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(71) Applicant (for all designated States except US): **IN-ERGY AUTOMOTIVE SYSTEMS RESEARCH (Société Anonyme)** [BE/BE]; Rue De Ransbeek, 310, B-1120 Brussels (BE).

(72) Inventor; and

(75) Inventor/Applicant (for US only): **ARNALSTEEN, Michel** [BE/BE]; 102 Kortemansstraat, B-1702 Groot-Bijgaarden (BE).

(74) Agents: **JACQUES, Philippe** et al.; SOLVAY (Société Anonyme), Intellectual Property Department, Rue De Ransbeek, 310, B-1120 Brussels (BE).

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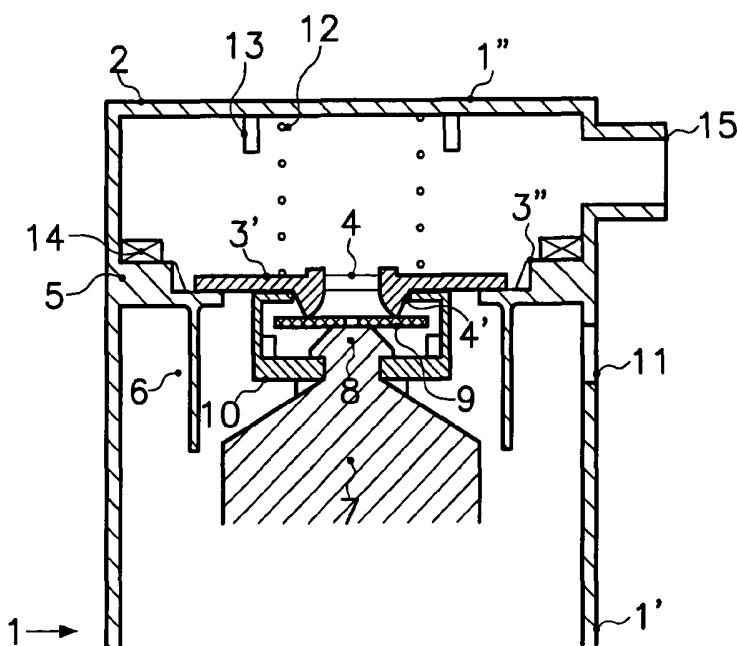
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(54) Title: SAFETY VALVE FOR THE VENTING CIRCUIT OF A LIQUID TANK



(57) Abstract: Safety valve for the venting circuit of a liquid tank Safety valve for the venting circuit of a liquid tank, comprising: a) a chamber (1) provided with a cover (2), which extends at least partly into the tank and is connected via an aperture (4) to the venting circuit; b) a float (7), which can slide vertically inside the chamber (1) and close off the venting aperture (4) in a high position; and c) a moveable wall (3), which divides the chamber (1) into a lower portion (1') in which the float (7) slides and an upper portion (1'') which connects with the venting circuit, this wall (3) being a moveable wall and having the venting aperture (4), said valve further including an aperture stop (13) integral either with the moveable wall (3) or with the cover (2).

Safety valve for the venting circuit of a liquid tank

The present invention relates to a safety valve for the venting circuit of a liquid tank, in particular a fuel tank with which a motor vehicle may be equipped.

Liquid tanks, in particular fuel tanks for motor vehicles, are nowadays generally provided *inter alia* with a venting circuit. This circuit allows air to be
5 introduced into the tank in the event of underpressure (especially for compensating for the volume of liquid consumed) or allows the gases contained in the tank to be removed in the event of overpressure (especially in the event of overheating). This circuit also allows the ducting and possible filtering of the gases that have to be discharged into the atmosphere, for the purpose of meeting the ever stricter
10 environmental requirements in this regard.

