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(54) A spiral heat exchanger

(57) A spiral heat exchanger (1) including a spiral body (2) formed by at least one spiral sheet wounded to form the spiral body (2) forming at least a first spiral-shaped flow channel for a first medium and a second spiral-shaped flow channel for a second medium, wherein the spiral body (2) is enclosed by a substantially cylindrical shell (4) being provided with connecting elements (8a, 8b, 9a, 9b) communicating with the first flow channel and the second flow channel, where the spiral body (2) is provided with at least one fixedly attached divider (3) on its outer peripheral surface, whereupon the at least two shell parts (4a, 4b) are fixedly attached, where the at least one fixedly attached divider (3) creates two separate flow channels between the outer peripheral surface of the spiral body (2) and the substantially cylindrical shell (4).

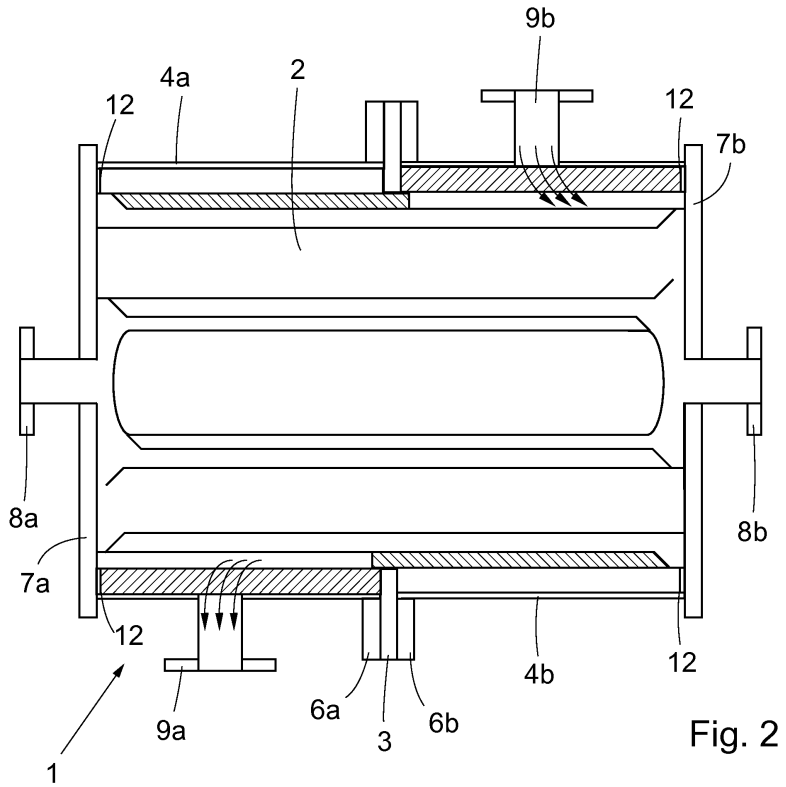

Fig. 2

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Description

AREA OF INVENTION

[0001] The present invention refers generally to spiral heat exchangers allowing a heat transfer between two fluids at different temperatures for various purposes. Specifically, the invention relates to a spiral heat exchanger being so that the inlet/outlets of the spiral body on the external shell are divided.

BACKGROUND OF INVENTION

[0002] Conventionally, spiral heat exchangers are manufactured by means of a winding operation. The two sheets are welded together at a respective end, wherein the welded joint will be comprised in a center portion of the sheets. The two sheets are wound around one another by use of a retractable mandrel or the like to form the spiral element of the sheets so as to delimit two separate passages or flow channels. Distance members, having a height corresponding to the width of the flow channels, may be attached to the sheets to allow the spiral heat exchanger to withstand higher pressures.

[0003] After retraction of the mandrel, two inlet/outlet channels are formed in the center of the spiral element. The two channels are separated from each other by the center portion of the sheets. A shell is formed by the outer turn of the welded of the spiral element. The side ends of the spiral element are processed, wherein the spiral flow channels may be laterally closed at the two side ends in various ways. Typically, a cover is attached to each of the ends. One of the covers may include two connection pipes extending into the center and communicating with a respective one of the two flow channels. At the radial outer ends of the spiral flow channels a respective header is welded to the shell or the spiral element form an outlet/inlet member to the respective flow channel. Alternatively, one single sheet is used for the manufacturing of the heat exchanger.

