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(71) Applicant: **Valeo Systemes Thermiques**
78322 Le Mesnil Saint-Denis Cedex (FR)

(72) Inventor: **BRITO MARTINS, Carlos**
78322 LE MESNIL SAINT DENIS CEDEX (FR)

(74) Representative: **Tran, Chi-Hai**
Valeo Systèmes Thermiques
8, rue Louis Lormand
CS 80517 La Verrière
78322 Le Mesnil Saint Denis Cedex (FR)

(54) A HEAT EXCHANGER

(57) The subject of an invention is, among others, a heat exchanger for a motor vehicle air conditioning system comprising: a first loop, a second loop being fluidly isolated from the first loop, and a container being fluidly isolated from the first loop and the second loop. The container remains in thermal cooperation with the first loop and the second loop by the means of volatile medium contained within the container.

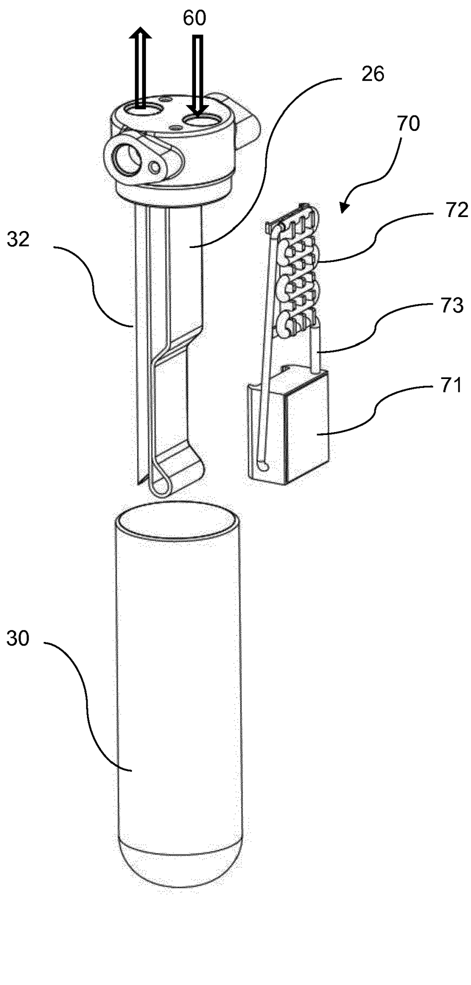

Fig. 3

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Description

FIELD OF THE INVENTION

[0001] The invention relates to a heat exchanger for motor vehicle, in particular for an internal heat exchanger.

BACKGROUND OF THE INVENTION

[0002] Motor vehicles are commonly equipped with a heating, ventilation and/or air conditioning system in order to regulate the aerothermal parameters of the air contained in the vehicle interior. Such a system cooperates with an air conditioning loop in order to cool the air flow before it is discharged from the casing to the vehicle interior. The loop includes a plurality of elements in which a refrigerant, such as a supercritical fluid, in particular carbon dioxide known as R744, circulates. These elements include at least one compressor, a gas cooler, an internal heat exchanger, an expansion member, an evaporator and an accumulator.

[0003] The refrigerant circulates from the compressor to the gas cooler, then through a "highpressure" (HP) loop of the internal heat exchanger, then to the expansion member, then through the evaporator, then to the accumulator, and finally through a "low pressure" (LP) loop of the internal heat exchanger, in order to return to the compressor. The compressor is intended to receive the refrigerant in the gaseous state and to compress it in order to bring it to high pressure. The gas cooler is capable of cooling the compressed refrigerant, at a relatively constant pressure, by transferring the heat to the environment. The expansion member is capable of reducing the pressure of the refrigerant leaving the gas cooler by bringing it at least partially to the liquid state. The evaporator is suitable for converting the refrigerant from the gaseous state to the liquid state coming from the expansion member, at a relatively constant pressure, by drawing heat in said air flow passing through the evaporator. The vaporized refrigerant is then suctioned by the compressor. These arrangements are such that the refrigerant is at high pressure inside the HP loop of the internal heat exchanger while it is at low pressure inside the LP loop of the internal heat exchanger.

