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

(11) **EP 4 215 823 A1**

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
26.07.2023 Bulletin 2023/30

(21) Application number: **23152192.3**

(22) Date of filing: **18.01.2023**

(51) International Patent Classification (IPC):
F24D 3/10 *(2006.01)*

(52) Cooperative Patent Classification (CPC):
F24D 3/1016

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC ME MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA
Designated Validation States:
KH MA MD TN

(30) Priority: **20.01.2022 TR 202200696**

(71) Applicant: **Daikin Europe N.V.**
8400 Oostende (BE)

(72) Inventor: **KILIÇ, Mehmet Serhan**
54300 Hendek (TR)

(74) Representative: **Brantsandpatents bv**
Pauline Van Pottelsberghelaan 24
9051 Ghent (BE)

(54) **AN EXPANSION APPARATUS**

(57) The present invention relates to an expansion apparatus that prevents closed-circuit fluid system pressure by balancing the expansion of heated fluid in closed-circuit fluid systems; has at least one fluid inlet and a flexible membrane that is directly in contact with atmospheric pressure which fluid is filled in.

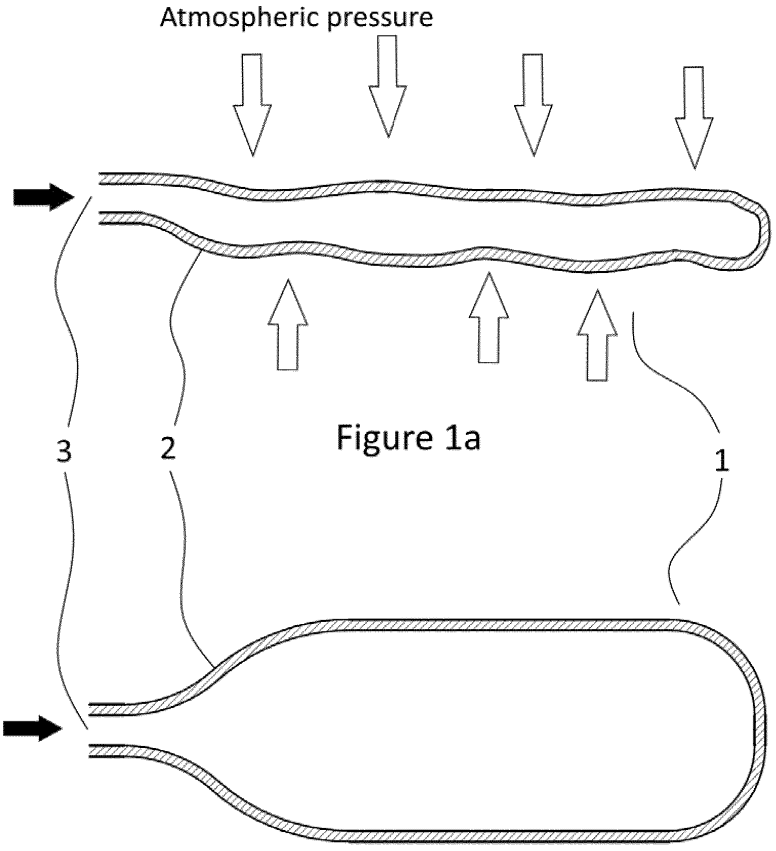

Figure 1a

Figure 1b

EP 4 215 823 A1

Description

Technical Field

[0001] The present invention relates to an expansion apparatus that prevents the increase of the closed-circuit installation pressure by balancing the expansion of the heated fluid in the installations through which a heated fluid is flowing. In particular, the invention discloses an expansion apparatus comprising at least one fluid inlet and a flexible membrane in which the fluid is filled through this fluid inlet and is directly subject to atmospheric pressure.

State of The Art

[0002] It is known that a fluid on closed systems expands when heated. As fluid expands it effects the pressure on closed systems by increasing its internal pressure. This increased pressure has the potential to harm the system. Expansion tanks are needed to relieve pressure and possible damage.

