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(54) Title: A METHOD AND A DEVICE FOR AN INTERNAL COMBUSTION ENGINE EXHAUST GAS RECIRCULATION SYSTEM AND A VEHICLE

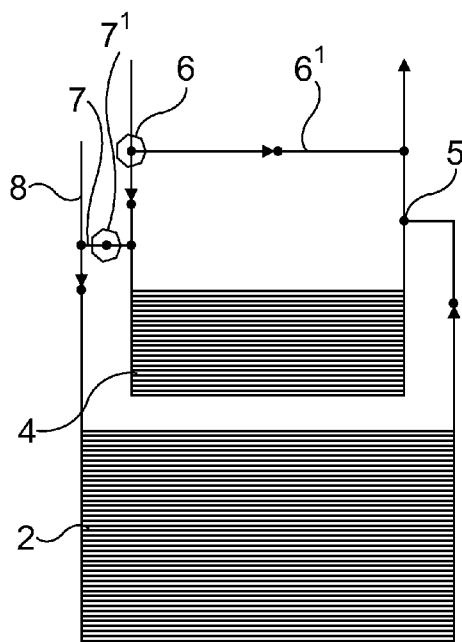


Fig.2

(57) Abstract: The present invention relates to a method for an internal charge engine, eg a diesel engine, having an exhaust gas recirculation, EGR, system comprising an exhaust gas cooler (4) and a charge air cooler (4) for providing a mixture of cooled exhaust gas and cooled fresh charge air to be charged to the engine for the charge in the engine, and, preferably, a by-pass valve (6) provided upstream of the exhaust gas cooler for providing a mixture of uncooled exhaust gases and cooled fresh charge air upon request. The method is especially characterized in the steps of - providing a connection (7) between a duct (8) for uncooled fresh charge air and the exhaust gas cooler (4) upstream of the exhaust gas cooler and, preferably, downstream of the by-pass valve (6), when provided, and - conducting uncooled fresh charge air through the exhaust gas cooler for blowing out exhaust gas condensate of the exhaust gas cooler. The invention also relates to a device and a vehicle.

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ML, MR, NE, SN, TD, TG).

— *with international search report (Art. 21(3))*

A METHOD AND A DEVICE FOR AN INTERNAL COMBUSTION ENGINE EXHAUST GAS RECIRCULATION SYSTEM AND A VEHICLE

BACKGROUND

5

Technical field

The present invention relates to a method according to the introductory portion of the attached claim 1.

10

The present invention also relates to a device according to the introductory portion of the attached claim 7.

The present invention further relates to a vehicle according to the attached claim 13.

15

Prior art

Technique of this kind is previously known and is used to meet, inter alia, emission levels according to Euro 5 specifications.

20

This kind of technique is, however, associated with certain problems.

Thus, during eg wintertime, when temperatures below 0°C appear, an air cooled EGR cooler is not used due to condensation of the exhaust gases.

25

A first problem is that when the EGR cooler is not used this may result in an uneven temperature distribution over a radiator, which is positioned behind the EGR / charge air coolers. Such an uneven temperature distribution will result in stresses in the radiator matrix and may then cause cracks and rupture.

30

A second problem is that under certain operation conditions, condensate may gather in the EGR cooler and freeze at temperatures below 0°C. When the condensate freezes it expands, which may cause cracks to appear in the EGR cooler tubes.

5 A third problem is that at very low temperatures and low engine loads, it might happen that the charge air to be charged will condensate and freeze in the charge air cooler. Under such operation conditions a lower cooling capacity of the charge air cooler is necessary. Today this is solved by covering the cooling package of the cooler to a certain extent by a separate curtain.

10

An object of the present invention is to provide solutions to the above identified problems associated with the previously known technique described.

SUMMARY OF THE INVENTION

15

This and other objects are obtained by means of a method, a device and a vehicle having the features specified in the attached claims 1, 7 and 13, respectively.

20

Further advantages are obtained by what is specified in the respective dependent claims.

