

PATENT COOPERATION TREATY

PCT

INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY

(Chapter I of the Patent Cooperation Treaty)

(PCT Rule 44bis)

Applicant's or agent's file reference 4311-333-POA	FOR FURTHER ACTION		See item 4 below
International application No. PCT/US2017/049485	International filing date (<i>day/month/year</i>) 30 August 2017 (30.08.2017)	Priority date (<i>day/month/year</i>) 30 August 2016 (30.08.2016)	
International Patent Classification (8th edition unless older edition indicated) See relevant information in Form PCT/ISA/237			
Applicant EATON CORPORATION			

<p>1. This international preliminary report on patentability (Chapter I) is issued by the International Bureau on behalf of the International Searching Authority under Rule 44 bis.1(a).</p> <p>2. This REPORT consists of a total of 11 sheets, including this cover sheet.</p> <p>In the attached sheets, any reference to the written opinion of the International Searching Authority should be read as a reference to the international preliminary report on patentability (Chapter I) instead.</p>																								
<p>3. This report contains indications relating to the following items:</p> <table> <tr> <td><input checked="" type="checkbox"/></td> <td>Box No. I</td> <td>Basis of the report</td> </tr> <tr> <td><input type="checkbox"/></td> <td>Box No. II</td> <td>Priority</td> </tr> <tr> <td><input type="checkbox"/></td> <td>Box No. III</td> <td>Non-establishment of opinion with regard to novelty, inventive step and industrial applicability</td> </tr> <tr> <td><input type="checkbox"/></td> <td>Box No. IV</td> <td>Lack of unity of invention</td> </tr> <tr> <td><input checked="" type="checkbox"/></td> <td>Box No. V</td> <td>Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement</td> </tr> <tr> <td><input type="checkbox"/></td> <td>Box No. VI</td> <td>Certain documents cited</td> </tr> <tr> <td><input type="checkbox"/></td> <td>Box No. VII</td> <td>Certain defects in the international application</td> </tr> <tr> <td><input checked="" type="checkbox"/></td> <td>Box No. VIII</td> <td>Certain observations on the international application</td> </tr> </table> <p>4. The International Bureau will communicate this report to designated Offices in accordance with Rules 44bis.3(c) and 93bis.1 but not, except where the applicant makes an express request under Article 23(2), before the expiration of 30 months from the priority date (Rule 44bis .2).</p>	<input checked="" type="checkbox"/>	Box No. I	Basis of the report	<input type="checkbox"/>	Box No. II	Priority	<input type="checkbox"/>	Box No. III	Non-establishment of opinion with regard to novelty, inventive step and industrial applicability	<input type="checkbox"/>	Box No. IV	Lack of unity of invention	<input checked="" type="checkbox"/>	Box No. V	Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement	<input type="checkbox"/>	Box No. VI	Certain documents cited	<input type="checkbox"/>	Box No. VII	Certain defects in the international application	<input checked="" type="checkbox"/>	Box No. VIII	Certain observations on the international application
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	Date of issuance of this report 05 March 2019 (05.03.2019)
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PATENT COOPERATION TREATY

From the
INTERNATIONAL SEARCHING AUTHORITY

PCT

WRITTEN OPINION OF THE
INTERNATIONAL SEARCHING AUTHORITY

(PCT Rule 43bis.1)

To: HOLLIS, BRIAN D. RMCK LAW GROUP, PLC P.O. BOX 210958 AUBURN HILLS MI 48321 USA		Date of mailing (day/month/year) 23 November 2017 (23.11.2017)	
Applicant's or agent's file reference 4311-333-POA		FOR FURTHER ACTION See paragraph 2 below	
International application No. PCT/US2017/049485	International filing date (day/month/year) 30 August 2017 (30.08.2017)	Priority date(day/month/year) 30 August 2016 (30.08.2016)	
International Patent Classification (IPC) or both national classification and IPC B60K 15/077(2006.01)i, B60K 15/035(2006.01)i, B60K 15/04(2006.01)i, F02M 25/08(2006.01)i, B60K 15/03(2006.01)i			
Applicant EATON CORPORATION			


