

(19) World Intellectual Property Organization
International Bureau



(43) International Publication Date
9 August 2007 (09.08.2007)

PCT

(10) International Publication Number
WO 2007/088023 A1

(51) International Patent Classification:
B60K 15/035 (2006.01)

(21) International Application Number:
PCT/EP2007/000786

(22) International Filing Date: 30 January 2007 (30.01.2007)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
10 2006 004 630.7 31 January 2006 (31.01.2006) DE
60/776,698 27 February 2006 (27.02.2006) US

(71) Applicants (for all designated States except US):
KAUTEX TEXTRON GMBH & CO. KG [DE/DE];
Kautexstr. 52, 53229 Bonn (DE). **RAVAL A.C.S. LTD**
[IL/IL]; Kibbutz Revivim, 85515 D.n. Halutza (IL).

(72) Inventors; and

(75) Inventors/Applicants (for US only): **HANDY, Paul**
[IL/IL]; Kibbutz Revivim, 85515 D.n. Halutza (IL).
MÜLLER-OHL, Felix [DE/DE]; Im Kreuzgarten 1,
53639 Königswinter (DE). **OSSEGE, Theodor** [DE/DE];
Bröhlweg 24, 53229 Bonn (DE). **VULKAN, Omer**
[IL/IL]; Kibbutz Mashbei Sadeh, 85510 D.n. Halutza

(IL). **KIRCHBERGER, Thorsten** [DE/DE]; Berner-
strasse 9, 38106 Braunschweig (DE). **OLSHANETSKY,**
Vladimir [IL/IL]; 11 Zilpah Street, 84513 Beer Sheva
(IL). **SCHUMACHER, Markus** [DE/DE]; Buschweg 52,
53757 Sankt Augustin (DE). **WOLF, Hartmut** [DE/DE];
Marienstrasse 19, 53639 Königswinter (DE).

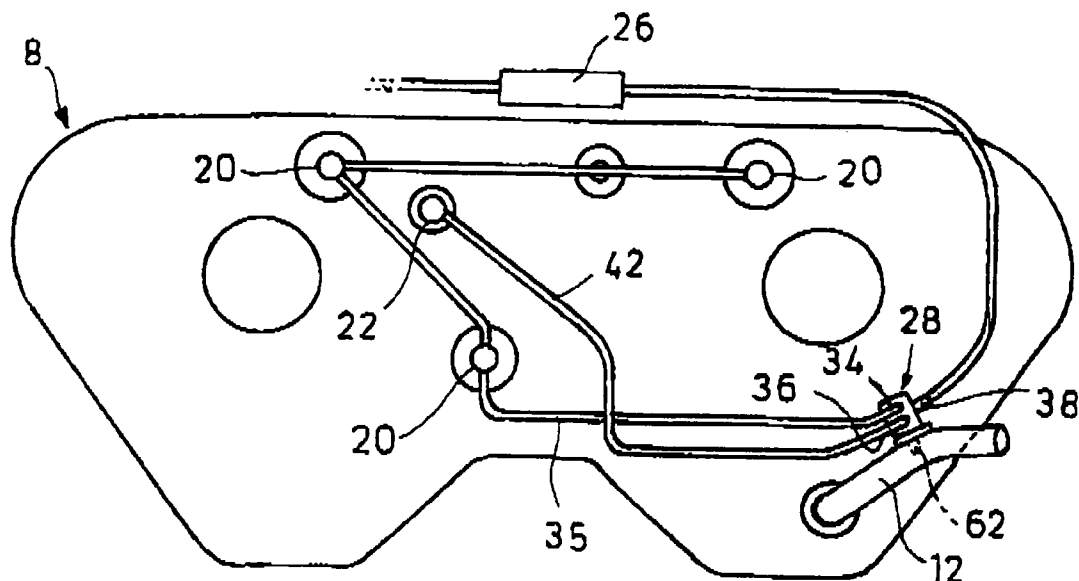
(74) Agent: **POLYPATENT**; Braunsberger Feld 29, 51429
Bergisch Gladbach (DE).

(81) Designated States (unless otherwise indicated, for every
kind of national protection available): AE, AG, AL, AM,
AT, AU, AZ, BA, BB, BG, BR, BW, BY, BZ, CA, CH, CN,
CO, CR, CU, CZ, DK, DM, DZ, EC, EE, EG, ES, FI, GB,
GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP,
KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT,
LU, LV, LY, MA, MD, MG, MK, MN, MW, MX, MY, MZ,
NA, NG, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RS, RU,
SC, SD, SE, SG, SK, SL, SM, SV, SY, TJ, TM, TN, TR,
TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States (unless otherwise indicated, for every
kind of regional protection available): ARIPO (BW, GH,
GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM,
ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM),
European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI,

[Continued on next page]

(54) Title: FUEL TANK FOR A MOTOR VEHICLE



(57) Abstract: A fuel tank (10) for a motor vehicle comprising a filler connection (12) enclosing a tank refueling passage (12) and operational and tank refueling venting conduits which are connected to a filler head (14) of the filler connection, wherein the filler head has at least one change-over switching valve (28) which in a first switching position (tank refueling position) opens a flow path from the tank refueling venting conduit to a venting passage, upstream of which a fuel vapor treating device is preferably connected, and closes a connection of the operational venting conduit to the tank refueling passage, and which in a second switching position (operational position) opens the connection of the operational venting conduit to the tank refueling passage and closes the flow path from the tank refueling venting conduit to the venting passage.

WO 2007/088023 A1



FR, GB, GR, HU, IE, IS, IT, LT, LU, LV, MC, NL, PL, PT,
RO, SE, SI, SK, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA,
GN, GQ, GW, ML, MR, NE, SN, TD, TG).

— *before the expiration of the time limit for amending the
claims and to be republished in the event of receipt of
amendments*

Published:

— *with international search report*

*For two-letter codes and other abbreviations, refer to the "Guid-
ance Notes on Codes and Abbreviations" appearing at the begin-
ning of each regular issue of the PCT Gazette.*

Fuel tank for a motor vehicle

The present invention relates to a vehicle fuel system and more specifically it is concerned with a switching valve for a fuel vapor venting system associated with a vehicle's fuel tank, for selectively connecting/disconnecting a venting system to a fuel treating device, such as a fuel vapor treating device, upon refueling.

A fuel tank or a closure connection for a filler connection of a fuel tank is known for example from DE 198 47 472 A1. DE 198 47 472 A1 describes a closure connection for a filler connection of a fuel tank of a motor vehicle comprising a flap which is arranged in a tank refueling passage and which is movable in the refueling operation, for switching a venting valve, comprising a first compensating chamber connected to the venting valve for tank refueling venting, and a second operational venting means connected to the venting valve, wherein the venting valve is adapted during operation to communicate the second compensating chamber with the tank refueling passage. That closure connection is distinguished in that there are provided interchange means for selectively connecting the first compensating chamber by way of a change-over switching valve to a filter or the tank refueling passage so that the closure connection can be adapted to different tank refueling systems.

In a variant of the tank refueling venting means, which is described in DE 198 47 472 A1, the gas volume flow which occurs upon refueling of the motor vehicle is discharged into the atmosphere by way of a compensating chamber and by way of a fuel vapor treating device. Provided in the flow path between the compensating chamber in question and the fuel vapor treating device is a valve member which closes the flow path in operation of the vehicle and opens it in a tank refueling situation. Operational venting for the motor vehicle is evidently effected in conventional manner in the venting system described in DE 198 47 472 A1.

In the operational venting situation, a plurality of venting points on the fuel tank are usually connected together by way of one or more operational venting

conduits which are also connected to the fuel vapor treating device. The venting points are normally disposed above the maximum permissible level of liquid in the fuel tank and are usually closed by float valves. Those valves also have a pressure-holding function or separate pressure-holding valves are provided in order to prevent overfilling of the fuel tank, in order to cause the refueling gun valve to shut off in good time during refueling.

