(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 1 930 683 A1

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
11.06.2008 Bulletin 2008/24

(51) Int Cl.:
F28F 9/04 *(2006.01)* ***B60H 1/00*** *(2006.01)*

(21) Application number: **06256220.2**

(22) Date of filing: **06.12.2006**

(84) Designated Contracting States:
AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HU IE IS IT LI LT LU LV MC NL PL PT RO SE SI SK TR
Designated Extension States:
AL BA HR MK RS

(71) Applicant: **Delphi Technologies, Inc.**
Troy, Michigan 48007 (US)

(72) Inventors:
- **Biver, Philippe**
  4804 Rodange (LU)
- **Bouvier, Joël**
  08140 Daigny (FR)
- **Damotte, Hervé**
  54400 Longwy (FR)

(74) Representative: **Waller, Stephen**
Murgitroyd & Company
Scotland House
165-169 Scotland Street
Glasgow G5 8PL (GB)

(54) **A pipe connecting structure for a heat exchanger**

(57) A pipe connecting structure for a heat exchanger comprising:-
a header portion defined by a plurality of parallel elongate header tubes;
a connector block having a side face adapted to abut against a side region of an outer one of said header tubes and connection means configured to connect a pipe thereto;
and joining means comprising at least one elongate tubular member adapted to be inserted through diametrically opposed holes formed in the side walls of at least said outer one of said header tubes, a first end of said at least one elongate tubular member extending through a corresponding hole in a side wall of the one of said plurality of header tubes furthest from said outer one of said header tubes ,whereby said first end communicates with an interior of said furthest one of said header tubes, and a second end of said at least one tubular member extending through a corresponding hole in said side face of the connector block, whereby said second end communicates with said connection means;
whereby the at least one tubular member of the joining means extends between said plurality of elongate header tubes to connect the plurality of elongate header tubes to one another and to the connector block.

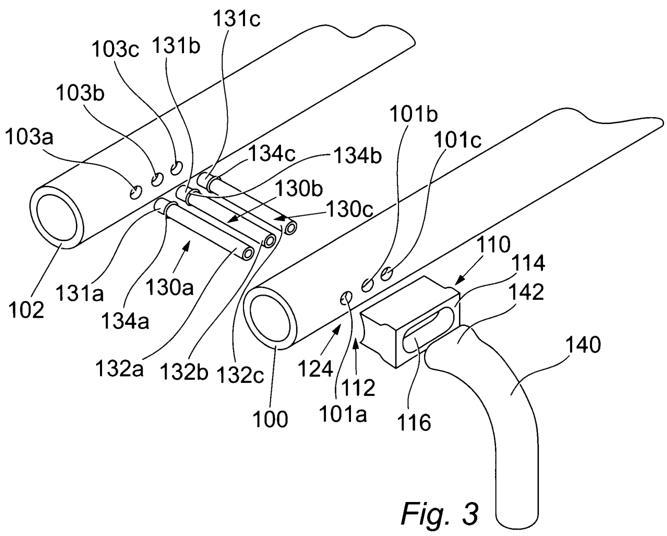

Fig. 3

EP 1 930 683 A1

Description

[0001] Heat exchangers are used in vehicles to cool engine coolant, to cool charge air and to heat and/or cool refrigerant in a vehicle air conditioning system. Such heat exchangers typically comprise upper and lower header tanks or manifolds having a plurality of fluid passages extending therebetween, air gaps, typically provided with strengthening ribs, are provided between the refrigerant passages to allow heat transfer between a flow of air passing through the air gaps and a flow of a fluid passing through the fluid passages.

[0002] Connection means are typically provided at ends of one or both of the header tanks for connecting to delivery and discharge conduits supplying fluid to be cooled/heated to and from the heat exchanger.

[0003] Typically such connection means are formed by brazing a pipe connection onto a connection block joined to an end region of a header tank. Such pipe connections are difficult to form in situe in the vehicle, particularly in the case of a heat exchanger (typically an evaporator) provided within a HVAC module of a vehicle air conditioning system, leading to packaging constraints due to the need for extended header tank end regions and fixed pipe routing. Such pipe connections can also lead to leakage problems, particularly where carbon dioxide is used as a refrigerant. When carbon dioxide is used as refrigerant, very high pressures in the range of up to more than 80 bar exist within the refrigerant circuit of the air conditioning system. The pressure loading on individual components of an air conditioning system therefore rises significantly.

[0004] What is needed is a more compact and reliable pipe connecting structure that provides more versatile pipe routing while better withstanding high refrigerant pressures while at the same time simplifying header construction.

[0005] According to the present invention there is provided a pipe connecting structure for a heat exchanger comprising:-

a header portion or manifold defined by a plurality of parallel elongate header tubes;

a connector block having a side face adapted to abut against a side region of an outer one of said header tubes and connection means configured to connect a pipe thereto;

and joining means comprising at least one elongate tubular member having a first end adapted to be inserted through a hole formed in a first side wall of at least said outer one of said header tubes, and a second end extending through a corresponding hole in said side face of the connector block, whereby said second end communicates with said connection means.

[0006] Preferably said at least one tubular member extends substantially perpendicular to said plurality of header tubes.

[0007] In one embodiment said first end of said at least one elongate tubular member is adapted to extend through a corresponding hole in a second side wall of said outer one of said header tubes diametrically opposite said first side wall and through an aperture in a side wall of the one of said plurality of header tubes furthest from said outer one of said header tubes, whereby said first end communicates with an interior of said furthest one of said header tubes, whereby the at least one tubular member of the joining means extends between, and perpendicular to, said plurality of elongate header tubes to connect the plurality of elongate pipes to one another and to the connector block.

[0008] Preferably said at least one tubular member of the joining means includes a radially extending flange located between said first and second ends and adapted to be positioned between sides faces of said furthest one of said header tubes and an adjacent header tube.

[0009] In one embodiment said header portion comprises two parallel elongate header tubes, a first tube corresponding to said outer one of said header tubes and a second tube corresponding to said furthest one of said header tubes, said radially extending flange being positioned between said first and second tubes.

[0010] Preferably the joining means comprises a plurality of parallel tubular members arranged in a plane containing the longitudinal axis of each of the plurality of header tubes of the header portion.

[0011] The connection means of the connector block may be adapted to receive said pipe with said pipe arranged parallel to said plurality of header tubes. Alternatively, the connection means of the connector block may be adapted to receive said pipe with the pipe arranged perpendicular to said plurality of header tubes.

[0012] In one embodiment the connection means of the connector block comprises a flange or stub to be received within an end of the pipe. In an alternative embodiment the connection means comprises an aperture for receiving an end of the pipe.

[0013] Preferred embodiments of the present invention will now be described, by way of example, with reference to the accompanying drawings, in which:-

Fig. 1 is a perspective view of a known pipe connecting structure for a heat exchanger;

Fig. 2 is a perspective view of a pipe connecting structure according to a first embodiment of the present invention;

Fig. 3 is an exploded view of the pipe connecting structure of Fig. 2;

Fig. 4 is a perspective view of a pipe connecting structure according to a second embodiment of the present invention;

Fig. 5 is an exploded view of the pipe connecting structure of Fig. 4;

Fig. 6 is a sectional view of the pipe connecting structure of Fig. 4 taken along line A-A;

Fig. 7 is a perspective view of a pipe connecting structure according to a third embodiment of the present invention;

Fig. 8 is a further perspective view of the pipe connecting structure of Fig. 7;

Fig. 9 is an exploded view of the pipe connecting structure of Fig. 6;

Figs. 10 and 11 are exploded perspective views of a pipe connecting structure according to a fourth embodiment of the present invention;

Fig. 12 is a sectional view of the pipe connecting structure of Fig. 10 taken along line B-B and;

Fig. 13 is a detailed perspective view of the pipe connecting structure of Fig. 10 with the conduit omitted.

