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(54) **Title**: METHOD AND SYSTEM FOR MONITORING OF OIL QUALITY DETERIORATION

(57) **Abstract**: Method and system for monitoring deterioration of the quality of oil which accumulates in a gathering space (2) in a motor vehicle.In a situation where the oil in the gathering space is allowed to cool to its gelling point, a first temperature value and a second temperature value which represent the temperature of the oil in respective first and second regions of the gathering space are generated. Gelling of the oil is detected on the basis of the difference between these temperature values. When gelling is detected, a gelling point value which represent the oil's gelling point is determined on the basis of one or more measured values for the temperature of the oil in the gathering space at the time when the gelling is detected. The gelling point value is then used to determine whether or not the quality of the oil has deteriorated to such an extent that it needs changing.

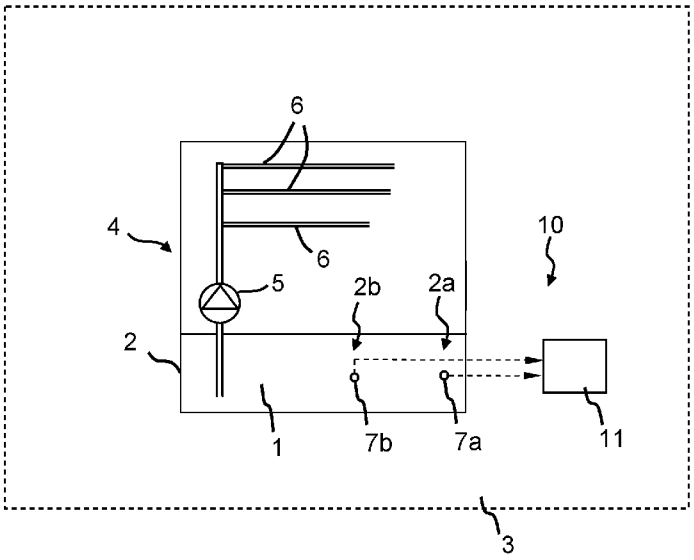

Fig 1

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Method and system for monitoring of oil quality deterioration

FIELD OF THE INVENTION AND PRIOR ART

The present invention relates to a method and a system for monitoring deterioration of the quality of oil which accumulates in a gathering space in a motor vehicle. The invention relates also to a computer programme and a computer programme product comprising computer programme code for implementing a method according to the invention, and an electronic control unit.

In a motor vehicle, oil may for example be used as lubricant in a combustion engine of the vehicle to lubricate movable parts of the engine. This motor oil is pumped from an oil sump in the engine and passes through lubricant ducts in the engine before running back to the sump. Oil may also be used as lubricant in a gearbox of a motor vehicle to lubricate movable parts of the gearbox. This gearbox oil is pumped from an oil sump in the gearbox and passes through lubricant ducts in the gearbox before running back to the sump. Oil may likewise be used as lubricant in a rear axle of a motor vehicle to lubricate a differential gear situated in the rear axle. This rear axle oil accumulates in a space in the bottom of the rear axle and has certain gearwheels of the differential gear partly immersed in it so that when they rotate they splash oil round to other movable parts of the differential gear.

Oil may also be used as brake medium in a hydrodynamic retarder of a motor vehicle. Heavy vehicles such as trucks, tractor units or buses are often provided with a supplementary brake in the form of a hydrodynamic retarder which comprises a rotor and a stator which cooperates with the rotor. The rotor of the retarder is connected or connectable to a driving shaft of the vehicle and is provided with an annular recess which faces towards a corresponding annular recess in the stator to form a toroidal space between the rotor and the stator. A plurality of

vanes are provided in the recesses of the rotor and of the stator. When the retarder is to exert braking action on the driving shaft, retarder oil is pumped into the toroidal space from a gathering container. The rotor's rotation relative to the stator causes the retarder oil to flow between their vanes, generating a braking action on the rotor and consequently braking the driving shaft. When the retarder's braking action is to cease, the retarder oil is returned to the gathering container.