1. This opinion contains indications relating to the following items:

- Box No. I Basis of the opinion
- Box No. II Priority
- Box No. III Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- Box No. IV Lack of unity of invention
- Box No. V Reasoned statement under Rule 43bis.1(a)(i) with regard to novelty, inventive step and industrial applicability; citations and explanations supporting such statement
- Box No. VI Certain documents cited
- Box No. VII Certain defects in the international application
- Box No. VIII Certain observations on the international application

2. **FURTHER ACTION**

If a demand for international preliminary examination is made, this opinion will be considered to be a written opinion of the International Preliminary Examining Authority ("IPEA") except that this does not apply where the applicant chooses an Authority other than this one to be the IPEA and the chosen IPEA has notified the International Bureau under Rule 66.1bis(b) that written opinions of this International Searching Authority will not be so considered.

If this opinion is, as provided above, considered to be a written opinion of the IPEA, the applicant is invited to submit to the IPEA a written reply together, where appropriate, with amendments, before the expiration of 3 months from the date of mailing of Form PCT/ISA/220 or before the expiration of 22 months from the priority date, whichever expires later.
For further options, see Form PCT/ISA/220.

Name and mailing address of the ISA/KR International Application Division Korean Intellectual Property Office 189 Cheongsa-ro, Seo-gu, Daejeon, 35208, Republic of Korea Facsimile No. +82-42-481-8578	Date of completion of this opinion 22 November 2017 (22.11.2017)	Authorized officer PARK, Tae Wook Telephone No. +82-42-481-3405	
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**WRITTEN OPINION OF THE
INTERNATIONAL SEARCHING AUTHORITY**

International application No.

PCT/US2017/049485

Box No. I Basis of this opinion

1. With regard to the **language**, this opinion has been established on the basis of :
 - the international application in the language in which it was filed
 - a translation of the international application into _____ which is the language of a translation furnished for the purposes of international search (Rules 12.3(a) and 23.1(b))
2. This opinion has been established taking into account the **rectification of an obvious mistake** authorized by or notified to this Authority under Rule 91 (Rule 43*bis*. I(a))
3. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, this opinion has been established on the basis of a sequence listing:
 - a. forming part of the international application as filed:
 - in the form of an Annex C/ST.25 text file.
 - on paper or in the form of an image file.
 - b. furnished together with the international application under PCT Rule 13*ter*. I(a) for the purposes of international search only in the form of an Annex C/ST.25 text file.
 - c. furnished subsequent to the international filing date for the purposes of international search only:
 - in the form of an Annex C/ST.25 text file (Rule 13*ter*. I(a)).
 - on paper or in the form of an image file (Rule 13*ter*. I(b) and Administrative Instructions, Section 713).
4. In addition, in the case that more than one version or copy of a sequence listing has been filed or furnished, the required statements that the information in the subsequent or additional copies is identical to that forming part of the application as filed or does not go beyond the application as filed, as appropriate, were furnished.
5. Additional comments:

**WRITTEN OPINION OF THE
INTERNATIONAL SEARCHING AUTHORITY**

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Box No. V Reasoned statement under Rule 43bis.1(a)(i) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Claims	<u>1-20</u>	YES
	Claims	<u>NONE</u>	NO
Inventive step (IS)	Claims	<u>NONE</u>	YES
	Claims	<u>1-20</u>	NO
Industrial applicability (IA)	Claims	<u>1-20</u>	YES
	Claims	<u>NONE</u>	NO

2. Citations and explanations :

Reference is made to the following documents:

D1: US 2016-0209292 A1 (FORD GLOBAL TECHNOLOGIES, L.L.C.) 21 July 2016

D2: KR 10-2015-0097851 A (HANSUNG UNIVERSITY INDUSTRY-UNIVERSITY COOPERATION FOUNDATION) 27 August 2015

1. Novelty and Inventive Step

1.1 Independent Claim 1

D1, which is considered to be the closest prior art to the subject matter of independent claim 1, discloses a fuel system (218) comprising: a fuel tank (220); a fuel vapor canister (222); a fuel tank isolation valve (FTIV) (252), wherein the FTIV (252) is normally a closed valve, that when opened, allows for the venting of fuel vapors from the fuel tank (220) to the canister (222); and a controller (212) that adjusts a volume of the fuel tank while maintaining spatial compartmentalization of bulk fuel within the fuel tank, and indicates degradation of the fuel tank based on a change in fuel tank pressure (see abstract, paragraphs [0034]-[0037], [0041]-[0048], and figure 2). Claim 1 differs from D1 in that a fuel tank system comprises a controller that (i) conducts a first pressure test that measures a pressure in the fuel tank over a time, (ii) closes the upstream canister valve based on a determination that a leak exists, (iii) conducts a second pressure test that measures a pressure in the fuel tank over a time subsequent to closing the upstream canister valve and (iv) determines a location of the leak based on comparing the first pressure test and the second pressure test. However, D2 discloses a method to check a leakage of evaporating gas comprising the steps of: measuring a pressure change (P1) in a fuel tank (20) for a predetermined time; closing a purge valve (12); measuring a pressure change (P2) in the fuel tank for a predetermined time; and determining

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**WRITTEN OPINION OF THE
INTERNATIONAL SEARCHING AUTHORITY**

International application No.

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Box No. VIII Certain observations on the international application

The following observations on the clarity of the claims, description, and drawings or on the question whether the claims are fully supported by the description, are made:

In claim 4, "the third pressure check" and "the fourth pressure check" seem to be writing errors for "the third pressure test" and "the fourth pressure test" (PCT Article 6).

In claim 9, "(iii) determines a potential location ..." seems to be a writing error for "(iv) determines a potential location ..." (PCT Article 6).

In claim 10, "(iv) conducts a third leak check ..., and (v) determines a potential location ..." seems to be a writing error for "(v) conducts a third leak check ..., and (vi) determines a potential location ..." (PCT Article 6).

In claim 13, "(vi) conducts a fourth leak check ..., and (v) determines a potential location ..." seems to be a writing error for "(vii) conducts a fourth leak check ..., and (viii) determines a potential location ..." (PCT Article 6).

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In case the space in any of the preceding boxes is not sufficient.

Continuation of : Box No. V

the leakage of evaporating gas based on comparing the pressure change (P1) and the pressure change (P2) (see paragraph [0031], claim 1, and figures 1-2). D1 and D2 are concerned with mutually related technical fields and there is no need for fundamental changes in the key features or for a new technical idea in combining the subject matters of D1 and D2. Accordingly, claim 1 would have been obvious over D1 in view of D2. Therefore, claim 1 does not involve an inventive step under PCT Article 33(3).

1.2 Dependent Claims 2-8

The additional feature of claim 2 is identical to a fuel filler pipe (211) and a fuel cap (205) in D1 (see figure 2). Accordingly, claim 2 would have been obvious over D1 in view of D2. Therefore, claim 2 does not involve an inventive step under PCT Article 33(3).

The additional feature of claim 3, characterized in that the valve assembly further comprises a recirculation line valve that moves between an open position and a closed position to open and close a recirculation line fluidly connected between the fuel tank and the filler pipe and cap assembly, would be easily conceived from grade vent valves (GVV) (283, 287) and a fill limit venting valve (FLVV) (285) that open and close conduits (271, 273, 275) connected to a vapor recovery line (231) disposed between the fuel tank (220) and the fuel filler pipe (211) in D1 (see paragraphs [0035]-[0036] and figure 2). Accordingly, claim 3 would have been obvious over D1 in view of D2. Therefore, claim 3 does not involve an inventive step under PCT Article 33(3).