A comparatively large number of valves have to be provided, depending on the respective number of venting locations to be provided in the fuel tank. If the valves are in the form of float valves, spillage of fuel over into one vent conduit or the other is inevitable, because of valve inertia. The pressure-holding valves also have a certain amount of leakage so that the risk of overfilling the tank rises with an increase in the number of the venting locations.

In addition it is desirable for the fuel tank to be kept substantially pressure-less during operation of the motor vehicle.

DE 195 40 267 B4 discloses a tank venting system for a fuel tank with an expansion region, a filler connection which is closable by a tank closure, a venting conduit connected to the expansion region and a venting valve, wherein the venting valve is adapted to close the venting conduit when the filler connection is open and to open the venting conduit when the filler connection is closed. The shut-off valve provided for that purpose between the fuel vapor treating device and the venting conduits of the fuel tank is arranged at the filler head of the filler connection, wherein the closure cap which is screwed into the filler connection causes actuation of the shut-off valve in such a way that the flow path from the operational venting conduits to the fuel vapor treating device is opened.

The tank venting system proposed in DE 195 40 267 B4 is suitable exclusively for tank refueling venting in accordance with the European system in which the fuel vapors produced are sucked away by means of a suitable device at the refueling gun. Integration of tank refueling venting as is provided in the closure connections in accordance with DE 198 47 472 A1 is not embodied in the tank venting system disclosed in DE 195 40 267 B4.

Several patents disclose fuel vapor control systems associated with a switching valve fitted on a refueling pipe, to be activated upon engagement of the refueling nozzle. Examples of such patents are disclosed herein below.

US 5,404,906 to Aoshima et al. discloses a fuel tank including a vent cutout valve having a first chamber connected to a vent tube, a second chamber in communication with a canister and a third chamber connected to an evaporation tube. The first and second chambers are defined by a first partition wall with a first communication bore and the second and third chambers are defined by a second partition wall with a second communication bore. A main body of the vent cutout valve is disposed within the second chamber to open the first communication bore when a shutter presses the main body of the vent cutout valve, and is provided with a check valve to close the second communication bore which is biased towards the second partition wall by a resilient member interposed between the check valve and the valve main body of the vent cutout valve.

US 5,983,963 to Pozgainer et al. discloses an on-board refueling vapor recovery system formed with a discrete switching path which is inserted in a pressure equalization line. Upon valve operation between a fuel filling mode position and an operating mode position, respectively, the valve switches the discrete switching path of the pressure equalization line to connect the equalization line to a fuel vapor receptor through a valve outlet when the valve is in operating mode position, while blocking the equalization line when the valve is in filling mode position. A roll-over valve can be integrated into the system, preferably coupled to a small-diameter pressure equalization duct with a fill vent line which, by operation of the valve, is open when a nozzle is introduced into a filling stub for the fuel tank, but closed when the nozzle is removed, leaving only an operating vent line, the pressure equalization line and the small-diameter pressure equalization duct in communication with the outlet from the valve leading to vapor receptor.

US 4,941,587 to Terada discloses a fuel tank system comprising a fuel tank, a fuel filler pipe connected to the fuel tank, a shutter assembly disposed in the fuel filler pipe, the shutter assembly being operable by a refueling nozzle to be

inserted into the fuel filler pipe, a guide disposed in the fuel filler pipe for guiding the inserted refueling nozzle toward the shutter assembly, an engagement member disposed in the fuel filler pipe and angularly movable through a constant angle by being engaged by the refueling nozzle inserted in the fuel filler pipe and guided to the shutter assembly, and a fuel vapor venting mechanism including an on-off valve responsive to the angular movement of the engagement member for providing fluid communication between the fuel tank and an associated mechanism such as a canister. The engagement member is positioned between the guide and the shutter assembly. The on-off valve is slidable on a 01645779\5-01 cylindrical surface which has a plurality of raised stripes or ridges extending axially for allowing the on-off valve to slide smoothly and also for permitting fuel vapors to flow in a large amount when the on-off valve is opened.

Other fuel vapor control systems including switching valves fitted on the refueling pipe are for instance disclosed in US 6,318,423 B1 and DE 195 267 A1.

It is accordingly an object of the present invention to provide an improved fuel tank including a vapor control system associated with a switching valve fitted on the refueling pipe, to be activated upon engagement of the refueling nozzle which can easily and reliably be operated. It is another object of the invention to provide that the fuel tank permits substantially pressure less venting during operation of the motor vehicle and is also to be as simple and inexpensive as possible to produce having regard to the bead removal catch and compensating volumes which are otherwise required.

It is a further object of the present invention to provide an improved switch valve for the fuel system which is designed such that additional bead removable containers, pressure compensating volumes or the like are avoided.

According to one aspect of the invention a fuel tank for a motor vehicle comprises a filler connection enclosing a tank refueling passage and operational and tank refueling venting conduits which are connected to a filler head of the filler connection, wherein the filler head has at least one switching valve which in a first switching position (tank refueling position) opens a flow path from the tank

refueling venting conduit to a venting passage, upstream of which a fuel vapor treating device is preferably connected, and closes a connection of the operational venting conduit to the tank refueling passage, and which in a second switching position (operational position) opens the connection of the operational venting conduit to the tank refueling passage and closes the flow path from the tank refueling venting conduit to the venting passage, wherein the operational venting means is connected to the venting passage by way of the change over switching valve, wherein the switching valve opens the flow path from the operational venting conduit to the venting passage in the second switching position and closes said flow path from the operational venting conduit to the venting passage in the first switching position, and wherein the connection of the operational venting conduit to the fuel vapor treating device has a fuel drainage to the tank refueling passage.

The fuel drainage is preferably of such a configuration that condensed or entrained fuel runs into the tank refueling passage only under the effect of the force of gravity.

The fuel tank according to the invention has the advantage over the state of the art that various venting points of the fuel tank do not require any pressure holding valves, and the air intake conduit can be connected directly to a fuel vapor treating device, wherein selectively tank refueling venting or operational venting can be effected by way of the fuel vapor treating device to the atmosphere.

In one embodiment the filler head includes a liquid trap for condensed fuel which is drainable into the refueling passage.

It is particularly advantageous when the liquid trap comprises a liquid trap compartment. The liquid trap compartment being integrated into a housing of the switching valve.

In one embodiment of the invention the liquid trap comprises sealing means for sealing the liquid trap compartment in order to prevent drainage under certain circumstances.

It is particularly advantageous if the liquid trap comprises a sealing plug displaceable between an open position for draining the liquid trap compartment and a closed position.

The switching valve may include a refueling nozzle sensor for selectively connecting the operational venting conduit and the refueling venting conduit to the fuel vapor treating device (carbon canister).

In the fuel tank according to the invention, the tank refueling venting conduit can be connected to the filler head without the interposition of a bead removal container or a compensating chamber. Additional bead removal, catch or compensating volumes are therefore not required.

Desirably, in the second switching position of the change-over switching valve the operation venting conduit is connected pressure-lessly open to the fuel vapor treating device. Pressure-less in the sense of the invention means that pressure losses occur only by virtue of the conduit cross-section itself and the resistance of the fuel vapor treating device.

It is particularly advantageous if there is provided in the flow path between the tank refueling venting conduit and the fuel vapor treating device a connection to the tank refueling passage, which is in the form of a recirculation opening or recirculation passage.

In that way a part of the gases which are displaced out of the tank volume in the tank refueling operation is recirculated through the tank refueling passage so as to avoid excessive loading of the fuel vapor treating device with liquid hydrocarbons.

In a variant of the fuel tank according to the invention between the tank refueling passage and the venting passage there is provided a roll-over valve which upon fuel blowback in the filler pipe closes at least the way to the fuel vapor treating device, so that when the vehicle rolls over fuel is reliably prevented from

overflowing out of the filler pipe into the fuel vapor treating device and into the surroundings.

