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

(11) EP 1 688 609 A1

# (12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
**09.08.2006 Bulletin 2006/32**

(51) Int Cl.:
***F02M 25/08*** *(2006.01)*

(21) Application number: **05002259.9**

(22) Date of filing: **03.02.2005**

(84) Designated Contracting States:
**AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HU IE IS IT LI LT LU MC NL PL PT RO SE SI SK TR**
Designated Extension States:
**AL BA HR LV MK YU**

(71) Applicant: **Delphi Technologies, Inc.**
**Troy Michigan 48007 (US)**

(72) Inventor: **Ziolkowski, Jaroslaw**
**25-151 Kielce (PL)**

(74) Representative: **Lukaszyk, Szymon et al**
**Kancelaria Patentowa Lukaszyk**
**ul. Glowackiego 8**
**40-062 Katowice (PL)**

## (54) Canister for evaporated fuel processing system

(57) A canister (1) for evaporated fuel processing system having a housing (2), inside of which at least one adsorbing chamber, filed with adsorbing agent (11), is placed, where in at least one adsorbing chamber across a vapours flow path at least one permeable plate (14, 18) is placed. Said plate has the form of uniform shape element able to displace along the adsorbing chamber and comprises at least two elastic connecting members fixed at one end to the wall of the adsorbing chamber and from the other end entering inside and transforming into the permeable plate (14, 18). Preferably the housing (2) and the plate (14, 18) are made of plastic in the form of single, integral moulding, where the internal surface of the wall of the housing (2) transforms into the first end of each connecting member, while the second end thereof transforms into the plate (14, 18). Therefore the number of distinct canister elements is greatly reduced.

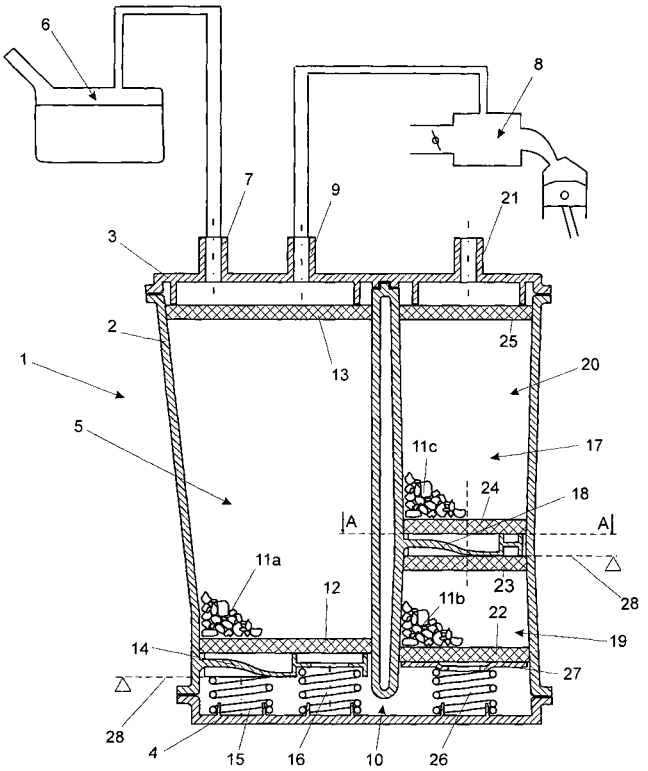


Fig. 1

EP 1 688 609 A1

## Description

**[0001]** The invention relates to a canister for evaporated fuel processing system having a housing, inside of which at least one adsorbing chamber, filed with adsorbing agent, is placed, where the inlet adsorbing chamber is connected to a fuel tank and to an intake pipe of an internal combustion engine and the outlet adsorbing chamber comprises an atmospheric port, where in at least one adsorbing chamber across a vapours flow path at least one permeable plate is placed.

**[0002]** A typical canister of the above kind is disclosed e.g. in the U.S. patent application US 2002/0078931 or European patent application EP 04460022.9 co-owned by the present applicant. A canister usually houses a plurality of serially connected adsorbing chambers. The first adsorbing chamber is connected to a fuel tank and to an intake pipe of an internal combustion engine and the last, outlet adsorbing chamber comprises an atmospheric port.

