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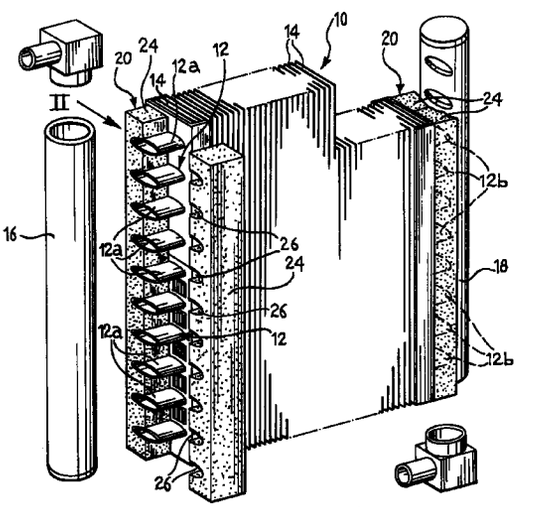
(54) A condenser for vehicle air-conditioning systems

(57) A condenser for vehicle air-conditioning systems which includes at least one row of tubes (12) fixed to a stack of substantially flat fins (14) by mechanical expansion of the tubes (12) after they have been inserted into aligned holes (26) in the fins (14). The condenser includes a pair of containment members (20) fitted to the portions (12a, 12b) of tubes between the manifolds (16, 18) and the stack of fins (14) so as to resist the radial deformations of these portions of tubes (12a, 12b).

FIG. 1



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Description

The present invention relates to a condenser for air-conditioning systems for vehicles.

More specifically, the invention relates to a condenser of the so-called mechanical assembly type, including at least one row of tubes fixed to a stack of substantially flat fins by mechanical expansion of the tubes once they have been inserted into aligned holes in the fins, in which the ends of the tubes projecting from the stack of fins are braze welded to a pair of tubular manifolds.

Condensers for vehicle air-conditioning systems constitute a very specific class of heat exchangers, owing to the arduous operating conditions to which they are subjected. Pressures inside the tubes can reach values of the order of 30 bar, before a safety system acts to cut off the equipment. The operating temperatures of the condenser reach peak values of 120-140°C. These operating conditions make the structural characteristics of a condenser substantially different from those of other types of heat exchanger fitted into a vehicle.

Condensers manufactured using braze welding technology use tubes having a plurality of micro-ducts separated from each other by partitions or ribs which enable the tube to withstand arduous operating conditions without suffering permanent deformations or damages resulting in leakage of refrigerant. Although condensers of this type give an excellent performance from the point of view of heat exchange, and have excellent structural strength, they have the disadvantage of being extremely expensive.

Condensers of the mechanical assembly type are less expensive than braze welded ones, but their heat exchange is generally less efficient. This is mainly due to the fact that mechanical assembly technology uses tubes with a circular cross section, the stable shape thereof being able to withstand the high levels of pressure in the system. However this shape of the tubes seriously impairs the heat exchange efficiency of the condenser.

The document Ep-A-0 633 435 of the same Applicant describes a condenser of the mechanical assembly type with tubes having an oblong cross section. Tubes of this type considerably improve the heat exchange efficiency of the condenser. However, tubes with an oblong cross section have problems with regard to structural strength. The aforesaid document EP-A-0 633 435 solves the problem of reduced structural strength of oblong-section tubes compared to circular-section tubes by adopting particular dimensions for the whole tubes-fins assembly.

The structure of the heat exchanger illustrated in this document has given excellent test results and is able to withstand the normal thermal and mechanical stresses during its use on board a vehicle.

However, experience has shown that there remain critical points from the point of view of structural strength, especially when the condenser is put though laboratory tests subjecting it to much greater conditions of stress than those normally present during operation on board a vehicle.

In particular, laboratory experience has revealed the presence of fragile points which could give rise to fractures, especially as a result of stress tests using pulsing pressure. A typical test of this type involves taking the condenser to around 100°C and stressing the tubes from within by a variable pressure alternating between 5 and 30 bar with a frequency of 0.5-3Hz.

The object of the invention is to provide improvements in condensers of the mechanical assembly type having tubes with an oblong cross section, in which the risks of fractures are eliminated or reduced even during pulsing pressure test conditions.

According to the present invention, this object is achieved by providing a heat exchanger with the characteristics claimed in the main claim.

More precisely, it was noticed that during pulsing pressure tests the end portions of tubes, between the manifolds and the fins stack, constitute areas at high risk of fracture. The portions of tubes inside the fins stack are subjected to a containment action against the radial expansion of the fins collars. This containment action does not affect the portions of tubes between the manifolds and the fins stack, with the result that when these portions are subjected to an internal pulsing pressure they undergo cyclical deformation, leading to leakages of refrigerant as a result of fatigue cracks after a certain number of stress cycles.

The present invention solves the problem of the lower structural strength of the portions of tubes outside the fins stack with the aid of a pair of containment members able to resist the radial deformations of these tubes portions.

