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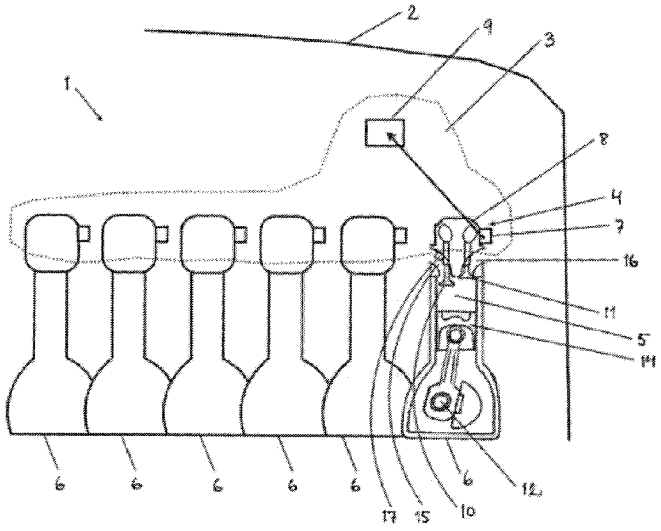


Fig. 1a

(57) Abstract: A method and a device to detect unwanted fue! supply, or a risk of unwanted fuel supply, to at least one cylinder in a combustion engine. The method comprises the steps - during at least a part of a working cycle of the cylinder, detecting the gas pressure in a combustion chamber of the cylinder; - comparing the detected gas pressure with expected values for the relevant operating condition of the engine; and - based on said comparison, determining whether there is unwanted fuel supply, or a risk of unwanted fuel supply. The detection of the gas pressure is carried out by detecting movements generated by changes in said gas pressure in a cylinder head belonging to said cylinder or in parts adjacent thereto in the engine.

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Method for detecting undesired supply of fuel in an internal combustion engine

FIELD OF THE INVENTION

The present invention relates to a method for detecting unwanted fuel supply, or a risk of unwanted fuel supply, to at least one cylinder in a combustion engine and a device for detecting unwanted fuel supply. The invention also relates to a computer program and a computer program product comprising computer program code for the implementation of a method according to the invention, and an electronic control device and a motor vehicle.

Unwanted fuel supply may occur in the form of fuel from an ordinary fuel supply system in the combustion engine, which fuel is supplied at the wrong time, or in the form of, for example, combustion gases originating from a crank house ventilation mechanism in the engine. Unwanted fuel may also be supplied to the cylinder as a result of too much engine oil being sucked into the cylinder's combustion chamber, via the column between the piston and the cylinder wall, which produces a so-called oil coating. Oil coating may, in addition to causing soot and coke in the combustion chamber, also lead to self-propelling of the engine, whereat the oil burns to such an extent that the engine may revolve and thus pull in even more oil. There is a risk of oil coating when the gas pressure in the cylinder's combustion chamber is low, such as in connection with a reduced flow through the combustion engine. This may occur if an inlet channel for supply of air or air- and fuel-mixture to the cylinder is clogged, or if the throttle valve that controls the inflow of air to

the inlet channel is kept closed for a long time, for example in order to avoid that a system for exhaust after treatment is cooled down by air flowing through it at dragging. The risk of oil coating increases even more at an increased pressure in the oil sump, containing the engine oil.

US 2011/0238283 describes a method to detect uncontrolled combustion in a cylinder of a combustion engine as a consequence of, for example, oil drops in the combustion chamber. According to the method, a pressure sensor fitted in the cylinder is used to detect a pressure in the cylinder, which is compared with a reference pressure. By comparing the pressure with a reference pressure, conclusions may be drawn about whether there is uncontrolled combustion.

One disadvantage of the above mentioned method is that it requires that a pressure sensor be fitted in the cylinders of the combustion engine. This is expensive and requires that holes be bored in the cylinder wall. Pressure sensors fitted inside the combustion chamber may also cause disruptions in the operation of the combustion engine.

SUMMARY OF THE INVENTION

The objective of the present invention is to provide a, in at least some aspect improved, manner of detecting unwanted fuel supply, or a risk of unwanted fuel supply, to one or more cylinders in a combustion engine.

This objective is achieved through the method and the device according to the enclosed claims. In one embodiment, a method

is achieved for detection of unwanted fuel supply, or a risk of unwanted fuel supply, to at least one cylinder in a combustion engine. The method comprises:

- during at least a part of a working cycle of the cylinder, detecting the gas pressure in a combustion chamber of the cylinder;
- comparing the detected gas pressure with expected values for the relevant operating condition of the engine; and
- based on said comparison, determining whether there is unwanted fuel supply, or a risk of unwanted fuel supply.

In the method, the detection of the gas pressure is carried out by detecting movements generated by said gas pressure change in a cylinder head belonging to said cylinder or in parts adjacent thereto in the engine.

With the innovative method it is thus possible to discover early on, whether the gas pressure in the cylinder is such that there is either unwanted fuel supply or a risk of unwanted fuel supply. Accordingly, it is possible to control the engine's operating conditions early on, so that the risk of coke and soot in the combustion chamber and the more serious risk of self-propelling is reduced. The innovative method also has the advantage that it may be carried out without any holes for pressure sensors having to be bored in the combustion chamber. In addition to a cost saving thus achieved, thanks to the invention disruptions that may be caused by t pressure sensors fitted in the cylinder chamber are also avoided. Preferably, the innovative method is used to detect unwanted fuel supply, or a risk of unwanted fuel supply, in the form of engine oil to the cylinder, but the method

may also be used to detect other unwanted fuel supply, in the form of, for example, combustion gases from the crank house or fuel from an ordinary fuel supply system, which is supplied at the wrong time or in the wrong amount.

