

(19)



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(11)

EP 0 823 609 A1

(12)

EUROPEAN PATENT APPLICATION

(43) Date of publication:
11.02.1998 Bulletin 1998/07

(51) Int. Cl.⁶: **F28D 1/053**, F25B 39/04

(21) Application number: **97112993.7**

(22) Date of filing: **29.07.1997**

(84) Designated Contracting States:
**AT BE CH DE DK ES FI FR GB GR IE IT LI LU MC
NL PT SE**
Designated Extension States:
AL LT LV RO SI

(30) Priority: **07.08.1996 IT TO960683**

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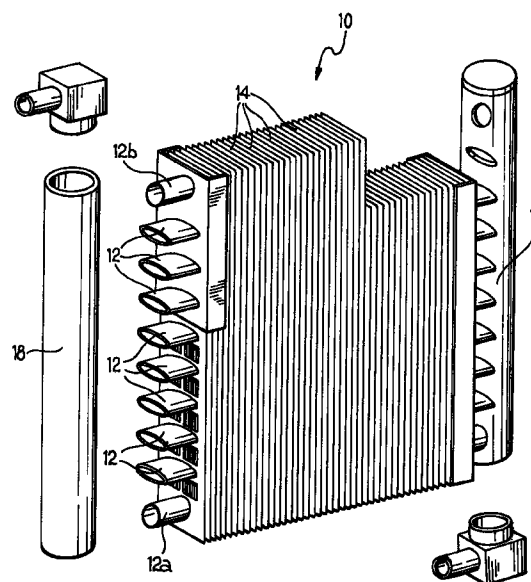
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(54) **A condenser for air-conditioning systems for vehicles**

(57) A condenser for air-conditioning systems for vehicles comprises at least one row of tubes (12, 12a, 12b) fixed to a pack of substantially flat fins (14) by mechanical expansion of the tubes (12). The condenser comprises a pair of tubes (12a, 12b) with circular cross-sections situated at the ends of the row and a plurality of tubes (12) with oblong cross-sections situated in the inner portion of the row.

FIG. 2



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Description

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

More precisely, the invention relates to a condenser of the so-called mechanically-assembled type, comprising at least one row of tubes fixed to a pack of substantially flat fins by mechanical expansion of the tubes after they have been inserted in aligned holes in the fins.

Condensers for vehicle air-conditioning systems constitute a very special class of heat exchangers because of the severe operating conditions to which they are subject. The pressures inside the tubes may reach values of the order of 30 bars before a safety system intervenes by switching off the system. The working temperatures of the condenser reach peak values of 120-140°C. These working conditions substantially differentiate the structural characteristics of a condenser from those of other types of heat exchangers present in a vehicle.

Condensers produced by braze-welding assembly techniques use tubes having a plurality of micro-ducts separated by walls or ribs which enable the tube to withstand severe operating conditions without undergoing permanent deformation or damages, with leakage of coolant to the exterior. Although condensers of this type have optimal performances from the point of view of heat-exchange capacity and optimal structural strength, they have the disadvantage of a very high cost.

Mechanically-assembled condensers are cheaper than braze-welded ones but generally have inferior heat-exchange efficiency. This is mainly due to the fact that the mechanical assembly technique uses tubes with circular cross-sections, the stable shape of which enables them to withstand the high pressure levels present in the system. However, the shape of the tubes greatly penalizes the heat-exchange performance of the condenser.

The Applicant's document EP-A-0 633 435 describes a mechanically-assembled condenser with tubes having oblong cross-sections. Tubes of this type considerably improve the performances of the condenser in terms of heat-exchange efficiency. However, tubes with oblong cross-sections present difficulties from the point of view of structural strength. The aforementioned document EP-A-0 633 435 solves the problem of the inferior structural strength of tubes with oblong cross-sections, in comparison with tubes with circular cross-sections, with the use of particular dimensions of the entire assembly of tubes-fins.

