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

(11) EP 3 466 840 A1

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
10.04.2019 Bulletin 2019/15

(51) Int Cl.:
B65D 88/46 *(2006.01)*

(21) Application number: **18198229.9**

(22) Date of filing: **02.10.2018**

(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 MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA ME
Designated Validation States:
KH MA MD TN

(30) Priority: **06.10.2017 TW 10634641**

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(54) SEALING DEVICE FOR A FLOATING ROOF OF AN OIL TANK

(57) A sealing device for an oil tank is mounted between a tank body and a floating roof and includes a fixed bracket, an inner layer plate secured to the fixed bracket, at least one inner spring plate secured on an annular inner diameter of the inner layer plate and applying a force directed toward an outer diameter of the inner layer plate, an outer layer plate arranged on an exterior face of the inner layer plate, with a gap being defined between an interior face of the outer layer plate and the exterior face of the inner layer plate, and at least one outer spring plate arranged in the gap between the outer layer plate and the inner layer plate and applying a force directed toward an outer diameter of the outer layer plate.

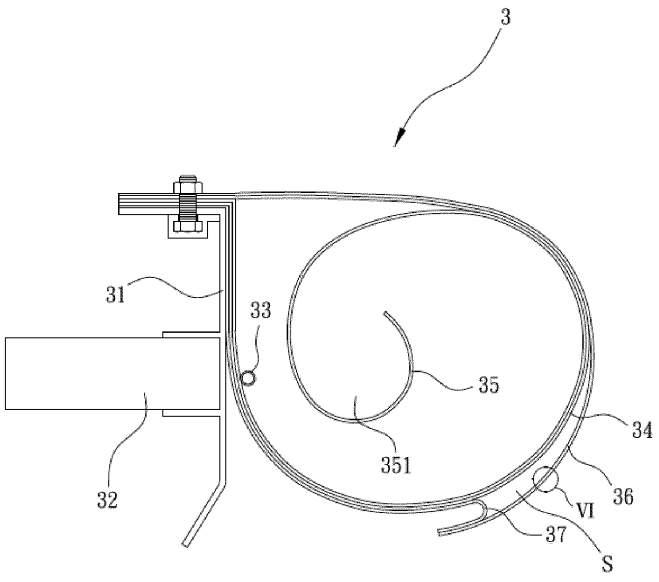

FIG. 4

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Description

Background of the invention

1. Field of the Invention

[0001] The present invention relates to a sealing device and, more particularly, to a sealing device for an oil tank.

2. Description of the Related Art

[0002] A conventional oil tank in accordance with the prior art shown in FIGS. 1 and 2 comprises a tank body B, a floating roof A mounted in the tank body B, and a sealing device C mounted between an inner wall of the tank body B and an outer diameter of the floating roof A. The floating roof A is placed on the top of an oil contained in the tank body B and is lifted or lowered with the liquid level to reduce diffusion of the oil air. The floating roof A includes a plurality of float units A1 and a plurality of connections B1 mounted between the float units A1 to connect the float units A1. The sealing device C includes a support leg C1 connected with the floating roof A and a foam body C3 secured on the support leg C1. Thus, the foam body C3 presses the inner wall of the tank body B to provide a sealing effect between the tank body B and the floating roof A, thereby preventing the oil air from leaking. However, the foam body C3 slides on the tank body B so that the foam body C3 is easily worn out during a long-term utilization due to the frequent friction between the foam body C3 and the tank body B, thereby decreasing the lifetime of the foam body C3, and thereby leaking the oil air. In addition, the operator has to care, repair or replace the foam body C3 during a period of time, thereby wasting the working time and manual labor, and thereby increasing the cost of maintenance, repair and replacement. Further, the operator has to work in the tank body B frequently, thereby causing danger to the operator.

Brief summary of the invention

[0003] The primary objective of the present invention is to provide a sealing device that has an excellent sealing effect, has a greater structural strength, has a longer lifetime, and has a wearproof feature.