The air conditioning HP loop includes a line that begins at the outlet of the compressor and ends at the inlet of the expansion member, according to a direction of circulation of the refrigerant inside the air conditioning loop, in which the gas cooler and the HP loop of the heat exchanger are inserted between these two points. The air conditioning loop also includes a LP line that beings at the outlet of the expansion member and ends at the inlet of the compressor, according to the direction of circulation of the refrigerant inside the air conditioning loop, in which the evaporator, the accumulator and the LP loop of the heat exchanger are inserted between these two points.

[0004] The accumulator performs a function of separation between a gaseous phase and a liquid phase of the refrigerant. To this end, the accumulator comprises a separation area dedicated to this function. The accumulator also performs a function of storing a circulating load of refrigerant according to the conditions of use of the air conditioning loop. For this, the accumulator comprises an area for accumulation of the refrigerant in liquid state, which the accumulation area collects from the evaporator. In general, the accumulator consists of a chamber housing the separation area and the accumulation area, and the chamber includes a lower wall that delimits the accumulation area in the bottom portion of the chamber. Thus, the refrigerant in liquid state coming from the evaporator separates into a gaseous phase and a liquid phase, the latter of which accumulates by gravity above the lower partition, inside the accumulation area.

[0005] The heat exchanger is called an internal heat exchanger because it is configured so that the refrigerant circulating inside the HP loop can transfer heat to the refrigerant circulating inside the LP loop. It is therefore understood that the exchange occurs between the same fluid circulating in different locations of the air conditioning loop, without an exchange with air, for example.

[0006] The performance of the internal heat exchanger is strictly dependent on its dimensions. The heat exchangers comprising HP and LP loop usually comprise a large number of heat exchange members of reduced hydraulic diameter, such as tubes. However, modern vehicles are full of electronic devices that reduce the space available in the engine bay. To facilitate a problem of packaging, it would be desired to create an internal heat exchanger of reduced number of tubes and interfaces that constitute the exchanger. Moreover, a good performance and rigidity against high pressure and temperature are also desired.

SUMMARY OF THE INVENTION

[0007] The object of the invention is, among others, a heat exchanger in particular for a motor vehicle air conditioning system comprising: a first loop, a second loop being fluidly isolated from the first loop, and a container being fluidly isolated from the first loop and the second loop.

[0008] The heat exchanger is characterised in that the container remains in a thermal cooperation with the first loop and the second loop by the means of volatile medium contained within the container.

[0009] According to an embodiment of the invention, the heat exchanger comprises a base portion and a shell portion.

[0010] According to an embodiment of the invention, the first loop comprises a first loop inlet, a transitional channel, and a first loop outlet.

[0011] According to an embodiment of the invention, the main axis of the first loop inlet and the main axis of the first loop outlet are aligned in parallel one to another.

[0012] According to an embodiment of the invention, the main axis of the first loop inlet overlaps the main axis of the first loop outlet.

[0013] According to an embodiment of the invention, the first loop is configured to receive a fluid at high pressure and temperature. The fluid is traveling through the components of the first loop at the desired flow rate.

[0014] According to an embodiment of the invention, the transitional channel is in a form of a channel running through the base portion. The transitional channel is of an essentially circular cross-section.

[0015] According to an embodiment of the invention, the transitional channel is in a form of a channel running from the base portion into the shell portion and back to base portion. The transitional channel is of an essentially rectangular cross-section.

[0016] According to an embodiment of the invention, the transitional channel comprises a plurality of microtubes. The microtubes are deployed parallelly one to another.

[0017] According to an embodiment of the invention, the second loop comprises a second loop inlet, a receiving channel, and a second loop outlet. The second loop inlet is fluidly communicated with the receiving channel by the volume of the shell portion.

[0018] According to an embodiment of the invention, the main axis of the second loop inlet and the main axis of the second loop outlet are aligned in the same plane.

