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(54) STOP CONTROL DEVICE FOR ENGINE

(57) A stop control device for an engine suppresses vibration of the engine occurring when the engine is stopped and prevents collision of the valve of the intake throttle valve at the same time. The stop control device includes an intake throttle valve 13 provided to be openable and closeable inside an intake passage 11 of an engine 1 and capable of closing the inside of the intake passage 11, and control means 14 for controlling the intake throttle valve 13. The control means 14 controls the intake throttle valve 13 so that the intake throttle valve 13 is rapidly closed to a predetermined opening degree near the completely closed state when the engine 1 is stopped, and controls, when the intake throttle valve 13 becomes the predetermined opening degree near the completely closed state, the intake throttle valve 13 so that the intake throttle valve 13 is closed to the completely closed state slower than when the intake throttle valve is closed to the predetermined opening degree near the completely closed state, so as to prevent the occurrence of an excessive impact when the intake throttle valve 13 closes the inside of the intake passage 11.

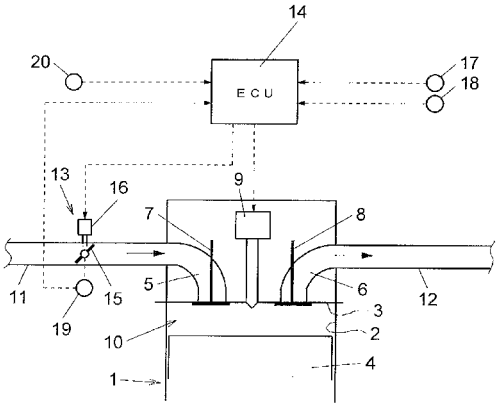

FIG. 1

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Description

TECHNICAL FIELD

[0001] The present invention relates to a stop control device for an engine that closes the inside of an intake passage of the engine by an intake throttle valve when the engine is stopped in order to suppress vibration of the engine when the engine is stopped.

BACKGROUND ART

[0002] A technique is known for suppressing vibration of an engine when the engine is stopped by closing the inside of an intake passage of the engine by an intake throttle valve when the engine is stopped (completely closing the intake throttle valve) and cutting off the intake air supplied to the engine (see, for example, Patent Documents 1 and 2). When the intake throttle valve is completely closed, the intake air supplied to the engine can be quickly cut off and combustion can be rapidly reduced by rapidly closing the intake throttle valve till it is completely closed. Therefore, such an approach is effective for suppressing vibration of the engine occurring when the engine is stopped. However, when the intake throttle valve is completely closed, where the intake throttle valve is rapidly closed to a completely closed state, parts of the intake throttle valve can collide. For this reason, the intake throttle valve is closed using a filter (see FIG. 4).

[0003] Patent Document 1: Japanese Patent Application Laid-open No. H11-13494
Patent Document 2: Japanese Patent Application Laid-open No. 2006-258078

DISCLOSURE OF THE INVENTION

PROBLEMS TO BE SOLVED BY THE INVENTION

[0004] The filter used to close completely the intake throttle valve has the following tradeoff characteristic. Thus, where the filter used when the intake throttle valve is completely closed is strong (the intake throttle valve is closed gradually), the time required to close completely the intake throttle valve increases and vibration of the engine occurring when the engine is stopped is affected. Where the filter is weak (the intake throttle valve is closed rapidly), the parts of intake throttle valve can collide. For this reason, it is desirable both to inhibit vibration of the engine when the engine is stopped and to prevent parts of the intake throttle valve from colliding with each other.

[0005] Accordingly, it is an object of the present invention to provide a stop control device for an engine that can inhibit vibration of the engine when the engine is stopped and also prevent parts of the intake throttle valve from colliding.