[0004] In accordance with the present invention, there is provided a sealing device for an oil tank, comprising a fixed bracket, an inner layer plate secured to the fixed bracket, at least one inner spring plate secured on an annular inner diameter of the inner layer plate and applying a force directed toward an outer diameter of the inner layer plate, an outer layer plate arranged on an exterior face of the inner layer plate, with a gap being defined between an interior face of the outer layer plate and the exterior face of the inner layer plate, and at least one outer spring plate arranged in the gap between the outer layer plate and the inner layer plate and applying a force directed toward an outer diameter of the outer layer plate. The inner layer plate has a radially sectional face that is curved to form a closed annular shape. The inner layer plate forms a circle surrounding the fixed bracket. The outer layer plate forms a circle surrounding the inner layer plate. The interior face of the outer layer plate and the exterior face of the inner layer plate are locally separated to form the gap.

[0005] Preferably, the at least one inner spring plate has a radially sectional face having a vortex shape.

[0006] Preferably, the outer layer plate has a free end spaced from the inner layer plate to form the gap.

[0007] Preferably, the at least one outer spring plate has a substantially U-shaped configuration, and has a first end secured to the fixed bracket and a second end contacting the interior face of the outer layer plate.

[0008] Preferably, the sealing device includes multiple inner spring plates that are centered at a center of the inner layer plate and are arranged in a radiating shape.

[0009] Preferably, the sealing device includes multiple outer spring plate that are centered at a center of the inner layer plate and are arranged in a radiating shape.

[0010] Preferably, the outer layer plate includes a metallic sheet plate and a fiber layer mounted on an exterior face of the metallic sheet plate.

[0011] Preferably, the fiber layer is made of carbon fiber.

[0012] Alternatively, the fiber layer is made of glass fiber.

[0013] Further benefits and advantages of the present invention will become apparent after a careful reading of the detailed description with appropriate reference to the accompanying drawings.

Brief description of several views of the drawing(s)

[0014]

FIG. 1 is a schematic view of a conventional oil tank in accordance with the prior art.

FIG. 2 is a locally enlarged cross-sectional view of a sealing device of the conventional oil tank taken along circle II as shown in FIG. 1.

FIG. 3 is a schematic view of an oil tank in accordance with the preferred embodiment of the present invention.

FIG. 4 is a locally enlarged cross-sectional view of a sealing device of the oil tank taken along circle IV as shown in FIG. 3.

FIG. 5 is a perspective view of the sealing device of the oil tank as shown in FIG. 4.

FIG. 6 is a locally enlarged cross-sectional view of the outer layer plate of the sealing device of the oil

tank taken along circle VI as shown in FIG. 4.

Detailed Description of the invention

[0015] Referring to the drawings and initially to FIG. 3, an oil tank in accordance with the preferred embodiment of the present invention comprises a tank body 2, a floating roof 1 mounted in the tank body 2, and a sealing device 3 mounted between an inner wall of the tank body 2 and an outer diameter of the floating roof 1. The floating roof 1 includes a plurality of float units 10 and a plurality of connections 20 mounted between the float units 10 to connect the float units 11. Each of the connections 20 is provided with a plurality of mounting grooves 21 locked onto the float units 10 by fastening screws, so that the float units 10 are combined by the connections 20.

[0016] Referring now to FIGS. 4-6, the sealing device 3 includes a fixed bracket 31, a support seat 32 mounted on a side of the fixed bracket 31, an inner layer plate 34 secured to the fixed bracket 31, at least one inner spring plate 35 secured on an annular inner diameter of the inner layer plate 34 and applying a force directed toward an outer diameter of the inner layer plate 34, an outer layer plate 36 arranged on an exterior face of the inner layer plate 34, with a gap S being defined between an interior face of the outer layer plate 36 and the exterior face of the inner layer plate 34, and at least one outer spring plate 37 arranged in the gap S between the outer layer plate 36 and the inner layer plate 34 and applying a force directed toward an outer diameter of the outer layer plate 36.

[0017] The fixed bracket 31 is made of a steel sheet that is bent to have a circular shape corresponding to the inner diameter of the tank body 2. The support seat 32 and the fixed bracket 31 are combined to construct a combination that is secured to the outer diameter of the floating roof 1.

[0018] The inner layer plate 34 is made of a steel sheet that is bent to have a circular shape corresponding to the inner diameter of the tank body 2. The inner layer plate 34 has a radially sectional face that is curved to form a closed annular shape. The inner layer plate 34 forms a circle surrounding the fixed bracket 31. Preferably, the inner layer plate 34 has the shape of a water drop.