[0004] One problem with the conventional spiral heat exchangers is that when both the flow channels for fluids end at the last turn of the spiral the flow channels needs to be sealed off from each other and to be connected to each connection. The sealing between the flow channels on the outer turn creates a half turn for a first fluid channel and another half turn for a second flow channel potentially giving balance problems. Another problem related to this is the connections that are arranged directly on the spiral body giving extra fatigue problems.

DISCLOSURE OF INVENTION

[0005] The object of the present invention is to overcome the problems mentioned above with the prior art spiral heat exchangers. More specifically, it is aimed at a spiral heat exchanger which is better balanced and more resistant to thermal fatigue, flexible to different applications and where the parts of the spiral heat exchanger can be manufactured in parallel.

[0006] This object is achieved by a spiral heat exchanger including a spiral body formed by at least one spiral sheet wounded to form the spiral body forming at least a first spiral-shaped flow channel for a first medium and a second spiral-shaped flow channel for a second medium, wherein the spiral body is enclosed by a substantially cylindrical shell being provided with connecting elements communicating with the first flow channel and the second flow channel, where the shell comprises at least two shell parts, and that the spiral body is provided with at least one fixedly attached divider on its outer peripheral surface, whereupon the at least two shell parts are fixedly attached, where the at least one fixedly attached divider creates two separate flow channels between the outer peripheral surface of the spiral body and the substantially cylindrical shell.

[0007] According a further aspect of the invention the divider is a flange arranged on the outer periphery of the spiral body.

[0008] According a further aspect of the invention the flange of the spiral body is symmetrically arranged at the centre of the spiral body having an equal distance to the ends of the spiral body from the at least one flange.

[0009] According another aspect of the invention the flange of the spiral body is asymmetrically arranged on the peripheral of the spiral body having a different distance to the ends of the spiral body from the at least one flange.

[0010] The at least one flange of the spiral body divides the outermost space of the spiral heat exchanger into at least two spaces, the outer most spaces being defined by the outer peripheral of the spiral body and the at least two shell parts at the location of the flange in respect of the ends of the spiral body.

[0011] The location of the flange along the peripheral of the spiral body allows control of the velocity of the mediums of the spiral heat exchanger.

[0012] According another aspect of the invention each shell is provided two connecting elements communicating with one of the two flow channels, and each shell is provided with one connecting element on its peripheral surface and with one connecting element arranged on one of its end surfaces for communication with one of the two flow channels.

[0013] According yet another aspect of the invention the at least two shell parts are each provided with a lid arranged at an open end of the at least two shell parts for closing the spiral heat exchanger.

[0014] Further aspects of the invention is apparent from the dependent claims and the description

BRIEF DESCRIPTION OF THE DRAWINGS

[0015] Further objects, features and advantages will appear from the following detailed description of several embodiments of the invention with reference to the draw-

ings, in which:

Fig. 1 is an exploded view of a spiral heat exchanger according to the present invention;
Fig. 2 is a cross sectional view of a spiral heat exchanger according to the present invention;
Fig. 3 shows a spiral heat exchanger according to the present invention being vertically mounted; and
Fig. 4 shows a spiral heat exchanger according to the present invention being horizontally mounted.

DETAILED DESCRIPTION OF EMBODIMENTS

[0016] A spiral heat exchanger includes at least two spiral sheets extending along a respective spiral-shaped path around a common centre axis and forming at least two spiral-shaped flow channels, which are substantially parallel to each other, wherein each flow channel includes a radially outer orifice, which enables communication between the respective flow channel and a respective outlet/inlet conduit and which is located at a radially outer part of the respective flow channel with respect to the centre axis, and a radially inner orifice, which enables communication between the respective flow channel and a respective inlet/outlet chamber, so that each flow channel permits a heat exchange fluid to flow in a substantially tangential direction with respect to the centre axis, wherein the centre axis extends through the inlet/outlet chambers at the radially inner orifice. Distance members, having a height corresponding to the width of the flow channels, may be attached to the sheets to enable the spiral heat exchanger to operate with higher pressure of the working fluids.

