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(72) Inventor: **Kalina, Andrzej R.**  
**32-020 Wieliczka (PL)**

(74) Representative: **Waller, Stephen**  
**Murgitroyd & Company**  
**Scotland House**  
**165-169 Scotland Street**  
**Glasgow G5 8PL (GB)**

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

(54) **Vapour recovery system for a vehicle fuel tank**

(57) A vapour recovery system for a vehicle fuel tank comprising a canister (10) defining at least one chamber (11) containing an adsorbent material for adsorbing fuel from fuel vapour laden air, the canister (10) having an inlet (13) for communication with the headspace of a vehicle fuel tank, a vent outlet (14) for communication with

the atmosphere and a purge outlet (15) for communication with the air intake of the vehicle engine, a first flow path (16) between the inlet (13) and the vent outlet (14), and a second flow path (17) between the inlet (13) and the purge outlet (15), wherein the second flow path (17) has a greater flow restriction and/or residence time than the first flow path (16).

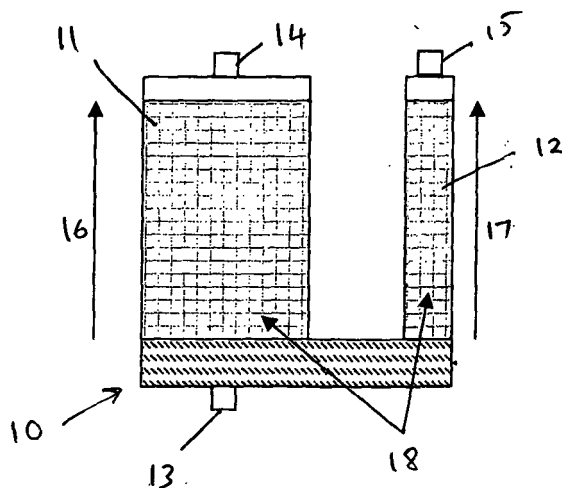


Fig.3

## Description

**[0001]** The present invention relates to a vapour recovery system for a vehicle fuel tank comprising a canister containing an adsorbent material, such as carbon, for adsorbing fuel from fuel vapour laden air, and in particular to a vapour recovery system adapted to avoid the need for a purge valve.

**[0002]** It is necessary to vent the air space in the upper regions of a vehicle fuel tank (known as the headspace) in order to avoid the formation of an air lock as a tank is emptied in use, during refuelling when air is displaced from the headspace as the tank is filled with fuel, and to compensate for pressure changes in the headspace due to evaporation of fuel and subsequent condensation during changes in ambient temperature.

**[0003]** However, vehicle emission standards place limits on the evaporative emission of fuel vapour from vehicle fuel tanks and fuel systems. To achieve these emission standards, most modern vehicles are equipped with venting and vapour recovery systems for preventing the release of fuel vapour during refilling, during vehicle operation and while the vehicle is stationary, while at the same time allowing the volume of air and fuel vapour in the tank to vary as the volume of fuel in the tank varies.

**[0004]** As illustrated in Figs. 1 and 2, a typical vapour recovery system comprises an adsorption canister 1 containing an activated carbon filter material 2 having an inlet 3 connected to a tank headspace vent passage, to trap fuel vapour while permitting the passage of air through a vent port 4 to the atmosphere during refuelling of a vehicle. Periodically, during operation of the vehicle, adsorbed fuel vapour trapped in the canister is removed by drawing air through the canister 1 through a purge outlet 5 communicating with the air-intake system of the engine such that the desorbed fuel vapour is burnt in the engine. The hydrocarbons are desorbed, transferred to engine and burnt.

**[0005]** The main function of the canister is to adsorb vapours from the fuel system and reduce environmental pollution due to evaporative emissions from gasoline powered engines.

**[0006]** Typically, the vapour recovery system includes a purge valve 6 between the canister purge outlet 5 and the engine. On most of the systems the purge valve 6 (normally solenoid valve) is controlled by an ECU. The ECU periodically opens the valve to allow hydrocarbons flow to engine. The periodical operation is required to limit amount of hydrocarbons delivered to engine. This is critical for engine performance, drivability and vehicle exhaust emissions.