The venting circuit generally includes a safety valve of the ROV (roll-over valve) type which as far as possible prevents liquid from coming out of the tank in the event of said tank rolling over or being at an excessively high angle of inclination. This safety valve must also respond rapidly and reliably when its
15 intervention conditions occur, but with minimum sensitivity to abnormal phenomena such as especially a very high flow rate, overpressure in the tank or low-amplitude waves.

The venting circuit may also include a safety valve of the FLVV (fill limit venting valve) which sets the maximum fill level of the tank and limits overfilling.

20 Some safety valves provide both the ROV function and the FLVV function.

Many safety valves employ a float, comprising an upper needle that closes off an aperture for connection between the tank and the venting circuit. The disadvantage of such valves is that when the aperture is closed off for a long time (for example when the tank remains for a long period at its maximum fill level),
25 the pressure rises inside the tank and can no longer be relieved by said aperture, hence the occurrence of an overpressure that has to be relieved by an additional device.

To alleviate this drawback, valves with a moveable valve seat have been developed. Thus, for example, patent US 5 004 002 discloses a valve with a needle
30 float and a moveable valve seat. This valve seat may be a diaphragm pierced by an aperture (see Figure 5), which rises above a certain pressure so as to separate the needle of the float from said aperture. The valve described in that patent was

developed for fuel systems that have to withstand a relatively high pressure level. Consequently, to prevent the needle sticking in the aperture, the movement of the float is blocked by means of a stop so that only the diaphragm can move above a certain pressure. The drawback of such a valve is therefore that, if a wave occurs
5 when the diaphragm and the needle are decoupled (that is to say during relief of an overpressure), liquid can be entrained into the system, (since the float is blocked and cannot move in order to close off the aperture). Furthermore, in this very situation and/or in the event of a large overpressure, there is a risk of the central part of the diaphragm remaining stuck against the upper wall of the valve, and thus
10 blocking the venting aperture.

The object of the present invention is to solve these problems by proposing a safety valve for the venting circuit of a liquid tank, comprising:

- a) a chamber provided with a cover, which extends at least partly into the tank and is connected via an aperture to the venting circuit;
 - 15 b) a float, which can slide vertically inside the chamber and close off the venting aperture in a high position; and
 - c) a moveable wall, which divides the chamber into a lower portion in which the float slides and an upper portion which connects with the venting circuit, this wall being a moveable wall and having (generally at its centre) the
20 venting aperture,
- said valve further including an aperture stop integral either with the moveable wall or with the cover of the chamber.

The safety valve is intended for the venting circuit of a tank that may contain any liquid. In particular, the liquid may be a fuel, a brake fluid or a lubricant.
25 More particularly, the liquid is a fuel. The tank may be intended for any use, especially for equipping a vehicle and even more especially for equipping a motor vehicle.

The chamber of the valve may have any shape, often internally tailored to the sliding of the float. Usually for this purpose it has a constant internal cross
30 section, at least in that portion where the float must be able to slide. In particular, it is internally cylindrical, at least in this portion.

The chamber of the valve is provided with a cover, which may either be moulded as one part with said chamber or it may form a separate part joined to the latter by any known means (mechanical fastening with a seal; welding etc.). This
35 cover is advantageously connected to the venting circuit. This connection generally has the shape of a nozzle.

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The valve float according to the invention generally has a head of appropriate size and shape for being able to close off the venting aperture. This head is advantageously provided with a seal, for ensuring that said closure is sealed off.

5 The external (lateral) shape of the float is obviously matched to that of the inside of the chamber in which it has to be able to slide. In particular, it is therefore externally cylindrical.

 The valve according to the invention includes a moveable wall that divides it into a lower portion in which the float slides and an upper portion that connects
10 with the venting circuit and is topped by the cover. By definition, this wall is therefore a partition wall and is moveable (by this it is meant that its central portion is moveable, but it is fastened via its edges (periphery) in the chamber - like any partition wall) and is pierced (generally at its centre) by the venting aperture. The term "moveable" is understood to mean that the centre of the
15 wall can move both relative to the chamber and relative to the float.