[0017] In Fig. 1 is shown an exploded view of a spiral heat exchanger 1 according to the present invention. The spiral heat exchanger 1 includes a spiral body 2, formed in a conventional way by winding two sheets of metal around a retractable mandrel, but it can also be formed in other ways. The sheets may be provided with studs or distance member (not shown) attached to the sheets or formed in the surface of the sheets. The studs or distance members serve to form the flow channels between the sheets and have a height corresponding to the width of the flow channels. In the drawing the spiral body 2 only has been schematically shown with a number of wounds, but it is obvious that it may include further wounds and that the wounds are formed from the centre of the spiral body 2 all the way out to the peripheral of the spiral body 2. Onto a central or middle portion of an outer peripheral of the spiral body 2 a flange 3 has been attached. The spiral body 2 is enclosed by a shell 4, which comprises two separate shell part 4a and 4b, and two covers 7a, 7b. Each of the shell parts 4a and 4b encloses one half of the spiral body 2. The covers 7a, 7b, which are flexibly mounted on the shell parts 4a, 4b, seal off the open ends of the spiral body 2. The flange 3 is typically a divider ring attached to the spiral body 2 by welding, by other means are also possible.

[0018] The shell part 4a is formed as a cylinder having an first end 5a, the first end 5a being provided with a flange 6a corresponding to the flange 3 of the spiral body 2 and enabling the shell part 4a to be attached to the flange 3. The second end portion 17a of the shell parts 4a is closed by the cover 7a having a first connection element 8a centrally attached. To the mantle of the shell part 4a is attached a second connection element 9a. The shell part 4b is substantially identical to the shell part 4a having a first end 5b with a flange 6b, a second end portion 17b closed by the cover 7a having a first connection element 8b and a second connection element 9b attached to the mantle of the shell part 4b. The connection elements 8a-b and 9a-9b are typically welded to the shell parts and are all provided with a flange for connecting the spiral heat exchanger 1 to a piping arrangement of the system of which the spiral heat exchanger 1 is a part of.

[0019] The spiral heat exchanger 1 is further provided with gaskets 10a, 10b, each gasket being arranged between the end portions 11a, 11b of the spiral body 2 and the inner surface of the covers 7a, 7b, respectively, to seal off from external leakage and bypass between different turns of the same flow channel. The gasket 10a, 10b, can be formed as a spiral similar to the spiral of the spiral body 2, is then squeezed onto each wound of the spiral body 2. Alternatively the gaskets 10a, 10b are squeezed between the spiral body 2 and the inner surface of the covers 7a, 7b. The gaskets can also be configured in other ways as long as the sealing effect is achieved.

[0020] The lids or end covers 7a, 7b are normally removably attached to the spiral heat exchanger 1 by hook bolts or similar, but they can also be fixedly attached by e.g. welding.

[0021] In Fig. 2 a cross sectional view of the spiral heat exchanger 1 according to the invention is shown.

[0022] The flange 3 enables that each of the flow channels encircles the outer turn of the spiral body 2, thus avoiding balance problems, and the flange 3 prevents mixing of the fluids in the flow channels.

[0023] If the spiral heat exchanger 1 is vertically mounted, i.e. covers 7a, 7b are directed upwards and downwards, respectively, and where the inlet A1, B1 and outlet A2, B2 to each flow channel are located on different sides in respect of flange 3 of the shell 4 (see Fig. 3), closing plates 12 are added to totally close the outer turn of the spiral body 2. The closing plates are located at the end of the spiral body 2, adjacent to the covers 7a, 7b, respectively. To also seal off the other wounds of the flow channels from each other the outermost edges of the spiral body 2 are folded or bent so that every second wound opening is closed and that the fold or bent is welded to secure the closure. This is done alternately on the two ends of the spiral body 2.

[0024] In horizontally mounted spiral heat exchanger 1, there is no need for closing plates since the inlet A1, B1 and outlet A2, B2 connections are arranged on the same side in respect of flange 3 of the shell 4 (see Fig. 4).

[0025] Although it has not been mentioned expressly it clear for a man skilled in the art that the outer surface of the spiral body may be provided with studs or distance members (not shown) that supports against the inner surface of the shell to resist the pressure of the working fluids of the spiral heat exchanger. Depending on the pressure differential between the two fluids one or both halves of the spiral body can be provided with studs.