MEANS FOR SOLVING THE PROBLEMS

[0006] In order to attain the above-described object, the present invention provides a stop control device for an engine including an intake throttle valve provided to be openable and closeable inside an intake passage of the engine and capable of closing the inside of the intake passage, and control means for controlling the intake throttle valve. The control means controls the intake throttle valve so that the intake throttle valve is rapidly closed to a predetermined opening degree near a completely closed state when the engine is stopped, and controls, when the intake throttle valve becomes the predetermined opening degree near the completely closed state, the intake throttle valve so that the intake throttle valve is closed to the completely closed state slower than when the intake throttle valve is closed to the predetermined opening degree near the completely closed state, so as to prevent the occurrence of an excessive impact when the intake throttle valve closes the inside of the intake passage.

[0007] The stop control device for an engine may further include opening degree detection means for detecting an opening degree of the intake throttle valve. The control means executes control such that the intake throttle valve is slowly closed from the predetermined opening degree near the completely closed state to the completely closed state after the intake throttle valve has been confirmed, by the opening degree detection means, to be stable at the predetermined opening degree near the completely closed state.

EFFECTS OF THE INVENTION

[0008] The present invention demonstrates an excellent effect of being capable of suppressing vibration of the engine when the engine is stopped and preventing parts of the intake throttle valve from colliding.

BRIEF DESCRIPTION OF THE DRAWING

[0009] FIG. 1 is a schematic diagram illustrating a stop control device for an engine according to an embodiment of the present invention.

FIG. 2 is a flowchart of processing implemented by an ECU.
FIG. 3 shows the operation of the intake throttle valve according to an embodiment of the invention.
FIG. 4 shows the operation of the intake throttle valve according to the conventional example.

EXPLANATION OF REFERENCE NUMERALS

[0010]

[0010] 1 engine (diesel engine)
11 intake passage (intake tube)

13 intake throttle valve
14 ECU (control means)
19 valve opening degree sensor (opening degree detection means)

BEST MODE FOR CARRYING OUT THE INVENTION

[0011] One embodiment of the present invention will be described below with reference to the appended drawings.

[0012] As shown in FIG. 1, an engine (in the present embodiment, a diesel engine) 1 is constituted by a cylinder 2, a cylinder head 3, a piston 4, an intake port 5, an exhaust port 6, an intake valve 7, an exhaust valve 8, and an injector (fuel injection device) 9. A combustion chamber 10 is formed by a space bounded by the cylinder 2, cylinder head 3, and piston 4, and fuel is directly injected from the injector 9 into the combustion chamber 10. An intake passage (intake tube) 11 is connected to the intake port 5, and an exhaust passage (exhaust tube) 12 is connected to the exhaust port 6.

[0013] A stop control device according to the present embodiment is constituted by an intake throttle valve 13 that is provided to be openable and closeable inside the intake passage 11 and capable of closing the inside of the intake passage 11 and a control means (referred to hereinbelow as ECU) 14 for controlling the intake throttle valve 13.

[0014] The intake throttle valve 13 according to the present embodiment is a butterfly valve. The intake throttle valve 13 has a valve (valve element) 15 installed inside the intake passage 11 so as to be capable of closing the inside of the intake passage 11 and an actuator (motor or the like) 16 driving the valve 15.

[0015] The ECU 14 reads the operation state of the engine 1 from various sensors and controls the intake throttle valve 13 on the basis of the operation state of the engine 1 so that the intake throttle valve 13 assumes a predetermined value. The aforementioned sensors include an engine speed sensor 17 that detects the speed of the engine 1, an accelerator depression degree sensor 18 that detects an accelerator depression degree, and an opening degree detection means (valve opening degree sensor) 19 that detects the opening degree of the intake throttle valve 13 (valve 15). The detection values of these sensors are inputted to the ECU 14.

[0016] In the usual operation mode of the engine 1, the ECU 14 controls the intake throttle valve 13 to a predetermined opening degree such as to obtain an intake air amount corresponding to the operation state of the engine 1.

[0017] Further, when the engine is stopped, the ECU 14 controls the intake throttle valve 13 so that the valve 15 closes the inside of the intake passage 11 with the object of suppressing the vibration of the engine 1 when the engine is stopped.

[0018] The operation of the intake throttle valve 13 when the engine is stopped will be explained below with reference to FIG. 2 and FIG. 3.