**[0003]** Loose and unstable adsorbent deposit requires a constant compression not to scatter inside the adsorbing chamber mainly due to vehicle chassis vibrations. For this reason the adsorbent deposit is preliminarily compressed usually by means of compensation springs pressing against appropriate permeable plates.

**[0004]** The fuel vapours, after entering into the canister from the fuel tank, are captured by the adsorbent included in the chambers. As a rule, activated carbon is used as the chamber-filling agent. After the start of the engine the vapours are inducted by negative pressure of the intake pipe and then burnt inside the combustion chamber. Once adsorbing capability of the first chamber is exhausted, the vapours pass through to successive adsorbing chambers, and after exceeding adsorptive capabilities of the outlet chamber they are discharged into the atmosphere.

**[0005]** To ensure that the container meets requirements of related governmental emission standards, e.g the LEV II (*Low-Emission Vehicle Program)* or the Zero Evap standard, that are in use in the USA, the emission of evaporated fuel into the atmosphere must be as low as possible. For this purpose the height of adsorbing chambers should be relatively large, as compared with diameters thereof. In addition, the outlet adsorbing chamber is frequently divided by a partition, defining the outer and the inner adsorbing layer. Such a partition produces an additional restraint against vapour flow, causing redistribution thereof within the entire volume of the adsorbent below the partition. As partition plate used in known canisters constructions is a separate part of the canisters, it may rotate or displace between the adsorbent layers, during the canister operation, such that in extreme case stops performing its functions.

**[0006]** The aim of the present invention is to provide a canister for evaporated fuel processing system, having a simple, economic constructions, which would be free of the aforementioned disadvantage, and would feature a greatly reduced number of elements and assembling steps necessary to manufacture thereof.

**[0007]** According to the present invention there is provided a canister, where at least one permeable plate has the form of uniform shape element able to displace along the adsorbing chamber and comprises at least two elastic connecting members fixed at one end to the wall of the adsorbing chamber and from the other end entering inside and transforming into the permeable plate.

**[0008]** The thickness of the connecting members is preferably lower than the working thickness of the plate. The term "working thickness", as used herein denotes the factual thickness of the plate within the adsorbing chamber.

**[0009]** Preferably the housing and said at least one permeable plate are made of plastic in the form of single, integral moulding, where the internal surface of the wall of the housing transforms into the first end of each connecting member, while the second end of each connecting member transforms into the plate, so as the housing, the connecting members and the plate are integral with each other.

**[0010]** Furthermore advantageously permeable plate in its neutral position is displaced in the direction opposite to the direction of the force of the compensation means.

**[0011]** The permeable plate preferably comprises a stabilising wall, which may surround the external edge of the plate. Alternatively the plate may be a solid block within the area of each segment defined by the connecting members.

**[0012]** To enable the vapour circulation the permeable plate preferably comprises at least one opening. In some cases the gaps between the connecting members and the plate may be quite sufficient

**[0013]** The permeable plate according to the invention may be either partition dividing the outlet adsorbing chamber into the internal and the external adsorbing layer or the closing plate of the adsorbing chamber leaning against the compensation means or both.

**[0014]** The invention is presented below in exemplary embodiments with reference to the drawings, of which:

Fig. 1 shows a schematic lateral cross-section of a canister for evaporated fuel processing system according to the present invention, along with typical components of the system,

Fig. 2 shows a top view of the permeable partition of the outlet adsorbing chamber along the line A-A of Fig. 1,

Fig. 3 shows a perspective cross-section of the permeable partition of the outlet adsorbing chamber in its neutral bottom position along the line B-B of Fig. 1,

Fig. 4 corresponds to Fig. 3 but the permeable partition was displaced in its top position,

Fig. 5 and Fig. 6 show other embodiments of the permeable partition.

**[0015]** As shown in Fig. 1 the canister 1 comprises a housing 2 closed at the top by the top cover 3 and at the bottom by the bottom cover 4. The housing 2 includes two adsorbing chambers filed with activated carbon.

**[0016]** The inlet adsorbing chamber 5 is connected with a fuel tank 6 by means of an inlet port 7 and with an intake pipe 8 of an internal combustion engine by means of an outlet port 9, and furthermore it is connected with the outlet adsorbing chamber 17 by means of a channel 10.

