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(71) Applicant: **DELPHI INTERNATIONAL OPERATIONS LUXEMBOURG S.À R.L.** [LU/LU]; Avenue de Luxembourg, L-4940 Bascharage (LU).

(72) Inventors: **HESLOP, Garon**; Laurel House, Dickley Lane, Lenham Kent ME17 2DD (GB). **JAMES, Gary**; 8 Blythe Road, Maidstone Kent ME15 7TR (GB).

(74) Agent: **NEILL, Andrew**; Delphi Diesel Systems, Courteney Road, Gillingham Kent ME8 0RU (GB).

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(54) Title: EXHAUST GAS RECIRCULATION TESTING METHOD

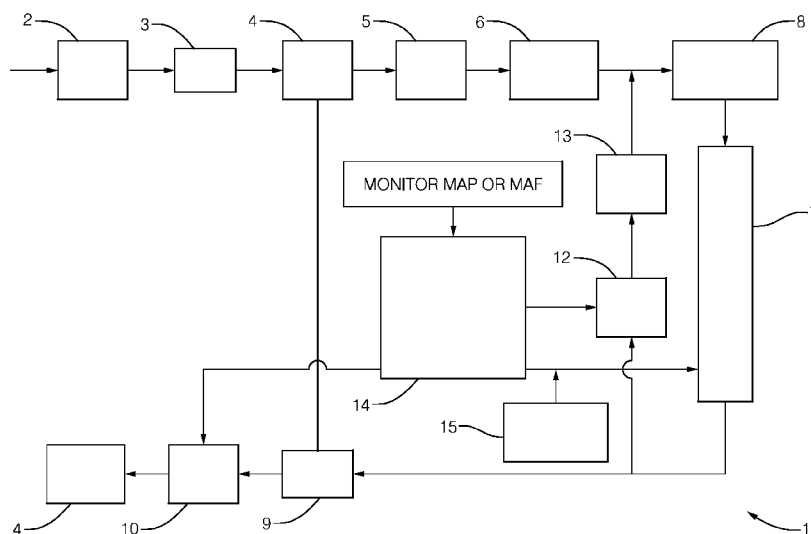


FIG. 1

(57) Abstract: A method of monitoring the functionality of an exhaust gas recirculation system/valve in a vehicle engine system which includes an exhaust brake comprising: applying said exhaust brake; monitoring the functionality of the exhaust gas recirculation system whilst the exhaust brake is applied.

Exhaust Gas Recirculation Testing Method

Field of the Invention

- 5 This invention relates to exhaust gas recirculation systems, and in particular to determining the functionality thereof.

Background of the Invention

In internal combustion engines, exhaust gas recirculation (EGR) is a technique used to reduce nitrogen oxide (NO_x) emissions in both petrol and diesel engines.

- 10 In EGR systems a portion of an engine's exhaust gas is recycled back to the engine cylinders. Because NO_x forms primarily when a mixture of nitrogen and oxygen is subjected to high temperature, the lower combustion chamber temperatures caused by EGR reduces the amount of NO_x the combustion generates

- 15 An error which may occur may be that the EGR valve may become blocked. There are two known methods for checking the functionality of the high pressure recycled exhaust flow. The methods involve monitoring the mass air flow (MAF) or boost pressure by way of sensors in response to perturbation of the EGR valve position. On commercial vehicles, which are not usually fitted with an intake
- 20 throttles, such a check is only possible during a limited set of speed and load operating points, when there is sufficient differential pressure across the EGR valve, for EGR to be expected to flow. Typically an engine ECU schedules such checks when certain conditions (operating points) are achieved. A problem is that

such a check cannot be carried out on demand, but is dependent on these required operating conditions to be present.

It is also difficult to flow EGR when the turbine is operating very efficiently,
5 providing lots of boost, e.g. at high load.

It is an object of the invention to provide a method whereby the EGR check can be performed over a greater time window.

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Summary of the Invention

In one aspect of the invention is provided a method of monitoring the functionality of an exhaust gas recirculation system/valve in a vehicle engine system which
15 includes an exhaust brake comprising: applying said exhaust brake; monitoring the functionality of the exhaust gas recirculation system whilst the exhaust brake is applied .

The method preferably is implemented when the vehicle is in a load off condition
20 or is in neutral gear. The method can be performed in gear, and during which fuelling to the engine can be adjusted to compensate for the reduction in torque as a result of applying the exhaust brake.