According to yet another embodiment of the invention there is provided one or more filling-limit-vent-valve (FLVV) for determining the maximum fuel level within the fuel tank, namely the level at which during refueling cutoff or shutoff occurs.

It is thus advantageous to link between the refueling process and the state of the valves during the refueling process. The valves are controllable in different ways. For example, pressure differentials, liquid level within the fuel tank and an activating plunger activated by the refueling nozzle.

In one alternative embodiment of the invention the fuel tank comprises a filler pipe, a fuel vapor treating device, such as a fuel vapor filter (carbon canister), at least one first valve and a switch valve mounted on the filler pipe at a filler head and comprising a refusing nozzle sensor for selectively disconnecting at least one first valve from the fuel vapor treating device responsive to the presence or absence of a refueling nozzle in the filler head. The first valve can be a fuel venting valve. A second valve can be filling limit valve (FLV). The system may be designed such that the switching valve selectively disconnects the valves from the fuel vapor treating device.

The term selectively is used to denote that either at least one first valve or at least one second valve are simultaneously connected flow communication with the fuel vapor treating device.

According to yet another aspect of the invention there is provided a switch valve for a fuel system comprising a housing fitted with a first valve inlet port, a second valve inlet port, a fuel vapor outlet port extending from a fuel vapor chamber, a sealing member articulated to a refueling nozzle sensor bias to project into a filler head, that sealing member adapted for sealing fluid from the first valve inlet port to the fuel vapor chamber responsive to the presence or absence of a refueling nozzle in the filler head, wherein an integrated liquid trap is provided for

capturing liquid fuel entering from the first valve inlet port and the second valve inlet port, and directing it into the filler head.

It is particularly advantageous when the switch valve selectively connects either the first valve inlet port or the second valve inlet port to the fuel vapor treating device.

By one specific design of the invention the refueling nozzle sensor is a plunger normally biased to project from the housing into the filler head or filler pipe, such that a refueling nozzle introduced into the filler head encounters said plunger entry retracts it.

In one embodiment the liquid trap comprises a compartment formed with an outlet port being in flow communication with a draining port connectable to the filler-head, and a sealing plug displaceable between a sealed position, wherein it seals said outlet port, and a normally open position for draining the liquid trap compartment through said draining port into the filler-head.

By a particular design of the invention, the sealing plug is displaceable along a substantially vertical axis.

By a further particular embodiment, the sealing member is a disc-like element articulated to the refueling nozzle sensor, and wherein the first valve inlet port extends into a first chamber fitted with a first sealing seat, and the second valve inlet port extends into a second chamber coaxially enveloping said first chamber and fitted with a second sealing seat, wherein the disc-like sealing element is sealingly engageable with either the first sealing seat or the second sealing seat. The arrangement is such that the liquid trap compartment is in flow communication with a second chamber being in flow communication with the second valve inlet port.

The liquid trap compartment is in flow communication with the second chamber being in flow communication with the filling-limit valve (FLV) inlet port.

In order to understand the invention and to see how it may be carried out in practice, some embodiments will now be described, by way of non-limiting examples only, with reference to the accompanying drawings, in which:

Figure 1 is schematic illustration of a vehicle's fuel system fitted with a switch-valve according to the present invention:

Figure 2A is a rear view of a filler-head of a filler neck fitted with the switch-valve;

Figure 2B is an isometric view of the switch-valve according to the present invention:

Figure 2C is an isometric view of a filler-head fitted with the switch-valve, the filler-head made translucent to facilitate visualizing a refueling nozzle and a sensor-plunger of the switch-valve;

Figure 3A is a section along line A-A in Figure 2B, illustrating the switch-valve at a non-refueling position;

Figure 3B is a section along line B-B in Figure 2B, illustrating the switch-valve at a non-refueling position;

Figure 3C is an isometric section along corresponding with Figure 3 A;

Figure 4A is a section along line A-A in Figure 2B, illustrating the switch-valve at a refueling position;

Figure 4B is a section along line B-B in Figure 2B, illustrating the switch-valve at a refueling position;

Figure 4C is an isometric section along corresponding with figure 4A; and

Figure 5 is a different modification of the switch valve according to the present invention.

Attention is first directed to Figure 1 of the drawings schematically illustrating a fuel system generally designated 8 and comprising a fuel tank 10 formed with a filler pipe 12 terminating at a filler-head 14 (at times referred to as *filler pipe neck*) adapted for receiving a refueling nozzle (the end of which is illustrated in Figure 2C and is designated 18).

The fuel tank 10 is further fitted with a plurality of valves, some of which are schematically represented. Venting valves, e.g. a roll-over valves (ROV) 20 being connected to a tubing 35 which is designed as an operational venting conduit. That means that this conduit which connects several roll-over valves 20 in series solves venting of the fuel tank during the normal course of operation of the vehicle. The roll-over valves normally being open. Furthermore, provided in the fuel tank 10 is a filling limit vent valve (FLVV) 22. Though only one filling limit vent valve is illustrated, it is to be understood that a fuel tank may comprise more than one filling limit vent valves.

The system further comprises a fuel-vapor treating device 26 (fuel vapor filter) e.g. a carbon canister, etc., also of known design.

The valves 20 and 22 and the fuel-vapor treating device 26 are in flow communication with a switch valve in accordance with the present invention generally designated 28 as will be hereinafter clarified.

The switch valve 28 is fixedly attached to the filler-head 14 at a substantially vertical orientation (Figures 2A and 2C) to be clarified hereinafter.

The switch valve 28 comprises a housing 32 fitted with a roll-over valve inlet port 34 connectable by appropriate tubing 35 to the one or more roll-over valves 20, and a filling-limit vent-valve inlet port 36, connectable by tubes 42 to the one or more filling-limit vent-valves 22. A fuel-vapor outlet port 38 is coupled to the fuel-vapor treating device 26 by tubing 42.

The housing 32 of the switch valve 28 is formed with a fuel vapor chamber 50 being in flow communication with the fuel vapor outlet port 38.

Coaxially formed within the housing 38 there is an ROV inlet chamber 52 from which the roll-over valve inlet port 34 extends terminating at an annular boundary seal 54 sealingly engageable by a displaceable sealing member 58 as will be discussed hereinafter. There is further formed a filling-limit vent-valve chamber 53, being in flow communication with the filling-limit vent-valve inlet port 36 and formed with an annular sealing seat 59.

Coaxially extending from the housing 32 there is a refueling nozzle sensor in the form of plunger 62 spring biased so as to project from the housing (Figures 3A-3C) such that at the assembled position (Figure 2A) projects into the part of the filler neck 14 such that it is engageable by a refueling nozzle 18 and is retractable thereby.

Sealing member 58 is coupled to the plunger 62 and is displaceable between a closed position (tank refueling position, wherein the refueling nozzle is introduced into the filler neck, Figures 4A -4C) wherein the ROV chamber 52 is disconnected from the fuel vapor chamber 50 and from the FLVV chamber 53 though the FLVV chamber 53 is in fluid flow with the fuel vapor chamber 50; and a substantially open position (operational position, Figures 3A-3C) wherein the ROV chamber 52 is in flow communication with the fuel vapor chamber 50, and however the FLVV chamber 53 is now disconnected from the ROV chamber and from the fuel vapor chamber 50. As seen in Figure 3C, at the open position the Sealing member 58 sealingly bears against the sealing seat 59, to thereby seal flow communication between the filling-limit vent-valve inlet port 36 and the vapor chamber 50.

As can further be seen in the drawings, the switch valve 28 is integrated with a liquid trap arrangement provided for capturing liquid fuel and droplets entering from the valves associated therewith and redirecting such fuel liquid into the filler-head. Accordingly, the liquid fuel trap comprises a liquid trap compartment 70 formed with an outlet aperture 72 being in flow communication

with a draining port 76 extending into an aperture (not seen) formed in the filler-head 14.