[0019] According to an embodiment of the invention, the shell portion is of a tubular shape, wherein the far end of the shell portion is closed by a spherical portion and the other end of the shell portion remains open and adapted to be assembled with the base portion.

[0020] According to an embodiment of the invention, the container comprises at least one volatile medium tank, and a heat dispersion portions disposed in the vicinity of the channel.

[0021] According to an embodiment of the invention, at least one volatile medium tank is deployed within the base portion, so as to be rinsed by the fluid under high pressure that flows through the first loop.

[0022] According to an embodiment of the invention, the volatile medium tank is of a cylindrical shape and comprising a plurality of fins deployed along the outer perimeter of the tank, so as to increase the heat exchange area between the container and the first loop.

[0023] According to an embodiment of the invention, the heat dispersion portions are in a form of plates stacked perpendicularly to the main axis of the channel. The stack of heat dispersion portions are deployed at the peak point of the channel, so that all plates remain in a thermal communication with the channel.

[0024] According to an embodiment of the invention, the container is in a form of the cuboidal volatile medium tank fluidly connected by the channel with the heat dispersion portions being in a form of meandering conduits.

[0025] According to an embodiment of the invention, the channel exits the volatile medium tank in its upper portion, so as the hot gaseous medium evaporate to the heat dispersion portions and directs the cooled liquid medium to the bottom portion of the volatile medium tank.

[0026] According to an embodiment of the invention, the container comprises a volatile substance.

[0027] According to an embodiment of the invention, the volatile substance has a boiling point between 56°C and 80°C, in particular 78, 37°C.

[0028] According to an embodiment of the invention, the container absorbs the heat from the first loop, so that the volatile substance comprised in the container evaporates from the volatile medium tank through the channel towards the heat dispersion portions.

[0029] According to an embodiment of the invention, the first loop is in a thermal cooperation with the second loop, so that the second loop absorbs the heat from the transitional channel by the surface wherein the HP channel enters the volume delimited by the shell portion.

[0030] According to an embodiment of the invention, the second loop absorbs the heat from the dispersion portions of the container, so that the volatile medium condensates and flows back through the channel to the volatile medium tank.

BRIEF DESCRITPTION OF DRAWINGS

[0031] Examples of the invention will be apparent from and described in detail with reference to the accompanying drawings, in which:

Fig. 1 shows a first cross-section of the invention in a first embodiment.

Fig. 2 shows the second cross-section of the invention in the first embodiment.

Fig. 3 shows the exploded view of the invention in the second embodiment.

Fig. 4 shows the first cross-section of the invention in the second embodiment.

DETAILED DESCRIPTION OF EMBODIMENTS

[0032] The subject of an invention is a heat exchanger 1 designed for a motor vehicle air conditioning system. At the first glance, the heat exchanger 1 comprises two elements, i.e. a base portion 20 and a shell portion 30.

[0033] The base portion 20 is substantially a cylindrical solid. It is responsible for delivering the refrigerant to the heat exchanger 1 and for receiving the refrigerant from the heat exchanger 1. The refrigerant is transferred by the openings and channels comprised within the base portion.

[0034] The invention requires a portion providing a volume isolated from the environment for refrigerant transfer. The isolating portion is a shell portion 30. The shell portion 30 is substantially a cylindrical tube wherein the far end of the tube is closed by a spherical portion. The opposite end of the shell portion 30 is open and it is adapted to be assembled with the base portion 20 by e.g. brazing. The shell portion 30 is assembled onto the necking made in the base portion 20 so that the outer perimeter of the shell portion 30 is substantially equal to the outer perimeter of the base portion 20 as presented in the Fig.1.

[0035] The heat exchanger 1 comprises two loops as presented in the Figs 1 and 2.

[0036] Both loops 50, 60 have at least one inlet and at least one outlet. The inlets and the outlets are fluidly isolated from each other as they are comprised within two different loops. In a preferred embodiment of an invention a first loop inlet 21, a first loop outlet 22, a second loop inlet 23 and the second loop outlet 24 are located in the base portion 20 as presented in the Figs 1 and 2.