[0019] The outer layer plate 36 has an arcuate shape and forms a circle surrounding the inner layer plate 34. The interior face of the outer layer plate 36 and the exterior face of the inner layer plate 34 are locally separated to form the gap S.

[0020] In the preferred embodiment of the present invention, the at least one inner spring plate 35 has a radially sectional face having a vortex shape. Thus, the at least one inner spring plate 35 has a vortex shape with an elastic force applied on the interior face of the inner layer plate 34, so that the inner layer plate 34 is expanded toward the outer diameter of the inner layer plate 34. The sealing device 3 further includes a roll 33 pressing and guiding the at least one inner spring plate 35 to stabilize the position of the at least one inner spring plate 35, and a steel cable extending through the vortex center 351 of the at least one inner spring plate 35 to enhance the whole structural strength of the at least one inner spring plate 35. The roll 33 is disposed in the inner layer plate 34 and located outside of the fixed bracket 31. Each of the inner layer plate 34 and the at least one outer spring plate 37 is provided with a through hole (not shown). The roll 33 is secured to the fixed bracket 31 by a fastening member (not shown) which extends through the through hole of each of the inner layer plate 34 and the at least one outer spring plate 37.

[0021] In the preferred embodiment of the present invention, the outer layer plate 36 has a fixed end secured to the inner layer plate 34 and has a free end spaced from the inner layer plate 34 to form the gap S.

[0022] In the preferred embodiment of the present invention, the at least one outer spring plate 37 has a substantially U-shaped configuration. The at least one outer spring plate 37 has a first end secured to the fixed bracket 31 and a second end contacting the interior face of the outer layer plate 36.

[0023] In another preferred embodiment of the present invention, the sealing device 3 includes multiple inner spring plates 35 that are centered at a center of the inner layer plate 34 and are arranged in a radiating shape.

[0024] In another preferred embodiment of the present invention, the sealing device 3 includes multiple outer spring plate 37 that are centered at a center of the inner layer plate 34 and are arranged in a radiating shape.

[0025] In the preferred embodiment of the present invention, as shown in FIG. 6, the outer layer plate 36 includes a metallic sheet plate 361 with a determined thickness, and a fiber layer 362 mounted on an exterior face of the metallic sheet plate 361.

[0026] In the preferred embodiment of the present invention, the fiber layer 362 is made of carbon fiber, glass fiber or the like.

[0027] In assembly, referring to FIGS. 4-6 with reference to FIG. 3, the sealing device 3 and the floating roof 1 are combined together and are mounted in the tank body 2. At this time, the fiber layer 362 of the outer layer plate 36 contacting the inner wall of the tank body 2. In such a manner, the at least one inner spring plate 35 applies an elastic force on the inner layer plate 34, and the at least one outer spring plate 37 applies an elastic force on the outer layer plate 36, to provide a closely airtight sealing effect between the outer layer plate 36 and the inner wall of the tank body 2, thereby preventing the oil air from leaking between the outer layer plate 36 and the inner wall of the tank body 2. In addition, the fiber layer 362 of the outer layer plate 36 is made of wearproof material and is not easily worn out during a long-term utilization, thereby enhancing the lifetime of the sealing device 3, and thereby facilitating maintenance, repair and replacement of the sealing device 3. Further, the fiber layer 362 of the outer layer plate 36 slides smoothly on the inner wall of the tank body 2, thereby preventing from

producing a spark due to the friction between the outer layer plate 36 and the tank body 2 during the sliding motion, and thereby ensuring the safety of the sealing device 3.

[0028] Although the invention has been explained in relation to its preferred embodiment(s) as mentioned above, it is to be understood that many other possible modifications and variations can be made without departing from the scope of the present invention. It is, therefore, contemplated that the appended claim or claims will cover such modifications and variations that fall within the scope of the invention.

Claims

1. A sealing device for an oil tank, comprising:

- a fixed bracket;
- an inner layer plate secured to the fixed bracket;
- at least one inner spring plate secured on an annular inner diameter of the inner layer plate and applying a force directed toward an outer diameter of the inner layer plate;
- an outer layer plate arranged on an exterior face of the inner layer plate, with a gap being defined between an interior face of the outer layer plate and the exterior face of the inner layer plate; and
- at least one outer spring plate arranged in the gap between the outer layer plate and the inner layer plate and applying a force directed toward an outer diameter of the outer layer plate;

characterized in that

- the inner layer plate has a radially sectional face that is curved to form a closed annular shape;
- the inner layer plate forms a circle surrounding the fixed bracket;
- the outer layer plate forms a circle surrounding the inner layer plate; and
- the interior face of the outer layer plate and the exterior face of the inner layer plate are locally separated to form the gap.