**[0017]** Activated carbon 11a filing the inlet adsorbing chamber 5 is held between the covers 12 and 13, being permeable for evaporated fuel, by means of permeable plate 14 and two springs 15 and 16. The springs prevents the activated carbon to move inside chamber due to vehicle vibrations, which might lead e.g. to displacement of the covers 12 and 13 and clogging the channels 7 and 9 by the carbon, which in turn would result in canister malfunction. Obviously the number of compensation springs may vary in dependence of the canister construction.

**[0018]** The outlet adsorbing chamber 17 is additionally divided into the inner layer 19 and the outer layer 20 by means of a partition plate 18 capable of limited longitudinal displacement. The partition 18 restricts the vapour flowing into the outer layer 20 and brings about redistribution thereof within the entire volume of the adsorbent downstream the partition 18, inside the inlet adsorbing chamber 5 and the inner layer 19 of the outlet adsorbing chamber 17. Fuel vapours are discharged from the outer layer 20 to the surrounding atmosphere through the atmospheric port 21.

**[0019]** Activated carbon 11b of the inner adsorbing layer 19 is held between covers 22 and 23, and activated carbon 11c of the outer adsorbing layer 20 is held between covers 24 and 25. The covers 23 and 24 lean against the partition, while the compensation spring 26 and the permeable plate 27 ensure appropriate pressure of both activated carbon layers 11b and 11c.

**[0020]** Filtering covers 12, 13, 22, 23, 24 and 25 are made e.g. from the polyurethane foam and prevent activated carbon to get out of the adsorbing chambers, thus disallowing to clog outlets or openings of the particular partitions.

**[0021]** Fuel vapours leaving the fuel tank 6 enters the canister 1 through the inlet port 7 and diffuse in the first adsorbing chamber 5, where the neutralization of light hydrocarbons is carried out. After the start of the engine, the fuel vapours, collected in the canister are inducted by negative pressure of the intake pipe 8 and then burnt inside the combustion chamber. If the vapours pressure is high, they flow through the channel 10 to the outlet adsorbing chamber 17, from which they are discharged into the atmosphere through the atmospheric port 21.

**[0022]** The housing 2 of the canister shown in Fig. 1 has the form of a single element mould, made of glass-fibre reinforced ethylene, along with the permeable plates 14 and 18 of similar construction. Therefore the number of distinct elements of the canister is greatly reduced. The dashed line 28 depicts the joining surface of internal cooperating parts of the moulding form (not shown) used for the manufacture of the internal elements of the canister, and in particular the permeable plates 14 and 18.

**[0023]** The permeable plate 18 is shown in Fig. 2 in the top-down view. The plate is an integral part of the housing 2 and has the form of a single element shape comprising three elastic, elongated, substantially parallel to each other, connecting members 29a, 29b and 29c entering inside the surface of the plate 18. The internal surface of the wall of the housing 2 transforms into the first end of each connecting member 29, while the second end of each connecting member 29 transforms into the plate 18. Therefore the housing 2, connecting members 29a, 29b and 29c and the plate 18 are integral with each other.

**[0024]** The dimensions of the connecting members depend on many parameters, in particular on the assumed length of longitudinal displacement of the plate. The connecting members practically disallow the plate to rotate between the adsorbent layers.

**[0025]** Along the external edge, the plate is surrounded by the stabilising wall 31. The wall defines the contact surface of the plate 18 with the filtering covers 23 and 24 of accordingly the inner 19 and the outer 20 adsorbing layer and ensures appropriate transversal stiffness of the plate 18. Obviously instead of the stabilising wall 31 the plate 18 may be a solid block within the area of each of four segments 30a, 30b, 30c and 30d defined by the connecting members 29a, 29b and 29c.

**[0026]** Additionally the plate 18 comprises the opening 32 for the restricted circulation of vapours between the adsorbing layers, although in some designs the presence of gaps between the connecting members 29 and the plate may be completely sufficient to ensure the flow.

**[0027]** Drawing Fig. 3 shows the plate 18 of thickness H in its bottom, neutral position. Such a shape of the plate is achieved during the moulding process. As shown, the connecting members 29a, 29b and 29c of thickness h are in neutral, unloaded state.