[0037] The loop 50,60 can be defined as the flow path through all components of the heat exchanger 1 necessary during the heat exchange process, wherein the inlet is a starting point of the loop within the heat exchanger 1 and the outlet is the finishing point of the loop within the heat exchanger 1.

[0038] The first loop 50 comprises at least one inlet and at least one outlet described in a previous paragraph. The first loop inlet 21 and the first loop outlet 22 are fluidly connected by a transitional channel 26 that, in its simplest form, is a channel of circular cross-section penetrating the base portion 20 parallelly to the first loop inlet 21 and/or the first loop outlet 22 and providing a fluidal communication thereof.

[0039] Fig. 2 shows an embodiment, wherein the main axis of the first loop inlet 21 overlaps the main axis of the first loop outlet 22.

[0040] The second loop 60 comprises at least one inlet and one outlet described in a previous paragraphs. The second loop inlet 23 and the second loop outlet 24 are fluidly connected by the space delimited by the shell portion 30 and by a receiving channel 32. The main axis of the second loop inlet 23 and the main axis of the second loop outlet 24 are aligned in the same plane.

[0041] The first loop 50 and the second loop 60 need to be fluidly isolated from each other within the heat exchanger 1 as the first loop 50 is configured to transfer the refrigerant of different properties than the second loop 60. The refrigerant traveling through the first loop 50 is of higher temperature and higher pressure than the one traveling through the second loop 60.

[0042] The heat exchange between the first loop 50 and the second loop 60 is conducted by a container 70 being fluidly isolated from the first loop 50 and the second loop 60. In the embodiment presented in the Figs 1 and 2, the container intermediates in the entire heat exchange between the first loop 50 and the second loop 60. The container 70 comprises at least one volatile medium tank 71, and a heat dispersion portions 72 disposed in the vicinity of the channel 73. The container 70 is filled with a volatile medium. The volatile medium in a liquid form is contained in volatile medium tank 71. The container 70 is fluidly isolated from the first loop 50 and the second loop 60, but remains in thermal cooperation with the first loop 50 and the second loop 60 by the means of volatile medium.

[0043] In the preferred embodiment of an invention, the volatile medium has a boiling point between around 78, 37°C. However, the substances having a boiling point from 56°C to 80°C are also suitable.

[0044] As the temperature in the first loop 50 increases, the heat is transferred to the volatile medium tank 71 of the container 70. The volatile medium is heated and evaporates. The evaporated, hot volatile medium travels through the channel 73 to the heat dispersion portions 72. The heat dispersion portions are of increased surface, so as to facilitate the heat exchange between the container 70 and second loop 60. The container 70 transfers the collected heat to the second loop 60. The heat transfer between the container 70 and second loop 60 is conducted in the shell portion 30. As the hot volatile medium is cooled down, it condensates and returns to the volatile medium tank 71 as a liquid.

[0045] In the embodiment presented in the Figs 1 and 2, the container 70 is located both in the base portion 20 and in the shell portion 30. The base portion 20 comprises two volatile medium tanks 71 of a cylindrical shape aligned parallelly one to another. The volatile medium tanks 71 are in a thermal communication with the transitional channel 26 of the first loop 50. The volatile medium tanks 71 comprise the fins on the outer perimeter, so that the heat exchange between the first loop 50 and the container 70 is facilitated.

Further, the volatile medium tanks 71 are in a fluidal communication with the channels 73. In the embodiment presented in the Figs 1 and 2, the channels are essentially tubular and closed on the end adjacent to the heat dispersion portions 72.

[0046] The heat dispersion portions 72 are in a form of plates stacked perpendicularly to the main direction of the channels 73. The heat delivered by the channels 73 is dispersed and transferred to the second loop 60. The volatile medium is cooled down and it condensates. The liquid volatile medium runs down the walls of the channels 73 and fills back the volatile medium tank 71.