2. The sealing device for an oil tank of claim 1, wherein the at least one inner spring plate has a radially sectional face having a vortex shape.

3. The sealing device for an oil tank of claim 1, wherein the outer layer plate has a free end spaced from the inner layer plate to form the gap.

4. The sealing device for an oil tank of claim 1, wherein the at least one outer spring plate has a substantially U-shaped configuration, and has a first end secured to the fixed bracket and a second end contacting the interior face of the outer layer plate.

5. The sealing device for an oil tank of claim 1, wherein the sealing device includes multiple inner spring plates that are centered at a center of the inner layer plate and are arranged in a radiating shape.

6. The sealing device for an oil tank of claim 1, wherein the sealing device includes multiple outer spring plate that are centered at a center of the inner layer plate and are arranged in a radiating shape.

7. The sealing device for an oil tank of claim 1, wherein the outer layer plate includes a metallic sheet plate and a fiber layer mounted on an exterior face of the metallic sheet plate.

8. The sealing device for an oil tank of claim 7, wherein the fiber layer is made of carbon fiber.

9. The sealing device for an oil tank of claim 7, wherein the fiber layer is made of glass fiber.

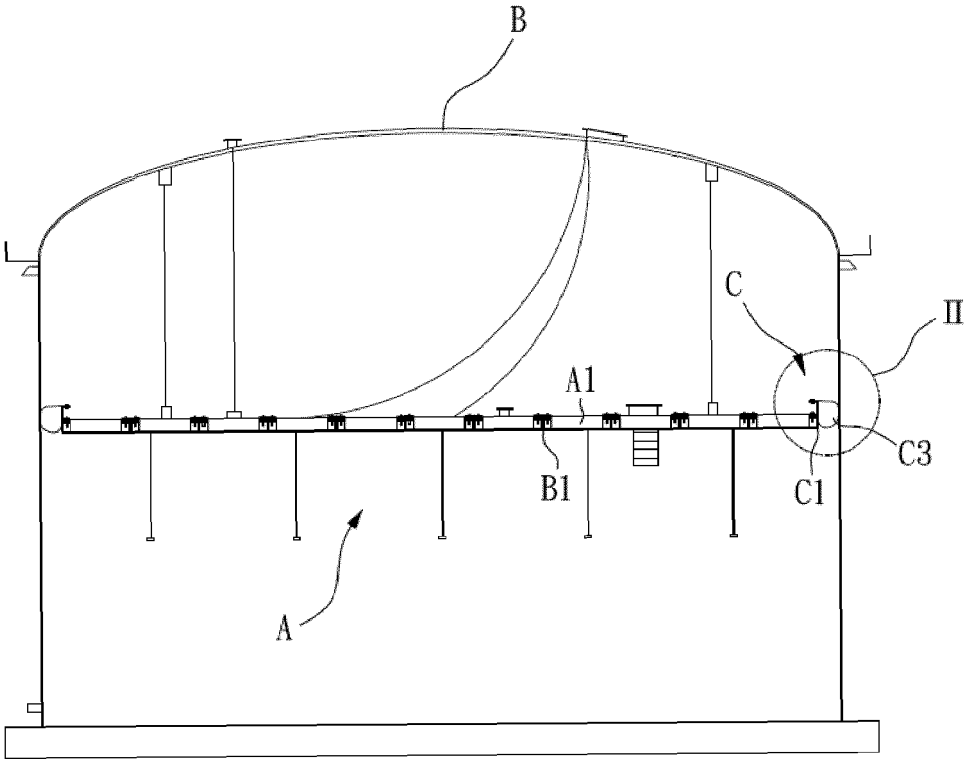

FIG. 1 (Prior Art)