[0003] Open expansion vessels are the oldest technique that is used for this purpose. As the technology evolved, this technique was replaced by closed expansion tanks. Current closed expansion tanks comprise a metal surface, expandable membrane, and an air section that paddings this membrane. Air section is the volume between metal surface and membrane.

[0004] Water on the system expands after heating and thus its volume increases. The expanded water enters the expansion tank and system pressure is reduced. In the meantime, it compresses the air inside the expansion tank. As water in the installation cools down, water volume and pressure decrease. As water volume decreases, compressed air inside the tank sends the water inside the system back to installation and adjust system pressure to a fixed level.

[0005] Expansion valves that currently used contain a metal container with expandable membrane and a padding air section thus they are both heavy and has big volumes. Also, due to the metal surface, they have a fixed structure. For this reason, it does not have flexibility and cannot be produced in geometries that cannot be made with a deep drawing die.

[0006] These disadvantages caused necessity for a new expansion apparatus.

[0007] In the utility model No. CN20829320, an expansion tank which is equipped with an elastic diagram that divides it into an air chamber and a water chamber in the middle. Furthermore, air pressure inside the air chamber is measured by a sensor, and air is supplied with the compressor instead of the missing air.

[0008] In the patent No. CN102864818A, an expansion tank with an expandable membrane and an extra air section padding disclosed.

[0009] However, both aforementioned documents give no solution that our invention gives about metal body that creates weight and volume disadvantage to boiler and central heating boilers. Consequently, it was necessary to come up with a suitable solution that performs the same function but does not contain the existing disadvantages, instead of the expansion tanks used in units such as combi boilers or boilers.

Objectives and Brief Description of the Invention

[0010] The aim of the present invention is to prevent increase in closed-circuit fluid installation pressure by balancing the expansion of heated fluid in the installations through which a heated fluid pass.

[0011] Another aim of the present invention is to obtain an expansion apparatus that takes up less space in units such as boilers and combi boilers, is light in terms of the material used, and has a small volume.

[0012] Another aim of the invention is to provide an expansion apparatus that performs the function of elements such as pipes that transport water in a closed circuit and does not require additional maintenance.

[0013] Another aim of the invention is to provide a sheath embodiment that acts as a stoper against the pressure in the membrane, and that prevents excessive swelling and damage of the membrane.

[0014] To achieve the above objectives, present invention is an expansion apparatus for reducing pressure increase in closed-circuit fluid systems that comprises at least one fluid inlet, and a membrane in flexible form directly subject to atmospheric pressure, in which the fluid is filled by means of the fluid inlet.

[0015] In the preferred embodiment of the invention, the mentioned membrane is made of elastomer material.

[0016] The expansion apparatus further comprises a sheath structured to cover the membrane and whose volume can change in proportion to the pressure change to which the membrane is subjected. The sheath is made of air-permeable material.

[0017] In another preferred embodiment of the expansion apparatus of the present invention comprises at least one fluid outlet in connection with the membrane allowing the expansion apparatus to be mounted in series to the closed-circuit fluid system and allowing the fluid in said membrane to be discharged from the expansion apparatus.

Brief Description of the Figures

[0018] In Figure 1a; section view of the empty expansion apparatus in preferred embodiment is shown.

[0019] In Figure 1b; section view of the expansion apparatus while filled with fluid in preferred embodiment is shown.

[0020] In Figure 2a; section view of the empty expansion apparatus in another preferred embodiment is shown.

[0021] In Figure 2b; section view of the filled expansion apparatus in another preferred embodiment is shown.

[0022] In Figure 3a; section view of the empty expansion apparatus comprising sheath in preferred embodiment is shown.

[0023] In Figure 3b; section view of the expansion apparatus comprising sheath while filled with fluid in preferred embodiment is shown.

[0024] In Figure 4a; section view of the empty expansion apparatus comprising sheath in another preferred embodiment is shown.

[0025] In Figure 4b; section view of the filled expansion apparatus comprising sheath in another preferred embodiment is shown.