 This wall is in general substantially horizontal at rest and, apart from the venting aperture, is generally impermeable (i.e. there is no other aperture bringing the lower portion into communication with the upper portion of the valve). It may be moulded as one part with the chamber, but preferably it is a separate part that is
20 fitted into the chamber by any appropriate means. The use of one or more inserts and corresponding support(s) gives good results. Preferably, the moveable wall rests in a circular groove (generally integral as one part with the chamber) where it is fitted by means of a fitting ring.

 The mobility of the partition wall may be provided by any known means.
25 Thus, it is possible to choose the shape and the constituent materials of this wall so as to obtain both mobility and sufficient sealing and mechanical strength. A non-uniform wall comprising a central portion and a peripheral portion of different nature and/or different geometry is very suitable. Good results are obtained when the central portion is thicker and based on a more rigid material than the peripheral
30 part of the wall. In particular, the central portion may consist of an injection-moulded part made of a thermoplastic and the peripheral portion of a diaphragm made of an elastomer. These two parts are joined together in an appropriate manner, preferably by welding or co-injection moulding if their constituent materials are compatible, or by adhesive bonding.

35 The venting aperture may have any shape. It may be a simple hole (circular aperture with no peripheral relief) made approximately at the centre of the

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moveable wall. It may also be circular aperture whose edges have a geometry and a mechanical strength that promote sealing of the closure of said aperture by the head of the float. This embodiment is easy to implement if the central portion of the wall is an injection-moulded part.

5 The valve according to the invention includes a stop that is apertured. By this is meant a stop either made of several parts (for example studs) or as a single wall but pierced by apertures, so that venting can continue even in the event of a large overpressure, when the moveable wall is in the high position against said stop.

10 According to the invention, this stop may be integral with (fastened to or produced as one part with) either the cover or the moveable wall. It extends either downwards or upwards, respectively, in the upper portion of the chamber. Preferably, this stop is fixed and therefore integral with the cover. Most particularly preferably, it is moulded as one part with the cover.

15 According to a preferred embodiment of the present invention, a preloading spring is interposed between the moveable wall and the cover of the valve. The preloading of the spring defines the pressure levels at which the wall will move so as to separate from/mate with the float.

20 As mentioned above, the safety valve according to the invention may provide the ROV and/or FLVV function of a fuel tank.

 The present invention applies particularly well to a valve that does provide both functions.

 The valve according to the invention may be assisted in its ROV function by any device known for this purpose, such as a heavy ball, a spring, etc.

25 It may also be assisted in its FLVV function so as to permit a certain amount of overfilling, commonly called "round up", by a suitable geometry of its constituent elements.

 Thus, for example, in a preferred embodiment of the invention, the chamber in which the float slides is a chamber closed at the bottom, that is to say provided with an impermeable base, but including at least one lateral opening via which
30 venting takes place. When the liquid level reaches this window, a first tripping of the filling nozzle occurs following the inflow of liquid into the chamber. If the tank continues to be filled, the liquid will progressively fill the chamber and the float will start to rise until obstructing the venting aperture. At this moment, there
35 is no longer any venting and the pressure will rise in the tank. Provided that measures are taken to ensure that the target pressure at which the wall rises (or P_C ,

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which depends on the resistance of the wall and/or of the preloading spring, as the case may be) is above the usual trip pressure of fuel tank filling nozzles (or P_D), the filling nozzle is definitively tripped and the maximum level of the tank is reached.

5 In operation, if the float still closes off the venting aperture and the pressure in the tank reaches the abovementioned target pressure (P_C), the wall rises (by elastic deformation and/or deployment of at least one of its constituent parts) and the venting aperture is freed. Even in the case of a very high overpressure, the wall
10 will be halted in its vertical movement by the stop and, since the latter is apertured, venting may continue. In the event of a wave at this particular moment, the float, which is still moveable, can close off the aperture and prevent liquid from penetrating into the venting circuit.