The movements which may be detected with the innovative method, and which are generated by pressure changes in a combustion chamber, may for example be vibrations, noise, that is to say gas movements, and various types of shape changes, such as protrusions, in said cylinder head or in parts adjacent thereto in the engine.

According to one embodiment of the invention, movements in the form of vibrations are detected. It has been shown that the pressure changes that arise during the operation of the cylinder in the combustion chamber in turn give rise to vibrations in the cylinder head and in adjacent parts in the engine. By reading these vibrations, a measured value of the pressure changes in the combustion chamber is obtained in a reliable manner.

According to one embodiment of the invention, movements in the form of strains in screws of the engine are detected, such as screws in main bearings or in connecting rod bearings, and in cylinder head bolts. The appearance of such movements depends on pressure changes in the combustion chamber, and may for example be detected by applying strain-sensors on such screws.

According to one embodiment of the invention, movements in the form of strains in an engine block part or in a cylinder head of the

engine are detected, and according to another embodiment of the invention, movements in the form of strains in the injector- or glow plug fixings are detected. These embodiments provide additional possibilities of determining pressure changes in the combustion chamber.

According to one embodiment of the invention, the detection of the gas pressure is done by detecting movements with a frequency of ≤ 250 Hz, 0.5 Hz–250 Hz or 0.5 Hz–200 Hz. The movements detected are thus movements with a relatively low frequency, and the basic frequency of the variation of the gas pressure in the combustion chamber, which is the same as the combustion engine's engine speed, lies within these intervals. Typically, this may be 60 revolutions per minute (1 Hz) for a marine diesel engine and as high as 12 000 revolutions per minute (approximately 200 Hz) for an otto engine in a motorbike. By detecting movements within these frequency areas, information about the main variation of the gas pressure during the cylinder's working cycle may be extracted.

According to one embodiment of the invention, the step of detecting the gas pressure is carried out in such a manner that the gas pressure detected is the gas pressure during a working cycle of the cylinder, when no fuel is supplied to the latter via an ordinary fuel supply system in the combustion engine. In this embodiment, based on the gas pressure, it may be determined with great certainty whether combustion in the cylinder takes place at a point in time when no fuel should be available, which indicates the occurrence of self-propelling and therefore also unwanted fuel supply from a fuel source. The embodiment is

advantageous also in the case, when there is no unwanted combustion, since it may be determined in a simple manner whether the gas pressure is at a normal level during a working cycle without fuel supply.

According to one embodiment of the invention, the step of detecting the gas pressure is carried out in such a manner that the gas pressure detected is the gas pressure during at least one compression and/or expansion stroke of the cylinder. By detecting the gas pressure during the compression and/or expansion stroke, it may be determined whether there is combustion in the cylinder.

According to one embodiment of the invention, the method comprises the steps:

- comparing the detected gas pressure with at least one determined alarm criterion for the relevant operating condition of the engine; and
- provided that the alarm criterion is met, setting an alarm.

Based on the alarm, an error signal may be generated in the form of, for example, an electronic message, an audio and/or light signal, or alternatively some other measure may be carried out, such as a control of the engine's operating conditions.

According to one embodiment of the invention, a first alarm criterion is set so that it is met, if the gas pressure in the combustion chamber falls short of a value determined for the relevant operating condition of the engine. A low gas pressure indicates that there is a risk of unwanted fuel supply in the form

of engine oil from the oil sump, which may occur if there is a low gas pressure in the combustion chamber, and in particular if, at the same time, there are leaking gaskets or the pressure in the oil sump is elevated. A low gas pressure in the cylinder then means that more engine oil follows the cylinder's piston into the combustion chamber, where there is a risk that it may form soot or coke and, in the worst case, lead to self-propelling. With the method according to this embodiment, a risk of engine oil coating in the cylinder is thus discovered early on, and countermeasures may be taken early on.

According to another embodiment of the invention, the method comprises the step, based on said alarm, of controlling the gas pressure in the cylinder to a higher level. For example, a throttle valve controlling the inflow of air to an inlet channel to the cylinder may be opened, which increases the flow of air through the cylinder, and thus also the gas pressure in the combustion chamber. Through this step, the risk of unwanted fuel supply in the form of engine oil may be reduced at an early stage.

According to one embodiment of the invention, a second alarm criterion is set so that it is met, if there is combustion in the combustion chamber during a working cycle of the cylinder, whereat no fuel is supplied to the cylinder via an ordinary fuel supply system. This indicates that there is unwanted fuel supply to the system, and an investigation of the cause thereof may be initiated and the error may be corrected when an alarm is generated.

According to one embodiment of the invention, the second alarm criterion is set in such a manner that it is met, if the gas pressure in the combustion chamber during a compression and/or an expansion stroke of the cylinder exceeds a value determined for the relevant operating condition of the engine. This is a simple way of detecting whether there is combustion during a compression and/or expansion stroke, when there should be no combustion. Alternative ways of detecting whether there is combustion include comparing a gas pressure gradient during a compression and/or expansion stroke with a gradient determined for the relevant operating condition, since combustion in the cylinder gives rise to larger gradients compared to an expansion stroke when the engine is dragged, i.e. turned around by external forces without any combustion occurring.

According to one embodiment of the invention, the method comprises the step, based on said alarm, of activating an exhaust brake in the combustion engine. This reduces the risk of self-propelling. Preferably, at the same time the ordinary fuel supply to the combustion engine is constricted. Other measures, such as closure of valves, increased exhaust gas recirculation (EGR) etc. may also be taken to prevent self-propelling.

