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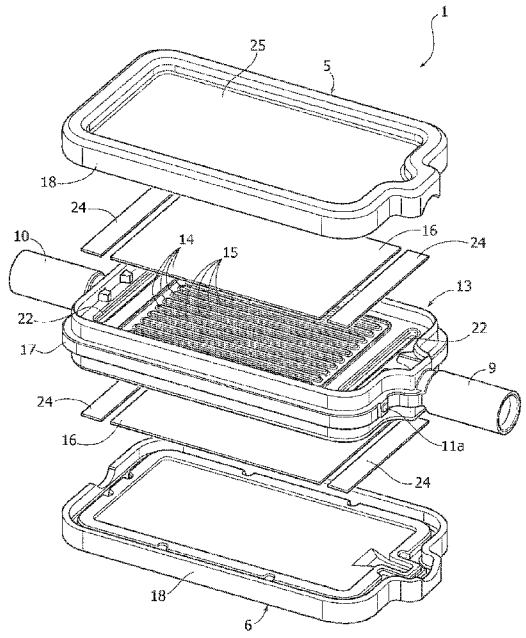
(54) Title: FILTER FOR INFUSION MEDICAL LINES

FIG. 4



(57) Abstract: Filter (1) for infusion medical lines comprising a flattened box-like body (2) provided inside which is a plate-shaped element (13) formed on whose one or both of the opposite faces are respective ribs (14) defining inner channels (15). Arranged on the ribs are respective filtering hydrophilic membranes (16) which separate the channels (15) from respective interspaces (23, 23) delimited by a pair of half-shells (5, 6). The interspaces (23, 23) are placed in communication with the inlet connector (9), the channels (15) are placed in communication with the outlet fitting (10) and the interspaces (23) are placed in communication with the outside through vent openings (11a, lib) arranged on the end walls (3, 4) of the box-like body (2).

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"Filter for infusion medical lines"

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Field of the invention

The present invention regards a filter for infusion medical lines and more in particular an IV filter.

Filters thus made conventionally comprise a flattened box-like body having a first end wall and a second end wall, a pair of greater lateral walls, and a pair of smaller lateral walls. Such filters are provided with an inlet connector for a liquid to be filtered and an outlet connector for the filtered liquid at the one and the other end wall. Arranged in the box-like body is a plate-shaped element formed on whose at least one of the opposite faces is a plurality of ribs defining parallel channels. Arranged on the or on each plurality of ribs is a respective filtering hydrophilic membrane which separates the channels from one or from respective interspaces delimited by the two greater walls. The or each interspace is placed in communication with the inlet connector and the channels are placed in communication with the outlet connector. Furthermore, the or each interspace is placed in communication with the external by means of openings with associated hydrophobic membranes for deaerating the liquid.

State of the prior art

Documents EP-1208857, EP-1421960, US4525182 and US5439587 disclose filters thus made, wherein the deaeration openings provided with hydrophobic membranes are provided on the pair of greater lateral walls of the box-like body. Such positioning of the deaeration openings entails the drawback that they can be inadvertently occluded when handling the filter, or

they can be unintentionally obstructed by objects present in proximity of the place of use of the filter, with the unacceptable risk of the liquid not being deaerated effectively.

Document WO 95/28215 describes a medical filter with multiple compartment comprising one or more vents each provided with a porous membrane for separating the air from the liquid. The vents are arranged at the ends of the box-like body but they are oriented perpendicularly to the greater faces of the filter, i.e. they terminate thereon, revealing the same drawbacks described above.

Document CN 104083819 describes a filter for medical lines having vent holes with respective membranes arranged in an end wall of the filter in proximity of the outlet connector for the liquid. The vent holes are placed in communication with a chamber designed to collect the liquid after it has been filtered by the hydrophilic membrane. The air venting is thus carried out only after filtering the liquid and it could be incomplete, in particular if the filter is used in a vertical position.

Summary of the invention

The object of the present invention is to overcome the aforementioned drawback.

With the aim of achieving such object, the invention regards a filter for infusion medical lines of the type defined in the preamble of claim 1 whose primary characteristic lies in the fact that the deaeration openings are provided on the end walls of the box-like body and so that - in use - the infusion liquid initially touches at least one of said hydrophobic membranes and subsequently touches and flows through said at least one hydrophilic membrane.