 To avoid any liquid entrainment while the venting aperture is open (or the float is not in the high position) and to assist the 1st tripping of the filling nozzle,
15 the valve according to this embodiment of the invention preferably includes a baffle, whether continuous or apertured, which lies inside the chamber parallel to the lateral wall of the latter and facing the opening. Preferably, it is a continuous baffle, substantially cylindrical in shape inside which the upper portion of the float slides. The outside diameter of the float in this region is therefore at least matched
20 to the inside diameter of the baffle. This baffle may be supported by a part separate from the chamber and fitted into the latter. Preferably, it is moulded as one part with the chamber, for example, in the extension of the support for the moveable wall, where appropriate.

 Finally, the valve according to this embodiment of the invention preferably
25 includes a secondary closure member, giving the valve a two-stage effect. This is an closure member for effectively closing off the venting aperture of the valve and itself having an aperture that can be closed off by a needle present on the head of the float. The role of this closure member is to make it easier for the valve to reopen, that is to say to provide decoupling between the head of the float and the
30 venting aperture. Preferably, the needle is integral with the head of the float. The float and the needle may be produced as a single part or may be produced separately and joined together. The term "needle" is understood to mean a tip of appropriate shape for closing off the aperture in the seal.

 Most particularly preferably, the secondary closure member according to
35 this embodiment of the invention consists essentially of a seal. By this it is meant in particular that the seal is "free", and not affixed to a support.

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This seal may have any shape. A substantially flat seal (such as a membrane portion) gives good results and is simple to produce in practice. This flat seal may have any outline. A flat seal of substantially circular shape (i.e. a washer) is particularly simple and gives good results. This seal may be made of any material, but preferably one that is flexible enough to ensure sealing. Elastomers are particularly suitable as constituent materials for the seal, particularly fluoroelastomers.

According to this embodiment of the invention, the head of the float is provided with a device for limiting the movement of the seal. Preferably, this device forms an integral part of said head (and/or of its needle), that is to say the head/needle has (have) a geometry that allows the seal to move essentially vertically relative to it, but with a limited travel.

According to a first embodiment, the needle has, at its upper end (tip), a larger cross section than that of the aperture in the seal but also a cross section that is generally smaller than the cross section of the aperture in the seal.

According to a second, preferred embodiment, the head of the float comprises vertical hooked fingers that surround the needle and have an upper end higher than the needle. In this way, the seal can slide vertically between the hooked end of the fingers and a position where it bears on the head of the float. The term "hooked" is understood in fact to mean any shape allowing the seal to be retained. This shape may for example be that of an "L" on its tip.

In this embodiment, there are preferably at least three fingers so as to prevent the seal from leaking between two consecutive fingers. Most particularly preferably, there are at least four of them so as to limit this risk. These fingers are preferably placed symmetrically on the head of the float, and therefore in the form of a cross with equal branches when there are four of them. Most particularly preferably, these fingers guide the seal during its vertical travel, so as to minimize its lateral movements.

Advantageously, the shape of the head of the float, and in particular the portion on which the seal rests in certain positions of the valve, is convex (domed or conical) so as to prevent the seal from sticking on the head in the event of liquid being deposited at this point.

The constituent elements of the valve may be made of any material. Preferably, they are based on a thermoplastic. In this case, it is obviously convenient to choose the material or materials in such a way that they withstand the operating stresses. Of course, the materials chosen must be inert with respect

to the liquids with which they have to be in contact, in particular inert with respect to fuels.

In particular in the case in which the liquid tank is a fuel tank made of plastic, most of the constituent elements of the valve according to the invention
5 are also made of plastic. The term "plastic" is understood to mean any polymeric synthetic material, whether thermoplastic or thermosetting, which is in the solid state under ambient conditions, as well as blends of at least two of these materials. The intended polymers comprise both homopolymers and copolymers (especial binary or ternary copolymers). Examples of such copolymers are, non-limitingly:
10 random copolymers, linear block copolymers, non-linear block copolymers, and graft copolymers. Thermoplastic polymers, including thermoplastic elastomers, and blends thereof are preferred.