BRIEF DESCRIPTION OF THE DRAWINGS

25

A better understanding of the present invention will be had upon considering the following detailed description when read in conjunction with the attached drawings in which like details are designated with the same designations throughout the several different views and in which:

- Fig. 1 schematically shows one embodiment of a part of a prior art EGR system,

- Fig. 2 schematically shows a part of a first embodiment of an EGR system according to one aspect of the present invention,
- Fig. 3 schematically shows a part of a second embodiment of an EGR system according to another aspect of the present invention,
- Fig. 4 shows process steps according to the present invention and
- Fig. 5 schematically shows a control configuration for the EGR system for obtaining a pre-determined system configuration by valve setting based upon values of pre-determined parameters..

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

Thus, according to what is previously known, Fig. 1, fresh air, indicated by an arrow 1, for charging to the engine combustion is compressed and then cooled in a charge air cooler 2 and further passed on to be mixed with exhaust gases, indicated by an arrow 3 of an EGR system exhaust gas duct 3', the exhaust gases being fed to and cooled in an EGR cooler 4, a mixing point downstream of said coolers being designated by 5. The mixture is further fed into the engine to take part in the combustion in the engine.

Preferably and as previously known, a by-pass valve 6 is arranged upstream of the exhaust gas cooler, so that uncooled exhaust gases via a by-pass duct 6' can be mixed with the cooled charge air, for eg winter and low temperature operation. Under such circumstances the exhaust gas cooler is by-passed, so that no condensate will appear in the exhaust gas cooler 4.

According to a first aspect of the present invention, as shown in Fig. 2, a connection 7 between an uncooled charge air duct 8 and the exhaust gas cooler preferably

downstream of the exhaust gas by-pass valve 6, when present, and upstream of the exhaust gas cooler is provided for, preferably controlled, conduct of uncooled charge air through the exhaust gas cooler, said connection preferably comprising a, preferably one way, valve 7' for controlling the flow through the connection.

5 In this way the uncooled charge air will blow out the condensate of the EGR cooler and the EGR cooler will heat external fresh cooling air, which will provide a more even stress distribution over the radiator. Thus, in this way a solution to the first and second problem is provided.

10 According to a second aspect of the present invention, as shown in Fig. 3, the solution shown in Fig. 2 is provided with a valve arrangement 9 for cutting off the charge air flow in the duct 8 downstream of said connection 7, so that no flow through the charge air cooler will take place. All charge air will pass through the EGR cooler 4, which, preferably and normally, has less cooling capacity than the
15 charge air cooler 2 normally used, which will result in that the risk for freezing will decrease for the EGR cooler 4 and will be eliminated for the charge air cooler 2 normally used.

The method as well as the function of the device according to the present invention
20 should to an extensive and sufficient extent have been made clear from the description given above.

Steps of the method are presented in Fig.4.

25 Thus, a first step 401 corresponds to providing the connection 7 between an uncooled charge air duct 8 upstream of the exhaust gas cooler 4 according to the first aspect of the present invention. When step 401 is completed step 402 is performed.

Step 402 comprises conducting uncooled fresh charge air via the connection 7
30 through the exhaust gas cooler for blowing out exhaust gas condensate of the ex-

haust gas cooler. By means of a valve 7' the flow through the connection 7 may be controlled in an on/off manner to be provided whenever wanted or in a manner to provide a desired amount of uncooled charge air continuously for longer periods of time through the exhaust gas cooler.

5

Step 403 is an optional step and corresponds to cutting off the uncooled charge air flow upstream of the charge air cooler 2 and downstream of said connection 7 and conducting the uncooled charge air flow through the exhaust gas cooler 4, which preferably and normally has a less cooling capacity than the charge air cooler 2.

10

Step 404 is also an optional step and corresponds to the step, known per se, of providing the by-pass valve 6 and the by-pass duct 6' upstream of the exhaust gas cooler.

15

Step 401 and 402 provides a solution to the first and second problem discussed in the prior art portion of the description.

20

Step 403 provides a solution to the third problem discussed in the prior art portion of the description. Step 404 is a step, which is not necessary for solving the first, second and third problem but is a preferred step, which provides an increased flexibility to the overall system in the adaption to a wide range of climate and environmental circumstances.