[0014] Fig. 1 illustrates a typical cross flow heat exchanger 1 having a first and second spaced manifolds or header tanks 2,3 with a plurality of coolant or refrigerant tubes 4 extending therebetween, said refrigerant tubes 4 being separated by fins to enhance refrigerant to air heat transfer. Refrigerant flows between the manifolds 2,3 via the tubes 4.

[0015] Each manifold 2,3 is formed from two parallel header tubes 10,11, each header tube 10,11 of the first manifold 2 communicating with a respective header tube 12,13 of the second manifold 3 via a respective number of said refrigerant tubes 4. One of the two header tubes 10 of the first manifold 2 comprises a refrigerant delivery conduit and the other header tube 11 of the first manifold 2 comprises a discharge conduit. The second manifold 3 is provided with bridging passageways between its two constituent header tubes 12,13 to provide cross flow.

[0016] A refrigerant delivery line 14 is connected to the first header tube 10 of the first manifold 2 and a refrigerant discharge line 15 is connected to the second header tube 11 of the first manifold 2. Such connections are made by a connector block 16 joined to the ends the header tubes 10,11 beyond the block of refrigerant tubes 4, apertures being formed in such connection block into which are fixed, typically by brazing, the ends of the delivery and discharge lines 14,15.

[0017] The connector block 16 also has to serve as a support and spacer for the ends of the header tubes 10,11, the header tubes 10,11 requiring further support, spacing and joining means adjacent the ends of the header tubes remote from the connector block 16, this requiring further brazing and/or assembly steps.

[0018] As illustrated in Figs 2 and 3, in a first embodiment of the present invention, an improved pipe connecting structure comprises a connector block 110 having a side face 112 configured to abut against a side region 124 of a first header tube 100 and having an elongated aperture or row of holes formed in said face 112 for receiving the ends of joining members 130a,130b, 130c as will be described below.

[0019] Each joining member 130a,130b,130c comprises a tubular body having a first portion 131a,131b, 131c, adapted to be inserted into a corresponding hole 103a,103b,103c formed in a side wall of a second header tube 102, and a second portion 132a,132b,132c, adapted to be inserted through diametrically opposed holes 101a, 101b,101c, formed in opposite side walls of the first header tube 100, whereby said second portion 132a,132b, 132c of the joining member 130a,130b,130c extends through said first header tube 100 and into the connector block 110, thus providing fluid communication between the second header tube 102 and the connector block 110.

[0020] A radially extending flange 134a,134b,134c is formed on each joining member 130a,130b,130c between said first and second portions thereof to be positioned, in use, between the first and second header tubes.

[0021] An outer face 114 of the connector block 110 is provided with an aperture 116 for receiving a flattened end 142 of a delivery or discharge conduit 140.

[0022] During assembly, the connector block 110 can be secured to the header tubes by inserting a tool through the aperture 116 into at least one of the joining members whereby regions of the joining member on either side of the respective apertures in the header tubes and be expanded or clinched to lock the components together. The joining members 130a,130b,130c, connector block 110 and the conduit 140 can then be sealed in their respective receiving apertures by brazing or by suitable adhesive.

[0023] Thus, a compact connecting structure is provided that serves to provide fluid connection between a delivery or discharge conduit and a header pipe of the manifold while at the same time supporting and correctly spacing the ends of the header tubes.

[0024] In a second embodiment, illustrated in Figs 4 to 6, the connector block 210 has a side face 212 configured to abut against a side region 224 of a first header tube 200 and having an elongated aperture or row of holes 211a,211b,211c formed in said face 212 for receiving the ends of joining members 230a,230b,230c.

[0025] As in the first embodiment, each joining member 230a,230b, 230c comprises a tubular body having a first portion 231 a,231 b,231 c, adapted to be inserted into a corresponding hole 203a,203b,203c formed in a side wall of a second header tube 202, and a second portion 232a,232b,232c, adapted to be inserted through diametrically opposed holes 201 a,201 b,201 c, formed in opposite side walls of the first header tube 200, whereby said second portion 232a,232b,232c of the joining member 230a,230b,230c extends through said first header tube 200 and into the connector block 210, thus providing fluid communication between the second header tube 202 and the connector block 210.

[0026] Again, a radially extending flange 234a,234b, 234c is formed on each joining member 230a,230b,230c between said first and second portions thereof to be positioned, in use, between the first and second header tubes.

[0027] In the second embodiment the connector block 210 comprises a substantially tubular body having an aperture 216 in one end face for receiving end 242 of a delivery or discharge conduit 240 such that said end of the conduit 240 is arranged parallel to the header tubes 200,202. An axial slot 244 is provided in the end of the conduit 240 for receiving the ends of the second portions 232a,232b,232c of the joining member 230a,230b,230c. The conduit 240 is formed with a bend spaced from said end 242. Such arrangement provides a degree of flexibility in the angle of the conduit extending from the manifold to provide more flexibility in installation of the heat exchanger by selecting the circumferential position of the slot 244 in the end of the conduit 240.

[0028] An aperture 205 is provided in an outer side of the connector block through which a tool can be inserted to deform or clinch the central joining member 230b to lock the connector block 210 to the header tubes 200,202, the connecting structure being subsequently sealed by means of brazing or adhesive.

[0029] As shown in Fig. 6, the ends of the header tubes 200,202 are sealed by means of a plug 250.

[0030] In a third embodiment, illustrated in Figs 7 to 9, the connector 310 is again joined to the header tubes 300,302 by means of joining members 330a,330b, 330c, each comprises a tubular body having a first portion 331a, 331b,331c, adapted to be inserted into a corresponding hole 303a,303b,303c formed in a side wall of a second header tube 302, and a second portion 332a,332b,332c, adapted to be inserted through diametrically opposed holes 301a,301b,301c, formed in opposite side walls of the first header tube 300, whereby said second portion 332a,332b,332c of the joining member 330a,330b,330c extends through said first header tube 300 and into the connector block 310, thus providing fluid communication between the second header tube 302 and the connector block 310.

[0031] Again, a radially extending flange 334a,334b, 334c is formed on each joining member 330a,330b,330c between said first and second portions thereof to be positioned, in use, between the first and second header tubes 300,302.

[0032] In the third embodiment , the connector block 310 is adapted to slidingly receive an end 342 of a delivery or discharge conduit 340 over a portion of the connector block 310. An axial slot 344 is provided in the end 342 of the conduit 340 to enable the conduit 340 to be slid over a substantially tubular portion 346 of the connector block 310, the tubular portion 315 having an opening 316 end to enable fluid communication between the conduit 340 and the joining members 330a,330b,330c and hence the second header tube 302.