[0019] As shown in FIG. 3, where an ignition key 20 is turned from ON to OFF (timing t0, S1 in FIG. 2), the ECU 14 stops fuel injection to the combustion chamber 10 performed by the injector 9 and also controls the intake throttle valve 13 so that the intake throttle valve 13 (valve 15) rapidly assumes a predetermined opening degree (opening degree o1) near the completely closed state and rapidly closes the intake throttle valve 13, without using a filter, to the predetermined opening degree o1 near the completely closed state (timing t1, S2 in FIG. 2).

[0020] Then, the ECU 14 checks whether or not the valve 15 has stabilized at the predetermined opening degree o1 near the completely closed state (whether or not the intake throttle valve 13 became the predetermined opening degree o1 near the completely closed state) (S3 in FIG. 2).

[0021] In the present embodiment, the ECU 14 determines that the valve 15 has stabilized at the predetermined opening degree o1 near the completely closed state (the intake throttle valve 13 became the predetermined opening degree o1 near the completely closed state) when it is determined on the basis of the opening degree of the intake throttle valve 13 detected by the valve opening degree sensor 19 that there is no overshoot or undershoot of the valve 15 and the intake throttle valve 13 (valve 15) has converged to the predetermined opening degree o1 near the completely closed state.

[0022] Once the ECU 14 has determined that the valve 15 has stabilized at the predetermined opening degree o1 near the completely closed state (the intake throttle valve 13 became the predetermined opening degree o1 near the completely closed state), the control unit controls the intake throttle valve 13 so that the intake throttle valve 13 (valve 15) is slowly completely closed at a substantially constant speed and completely closes the intake throttle valve 13 using a filter at a rate less than that at which the intake throttle valve is closed to the predetermined opening degree o1 near the completely closed state (timing t2, S4 in FIG. 2).

[0023] In this case, the predetermined opening degree o1 near the completely closed state is set to an opening degree such that the valve 15 that repeatedly overshoots and undershoots does not collide with an inner wall surface of the intake passage 11 or a stopper inside the intake passage 11.

[0024] In the present embodiment, by rapidly closing the intake throttle valve 13 to the predetermined opening degree o1 near the completely closed state when the engine is stopped, it is possible to cut off rapidly the air inside the intake passage 11, reduce rapidly the combustion inside the combustion chamber 10 and quickly decrease the speed of the engine (see FIG. 3). As a result, vibration of the engine 1 when the engine is stopped can be effectively suppressed.

[0025] In the present embodiment, by temporarily stopping the intake throttle valve 13 at the predetermined opening degree o1 near the completely closed state and

then gradually completely closing the intake throttle valve 13 from the predetermined opening degree o1 near the completely closed state at a rate lower than that at which the valve is closed to the predetermined opening degree o1 near the completely closed state, rather than completely closing the intake throttle valve 13 in one cycle at a high speed, it is possible to avoid the collision of the valve 15 of the intake throttle valve 13.

[0026] As described above, in accordance with the present embodiment, when the engine is stopped, the intake throttle valve 13 is controlled so that the intake throttle valve 13 is closed rapidly to the predetermined opening degree o1 near the completely closed state, and when the intake throttle valve 13 becomes the predetermined opening degree o1 near the completely closed state, the intake throttle valve 13 is controlled so that the intake throttle valve 13 is completely closed at a rate lower than that at which the valve is closed to the predetermined opening degree o1 near the completely closed state, so as to prevent the occurrence of an excessive impact when the intake throttle valve 13 closes the inside of the intake passage 11. As a result, it is possible to inhibit the vibration of the engine 1 when the engine is stopped and also prevent the collision of the valve 15 of the intake throttle valve 13.

[0027] The preferred embodiment of the present invention is explained above, but the present invention is not limited to the above-described embodiment and can be implemented in a variety of other embodiments.