Reference Numbers

[0026]

1 Expansion apparatus
2 Membrane
3 Fluid inlet
4 Sheath
5 Fluid outlet

Detailed Description of the Invention

[0027] The present invention discloses an expansion apparatus (1) based on pressure expansion principle. According to the Figure 1a, the expansion apparatus (1) comprises at least one fluid inlet (3), and a membrane (2) in flexible form directly subject to atmospheric pressure, in which the fluid is filled by means of the fluid inlet (3). The membrane (2) is made of elastomer class material inside of which is fiber supported or not supported.

[0028] With amount of the fluid that enters through fluid inlet (3) increases because of pressure in the fluid system, membrane will be filled with more water, and it will swell like a balloon as shown in the Figure 1b. In this case of sudden pressure rise on the closed-circuit thus increasing water volume, water will be filled to another area i.e., to expansion apparatus (1) without harming the fluid system.

[0029] Embodiment that shown in Figure 1a and 1b, in closed-circuit fluid systems, for example like heating systems or boilers, combis that work on these systems, fulfils the purpose of a closed expansion tank.

[0030] In Figure 2a and 2b, another preferred embodiment of the expansion apparatus in empty and filled form is shown respectively. According to the Figure 2a, expansion apparatus has a fluid outlet (5) in an addition to the fluid inlet (3). With this fluid outlet (5), it is possible to connect the expansion apparatus in series (1) to the closed-circuit fluid system. In this embodiment, only difference from the expansion apparatus (1) without fluid outlet (5) is that fluid inside the membrane (2) will flow out from the fluid outlet (5) to another system. In both situations, as the fluid inside the closed circuit expands, it will blow the membrane (2) up, and pressure rise within the system will be prevented.

[0031] In the embodiment shown in Figure 2b, expansion apparatus (1) also fulfills the function of a fluid transfer member like pipe. By this way, it is possible to save more space in units that need to be compact like boilers. Besides, it provides a volume advantage since the difficult shapes that need to be given to pipes can be given to the expansion apparatus (2).

[0032] In Figure 3a and 3b, section view of another preferred embodiment of expansion apparatus (1) is shown schematically. The expansion apparatus (1) of the preferred embodiment comprises a membrane in flexible form (2), a fluid inlet (3) in which fluid enters from closed-circuit fluid system, a sheath (4) that protects the membrane (2) from foreign unwanted substances particles such as dust.

[0033] This sheath (4) is configured to in a way to cover the membrane (2), and its volume is able to change in proportion to the pressure change to which the membrane (2) is subjected. Sheath (4) serves as a second layer for the purpose of blocking physical contact of foreign materials like dust with membrane (2). The sheath (4) has a structure that is stretched in the bulky state of the membrane (2) and crumpled when it is deflated. In addition, the cover (4) has a certain strength that will both protect the membrane (2) from foreign substances and prevent it from further swelling with pressure. The material of the sheath (4) is selected from a material that is air-permeable, which will not prevent the membrane (2) from being directly subjected to atmospheric pressure.

[0034] In another embodiment shown in Figures 4a and 4b, expansion apparatus (1) comprises

- at least one fluid inlet (3),
- a membrane (2) in flexible form directly subject to atmospheric pressure, in which the fluid is filled by means of the fluid inlet (3),
- at least one fluid outlet (5) in connection with the membrane (2), and
- a sheath (4) that is configured to in a way to cover the membrane (2).

[0035] As it can be understood from Figures 1 to 4, an air gap unconnected with outside and isolated is not available in between membrane (2) and sheath (4), by which are constituted expansion apparatus (1). The membrane (2) is expected to have at least 2-4 mm of thickness, and sheath (4) is envisaged to have at least 1 mm thickness. The thickness values of membrane (2) and sheath (4) depend on the type of the material and amount of internal pressure inside the fluid system that expansion apparatus (1) to be connected to.

[0036] At the preferred embodiments of the present invention, atmospheric air is the padding for the expansion apparatus (1), it is not necessary to have closed space for the expansion. This way expansion apparatus (1) saves volume in boilers and tanks. Also, there is no demand for necessities like filling of padding air, supplying air in case of leakage, and comprising a relief valve

connection.