A sealing plug 80 is received within a plug receptacle 82 and is spring biased by a light coiled spring 86 such that it is normally in an open position, i.e. not sealing the outlet aperture 72. However, at the event of roll-over of the vehicle, the sealing plug 80 is displaced into its sealed position by gravity forced acting on it and further owing to urge of the coiled spring 86.

It is noticed that the receptacle 82 and accordingly the plug 80 extend upon a substantially vertical axis of the filler pipe 22 (Figure 2A) and accordingly, displacement of the plug 80 into its closed sealing position, occurs upon bouncing of the vehicle owing to inertia forces.

In the normal course of operation, i.e. whenever the vehicle is not being refueled, the plunger 62 is at its extracted position namely, projecting into the filler-head 14 whereby the sealing member 58 articulated thereto is disengaged from the annular sealing shoulder 54 and whereby the ROV chamber 52 is in flow communication with the fuel vapor chamber 50, allowing fuel vapor flow between the one or more roll-over valves 20 and the fuel-vapor treating device 26. However, at this position, it is appreciated that the FLVV chamber 53 is disconnected, to thereby prevent fuel vapor flow in direction towards the at least one FLVV. Fuel droplets accumulating within the housing 32 will collect at the liquid trap compartment 70 and each time the plug 80 displaces into its open position such liquid fuel will drain through aperture 72 and eventually through port 76 back to the filler-head 14 and the fuel tank 10.

However, upon refueling, a refueling nozzle 18 is introduced into the filler-head 14 (Figure 2C) resulting in retraction of the plunger 62 such that the sealing member 58 now sealingly engages the annular sealing edge 54 whereby fluid flow is now established between the FLVV chamber 53 and the fuel vapor chamber 50, to thus facilitate fluid flow between the one ore more filling-limit vent-valves (FLVVs) and the fuel-vapor treating device 26 for preventing over fueling (determining a cutoff/shutoff level).

A modification of the present invention is illustrated in Figure 5 of the drawings, where a switch valve generally designated 90 is of a general appearance similar to that described in connection with the previous embodiment. However, the filling-limit vent-valve inlet port 92 extends into an inlet chamber 94 having a base wall 96 attachable to the filler-head (e.g. by wheat welding), and formed with apertures 98. The arrangement is such that fuel vapor entering the filling-limit vent-valve inlet port 36 from the filling-limit vent-valves (not shown) will be sucked into the filler-head owing to vacuum residing at the filler-head which according to some regulations is a requirement during refueling. Thus, fuel vapor will substantially not flow towards the fuel-vapor treating device (not shown) but will rather be suctioned into the filler-head and back to the fuel tank.

Alternatively, the same switch valve as in accordance with any of the previous embodiments may be used, however, with a plug (not shown) fitted over the second valve inlet port (filling-limit vent-valve inlet port), whereby the line extending from the filling limit vent-valve (line 42 in Figure 1) is directly coupled to the filler head.

The arrangement where the at least one second valve is in direct flow communication with the filler-head via normally open flow path formed at the switch valve and through a corresponding opening at the filler-head is suitable also for use in vehicles where there is fitted an on-board-diagnostic system (OBD) for testing the fuel system and detecting faults therein. In this case, when pressure (typically vacuum) is applied, e.g. at the fuel treating system, pressure also extends through the switch valve and via the valves fitted in the fuel tank, into the fuel tank, i.e. the switch valve according to the invention does not interfere with operation of the OBD: At a normal assembly, a check valve extends between the fuel tank and the filler tube, thus prohibiting or interfering in the pressure equilibrium process between the tank and the filler head. However with the provision of a switch valve as disclosed herein above, the same pressure as at the fuel tank resides at the filler owing to the open flow path extending between filler-head and the fuel tank, via the switch valve-head.

Still, it is known that during refueling a large volume of air enters the fuel tank. To reduce this phenomenon, it is known to circulate air, i.e. to return excessive air through an air tube. In the present case, where an open flow path extends between filler-head and the fuel tank, via the switch valve-head, air within the fuel tank can now flow via the open flow path into the filler-head, so as to reduce air suction into the fuel tank during refueling, in a recirculation fashion.

Whilst several embodiments have been shown and described, it is to be understood that it is not intended thereby to limit the disclosure of the invention, but rather it is intended to cover all embodiments, modifications and arrangements falling within the spirit and the scope of the present invention, as defined in the appended claims, *mutatis mutandis*.

CLAIMS

1. A fuel tank for a motor vehicle comprising a filler connection enclosing a tank refueling passage and operational and tank refueling venting conduits which are connected to a filler head of the filler connection, wherein the filler head has at least one change-over switching valve which in a first switching position (tank refueling position) opens a flow path from the tank refueling venting conduit to a venting passage, upstream of which a fuel vapor treating device is preferably connected, and closes a connection of the operational venting conduit to the tank refueling passage, and which in a second switching position (operational position) opens the connection of the operational venting conduit to the tank refueling passage and closes the flow path from the tank refueling venting conduit to the venting passage, wherein the operational venting means is connected to the venting passage by way of the change-over switching valve, wherein the change-over switching valve opens the flow path from the operational venting conduit to the venting passage in the second switching position and closes said flow path from the operational venting conduit to the venting passage in the first switching position, and wherein the connection of the operational venting conduit to the fuel vapor treating device has a fuel drainage into the tank refueling passage.

2. Fuel tank as set forth in claim 1 characterized in that the filler head includes a liquid trap for condensed fuel which is drainable into the refueling passage.

3. Fuel tank as set forth in claim 2, characterized in that the liquid trap comprises a liquid trap compartment, the liquid trap compartment being integrated into a housing of the switch valve.

4. Fuel tank as set forth in claim 3, characterized in that the liquid trap comprises a sealing plug displaceable between an open position for draining the liquid trap compartment and a closed position.

5. Fuel tank as set forth in claim 1, characterized in that the switch valve includes a refueling nozzle sensor for selectively connecting the operational

venting conduit and the refueling venting conduit to the fuel vapor treating device (fuel-vapor-filter).

6. Fuel tank as set forth in one of the preceding claims characterized in that the tank refueling venting conduit is connected to the filler head without the interposition of a bead removal container or a compensating chamber.

7. Fuel tank as set forth in one of the preceding claims, characterized in that in the second switching position of the change-over switching valve the operation venting conduit is connected pressure-lessly to the fuel vapor treating device.

8. Fuel tank as set forth in one of the preceding claims, characterized in that there is provided in the flow path between the tank refueling venting conduit and the fuel vapor treating device at least one connection to the tank refueling passage, which is in the form of a recirculation opening or recirculation passage.

9. Fuel tank as set forth in one of the preceding claims, characterized that in that between the tank refueling passage and the venting passage there is provided a roll-over valve which upon fuel blowback in the filler pipe closes at least the way to the fuel vapor treating device.

10. Switch valve for a fuel system comprising a housing fitted with a first valve inlet port, a second valve inlet port, a fuel vapor outlet port extending from a fuel vapor chamber, a sealing member articulated to a refueling nozzle sensor biased to project into a filler head, said sealing member adapted for sealing fluid flow from the first valve inlet port to the fuel vapor chamber responsive to the presence or absence of a refueling nozzle in the filler head, wherein an integrated liquid trap is provided for capturing liquid fuel entering from the first valve inlet port and/or from the second valve inlet port, and directing it to the filler head.

11. A switch valve as said forth in claim 10, characterized in that the switch valve selectively connects either the first valve inlet port or the second valve inlet port, to the fuel vapor treating device.

12. A switch valve as said forth in claim 10, characterized in that the refueling nozzle sensor is plunger normally biased to project from the housing to the filler head of the filler pipe, such that a refueling nozzle introduced into the filler head encounters said plunger and retracts it.