To function satisfactorily, the oil used as lubricant in a combustion engine, gearbox or rear axle and the oil used as brake medium in a retarder need to be of appropriate viscosity. For example, the viscosity of oil used as lubricant must not be too low. If it becomes too low, the oil will be so fluid as to no longer impart a satisfactory lubricant effect, with consequent risk of mechanical damage. Nor should the viscosity of the oil be too high. If it becomes too high, the oil will be so viscous that it becomes difficult or in the worse case impossible to pump through the lubricant ducts in a combustion engine or gearbox or to and from the toroidal space in a retarder. This may lead to lack of lubrication, with consequent mechanical damage to an engine or gearbox, and to lack of braking action by the retarder.

There are various reasons for changes in oil viscosity. Such changes may be gradual, e.g. due to oxidation. In some cases the oil may also undergo a large and rapid change in viscosity, e.g. if water or fuel comes into contact with and dilutes it.

Oil continually oxidises. This oxidation increases with rising oil temperature, causing an obvious problem with regard to motor oil and gearbox oil. There is also a risk of motor oil being exposed to soot making its way into it and thereby causing raised viscosity, and to fuel leaking into the oil and thereby lowering its viscosity.

Rear axle oil is gradually degraded by being sheared between the gearwheels in the rear axle's differential gear, leading to its viscosity gradually rising.

Retarder oil is gradually degraded by the very high temperatures to which it is subject during retarder braking, leading to its viscosity gradually rising.

When oil in a motor vehicle deteriorates so much that it may well no longer be able to perform its task, it needs replacing by new oil. Such oil changing may for example take place at certain intervals of time which are of predetermined length or are calculated on the basis of relevant parameters, e.g. mileage and oil temperatures. As the interval needs to be set with a certain safety margin to avoid risk of damage and other problems, the oil is in many cases changed while still fully functional, resulting in unnecessarily large oil consumption. Various types of systems for monitoring of motor oil quality deterioration have been developed with a view to better precision in determining when changes of motor oil are needed. For example, a practice known from DE 100 13 590 A1 and EP 2 159 387 A1 is to measure the viscosity of motor oil by means of a viscosimeter and determine the need for oil change by analysis of measured viscosity values. A practice known from US 2005/0039521 A1 is to calculate the viscosity of motor oil on the basis of measured values for oil pressure, oil temperature and engine speed and determine the need for oil change by analysis of calculated viscosity values.

OBJECT OF THE INVENTION

The object of the present invention is to propose a novel and advantageous way of monitoring deterioration of the quality of oil which accumulates in a gathering space in a motor vehicle.

SUMMARY OF THE INVENTION

According to the present invention, said object is achieved by a method with the features defined in claim 1 and a system with the features defined in claim 9.

According to the invention,
- in a situation where the oil in the gathering space is allowed to cool from a temperature above its gelling point to a temperature corresponding to or below its gelling point, measured values from temperature sensors are used to continuously generate a first temperature value which represents the temperature of the oil in a first region of the gathering space and a second temperature value which represents the temperature of the oil in a second region of the gathering space,
- during the cooling of the oil, a differential value representing the prevailing difference between the first temperature value and the second temperature value is determined continuously and is compared with a limit value for detection of gelling of the oil,
- when gelling is detected, a gelling point value which represents the oil's gelling point is determined on the basis of one or more measured values for the temperature of the oil in the gathering space at the time when the gelling is detected, and
- the gelling point value is used to determine whether or not the quality of the oil has deteriorated to such an extent that it needs changing.

When the oil in the gathering space cools, heat is released from the oil via the sidewalls and bottom of the gathering space and via the oil surface. The gradual cooling at the edges of the oil volume in the gathering space leads to differences in oil density which result in circulation of the oil in the gathering space and heat transfer by natural convection. So long as the temperature of the oil in the gathering space is above its gelling point, the natural convection will lead to equalisation of the temperature of the oil in the gathering space. The natural convection thus counteracts temperature stratification of the oil in the gathering space, which means that there will be no obvious temperature differences between the various regions of the oil in the

gathering space which have not yet undergone gelling. When the oil in the gathering space reaches such a low temperature as to undergo gelling, however, the natural convection and consequent temperature equalisation cease, leading to more obvious oil temperature differences in different parts of the gathering space. By registering such temperature differences it thus becomes possible to detect gelling of the oil in the gathering space. The solution according to the invention is also based on the fact that a change in the quality of an oil leads to a change in its gelling point.