[0047] In the embodiment presented in the Figs 1-4, the second loop 60 is located both in the base portion 20 and in the shell portion 30. The refrigerant under low pressure (LP) enters the second loop 60 through the second inlet 23. The second inlet 23 delivers the refrigerant into the shell portion 30. In an embodiment presented in the Figs 1 and 2, the heated refrigerant of second loop 60 is collected by the receiving channel 32 and it is directed to the second outlet 24.

The fluid fills the volume delimited by the shell portion 30. As the second loop 60 meets the heat dispersion portions 72 of the container 70, it absorbs the heat cumulated in the container 70. In embodiment presented in the Figs 3 and 4, the heated refrigerant of second loop 60 is collected by the second outlet 24.

[0048] In another embodiment of an invention, pre-

sented in the Figs 3 and 4, the first loop 50 comprises the transitional channel 26 that is in a form of a flat tube having essentially rectangular cross-section that runs from the base portion 20 into the shell portion 30 and back to base portion 20. The transitional channel 26 in a form of the flat tube comprises at least one micro channel 27. The micro channels 27 enable uniform heat dispersion throughout the surface of the transitional channel 26. The transitional channel 26 exits and enters the base portion 20 in a direction perpendicular to the plane determined by the cross-section area of the shell portion 30. The tip returns the transitional channel 26 by the u-shaped portion thereof, so that the refrigerant is directed to the first outlet 22. The returning portion of the transitional channel 26 comes into contact with the entering portion of the transitional channel 26 in the vicinity of the u-shaped portion, as presented in the Fig. 3. A returning portion slopes towards the entering portion, so that both portions contact each other and then it slopes back to its nominal position. As a result, the contact portion is created for receiving container 70. It allows a tight assembly of the container 70 with the transitional channel 26, thus a reduction of the entire heat exchanger 1 dimensions.
In an embodiment of an invention, presented in the Figs 3 and 4, the second loop 60 works in the opposite manner as presented in the previous embodiment, i.e. in the embodiment presented in the Figs 3 and 4, the refrigerant delivery between the second inlet 23 and the volume of the shell portion 30 is supported by the receiving channel 32.

[0049] In an embodiment of an invention, presented in the Figs 3 and 4, the container 70 is in a form of the cuboidal volatile medium tank 71 fluidly connected by the channels 73 with the heat dispersion portions 72. The container 70 is assembled with the flat tube by the protrusions extending along the two edges of the volatile medium tank 71. In this embodiment in a form of meandering conduits. In this embodiment, the channels are fluidly connected by the heat dispersion portions 72. The volatile medium evaporates towards the dispersion portions 72 through the channel 73 located on the upper wall of the volatile medium tank 73. Next, the volatile medium meanders along the heat dispersion portions 72. The heat dispersion portions 72 are rinsed by the second loop 60. so that the volatile medium of container 70 condensates and runs down the second portion of the channel 73 which enters the lateral wall of the volatile medium tank.

[0050] Other variations to the disclosed embodiments can be understood and effected by those skilled in the art in practicing the claimed invention, from a study of drawings, the disclosure, and the appended claims. The mere fact that certain measures are recited in mutually different dependent claims does not indicate that a combination of these measures cannot be used to the advantage.

Claims

1. A heat exchanger (1) in particular for a motor vehicle air conditioning system comprising:

a) a first loop (50);
b) a second loop (60) being fluidly isolated from the first loop (50);
c) a container (70) being fluidly isolated from the first loop (50) and the second loop (60),

characterised in that:
the container (70) remains in thermal cooperation with the first loop (50) and the second loop (60) by the means of volatile medium contained within the container (70).

2. The heat exchanger (1) of claim 1, comprising a base portion (20) and a shell portion (30).

3. The heat exchanger (1) according to claim 1, wherein the first loop (50) comprises a first loop inlet (21), a transitional channel (26), and a first loop outlet (22).

4. The heat exchanger (1) according to all preceding claims, wherein the transitional channel (26) is in a form of a channel running through the base portion (20), the transitional channel (26) being of essentially circular cross-section.