Further characteristics and advantages of the present invention will become clear from the detailed description which follows, provided purely by way of non-limitative example, with reference to the appended drawings, in which:

Figure 1 is a partially exploded schematic perspective view of a condenser according to the present invention, and

Figure 2 is a perspective view of the portion indicated by the arrow II in Figure 1.

With reference to Figures 1 and 2, a condenser for a vehicle air-conditioning systems is indicated 10. The condenser 10 includes a row of tubes 12 having an oblong cross section, oval in this particular case. Each tube 12 is inserted into a series of aligned holes through substantially flat fins 14, superimposed to form a stack. The tubes 12 and the fins 14 are connected together by mechanical expansion of the tubes, once they have been inserted, with a slight clearance, into the aligned holes in the fins. The ends of the tubes which project from the fins stack 14 are fixed by braze welding to

respective manifolds 16 and 18.

Structural strength tests have shown that the portions of tubes, indicated 12a and 12b in Figure 1, between the manifolds 16, 18 and the fins stack 14 are at greater risk of fracture, especially in the presence of internal pulsing pressure which causes fatigue in these portions.

According to the invention, a pair of containment members 20, designed to resist the radial deformations of the portions 12a and 12b, is used to increase the structural strength of these portions.

Each containment member 20 has a plurality of seats 22 which are form fitted to the outer surfaces of the portions of tubes 12a and 12b. Each containment member 20 is constituted by a pair of flanges 24 which, once assembled, are fixed to each other by any known system, for example by screws or welding. Each flange 24 has parts 26 of the seats 22 which are complementary to the parts 26 of the other flange 24. The flanges 24 may be made either of metal or of moulded plastics.

The deformation-containment member 20 also acts to protect the end portions of the tubes from possible damages while the finished condenser is being fitted into a vehicle or into a preassembled module.

Claims

1. A condenser for vehicle air-conditioning systems, including at least one row of tubes (12) fixed to a stack of substantially flat fins (14) by mechanical expansion of the tubes after they have been inserted into aligned holes (26) in the fins (14), in which the ends of the tubes projecting from the stack of fins (14) are fixed to a pair of tubular manifolds (16, 18), characterised in that it includes a pair of containment members (20) fitted to the portions of tubes (12a, 12b) extending between the manifolds (16, 18) and the stack of fins (14), acting to resist the radial deformation of these portions of tubes (12a, 12b).

2. A condenser according to Claim 1, characterised in that each of the containment members (20) has a plurality of seats (22) which are form-fitted to the outer surfaces of the portions of tubes (12a, 12b).

3. A condenser according to Claim 2, characterised in that each of the containment members (20) includes a pair of flanges (24), which can be coupled to each other, each one of which has seat parts (22) which are complementary to those of the other flange.