The solution according to the invention provides a simple way to monitor deterioration of the quality of an oil in a motor vehicle and to decide when oil changing is needed, without having to use other than relatively simple and inexpensive temperature sensors. This monitoring is feasible in cold conditions where the ambient temperature is low enough to cool the oil to a temperature corresponding to or below its gelling point, as in cold climates. In conditions of warmer ambient temperature, the oil change interval has to be based on other criteria.

According to an embodiment of the invention, the gelling point value is compared with an upper gelling point limit value and/or a lower gelling point limit value, and a warning signal or a message indicating need of oil change is generated if the comparison shows that the gelling point value is higher than or equal to the upper gelling point limit value or lower than or equal to the lower gelling point limit value. This makes it easy for the gelling point value determined to be analysed to see whether the viscosity of the oil has become inappropriately high or inappropriately low.

According to another embodiment of the invention, gelling point values are determined at various times to obtain a series of gelling point values which are then analysed to determine whether or not the quality of the oil has deteriorated to such an extent that it needs changing.

According to a further embodiment of the invention, a trend line showing how the gelling point value changes with the vehicle's operating time is generated, preferably by linear regression or moving average. Each new gelling point value determined is compared with the trend line of the previous values to determine whether it follows or deviates from the trend line, and a warning signal or a message which indicates need of oil change is generated when it is found that a gelling point value or a given number of consecutive gelling point values deviate from the trend line. This makes it easy for the latest gelling point value determined to be analysed to see whether the oil has suddenly undergone a substantial increase or decrease in viscosity, e.g. because of fuel leakage or some other sudden mishap, without having to resort to comparison with predetermined limit values. This latter analysis method does however not make it possible to detect that the viscosity of the oil has become inappropriately high or inappropriately low through gradual change.

Other advantageous features of the method and system according to the invention are indicated by the dependent claims and the description set out below.

The invention relates also to a computer programme with the features defined in claim 13, a computer programme product with the features defined in claim 14 and an electronic control unit with the features defined in claim 15.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention is described below in more detail on the basis of embodiment examples with reference to the attached drawings, in which

Fig. 1 is a schematic diagram of a motor vehicle with a combustion engine and a system according to the invention for monitoring deterioration of the quality of the engine's motor oil,

Fig. 2 shows a trend line of how the gelling point value of an oil changes with a motor vehicle's operating time,

Fig. 3 is a schematic diagram of an electronic control unit for implementing a method according to the invention,

Fig. 4 is a flowchart illustrating a method according to a first embodiment of the invention, and

Fig. 5 is a flowchart illustrating a method according to a second embodiment of the invention.

DETAILED DESCRIPTION OF EMBODIMENTS OF THE INVENTION

Fig. 1 depicts schematically a system 10 according to the invention for monitoring deterioration of the quality of oil 1 which accumulates in a gathering space 2 in a motor vehicle 3. In the example illustrated, the gathering space 2 takes the form of an oil sump in a combustion engine 4 of the vehicle. In this case the oil thus takes the form of motor oil used as lubricant for movable parts of the engine. The oil 1 is pumped from the gathering space 2 by an oil pump 5 and passes through lubricants ducts 6 in the engine. The oil runs back down into the gathering space from the lubricant ducts.

The system 10 according to the invention might also be arranged to monitor deterioration of the quality of oil which accumulates in a gathering space in some other part of the vehicle, e.g. gearbox oil which accumulates in an oil sump in a gearbox of the vehicle and/or rear axle oil which accumulates in a space at the bottom of a rear axle of the vehicle and/or retarder oil which accumulates in a gathering space associated with a hydrodynamic retarder of the vehicle.