[0033] An aperture 305 is provided in an outer side of the connector block through which a tool can be inserted to deform or clinch the central joining member 330b to lock the connector block 310 to the header tubes 300,302, the connecting structure being subsequently sealed by means of brazing or adhesive. A plug 350 is inserted into the ends of the header tubes 300,302 to close the tubes.

[0034] A fourth embodiment of the present invention is illustrated in Figs 10 to 13. In the fourth embodiment, the connector block 410 is adapted to provide fluid communication with the header tube 400 to which it is abutted.

[0035] The connector block 410 has a side face 412 configured to abut against a side region 424 of a first header tube 400 and having an elongated row of holes formed in said face 412 for receiving the ends of joining members 430a,430b,430c as will be described below.

[0036] Each joining member 430a,430b,430c comprises a tubular body having a first portion 431 a,431 b, 431 c, adapted to be inserted into a corresponding hole 401 a,401 b,401 c formed in the side region 424 of the first header tube 400, and a second portion 432a,432b, 432c, adapted to be inserted into the corresponding hole in the connector block 410, thus providing fluid communication between the second header tube 102 and the connector block 110. The first portion 431a,431b,431c of each joining member has a smaller diameter than the second portion 432a,432b,432c to limit the insertion of each joining member into its corresponding aperture in the header tube 400.

[0037] An outer face 414 of the connector block 110 is provided with an aperture 416 for receiving a flattened end 442 of a delivery or discharge conduit 440.

[0038] During assembly, the connector block 410 can be secured to the header tubes by inserting a tool through the aperture 416 into at least the central one 430b of the joining members to deform or clinch the end regions of the joining member to lock the components together. The joining members 430a,430b,430c, connector block 410 and the conduit 440 can then be sealed in their respective receiving apertures by brazing or by suitable adhesive.

[0039] The plug 450 serves to close the ends of the header tubes while at the same time holding the two header tubes together at the correct spacing.

[0040] Thus, a compact face connecting structure is provided that can provide a pipe connection with the header tube either the closest or furthest from the connection block by the use of the appropriate joining members.

[0041] Various modifications and variations to the described embodiments of the inventions will be apparent to those skilled in the art without departing from the scope of the invention as defined in the appended claims. Although the invention has been described in connection with specific preferred embodiments, it should be understood that the invention as claimed should not be unduly limited to such specific embodiments.

[0042] While three parallel joining members are used in the described embodiments, it is envisaged that one or more member could be used or a single member in the form of a flattened pipe having a width in the axial direction of the header tubes greater than that in the radial direction of the header tubes. However, multiple small tubes provide greater resistance to high pressure than a single large joining member and thus are considered particularly suitable for use with carbon dioxide refrigerant.

[0043] Where the joining members 330a,330b,330c extend though the first header tube 300 into the second header tube 302, they may be provided with radial apertures in their second portions 332a,332b,332c if fluid communication between the connector block 310 and the first header tube 300 as well as the second header tube 302 is desired.

Claims

1. A pipe connecting structure for a heat exchanger comprising:-

    a header portion or manifold defined by a plurality of parallel elongate header tubes;
    a connector block having a side face adapted to abut against a side region of an outer one of said header tubes and connection means configured to connect a pipe thereto;
    and joining means comprising at least one elongate tubular member having a first end adapted to be inserted through a hole formed in a first side wall of at least said outer one of said header tubes, and a second end extending through a corresponding hole in said side face of the connector block, whereby said second end communicates with said connection means.

2. A pipe connecting structure as claimed in claim 1, wherein the at least one tubular member of the joining means extends substantially perpendicular to said header tubes.

3. A pipe connecting structure as claimed in claim 2, wherein said first end of said at least one elongate tubular member is adapted to extend through a corresponding hole in a second side wall of said outer one of said header tubes diametrically opposite said first side wall and through an aperture in a side wall of the one of said plurality of header tubes furthest from said outer one of said header tubes, whereby said first end communicates with an interior of said furthest one of said header tubes, whereby the at least one tubular member of the joining means extends between, and perpendicular to, said plurality of elongate header tubes to connect the plurality of elongate pipes to one another and to the connector block.

4. A pipe connecting structure as claimed in claim 3, wherein said at least one tubular member of the joining means includes a radially extending flange located between said first and second ends and adapted to be positioned between sides faces of said furthest one of said header tubes and an adjacent header tube.

5. A pipe connecting structure as claimed in claim 4, wherein said header portion comprises two parallel elongate header tubes, a first tube corresponding to said outer one of said header tubes and a second tube corresponding to said furthest one of said header tubes, said radially extending flange being positioned between said first and second tubes.

6. A pipe connecting structure as claimed in claim 2, wherein the diameter of said first end of said at least one tubular member is smaller than the diameter of said second end.

7. A pipe connecting structure as claimed in any preceding claim, wherein the joining means comprises a plurality of parallel tubular members arranged in a plane containing the longitudinal axis of each of the plurality of header tubes of the header portion.

8. A pipe connecting structure as claimed in any preceding claim, wherein the connection means of the connector block is adapted to receive said pipe with said pipe arranged parallel to said plurality of header tubes.

9. A pipe connecting structure as claimed in any of claims 1 to 7, wherein the connection means of the connector block is adapted to receive said pipe with the pipe arranged perpendicular to said plurality of header tubes.

10. A pipe connecting structure as claimed in any preceding claim, wherein said connection means comprises a flange or stub to be received within an end of the pipe.

11. A pipe connecting structure as claimed in any preceding claim, wherein the connection means comprises an aperture for receiving an end of the pipe.

