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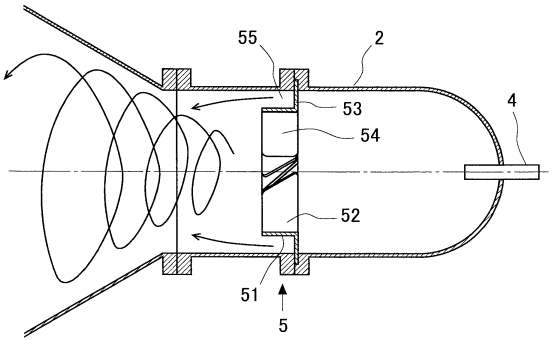
(54) EXHAUST PURIFICATION DEVICE FOR INTERNAL COMBUSTION ENGINE

(57) An object is to suppress any deviation of an addition agent to be supplied into an exhaust gas discharged from an internal combustion engine so that the addition agent is dispersed more uniformly. For this purpose, there is provided an exhaust gas purification apparatus for an internal combustion engine, comprising an exhaust gas purification catalyst which is provided for an exhaust gas passage of the internal combustion engine; a supply unit which supplies an addition agent to the exhaust gas purification catalyst; and a dispersing unit (5) which is provided between the exhaust gas purification catalyst and the supply unit and which disperses the addition agent; wherein the dispersing unit (5) includes a first gas flow forming portion (54) and a second gas flow forming portion (55); and the first gas flow forming portion (54) and the second gas flow forming portion (55) are formed so that a first gas flow having passed through the first gas flow forming portion (54) and a second gas flow having passed through the second gas flow forming portion (54) interfere with each other.

[FIG. 3]



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Description

TECHNICAL FIELD

[0001] The present invention relates to an exhaust gas purification apparatus for an internal combustion engine.

BACKGROUND ART

[0002] A technique is known in relation to an SCR system provided with a selective catalytic reduction NOx catalyst and an injection valve for injecting an aqueous urea solution (urea-water solution), wherein a disperser is provided between the selective catalytic reduction NOx catalyst and the injection valve in order to disperse the aqueous urea solution (see, for example, Patent Document 1). The exhaust gas and the aqueous urea solution are allowed to swirl by means of the disperser. Therefore, the mixing of the aqueous urea solution and the exhaust gas and the vaporization are facilitated.

[0003] Another technique is known, wherein the exhaust gas is allowed to flow through only an outer circumferential side of a disperser (see, for example, Patent Document 2). In this technique, a central portion of the disperser has a protruding shape directed to the downstream side in the flow direction of the exhaust gas, and the central portion is closed so that the exhaust gas does not flow therethrough.

[0004] Still another technique is known, wherein a space is provided between a disperser and an exhaust tube (see, for example, Patent Document 3).

[0005] In the meantime, when the flow direction of the exhaust gas is changed by the disperser, it is feared that the reducing agent, which is contained in the exhaust gas, may be directed to the wall surface of the exhaust gas passage. For example, when the exhaust gas is allowed to swirl by the disperser, the aqueous urea solution, which is contained in the exhaust gas, is deviated or one-sided in the vicinity of the wall surface of the exhaust tube on account of the centrifugal force in some cases. If the aqueous urea solution adheres to the wall surface of the exhaust tube, it is feared that any deposit or precipitate originating from urea may be accumulated or piled up on the wall surface of the exhaust tube. Further, the aqueous urea solution, which arrives at the selective catalytic reduction NOx catalyst, is decreased by the amount of adhesion to the wall surface of the exhaust tube. Therefore, it is feared that the purification rate of NOx may be lowered on account of the shortage of the aqueous urea solution in the selective catalytic reduction NOx catalyst.

PRECEDING TECHNICAL DOCUMENTS

Patent Documents:

[0006]

Patent Document 1: JP2008-274941A;
Patent Document 2: JP2008-144644A;
Patent Document 3: JP2008-280999A.