When the combustion engine 4 is running, the oil 1 is warmed by the heat generated by the engine. After the engine has been switched off, the oil will gradually cool to a level corresponding to the ambient temperature. If the ambient temperature is low enough, the temperature of the cooling oil will drop to a level at which it undergoes gelling. The temperature at which gelling occurs in the oil, i.e. its gelling point, depends inter alia on the quality of the oil.

One or more first temperature sensors 7a are provided to measure the temperature of the oil in a first region 2a of the gathering space 2, and one or more second temperature sensors 7b to measure the temperature of the oil in the second region 2b of the gathering space. In the embodiment depicted in Fig. 1, said first and second regions 2a, 2b of the gathering space are situated at a distance from one another in a horizontal direction but might alternatively be situated at a distance from one another in a vertical direction or in both horizontal and vertical directions.

The system 10 according to the invention comprises an electronic data processing device 11 connected to said temperature sensors 7a, 7b to receive from them measured values for the temperature of the oil in said first and second regions 2a, 2b of the gathering space.

The electronic data processing device 11 is adapted, in a situation where the oil in the gathering space 2 is allowed to cool from a temperature above its gelling point to a temperature which corresponds to or is below its gelling point, to using measured values from said temperature sensors 7a, 7b to generate a first temperature value V_{T1} which represents the temperature of the oil in said first region 2a of the gathering space, and a second temperature value V_{T2} which represents the temperature of the oil in said second region 2b of the gathering space. The data processing device 11 is further adapted to determining continuously during the cooling of the oil a differential value V_{diff} which represents the prevailing difference between the first

temperature value V_{T1} and the second temperature value V_{T2}, and to comparing this differential value V_{diff} with a limit value V_G for detection of gelling of the oil. The differential value V_{diff} is with advantage calculated as the difference $V_{diff}= V_{T1}-V_{T2}$ or the difference $V_{diff}= V_{T2}-V_{T1}$, and gelling of the oil is detected when it is found that the differential value V_{diff} has an absolute value greater than or equal to the limit value V_G.

The limit value V_G is chosen such that it is somewhat greater than the small oil temperature differences which may in normal circumstances occur between the two regions 2a, 2b of the gathering space during the cooling of the oil before its temperature has dropped low enough for gelling to occur.

When it detects gelling, i.e. when the aforesaid comparison between the differential value V_{diff} and the limit value V_G shows that the oil in the gathering space 2 has undergone gelling, the data processing device 11 is adapted to using one or more measured values for the temperature of the oil in the gathering space at the time when the gelling is detected as a basis for determining a gelling point value V_{Tgel} which represents the gelling point of the oil. The data processing device 11 is further adapted to using this gelling point value V_{Tgel} to determine whether or not the quality of the oil has deteriorated to such an extent that the oil needs changing.

The gelling point value V_{Tgel} is with advantage determined on the basis of the temperature of the oil measured in said first region 2a and/or second region 2b of the gathering space at the time when the gelling is detected. For example, said first temperature value V_{T1} or said second temperature value V_{T2} at the time when the gelling is detected, or an average of these two values, may be adopted as the current gelling point value V_{Tgel}.

According to a first alternative, the data processing device 11 is adapted to comparing the gelling point value V_{Tgel} with an upper gelling point limit value V_{G1} and/or a lower gelling point limit

value V_{G2} and to generating a warning signal, e.g. in the form of an acoustic of visual signal, or a message which indicates need of oil change if said comparison shows that the gelling point value V_{Tgel} is above or equal to the upper gelling point limit value V_{G1} or below or equal to the lower gelling point limit value V_{G2}. A driver in the vehicle 3 may thus for example be made aware that the state of the oil is such that it needs changing.

The upper gelling point limit value V_{G1} may for example be determined by causing a reference oil with raised gelling point to be received in the gathering space 2 or a gathering space of similar configuration, followed by determining as described above the gelling point for this reference oil. The upper gelling point limit value V_{G1} may be set to correspond to the value of the gelling point thus determined. The upper gelling point limit value might of course also be determined in some other way.