Claims

1. An expansion apparatus (1) for reducing pressure increase in closed-circuit fluid systems **characterized by** comprising

   - at least one fluid inlet (3), and
   - a membrane (2) in flexible form directly subject to atmospheric pressure, in which the fluid is filled by means of the fluid inlet (3).

2. The expansion apparatus (1) according to claim 1 wherein the membrane (2) is made of elastomer material.

3. The expansion apparatus (1) according to claim 1 or 2, wherein it comprises a sheath (4) structured to cover the membrane (2) and whose volume is able to change in proportion to the pressure change to which the membrane (2) is subjected.

4. The expansion apparatus (1) according to claim 3 wherein the sheath (4) is made of air-permeable material.

5. The expansion apparatus (1) according to any one of claims 1 to 4, wherein it comprises at least one fluid outlet (5) in connection with the membrane (2) allowing the expansion apparatus (1) to be mounted in series to the closed-circuit fluid system and allowing the fluid in said membrane (2) to be discharged from the expansion apparatus (1).

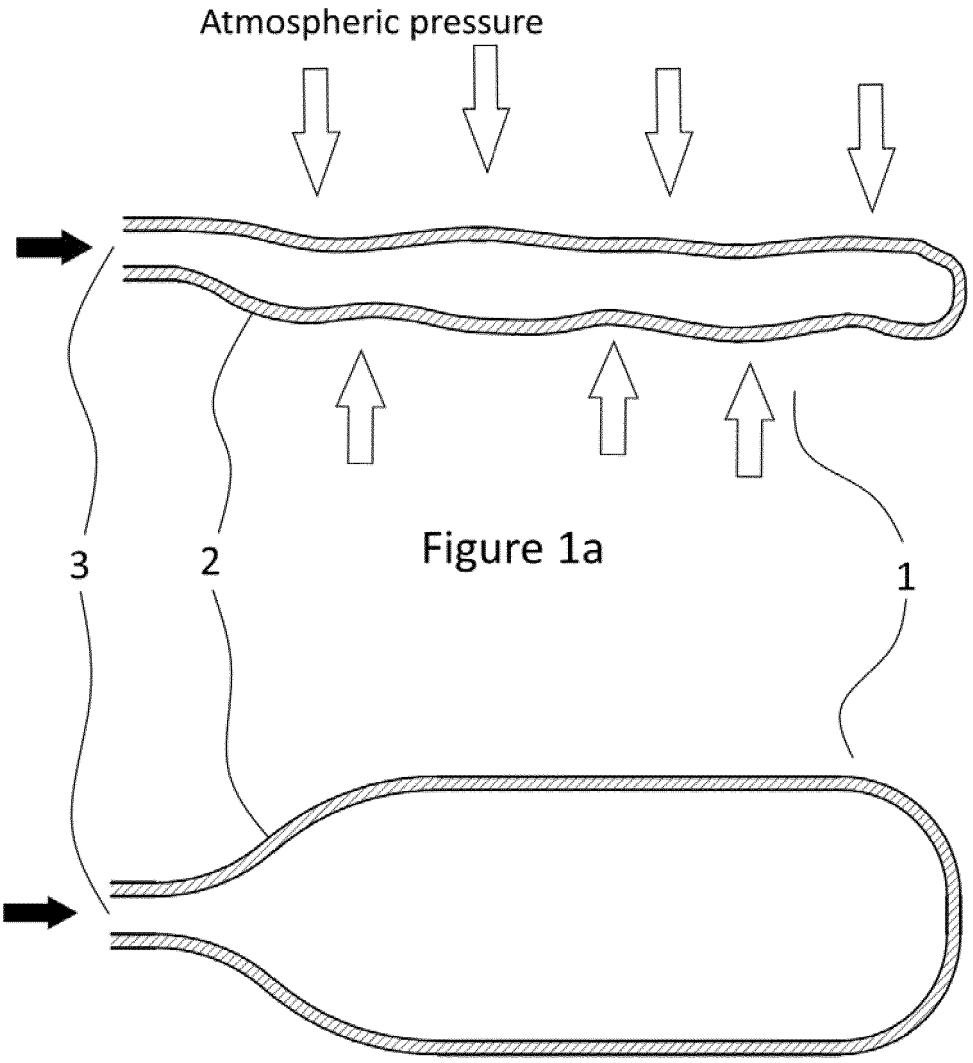

Figure 1a

Figure 1b

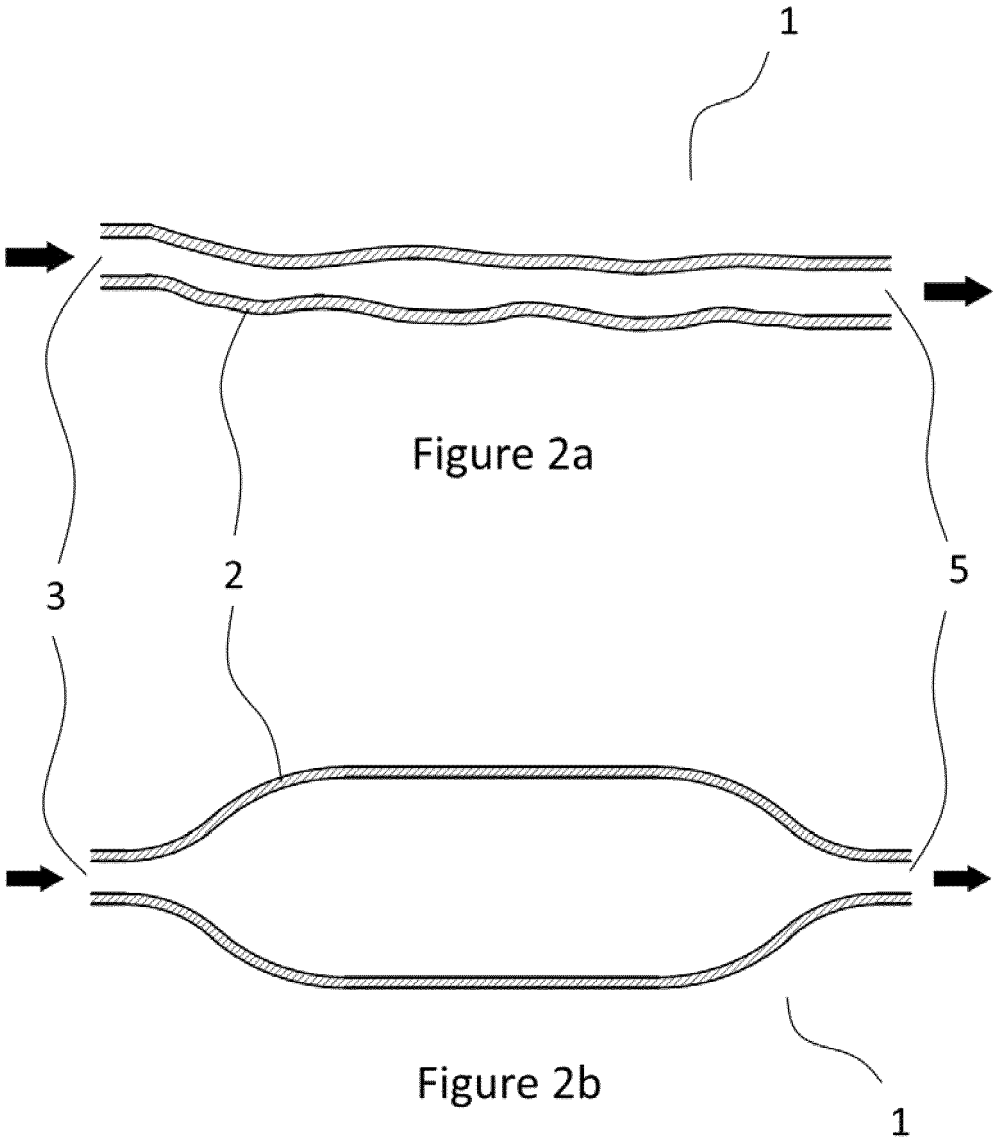

Figure 2a