25

The general advantages of the solutions according to the present invention are reduced risk for break-down and failure of all cooler components. Further, said solutions may be obtained at comparatively low cost and will require very limited space, requested cooler capacity etc.

30

Above the invention has been described in association with preferred embodiments and examples.

The principles of the solutions according to the present invention have been described herein in association with simple schematic figures. In practice a piping system fulfilling said principles may of course be configured in several different ways depending on the circumstances, space provision, requested cooler capacity etc.

Thus, of course further embodiments as well as minor changes and additions may be imagined without departing from the basic inventive idea.

Embodiments may, as mentioned, be provided wherein a by-pass valve 6 and a by-pass duct 6' are not present.

Further, embodiments may be provided wherein a valve arrangement 9 is not provided for cutting off the uncooled charge air flow through the charge air cooler 2, eg for use in areas where very low temperatures may not be expected.

Further, the valves V of the system valves 6, 7' and 9 may be manually operated but all or some of the valves V, Fig. 5, may be chosen to be arranged to be operated by operating means 501 arranged to be controlled by a control unit 502, which may be part of the overall control system, CPU, of the vehicle or a separate unit. In such embodiments a control unit is provided with information about out-door temperature, operational parameters, such as engine load etc, which are parameters normally provided by the vehicle control system sensors 503. Based upon such parameters a pre-determined setting of the valves of the system is arranged to be performed to obtain a pre-determined system configuration adapted to the parameter values at hand.

Thus, the invention should not be considered limited to the embodiments shown but may be varied within the scope of the appended claims.

CLAIMS

1. A method for an internal charge engine, eg a diesel engine, having an exhaust gas recirculation, EGR, system comprising an exhaust gas cooler and a charge air cooler for providing a mixture of cooled exhaust gas and cooled fresh charge air to be charged to the engine for the combustion in the engine, and, preferably, a by-pass valve provided upstream of the exhaust gas cooler for providing a mixture of uncooled exhaust gases and cooled fresh charge air upon request, **characterized in** the steps of

- providing a connection (7) between a duct (8) for uncooled fresh charge air and the exhaust gas cooler (4) upstream of the exhaust gas cooler and, preferably, downstream of the by-pass valve (6), when provided, and

- conducting uncooled fresh charge air through the exhaust gas cooler for blowing out exhaust gas condensate of the exhaust gas cooler.

2. A method according to claim 1, **characterized in** the step of

- controlling the flow of uncooled charge air through said connection (7) by means of a valve (7').

3. A method according to claim 2, **characterized in** the step of

- providing said valve (7') for controlling said flow as a one way valve.

4. A method according to claim 2 or 3, **characterized in** the step of

- cutting off the uncooled charge air flow upstream of the charge air cooler (2) and downstream of said connection (7) for conducting the uncooled charge air flow through the exhaust gas cooler (4).

5 5. A method according to claim 4, **characterized in** the step of providing the exhaust gas cooler with a lower cooling capacity than the charge air cooler.

6. A method according to anyone of claims 1 – 5, characterized in the step of

10 - providing operating means (501) and a control unit (502) for setting of chosen valves (V) of the EGR system and

- setting said valves for obtaining a pre-determined system configuration in response to the values of pre-determined parameters.

15

7. A device for an internal charge engine, eg a diesel engine, having an exhaust gas recirculation, EGR, system comprising an exhaust gas cooler and a charge air cooler for providing a mixture of cooled exhaust gas and cooled fresh charge air to be charged to the engine for the combustion in the engine and, preferably, a by-pass valve provided upstream of the exhaust gas cooler for providing a mixture of un-

20 cooled exhaust gas and cooled fresh charge air upon request, **characterized in a** connection (7) between a duct (8) for uncooled fresh charge air and the exhaust gas cooler (4) upstream of the exhaust gas cooler and, preferably, downstream of the by-pass valve (6), when provided.

25

8. A device according to claim 7, wherein a control valve (7') for controlling the flow through said connection is provided.

9. A device according to claim 8, wherein said control valve is a one way valve.

30

10. A device according to claim 8 or 9, wherein a valve arrangement (9) is provided for cutting off the uncooled charge air flow upstream of the charge air cooler (2) and downstream of said connection (7) for conducting the uncooled charge air flow through the exhaust gas cooler (4).