13. A switch valve as said forth in claim 10, characterized in the liquid trap comprises a liquid trap compartment formed with an outlet port being in flow communication with a draining port connectable to the filler-head, and a sealing plug displaceable between a sealed position, wherein it seals said outlet port, and a normally open position for draining the liquid trap compartment through said draining port into the filler-head.

14. A switch as said forth in claim 13, characterized in that the sealing plug is displaceable along a substantially vertical axis.

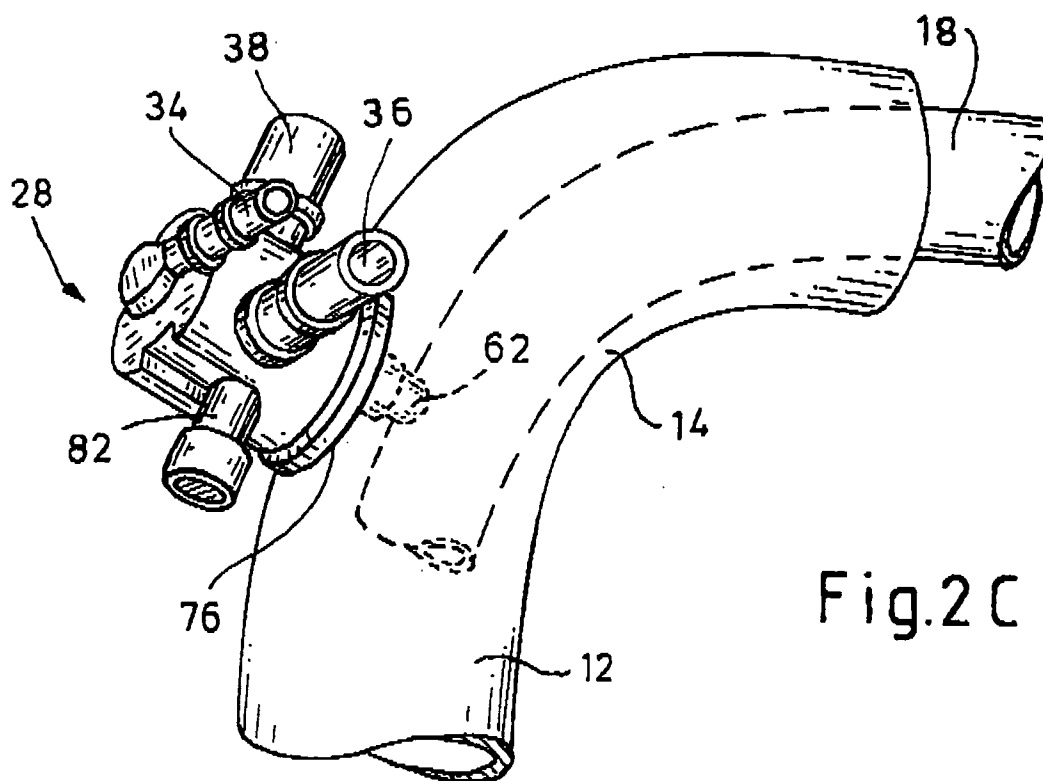
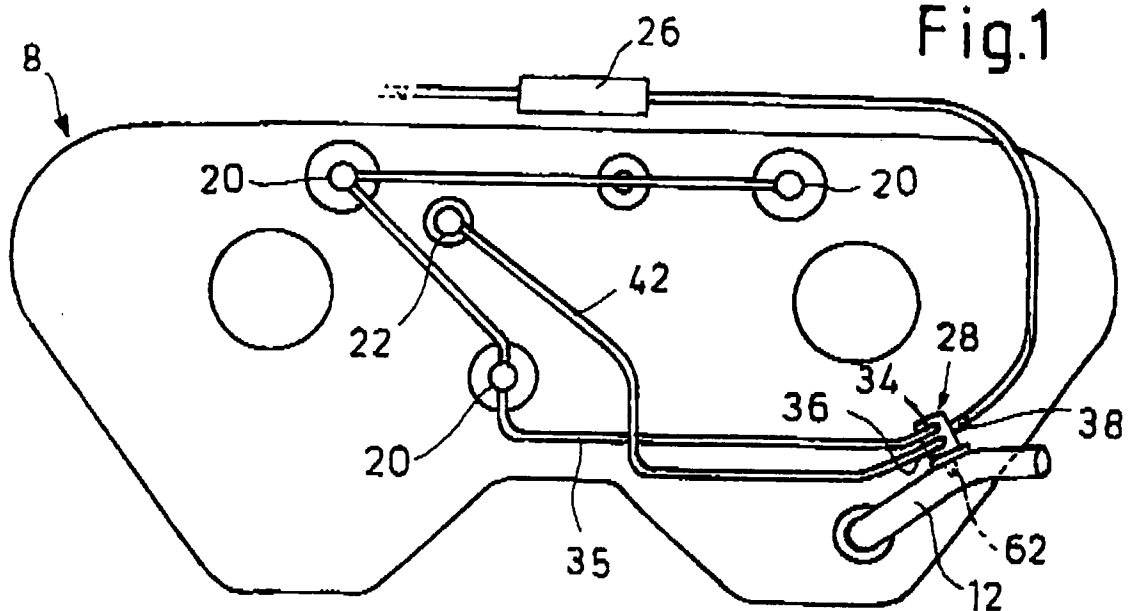
15. A switch valve as said forth in claim 10 or 11, characterized in that the sealing member is a disc-like element articulated to the refueling nozzle sensor, and wherein the first valve inlet port extends into a first chamber fitted with a first sealing seat, and the second valve inlet port extends into a second chamber coaxially enveloping said first chamber and fitted with a second sealing seat, wherein the disc-like sealing element is sealingly engageable with either the first sealing seat or the second sealing seat.

16. A switch valve as said forth in claim 10, characterized in that the liquid trap compartment is in flow communication with a second chamber being in flow communication with the second valve inlet port.

17. A switch valve as said forth in claim 10, characterized in that the first valve inlet port is connectable to one or more venting valves and the second valve inlet port is connectable to one or more filling-limit valve (FLV).

18. A switch valve as said forth in claim 10, characterized in that a direct flow path is formed at a base wall of the valve attachable to the filler-head.

