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(54) **Poly valve device for gas tank**

(57) A poly valve device for a gas tank comprising a valve body (1) with a flange (2) for mounting the device on the gas tank; an overfill protection valve (3) mounted on an internal side of the valve body (1) with regard to the tank when the device is mounted thereon; a fill port (4) on an external side of the valve body (1) and in communication with the overfill protection valve (3); a level indicator means (6,7) on the internal side of the valve body (1); means (8,9) for transmitting information of the level of liquid in the tank from the level indicator means (6) to the external side of the valve body (1); a valve means mounted on the valve body for delivering gas from the tank to a user; wherein the poly valve device further comprises a level sensing means (5) with a floater (10) hinged on the overfill protection valve (3) and/or on the level indicator means (6) and cooperating with both of them for providing information of the level of liquid.

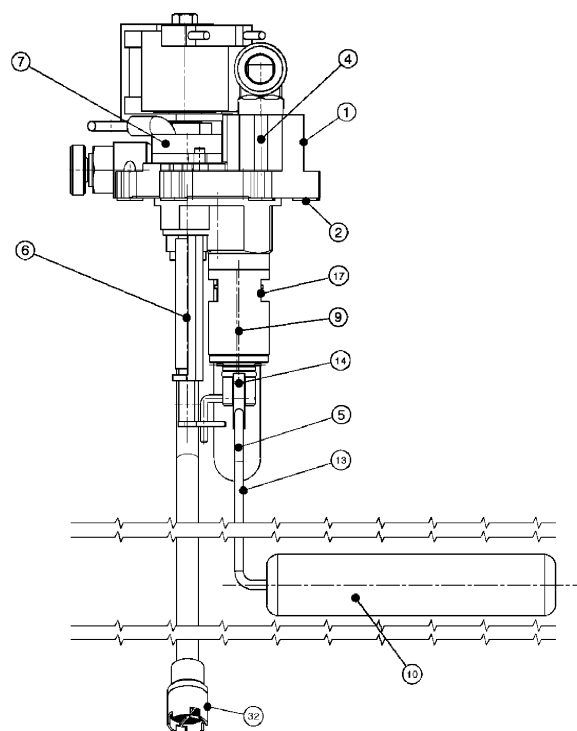


Fig. 1

Description

Technical Field

[0001] The present invention is directed to a poly valve for a gas tank, more particularly for a gas tank of a vehicle, preferably a LPG tank.

Background Art

[0002] A poly valve device for a LPG tank is already known from FR 2 816 033 A (GIAT INDUSTRIES) 03.05.2002. The device disclosed therein comprises a valve body with a flange for mounting on a gas tank, an overfill sensing means, an electrically operated overfill protection valve connected to the overfill sensing means, a valve means for delivering gas to the end user and a liquid level gauge transmitting its information electrically via a wire connection through the poly valve body.

[0003] This arrangement is quite bulky since it requires enough places on the valve body for mounting the series of devices mentioned here above. Additionally, there is a need for reducing the size of such poly valve devices, in particular in order to reduce the diameter of the hole of the tank receiving such a valve device to 48 mm.

Disclosure of Invention

[0004] The present invention seeks to solve the above mentioned problem by proposing a poly valve device for a gas tank comprising a valve body with a flange for mounting the device on the gas tank; an overfill protection valve mounted on an internal side of the valve body with regard to the tank when the device is mounted thereon; a fill port on an external side of the valve body and in communication with the overfill protection valve; a level indicator means on the internal side of the valve body; means for transmitting information of the level of liquid in the tank from the level indicator means to the external side of the valve body; a valve means mounted on the valve body for delivering gas from the tank to a user; the poly valve device further comprising a level sensing means with a float hinged on the overfill protection valve and/or on the level indicator means and cooperating with both of them for providing information of the level of liquid.

[0005] Preferably the overfill protection valve is mounted on the valve body by fitting and crimping.

[0006] The overfill protection valve can comprise a generally cylindrical overfill protection valve body, one end of which being fitted and crimped in a corresponding bore of the valve body.

[0007] Preferably the level sensing means comprises a rod hinged on the overfill protection valve, the float being on the rod, and a cam at a hinged section of the level sensing means, the cam interacting with the overfill protection valve for preventing an overfilling of the tank by closing the overfill protection valve when the level of

liquid in the tank reaches a predetermined level upon refilling.