SUMMARY OF THE INVENTION

Task to Be Solved by the Invention:

[0007] An object of the present invention is to suppress any deviation of an addition agent to be supplied into an exhaust gas discharged from an internal combustion engine so that the addition agent is dispersed more uniformly. Solution for the Task:

[0008] In order to achieve the object described above, according to the present invention, there is provided an exhaust gas purification apparatus for an internal combustion engine, comprising:

an exhaust gas purification catalyst which is provided for an exhaust gas passage of the internal combustion engine;
a supply unit which is provided for the exhaust gas passage at a position upstream from the exhaust gas purification catalyst and which supplies an addition agent to the exhaust gas purification catalyst; and
a dispersing unit which is provided between the exhaust gas purification catalyst and the supply unit and which disperses the addition agent, wherein:
the dispersing unit includes a first gas flow forming portion and a second gas flow forming portion; and
the first gas flow forming portion and the second gas flow forming portion are formed so that a first gas flow having passed through the first gas flow forming portion and a second gas flow having passed through the second gas flow forming portion interfere with each other.

[0009] In this construction, when the addition agent is supplied from the supply unit, the addition agent flows into the dispersing unit. In the dispersing unit, for example, it is also appropriate that the flow direction of the exhaust gas is changed and/or the disturbance of the exhaust gas is strengthened. The first gas flow having passed through the first gas flow forming portion and the second gas flow having passed through the second gas flow forming portion interfere with each other on the downstream side from the dispersing unit. In this way, the both gas flows interfere with each other, and thus the deviation of the addition agent is decreased as compared with a case in which it is assumed that each of the first gas flow and the second gas flow flows singly. Accordingly, it is possible to suppress the addition agent from being deviated or one-sided in the vicinity of the wall surface of the exhaust gas passage.

[0010] In the present invention, it is also preferable that the first gas flow forming portion is provided at a central portion of the dispersing unit, and the second gas flow

forming portion is provided outside the central portion independently from the first gas flow forming portion.

[0011] The addition agent may be supplied so that the addition agent passes through only the first gas flow forming portion, or the addition agent may be supplied so that the addition agent passes through the first gas flow forming portion and the second gas flow forming portion. That is, the addition agent may be supplied so that the addition agent is contained in at least the first gas flow. The first gas flow forming portion is provided on the central axis side of the exhaust gas passage, and the second gas flow forming portion is provided on the side of the wall surface of the exhaust gas passage as compared with the first gas flow forming portion. The second gas flow forming portion may be a space disposed between the first gas flow forming portion and the wall surface of the exhaust gas passage. The flow direction of the exhaust gas is changed in the dispersing unit, and thus the swirling flow, which swirls, for example, about the center of the central axis of the exhaust gas passage, is generated. The swirling flow may be generated in only the first gas flow forming portion. The disturbance of the exhaust gas may be strengthened by changing the flow direction of the exhaust gas in the dispersing unit.

[0012] The second gas flow forming portion is provided outside the first gas flow forming portion, and thus the second gas flow is formed around the first gas flow. Further, the first gas flow having passed through the first gas flow forming portion and the second gas flow having passed through the second gas flow forming portion interfere with each other. Thus, the second gas flow pushes and returns the first gas flow toward the central axis. Accordingly, it is possible to suppress the first gas flow from being directed to the wall surface of the exhaust gas passage. Therefore, it is possible to suppress the addition agent from being deviated or one-sided in the vicinity of the wall surface of the exhaust gas passage.

[0013] In the present invention, it is also preferable that a passage for the exhaust gas, which is formed in the first gas flow forming portion, has a cross-sectional area which is larger than a cross-sectional area of a passage for the exhaust gas which is formed in the second gas flow forming portion.

[0014] Accordingly, the resistance of the exhaust gas is increased in the first gas flow forming portion as compared with the second gas flow forming portion. Therefore, the velocity of the second gas flow is faster than the velocity of the first gas flow. Accordingly, the first gas flow is pushed and returned by the second gas flow toward the central axis of the exhaust gas passage from the side of the wall surface of the exhaust gas passage. Therefore, it is possible to further suppress the first gas flow from being directed to the wall surface of the exhaust gas passage. Accordingly, it is possible to further suppress the addition agent from being deviated in the vicinity of the wall surface of the exhaust gas passage.

[0015] In the present invention, it is also preferable that the second gas flow forming portion is formed so that a flow direction of the exhaust gas allowed to pass through the second gas flow forming portion is a direction which is directed toward a central axis of the exhaust gas passage or parallel to a wall surface of the exhaust gas passage.

[0016] That is, the second gas flow is prohibited from being directed to the wall surface of the exhaust gas passage, and thus the first gas flow can be pushed and returned by the second gas flow in the direction directed to the central axis of the exhaust gas passage. Therefore, it is possible to suppress the first gas flow from being directed to the wall surface of the exhaust gas passage. Accordingly, it is possible to further suppress the addition agent from being deviated in the vicinity of the wall surface of the exhaust gas passage.