Claims

1. A stop control device for an engine, comprising:

an intake throttle valve provided to be openable and closeable inside an intake passage of the engine and capable of closing the inside of the intake passage; and
control means for controlling the intake throttle valve, wherein
the control means controls the intake throttle valve so that the intake throttle valve is rapidly closed to a predetermined opening degree near a completely closed state when the engine is stopped, and controls, when the intake throttle valve becomes the predetermined opening degree near the completely closed state, the intake throttle valve so that the intake throttle valve is closed to the completely closed state slower than when the intake throttle valve is closed to the predetermined opening degree near the completely closed state, so as to prevent the occurrence of an excessive impact when the intake throttle valve closes the inside of the intake passage.

2. The stop control valve for an engine according to claim 1, further comprising:

opening degree detection means for detecting an opening degree of the intake throttle valve, wherein
the control means executes control such that the intake throttle valve is slowly closed from the predetermined opening degree near the completely closed state to the completely closed state after the intake throttle valve has been confirmed, by the opening degree detection means, to be stable at the predetermined opening degree near the completely closed state.

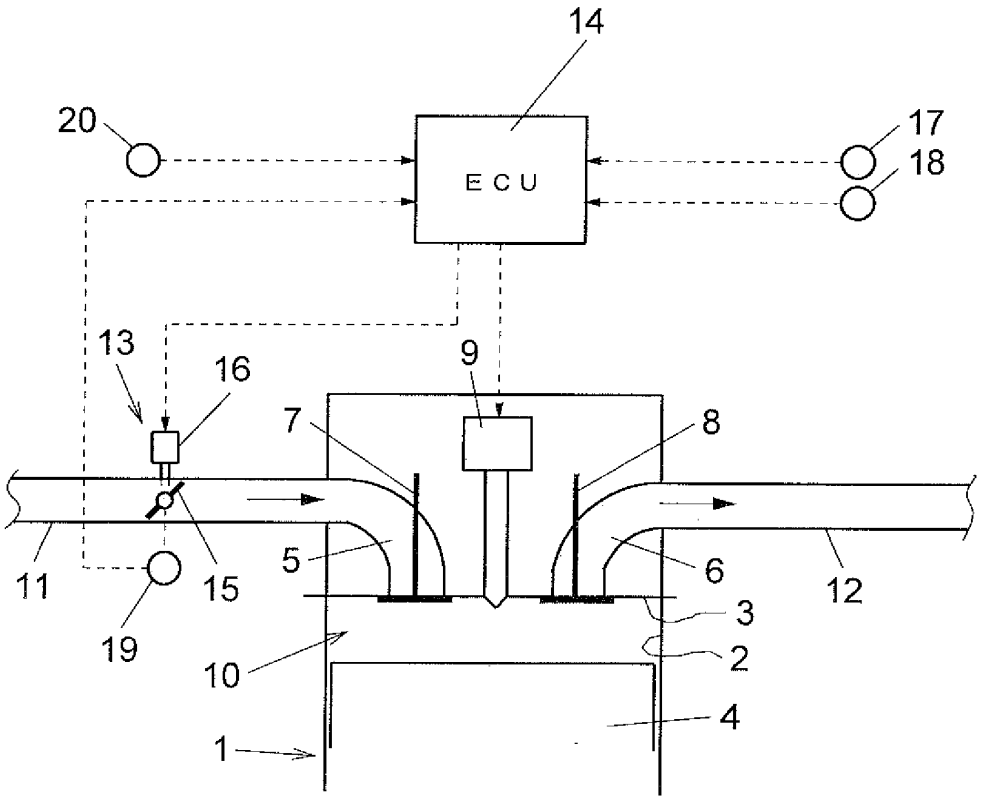


FIG. 1

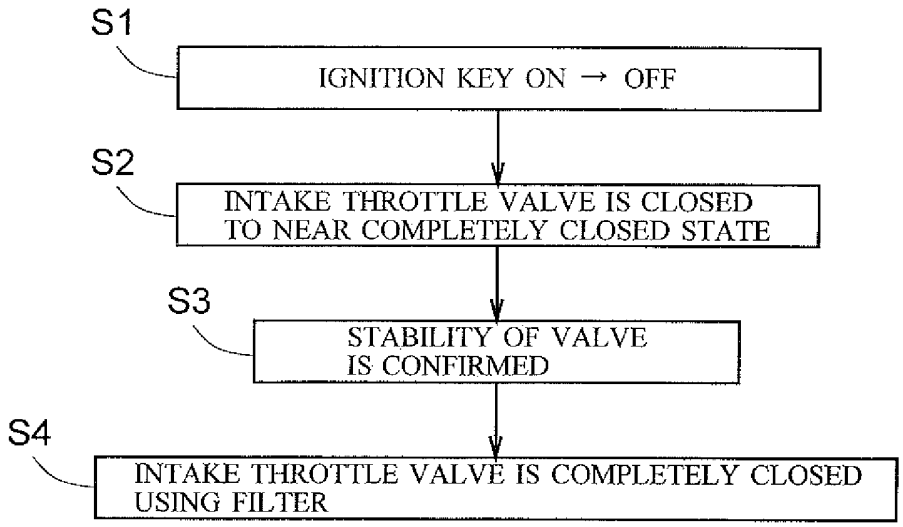
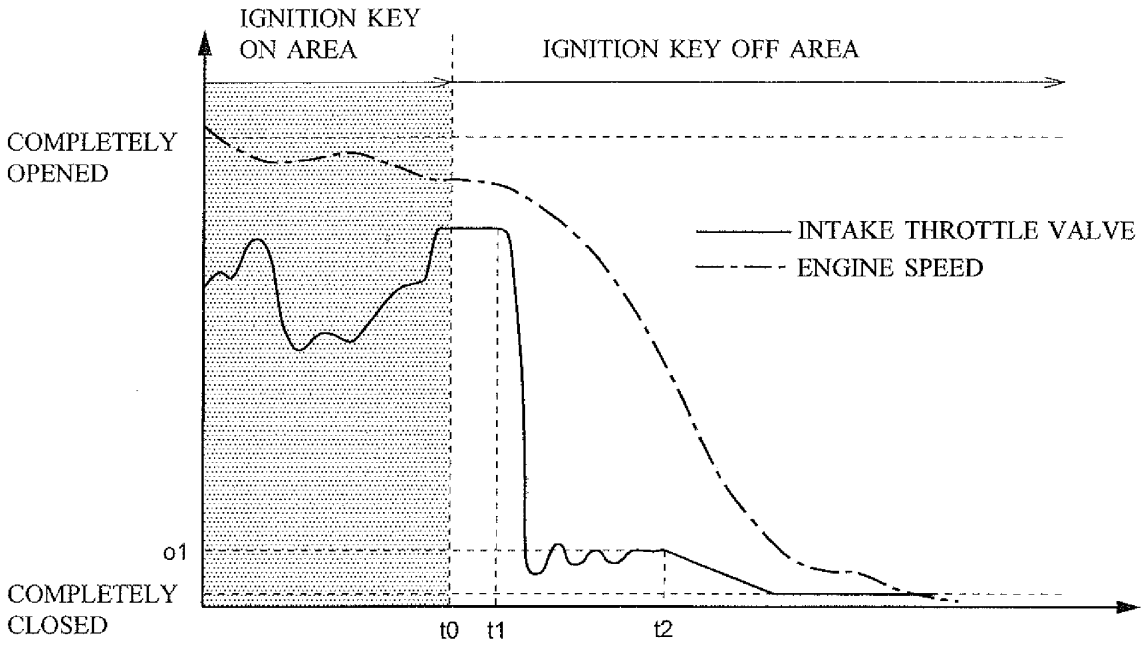

S1
IGNITION KEY ON → OFF
S2
INTAKE THROTTLE VALVE IS CLOSED TO NEAR COMPLETELY CLOSED STATE
S3
STABILITY OF VALVE IS CONFIRMED
S4
INTAKE THROTTLE VALVE IS COMPLETELY CLOSED USING FILTER