**[0007]** In order to avoid the passage of air directly from the vent outlet to the purge outlet, a partition wall 7 extends within the canister 1 between the vent outlet and purge outlet.

**[0008]** In some applications, such as powered two wheelers, a mechanical valve (diaphragm or ball-spring valve) is used instead of a solenoid valve to simplify the

system and reduce total cost. In such solution, the valve does not provide means of hydrocarbons control during engine operation. Its function is limited to on/off operation. The valve is open all the time during purge and remains closed when engine is off, limiting vapour flow from canister to the engine manifold and reducing evaporative emissions.

**[0009]** However, for low cost applications it is desirable to eliminate the need for a purge valve.

**[0010]** According to the present invention there is provided a vapour recovery system for a vehicle fuel tank comprising a canister defining at least one chamber containing an adsorbent material for adsorbing fuel from fuel vapour laden air, the canister having an inlet for communication with the headspace of a vehicle fuel tank, a vent outlet for communication with the atmosphere and a purge outlet for communication with the air intake of the vehicle engine, a first flow path between the inlet and the vent outlet, and a second flow path between the inlet and the purge outlet, wherein the second flow path has a greater flow restriction and/or residence time than the first flow path.

**[0011]** Due to the high restriction and/or greater residence time of the flow path between the canister inlet and the purge outlet, vapour preferentially flows from the canister inlet to the vent outlet. This eliminates the need for a purge valve associated with the purge outlet.

**[0012]** In one embodiment the cross sectional area of the first flow path is greater than the cross sectional area of the second flow path. Preferably the minimum cross sectional area of the first flow path is greater than the minimum cross sectional area of the second flow path. Alternatively, or additionally, the adsorbent material located in the second flow path has a higher restriction to the passage of air than the adsorbent material located in the first flow path.

**[0013]** The canister may be provided with a further inlet for connection to ambient air for supplying ambient air into said second flow path.

**[0014]** Preferably the canister is divided into first and second chambers, each of said first and second chambers having an inlet end communicating with said canister inlet, said vent outlet being provided at an outlet end of the first chamber and said purge outlet being provided at an outlet end of said second chamber, wherein said first flow path, comprising an adsorption flow path, is defined through said first chamber and said second flow path, comprising a purge flow path, is defined through said second chamber.

**[0015]** The second chamber may have at least one region of restricted cross sectional area, to provide a flow restriction in the purge flow path, and at least one region of greater cross sectional area, to provide an increased adsorption capacity.

**[0016]** The second chamber may be provided with a fresh air inlet in a side region thereof.

**[0017]** Embodiments of the present invention will now be described, by way of example only, with reference to

the accompanying drawings, in which:-

Fig. 1 is a schematic view of a known vapour recovery system during a canister load cycle, such as when the vehicle is inoperative.

Fig. 2 is a schematic view of the vapour recovery system of Fig. 1 during a canister purge cycle;

Fig. 3 is a schematic view of a vapour recovery system according to a first embodiment of the present invention;

Fig. 4 is a schematic view of a vapour recovery system according to a second embodiment of the present invention;

Fig. 5 is a schematic view of a vapour recovery system according to a third embodiment of the present invention; and

Fig. 6 is a schematic view of a vapour recovery system according to a fourth embodiment of the present invention.

In a first embodiment of the present invention, as illustrated in Fig. 3, the vapour recovery system for a vehicle fuel tank comprises a canister 10 divided into first and second chambers 11, 12, each chamber containing a body of adsorbent material 18, such as activated carbon, for adsorbing fuel from fuel vapour laden air. The canister 10 has an inlet 13 for connection to the headspace of a vehicle fuel tank, a vent outlet 14 communicating with the atmosphere and a purge outlet 15 for communication with the air intake of the vehicle engine. The first chamber 11 defines an adsorption flow path 16 between the inlet and the vent outlet and the second chamber 12 defines a purge flow path 17 between the inlet and the purge outlet. In the embodiment shown in Fig. 3, the first chamber 11 is wider than the second chamber whereby the purge flow path has a greater flow restriction than the adsorption flow path.