Any type of thermoplastic polymer or copolymer, the melting point of which is below the decomposition temperature, is suitable. Thermoplastics having a
15 melting range spread over at least 10 degrees Celsius are particularly suitable. Examples of such materials include those that exhibit polydispersion in their molecular weight.

In particular, the valve according to the invention may be made of polyolefins, grafted polyolefins, thermoplastic polyesters, polyketones,
20 polyamides and copolymers thereof.

One polymer often used in plastic fuel tanks is polyethylene, in particular high-density polyethylene (HDPE) possibly in a multilayer structure including a barrier layer (for example based on EVOH, or hydrolysed ethylene/vinyl acetate copolymer) or one with a surface treatment (fluorination or sulphonation for
25 example) for the purpose of making it impermeable to the fuels for which it is intended. Consequently, when the valve according to the invention includes a cover separate from the tank, this is preferably based on HDPE, so as also to be welded to the tank. As for the other parts of the valve, these are preferably based on at least one hydrocarbon-impermeable plastic. Examples of such hydrocarbon-
30 impermeable plastics are, non-limitingly: polyethylene terephthalate or polybutylene terephthalate, polyamides, polyketones and polyacetals. It should be noted that all these parts, the cover included, may be multilayer structures, comprising, for example, at least one high-density polyethylene layer and optionally a hydrocarbon barrier layer (on the surface or within said structures).

35 In the case of a plastic fuel tank, and in particular one based on HDPE, good results have been obtained with valves, including a cover, based on HDPE, a

chamber and a float made of POM (polyoxymethylene) or PBT (polybutylene terephthalate), and a hybrid moveable wall based on POM or PBT for the central portion and on a fluoroelastomer for the peripheral portion.

5 The method and location for fitting the valve to the tank may be chosen in any usual manner suitable for the specific conditions. Preferably, the valve is assembled directly on the upper wall of the tank, either by welding its cover (see above) to the wall of the tank, or by snap-fastening said cover into a relief of or on said wall.

10 The invention will be illustrated in a non-limiting manner by Figures 1 and 2, which show a valve according to a preferred embodiment of the invention (or at least one portion thereof).

The safety valve illustrated in these figures comprises a chamber (1) that extends inside the tank (not shown) and is provided with a cover (2) and with an impermeable base (not shown). This chamber (1) also includes a moveable wall
15 (3) having a rigid central portion (3') provided with a venting aperture (4), and a flexible peripheral portion (3'') consisting of a diaphragm. The edge of the aperture (4) is provided with a lip (4') having a geometry that promotes effective sealing. This wall (3) rests on a circular groove (5) moulded as one part with a cylindrical baffle (6) in which the head of a float (7) slides. This float (7) includes a needle
20 (8) (produced as a single part with the float) on which a seal (9) having an aperture rests and which is surrounded by fingers (10) that limit its vertical travel relative to the needle. The chamber (1) includes, in its lower portion (1'), a lateral opening (11) that allows the flow of gases. It also includes, in its upper portion (1''), a preloaded spring (12), the preload of which is adapted so that the wall (3) rises at a
25 pressure above the usual trip pressure (P_D) of fuel tank filling nozzles. This spring is therefore interposed between the cover (2) and the moveable wall (3). It is in fact housed via its upper portion in a stop (13) that forms an integral part of the cover (2) and that makes it possible to avoid, in the event of a high overpressure, the central portion (3') of the moveable part from sticking on the cover (2) and consequently prevents venting via the aperture (4). To allow this venting when the
30 diaphragm is stuck thereto, this stop (13) consists in fact of separate studs.