According to a second aspect of the invention, the above mentioned objective is achieved via a device adapted to detect unwanted fuel supply, or a risk of unwanted fuel supply, to at least one cylinder in a combustion engine, characterised in that it comprises at least one sensor element, adapted to be arranged separately from the cylinder's combustion chamber on a part of a cylinder head belonging to the cylinder or on adjacent parts of

the engine, and adapted to detect movements of said cylinder head or of adjacent parts in the engine generated by changes in said gas pressure, and in that it also comprises a device adapted, based on the detected movements, to determine the gas pressure and to compare this with expected values for the relevant operating condition of the engine, and based on the comparison to determine whether there is unwanted fuel supply. The function of such a device and the possibilities it offers is described in the discussion above of the innovative method. The placement of the sensor elements on a cylinder head belonging to the cylinder or on parts adjacent thereto in the engine also achieves the advantage that the signal from the sensor element becomes easier to process, than if the sensor element is placed, instead, on for example the combustion engine's engine block.

The invention also relates to a computer program, a computer program product, an electronic control device, and a motor vehicle which uses the above.

The invention is not limited to any specific type of combustion engine, but encompasses Otto engines as well as compression ignited engines, nor to any specific fuel, non-exhaustive examples of which may comprise fuel in the form of petrol, ethanol, diesel and gas. An ordinary fuel supply system in the vehicle may thus be for example a system, where an air- and fuel-mixture is supplied to the cylinder via an inlet channel, or one where the fuel is injected separately.

Likewise, the invention comprises combustion engines intended for all types of use, such as in industrial applications, in crushing

machines and various types of motor vehicles, wheeled motor vehicles as well as trucks and buses, and boats and crawlers or similar vehicles.

BRIEF DESCRIPTION OF THE DRAWINGS

Below are descriptions of example embodiments of the invention, with reference to the enclosed drawings, in which:

Fig. 1a is a schematic view illustrating a part of a combustion engine, in which a device according to one embodiment of the invention is arranged,

Fig. 1b shows a possible location of a sensor element,

Fig. 2 is a diagram which schematically shows the gas pressure in the combustion chamber of a cylinder in a combustion engine as a function of time during a working cycle of the cylinder with and without combustion, respectively,

Fig. 3 is a flow chart showing a method according to one embodiment of the invention, and

Fig. 4 is a fundamental diagram of an electronic control device for the implementation of a method according to the invention.

DETAILED DESCRIPTION OF EMBODIMENTS ACCORDING TO THE INVENTION

Fig. 1a illustrates very schematically a combustion engine 1, in which a device for detection of unwanted fuel supply, or a risk of unwanted fuel supply, according to one embodiment of the invention is arranged. The combustion engine is arranged in an implied motor vehicle 2, for example a truck. The engine 1 is equipped with a device 3, indicated with a dashed line, adapted to detect operating conditions in the engine, and such device has a schematically drawn device 4, which is adapted to detect the pressure in the combustion chambers 5 of the combustion engine's cylinders 6, of which there are six in this case, but of which there may be any number. Each cylinder 6 comprises a piston 14, arranged to operate a crankshaft 12, an inlet valve 10, controlling the gas in-flow from an inlet channel 15 to the cylinder's combustion chamber 5, and an exhaust valve 11, controlling the outflow of exhausts via an exhaust channel 16. In the inlet channel 15, a pressure sensor 17 is arranged. A throttle-valve (not displayed) may be arranged upstream of the pressure sensor 17, in order to control the air inflow into the inlet channel 15.

The device 4 has, in order to be able to detect said pressures in the combustion chambers 5, one sensor element 7 per cylinder 6, and this is arranged separately from the associated combustion chamber 5 on the respective cylinder's cylinder head 8. The sensor elements 7 in this case are piezo resistive sensors, adapted to detect movements generated by pressure changes in the relevant combustion chambers 5, which movements

propagate in the cylinder head 8. The movements may, for example, be in the form of vibrations.

The device 3 also comprises a unit 9, which may consist of the vehicle's electronic control device, adapted to receive information about the detected movements from the sensor elements 7, and to compare such information, or information calculated based on such sensor information, with values stored in relation to the desired operating conditions in the engine.

Fig. 1b shows another placement of the sensor element 7. The sensor element is here placed on a section adjacent to the cylinder head. In this example, the sensor element is placed on the engine, specifically on the engine block. The sensor elements/sensors 7 may be of a suitable type, e.g. piezo resistive or piezo electrical elements or optical sensors. The sensor element may here be placed on the engine, in an area adjacent to the outlet of the exhaust channel from a cylinder. For example on a surface on the engine block next to the outlet, on the engine, of the exhaust channel from a cylinder. The surface where the sensor 7 is placed may be substantially vertical. The sensor may be arranged to detect movements, which are perpendicular to the movements of the piston. The sensor may also be arranged to detect movements, which are perpendicular both in relation to the piston's direction of movement and in relation to the engine's longitudinal direction. In one embodiment, the sensor is located on the engine's long side. The sensor may be arranged to detect movements in a direction, which is perpendicular in relation to the surface on which it is placed.

In another embodiment (not displayed) the sensor element 7 may be placed in a corresponding manner as when placed on the engine at the outlet of the exhaust channel from a cylinder, but instead placed in a corresponding location on the engine, at the inlet channel's inlet to a cylinder.

The signal detected by the sensor element 7 may be treated in various ways. For example, the following signal treatment steps may be carried out. First the sensor's electrical signal is entered into a control device/signal treatment device. The signal is filtered with a bandpass filter in order to remove superfluous information, which does not belong to the frequency range around which information is required. The signal is evened out by way of filtering, averaging or by being replaced with one or several continuous function(s) with good likeness. Subsequently, the signal is scaled, e.g. with the help of the correlation between pressure and volume at compression. Subsequently, (a) suitable part(s) of the signal is/are transformed to the pressure domain. Supplemental modelling closes gaps in the signal's reliability, in order to form a pressure curve. The thus formed pressure curve is used to calculate different values at engine control. In some embodiments one or several of the steps above may be omitted.