EFFECT OF THE INVENTION

[0017] According to the present invention, it is possible to suppress any deviation of the addition agent to be supplied into the exhaust gas discharged from the internal combustion engine so that the addition agent is dispersed more uniformly.

BRIEF DESCRIPTION OF THE DRAWINGS

[0018]

Fig. 1 shows a schematic arrangement of an exhaust gas purification apparatus for an internal combustion engine according to an embodiment.

Fig. 2 shows a disperser as viewed from the upstream side in the flow direction of the exhaust gas.

Fig. 3 shows a sectional view as obtained when the disperser is sectioned in parallel to the flow direction of the exhaust gas.

MODE FOR CARRYING OUT THE INVENTION

[0019] A specified embodiment of the exhaust gas purification apparatus for the internal combustion engine according to the present invention will be explained below on the basis of the drawings.

First Embodiment

[0020] Fig. 1 shows a schematic arrangement of an exhaust gas purification apparatus for an internal combustion engine according to an embodiment of the present invention. The internal combustion engine 1 shown in Fig. 1 may be either a diesel engine or a gasoline engine.

[0021] An exhaust gas passage 2 is connected to the internal combustion engine 1. An exhaust gas purification catalyst 3 (hereinafter simply referred to as "catalyst 3") is provided at an intermediate position of the exhaust gas passage 2. The catalyst 3 is such a catalyst that the temperature is raided, the exhaust gas is purified, or the pu-

rification ability is restored by supplying an addition agent. As for the catalyst 3, it is possible to exemplify, for example, an absorption reduction type NOx catalyst, a selective catalytic reduction NOx catalyst, a three way catalyst, an oxidation catalyst, and a hydrolysis catalyst. The catalyst 3 may be a catalyst having an oxidation function. Further, a particulate filter, which collects the particulate matter, may be provided, and the particulate filter may be a carrier for the catalyst 3. The catalyst 3 may be arranged upstream from the particulate filter.

[0022] An injection valve 4, which injects the addition agent into the exhaust gas, is provided for the exhaust gas passage 2 at a position disposed on the upstream side from the catalyst 3. The addition agent can be, for example, a reducing agent or an oxidizing agent. For example, fuel, aqueous urea solution, or ammonia can be used for the addition agent. What is used for the addition agent is determined depending on the type of the catalyst 3. In this embodiment, the injection valve 4 corresponds to the supply unit according to the present invention.

[0023] A disperser 5, which disperses the addition agent into the exhaust gas, is provided for the exhaust gas passage at a position disposed downstream from the injection valve 4 and upstream from the catalyst 3. In this embodiment, the disperser 5 corresponds to the dispersing unit according to the present invention.

[0024] In this context, Fig. 2 shows the disperser 5 as viewed from the upstream side in the flow direction of the exhaust gas. Fig. 3 shows a sectional view as obtained when the disperser 5 is sectioned in parallel to the flow direction of the exhaust gas.

[0025] The disperser 5 is provided with a cylinder portion 51 which is formed so that the outer diameter is smaller than the inner diameter of the exhaust gas passage 2 and the hollow cylindrical shape coaxial with the central axis of the exhaust gas passage 2 is provided. A plurality of plates 52 having the same shape extend from the inner circumferential surface of the cylinder portion 51 toward the central axis. The plurality of plates 52 are arranged radially at equal angles about the center of the central axis of the cylinder portion 51. The central axes of the respective plates 52, which extend from the inner circumferential surface of the cylinder portion 51 to arrive at the forward ends of the plates 52, are perpendicular to the central axis direction of the cylinder portion 51. The length, which ranges from the inner circumferential surface of the cylinder portion 51 to the forward end of the plate 52, is smaller than the radius of the cylinder portion 51, and the respective plates 52 are provided so that they are not brought in contact with each other. Each of the plates 52 is inclined by a predetermined angle with respect to the central axis of the cylinder portion 51. Further, a gap is provided between the plate 52 and the plate 52 so that the exhaust gas can flow. The plates 52 are arranged as described above, and thus the exhaust gas swirls about the center of the central axis of the cylinder portion 51.