The hydrophobic membranes are arranged at the

ends of the greater lateral walls of the plate-shaped element at respective transverse manifolds which are in turn placed in communication with the deaeration openings.

The inlet and outlet connectors for the liquid are conveniently coaxial so that - in use - torsional moments are not generated in the inflow and outflow tubes of the medical liquid.

The inlet and outlet connectors for the liquid can be designed for tube-tube or luer-tube or tube-luer or luer-luer connections of said medical line.

The or each filtering hydrophilic membrane can also be obtained as a single piece with the respective hydrophobic membranes.

The invention also regards a method for filtering and deaerating an infusion liquid for medical lines which provides for the use of a filter as claimed herein.

Brief description of the drawings

Further characteristics and advantages of the invention will be apparent from the following detailed description, with reference to the attached drawings, provided by way of non-limiting example, wherein:

- figure 1 is a schematic perspective view of an embodiment of the filter according to the invention,
- figure 2 is a plan and partially sectioned view of figure 1,
- figure 3 is a front elevational view according to arrow III of figure 1,
- figure 4 is an exploded view of the filter of figure 1,
- figure 5 is a longitudinal sectional view according to line A-A of figure 2,
- figure 6 is an enlargement of the portion of the filter in the circle of figure 5,

- figure 7 is a cross-sectional view according to line B-B of figure 2,
- figure 8 is a cross-sectional view according to line D-D of figure 2.

Detailed description of the invention

Initially with reference to figures 1-3, the infusion filter according to the invention is indicated in its entirety with 1.

It comprises a flattened box-like body 2 formed by a pair of half-shells 5, 6. The box-like body 2 comprises a first and second end wall 3, 4, a pair of greater lateral walls 25, 26, and a pair of smaller lateral walls 7, 8. Arranged at the first end wall 3 is an inlet connector 9 of a liquid to be filtered and arranged at the second end wall 4 is an outlet connector 10 for the filtered liquid. A first vent opening, in the form of a hole 11a, is provided for on the first end wall 3 in proximity of the inlet connector 9 and a second vent opening, in the form of a hole 11b, is provided on the second end wall 4 in proximity of the outlet connector 10.

Visible in the partial section of figure 2 is a duct 12 which connects the hole 11a with the internal of the box-like body 2. A similar duct not visible in the drawings connects the hole 11b with the internal of the box-like body 2.

Now, with reference to figures 4 to 8 a plate-shaped element in the half-shells 5, 6 formed on whose opposite faces are respective pluralities of ribs 14 which define channels 15 extending longitudinally between the connectors 9, 10 is indicated with 13. Provided in proximity of the ends of the channels 15 of each face and perpendicularly thereto are transverse manifolds 22. The opposite manifolds 22 of each end of the plate-shaped element 13 are placed in communication

with each other by means of respective passages of the plate-shaped element 13, one of which is indicated with 27 in figure 7, and furthermore they are placed in communication respectively with the vent hole 11a and with the vent hole 11b. Resting on each face of the plate-shaped element 13 is a respective hydrophilic membrane 16 which is welded to the plate-shaped element 13. Two pairs of hydrophobic membranes 24 are arranged above the four manifolds 22 and for example fixed by means of welding. The two pairs of hydrophobic membranes 24 can also be integrated and obtained as a single piece respectively with the one and with the other hydrophilic membrane 16.

The plate-shaped element 13 has a projecting perimeter edge 17 which is coupled with respective annular lips 18 of the half-shells 5, 6.

The inlet 9 and outlet 10 connectors for the liquid are coaxial to each other, are integrally joined to the plate-shaped element 13 and they can be configured for the tube-tube or luer-tube or tube-luer or luer-luer connections of the medical line.

Figures 5-8 show two interspaces 23, 23 coplanar to the faces of the plate-shaped element 13, separated by it by means of the respective hydrophilic membranes 16, 16 and each externally delimited by the respective half-shell 5, 6. A passage 19 (figure 5), provided on the plate-shaped element 13 at the end of the inlet connector 9 places both the interspaces 23, 23 in communication with such connector 9.

Referring more in detail with figure 6, a passage 21 of the plate-shaped element 13 places the outlet connector 10 in communication with the plurality of channels 15.

As clear from the above, the filter 1 according to the invention has a configuration that is compact and

small in size.