5

11. A device according to claim 10, wherein the exhaust gas cooler has a lower cooling capacity than the charge air cooler.

10

12. A device according to anyone of claims 7 – 11, wherein control means (501) are provided for setting of chosen valves (V) of the EGR system, a control unit (502) being provided for activating setting of said valves to obtain a pre-determined system configuration based upon values of pre-determined parameters.

15

13. A vehicle, eg a truck or a bus, characterized in that it is provided with a device according to anyone of claim 7 - 11.

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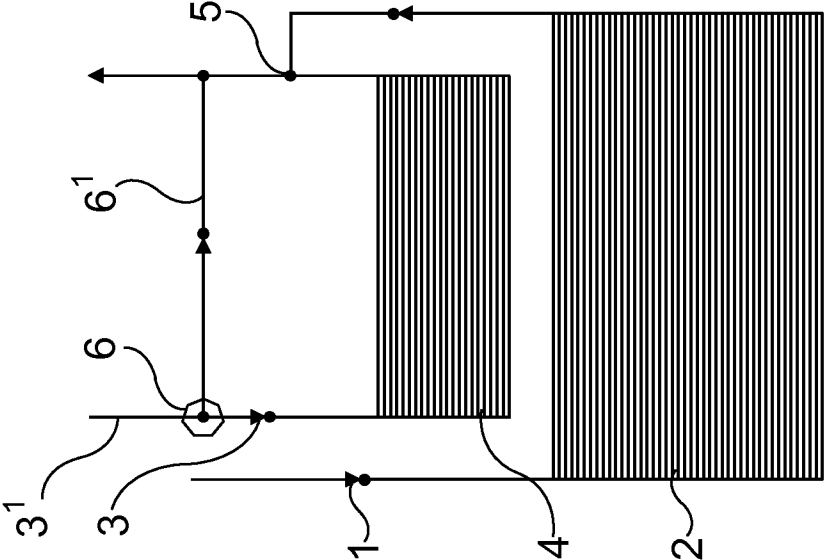