The lower gelling point limit value V_{G2} may for example be determined by causing a reference oil with reduced gelling point to be received in the gathering space 2 or a gathering space of similar configuration, followed by determining as described above the gelling point for this reference oil. The lower gelling point limit value V_{G2} may be set to correspond to the value of the gelling point thus determined. The lower gelling point limit value might of course also be determined in some other way.

According to a second alternative, the data processing device 11 is adapted to determining the gelling point value V_{Tgel} at various times and to obtaining as described above a series of gelling point values and determining by analysis of them whether or not the quality of the oil has deteriorated to such an extent as to need changing.

In this latter case the data processing device 11 may for example be adapted to using said series of gelling point values to generate a trend line TL (see Fig. 2) which shows how the gelling point value V_{Tgel} has changed with the vehicle's operating time

T_{op}, and then comparing each new gelling point value V_{Tgel} with the trend line for the previous values in order to determine whether the new gelling point value follows or deviates from the trend line. Operating time means here the cumulative value of the time during which the vehicle has been in operation since the latest oil change. Where it is found that the gelling point value V_{Tgel} or a given number of consecutive gelling point values differ from the trend line TL, the data processing device 11 is adapted to generating a warning signal, e.g. in the form of an acoustic or visual signal, or a message which indicates need of oil change. A driver in the vehicle 3 may thus for example be made aware that the state of the oil is such that it needs changing.

The aforesaid trend line TL may for example be generated by linear regression or moving average. It is updated continuously when each new gelling point value V_{Tgel} is determined. Whether or not a new gelling point value deviates from the trend line TL is assessed on the basis of predetermined criteria. One such criterion may for example be that a gelling point value is deemed to deviate from the trend line TL if it is not within the prevailing standard deviation from the trend line, or not within the given multiple of the standard deviation, e.g. four times the standard deviation, from the trend line.

The data processing device 11 indicated above may be implemented by means of a single electronic control unit of the vehicle 3, as illustrated in Fig. 1 but might alternatively be implemented by means of two or more mutually cooperating electronic control units of the vehicle.

Fig. 4 is a flowchart illustrating a first embodiment of a method according to the present invention for monitoring deterioration of the quality of oil 1 which accumulates in a gathering space 2 in a motor vehicle 3. This method comprises the following steps:

A1) in a situation where the oil in the gathering space 2 is allowed to cool from a temperature above its gelling point to a level corresponding to or below its gelling point, measured

values from temperature sensors 7a, 7b are used to generate continuously a first temperature value V_{T1} which represents the temperature of the oil in a first region 2a of the gathering space, and a second temperature value V_{T2} which represents the temperature of the oil in a second region 2b of the gathering space,

B1) a differential value V_{diff} which represents the prevailing difference between the first temperature value V_{T1} and the second temperature value V_{T2} is determined continuously during the cooling of the oil and is compared with a limit value V_G for detection of gelling of the oil,

C1) when gelling is detected, a gelling point value V_{Tgel} representing the gelling point of the oil is determined on the basis of one or more measured values for the temperature of the oil in the gathering space at the time when the gelling is detected,

D1) the gelling point value V_{Tgel} is compared with an upper gelling point limit value V_{G1} and a lower gelling point limit value V_{G2}, and

E1) a warning signal or a message which indicates need of oil change is generated if the comparison at step D1 shows that the gelling point value V_{Tgel} is above or equal to the upper gelling point limit value V_{G1} or below or equal to the lower gelling point limit value V_{G2}.

Fig. 5 is a flowchart illustrating a second embodiment of a method according to the present invention for monitoring deterioration of the quality of oil 1 which accumulates in a gathering space 2 in a motor vehicle 3. This method comprises steps A2-C2 corresponding to the above steps A1-C1 and the following additional steps:

D2) the gelling point value V_{Tgel} is compared with a trend line TL for previous gelling point values to determine whether the new gelling point value follows or deviates from the trend line,

E2) a warning signal or a message which indicates need of oil change is generated if the comparison at step D2 shows that the new gelling point value V_{Tgel} deviates from said trend line TL,

F2) if the comparison at step D2 shows instead that the new gelling point value V_{Tgel} follows said trend line TL, the trend line is updated on the basis of the new gelling point value.