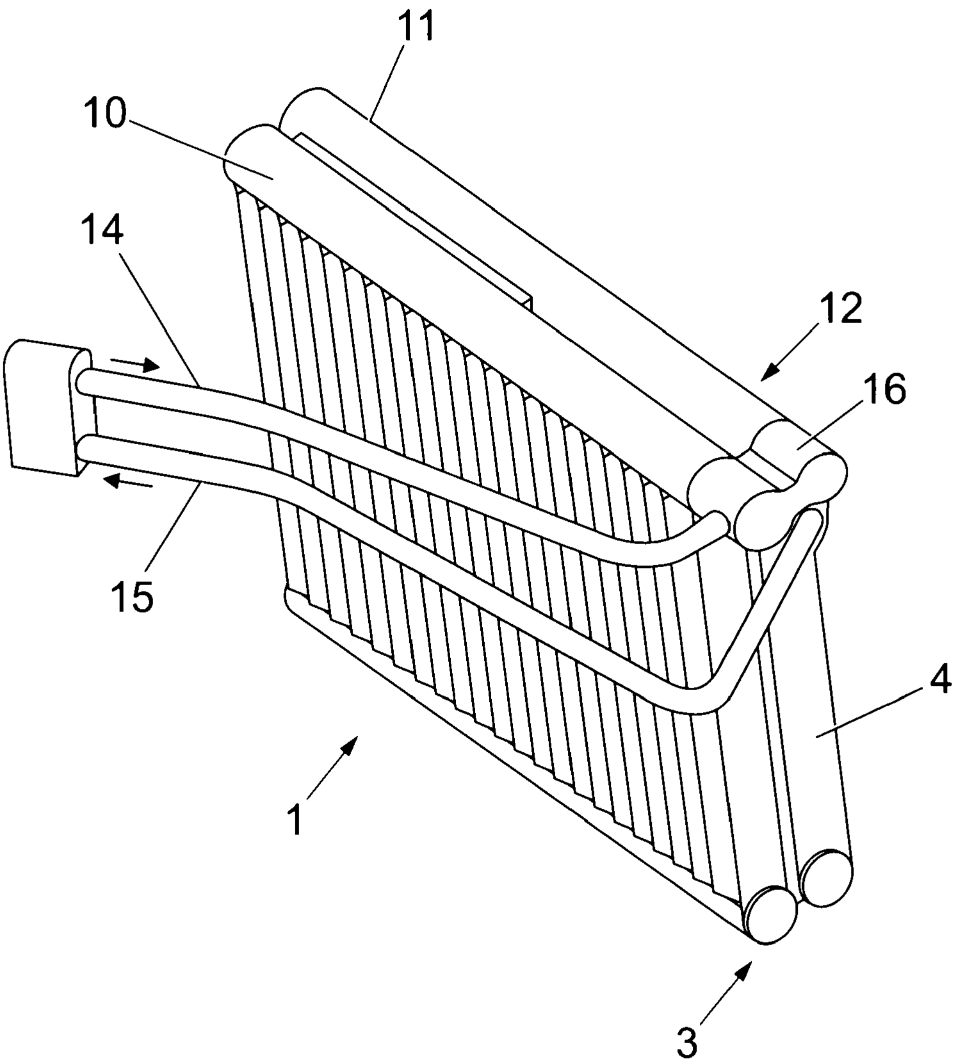

Fig. 1

Prior Art

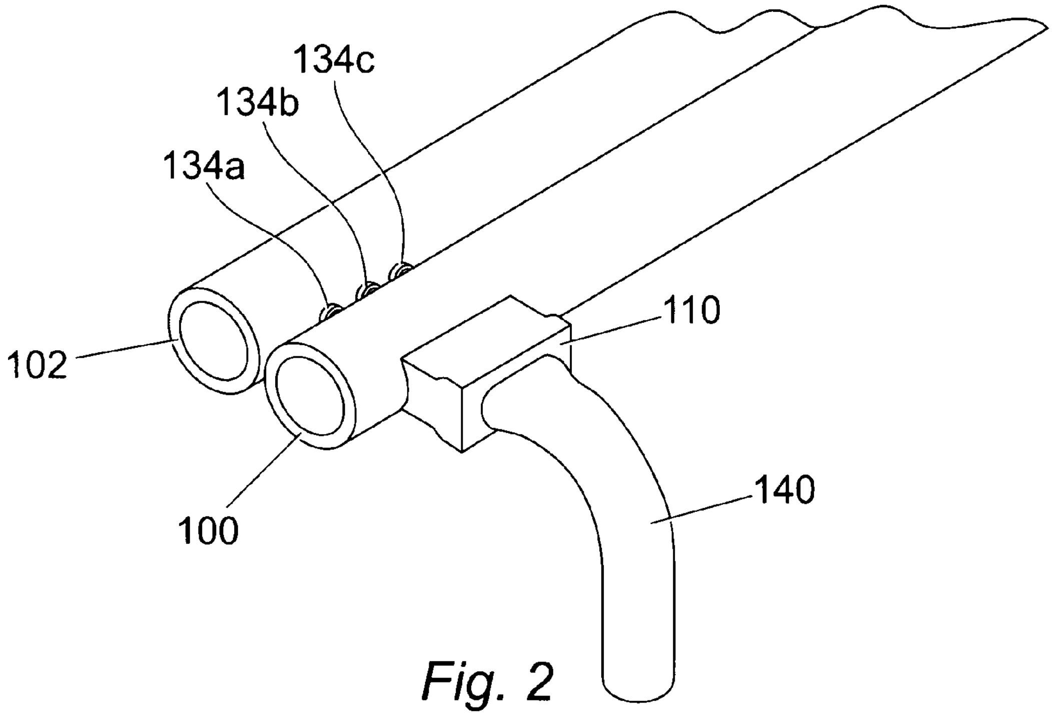
134c
134b
134a
110
102
100
140

Fig. 2

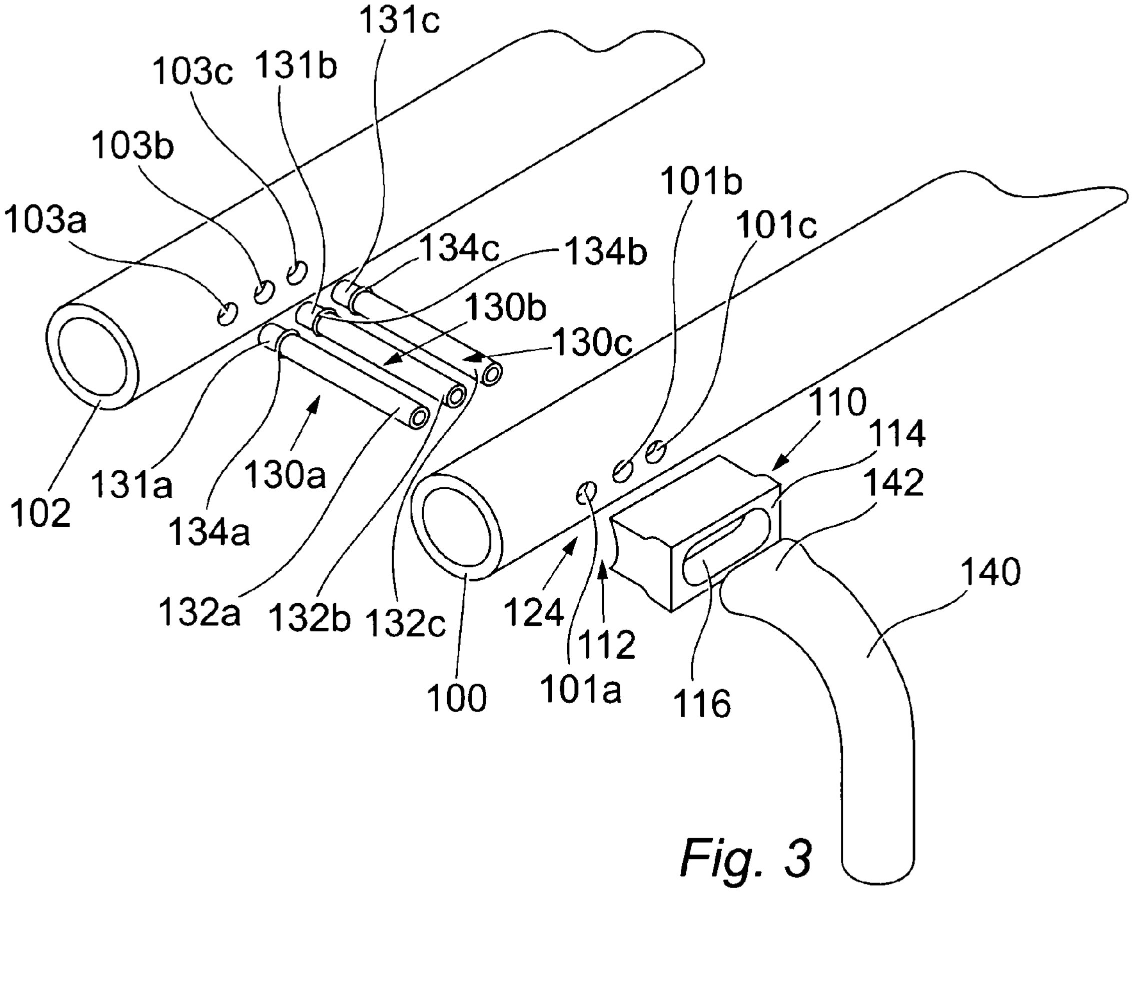
131c
103c
131b
103b
103a
101b
101c
134c
134b
130b
130c
110
114
142
102
131a
130a
134a
132a
132b
132c
100
124
112
101a
116
140