5. The heat exchanger (1) according claims 1-3, wherein the transitional channel (26) is in a form of a channel running from the base portion (20) into the shell portion (30) and back to base portion (20), the transitional channel (26) being of essentially rectangular cross-section.

6. The heat exchanger (1) according to the preceding claim, wherein the transitional channel (26) is in a form of a flat tube with micro channels (27), the micro channels (27) being deployed parallelly one to another.

7. The heat exchanger (1) according to all preceding claims, wherein the second loop (60) comprises a second loop inlet (23), a receiving channel (32), and a second loop outlet (24); the second loop inlet (23) being fluidly communicated with the receiving channel (32) by the volume of the shell portion (30).

8. The heat exchanger (1) according to all preceding claims, wherein the shell portion (30) is of a tubular shape, the far end of the shell portion (30) being closed by a spherical portion, the other end of the shell portion (30) remaining open and adapted to be assembled with the base portion (20).

9. The heat exchanger (1) according to all preceding claims, wherein the container (70) comprises at least one volatile medium tank (71), and a heat dispersion portions (72) disposed in the vicinity of the channel (73).

10. The heat exchanger (1) according to claim 9, wherein at least one volatile medium tank (71) is deployed within the base portion (20), so as to be rinsed by the fluid under high pressure (HP) that flows through the first loop (50).

11. The heat exchanger (1) according to the preceding claim, wherein the volatile medium tank (71) is of a cylindrical shape and comprises a plurality of fins deployed along the outer perimeter of the volatile medium tank (71).

12. The heat exchanger (1) according to claim 9, wherein the heat dispersion portions (72) are in a form of plates stacked perpendicularly to the main axis of the channel (73), the stack of heat dispersion portions (72) being deployed at the upper portion of the channel (73), so that all plates remain in a thermal communication with the channel (73).

13. The heat exchanger (1) according to claim 9,, wherein the container (70) comprises the cuboidal volatile medium tank (71) fluidly connected by the channel (73) with the heat dispersion portions (72) being in a form of meandering conduits.

14. The heat exchanger (1) according to all preceding claims, wherein the container (70) comprises a volatile substance.

15. The heat exchanger (1) according to all preceding claims, wherein the volatile substance has a boiling point between 56°C and 80°C, in particular 78,37°C.