The additional feature of claim 4, characterized in that the controller (i) conducts a third pressure test that measures a pressure in the fuel tank over a time, and (ii) closes the recirculation line valve based on a determination that a leak exists, (iii) conducts a fourth pressure test that measures a pressure in the fuel tank over a time subsequent to closing the recirculation line valve and (iv) determines a location of the leak based on comparing the third pressure check and the fourth pressure check, would be easily conceived from applying the method of D2 which determines the leakage by measuring the pressure before and after closing the valve (see paragraph [0031], claim 1, and figures 1-2) to the fuel system of D1 which includes the grade vent valves (GVV) (283, 287) and the fill limit venting valve (FLVV) (285) that open and close conduits (271, 273, 275) connected to the vapor recovery line (231) disposed between the fuel tank (220) and the fuel filler pipe (211) (see paragraphs

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[0035]-[0036] and figure 2). Accordingly, claim 4 would have been obvious over D1 in view of D2. Therefore, claim 4 does not involve an inventive step under PCT Article 33(3).

The additional feature of claim 5 is identical to a pressure sensor (291) in D1 (see paragraph [0048] and figure 2). Accordingly, claim 5 would have been obvious over D1 in view of D2. Therefore, claim 5 does not involve an inventive step under PCT Article 33(3).

The additional feature of claim 6 is identical to the feature of D1 in that the controller (12) receives information from the pressure sensor (291) (see paragraph [0048] and figure 2). Accordingly, claim 6 would have been obvious over D1 in view of D2. Therefore, claim 6 does not involve an inventive step under PCT Article 33(3).

The additional feature of claim 7, characterized in that the controller compares the measured pressure over time and an expected pressure over time and determines whether a leak exists based on comparing the measured and expected pressures over time, would be easily conceived from the step of determining the leakage of evaporating gas based on comparing the pressure change (P1) and the pressure change (P2) in D2 (see paragraph [0031], claim 1, and figures 1-2). Accordingly, claim 7 would have been obvious over D1 in view of D2. Therefore, claim 7 does not involve an inventive step under PCT Article 33(3).

The additional feature of claim 8 is identical to the feature of D1 in that the fuel vapor canister (222) is configured to trap fuel vapors from the fuel tank (220) and purges the fuel vapor to an engine intake (223) via a purge line (228) and a purge valve (261) (see paragraphs [0041]-[0043] and figure 2). Accordingly, claim 8 would have been obvious over D1 in view of D2. Therefore, claim 8 does not involve an inventive step under PCT Article 33(3).

1.3 Independent Claim 9

D1, which is considered to be the closest prior art to the subject matter of independent claim 9, discloses a fuel system (218) comprising: a fuel tank (220) having a pressure sensor (291); a fuel filler pipe (211); a fuel vapor canister (222); a fuel tank isolation valve (FTIV) (252), wherein the FTIV (252) is normally closed valve, that when opened, allows for the venting of fuel vapors from the fuel tank (220) to the canister (222); and a controller (212)