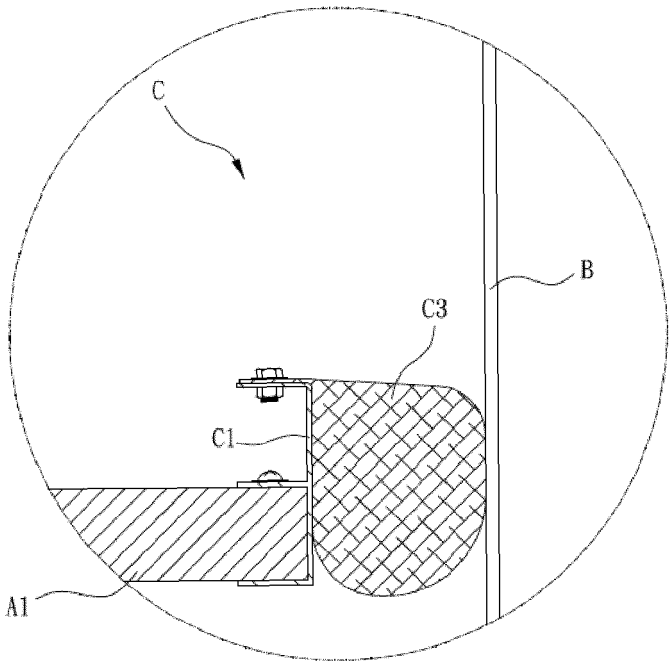

FIG. 2 (Prior Art)