Fig.1

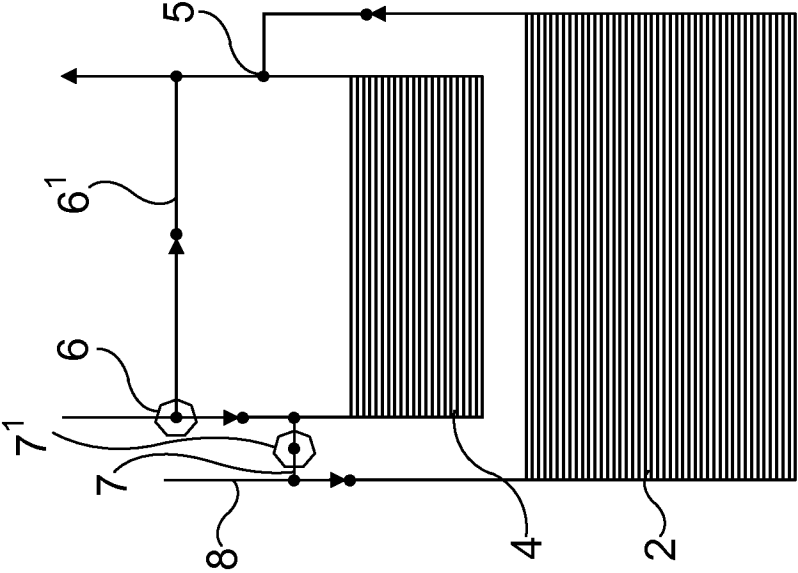


Fig.2

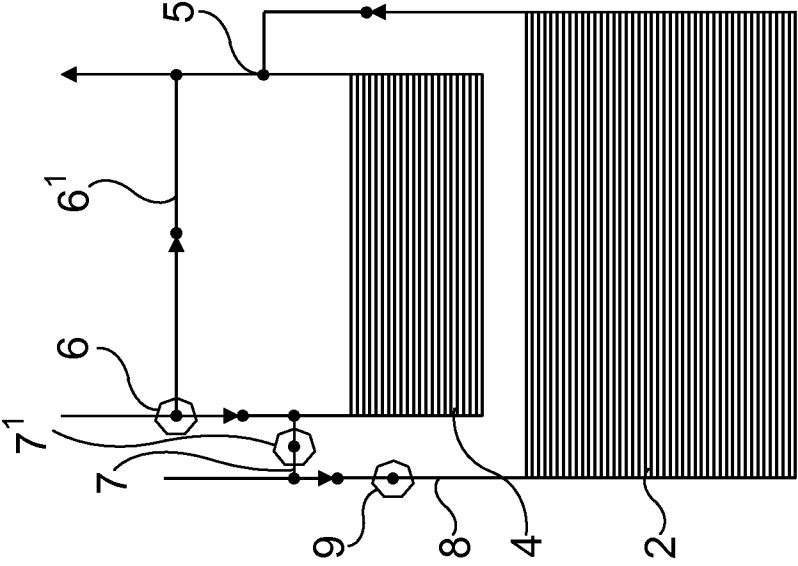


Fig.3

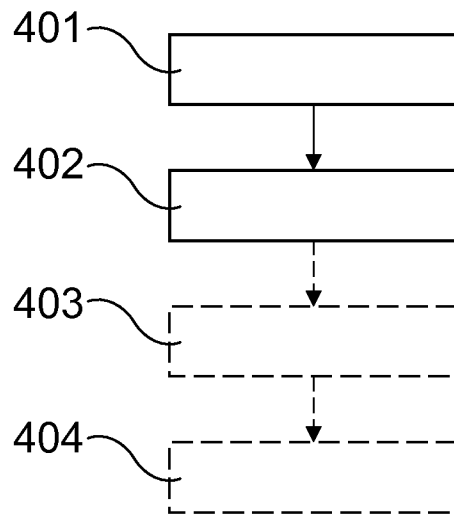


Fig. 4

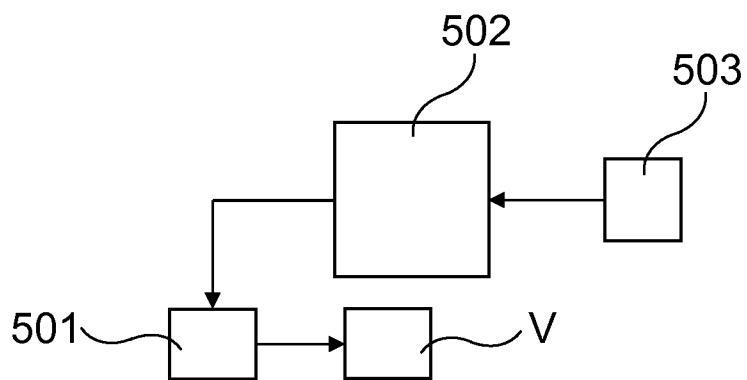


Fig. 5

INTERNATIONAL SEARCH REPORT

International application No.

PCT/SE2010/050261

A. CLASSIFICATION OF SUBJECT MATTER

IPC: see extra sheet

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)

IPC: F02M, F02B

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

SE,DK,FI,NO classes as above

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

EPO-INTERNAL, WPI DATA, PAJ

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 2007045768 A1 (INSTITUT FRANCSAIS DU PETROLE), 26 April 2007 (26.04.2007), page 6, line 22 - line 27; page 7, line 28 - page 8, line 14, figure 1, abstract --	1-13
X	WO 2007011299 A1 (SCANIA CV AB (PUBL)), 25 January 2007 (25.01.2007), page 2, line 11 - page 3, line 8, figures 1-5, abstract --	1-13
X	JP 11257161 A, NISSAN DIESEL MOTOR CO LTD, 1999-09-21; (abstract) Retrieved from: PAJ database; Original document: Figure 1 --	1-13

☒ 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

9 June 2010

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INTERNATIONAL SEARCH REPORT

International application No.

PCT/SE2010/050261

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

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Cited literature, if any, will be enclosed in paper form.

INTERNATIONAL SEARCH REPORT
Information on patent family members

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