Fig. 3

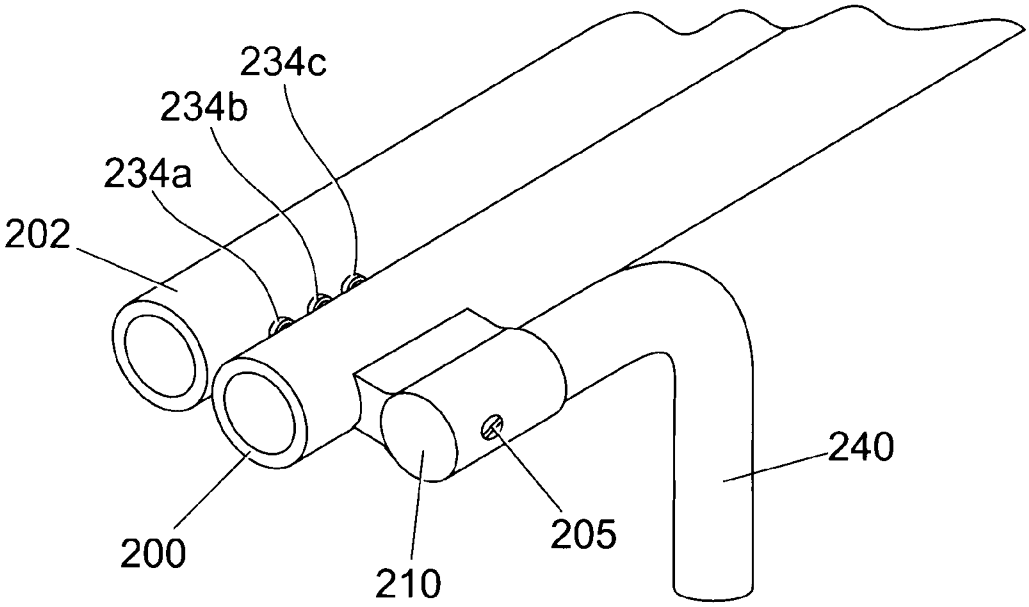
234c
234b
234a
202
240
200
205
210

Fig. 4

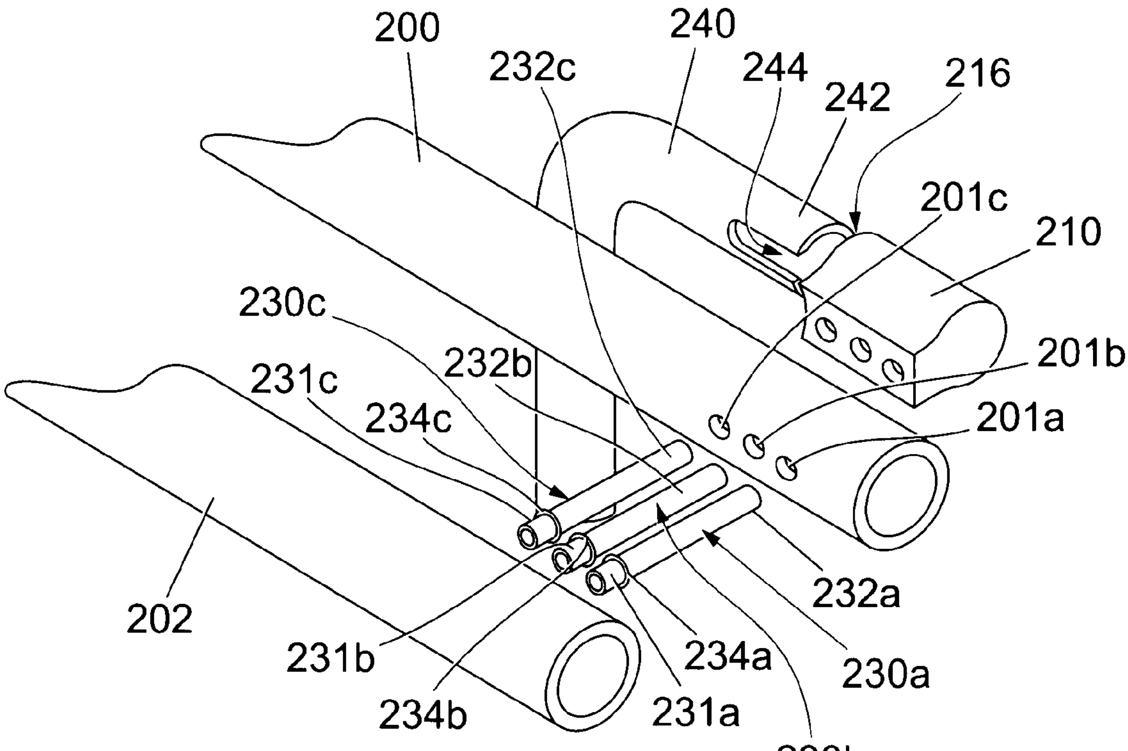
200
240
232c
244
242
216
201c
210
230c
232b
231c
234c
201b
201a
232a
202
231b
234a
230a
234b
231a
230b

Fig. 5

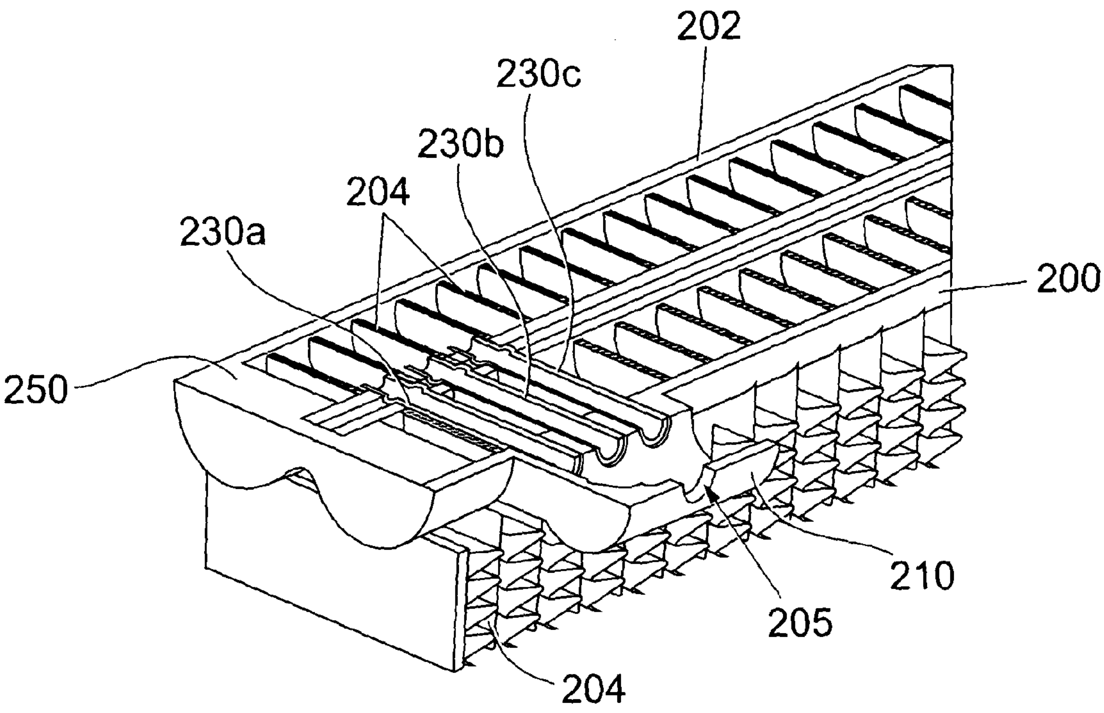
202
230c
230b
204
230a
200
250
210
205
204