[0026] For example, the shape, the number, and the angle of the plates 52 may be determined, for example, by an experiment. Any other member, which increases the disturbance in relation to the exhaust gas or which swirls the exhaust gas, may be provided in place of the plates 52. For example, one plate may be provided at a position disposed on the central axis side as compared with the cylinder portion 51. A plurality of holes may be provided through the plate.

[0027] A plurality of fixing portions 53, which connect the outer wall of the cylinder portion 51 and the inner wall of the exhaust gas passage 2 and which fix the cylinder portion 51 in the exhaust gas passage 2, are provided outside the cylinder portion 51. A space, through which the exhaust gas can flow, is provided between the cylinder portion 51 and the exhaust gas passage 2.

[0028] In the disperser 5 constructed as described above, the exhaust gas flows inside the cylinder portion 51 and outside the cylinder portion 51 respectively. In this embodiment, the inner side, which is disposed inside the cylinder portion 51, is referred to as "first gas flow forming portion 54", and the outer side, which is disposed outside the cylinder portion 51, is referred to as "second gas flow forming portion 55". Further, the gas flow, which passes through the first gas flow forming portion 54, is referred to as "first gas flow", and the gas flow, which passes through the second gas flow forming portion 55, is referred to as "second gas flow".

[0029] When the exhaust gas passes through the first gas flow forming portion 54, then the flow direction of the exhaust gas is changed by the plurality of plates 52, and the exhaust gas swirls about the center of the central axis of the exhaust gas passage 2. Accordingly, when the addition agent is supplied toward the first gas flow forming portion 54, then the addition agent and the exhaust gas swirl, and thus the addition agent is dispersed in the first gas flow. In this context, if it is assumed that the second gas flow is absent, it is feared that the addition agent contained in the first gas flow may be deviated by the centrifugal force on the side of the wall surface of the exhaust gas passage 2.

[0030] In relation thereto, the first gas flow forming portion 54 and the second gas flow forming portion 55 are formed so that passage for the exhaust gas, which is formed in the first gas flow forming portion 54, has the cross-sectional area that is larger than the cross-sectional area of the passage for the exhaust gas which is formed in the second gas flow forming portion 55. Accordingly, the resistance of the exhaust gas is large in the first gas flow forming portion 54 as compared with the second gas flow forming portion 55. That is, the first gas flow forming portion 54 and the second gas flow forming portion 55 are formed so that the resistance, which is brought about when the exhaust gas passes through the first gas flow forming portion 54, is larger than the resistance which is brought about when the exhaust gas passes through the second gas flow forming portion 55. Therefore, the velocity of the second gas flow is faster than the velocity of

the first gas flow. Accordingly, the first gas flow is pushed and returned by the second gas flow from the side of the wall surface of the exhaust gas passage 2 to the side of the central axis of the exhaust gas passage 2. Therefore, it is possible to suppress the addition agent from being deviated on the side of the wall surface of the exhaust gas passage 2. The optimum shapes of the first gas flow forming portion 54 and the second gas flow forming portion 55 can be determined, for example, by an experiment.

[0031] Further, the second gas flow forming portion 55 is formed so that the flow direction of the exhaust gas allowed to pass through the second gas flow forming portion 55 is separated from the wall surface of the exhaust gas passage 2 or parallel thereto. That is, the second gas flow is prohibited from being directed to the wall surface of the exhaust gas passage 2. For example, the resistance, which is brought about when the exhaust gas passes through the first gas flow forming portion 54, is made larger than the resistance which is brought about when the exhaust gas passes through the second gas flow forming portion 55, and thus the second gas flow advances in the central axis direction of the exhaust gas passage 2. Accordingly, it is possible to suppress the first gas flow from being directed to the wall surface of the exhaust gas passage 2.

[0032] In this way, the first gas flow and the second gas flow interfere with each other on the downstream side from the disperser 5. Accordingly, it is possible to suppress the addition agent from being deviated or one-sided in the vicinity of the wall surface of the exhaust gas passage 2. Further, the addition agent can be dispersed in a short distance, and hence it is possible to shorten the distance between the disperser 5 and the catalyst 3. Therefore, it is easy to install the disperser 5 as compared with the conventional technique. Further, an appropriate amount of the addition agent can be also supplied to the vicinity of the central axis of the catalyst 3, because it is possible to suppress the addition agent from being deviated or one-sided in the vicinity of the wall surface of the exhaust gas passage 2. Accordingly, it is possible to improve the purification performance for purifying the exhaust gas.