Fig. 2 schematically shows a diagram of the gas pressure in the combustion chamber 5 of a cylinder 6 as a function of time t during a part of a working cycle of the cylinder corresponding to a compression stroke, when the piston 14 moves from its bottom dead centre BDC to its top dead centre TDC, and a subsequent expansion stroke, when the piston 14 moves from the top dead

centre TDC to the bottom dead centre BDC. The gas pressure P1 in the absence of combustion in the cylinder is shown as a solid line, and the gas pressure P2 at combustion in the cylinder is shown during the expansion stroke as a dashed line. As shown, at combustion the gas pressure in the combustion chamber 5 is at a higher level than in the absence of combustion.

During a method according to one embodiment of the invention, illustrated in Fig. 3, in a step S1 movements of the cylinder head 8 are detected with the help of the sensor element 7 during a working cycle of the cylinder. Preferably, the detection takes place during a working cycle when no fuel is supplied to the cylinder via an ordinary fuel supply system, that is to say when the engine is dragged. The signal from the sensor element 7 is converted by the control device 9 in a step S2, into a gas pressure in the combustion chamber. In order to calculate the gas pressure in the combustion chamber, in addition to the signal from the sensor element 7, a signal from the pressure sensor 17 in the inlet channel 15 may be used. In a subsequent step S3, the calculated gas pressure is then compared with one or several alarm criteria.

A first alarm criterion is set in such a manner that it is deemed met, if the gas pressure at a given occasion in the cylinder falls short of a value determined for the relevant occasion. This first alarm criterion is thus set in such a manner that it is met if the gas pressure in the combustion chamber is so low that it may lead to oil coating on the cylinder. If the first alarm criterion is met, an alarm may be set in step S4a. Based on the alarm, in a step S5, the gas pressure in the combustion chamber 5 may then

be controlled to a higher level, for example by opening the throttle valve that controls the air supply to the inlet channel 15, and thus to the combustion chamber. The result is that the air flow, and thus also the gas pressure in the combustion chamber, increases. The risk of oil coating may therefore be eliminated.

A second alarm criterion is set in such a manner that it is met if the gas pressure in the combustion chamber 5, at a given point in time during an expansion stroke of the cylinder 6, exceeds a value determined for the relevant point in time. This second alarm criterion is thus set in such a manner that it is met, if there is a combustion in the combustion chamber without any supply of fuel from an ordinary fuel supply system in the combustion engine. If the second alarm criterion is met, there is a risk of self-propelling of the combustion engine, for example because the piston 14 pulls in sufficient amounts of engine oil into the combustion chamber 5 for the engine to be able to turn with the engine oil as fuel, without any ordinary fuel supply. If the second alarm criterion is met, an alarm is set in a step S4b, based upon which an exhaust brake in the engine is activated in step S6, at the same time as the ordinary fuel supply is stopped. In this manner, it is possible to interrupt self-propelling at an early stage.

If no alarm criterion is met, no measure is taken.

Preferably, the detection of the gas pressure in the combustion engine 5 occurs separately for the respective cylinder 6 in the combustion engine. It is then possible to determine directly in which cylinder 6 there are potential problems. This is especially

applicable in multi-cylinder combustion engines, where each cylinder 6 has a separate cylinder head 8, as displayed in Fig. 1. For multi-cylinder combustion engines, where several cylinders share one common cylinder head, the detection may occur either separately or jointly, but with a joint detection some information is lost, relating to the cylinder to which unwanted fuel supply occurs.

A computer program code for the implementation of a method according to the invention is suitably included in a computer program, loadable into the internal memory of a computer, such as the internal memory of an electronic control device of a combustion engine. Such a computer program is suitably provided via a computer program product, comprising a data storage medium readable by an electronic control device, which data storage medium has the computer program stored thereon. Said data storage medium is e.g. an optical data storage medium in the form of a CD-ROM, a DVD, etc., a magnetic data storage medium in the form of a hard disk drive, a diskette, a cassette, etc., or a Flash memory or a ROM, PROM, EPROM or EEPROM type memory.

Fig. 4 very schematically illustrates an electronic control device 9 comprising execution means 20, such as a central processor unit (CPU), for the execution of computer software. The execution means 20 communicates with a memory 21, e.g. a RAM memory, via a data bus 22. The control device 9 also comprises a data storage medium 23, e.g. in the form of a Flash memory or a ROM, PROM, EPROM or EEPROM type memory. The execution means 20 communicates with the data storage means 23 via the

data bus 22. A computer program comprising computer program code for the implementation of a method according to the invention is stored on the data storage medium 23.

The invention is obviously not limited in any way to the embodiments described above, but numerous possible modifications thereof should be obvious to a person skilled in the area, without such person departing from the spirit of the invention as defined by the appended claims. For example, the method may be carried out for a two stroke engine as well as for a four stroke engine as described above.

CLAIMS

1. Method for detection of unwanted fuel supply, or a risk of unwanted fuel supply, to at least one cylinder (6) in a combustion engine (1) comprising the steps:

- during at least a part of a working cycle of the cylinder (6), detecting the gas pressure in a combustion chamber (5) of the cylinder (6);
- comparing the detected gas pressure with expected values for the relevant operating condition of the engine (1); and
- based on said comparison, determining whether there is unwanted fuel supply, or a risk of unwanted fuel supply,

characterised in that the detection of the gas pressure takes place by detecting movements generated by changes in said gas pressure in a cylinder head (8) belonging to said cylinder (6) or in parts adjacent thereto in the engine.