Fig. 6

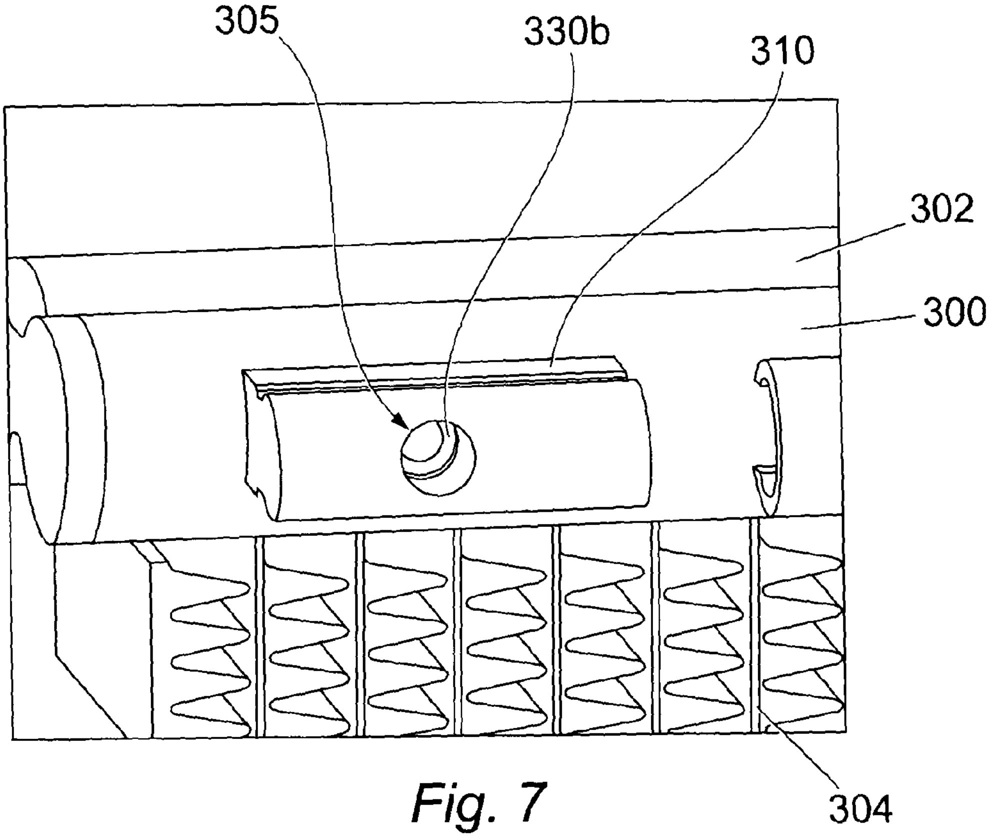
305
330b
310
302
300
304

Fig. 7

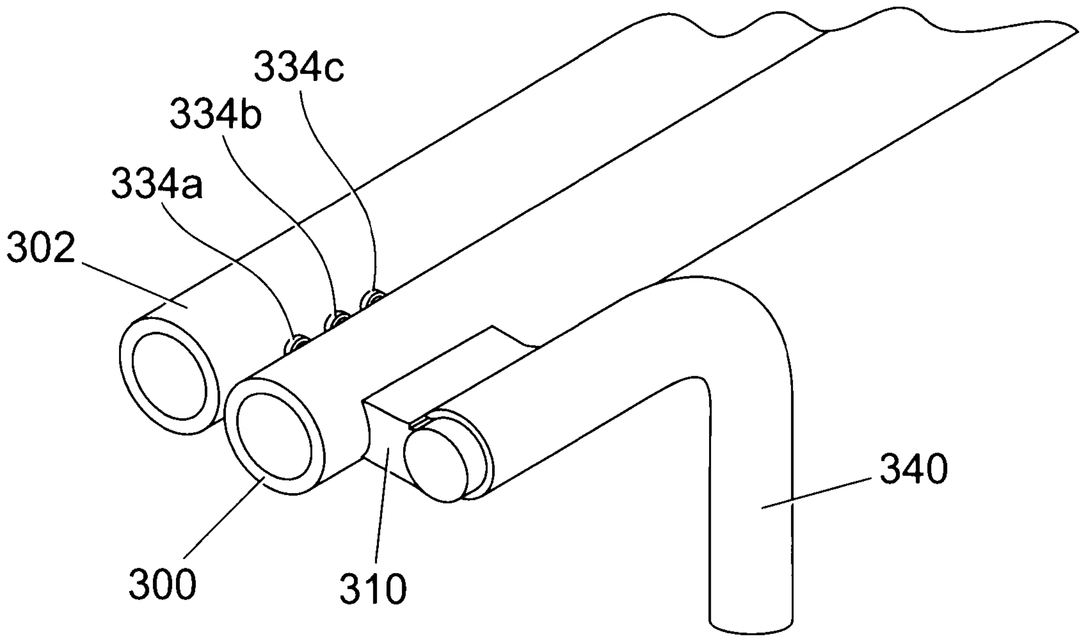
334c
334b
334a
302
340
300
310

Fig. 8

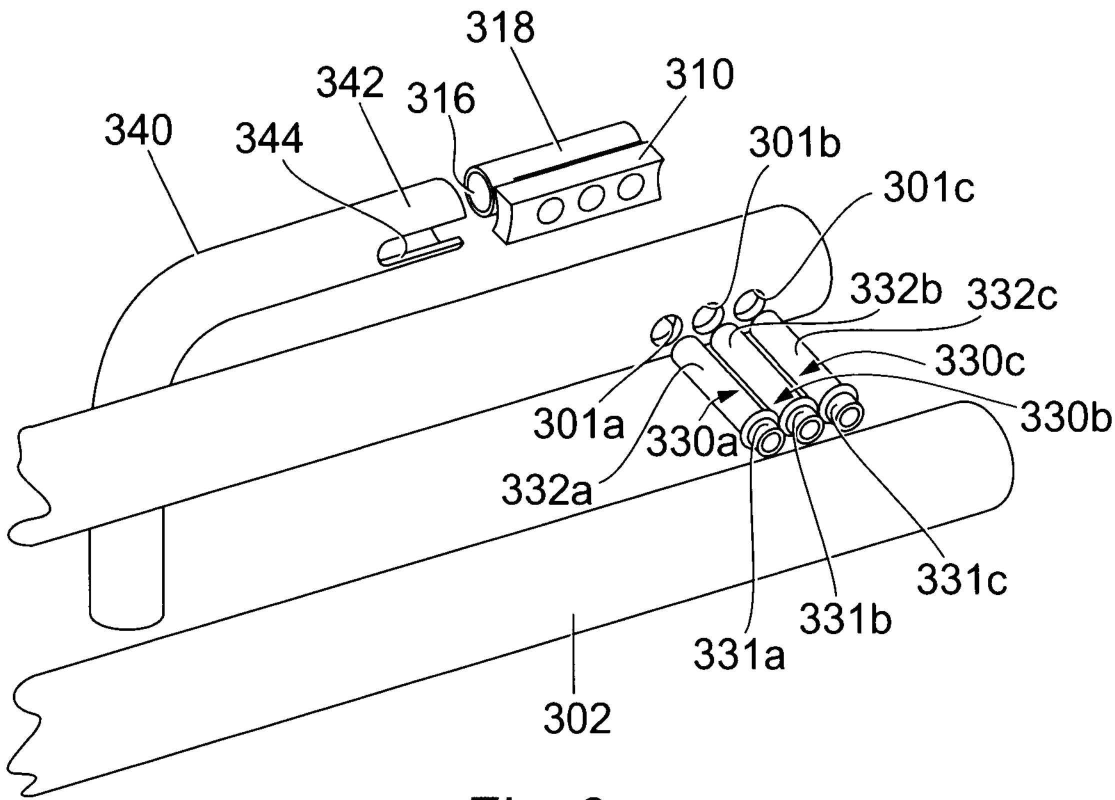
318
342
316
310
340
344
301b
301c
332b
332c
330c
301a
330a
330b