1/6



2 / 6

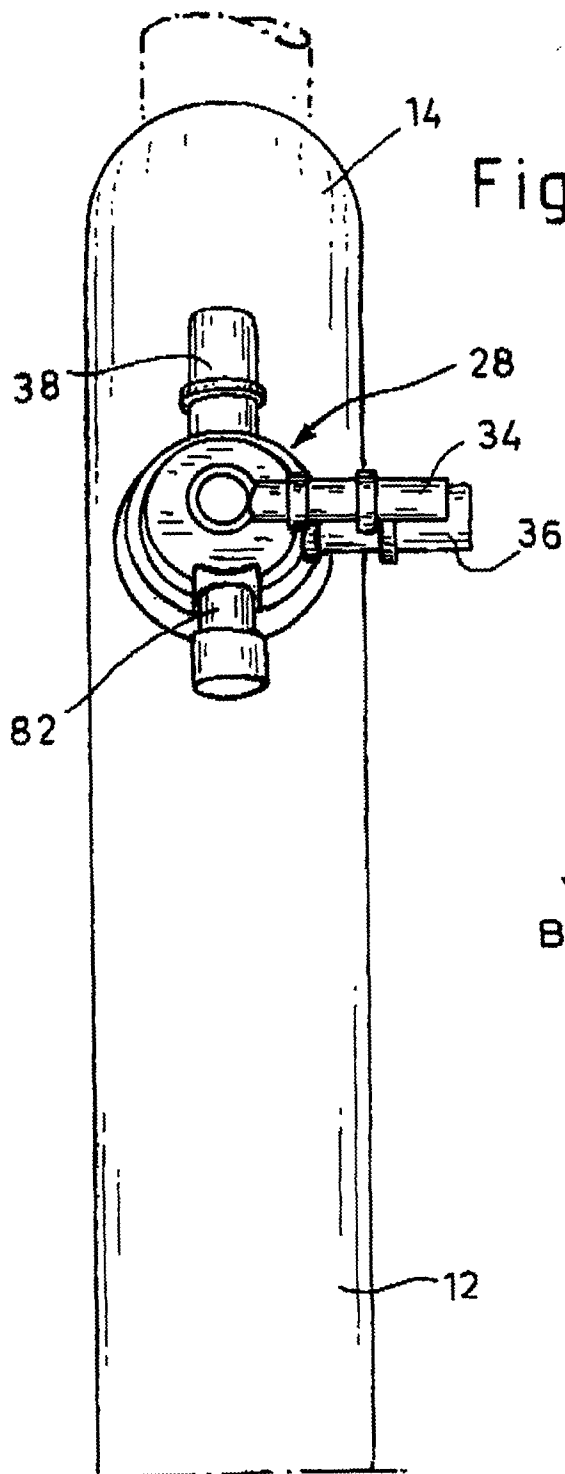


Fig. 2 A

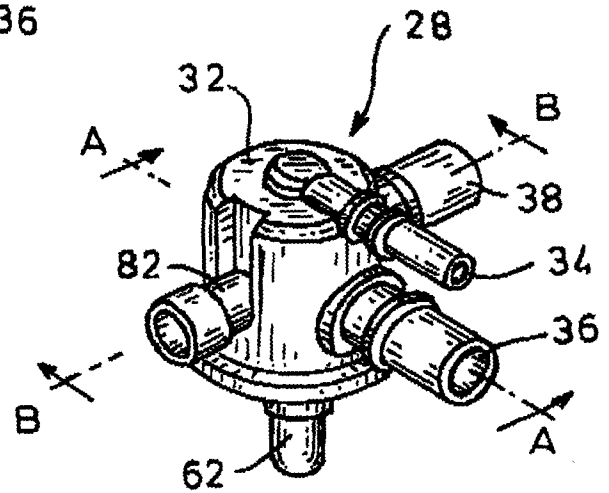
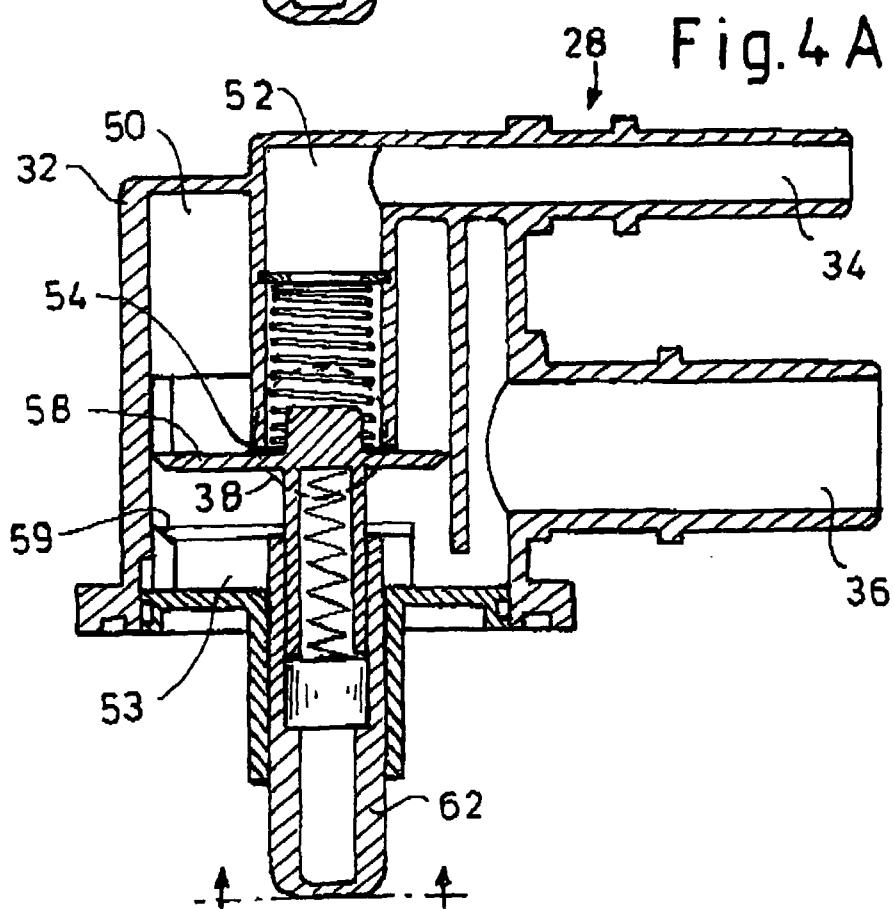
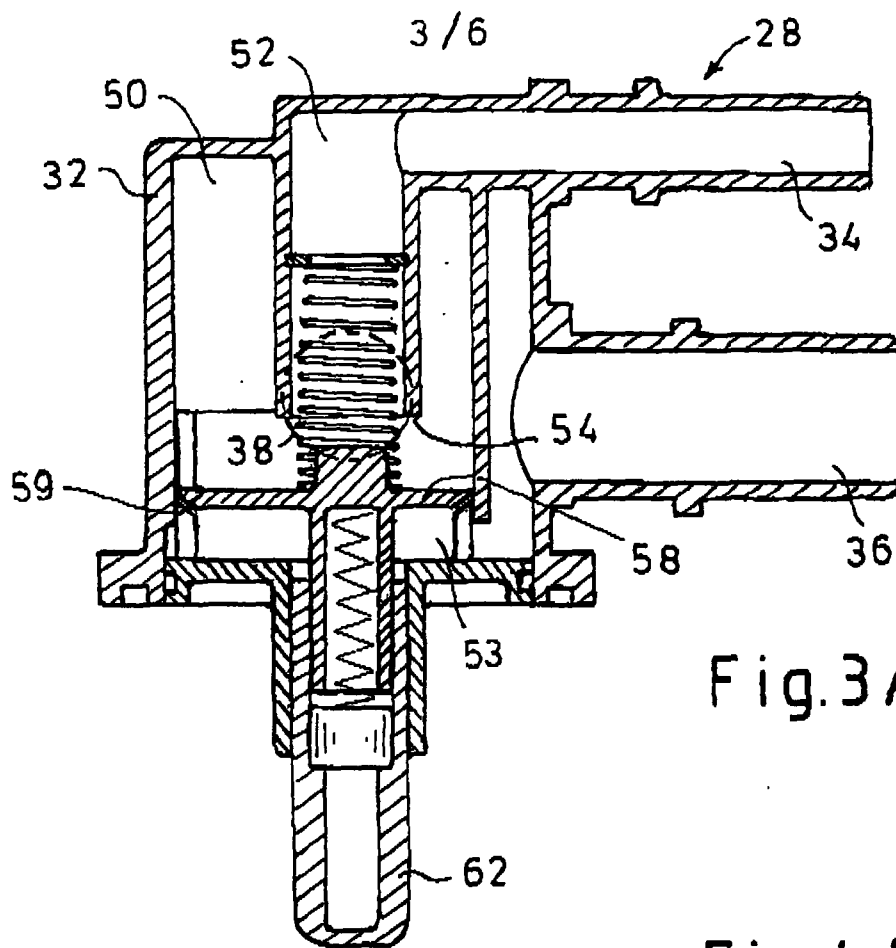