This valve also includes a ring (14), which serves for fitting the diaphragm into the groove (5) where it rests, and also a nozzle (15), integral with the cover (2) and allowing the valve to be connected to the venting circuit of the tank.

35 Figure 1 shows said safety valve in a closed position, reached when the filling nozzle trips at the end of filling, and Figure 2 illustrates this same valve, but

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as it reopens following a rise in pressure in the tank above the critical threshold (P_C), while it is still at its maximum fill level.

In this case, as illustrated by the thick vertical arrows, the wall is raised by tension in the diaphragm (3") and the gases under pressure can be discharged as indicated by the fine arrow, firstly by passing between the lips (4') of the aperture (4) and the fingers (10) of the float (7) and then via said aperture (4).

If a wave occurs in this position, the float will rise, supported by said wave, and will close off the aperture (4) via its seal (9) and its needle (8). When the wave has passed, the separation of the float (7) (initiated by its weight when it redescends) is facilitated by the fact that the aperture in the seal (9) is smaller than the venting aperture (4), and therefore the force exerted by a pressure difference on either side of this aperture is smaller.

CLAIMS

1. - Safety valve for the venting circuit of a liquid tank, comprising:
- a) a chamber (1) provided with a cover (2), which extends at least partly into the tank and is connected via an aperture (4) to the venting circuit;
- 5 b) a float (7), which can slide vertically inside the chamber (1) and close off the venting aperture (4) in a high position; and
- c) a moveable wall (3), which divides the chamber (1) into a lower portion (1') in which the float (7) slides and an upper portion (1'') which connects with the venting circuit, this wall (3) being a moveable wall and having the venting
- 10 aperture (4),
said valve further including an aperture stop (13) integral either with the moveable wall (3) or with the cover (2), which extends either downwards or upwards in the upper portion of the chamber, and against which the moveable wall bears when it is in the high position.
- 15 2. - Valve according to the preceding claim, in which the moveable wall (3) rests in a circular groove (5) where it is fitted by means of a fitting ring (14).
3. - Valve according to either of the preceding claims, in which the moveable wall (3) is non-uniform and comprises a central portion (3') and a peripheral portion (3'') of different nature and/or different geometry.
- 20 4. - Valve according to the preceding claim, in which the central portion (3') is an injection-moulded part made of a thermoplastic and the peripheral portion (3'') is a diaphragm made of an elastomer.
5. - Valve according to any one of the preceding claims, in which the stop (13) is moulded as one part with the cover (2).
- 25 6. - Valve according to any one of the preceding claims, in which a preloaded spring (12) is interposed between the moveable wall (3) and the cover (2).
7. - Valve according to the preceding claim, the chamber (1) of which is provided with an impermeable base, but includes at least one lateral opening (11),

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the preload of the spring (13) of which is such that the target pressure at which the wall (3) rises is above the usual trip pressure of fuel tank filling nozzles.

8. - Valve according to the preceding claim, in which a baffle (6) lies inside the chamber (1) parallel to the lateral wall of the latter and facing its lateral opening (11).

9. - Valve according to any one of the preceding claims, characterized in that it includes a secondary closure member (9) for closing off the venting aperture (4) in the moveable wall (3), said secondary closure member (9) including an aperture that can be closed off by a needle (8) of the float (7).

10. - Fuel tank equipped with a valve according to any one of the preceding claims.