[0008] The level indicator means can comprise an elongated element rotatably supported on the valve body and generally perpendicular to the flange, a first end of the elongated element cooperating with the hinged section of the level sensing means and the second end of the elongated element transmitting by its rotation the information of the level of liquid in the tank to the external side of the valve body.

[0009] The second end of the elongated element can comprise magnetic means designed for transmitting the rotational position of the elongated element to an indicator on the external side of the valve body.

[0010] The first end of the elongated element can comprise a slot distant from a rotational axis of the elongated element and engaging with the rod or a pivot of the hinged section.

[0011] The overfill protection valve can comprise a piston with sealing means for closing the overfill protection valve, the piston having a polygonal, preferably hexagonal, section.

[0012] Preferably the piston has a passage from an upper side with the sealing means to a lower side of the piston and the overfill protection valve further comprises an overfill protection valve body and a control valve operated by the level sensing means and able to close a chamber of the overfill protection valve formed by the lower side of the piston and the overfill protection valve body.

Brief Description of Drawings

[0013] Figure 1 is a view of the poly valve device of the present invention.

[0014] Figure 2 is a sectional view of the poly valve device of figure 1.

[0015] Figure 3 is a perspective view of the device of the present invention.

Best Mode for Carrying Out the Invention

[0016] The poly valve device comprises a valve body 1 with a flange 2 for sealingly mounting on a flat portion of a gas tank, for example, a gas powered vehicle. The device comprises a series of devices for fulfilling a series of functions:

[0017] - A shut-off valve for gas delivery to the end user. This valve is located approximately in the middle of the valve body 1 (it cannot be seen on the figures) and mounted from the upper side of the valve body. The valve is actuated by a magnetic coil screwed on top of the shut-off valve. This magnetic coil is apparent on the top of the valve illustrated on the figures.

[0018] - An overfill protection valve 3 mounted on the lower side of the valve body within the contour of the flange. The details of this protection valve are illustrated on figure 2 which shows a hollow overfill protection valve

body 11 fitted in a bore 12 of the valve body. The overfill protection valve is thereby in fluid connection with a passageway made in the valve body 1 extending from the lower side to the lower side of this latter. The passageway is in connection with a fill port 4 on the upper side of the valve body 1.

[0019] A check valve is located in the passageway in order to allow a flow of gas from the fill port to the gas tank and to block any counter flow from the tank to the fill port.

[0020] The overfill protection valve body 11 is generally cylindrical and comprises a piston 17 slidably mounted therein. This piston has sealing means at its upper end in the form here of an elastomer o-ring arranged in a circular nut. This o-ring cooperates with a seat in the overfill protection valve body 11. The piston is held in its upper position as shown in figure 2 by means of a resilient means like a spring. The piston has a cavity which is in connection with the upper side of the piston via a passageway along its longitudinal axis. The lower side of the piston and the interior of the overfill protection valve define a chamber 20. The lower side of the overfill protection valve body has a control valve which is designed for shutting off the chamber 20. The upper surface of the piston in contact with the gas when refilling and the resilient means of the piston are dimensioned such that, upon refilling, the piston 17 is lowered down under the refill pressure. A small portion of the refill gas flows through the passageway of the piston to the chamber 20 and through a control valve 19 which is held in an open position by a level sensing means 5. When a predetermined level of liquid gas is reached upon filling, the level sensing means releases the control valve 19 which is normally closed from an opened position to a closed position. This has for effect to close the exit of the chamber 20 and therefore to increase the pressure in the chamber 20. This increase of pressure has for effect to lift the piston 17 and to close the overfill protection valve. This closing movement is due to the difference of surfaces on the upper side and the lower side of the piston 17. The higher the refill pressure is, the more the protection valves closes thereby providing an improved overfill protection valve.

[0021] - A level indicator comprising a rod 6 arranged perpendicularly to the flange surface of the poly valve device, the angular position of which being coupled to the position of a level sensing means 5, and level indicating means on the external side of the valve body 1 and coupled to the rod 6 in order to indicate the level of liquid in the tank. The rod 6 supported by a bearing element 21 in order to be able to freely rotate. The bearing element is preferably made of plastic and supports the rod 6 at two locations, i.e. at a first location close to the valve body 1 and at a second location distant from the valve body 1. Figure 2 shows indeed such a supporting element with a first major bearing section close to the valve body 1, an elongate element extending from this major bearing section with a second minor bearing sec-