2. Method according to claim 1, **characterised in** that movements in the form of vibrations are detected.

3. Method according to claim 1, **characterised in** that movements in the form of strains in screws in the engine are detected, such as screws in main bearings and in connecting rod bearings and in cylinder head bolts.

4. Method according to claim 1, **characterised in** that movements in the form of strains in an engine block part or a cylinder head (8) of the engine are detected.

5. Method according to claim 4, **characterised in** that the detection is carried out in or on said cylinder head (8).

6. Method according to claim 4, **characterised in** that the detection is carried out on the engine, in an area adjacent to the outlet of the exhaust channel from a cylinder.

7. Method according to claim 4, **characterised in** that the detection is carried out on the engine, in an area adjacent to the inlet of the suction channel to a cylinder.

8. Method according to claim 1, **characterised** in that movements in the form of strains on injector- or glow plug fixings are detected.

9. Method according to any of the previous claims, **characterised** in that the detection of the gas pressure takes place by way of detecting movements with a frequency of ≤ 250 Hz, 0.5 Hz–250 Hz or 0.5 Hz–200 Hz.

10. Method according to any of the previous claims, **characterised** in that the step of detecting the gas pressure is carried out in such a manner that the gas pressure detected is the gas pressure during a working cycle of the cylinder (6) when no fuel is supplied to the same via an ordinary fuel supply system in the combustion engine.

11. Method according to any of the previous claims, **characterised** in that the step of detecting the gas pressure is carried out in such a manner that the gas pressure detected is

the gas pressure during at least one compression- and/or one expansion stroke of the cylinder (6).

12. Method according to any of the previous claims, **characterised** in that it comprises the steps:

- comparing the detected gas pressure with at least one determined alarm criterion for the relevant operating condition of the engine; and
- provided that the alarm criterion is met, setting an alarm.

13. Method according to claim 12, **characterised** in that a first alarm criterion is set in such a manner that it is met, if the gas pressure in the combustion chamber (5) falls short of a value determined for the relevant operating condition of the engine.

14. Method according to claim 13, **characterised** in that it comprises the step, based on said alarm, of controlling the gas pressure in the cylinder (6) to a higher level.

15. Method according to any of claims 12-14, **characterised** in that a second alarm criterion is set in such a manner that it is met, if there is combustion in the combustion chamber (5) during a working cycle of the cylinder (6) when no fuel is supplied to the latter via an ordinary fuel supply system.

16. Method according to claim 15, **characterised** in that the second alarm criterion is set in such a manner that it is met, if the gas pressure in the combustion chamber (5) during a compression- and/or expansion stroke of the cylinder (6) exceeds

a value determined for the relevant operating condition of the engine.

17. Method according to any of claims 12-16, **characterised** in that it comprises the step, based on said alarm, of activating an exhaust brake at the combustion engine.

18. Device adapted to detect unwanted fuel supply, or a risk of unwanted fuel supply, to at least one cylinder (6) in a combustion engine (1), **characterised** in that it comprises at least one sensor element (7), adapted to be arranged separately from the combustion chamber (5) of the cylinder (6), on a part of a cylinder head (8) belonging to a cylinder (6) or on parts adjacent thereto in the engine, and adapted to detect movements generated by changes in said gas pressure in the cylinder head (8), or in the parts adjacent thereto in the engine, and in that it also comprises a device adapted, based on the detected movements, to determine the gas pressure and comparing this with values expected for the relevant operating condition in the engine, and based on such comparison to determine whether there is unwanted fuel supply.

19. Device according to claim 18, **characterised in** that said sensor element (7) is arranged in or on said cylinder head (8).

20. Device according to claim 18, **characterised in** that said sensor element (7) is placed on the engine, in an area adjacent to the outlet of the exhaust channel from a cylinder.

21. Device according to claim 18, **characterised in** that said sensor element (7) is placed on the engine in an area adjacent to the inlet of the suction channel to a cylinder.

22. Computer program which may be downloaded directly to the internal memory of a computer, which computer program comprises a computer program code in order to make the computer control the steps according to any of claims 1-17 when said computer program is executed in the computer.

23. A computer program product comprising a non-volatile data storage medium which is readable by a computer, the computer program code of a computer program according to claim 22 being stored on the data storage medium.

24. Electronic control device (9) for a combustion engine, comprising an execution means (20), a memory (21) connected to the execution means and a data storage medium (23) connected to the execution means, the computer program code in a computer program according to claim 22 being stored on said data storage medium (23).

25. Motor vehicle comprising an electronic control device (9) according to claim 24.

26. Motor vehicle according to claim 25, characterised in that it is a wheeled motor vehicle, such as a truck or a bus, or a boat or a crawler.