**[0028]** Drawing Fig. 4 shows the plate 18 in its top position, which it would have under the action of the force directed upwardly. As shown, the connecting members are deflected enabling the displacement of the plate in the chamber of the distance H-h (cf. Fig. 3).

**[0029]** The plate should be preferably designed in such a way that under the pressure of the compensation spring it takes one of the intermediate positions between the bottom neutral position (Fig. 3) and the top position (Fig. 4).

**[0030]** The design of the plate 14 of the inlet adsorbing chamber is similar. The plate however comprises a socket for the springs 15 and 16.

**[0031]** The drawings Fig. 5 and Fig. 6 present other embodiments of the permeable plate according to the

invention. Reference numerals of elements having the same functions remain the same as above.

**[0032]** The partition 18a shown in Fig. 5 comprises only two connecting members 29a and 29b. Furthermore it comprises a number of orifices 32.

**[0033]** The partition 18b of the drawing Fig. 6 is used as a partition for the adsorbing chambers having a substantially circular cross-section. It comprises four members 29a-29d. Additionally, in this embodiment each orifice 32 is surrounded by the stabilising wall 31 performing the similar functions to that shown in Fig. 2.

**[0034]** The presented embodiments of the canister are quoted exclusively to illustrate operation principle of the appliance and in any case cannot be considered as exhausting solutions to which the invention is limited. It is obvious that the permeable plate of the present invention may be equally used in canisters having only one adsorbing chamber or canisters without the partition dividing the outer adsorbing chamber into separate layers.

## Claims

1. A canister for evaporated fuel processing system having a housing, inside of which at least one adsorbing chamber, filed with adsorbing agent, is placed, where the inlet adsorbing chamber is connected to a fuel tank and to an intake pipe of an internal combustion engine and the outlet adsorbing chamber comprises an atmospheric port, where in at least one adsorbing chamber across a vapours flow path at least one permeable plate is placed, **characterised in that**, said at least one permeable plate (14, 18) has the form of uniform shape element able to displace along the adsorbing chamber and comprises at least two elastic connecting members (29) fixed at one end to the wall of the adsorbing chamber and from the other end entering inside and transforming into the permeable plate (14, 18).

2. The canister as claimed in Claim 1, **characterised in that**, the thickness (h) of the connecting members (29) is lower than the working thickness (H) of the permeable plate (14, 18).

3. The canister as claimed in Claim 1 or 2, **characterised in that**, the housing (2) and said at least one permeable plate (14, 18) are made of plastic in the form of single, integral moulding, where the internal surface of the wall of the housing (2) transforms into the first end of each connecting member (29), while the second end of each connecting member (29) transforms into the plate (14, 18).

4. The canister as claimed in Claim 1 or 2 or 3, **characterised in that**, the permeable plate (14, 18) in its neutral position is displaced in the direction opposite to the direction of the force of the compensation means.

5. The canister as claimed in any one of Claims 1 to 4, **characterised in that**, the permeable plate (14, 18) comprises a stabilising wall (31).

6. The canister as claimed in Claim 5, **characterised in that** the stabilising wall (31) surrounds the external edge of the permeable plate (14, 18).

7. The canister as claimed in any one of Claims 1 to 4, **characterised in that**, the permeable plate (14, 18) is a solid block within the area of each segment (30) defined by the connecting members (29).

8. The canister as claimed in any one of the preceding claims, **characterised in that**, the permeable plate (14, 18) comprises at least one opening (32) for the vapour circulation.

9. The canister as claimed in any one of Claims 1 to 8, **characterised in that**, the permeable plate (18) is a partition dividing the outlet adsorbing chamber into the internal (19) and the external (20) adsorbing layer.

10. The canister as claimed in any one of Claims 1 to 8, **characterised in that**, the permeable plate (14) is the closing plate of the adsorbing chamber (5) leaning against the compensation means (15, 16).