FIG. 2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ENGINE SPEED
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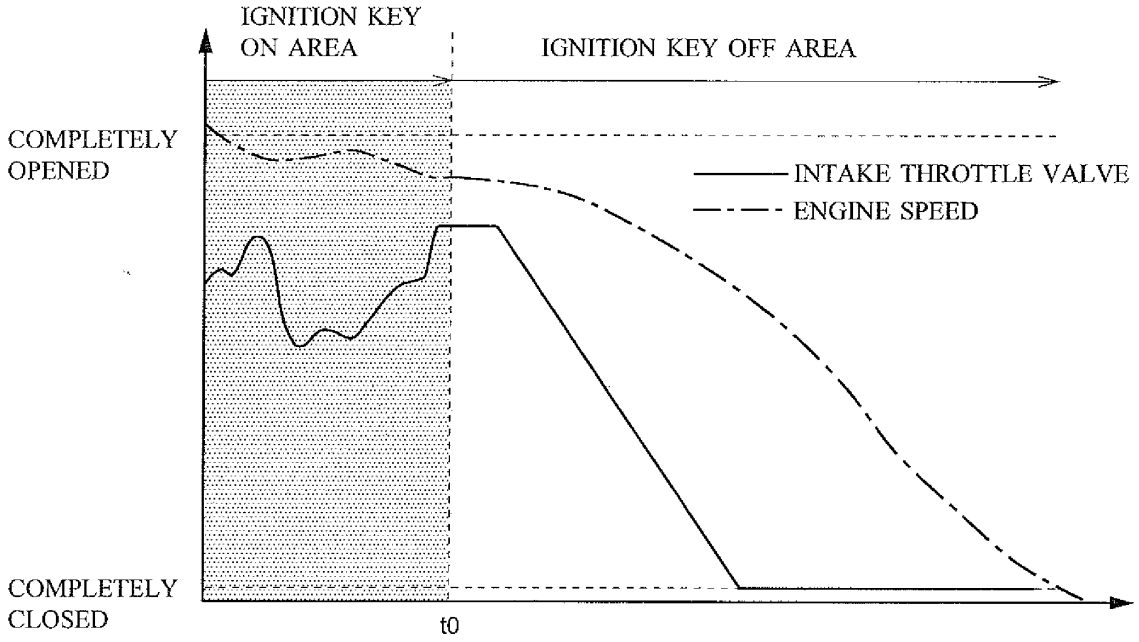
FIG. 3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INTAKE THROTTLE VALVE
ENGINE SPEED
COMPLETELY
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t0

FIG. 4

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2009/052672

A. CLASSIFICATION OF SUBJECT MATTER
F02D17/00(2006.01)i, *F02D9/02*(2006.01)i, *F02D11/10*(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)
F02D17/00, F02D9/02, F02D11/10

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 1996-2009
Kokai Jitsuyo Shinan Koho 1971-2009 Toroku Jitsuyo Shinan Koho 1994-2009

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.
Y	JP 2000-045827 A (Toyota Motor Corp.), 15 February, 2000 (15.02.00), Abstract; Par. Nos. [0009] to [0010], [0063] (Family: none)	1-2
Y	JP 10-089095 A (Toyota Motor Corp.), 07 April, 1998 (07.04.98), Par. No. [0097]; Figs. 3, 11 (Family: none)	1-2
Y	JP 08-303285 A (Hitachi, Ltd.), 19 November, 1996 (19.11.96), Par. No. [0103]; Figs. 10, 11 (Family: none)	2

☒ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

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Date of the actual completion of the international search	Date of mailing of the international search report
11 March, 2009 (11.03.09)	24 March, 2009 (24.03.09)
Name and mailing address of the ISA/ Japanese Patent Office Facsimile No.	Authorized officer Telephone No.

Form PCT/ISA/210 (second sheet) (April 2007)

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2009/052672

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	JP 06-074084 A (Robert Bosch GmbH), 15 March, 1994 (15.03.94), Par. Nos. [0011] to [0013]; Fig. 1 & GB 2267581 A & DE 4218541 A & MX 9303364 A	2

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REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP H1113494 B **[0003]**
- JP 2006258078 A **[0003]**