During use, the infusion liquid - through the inlet connector 9 and the passage 19 - enters into the interspaces 23, 23 initially touching the proximal hydrophobic membranes 24, 24 which allow the air trapped in the liquid to flow out into the respective manifolds 22 before being dispersed outside the filter 1 through the duct 12 and the hole 11a.

Subsequently, the fluid touches and flows through the filtering hydrophilic membrane 16, 16 so as to be conveyed from the channels 15 towards the passage 21 and flow out through the outlet connector 10.

The filter 1 according to the invention is normally used in a vertical portion of an infusion line, i.e. it is oriented so that the inlet connector 9 is positioned at the upper part with respect to the outlet connector 10. After touching the proximal hydrophobic membranes 24, should the liquid still contain air, for example due to the orientation of use different from the one described previously, the residual air can flow out through the distal membranes 24 and the respective manifolds 22 connected to the hole 11b.

The arrangement of the hydrophobic membranes 24 upstream and downstream of the flow in the interspaces 23 of the filter 1 reveals the further advantage lying in the fact that, in particular during the priming, the air contained in the liquid accumulates in the end areas of the filter 1 so as not to occlude part of the filtering surfaces; in this manner, the air has more time to flow out with respect to the known solutions described previously.

Obviously, the construction details and the embodiments may widely vary with respect to what has been described and illustrated, without departing from

the scope of protection of the present invention as defined in the claims that follow. Thus, for example, the filter could generally have a different shape with respect to the one represented in the drawings and it could also be provided with a single filtering hydrophilic membrane 16 arranged on ribs 14 formed on only one of the faces of the plate-shaped element 13.

CLAIMS

1. A filter (1) for infusion medical lines comprising a flattened box-like body (2) including a pair of half-shells (5, 6) and provided with an inlet connector (9) for a liquid to be filtered and an outlet connector (10) for the filtered liquid, said connectors (9, 10) being provided respectively at a first end wall (3) and at a second end wall (4) of the box-like body (2), a plate-shaped element (13) being arranged within the box-like body (2) formed on whose at least one of the opposite faces are ribs (14) which define inner channels (15) parallelly extending between said connectors (9, 10), on said ribs (14) there being arranged at least one filtering hydrophilic membrane (16) which separates said channels (15) from an interspace (23) delimited by the corresponding half-shell (5, 6), said interspace(23) being placed in communication with the inlet connector (9) and said channels (15) communicating with the outlet connector (10), and said interspace(23) further being placed in communication with the outside through vent openings (11a, 11b) with associated hydrophobic membranes (24), characterized in that said vent openings (11a, 11b) are arranged on said end walls (3, 4) of the box-like body (2) and so that - in use - the infusion liquid initially touches at least one of said hydrophobic membranes and subsequently touches and flows through said at least one hydrophilic membrane (16).

2. Filter according to claim 1, characterized in that said channels (15) are provided on both opposite faces of said plate-shaped element (13) and a pair of filtering hydrophilic membranes (16) separate said channels (15) from a pair of interspaces (23) each delimited by a respective half-shell (5, 6).