tion in the form of a clip. The lower end 15 of the rod 6, i.e. close to the second minor bearing section of the supporting element 21 features a section extending essentially perpendicularly to the longitudinal axis of the rod. This section is preferably in the form of an opened slot and engages with a moving part of the level sensing means 5. The angular position of the rod 6 is therefore dependent on the level of liquid in the tank. The upper end 8 is designed to transmit its angular position to the external side of the valve body 1. Preferably, the upper end 8 comprises a permanent magnet with a magnetic field main direction generally perpendicular to the longitudinal axis of the rod 6. The level indicating means preferably comprise a section 7 for indicating the level to the user and a section 9 which receives the information about the level from the rod 6. Preferably, the section 9 comprises permanent magnets, the magnetic field of which being coupled with the magnetic field of the upper end 8 of the rod 6. The rod does not therefore need to traverse the valve body 1. An alternative to the magnetic coupling means could be the use of any known electrical angular sensor or encoder like a hall-effect one for example, which would be connected to the level indicating means by means of electrical leads or wires traversing the valve body.

[0022] - A pressure relief valve which is not apparent on the figures.

[0023] The poly valve device has been rendered particularly compact by means of a series of measures.

[0024] A first measure is the use of a common level sensing means 5 for both the overfill protection valve and the level indicator. The level sensing means comprises a rod 13 (see figure 1), one end of which being hinged on the overfill protection valve body 11 and the other end of which carrying a floater 10. Figure 1 shows that the rod 13 is bent to 90 degrees close to the floater 10. Many configurations can be contemplated to that respect depending on the design of the tank on which the poly valve device is to be mounted on. The hinged section level sensing means comprises a cam 14 linked to the rod 13 and a pivot 16 traversing the overfill protection valve body 11 and the cam 14. The profile of the cam cooperates with a section of the control valve 19 such that the position of the movable part of this control valve 19 is dependent on the angular position of the cam 14. The pivot 16 comprises a section extending from the overfill protection valve body 11 at approximately 90°. The pivot 16 is firmly fixed to the cam in the present embodiment so that its extending section moves as the rod 13 swings around the pivot axis. The extending section of the pivot engages with the slot extending from the lower end 15 of the rod 6 of the level indicator means. Any variation of the level of liquid in the tank will therefore impart a tilting movement of the rod/floater assembly 13/10 and also a rotation movement of the cam 14 and of the rod 6 of the level indicator means. This change of angular position of the rod 6 will be transmitted to the level indicator 7 on the external side of the valve body 1. When reaching a pre-

determined level of liquid in the tank, typically about 80-90% of the total capacity, the angular position of the cam and the cam profile are such that the control valve 19 is not maintained in its open position anymore, i.e. practically, the portion of the cam profile in contact with the control valve at this angular position of the cam is lowered such that the control valve 19 closes and the overfill protection valves closes and stop the refilling operation.

[0025] Variations in the design of the hinged section of the rod/floater assembly 13/10 can be considered. Indeed, for example, the end portion of the rod 13 could be bent to approximately 90° and be inserted in the overfill protection valve body and the cam 14 instead of the pivot. The extending section or slot of the lower end 15 of the rod 6 of the level indicator means would then directly engage with the rod 13 of the level sensing means. Many other variations apparent to the skilled person are here-with contemplated. For example, the rod/floater assembly 13/10 could be hinged on the bearing element 21 instead of the overfill protection valve body, or on both the bearing and the overfill protection valve body.

[0026] A second measure for rendering the poly valve compact is the fitting and crimping of the overfill protection valve body 11 in the poly valve body 1. Indeed, the overfill protection valve body needs to be of a certain size, in particular with respect to its diameter in order to achieve certain performances with respect to the acceptable flow of liquid gas when refilling. The common way for mounting such a valve is by screwing. This requires a certain wall thickness of the bore of the poly valve body 1 where the thread is to be cut, as is well known in the art. At the contrary, the use of the method of fitting followed by crimping requires much less wall thickness of the receiving bore. Additionally, fitting and crimping instead of screwing renders much easier the angular positioning of the overfill protection valve body 11.

[0027] A third measure is the fitting and crimping of the supporting element 21 in a bore of the poly valve body 1. This provides the same advantages with regard to compactness as for the overfill protection valve.