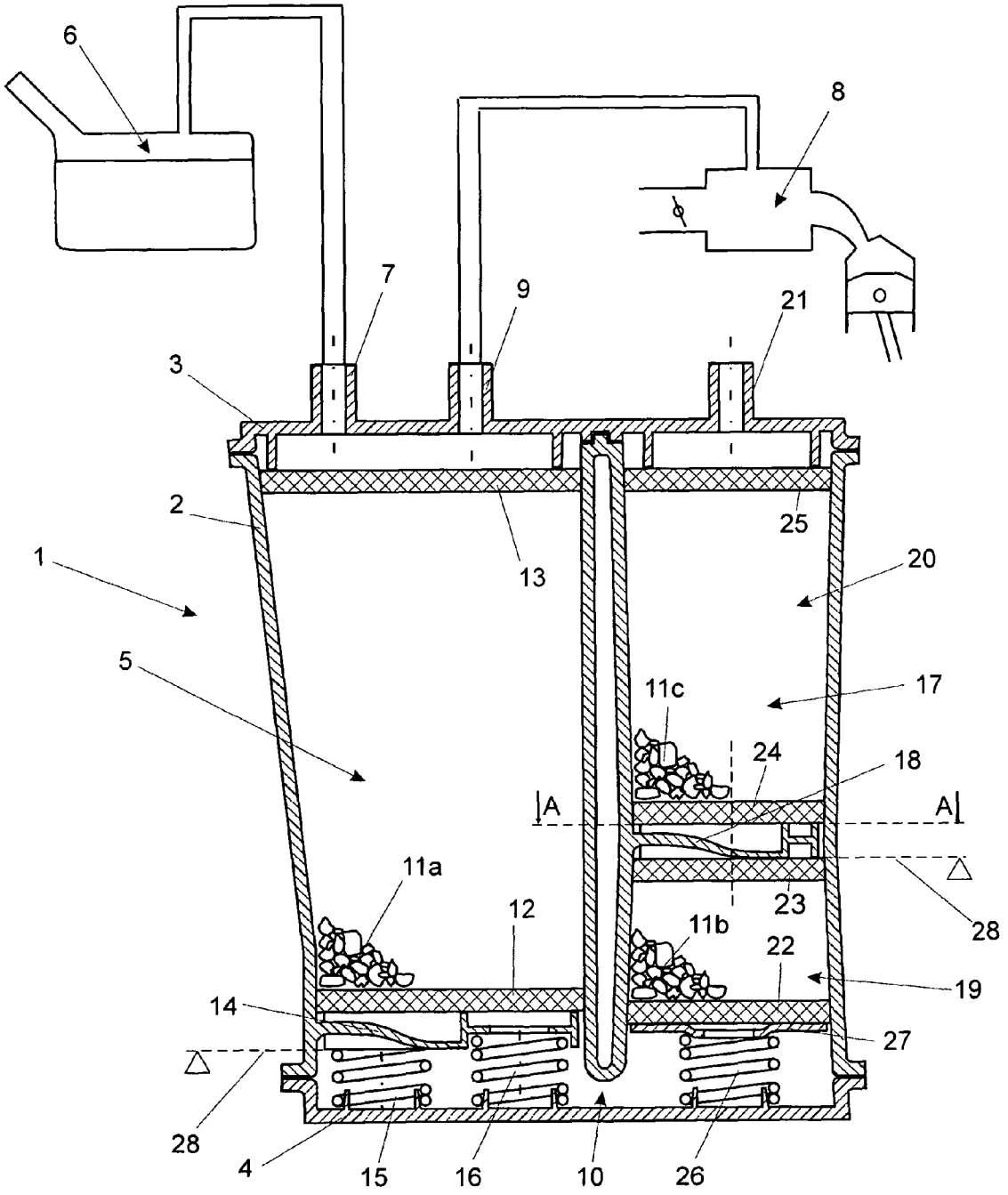
6
8
7
9
21
3
2
25
1
13
20
5
11c
17
24
18
A
A
11a
12
11b
23
28
22
19
14
27
28
4
15
16
10
26