332a
331c
331b
331a
302

Fig. 9

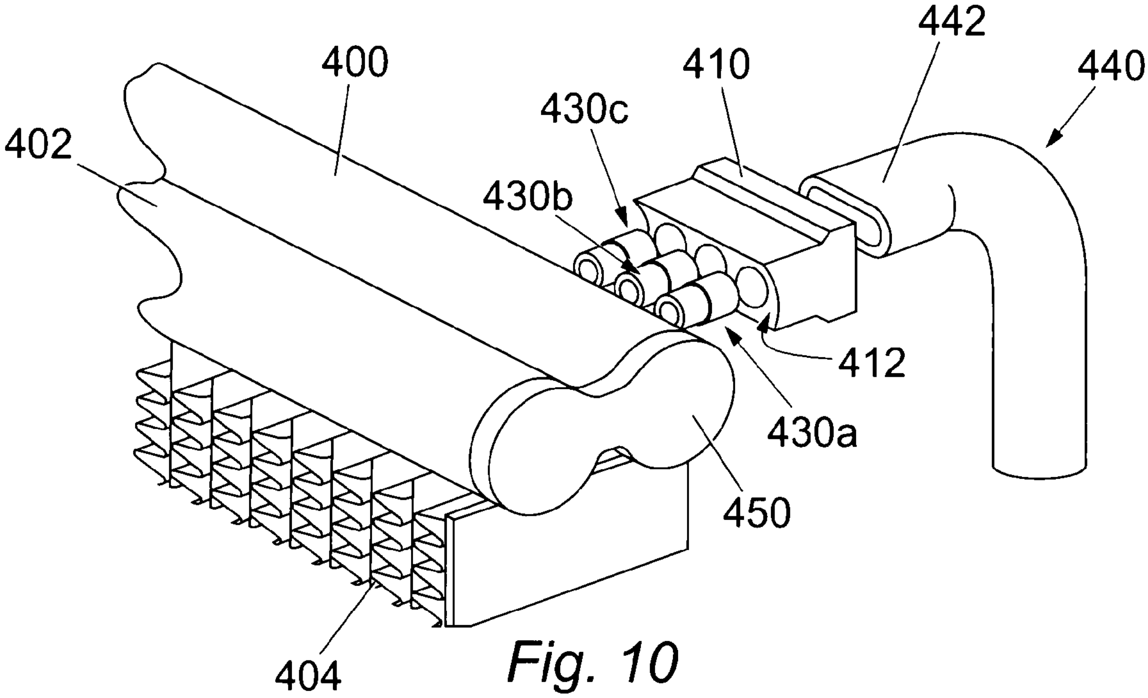
400
442
410
440
430c
402
430b
412
430a
450
404

Fig. 10

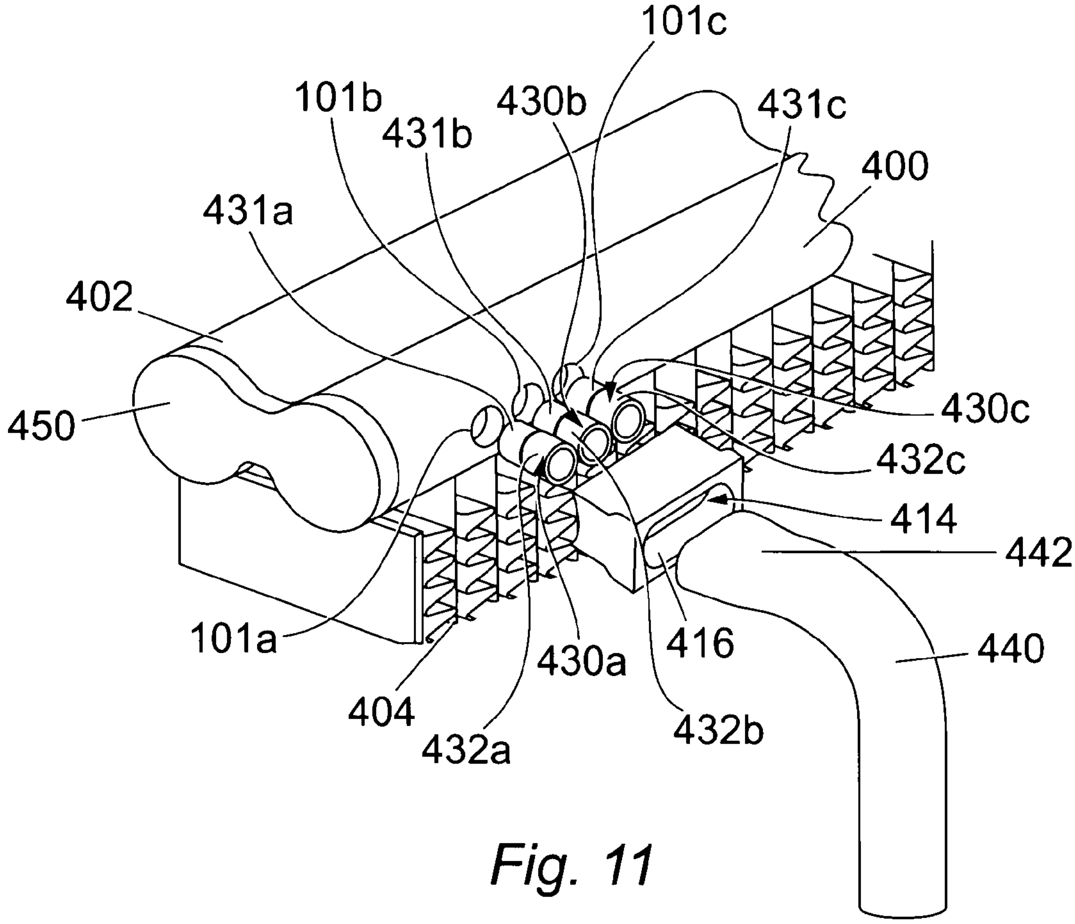
101c
101b
430b
431c
431b
400
431a
402
430c
450
432c
414
442
101a
430a
416
440
404
432b
432a