[0028] A fourth measure is the use of a piston 17 for the overfill protection valve of polygonal cross-section. Indeed, it has been found that a circular section of the piston can lead to a jamming of the piston due to impurities in the gas. A polygonal cross-section, preferably a hexagonal cross-section, of the piston reduces the risk of jamming. In order to maximize the flow capacity of the overfill protection valve without increasing its diameter, the stroke of the piston and the size of the side openings in the overfill protection valve body have to be increased and the spring rate has to be relatively low. These three measures can increase the risk of jamming of the piston and the selection of a polygonal cross-section alleviates this difficulty while providing a high capacity overfill protection valve.

Claims

1. A poly valve device for a gas tank comprising

- 5 a valve body (1) with a flange (2) for mounting the device on the gas tank;
- an overfill protection valve (3) mounted on an internal side of the valve body (1) with regard to the tank when the device is mounted thereon;
- 10 a fill port (4) on an external side of the valve body (1) and in communication with the overfill protection valve (3);
- a level indicator means (6,7) on the internal side of the valve body (1);
- 15 means (8,9) for transmitting information of the level of liquid in the tank from the level indicator means (6) to the external side of the valve body (1);
- 20 a valve means mounted on the valve body for delivering gas from the tank to a user;

characterized in that

the poly valve device further comprises a level sensing means (5) with a floater (10) hinged on the overfill protection valve (3) and/or on the level indicator means (6) and cooperating with both of them for providing information of the level of liquid.

2. A poly valve device for a gas tank according to claim 1, wherein the overfill protection valve (3) is mounted on the valve body (1) by fitting and crimping.

3. A poly valve device for a gas tank according to claim 1, wherein the overfill protection valve (3) comprises a generally cylindrical overfill protection valve body (11), one end of which being fitted and crimped in a corresponding bore (12) of the valve body.

4. A poly valve device for a gas tank according to the preceding claim, wherein the level sensing means (5) comprises a rod (13) hinged on the overfill protection valve (3), the floater (10) being on the rod (13), and a cam (14) at a hinged section of the level sensing means (5), the cam (14) interacting with the overfill protection valve (3) for preventing an overfilling of the tank by closing the overfill protection valve (3) when the level of liquid in the tank reaches a predetermined level upon refilling.

5. A poly valve device for a gas tank according to the preceding claim, wherein the level indicator means (6) comprises an elongated element rotatably supported on the valve body (1) and generally perpendicular to the flange (2), a first end (15) of the elongated element (6) cooperating with the hinged section of the level sensing means (5) and the second end (8) of the elongated element transmitting by its rotation the information of the level of liquid in the

tank to the external side of the valve body (1).

6. A poly valve device for a gas tank according to the preceding claim, wherein the second end (8) of the elongated element (6) comprises magnetic means designed for transmitting the rotational position of the elongated element to an indicator (7) on the external side of the valve body. 5
7. A poly valve device for a gas tank according to the preceding claim, wherein the first end (15) of the elongated element comprises a slot distant from a rotational axis of the elongated element (6) and engaging with the rod (13) or a pivot (16) of the hinged section. 10 15
8. A poly valve device for a gas tank according to the preceding claim, wherein the overfill protection valve (3) comprises a piston (17) with sealing means (18) for closing the overfill protection valve (3), the piston (17) having a polygonal, preferably hexagonal, section. 20
9. A poly valve device for a gas tank according to the preceding claim, wherein the piston (17) has a passage from an upper side with the sealing means (18) to a lower side of the piston and the overfill protection valve (3) further comprises an overfill protection valve body (11) and a control valve (19) operated by the level sensing means (5) and able to close a chamber (20) of the overfill protection valve (3) formed by the lower side of the piston (17) and the overfill protection valve body (11). 25 30