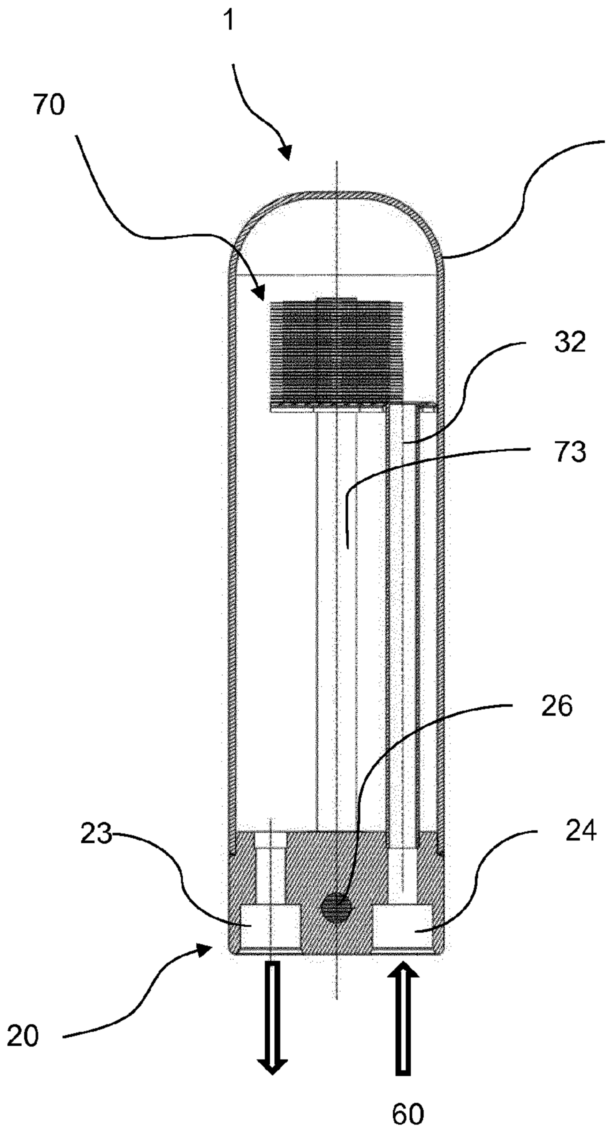

Fig. 1

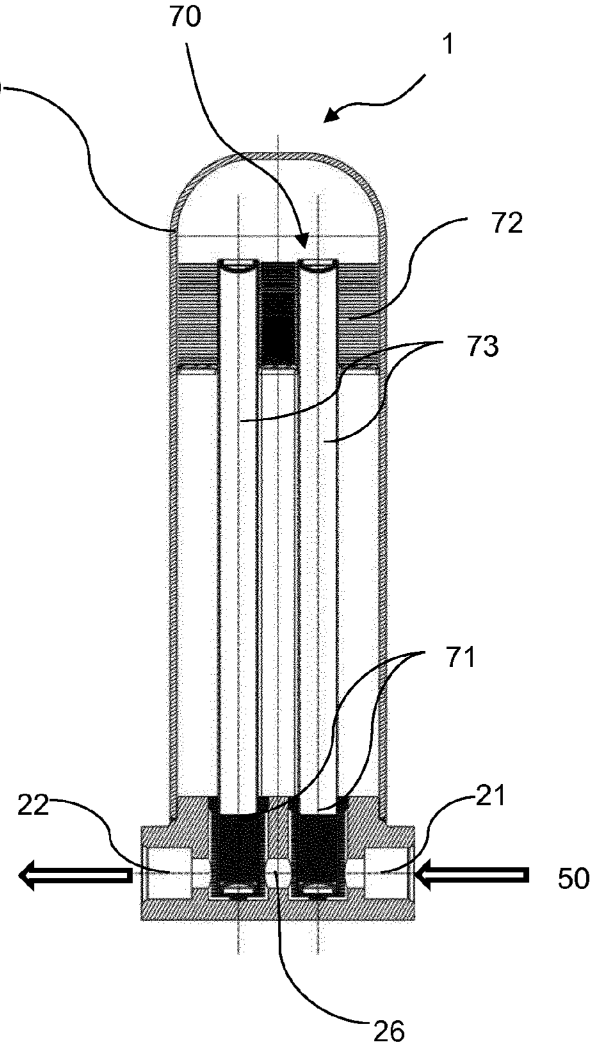

Fig. 2

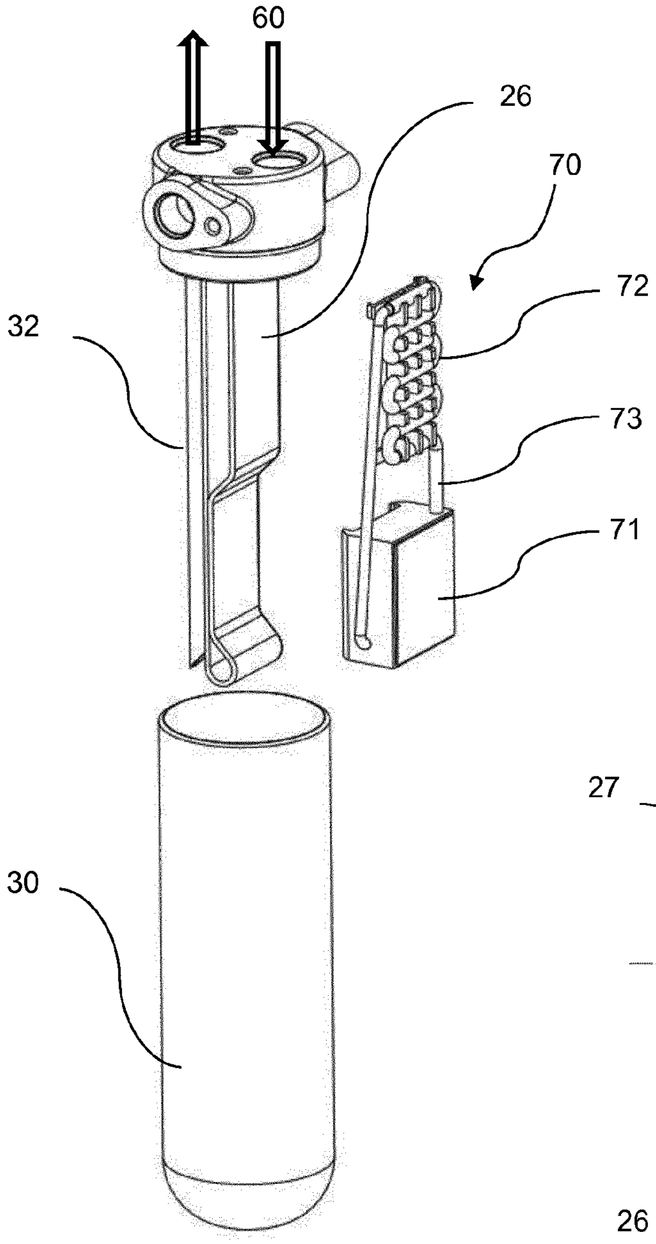

Fig. 3

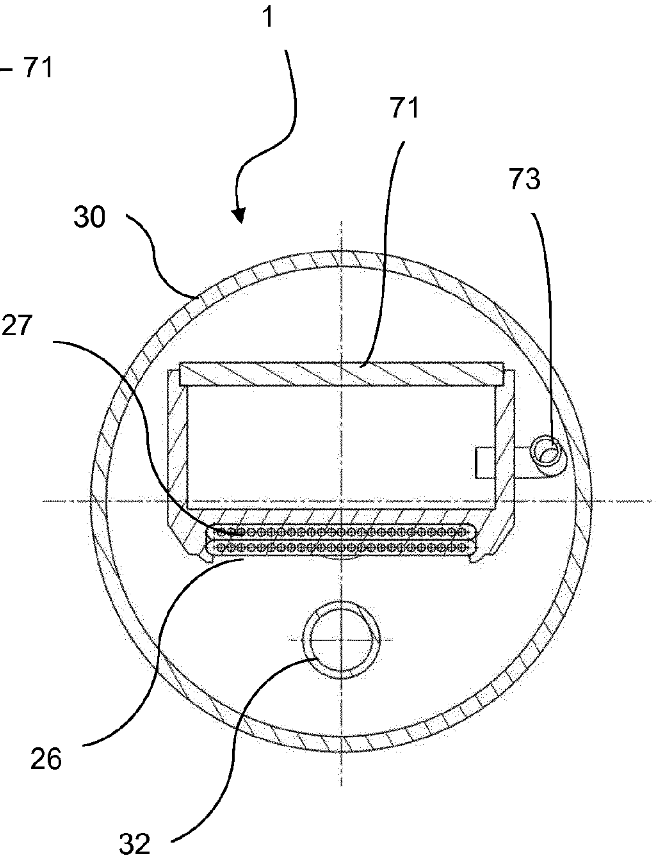

Fig. 4

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EUROPEAN SEARCH REPORT

Application Number
EP 19 17 8463

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	US 6 681 597 B1 (YIN JIAN-MIN [US] ET AL) 27 January 2004 (2004-01-27) * figure 1 * -----	1-15	INV. F28D7/00 F25B43/00 F28D15/00 F28D15/02
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A	US 2006/236716 A1 (GRIFFIN GARY E [US] ET AL) 26 October 2006 (2006-10-26) * figure 5c * -----	1-15	

TECHNICAL FIELDS SEARCHED (IPC)

F28D
F25B

The present search report has been drawn up for all claims

1

Place of search	Date of completion of the search	Examiner
Munich	12 November 2019	Vassoille, Bruno

CATEGORY OF CITED DOCUMENTS

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