3. Filter (1) according to claim 1 or claim 2,

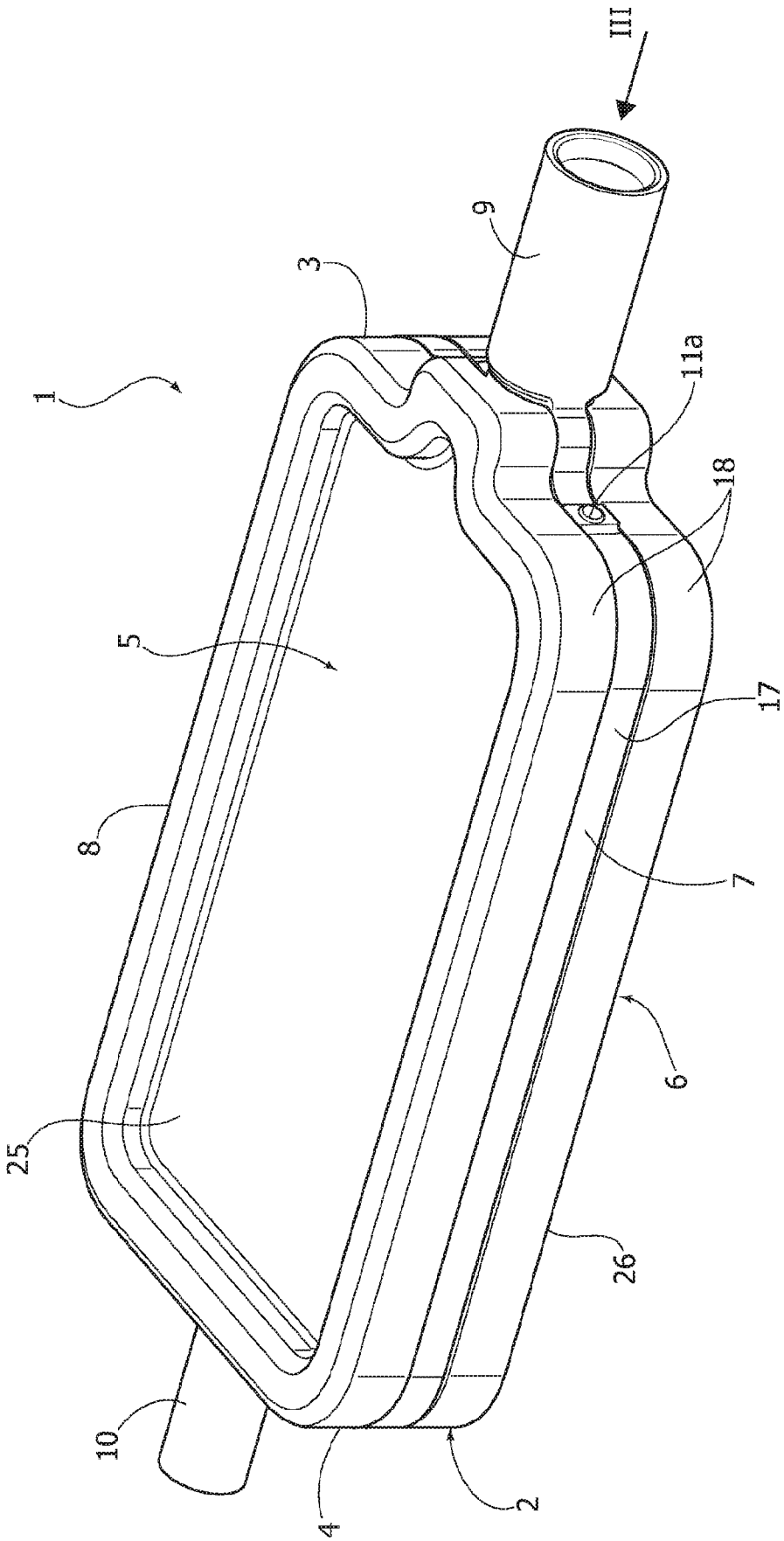
characterized in that at the ends of the opposite faces of the plate-shaped element (13) there are provided transverse manifolds (22) on which said hydrophobic membranes (24) are arranged, said transverse manifolds (22) being placed in communication with said vent openings (11a, 11b).

4. Filter (1) according to any one of claims 1 to 3, characterized in that said inlet connector (9) and said outlet connector (10) are coaxial.

5. Filter (1) according to one or more of the preceding claims, characterized in that said inlet connector (9) and said outlet connector (10) are designed for tube-tube or luer-tube or tube-luer or luer-luer connections of said medical line.

6. Filter (1) according to one or more of the preceding claims, characterized in that the or each filtering hydrophilic membrane (16) is made of one piece with said hydrophobic membranes (24).