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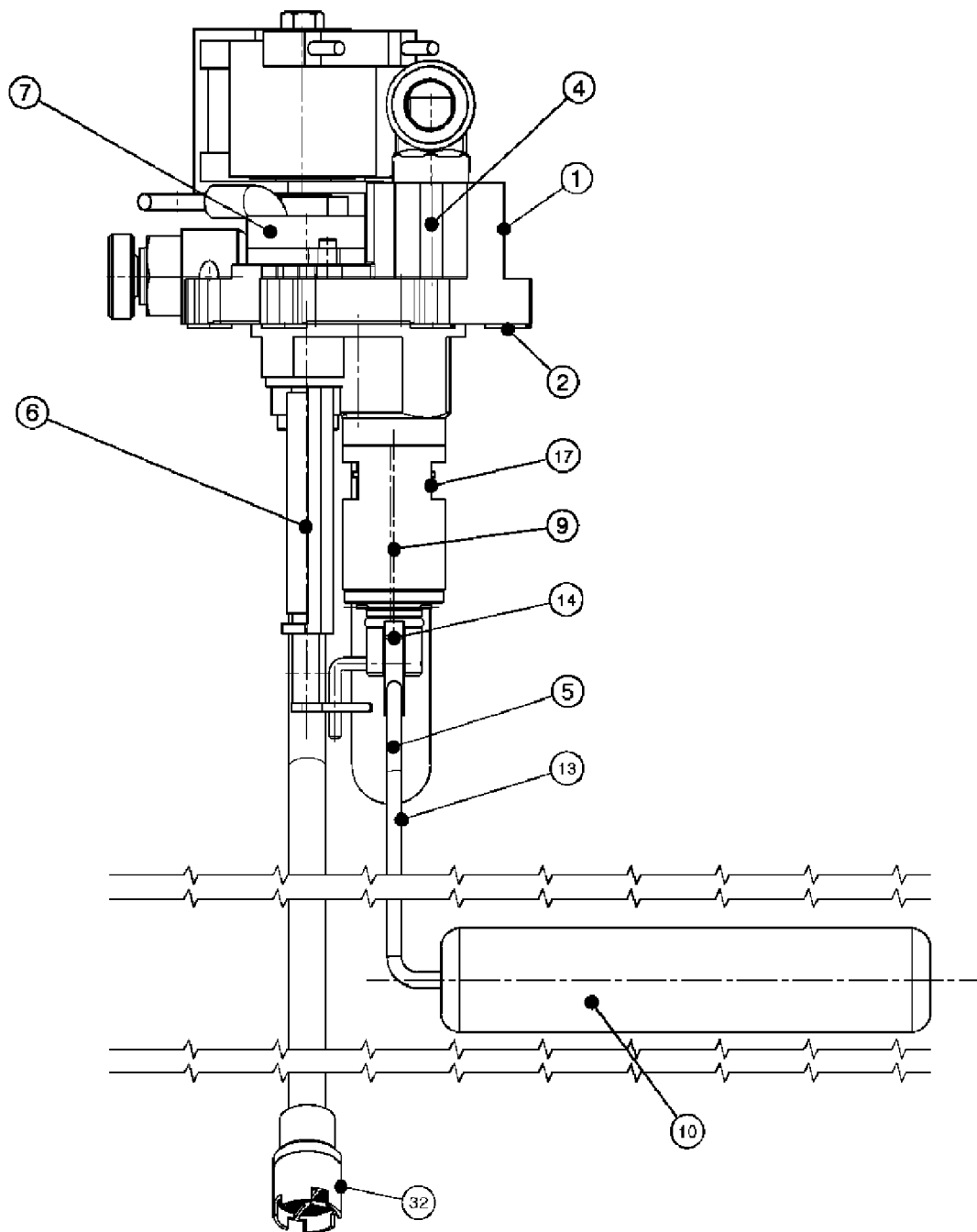