Fig. 11

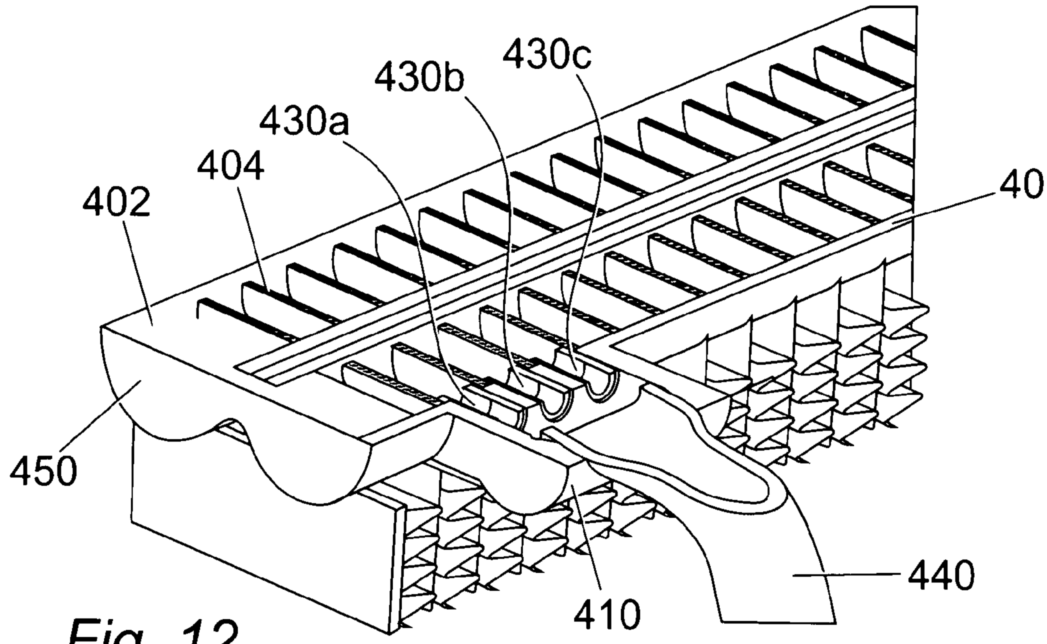
430b
430c
430a
404
402
400
450
440
410

Fig. 12

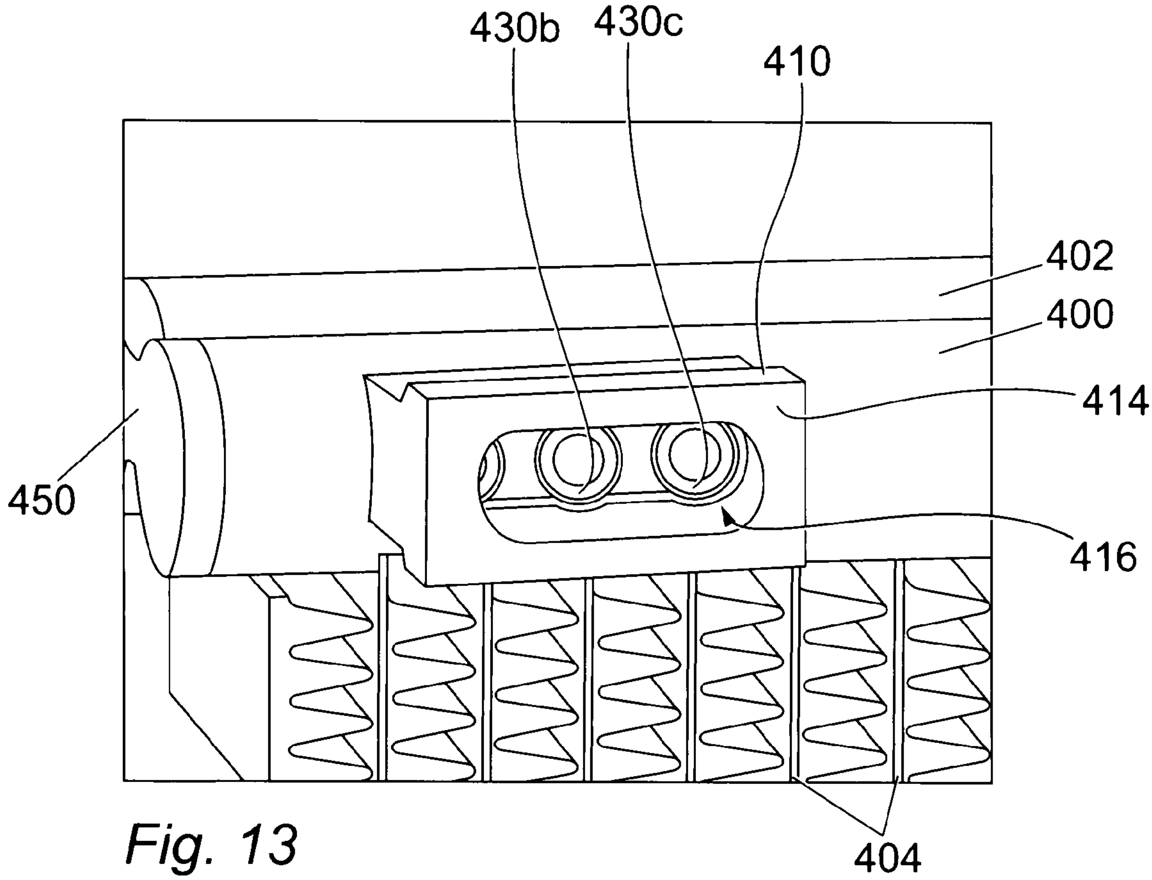
430b
430c
410
402
400
414
450
416
404

Fig. 13

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 06 25 6220

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A	DE 101 33 940 A1 (BEHR GMBH & CO [DE]) 23 January 2003 (2003-01-23) * the whole document * -----	1-11	INV. F28F9/04 B60H1/00
A	EP 1 710 529 A (FRAPE BEHR SA [ES]) 11 October 2006 (2006-10-11) * the whole document * -----	1-11	
A	US 2005/275219 A1 (HIYAMA JINICHI [JP] ET AL) 15 December 2005 (2005-12-15) * the whole document * -----	1-11	
			TECHNICAL FIELDS SEARCHED (IPC)
			B60H F28F

The present search report has been drawn up for all claims

1

Place of search	Date of completion of the search	Examiner
Munich	25 April 2007	Chavel, Jérôme

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 06 25 6220

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

25-04-2007

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
DE 10133940 A1	23-01-2003	NONE	
EP 1710529 A	11-10-2006	WO 2006102951 A1	05-10-2006
US 2005275219 A1	15-12-2005	JP 2004347210 A	09-12-2004

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82