**[0018]** The flow restriction of the purge flow path 17 is at least twice that of the adsorption flow path 16, thus vapour laden air from the headspace of the fuel tank preferentially flows through the adsorption flow path 16 from the inlet 13 to the vent outlet 14.

**[0019]** During rest, because the adsorbent material 20 in the purge flow path 17 adsorbs very little fuel vapour from the tank, it stays considerably clean. When the engine is started, vapours from first chamber 11 of the canister flow through the adsorbent material in the purge flow path 17 due to the vacuum produced in the engine intake. Under such conditions, the purge flow path 17 acts as a delay line, so engine can warm up before fuel vapour from the canister reaches the engine. This improves engine performance and helps to control exhaust emissions.

**[0020]** In a second embodiment of the invention, illustrated in Fig 4, the second chamber 12 defining the purge flow path 17 contains an adsorbent material 20b having a greater resistance to flow than the adsorbent material 20a contained in the first chamber, to further restrict the flow of vapour through the purge flow path.

**[0021]** In a third embodiment, as illustrated in Fig 5, the second chamber 12 contains narrower cross section regions 22, 23 to provide a flow restriction in the purge flow path, and a wider cross section increased volume region 24 therebetween to provide a greater adsorption capacity. This improves the vapour recovery system performance. The large cross section region 24 of the second chamber 12 increases residence time of vapour within the second chamber 24, so peak concentrations of hydrocarbons at the purge outlet 15 are reduced.

**[0022]** In a fourth embodiment, illustrated in Fig 6, a diluting feature can be implemented to further improve system performance. A fresh air inlet 30 is provided in a side region of the second chamber 12 to enable fresh air to be drawn into the purge flow path 17 to further reduce the peak concentrations of hydrocarbons at the purge outlet 15.

**[0023]** The vapour recovery system of the present invention can be used on simple systems, like powered two wheelers in developing countries, to avoid the use of control valves, reduce total vapour recovery system cost and improving system reliability as no movable parts are necessary.

**[0024]** Various modifications and variations to the described embodiments of the inventions will be apparent to those skilled in the art without departing from the scope of the invention as defined in the appended claims. Although the invention has been described in connection with specific preferred embodiments, it should be understood that the invention as claimed should not be unduly limited to such specific embodiments.