FIG. 1



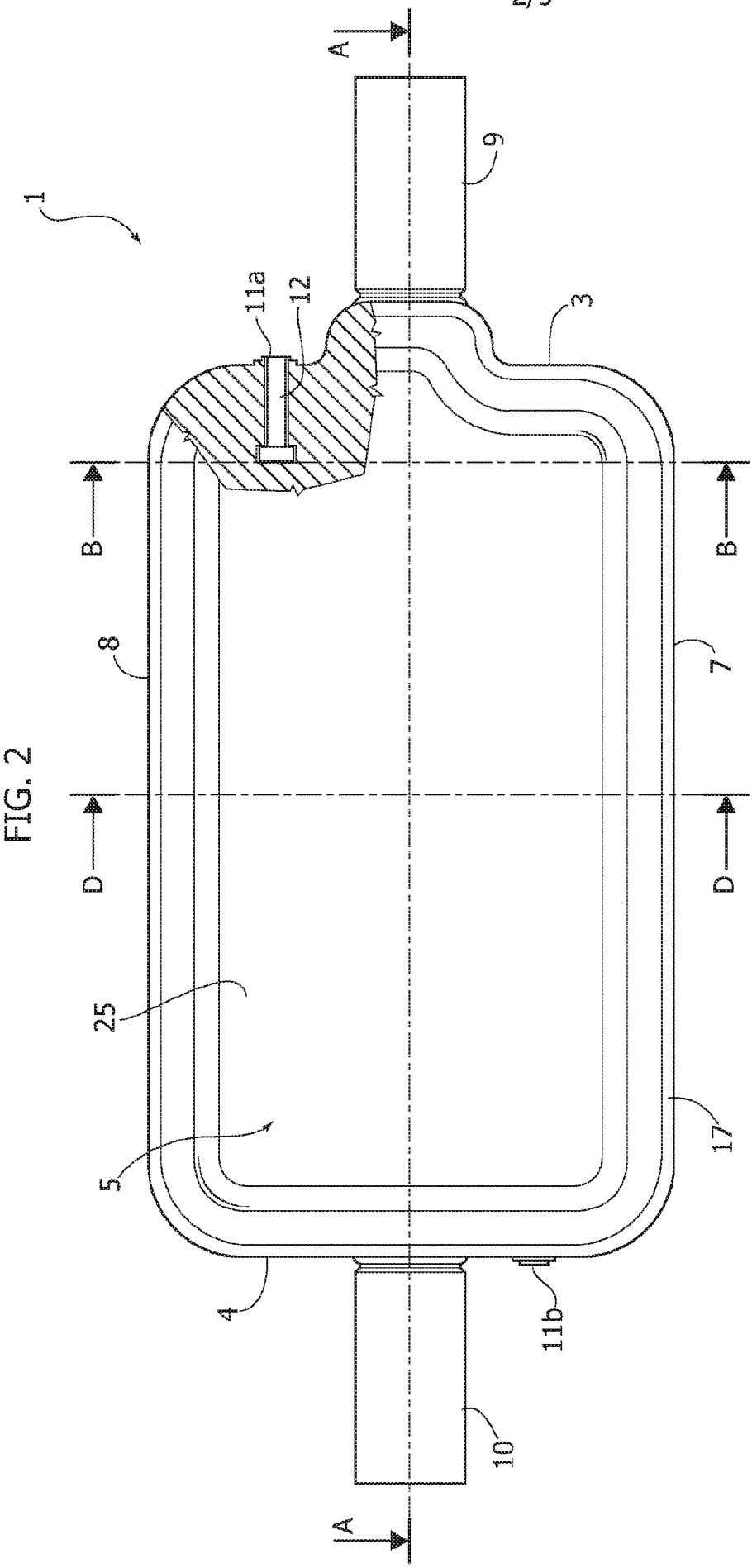


FIG. 2