Brief description of the figures

25

The invention will now be described by way of example and with reference to the following figures of which:

Figure 1 shows a schematic diagram of an engine system to which methodology of examples can be applied.

Detailed Description

Figure 1 shows an engine system 1 to which examples of the invention may be applied. The figure shows schematically the flow components of an engine system 1 which employs EGR. Specifically it shows the layout of the components of a typical turbo-charged diesel engine, with the strategy for the invention located in an engine control unit.

Air flow into the system is filtered by air filter 2 and may pass through a mass air flow (MAF) sensor 3 if fitted. A compressor 4 of a turbocharged system compresses the air which subsequently passes through an intercooler 5 and a throttle valve 6, before entering the engine 7. A boost (MAP) pressure sensor 8 senses the pressure at the engine intake. Exhaust gases exiting the engine power the turbo 9 and an exhaust brake unit 10 before being passed through exhaust after-treatment units 11. In order to provide EGR, an EGR valve 12 and EGR cooler 13 are provided as shown. An ECU control various engine systems including the exhaust brake and EGR valve, and may also monitor MAP and MAF.

An exhaust brake is a means of slowing an engine by closing off the exhaust path from the engine, causing the exhaust gases to be compressed in the exhaust manifold, and in the cylinder. Since the exhaust is being compressed, and there is

no fuel being applied, the engine works backwards, slowing down the vehicle. The amount of negative torque generated is usually directly proportional to the back pressure of the engine. Known applications of the exhaust brake on commercial vehicles, are to slow the vehicle when in gear on tip-out, and to warm the engine faster.

An Engine Control Unit is shown which in aspects of the invention provides the necessary control of the methodologies.

In a simple example of the invention, instead of just passively waiting for the driver to encounter the required operating conditions for the EGR flow to be checked, the exhaust brake which is usually fitted to most trucks, is applied in under certain conditions, where there is no detrimental effect – such as power off conditions, braking conditions (for example when said air brake is usually used) or when the vehicle is in neutral gear and/or any condition when the air brake is conventionally used. Application of the exhaust brake increases the engine back pressure, thus creating conditions conducive for EGR flow and thereby allowing known methods for evaluating the EGR flow to be executed, when they might otherwise not have been able to run.

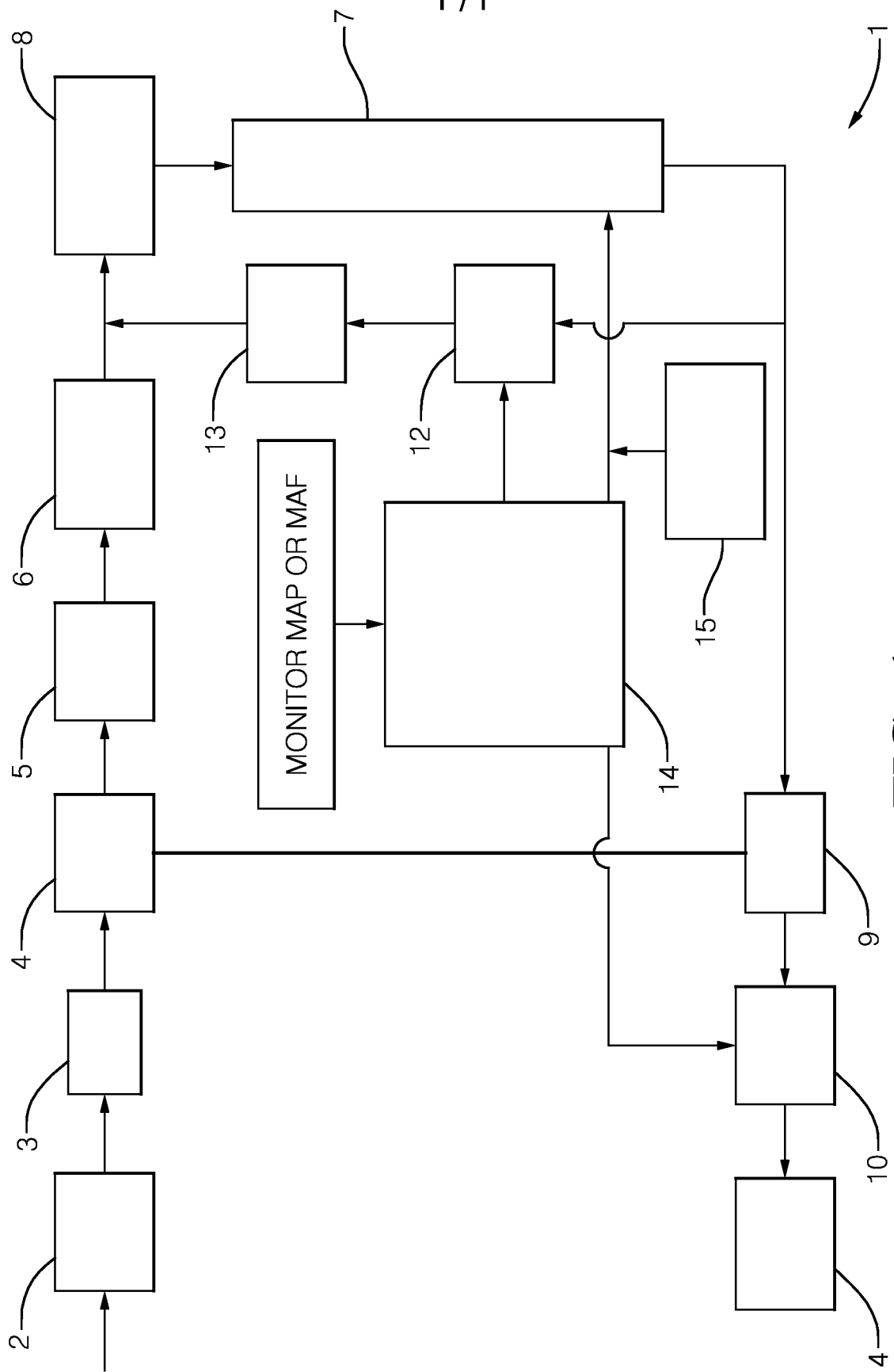
The situations when the invention will be of benefit, are those that leave the vehicle with acceptable driveability and performance and do not compromise safety. Certainly the window of opportunity will be increased in neutral gear and probably elsewhere too. Known applications of the exhaust brake on commercial vehicles, are to slow the vehicle when in gear on tip-out, and to warm the engine faster.