## Claims

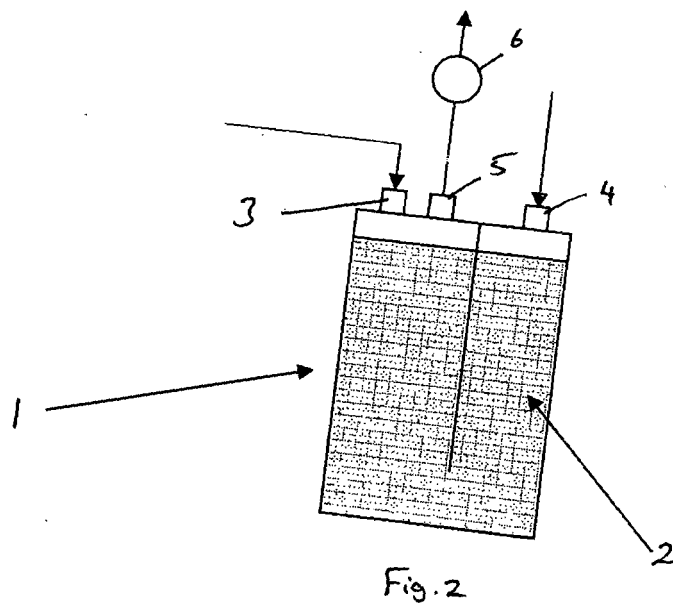
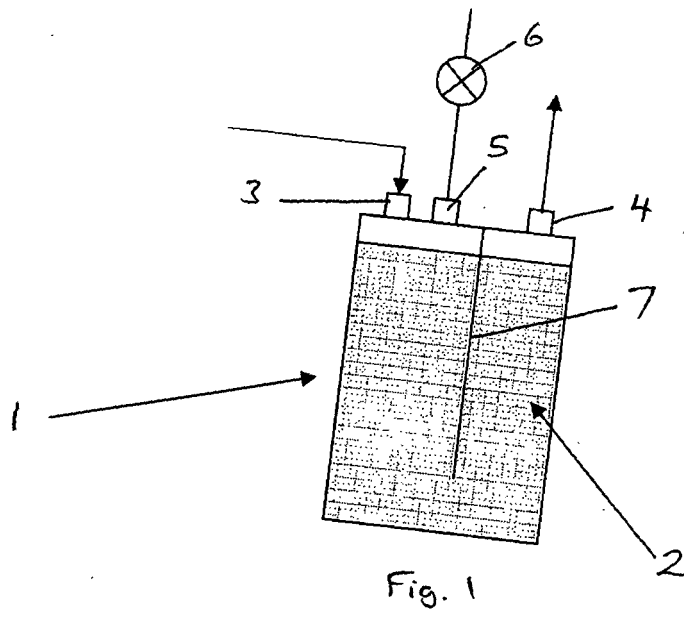
1. A vapour recovery system for a vehicle fuel tank comprising a canister defining at least one chamber containing an adsorbent material for adsorbing fuel from fuel vapour laden air, the canister having an inlet for communication with the headspace of a vehicle fuel tank, a vent outlet for communication with the atmosphere and a purge outlet for communication with the air intake of the vehicle engine, a first flow path between the inlet and the vent outlet, and a second flow path between the inlet and the purge outlet, wherein the second flow path has a greater flow restriction and/or residence time than the first flow path.
2. A vapour recovery system as claimed in claim 1, wherein the cross sectional area of the first flow path is greater than the cross sectional area of the second flow path.

3. A vapour recovery system as claimed in claim 1, wherein the minimum cross sectional area of the first flow path is greater than the minimum cross sectional area of the second flow path. 5
4. A vapour recovery system as claimed in any preceding claim, wherein the adsorbent material located in the second flow path has a higher restriction to the passage of air than the adsorbent material located in the first flow path. 10
5. A vapour recovery system as claimed in any preceding claim, wherein the canister is provided with a further inlet for connection to a ambient air for supplying ambient air into said second flow path. 15
6. A vapour recovery system as claimed in any preceding claim, wherein the canister is divided into first and second chambers, each of said first and second chambers having an inlet end communicating with said inlet at a first end thereof, said vent outlet being provided at an outlet end of the first chamber and said purge outlet being provided at an outlet end of said second chamber, wherein said first flow path, comprising an adsorption flow path, is defined through said first chamber and said second flow path, comprising a purge flow path, is defined through said second chamber. 20 25
7. A vapour recovery system as claimed in claim 6, wherein the second chamber has at least one region of restricted cross sectional area, to provide a flow restriction in the purge flow path, and at least one region of greater cross sectional area, to provide an increased adsorption capacity. 30 35
8. A vapour recovery system as claimed in claim 6 or claim 7, wherein said second chamber is provided with a fresh air inlet in a side region thereof. 40

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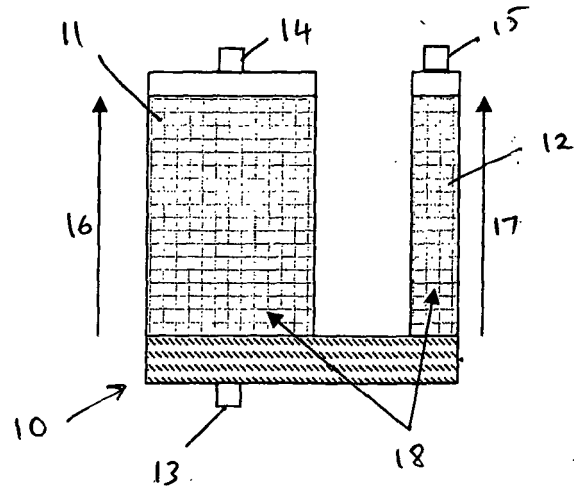