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that adjusts a volume of the fuel tank while maintaining spatial compartmentalization of bulk fuel within the fuel tank, and indicates degradation of the fuel tank based on a change in fuel tank pressure (see abstract, paragraphs [0034]-[0037], [0041]-[0048], and figure 2). Claim 9 differs from D1 in that a fuel tank system comprises: a recirculation line valve that moves between an open position and a closed position to open and close a recirculation line that fluidly connects the fuel tank and the filler pipe; an inlet check valve that moves between an open position and a closed position to open and close a vapor line that fluidly connects the fuel tank and the filler pipe (hereinafter, difference 1); and a controller that (i) conducts a first leak check wherein a first calculated pressure change is compared to a first measured pressure in the fuel tank, (ii) closes one of the upstream canister valve, recirculation line valve and inlet check valve, and (iii) conducts a second leak check wherein a second calculated pressure change is compared to a second measured pressure in the fuel tank, and (iv) determines a potential location of a leak based on the first and second leak checks (hereinafter, difference 2). However, difference 1 would be easily conceived from grade vent valves (GVV) (283, 287) and a fill limit venting valve (FLVV) (285) that open and close conduits (271, 273, 275) connected to a vapor recovery line (231) disposed between the fuel tank (220) and the fuel filler pipe (211) in D1 (see paragraphs [0035]-[0036] and figure 2), and D2 discloses a method to check a leakage of evaporating gas comprising the steps of: measuring a pressure change (P1) in a fuel tank (20) for a predetermined time; closing a purge valve (12); measuring a pressure change (P2) in the fuel tank for a predetermined time; and determining the leakage of evaporating gas based on comparing the pressure change (P1) and the pressure change (P2), which corresponds to difference 2 (see paragraph [0031], claim 1, and figures 1-2). D1 and D2 are concerned with mutually related technical fields and there is no need for fundamental changes in the key features or for a new technical idea in combining the subject matters of D1 and D2. Accordingly, claim 9 would have been obvious over D1 in view of D2. Therefore, claim 9 does not involve an inventive step under PCT Article 33(3).

1.4 Dependent Claims 10-17

The additional feature of claim 10, characterized in that the controller (v) conducts a third leak check wherein a third calculated pressure change is compared to a third measured pressure in the fuel tank, and (vi) determines a potential location of a leak based on the first and third leak check, would be easily conceived from applying the method of D2 which determines the leakage by measuring the pressure before and after closing the valve (see paragraph [0031],

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claim 1, and figures 1-2) to the fuel system of D1 which includes the grade vent valves (GVV) (283, 287) and the fill limit venting valve (FLVV) (285) that open and close conduits (271, 273, 275) connected to the vapor recovery line (231) disposed between the fuel tank (220) and the fuel filler pipe (211) (see paragraphs [0035]-[0036] and figure 2). Accordingly, claim 10 would have been obvious over D1 in view of D2. Therefore, claim 10 does not involve an inventive step under PCT Article 33(3).

The additional features of claims 11 and 12, characterized in that: the third leak check includes closing the recirculation line valve (claim 11); and the third leak check includes closing the inlet check valve (claim 12), would be easily conceived from the grade vent valves (GVV) (283, 287) and the fill limit venting valve (FLVV) (285) that open and close conduits (271, 273, 275) connected to the vapor recovery line (231) disposed between the fuel tank (220) and the fuel filler pipe (211) in D1 (see paragraphs [0035]-[0036] and figure 2). Accordingly, claims 11 and 12 would have been obvious over D1 in view of D2. Therefore, claims 11 and 12 do not involve an inventive step under PCT Article 33(3).

The additional feature of claim 13, characterized in that the controller (vii) conducts a fourth leak check wherein a fourth calculated pressure change is compared to a fourth measured pressure in the fuel tank, and (viii) determines a potential location of a leak based on the first and fourth leak check, would be easily conceived from applying the method of D2 which determines the leakage by measuring the pressure before and after closing the valve (see paragraph [0031], claim 1, and figures 1-2) to the fuel system of D1 which includes the grade vent valves (GVV) (283, 287) and the fill limit venting valve (FLVV) (285) that open and close conduits (271, 273, 275) connected to the vapor recovery line (231) disposed between the fuel tank (220) and the fuel filler pipe (211) (see paragraphs [0035]-[0036] and figure 2). Accordingly, claim 13 would have been obvious over D1 in view of D2. Therefore, claim 13 does not involve an inventive step under PCT Article 33(3).

The additional features of claims 14 and 15, characterized in that: the fourth leak check includes closing the recirculation line valve (claim 14); and the fourth leak check includes closing the inlet check valve (claim 15), would be easily conceived from the grade vent valves (GVV) (283, 287) and the fill limit venting valve (FLVV) (285) that open and close conduits (271, 273, 275) connected to the vapor recovery line (231) disposed between the fuel tank (220) and the fuel filler pipe (211) in D1 (see paragraphs [0035]-[0036] and figure 2).