FIG. 1

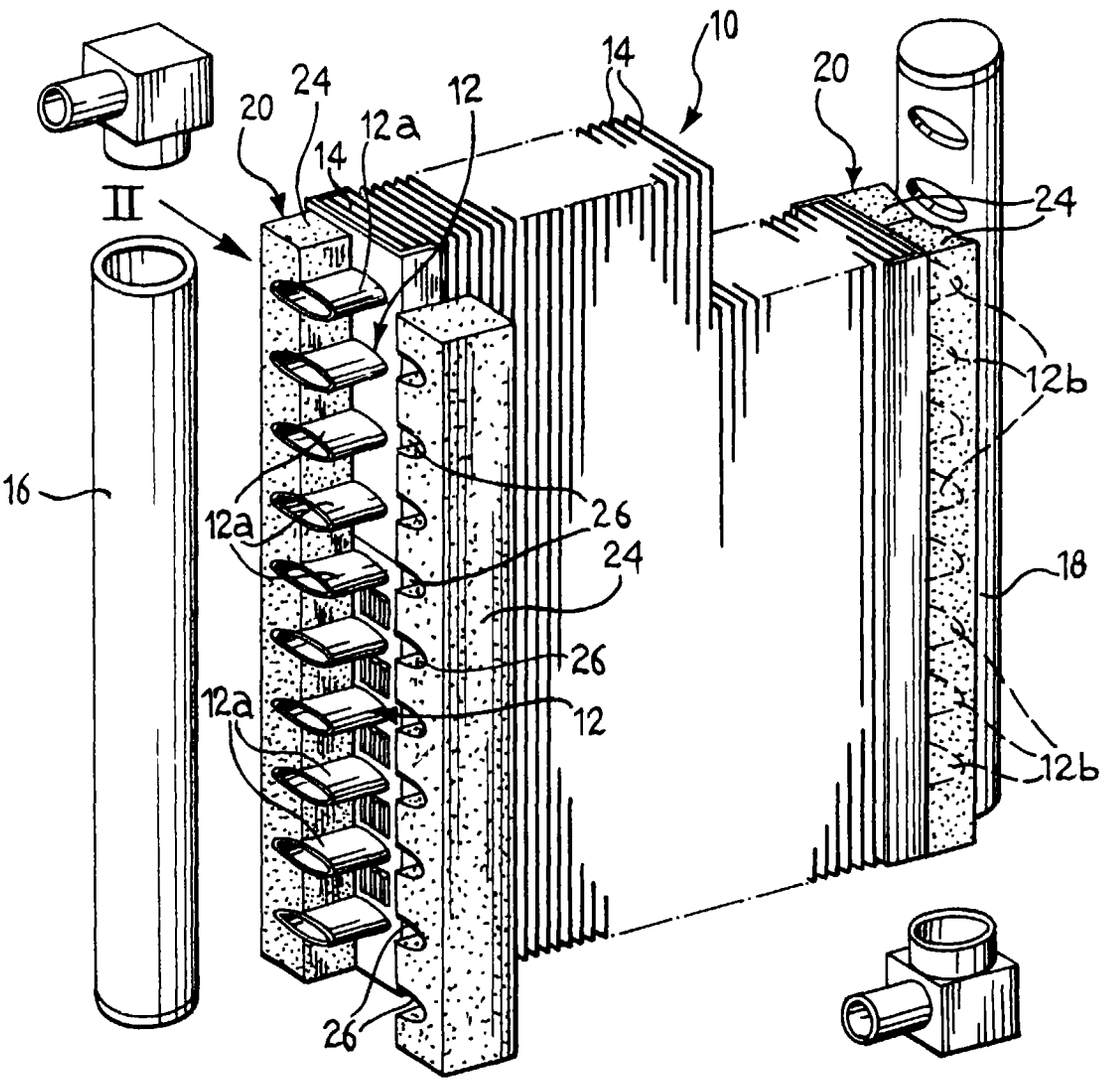
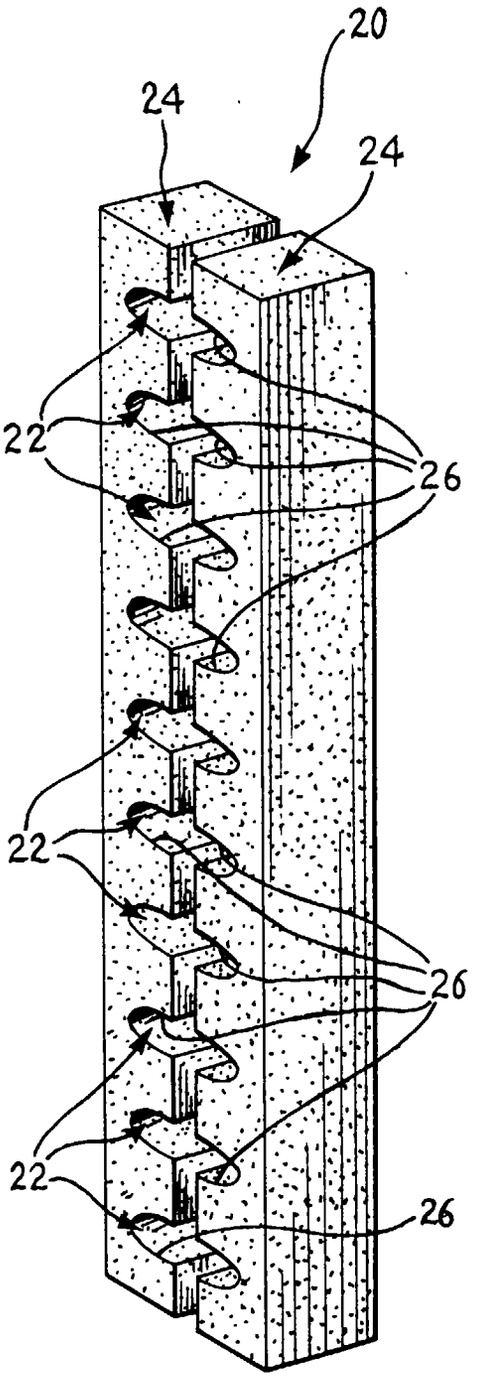


FIG. 2



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EUROPEAN SEARCH REPORT

Application Number
EP 97 10 2565

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.6)
A	EP 0 246 779 A (COVRAD HEAT TRANSFER LIMITED) 25 November 1987 * page 3, line 16 - line 27; figure 1 *	1	F28F9/00 F28D1/053
A	GB 790 704 A (SERCK RADIATORS LIMITED) 12 February 1958 * the whole document *	1	
A	FR 2 337 867 A (CHAUSSON USINES SA) 5 August 1977 * the whole document *	1	
A	WO 92 08090 A (LLANELLI RADIATORS LTD) 14 May 1992 * the whole document *	1	

TECHNICAL FIELDS SEARCHED (Int.Cl.6)

F28F
F28D
B60H
F25B

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	15 May 1997	Zaegel, B

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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A : technological background
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T : theory or principle underlying the invention
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