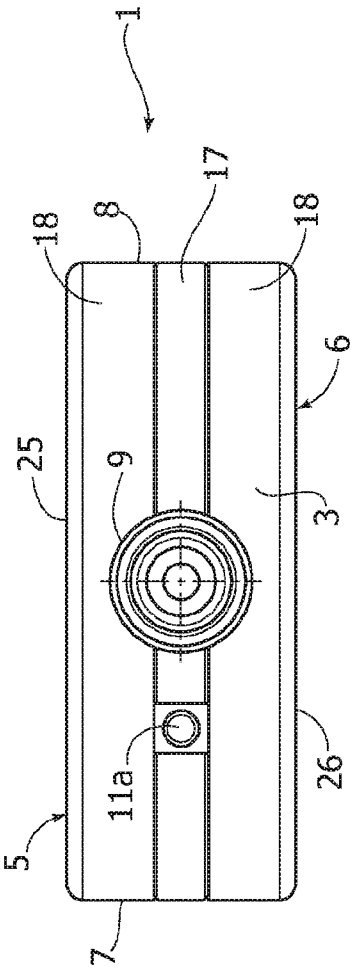
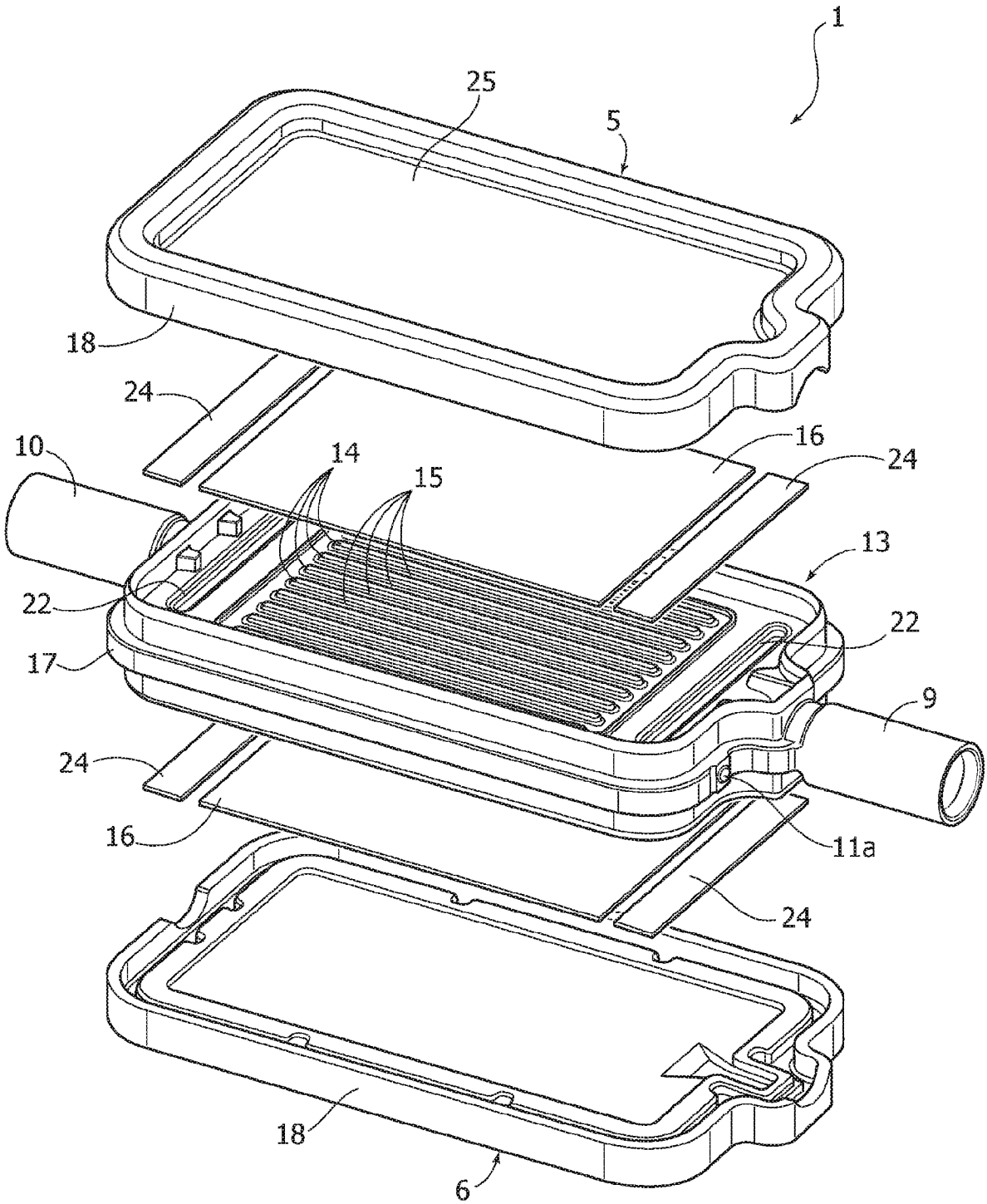