Figure 2b

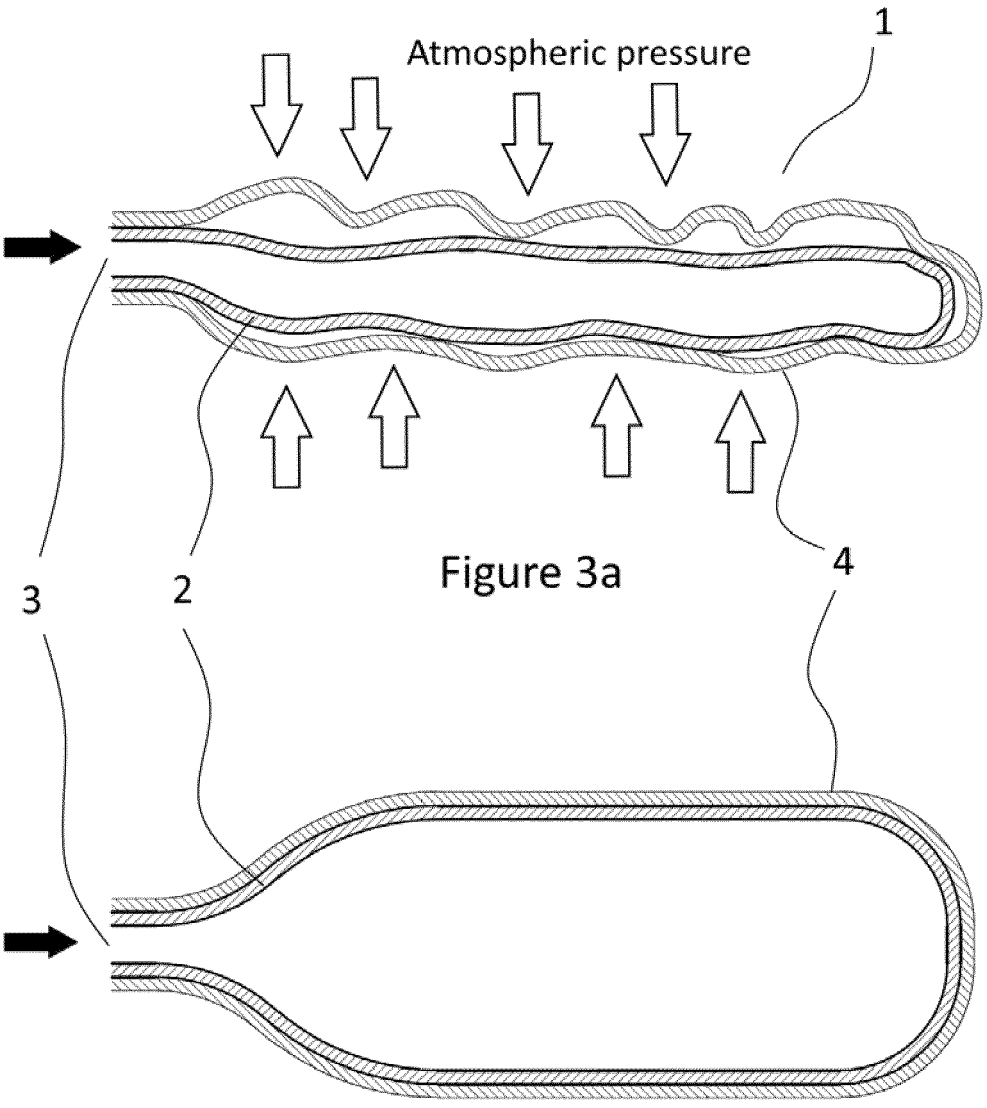

Figure 3a

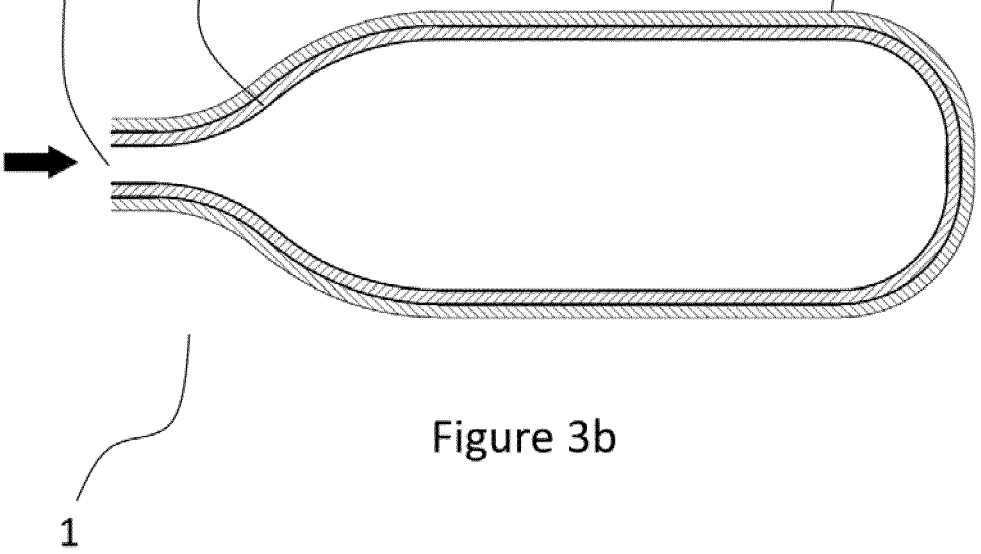

Figure 3b

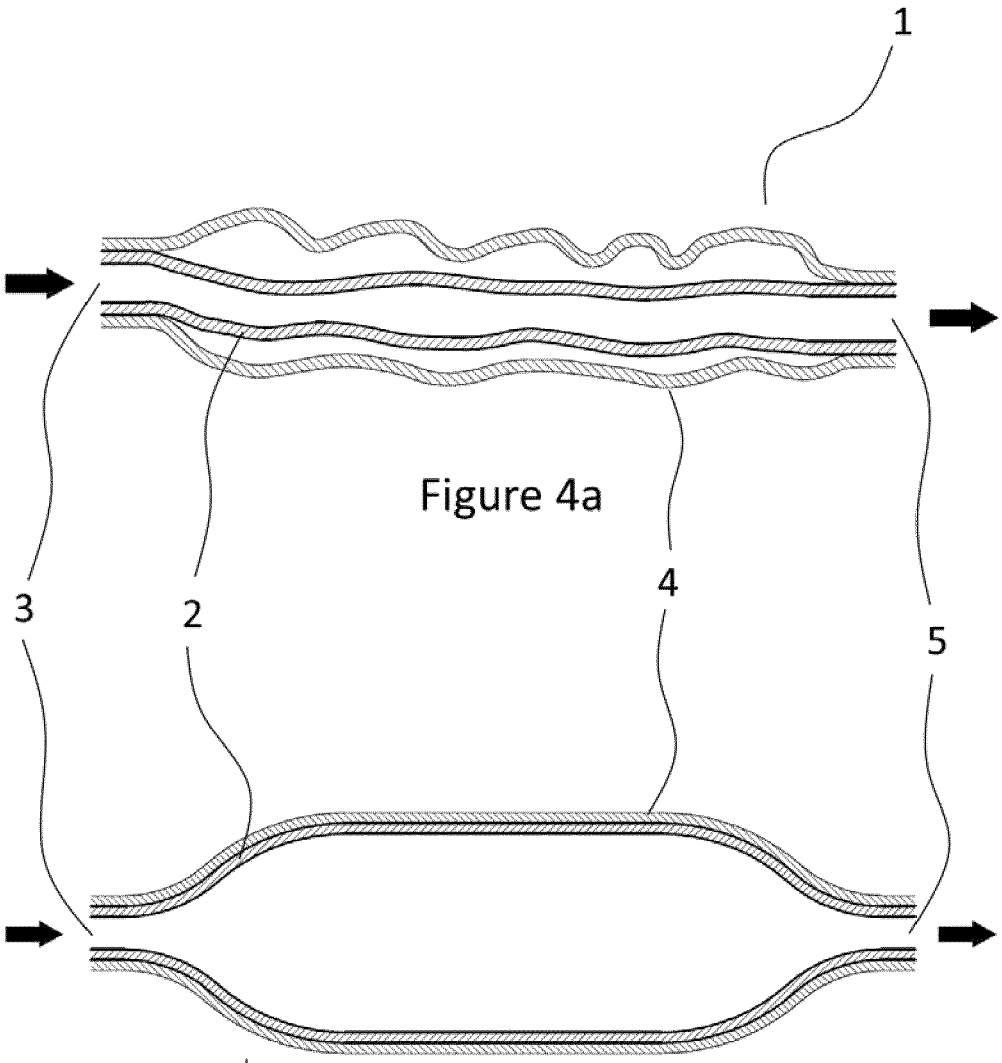

Figure 4a

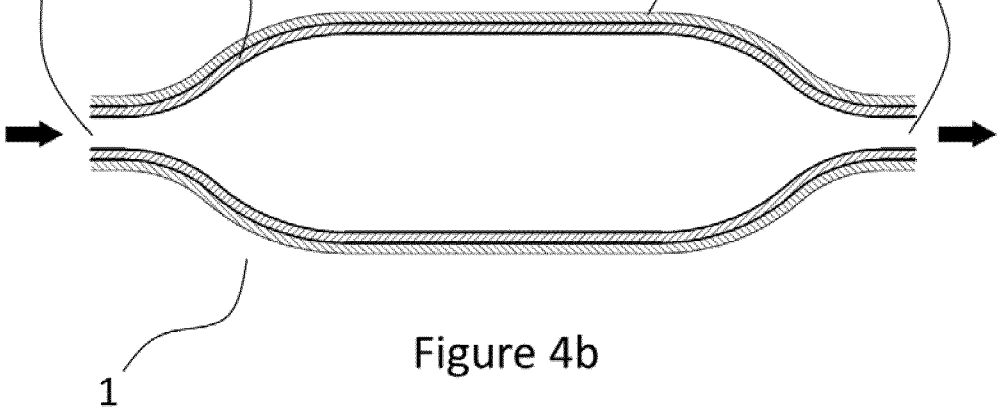

Figure 4b

Europäisches Patentamt
European Patent Office
Office européen des brevets

EUROPEAN SEARCH REPORT

Application Number
EP 23 15 2192

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	GB 1 460 103 A (FLAMCO BV) 31 December 1976 (1976-12-31) * page 1, line 9 - page 2, line 39; claim 1; figure 1 *	1,2	INV. F24D3/10
X	GB 2 188 412 A (PRESSURE UNITS LIMITED) 30 September 1987 (1987-09-30) * page 1, lines 56-105; figure 1 *	1,2	