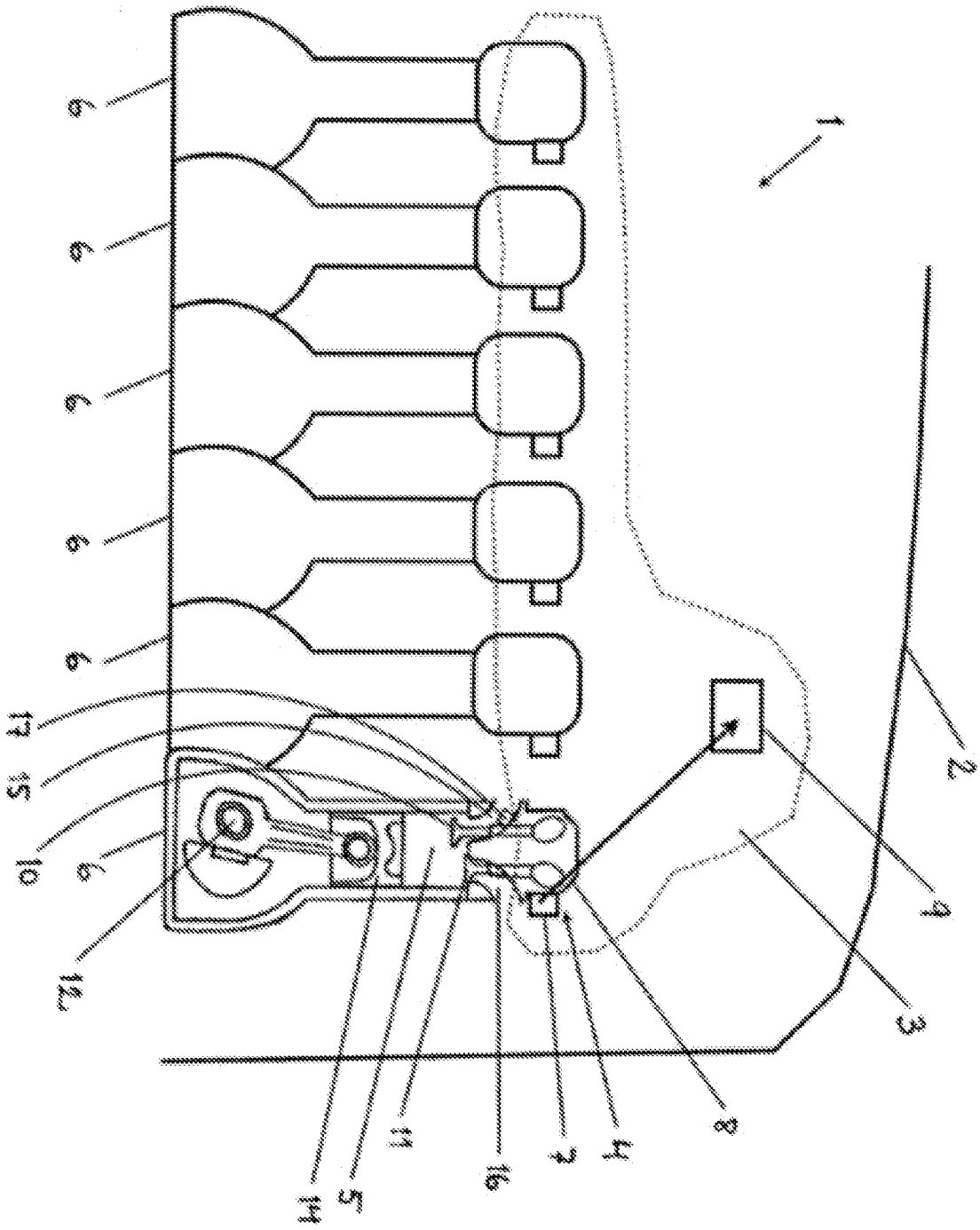


Fig. 1a

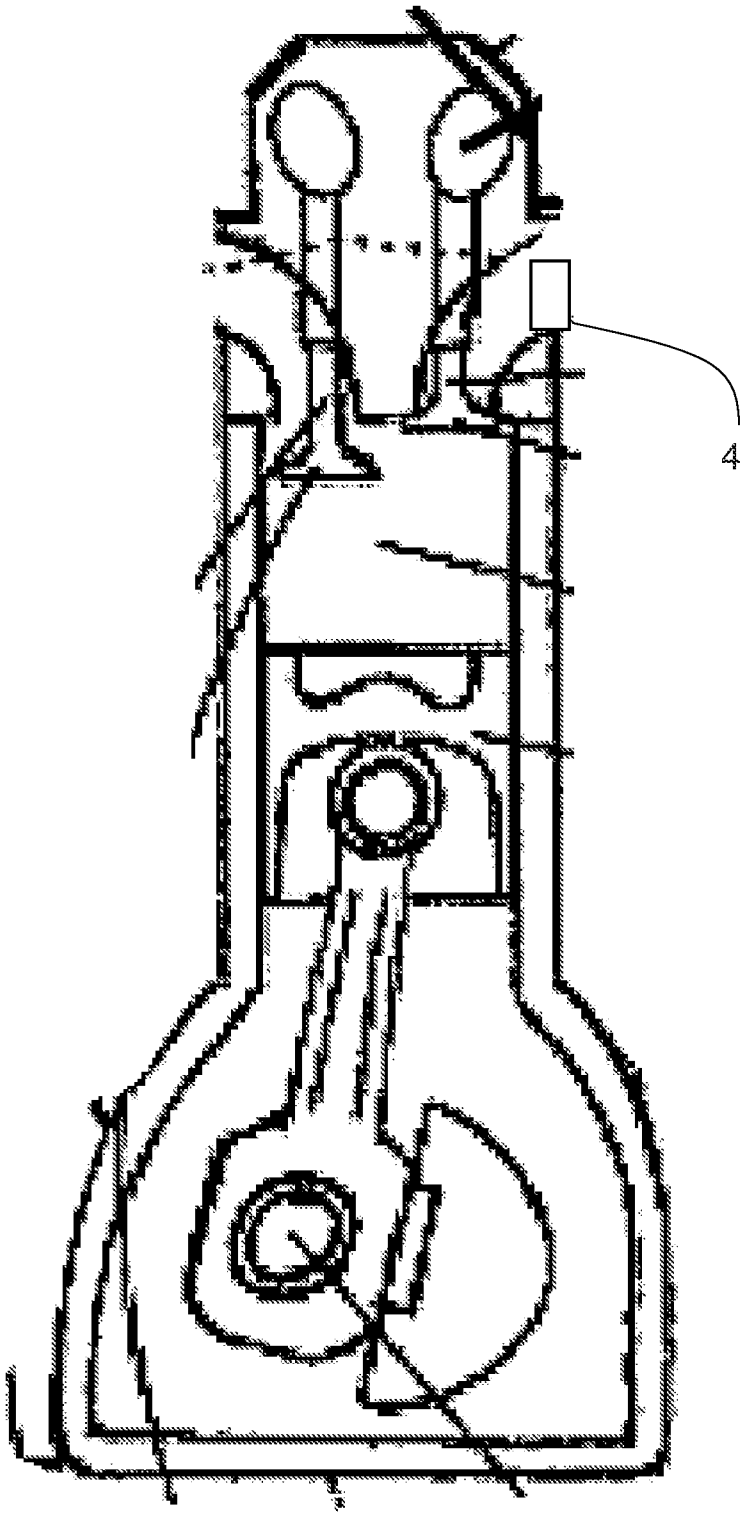


Fig. 1b

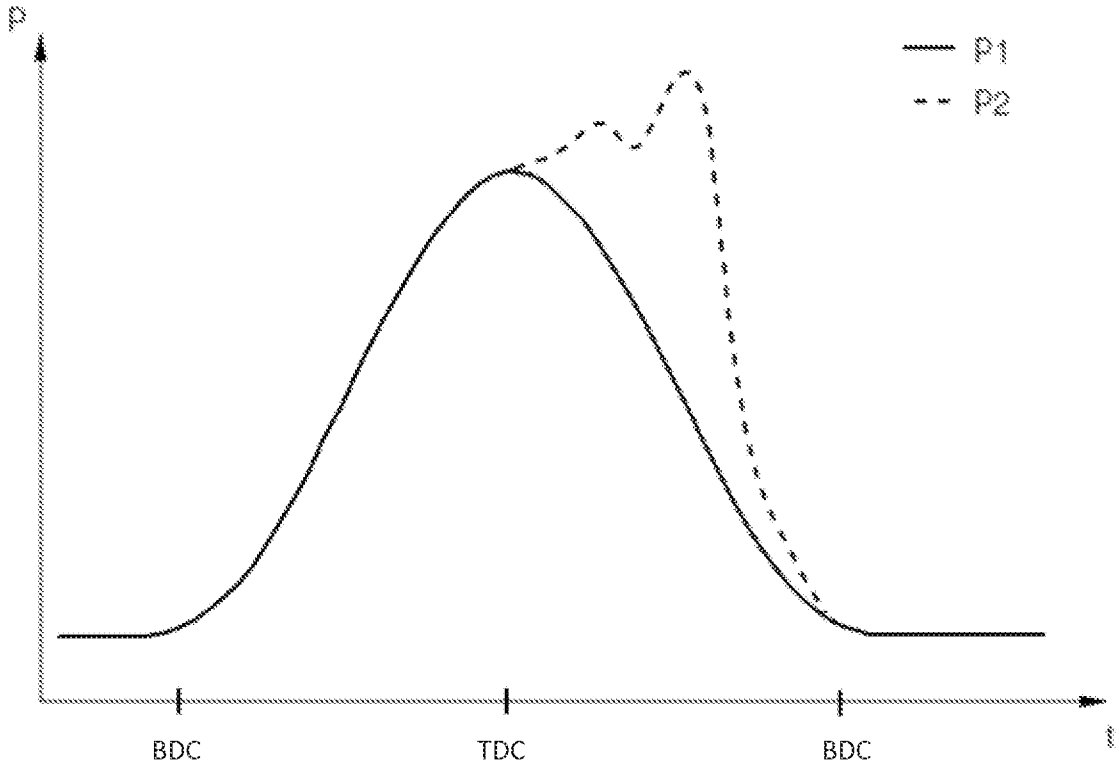


Fig. 2

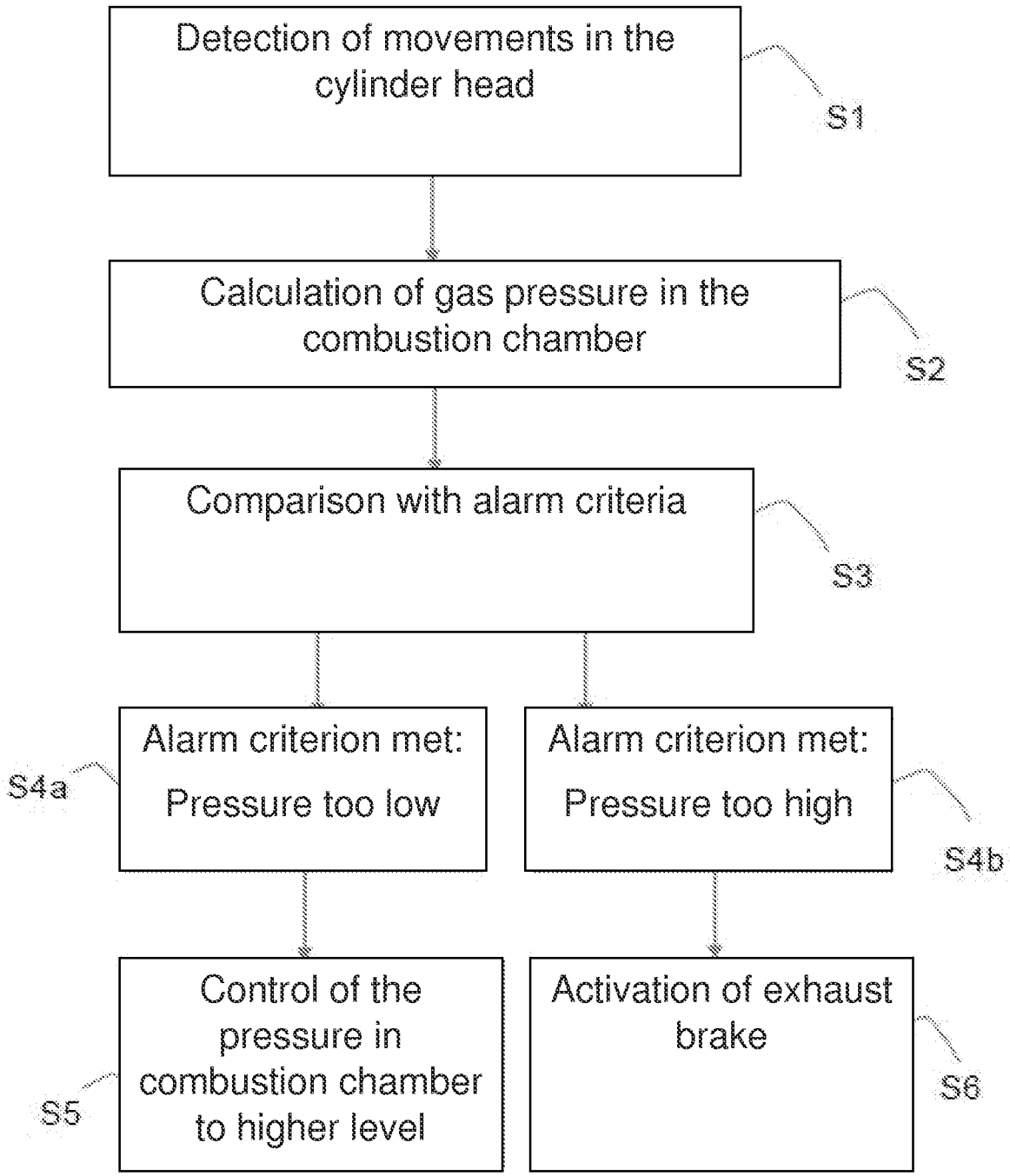

Detection of movements in the cylinder head
S1
Calculation of gas pressure in the combustion chamber
S2
Comparison with alarm criteria
S3
Alarm criterion met:
Pressure too low
S4a
Alarm criterion met:
Pressure too high
S4b
Control of the pressure in combustion chamber to higher level
S5
Activation of exhaust brake
S6

Fig. 3

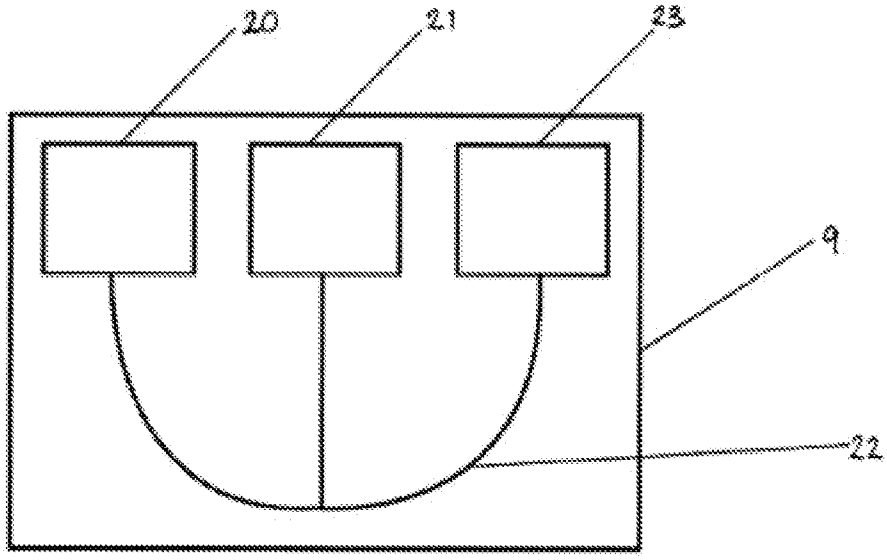


Fig. 4

INTERNATIONAL SEARCH REPORT

International application No.
PCT/SE2015/050708

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: F02D, G01M

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, PAJ, 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	US 4606312 A (NAKANO HIDEAKI ET AL), 19 August 1986 (1986-08-19); abstract; column 3, line 10 - line 14; column 4, line 18 - line 54; column 5, line 7 - line 12; figures 1,4 --	1-26