FIG. 3

FIG. 4



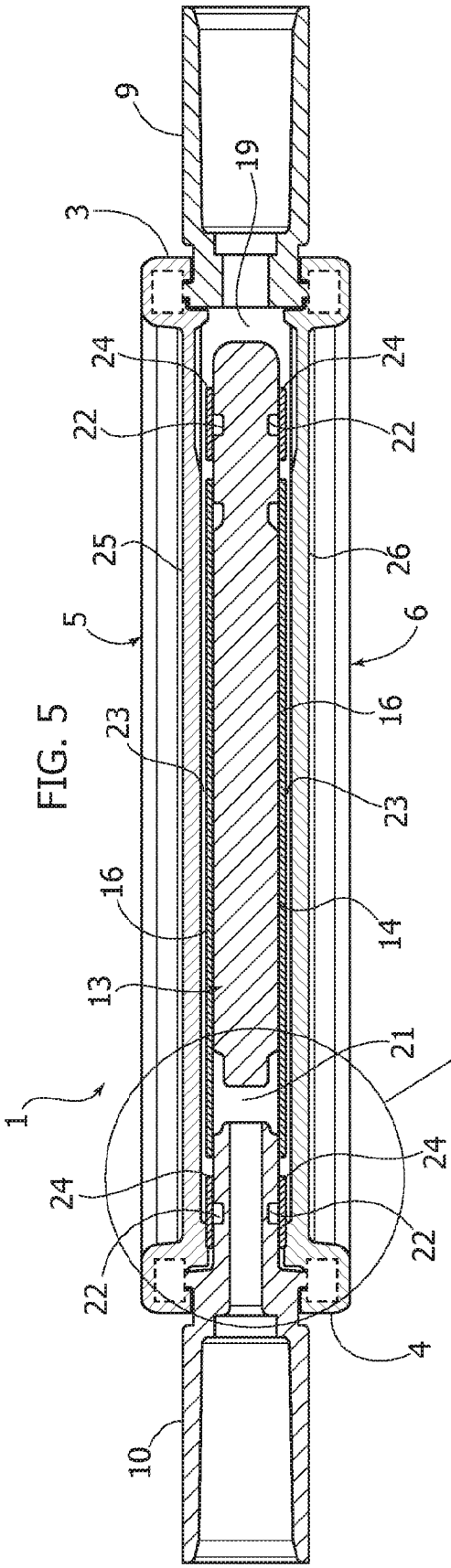

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FIG. 5

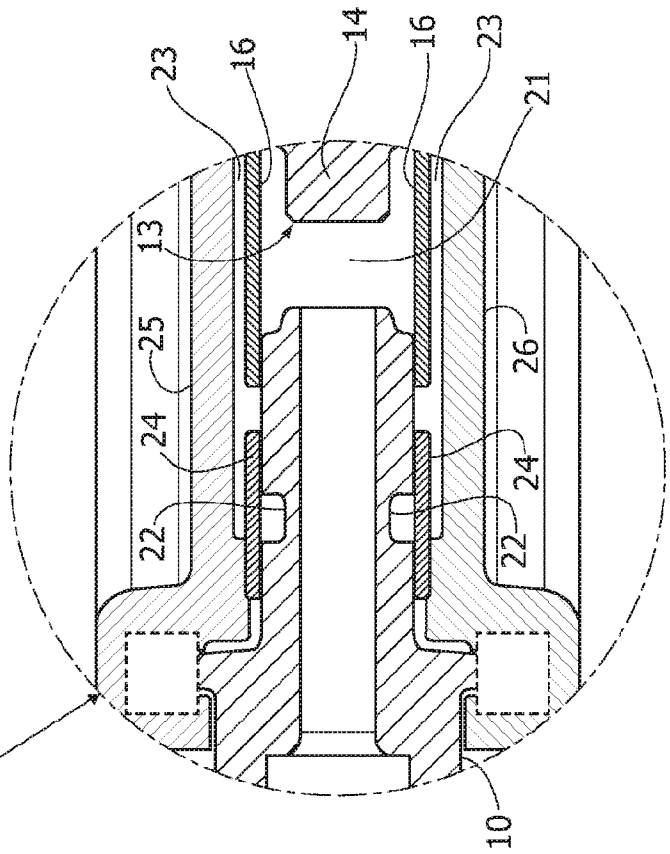
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FIG. 6