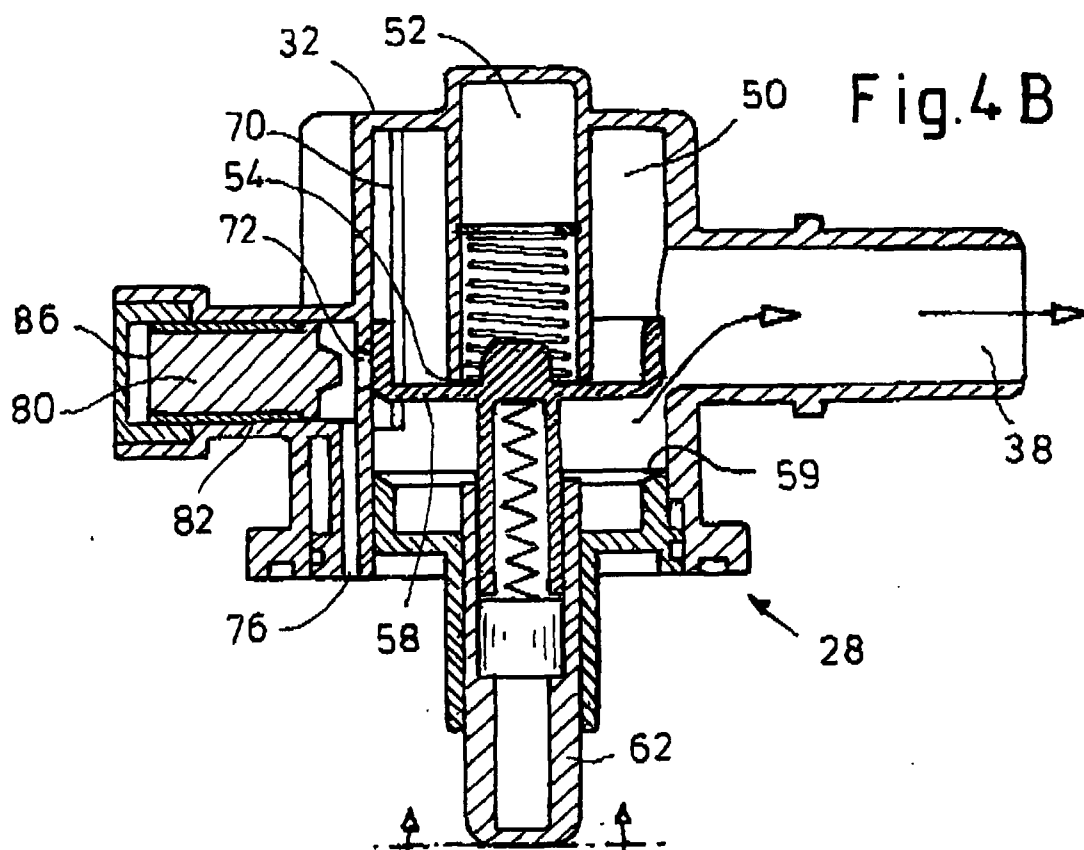
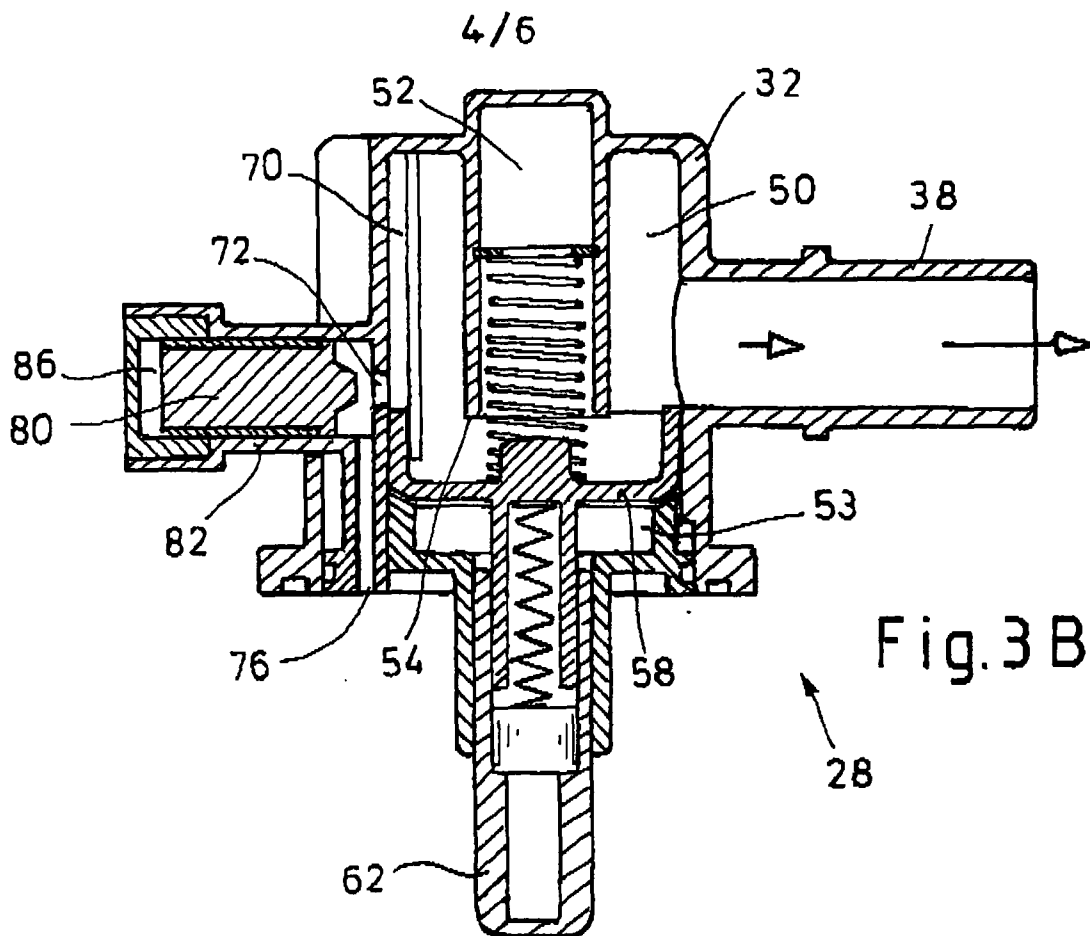
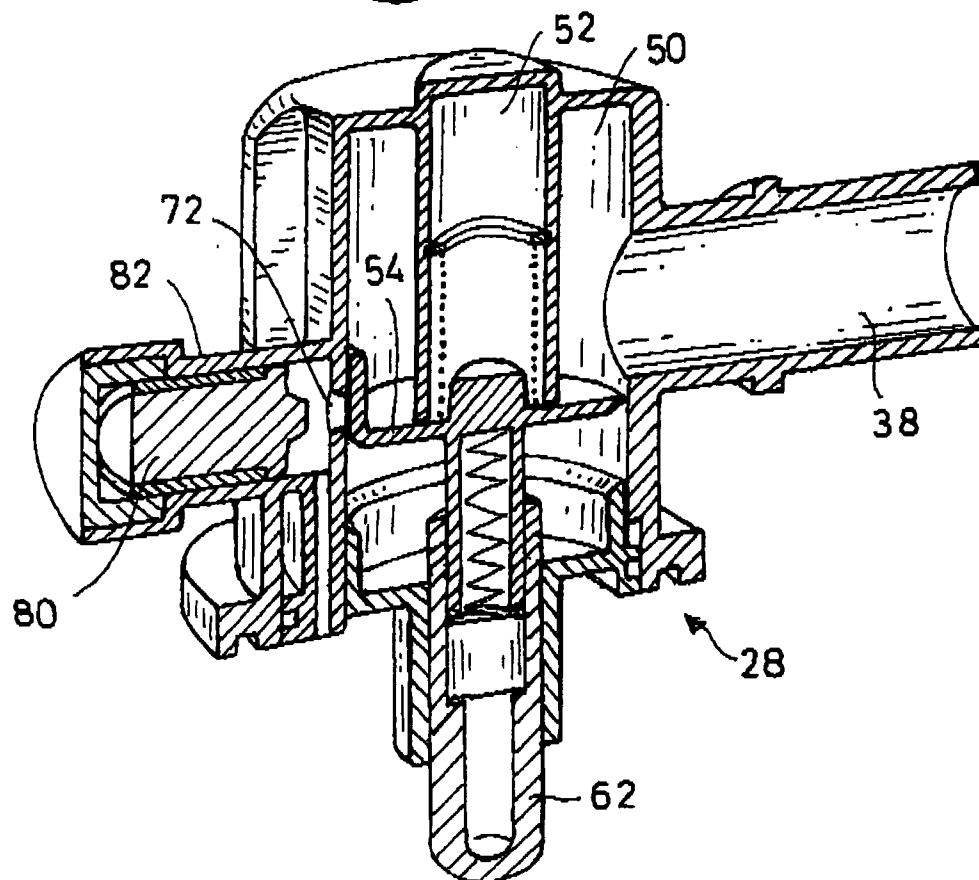
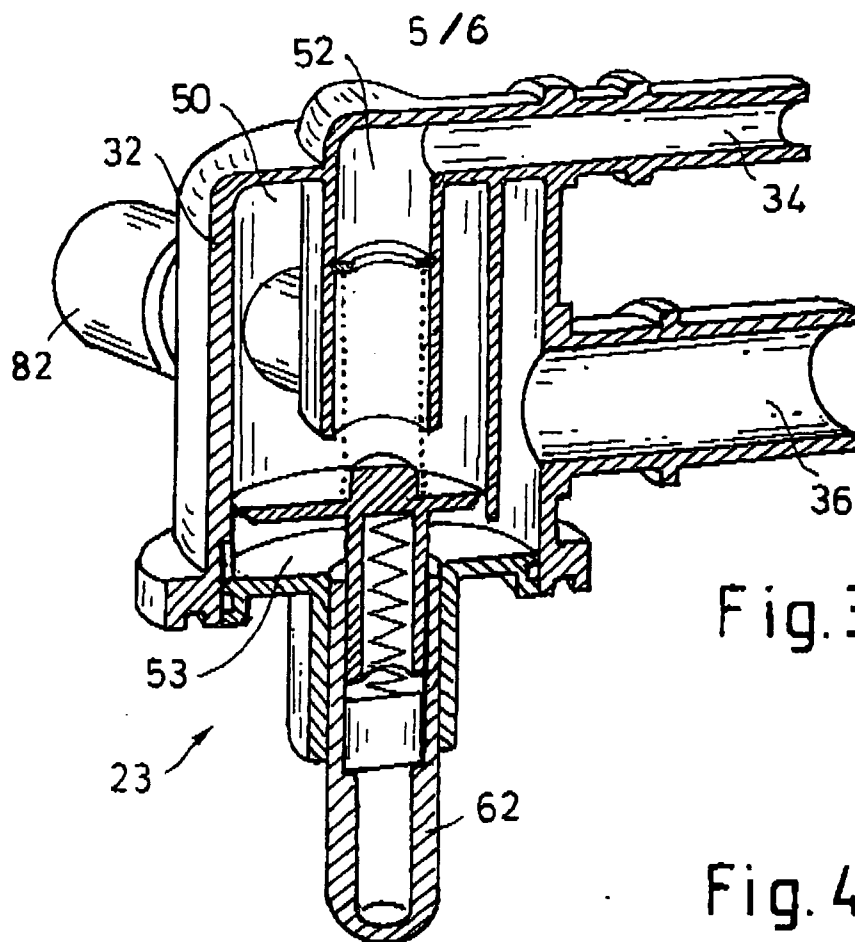