Fig. 1

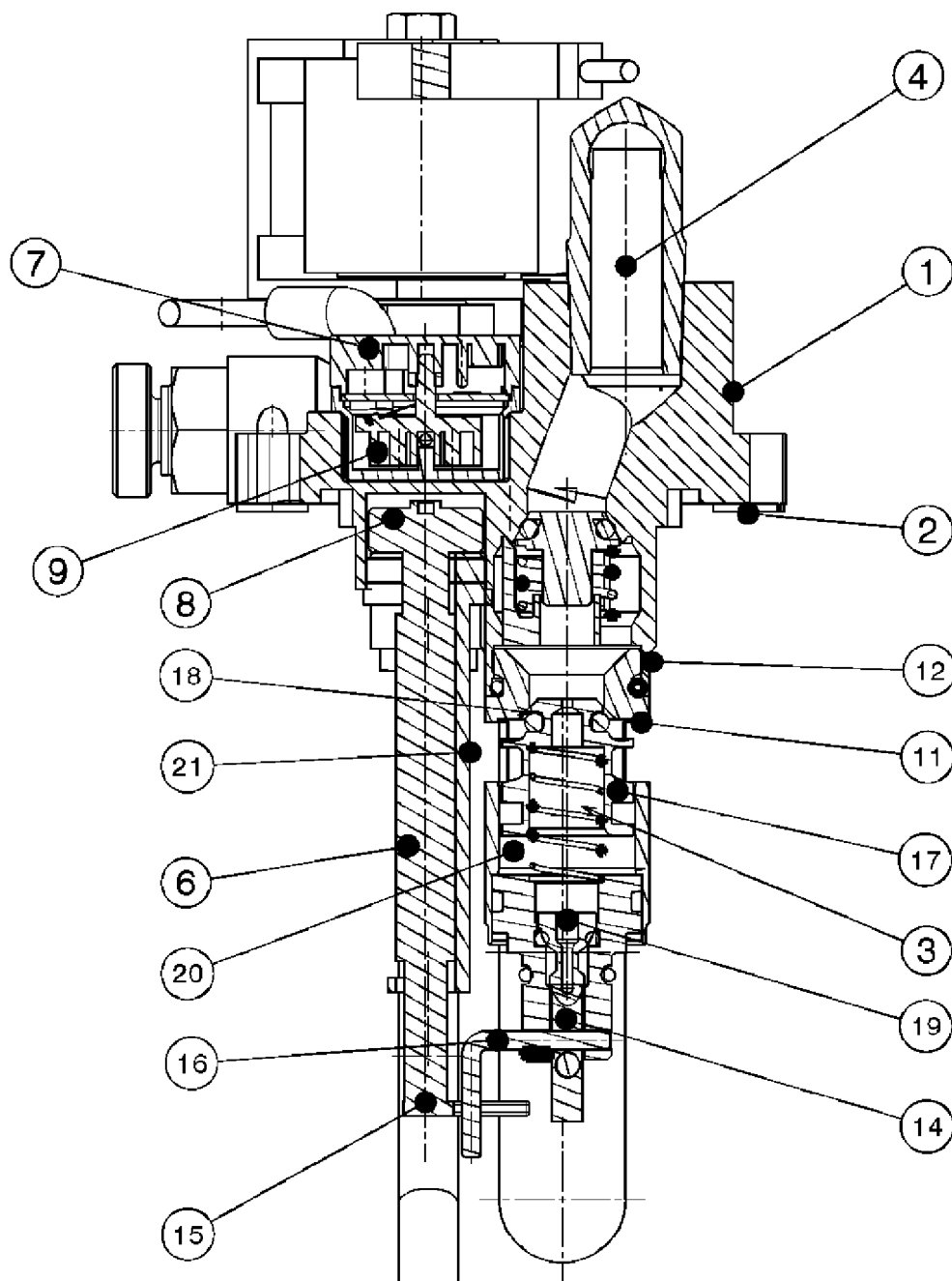


Fig. 2

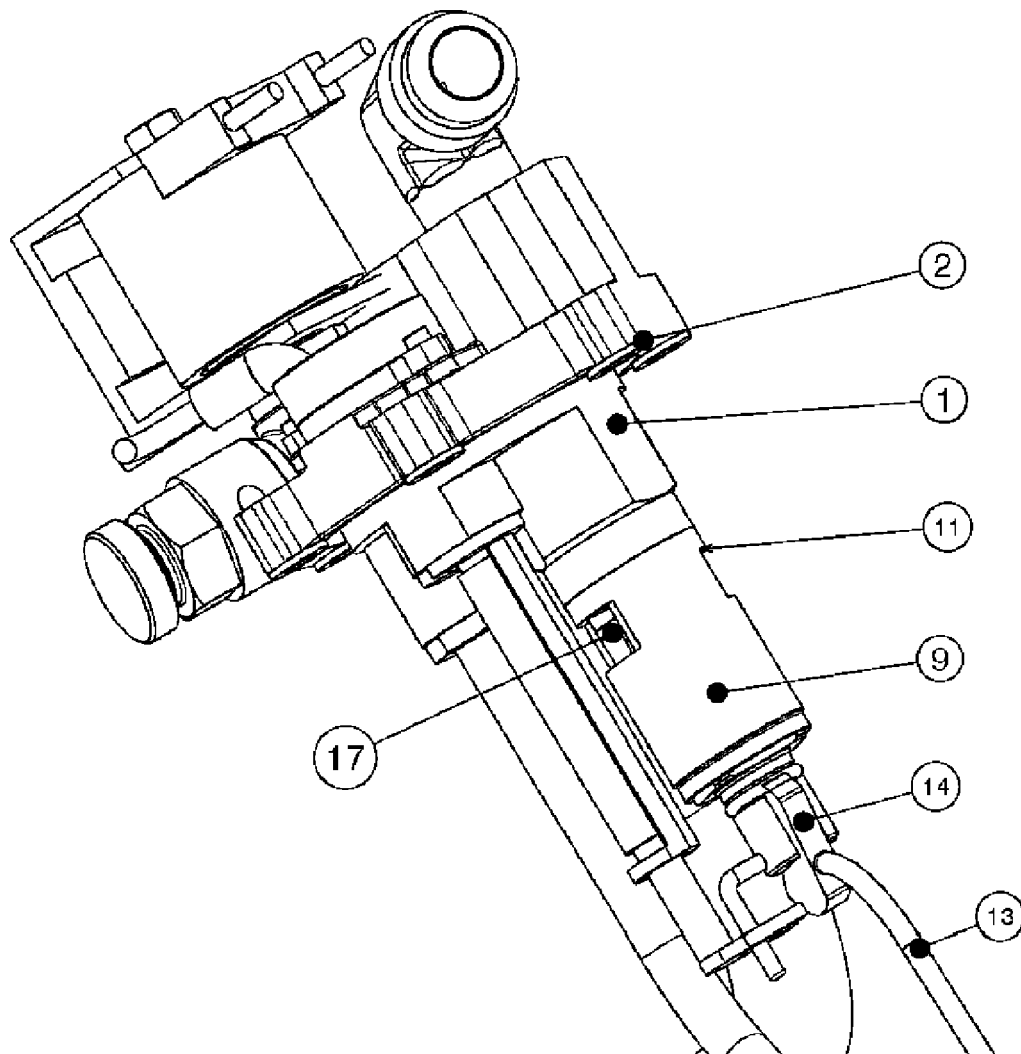


Fig. 3



European Patent
Office

EUROPEAN SEARCH REPORT

Application Number
EP 07 11 0903

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Place of search Munich		Date of completion of the search 12 June 2008	Examiner Nicol, Boris
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	

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EPO FORM 1503 03 82 (P04C01)

**CLAIMS INCURRING FEES**

The present European patent application comprised at the time of filing more than ten claims.

- ☐ Only part of the claims have been paid within the prescribed time limit. The present European search report has been drawn up for the first ten claims and for those claims for which claims fees have been paid, namely claim(s):
- ☐ No claims fees have been paid within the prescribed time limit. The present European search report has been drawn up for the first ten claims.

LACK OF UNITY OF INVENTION

The Search Division considers that the present European patent application does not comply with the requirements of unity of invention and relates to several inventions or groups of inventions, namely:

see sheet B

- ☐ All further search fees have been paid within the fixed time limit. The present European search report has been drawn up for all claims.
- ☐ As all searchable claims could be searched without effort justifying an additional fee, the Search Division did not invite payment of any additional fee.
- ☒ Only part of the further search fees have been paid within the fixed time limit. The present European search report has been drawn up for those parts of the European patent application which relate to the inventions in respect of which search fees have been paid, namely claims:
1-3, 5-9
- ☐ None of the further search fees have been paid within the fixed time limit. The present European search report has been drawn up for those parts of the European patent application which relate to the invention first mentioned in the claims, namely claims:
- ☐ The present supplementary European search report has been drawn up for those parts of the European patent application which relate to the invention first mentioned in the claims (Rule 164 (1) EPC).



The Search Division considers that the present European patent application does not comply with the requirements of unity of invention and relates to several inventions or groups of inventions, namely:

1. claims: 1-3

A poly valve device for a gas tank according to claim 1, wherein the overfill protection valve is mounted on the valve body by fitting and crimping.

2. claim: 4

A poly valve device for a gas tank according to claim 1, wherein the level sensing means comprises a rod hinged on the overfill protection valve, and the floater being on the rod, and a cam at a hinged section of the level sensing means.

3. claims: 5-7

A poly valve device for a gas tank according to claim 1, wherein the level sensing means comprises an elongate element rotatably supported on the valve body for transmitting information of the level of liquid in the tank to the external side of the valve body.

4. claims: 8,9

A poly valve device for a gas tank according to claim 1, wherein the overfill protection valve comprises a piston with sealing means for closing the overfill protection valve, the piston having a polygonal preferably hexagonal section.

**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

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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
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12-06-2008

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