Fig. 3

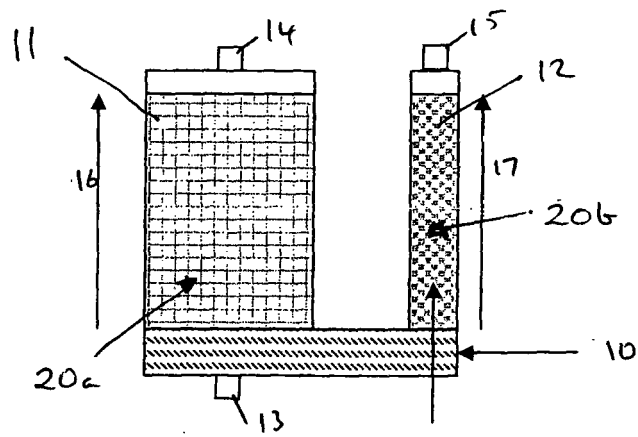


Fig. 4

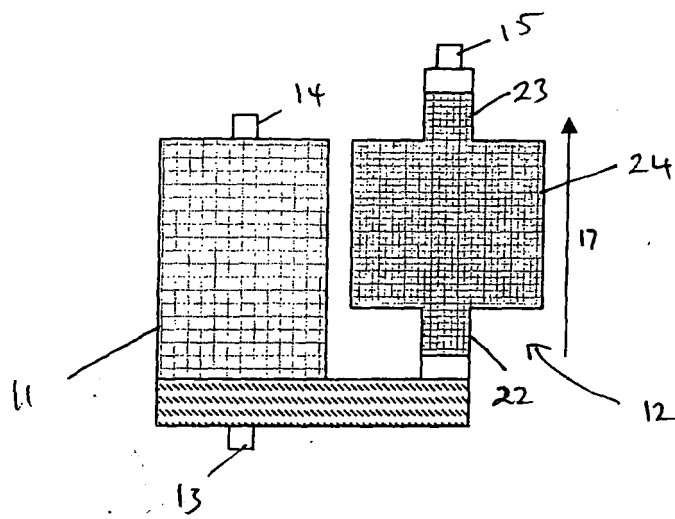


Fig. 5

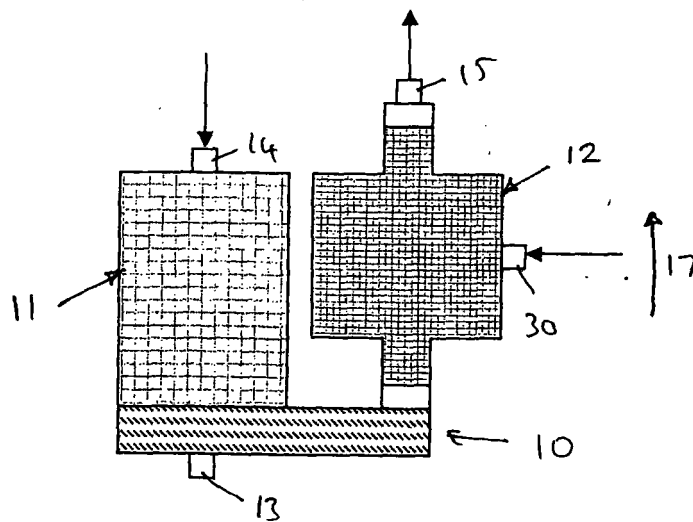


Fig. 6



European Patent  
Office

# EUROPEAN SEARCH REPORT

Application Number  
EP 07 25 0510

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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			TECHNICAL FIELDS SEARCHED (IPC)
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The present search report has been drawn up for all claims			
Place of search <b>Munich</b>		Date of completion of the search <b>6 July 2007</b>	Examiner <b>Dorfstätter, Markus</b>
<p>CATEGORY OF CITED DOCUMENTS</p> <p>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</p> <p>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 ..... &amp; : member of the same patent family, corresponding document</p>			

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**ANNEX TO THE EUROPEAN SEARCH REPORT  
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