PARTS LIST

[0033] 1: internal combustion engine, 2: exhaust gas passage, 3: exhaust gas purification catalyst, 4: injection valve, 5: disperser, 51: cylinder portion, 52: plate, 53: fixing portion, 54: first gas flow forming portion, 55: second gas flow forming portion.

Claims

1. An exhaust gas purification apparatus for an internal combustion engine, comprising:

   an exhaust gas purification catalyst which is provided for an exhaust gas passage of the internal combustion engine;

   a supply unit which is provided for the exhaust gas passage at a position upstream from the exhaust gas purification catalyst and which supplies an addition agent to the exhaust gas purification catalyst; and

   a dispersing unit which is provided between the exhaust gas purification catalyst and the supply unit and which disperses the addition agent, wherein:

   the dispersing unit includes a first gas flow forming portion and a second gas flow forming portion; and

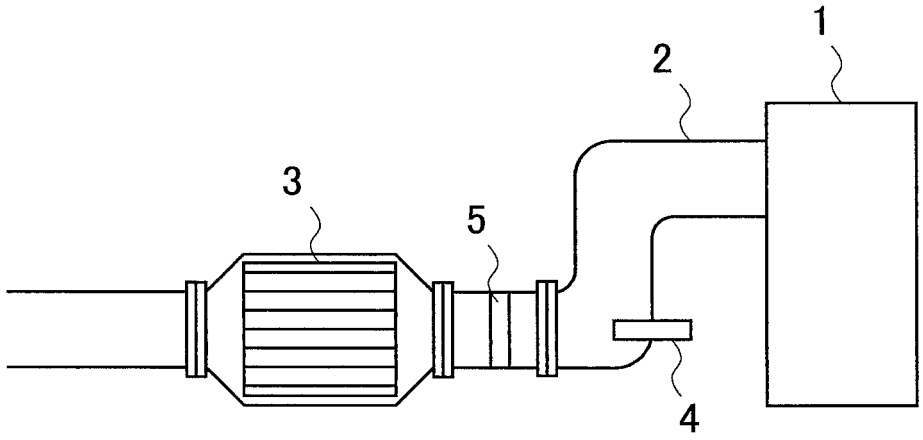
   the first gas flow forming portion and the second gas flow forming portion are formed so that a first gas flow having passed through the first gas flow forming portion and a second gas flow having passed through the second gas flow forming portion interfere with each other.

2. The exhaust gas purification apparatus for the internal combustion engine according to claim 1, wherein the first gas flow forming portion is provided at a central portion of the dispersing unit, and the second gas flow forming portion is provided outside the central portion independently from the first gas flow forming portion.

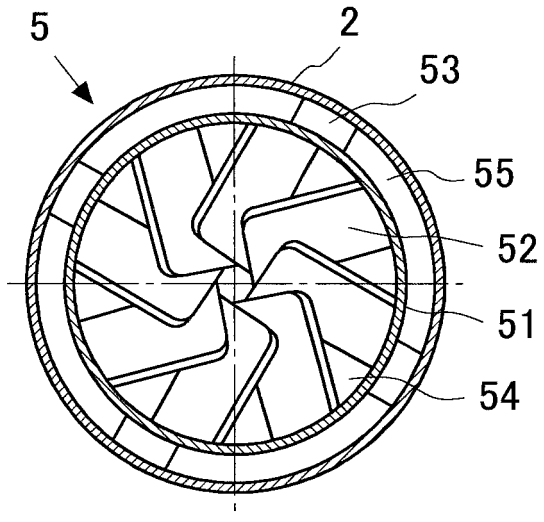
3. The exhaust gas purification apparatus for the internal combustion engine according to claim 1 or 2, wherein a passage for the exhaust gas, which is formed in the first gas flow forming portion, has a cross-sectional area which is larger than a cross-sectional area of a passage for the exhaust gas which is formed in the second gas flow forming portion.

4. The exhaust gas purification apparatus for the internal combustion engine according to any one of claims 1 to 3, wherein the second gas flow forming portion is formed so that a flow direction of the exhaust gas allowed to pass through the second gas flow forming portion is a direction which is directed toward a central axis of the exhaust gas passage or parallel to a wall surface of the exhaust gas passage.