The structure of the heat exchanger described in this document has given optimal experimental results and can withstand the normal thermal and mechanical stresses which occur during use in a vehicle.

However, tests have shown that there are still critical points from the point of view of structural strength, particularly when the condenser is subjected to laboratory tests which produce more severe stress conditions

than those which normally occur during the use of the condenser in a vehicle.

In particular, laboratory tests have shown the presence of weak points which may give way, particularly as a result of pulsed-pressure stress tests. A typical test of this type provides for the condenser to be brought to a temperature of about 100°C and for the tubes to be stressed from the interior with a pressure variable alternately between 5 and 30 bars at a frequency of the order of 0.5-3 Hz.

The object of the present invention is to provide improvements to mechanically-assembled condensers having tubes with oblong cross-sections, which eliminates or reduces the risks of their giving way, even in pulsed-pressure test conditions.

According to the present invention, this object is achieved by a heat exchanger having the characteristics forming the subjects of the main claim.

More precisely, it has been noted that, during pulsed-pressure stress tests, the tubes at the ends of the row constitute the points with the greatest probability of giving way.

According to the present invention, in order to overcome this problem, tubes with circular cross-sections are used at the ends of the row and tubes with oblong cross-sections are used in the inner portion of the row.

By virtue of this characteristic, a greater structural strength of the assembly of tubes-fins is achieved at the ends of the row by virtue of the greater intrinsic resistance to radial deformation of tubes with circular cross-sections.

Further characteristics and advantages of the present invention will become clear in the course of the following detailed description, given purely by way of non-limiting example, with reference to the appended drawings, in which:

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

Figure 2 is a schematic, perspective view of the condenser of Figure 1, and

Figure 3 is a plan view of an end region of the condenser.

With reference to the drawings, a condenser for vehicle air-conditioning systems is indicated 10. The condenser 10 comprises a row of tubes 12, each of which is fitted in a series of aligned holes 26 (Figure 3) formed through substantially flat fins 14 superposed on one another so as to form a pack. The connection between the tubes 12 and the fins 14 is achieved by mechanical expansion of the tubes after they have been inserted with slight clearance through the aligned holes of the fins. The ends of the tubes which project from the pack of fins 14 are braze-welded to respective manifolds 16 and 18.

Experimental structural strength tests have shown that the tubes disposed at the ends of the row are more exposed to the risk of breakage, particularly in the presence of pulsing internal pressure which causes fatigue stressing of the system.

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According to the invention, in order to increase the structural strength of the assembly of tubes-fins, tubes 12a and 12b with circular cross-sections are used at the ends of the row. The remaining tubes 12 situated in the inner portion of the row have oblong (for example, oval) cross-sections in order to achieve good heat-exchange characteristics of the condenser.

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Experimental tests have shown that the tubes with circular cross-sections do not require the assistance of the surrounding fins to withstand the internal pressure. The use of tubes with circular cross-sections instead of tubes with oblong cross-sections at the ends of the row therefore achieves the necessary strength characteristics to pass the most demanding tests without the need for additional lateral restraint systems. This solution also has the advantage of considerable stability as well as good structural strength.

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Claims

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1. A condenser for air-conditioning systems for vehicles, comprising at least one row of tubes (12, 12a, 12b) fixed to a pack of substantially flat fins (14) by mechanical expansion of the tubes after they have been inserted in aligned holes (26) in the fins (14), characterized in that it comprises a pair of tubes (12a, 12b) with circular cross-sections situated at the ends of the row and a plurality of tubes (12) with oblong cross-sections situated in the inner portion of the row.

