in plan view and the peripheral region having the transverse portion 21 : 23 extends over one or more edges of the plate.

7. A heat exchanger according to any one of the preceding claims characterised in that the tubes 15 are arranged in an array and the supplementary plate 20 is apertured to receive tubes 15 in the outermost part of the array.

8. A heat exchanger according to any one of the preceding claims characterised in that the supplementary plate 20 has a transverse portion 21 and associated flanged portion 22 secured to the tube plate 12 along one edge of the supplementary plate, and along another edge of the supplementary plate is a transverse portion 23 which engages the tube plate.

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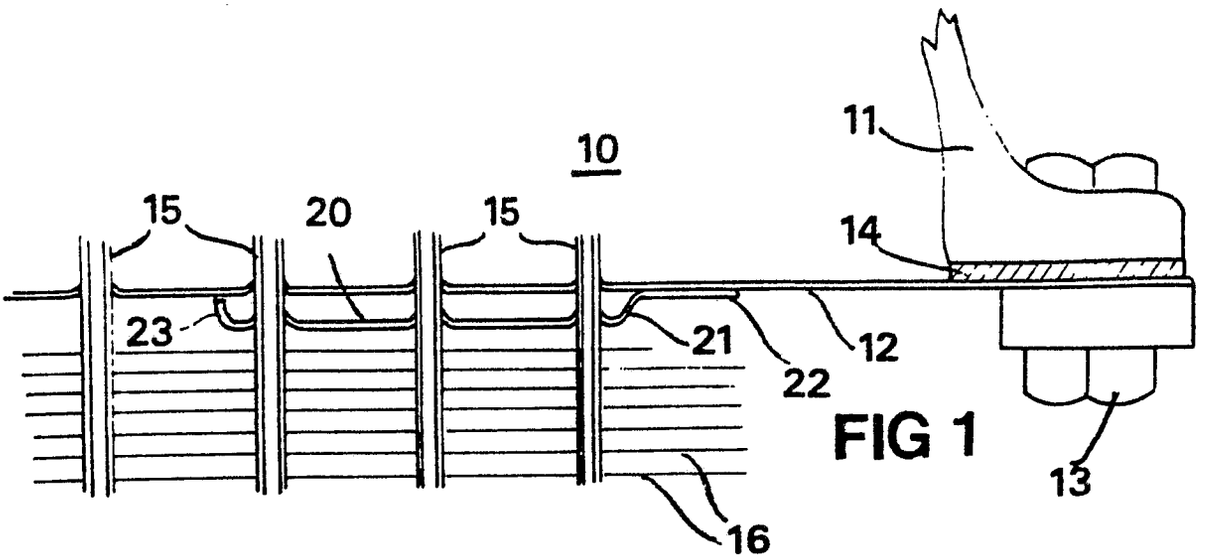