Computer programme code for implementing a method according to the invention is with advantage included in a computer programme which can be read into the internal memory of a computer, e.g. the internal memory of an electronic control unit of a motor vehicle. Such a computer programme is with advantage provided via a computer programme product comprising a data storage medium which can be read by a computer and which has the computer programme stored on it. Said data storage medium is for example an optical data storage medium in the form of a CD ROM disc, a DVD disc etc., a magnetic data storage medium in the form of a hard disc, a diskette, a cassette tape etc., or a flash memory or a memory of the ROM, PROM, EPROM or EEPROM type. Fig. 3 illustrates very schematically an electronic control unit 20 comprising an execution means 21, e.g. a central processor unit (CPU), for execution of computer software. The execution means 21 communicates with a memory 22, e.g. of the RAM type, via a data bus 23. The control unit 20 comprises also a data storage medium 24, e.g. in the form of a flash memory or a memory of the ROM, PROM, EPROM or EEPROM type. The execution means 21 communicates with the data storage medium 24 via the data bus 23. A computer programme comprising computer programme code for implementing a method according to the invention, e.g. in accordance with any of the embodiments illustrated in Figs. 3 and 4, is stored on the data storage medium 24.

The invention is of course in no way restricted to the embodiments described above, since many possibilities for modifications thereof are likely to be obvious to one skilled in the art without therein having to deviate from the invention's basic concept such as defined in the attached claims.

CLAIMS

1. A method for monitoring deterioration of the quality of oil which accumulates in a gathering space (2) in a motor vehicle (3), **characterised** in that the method comprises the following steps:

A) in a situation where the oil in the gathering space (2) is allowed to cool from a temperature above its gelling point to a level corresponding to or below its gelling point, measured values from temperature sensors (7a, 7b) are used to generate continuously a first temperature value (V_{T1}) which represents the temperature of the oil in a first region (2a) of the gathering space, and a second temperature value (V_{T2}) which represents the temperature of the oil in a second region (2b) of the gathering space,

B) a differential value (V_{diff}) which represents the prevailing difference between the first temperature value (V_{T1}) and the second temperature value (V_{T2}) is determined continuously during the cooling of the oil and is compared with a limit value (V_G) for detection of gelling of the oil,

C) when gelling is detected, a gelling point value (V_{Tgel}) representing the gelling point of the oil is determined on the basis of one or more measured values for the temperature of the oil in the gathering space at the time when the gelling is detected,

D) the gelling point value (V_{Tgel}) is used to determine whether or not the quality of the oil has deteriorated to such an extent that it needs changing.

2. A method according to claim 1, **characterised** in that the gelling point value (V_{Tgel}) is determined on the basis of the measured temperature of the oil in said first and/or second regions (2a, 2b) of the gathering space at the time when the gelling is detected.

3. A method according to claim 1 or 2, **characterised** in that gelling of the oil is detected when it is found that the

differential value (V_{diff}) has an absolute value greater than or equal to the limit value (V_G).

4. A method according to any one of claims 1-3, **characterised**
- in that the gelling point value (V_{Tgel}) is compared with an upper gelling point limit value (V_{G1}) and a lower gelling point limit value (V_{G2}), and
- that a warning signal or a message which indicates need of oil change is generated if the comparison at step D1 shows that the gelling point value (V_{Tgel}) is above or equal to the upper gelling point limit value (V_{G1}) or below or equal to the lower gelling point limit value (V_{G2}).

5. A method according to claim 4, **characterised** in that said upper gelling point limit value (V_{G1}) is determined by performing steps A-C with a reference oil with raised gelling point in the gathering space (2) or a gathering space of similar configuration.