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FIG. 1

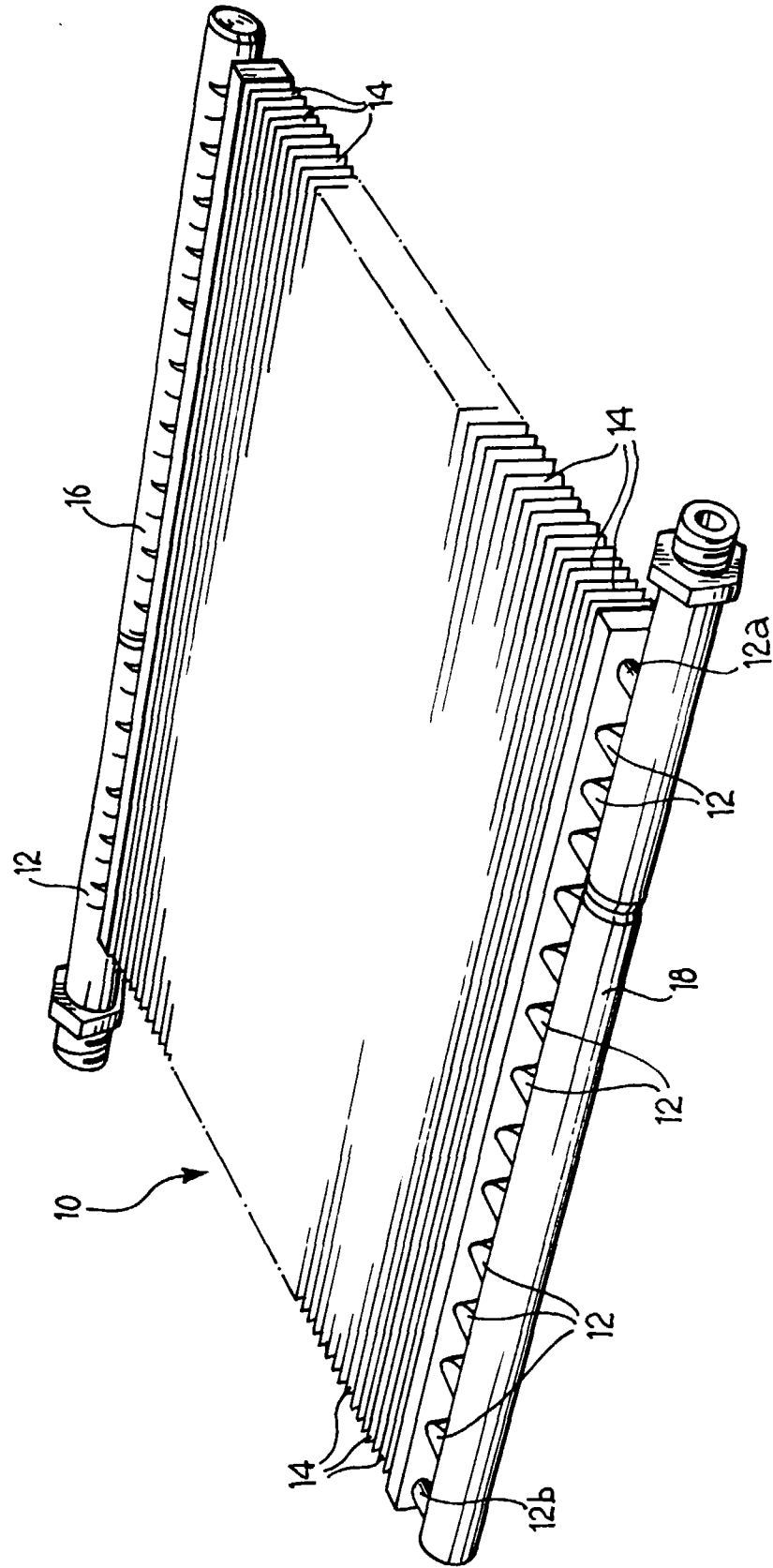


FIG. 2

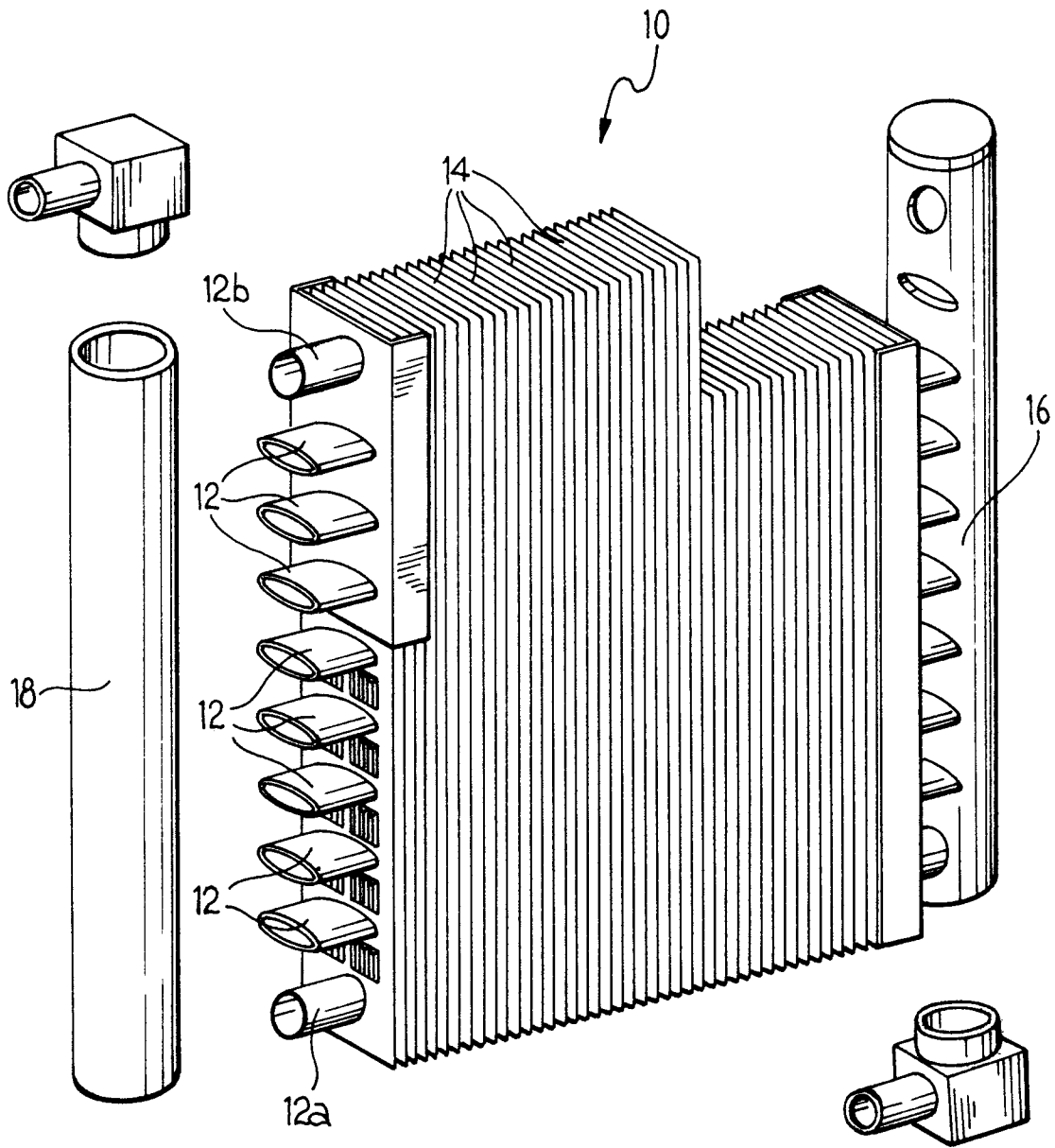
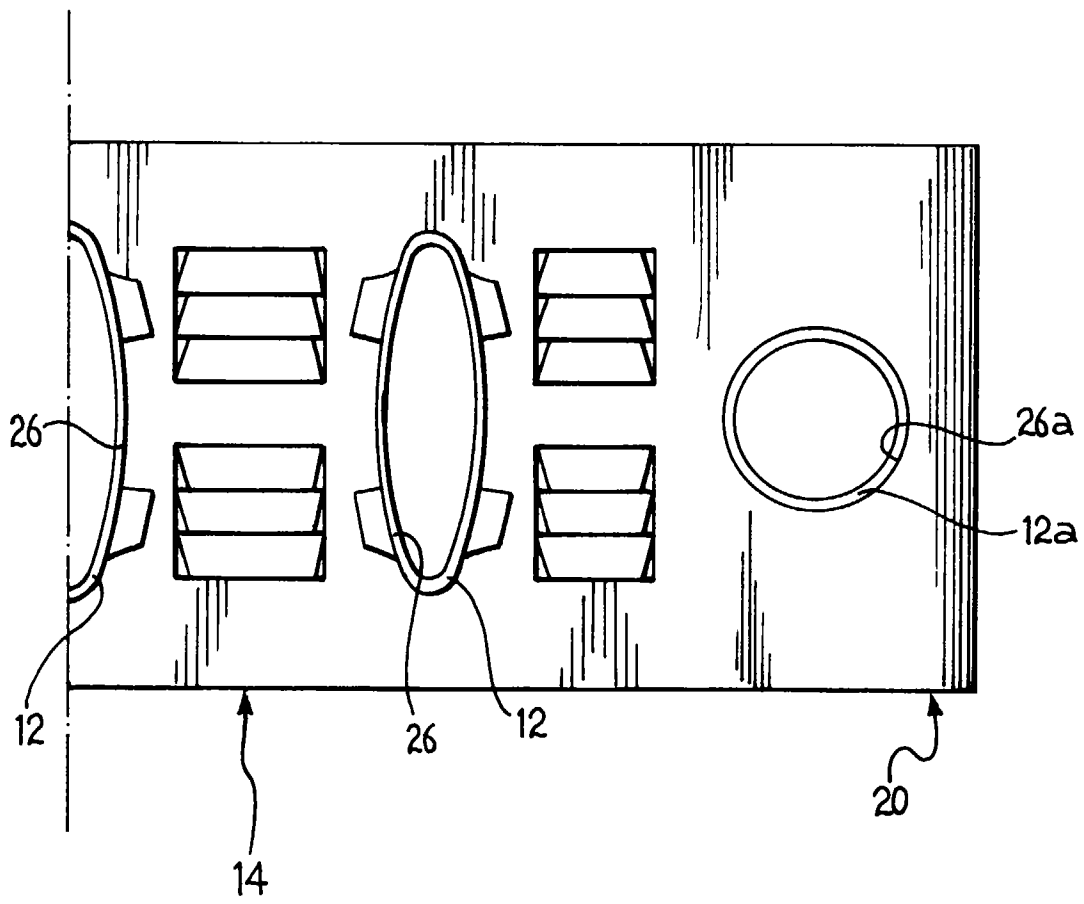


FIG. 3





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EUROPEAN SEARCH REPORT

Application Number
EP 97 11 2993

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)
D,Y	EP 0 633 435 A (BORLETTI CLIMATIZZAZIONE SRL) * abstract; figure 3 *	1	F28D1/053 F25B39/04
Y	DE 41 22 904 A (KÜHLERFABRIK LÄNGERER & REICH GMBH & CO KG) * column 2, line 35 - column 2, line 47 * * column 4, line 29 - column 6, line 10; figures 1,5 *	1	
A	FR 380 090 A (GROUVELLE ET AL) * the whole document *	1	
A	US 1 759 167 A (MODINE) * the whole document *	1	
			TECHNICAL FIELDS SEARCHED (Int.Cl.6)
			F28D F28F F25B
The present search report has been drawn up for all claims			
Place of search		Date of completion of the search	Examiner
THE HAGUE		17 November 1997	Beltzung, F
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