[0026] The functionality of the spiral heat exchanger 1 of Fig. 2 is as follows: A first medium enters the spiral heat exchanger 1 through the first connection element 8a formed as an inlet and where first connection element 8a is connected to a piping arrangement. The first connection element 8a communicates with a first flow channel of the spiral body 2 and the first medium is transported through the first flow channel to the second connection element 9a formed as an outlet, where the first medium leaves the spiral heat exchanger 1. The second connection element 9a is connected to a piping arrangement for further transportation of the first medium.

[0027] A second medium enters spiral heat exchanger 1 through the second connection element 9b formed as an inlet, the second connection element 9b being connected to a piping arrangement. The second connection element 9b communicates with a second flow channel of the spiral body 2 and the first medium is transported through the second flow channel to the first connection element 8b formed as an outlet, where the second medium leaves the spiral heat exchanger 1. The first connection element 8b is connected to a piping arrangement for further transportation of the second medium.

[0028] Inside the spiral body 2 a heat exchange will occur between the first and second medium, so that one medium is heated and the other medium is cooled. Depending on the specific use of the spiral heat exchanger 1 the selection of the two mediums will vary. In the above it has been described as the two mediums circulate in opposite directions through the spiral heat exchanger 1, but it is apparent that they may also circulate parallel directions.

[0029] As shown by Figs. 3-4 the spiral heat exchanger 1 according to the present invention can be set up differently depending on the specific application (vertically or horizontally mounted) of the spiral heat exchanger 1.

[0030] As the flange 3 divides the outer surface or peripheral of the spiral body 2 into two separate chambers the distribution of the medium will be improved as the medium will only need to distribute on the half of the length of the spiral body 2.

[0031] Since the shell 4 of the spiral heat exchanger 1 according to the invention is provided as two separate and independent shell parts 4a, 4b it is possible to using different materials for the two shell parts 4a, 4b.

[0032] An advantage by having the connection elements only attached to the shell 4 and not being in contact with the spiral body 2, which otherwise is the normal construction of spiral heat exchangers, is that the thermal fatigue or stress is significantly reduced.

[0033] The spiral heat exchanger according to the present invention benefits among many things in that it has better balance, the distribution is improved, the thermal fatigue is reduced and the manufacturing of the spiral heat exchanger is faster and cheaper since the shell and spiral body can be manufactured in parallel.

[0034] In the above description the term connecting element has been used as an element connected to spiral heat exchanger and more specifically to the flow channels of the spiral heat exchanger, but it should be understood that the connecting element is a connection pipe or similar that typically are welded onto the spiral heat exchanger and may include means for connecting further piping arrangements to the connecting element.

[0035] The invention is not limited to the embodiments described above and shown on the drawings, but can be supplemented and modified in any manner within the scope of the invention as defined by the enclosed claims.

Claims

1. A spiral heat exchanger (1) including a spiral body (2) formed by at least one spiral sheet wounded to form the spiral body (2) forming at least a first spiral-shaped flow channel for a first medium and a second spiral-shaped flow channel for a second medium, wherein the spiral body (2) is enclosed by a substantially cylindrical shell (4) being provided with connecting elements (8a, 8b, 9a, 9b) communicating with the first flow channel and the second flow channel, **characterized in that** the spiral body (2) is provided with at least one fixedly attached divider (3) on its outer peripheral surface, whereupon the at least two shell parts (4a, 4b) are fixedly attached, where the at least one fixedly attached divider (3) creates two separate flow channels between the outer peripheral surface of the spiral body (2) and the substantially cylindrical shell (4).

2. A spiral heat exchanger (1) according to claim 1, wherein the divider is a flange (3) arranged on the outer periphery of the spiral body (2).

3. A spiral heat exchanger (1) according to claim 2, wherein the flange (3) of the spiral body (2) is symmetrically arranged at the centre of the spiral body (2) having an equal distance to the ends (11a, 11b) of the spiral body (2) from the at least one flange (3).

4. A spiral heat exchanger (1) according to claim 2, wherein the flange (3) of the spiral body (2) is asymmetrically arranged on the peripheral of the spiral body (2) having a different distance to the ends (11a, 11b) of the spiral body (2) from the at least one flange (3).

5. A spiral heat exchanger (1) according to any of

claims 3 or 4, wherein the at least one flange (3) of the spiral body (2) divides the outermost space of the spiral heat exchanger (1) into at least two spaces, the outer most spaces being defined by the outer peripheral of the spiral body (2) and the at least two shell parts (4a, 4b).