Fig. 1

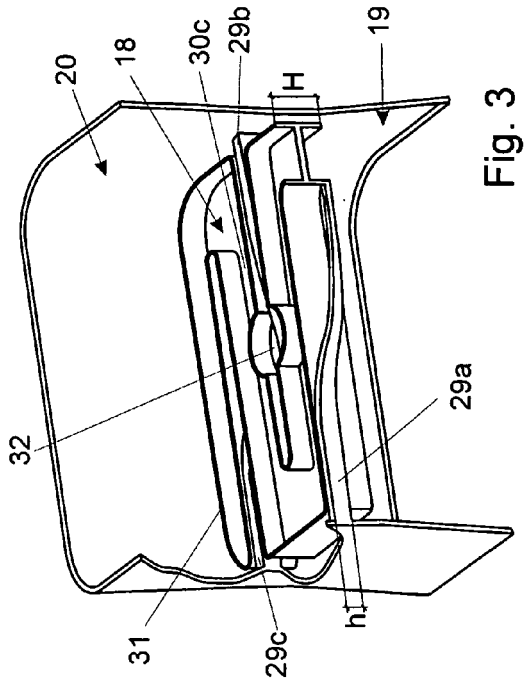


Fig. 3

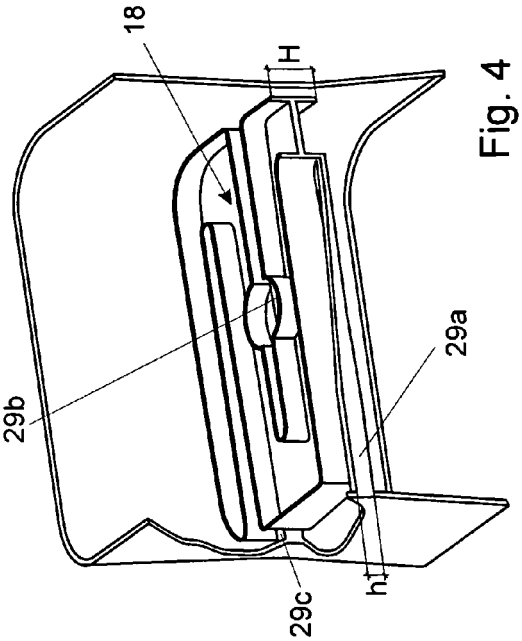


Fig. 4

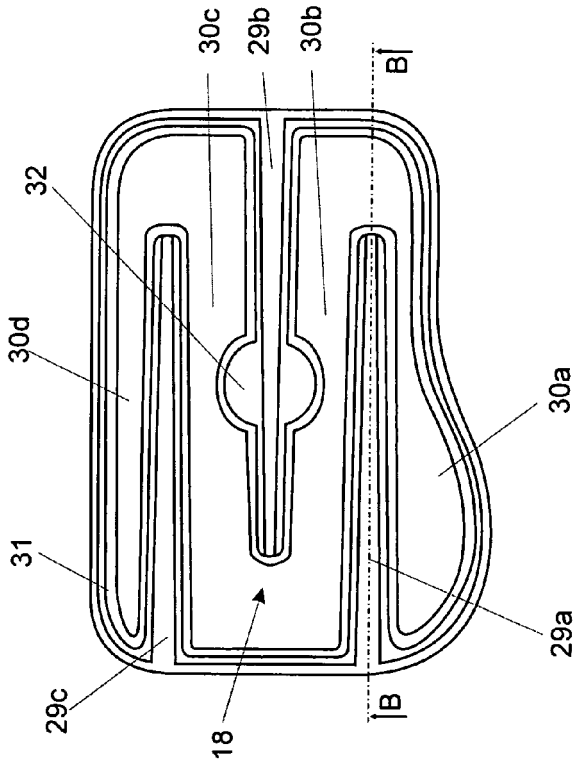


Fig. 2

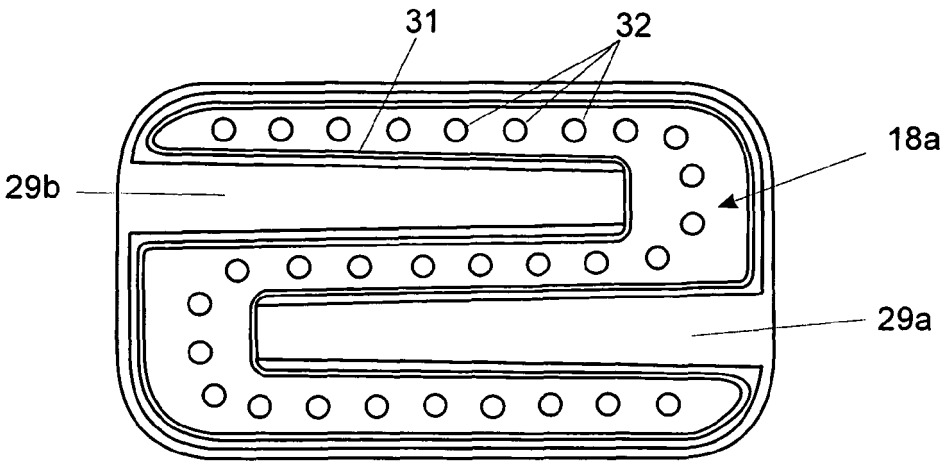


Fig. 5

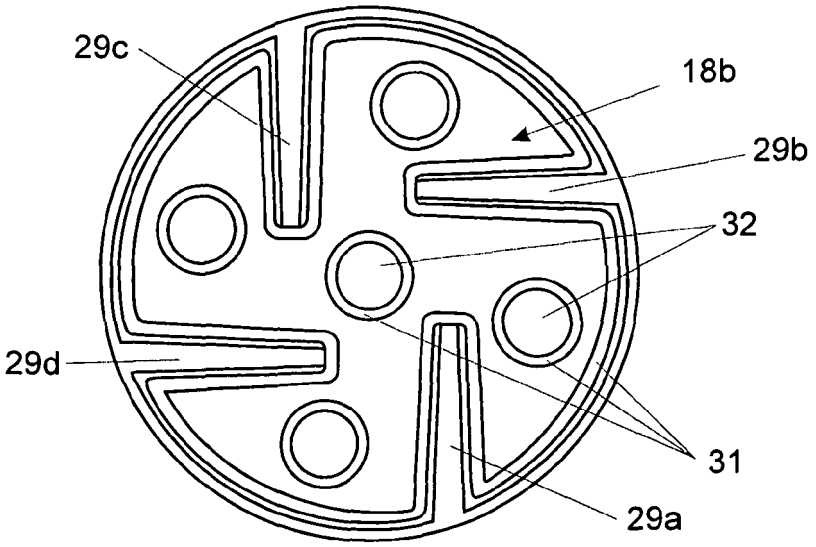


Fig. 6

European Patent Office

# EUROPEAN SEARCH REPORT

Application Number
EP 05 00 2259

## DOCUMENTS CONSIDERED TO BE RELEVANT

| Category | Citation of document with indication, where appropriate, of relevant passages | Relevant to claim | CLASSIFICATION OF THE APPLICATION (Int.Cl.7) |
|---|---|---|---|
| X<br>Y | US 5 119 791 A (GIFFORD ET AL)<br>9 June 1992 (1992-06-09)<br>* the whole document *<br>----- | 1-8<br>9,10 | F02M25/08 |
| A<br>Y | US 2001/039881 A1 (MORIYAMA ET AL)<br>15 November 2001 (2001-11-15)<br>* the whole document *<br>----- | 1,3,8<br>9,10 | |
| A | US 5 599 384 A (YOSHIDA ET AL)<br>4 February 1997 (1997-02-04)<br>* the whole document *<br>----- | 1,3,8,10 | |
| A | US 5 538 542 A (WATANABE ET AL)<br>23 July 1996 (1996-07-23)<br>* the whole document *<br>----- | 1,5-8 | |

TECHNICAL FIELDS SEARCHED (Int.Cl.7)

F02M

The present search report has been drawn up for all claims

| Place of search | Date of completion of the search | Examiner |
|---|---|---|
| The Hague | 28 June 2005 | Van Zoest, A |

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 05 00 2259

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.

28-06-2005

| Patent document cited in search report | Publication date | Patent family member(s) | Publication date |
|---|---|---|---|
| US 5119791 A | 09-06-1992 | NONE | |
| US 2001039881 A1 | 15-11-2001 | JP 2001323845 A | 22-11-2001 |
| US 5599384 A | 04-02-1997 | JP 3158266 B2 | 23-04-2001 |
| | | JP 8004604 A | 09-01-1996 |
| US 5538542 A | 23-07-1996 | JP 3265094 B2 | 11-03-2002 |
| | | JP 7139441 A | 30-05-1995 |

EPO FORM P0459

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