Fig. 2 B







6/6

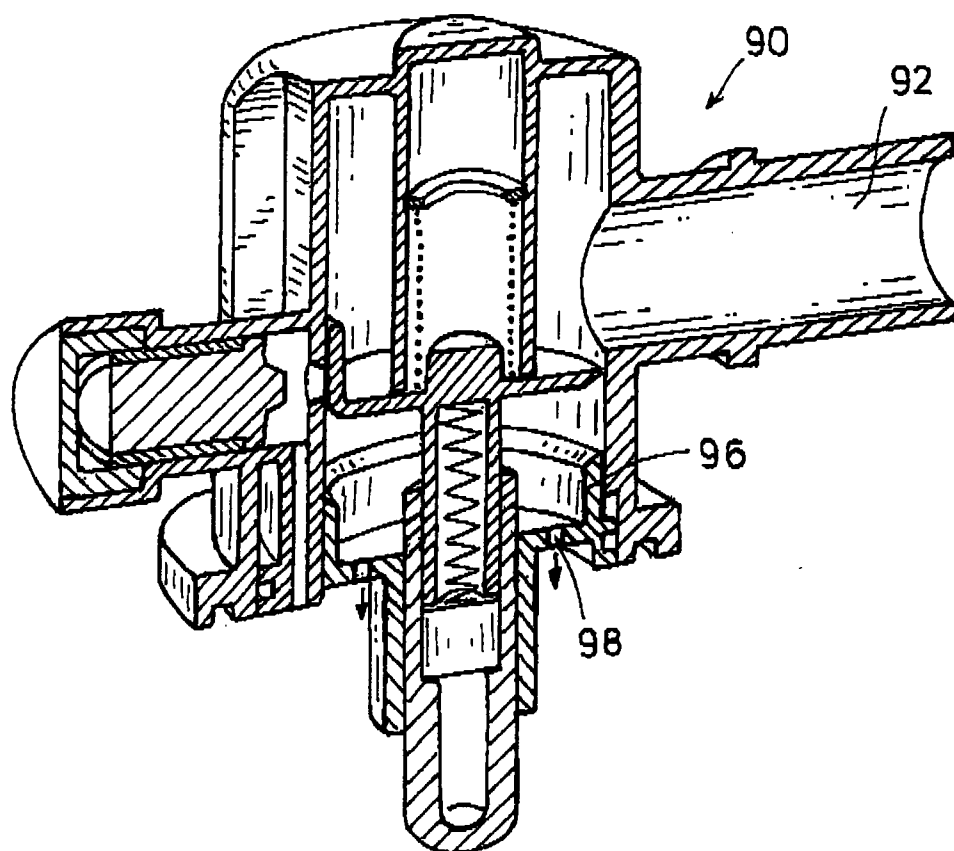


Fig.5

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2007/000786

A. CLASSIFICATION OF SUBJECT MATTER
INV. B60K15/035

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

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)

EP0-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	DE 43 43 498 A1 (KEEPER KK [JP]) 23 June 1994 (1994-06-23)	1
Y	column 7, line 53 - column 8, line 5; figures 12-17	2,3,5-12
Y	DE 195 40 267 A1 (VDO SCHINDLING [DE] SIEMENS AG [DE]) 30 April 1997 (1997-04-30) claim 1	2,3,5-12
X	US 4 836 835 A (HARRIS ROBERT S [US] ET AL) 6 June 1989 (1989-06-06) figure 1	1,10
A	US 5 215 132 A (KOBAYASHI JIRO [JP]) 1 June 1993 (1993-06-01) the whole document	1,10



Further documents are listed in the continuation of Box C.



See patent family annex.

* Special categories of cited documents :

A document defining the general state of the art which is not considered to be of particular relevance

E earlier document but published on or after the international filing date

L document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

O document referring to an oral disclosure, use, exhibition or other means

P document published prior to the international filing date but later than the priority date claimed

T later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

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.

G document member of the same patent family

Date of the actual completion of the international search

23 May 2007

Date of mailing of the international search report

04/06/2007

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

TAMME, H

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/EP2007/000786

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
DE 4343498	A1	23-06-1994	FR
		US	2699463 A1
			5404906 A
			24-06-1994
			11-04-1995
DE 19540267	A1	30-04-1997	NONE
US 4836835	A	06-06-1989	NONE
US 5215132	A	01-06-1993	NONE