- 1/1 -

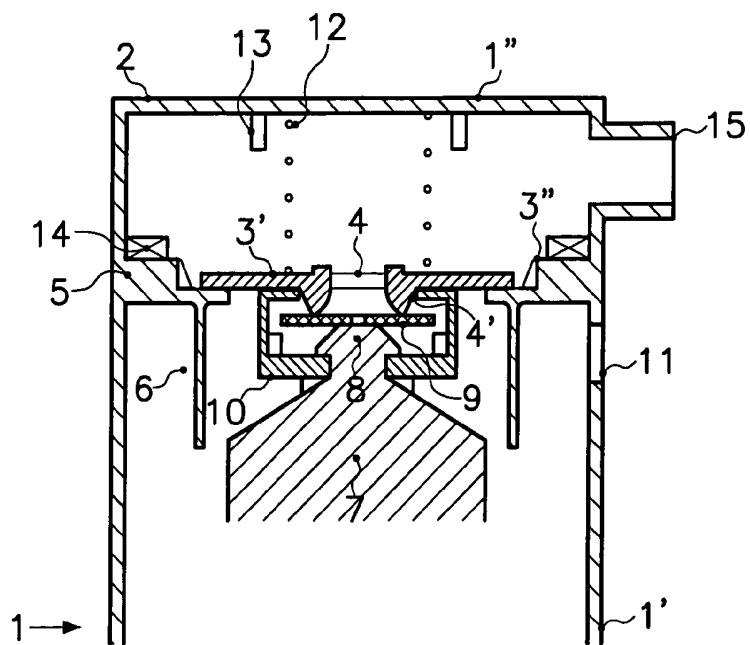


Fig. 1

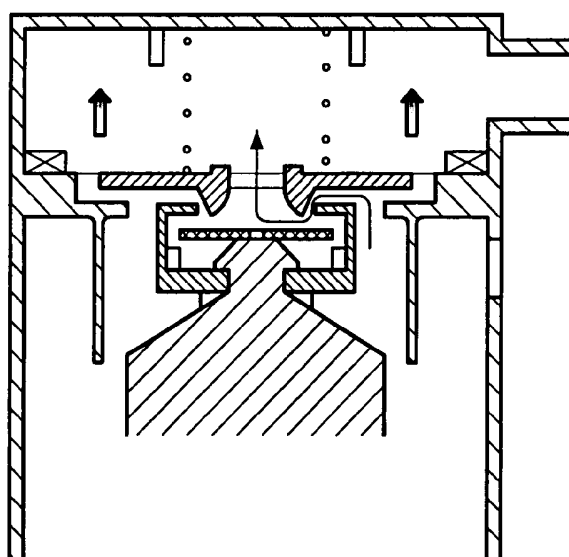


Fig. 2

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2006/062423

A. CLASSIFICATION OF SUBJECT MATTER
INV. B60K15/035 F16K24/04 F16K17/36

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)
B60K F16K

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 practical, search terms used)

EPO-Internal, WPI Data, PAJ

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2004/045602 A1 (PALVOLGYI SANDOR ET AL) 11 March 2004 (2004-03-11) abstract; figures 1-5	1-3,5-7, 9,10
Y	-----	8
Y	US 2002/074037 A1 (ENGE TREVOR L) 20 June 2002 (2002-06-20) paragraph [0023] figure 2	8
X	US 6 719 000 B1 (FORSYTHE ALAN K ET AL) 13 April 2004 (2004-04-13) column 4, line 21 - line 25 pages 1-4	1-3,5,6, 9,10
X	US 5 582 198 A (NAGINO ET AL) 10 December 1996 (1996-12-10) abstract; figures 1-5	1-3,5-7, 9,10
	----- -/-	

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

☒ See patent family annex.

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X document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

Y document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

Z document member of the same patent family

Date of the actual completion of the international search

4 September 2006

Date of mailing of the international search report

13/09/2006

Name and mailing address of the ISA/

European Patent Office, P.B. 5818 Patentlaan 2
NL - 2280 HV Rijswijk
Tel. (+31-70) 340-2040, Tx. 31 651 epo nl,
Fax: (+31-70) 340-3016

Authorized officer

Awad, P

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2006/062423

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 5 004 002 A (KOBAYASHI ET AL) 2 April 1991 (1991-04-02) cited in the application abstract; figure 3 -----	1-3, 5-7, 10

INTERNATIONAL SEARCH REPORT

International application No
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