X	WO 02/39007 A1 (WATTS INVEST COMPANY [US]; BERTAGNA PETER J [US]) 16 May 2002 (2002-05-16) * page 2, line 25 - page 4, line 24; figures 2,3,5 *	1,2,5	
X A	CN 102 691 850 A (ZHANG XIUYING) 26 September 2012 (2012-09-26) * paragraphs [0017] - [0022]; figure 1 *	1-3 4	
			TECHNICAL FIELDS SEARCHED (IPC)
			F24D

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	26 May 2023	Hoffmann, Stéphanie

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

EPO FORM 1503 03.82 (P04C01)

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 23 15 2192

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.

26-05-2023

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
GB 1460103 A	31-12-1976	BE 814908 A	13-11-1974
		DE 2422915 A1	05-12-1974
		FR 2229932 A1	13-12-1974
		GB 1460103 A	31-12-1976
		NL 7306849 A	19-11-1974
GB 2188412 A	30-09-1987	NONE	
WO 0239007 A1	16-05-2002	AU 2021002 A	21-05-2002
		CA 2428202 A1	16-05-2002
		US 6418969 B1	16-07-2002
		WO 0239007 A1	16-05-2002
CN 102691850 A	26-09-2012	NONE	

EPO FORM P0459

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

REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- CN 20829320 **[0007]**
- CN 102864818 A **[0008]**