- Alternatively, in other embodiments, an EGR flow check may be forced by applying the exhaust brake even when, for example, the vehicle is in gear. Such methods may be implemented such that (e.g. the torque controller/ECU) the fuelling is adjusted appropriately (by providing more fuel) to compensate for the
5 braking action. So in this manner the method a check can be forced to occur while the vehicle was in gear. This would be a small fuel penalty, but only a very short period is needed (e.g. 1 or 2 seconds) to perform the check. The optional functional block of fuel adjustment is shown in the figure as 15.
- 10 The invention allows the range of operating conditions where the EGR flow check can be carried out, to be expanded.

The invention is applicable to engine systems without turbochargers.

Claims

1. A method of monitoring the functionality of an exhaust gas recirculation system/valve in a vehicle engine system which includes an exhaust brake
5 comprising, in one mode of operation:
i) applying said exhaust brake;
ii) monitoring the functionality of the exhaust gas recirculation system only whilst the exhaust brake is applied.
- 10 2. A method as claimed in claim 1 wherein said step i) and ii) are performed when the vehicle is in a load off condition or is in neutral gear.
3. A method as claimed in claim 1 wherein steps i) and ii) are performed in gear, and during which fuelling to the engine is adjusted to compensate for the
15 reduction in torque as a result of applying the exhaust brake.
4. A system for monitoring the functionality of an exhaust gas recirculation system/valve in a vehicle engine system which includes an exhaust brake comprising:
20 i) means to apply said exhaust brake;
ii) means to monitor the functionality of the exhaust gas recirculation system only whilst the exhaust brake is applied.



INTERNATIONAL SEARCH REPORT

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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) F02D F02M		
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 practicable, search terms used) EPO-Internal, WPI Data		
C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	JP 2010 127243 A (TOYOTA MOTOR CORP) 10 June 2010 (2010-06-10)	1,2,4
Y	abstract; figures 1,2 paragraphs [0025] - [0035] -----	3
Y	JP H11 117798 A (TOYOTA MOTOR CORP) 27 April 1999 (1999-04-27) abstract -----	3
☐ Further documents are listed in the continuation of Box C. ☒ See patent family annex.		
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"A" document defining the general state of the art which is not considered to be of particular relevance "E" earlier application or patent 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 "&" document member of the same patent family		
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Information on patent family members

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