FIG. 8

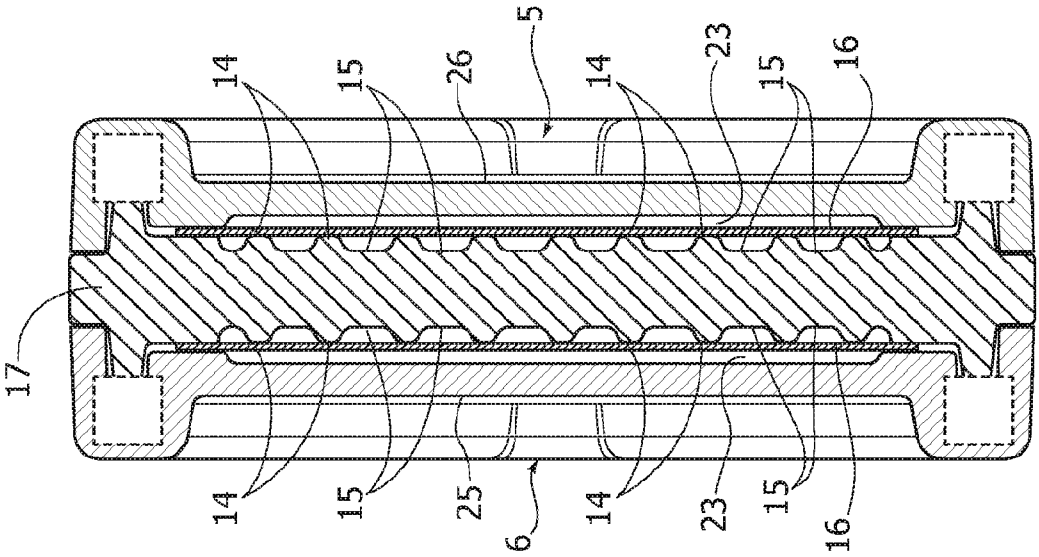
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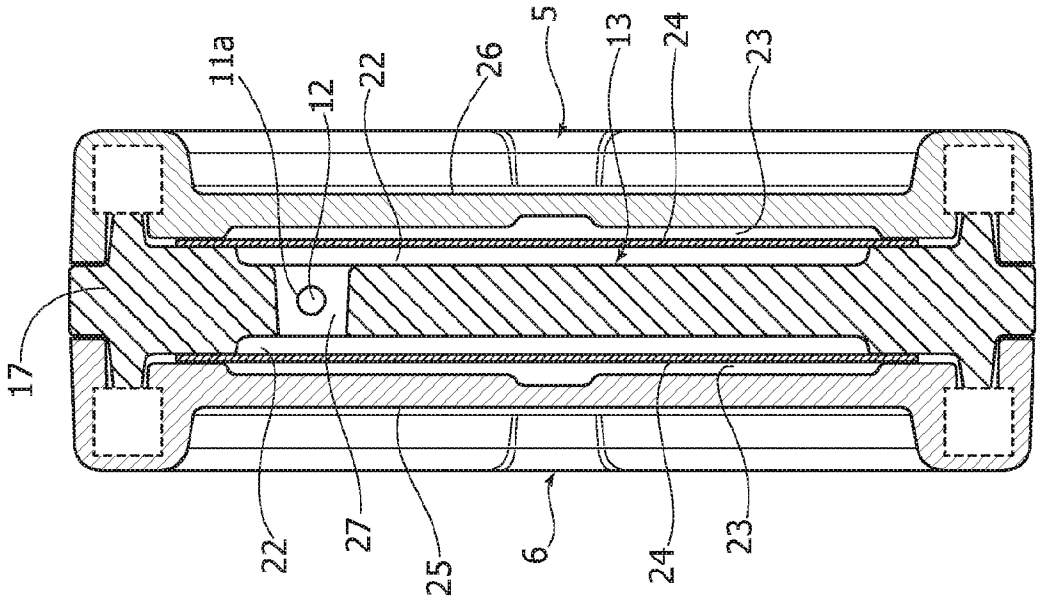
FIG. 7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INTERNATIONAL SEARCH REPORT

International application No
PCT/IB2019/052079

A. CLASSIFICATION OF SUBJECT MATTER
INV. A61M5/38
ADD. A61M5/165

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
A61M

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

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X Y	CN 104 083 819 B (TIANJIN HANACO XINGDA MEDICAL CO LTD) 10 May 2017 (2017-05-10) paragraph [0040] - paragraph [0042]; figure 2	1,3-6 2
X	WO 95/28215 A1 (PALL CORP [US]; MATKOVICH VLADO I [US]; WORTHAM SAMUEL T [US]; BORMANN) 26 October 1995 (1995-10-26) page 34 - page 35; figures 1,4	1,3-6
A	EP 0 784 988 A1 (FILTERTEK INC [US]) 23 July 1997 (1997-07-23) column 5 - column 6	1-6
Y	WO 95/03842 A1 (MILLIPORE CORP [US]) 9 February 1995 (1995-02-09) columns 5-6; figure 2	2

☐ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

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Date of the actual completion of the international search	Date of mailing of the international search report
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Name and mailing address of the ISA/	Authorized officer
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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
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