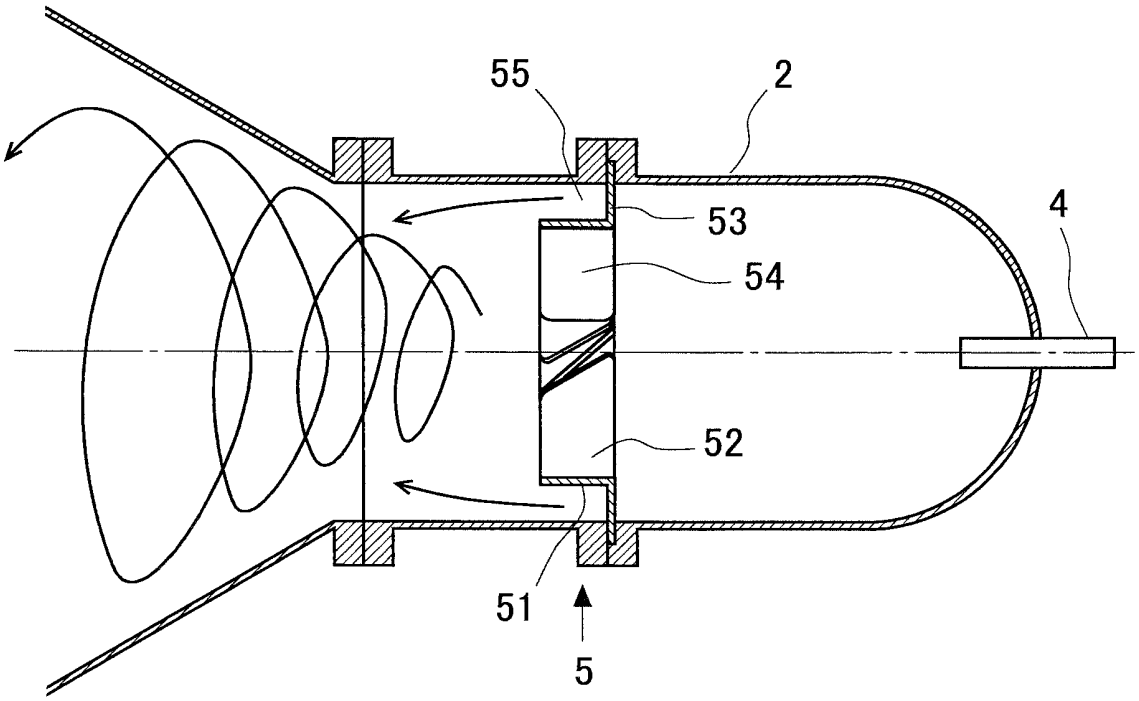
[FIG. 1]



[FIG. 2]



[FIG. 3]



INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2011/062704

A. CLASSIFICATION OF SUBJECT MATTER
F01N3/08(2006.01)i, *F01N3/24*(2006.01)i, *F01N3/36*(2006.01)i

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)
F01N3/08, F01N3/24, F01N3/36

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Jitsuyo Shinan Koho	1922-1996	Jitsuyo Shinan Toroku Koho	1996-2011
Kokai Jitsuyo Shinan Koho	1971-2011	Toroku Jitsuyo Shinan Koho	1994-2011

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	JP 2008-128093 A (Mitsubishi Fuso Truck and Bus Corp.), 05 June 2008 (05.06.2008), paragraphs [0002] to [0036]; fig. 1 to 4 (Family: none)	1-4
X	JP 2008-280882 A (Toyota Motor Corp.), 20 November 2008 (20.11.2008), paragraphs [0005] to [0037]; fig. 1 to 12 & WO 2008/139942 A1	1-4
X	JP 2009-144614 A (Tokyo Roki Co., Ltd.), 02 July 2009 (02.07.2009), paragraphs [0005] to [0013]; fig. 1 to 3 (Family: none)	1-4

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

☐ See patent family annex.

* Special categories of cited documents:
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"&" document member of the same patent family

Date of the actual completion of the international search 17 August, 2011 (17.08.11)	Date of mailing of the international search report 30 August, 2011 (30.08.11)
Name and mailing address of the ISA/ Japanese Patent Office Facsimile No.	Authorized officer Telephone No.

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REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP 2008274941 A **[0006]**
- JP 2008144644 A **[0006]**
- JP 2008280999 A **[0006]**