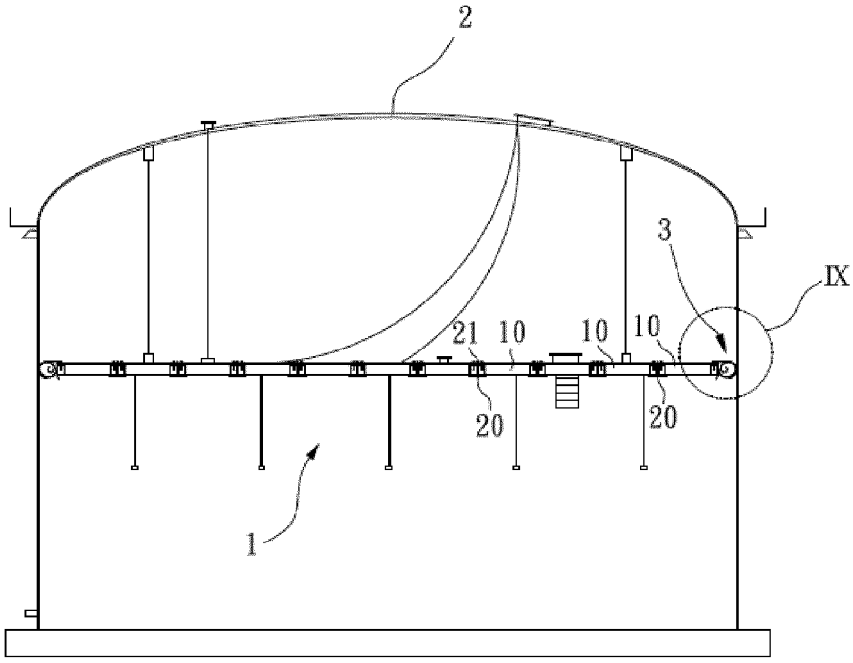

FIG. 3

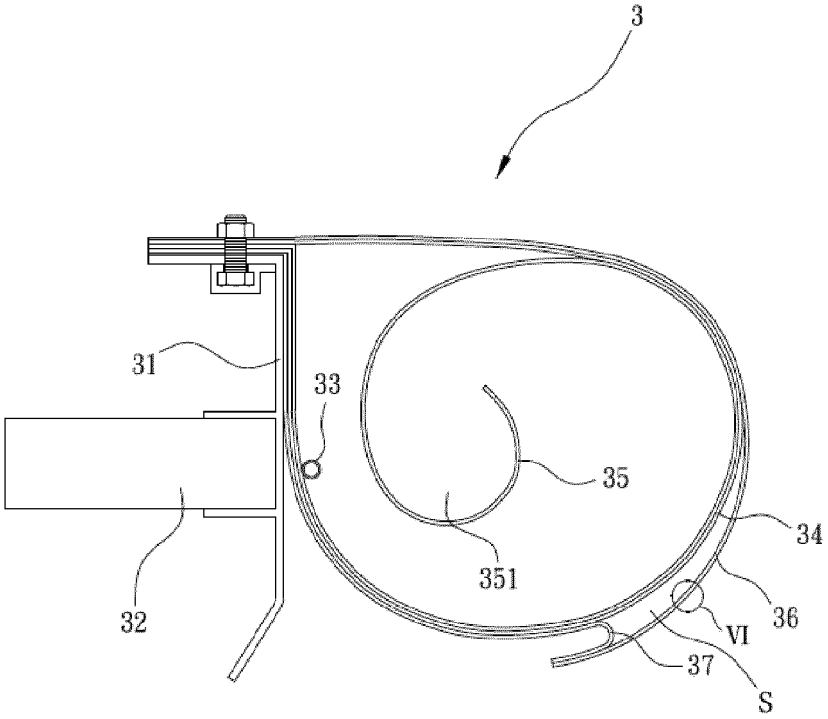

FIG. 4

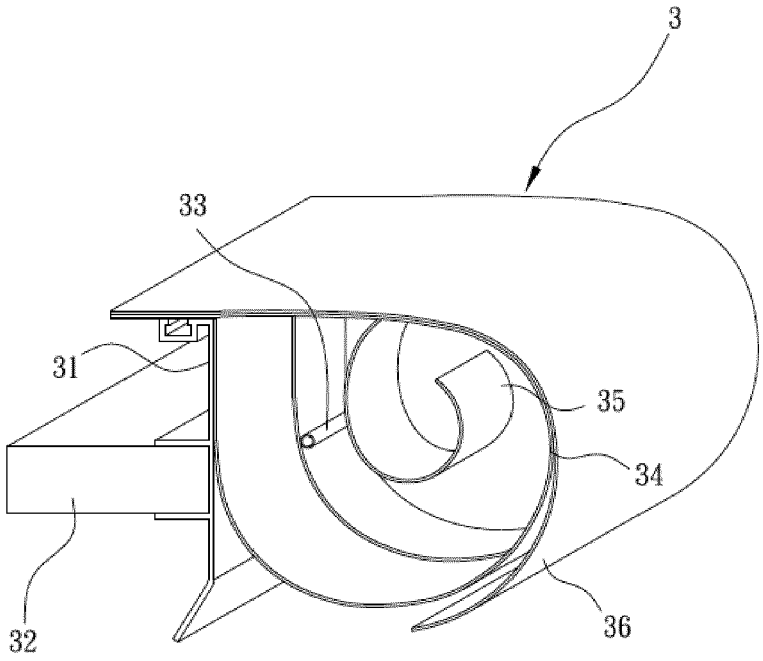

FIG. 5

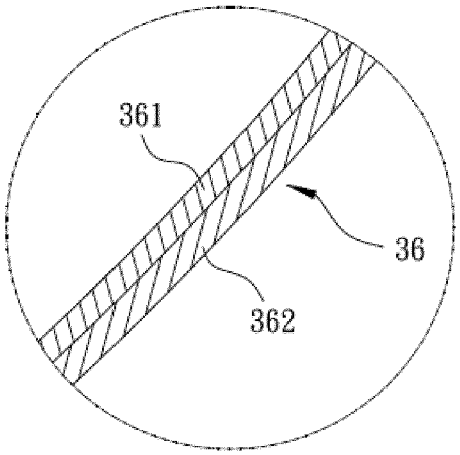

FIG. 6

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EUROPEAN SEARCH REPORT

Application Number
EP 18 19 8229

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	JP S54 17218 U (?) 3 February 1979 (1979-02-03) * figures 1-5 *	1-9	INV. B65D88/46
A	GB 1 478 976 A (ARPAL FLOATING COVERS) 6 July 1977 (1977-07-06) * page 1, column 1, line 47 - page 2, column 1, line 12 * * figures 1, 2 *	2	
A	CN 106 586 302 A (YIN YAN) 26 April 2017 (2017-04-26) * page 4, paragraph 35-37 * * figures 1, 2 *	1	

TECHNICAL FIELDS SEARCHED (IPC)

B65D

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	15 January 2019	Piolat, Olivier

CATEGORY OF CITED DOCUMENTS

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Patent document cited in search report	Publication date	Patent family member(s)	Publication date
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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82