X	CA 2809291 A1 (HUANG JIAN ET AL), 21 May 2013 (2013-05-21); paragraphs [0003]-[0005], [0014], [0026]-[0027], [0030] --	1-26
A	GB 2314882 A (CUMMINS ENGINE CO INC), 14 January 1998 (1998-01-14); page 1, line 12 - line 25; page 3, line 1 - line 10; page 12, line 16 - line 29; figures --	3-7

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

* Special categories of cited documents:
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"E" earlier application or patent but published on or after the international filing date
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"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
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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
26-10-2015	26-10-2015
Name and mailing address of the ISA/SE Patent- och registreringsverket Box 5055 S-102 42 STOCKHOLM Facsimile No. + 46 8 666 02 86	Authorized officer Marianne Dickman Telephone No. + 46 8 782 28 00

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/SE2015/050708

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

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A	US 20080228341 A1 (ORIFIJ MURAD), 18 September 2008 (2008-09-18); paragraphs [0006], [0077] --	1-26
A	US 20020066437 A1 (WEISMAN STEVEN M), 6 June 2002 (2002-06-06); paragraphs [0021], [0044], [0057]-[0058] --	1-26
A	US 20110238283 A1 (MIERSCH-WIEMERS OLIVER ET AL), 29 September 2011 (2011-09-29); paragraphs [0007], [0013] -- -------	1-26

International application No.
PCT/SE2015/050708

Continuation of: second sheet

International Patent Classification (IPC)

F02D 35/02 (2006.01)
G01M 15/08 (2006.01)
G01M 15/12 (2006.01)

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