6. A spiral heat exchanger (1) according to claim 2, wherein each shell (4a, 4b) is provided two connecting elements (8a, 9a, 8b, 9b) communicating with one of the two flow channels.

7. A spiral heat exchanger (1) according to claim 6, wherein each shell (4a, 4b) is provided with one connecting element (9a, 9b) on its peripheral surface and with one connecting element (8a, 8b) arranged on one of its end surfaces (7a, 7b) for communication with one of the two flow channels.

8. A spiral heat exchanger (1) according to claim 1, wherein the at least two shell parts (4a, 4b) are each provided with a lid (7a, 7b) arranged at an open end (17a, 17b) of the at least two shell parts (4a, 4b) for closing the spiral heat exchanger (1).

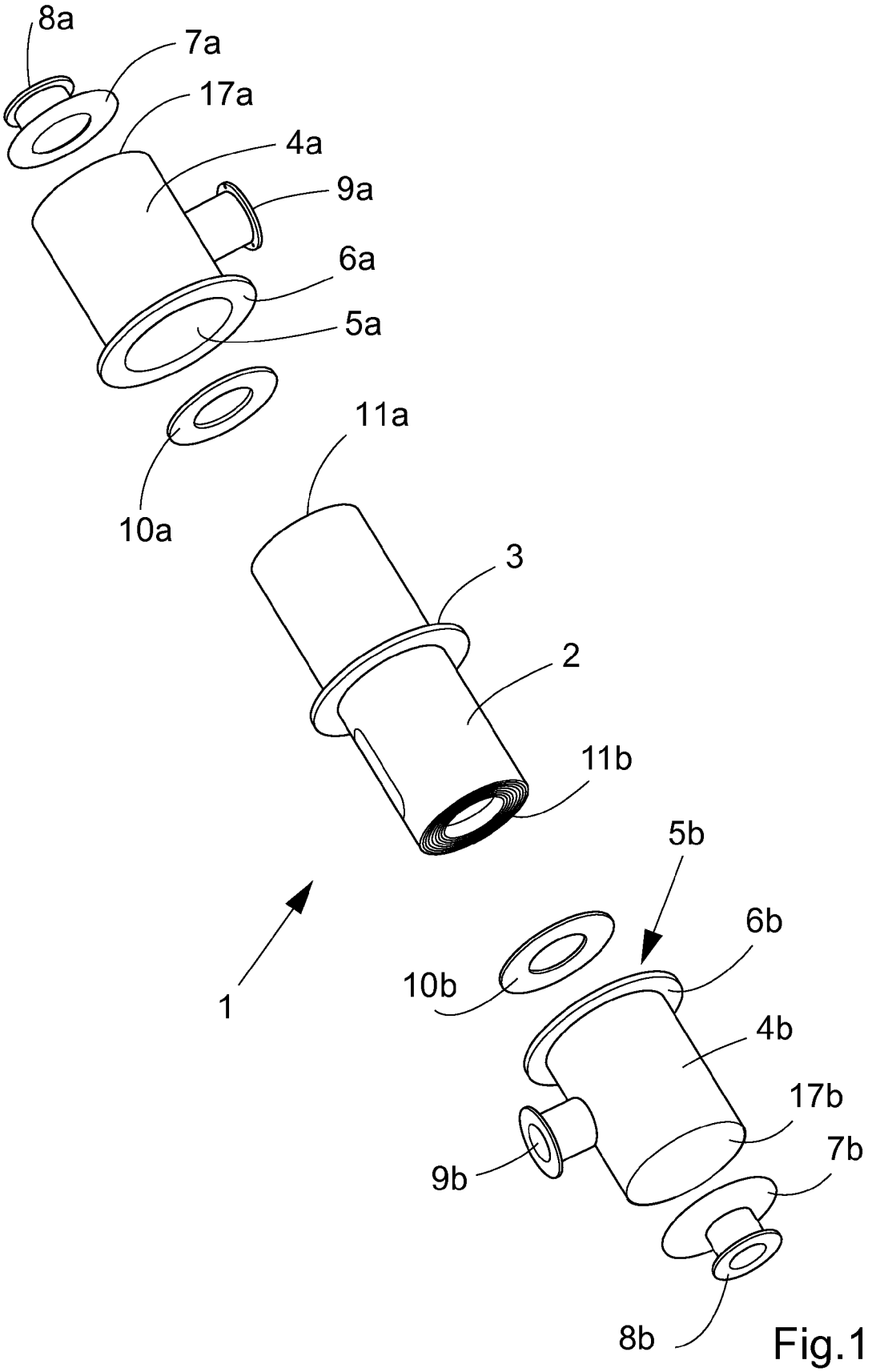

Fig.1

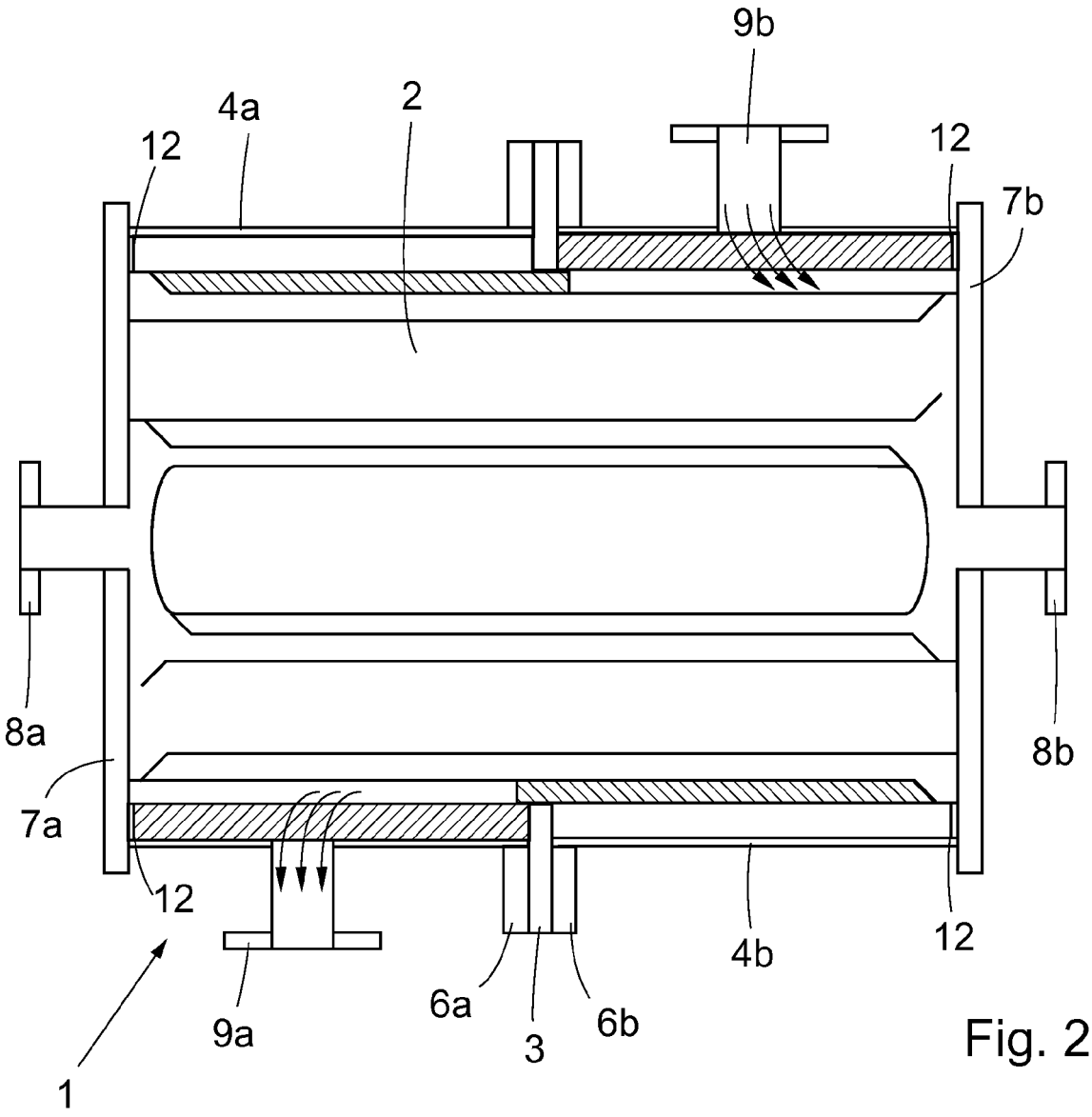

Fig. 2

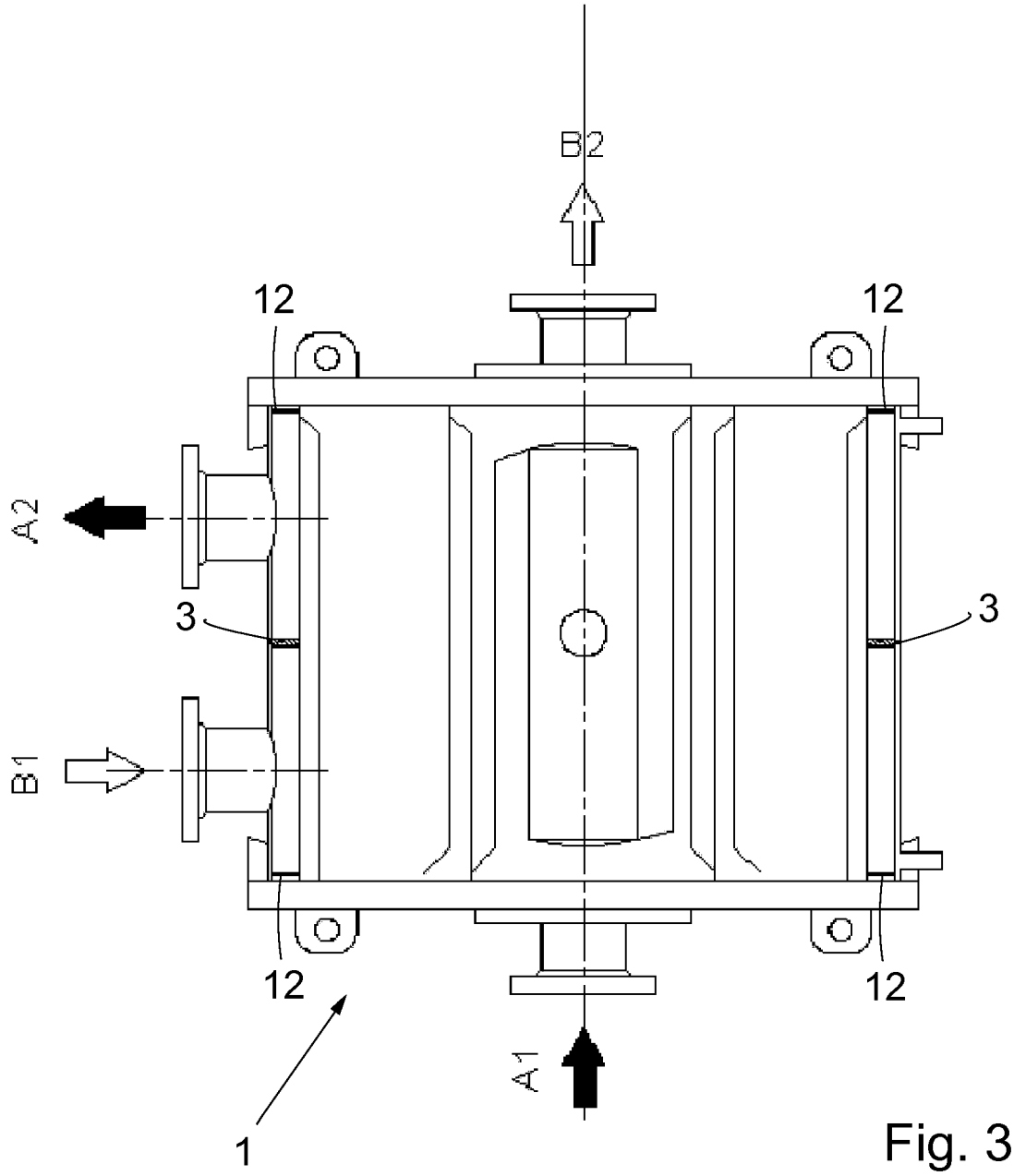

Fig. 3

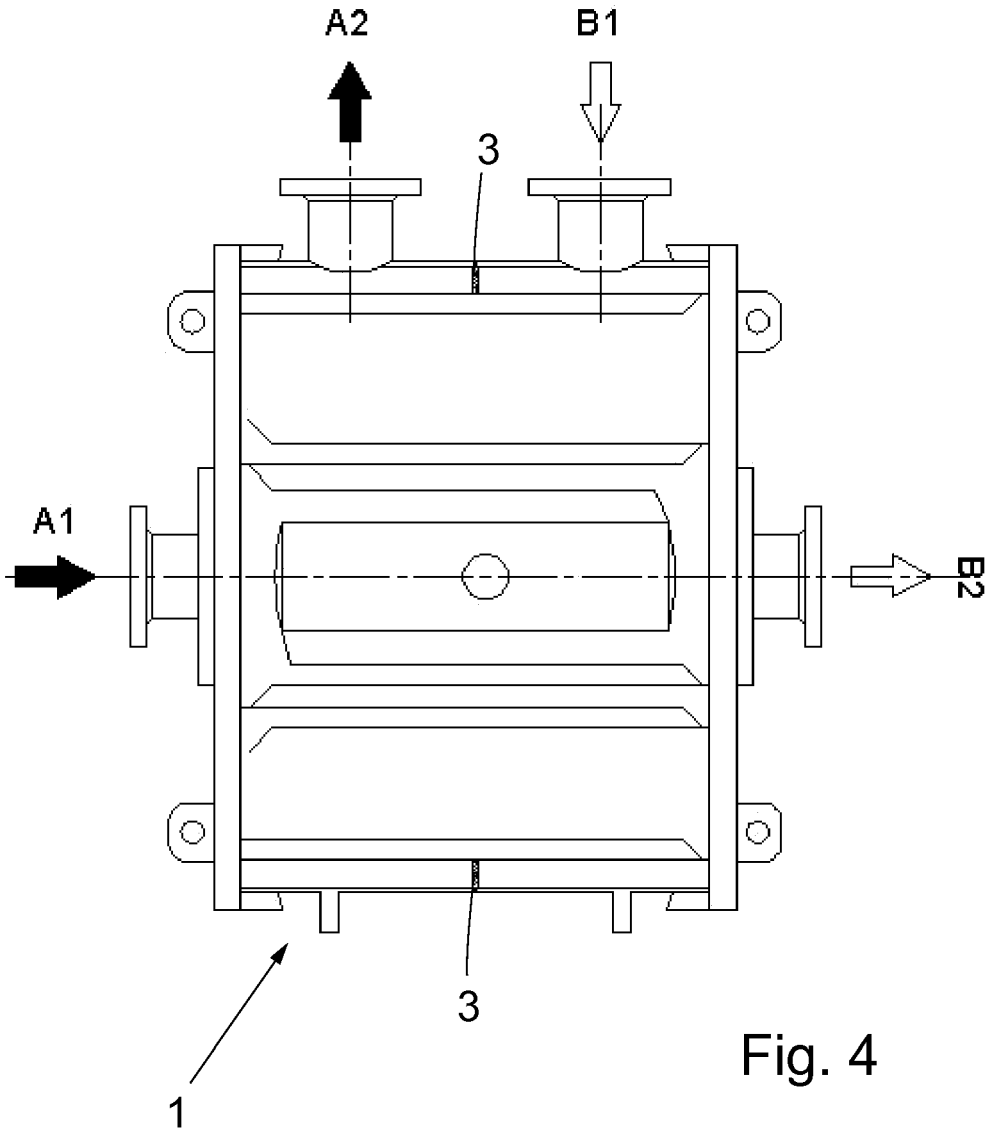

Fig. 4

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EUROPEAN SEARCH REPORT

Application Number
EP 09 16 2467

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
E	EP 2 071 264 A (ALFA LAVAL SPIRAL SNC [FR]; ALFA LAVAL CORP AB [SE]) 17 June 2009 (2009-06-17) * figures 1,2 *	1-8	INV. F28D9/04 F28F9/00
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A	DE 27 44 002 A1 (HOECHST AG) 12 April 1979 (1979-04-12) * page 8, paragraph 4; figure 3 *	1-8	
A	GB 776 529 A (ROSENBLADS PATENTER AB) 5 June 1957 (1957-06-05) * figure 4 *	1-8	

TECHNICAL FIELDS SEARCHED (IPC)

F28D
F28F

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	18 November 2009	Martínez Rico, Celia

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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A : technological background
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EPO FORM 1503 03.82 (P04C01)

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 09 16 2467

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
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18-11-2009

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