FIG 1

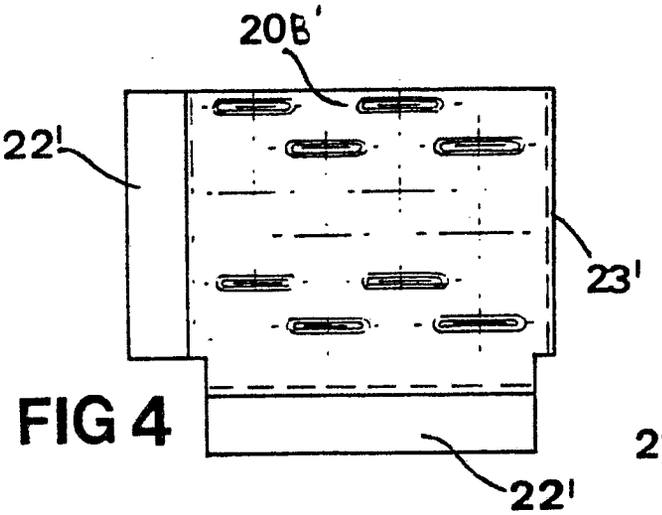


FIG 4

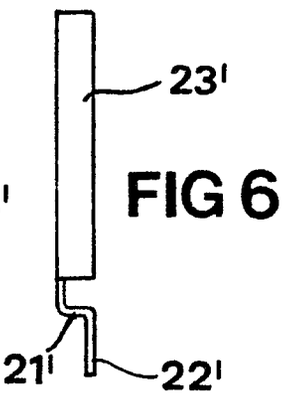


FIG 6

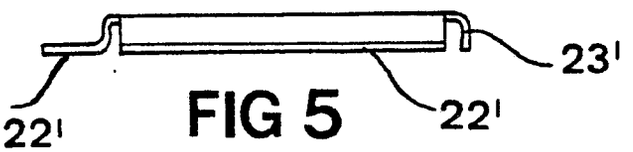


FIG 5

FIG.2

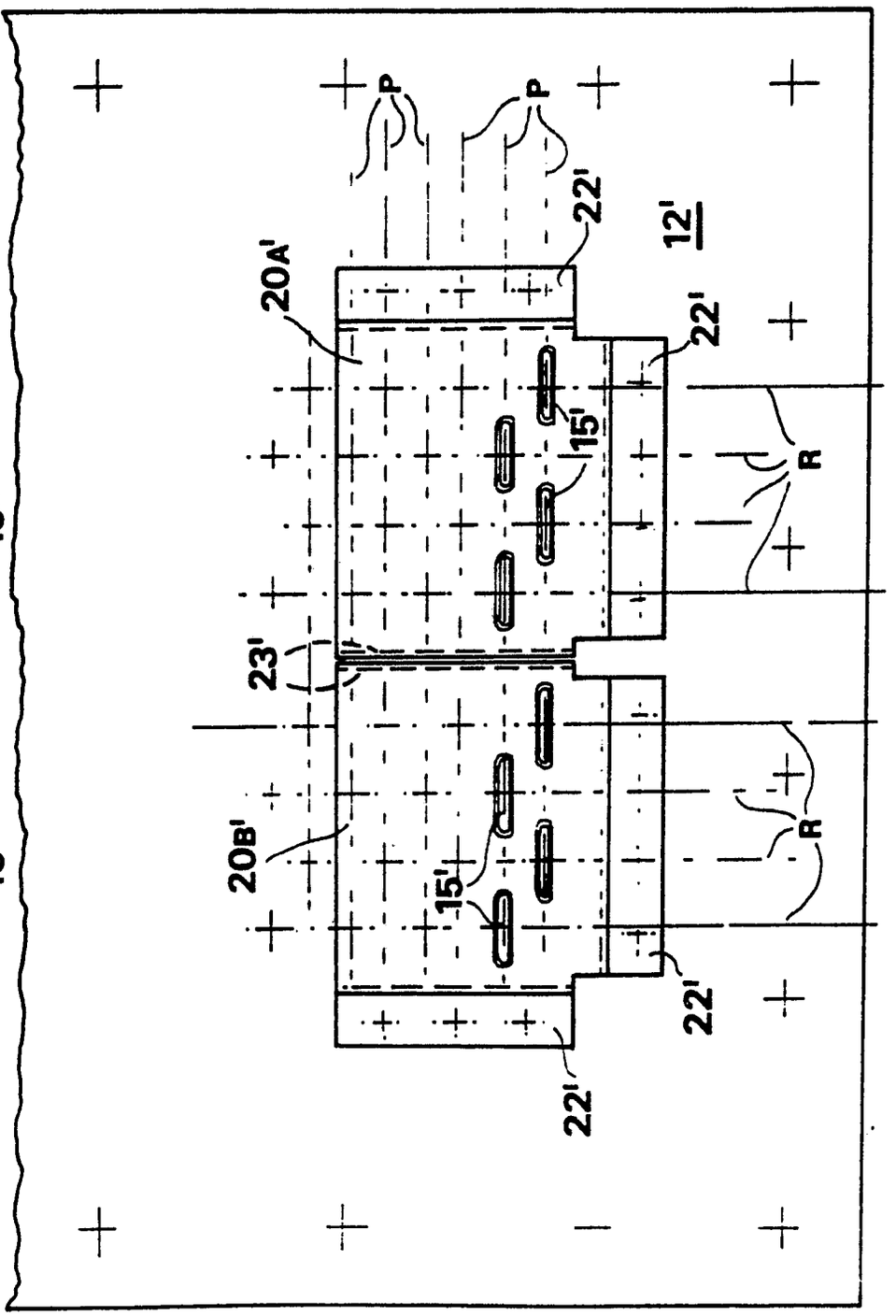
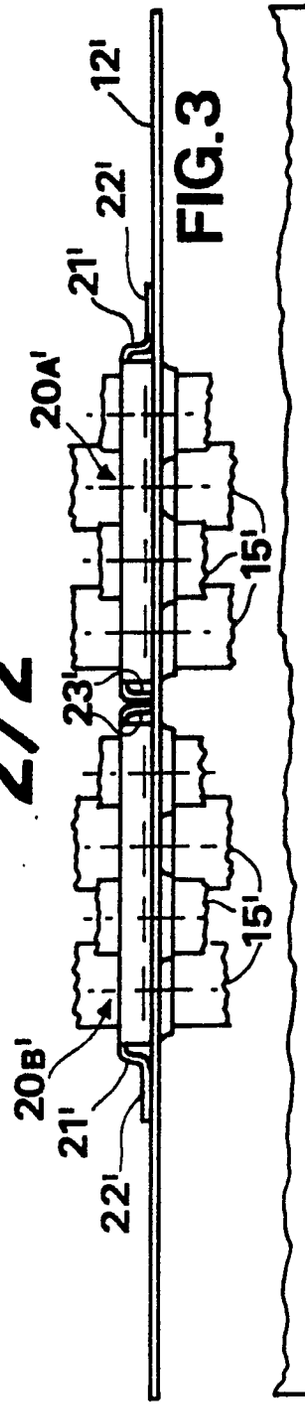


FIG.3



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EUROPEAN SEARCH REPORT

0246779
Application number

EP 87 30 4023

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.4)
X	GB-A-2 086 561 (CHAUSSON) * Page 2, lines 18-27; figure 3 *	1	F 28 F 9/02
Y		2,8	

Y	PATENT ABSTRACTS OF JAPAN, vol. 9, no. 256 (M-421)[1979], 15th October 1985; & JP-A-60 105 895 (NIPPON DENSO K.K.) 11-06-1985	2,8	

X	GB-A- 191 175 (HEENAN & FROUDE) * Page 2, lines 7-72; figure 1 *	1	

A	GB-A- 904 498 (BORG-WARNER CORP.) * Page 2, lines 66-71; figure 5 *	3	TECHNICAL FIELDS SEARCHED (Int Cl.4)
	---		F 28 F
A	US-A-2 950 092 (DI NIRO) * Figure 3 *	4	

A	GB-A- 790 704 (SERCK RADIATORS) * Page 2, figure 1 *	1,5	

A	US-A-1 510 807 (SOULE) * Figures 3,5 *	6,7	

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	26-08-1987	HOERNELL, L.H.

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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