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Accordingly, claims 14 and 15 would have been obvious over D1 in view of D2. Therefore, claims 14 and 15 do not involve an inventive step under PCT Article 33(3).

The additional feature of claim 16, characterized in that the upstream canister valve, recirculation line valve and inlet check valves are electrically actuated, is merely a variation of the grade vent valves (GVV) (283, 287) and the fill limit venting valve (FLVV) (285) in D1 (see paragraph [0036] and figure 2). Accordingly, claim 16 would have been obvious over D1 in view of D2. Therefore, claim 16 does not involve an inventive step under PCT Article 33(3).

The additional feature of claim 17 is identical to the feature of D1 in that the fuel vapor canister (222) is configured to trap fuel vapors from the fuel tank (220) and purges the fuel vapor to an engine intake (223) via a purge line (228) and a purge valve (261) (see paragraphs [0041]-[0043] and figure 2). Accordingly, claim 17 would have been obvious over D1 in view of D2. Therefore, claim 17 does not involve an inventive step under PCT Article 33(3).

1.5 Independent Claim 18

Claim 18 relates to a method for detecting a leak in a fuel tank system, and it has the same technical features as claim 1. Thus, the same reasoning applies to claim 18. Accordingly, claim 18 would have been obvious over D1 in view of D2. Therefore, claim 18 does not involve an inventive step under PCT Article 33(3).

1.6 Dependent Claims 19 and 20

The additional feature of claim 19 is characterized in that the fuel tank system further includes a filler pipe and cap assembly (hereinafter, feature 1) and a recirculation line valve that moves between an open position and a closed position to open and close a recirculation line fluidly connected between the fuel tank and the filler pipe and cap assembly (hereinafter, feature 2), the method further comprising: performing a third pressure test that measures a pressure in the fuel tank over a time; and closing the recirculation line valve based on a determination that a leak exists (hereinafter, feature 3). D1 discloses that the fuel system comprises a fuel filler pipe (211) and a fuel cap (205), which corresponds to feature 1 (see

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figure 2), and feature 2 would be easily conceived from grade vent valves (GVV) (283, 287) and a fill limit venting valve (FLVV) (285) that open and close conduits (271, 273, 275) connected to a vapor recovery line (231) disposed between the fuel tank (220) and the fuel filler pipe (211) in D1 (see paragraphs [0035]-[0036] and figure 2). In addition, feature 3 would be easily conceived from applying the method of D2 which determines the leakage by measuring the pressure before and after closing the valve (see paragraph [0031], claim 1, and figures 1-2) to the fuel system of D1 which includes the grade vent valves (GVV) (283, 287) and the fill limit venting valve (FLVV) (285) that open and close conduits (271, 273, 275) connected to the vapor recovery line (231) disposed between the fuel tank (220) and the fuel filler pipe (211) (see paragraphs [0035]-[0036] and figure 2). Accordingly, claim 19 would have been obvious over D1 in view of D2. Therefore, claim 19 does not involve an inventive step under PCT Article 33(3).

The additional feature of claim 20, concerning the step of performing a fourth pressure test that measures a pressure in the fuel tank over a time subsequent to closing the recirculation line valve; and determining a location of the leak based on comparing the third pressure test and the fourth pressure test, would be easily conceived from applying the method of D2 which determines the leakage by measuring the pressure before and after closing the valve (see paragraph [0031], claim 1, and figures 1-2) to the fuel system of D1 which includes the grade vent valves (GVV) (283, 287) and the fill limit venting valve (FLVV) (285) that open and close conduits (271, 273, 275) connected to the vapor recovery line (231) disposed between the fuel tank (220) and the fuel filler pipe (211) (see paragraphs [0035]-[0036] and figure 2). Accordingly, claim 20 would have been obvious over D1 in view of D2. Therefore, claim 20 does not involve an inventive step under PCT Article 33(3).

2. Industrial Applicability

Claims 1-20 have industrial applicability under PCT Article 33(4).