6. A method according to claim 4 or 5, **characterised** in that said lower gelling point limit value (V_{G2}) is determined by performing steps A-C with a reference oil with reduced gelling point in the gathering space (2) or a gathering space of similar configuration.

7. A method according to any one of claims 1-3, **characterised**
- in that individual test cycles each comprising steps A-C are conducted at different times to obtain a series of gelling point values (V_{Tgel}), and
- that by analysis of said gelling point values (V_{Tgel}) it is determined whether or not the quality of the oil has deteriorated to such an extent that it needs changing.

8. A method according to claim 7, **characterised**
- in that a trend line (TL) showing how the gelling point value (V_{Tgel}) has changed with the vehicle's operating time is generated, preferably by linear regression or moving average,

- that each new gelling point value (V_{Tgel}) is compared with the trend line (TL) for the previous values to determine whether the new gelling point value (V_{Tgel}) follows or deviates from the trend line, and
- that a warning signal or a message which indicates need of oil change is generated when it is found that a gelling point value (V_{Tgel}) or a given number of consecutive gelling point values deviate from said trend line (TL).

9. A system for monitoring deterioration of the quality of oil which accumulates in a gathering space in a motor vehicle, **characterised**

- in that the system (10) comprises an electronic data processing device (11) which, in a situation where the oil in the gathering space is allowed to cool from a temperature above its gelling point to a level corresponding to or below its gelling point, uses measured values from temperature sensors to generate continuously a first temperature value (V_{T1}) which represents the temperature of the oil in a first region (2a) of the gathering space, and a second temperature value (V_{T2}) which represents the temperature of the oil in a second region (2b) of the gathering space,
- that the data processing device (11) is adapted to determining continuously during the cooling of the oil, and to comparing with a limit value (V_G) for detection of gelling of the oil, a differential value (V_{diff}) which represents the prevailing difference between the first temperature value (V_{T1}) and the second temperature value (V_{T2}),
- that the data processing device (11) is adapted, when gelling is detected, to determining, on the basis of one or more measured values for the temperature of the oil in the gathering space at the time when the gelling is detected, a gelling point value (V_{Tgel}) which represents the gelling point of the oil, and
- that the data processing device (11) is adapted to using the gelling point value (V_{Tgel}) to determine whether or not the quality of the oil has deteriorated to such an extent that it needs changing.

10. A system according to claim 9, **characterised** in that the data processing device (11) is adapted
- to comparing the gelling point value (V_{Tgel}) with an upper gelling point limit value (V_{G1}) and a lower gelling point limit value (V_{G2}), and
- to generating a warning signal or a message which indicates need of oil change if said comparison shows that the gelling point value (V_{Tgel}) is above or equal to the upper gelling point limit value (V_{G1}) or below or equal to the lower gelling point limit value (V_{G2}).

11. A system according to claim 9, **characterised** in that the data processing device (11) is adapted
- to determining gelling point values (V_{Tgel}) at various times to obtain a series of gelling point values, and
- to determining by analysis of said gelling point values (V_{Tgel}) whether or not the quality of the oil has deteriorated to such an extent that it needs changing.

12. A system according to claim 11, **characterised** in that the data processing device (11) is adapted
- to generating a trend line (TL) showing how the gelling point value (V_{Tgel}) has changed with the vehicle's operating time,
- to comparing each new gelling point value (V_{Tgel}) with the trend line (TL) for the previous values to determine whether the new gelling point value (V_{Tgel}) follows or deviates from the trend line, and
- to generating a warning signal or a message which indicates need of oil change when it is found that a gelling point value (V_{Tgel}) or a given number of consecutive gelling point values deviate from said trend line (TL).

13. A computer programme comprising computer programme code for causing a computer to implement a method according to any one of claims 1-8 when the computer programme is executed in the computer.

14. A computer programme product comprising a data storage medium which can be read by a computer and on which the programme code of a computer programme according to claim 13 is stored.

15. An electronic control unit of a motor vehicle comprising an execution means (21), a memory (22) connected to the execution means and a data storage medium (24) which is connected to the execution means and on which the computer programme code of a computer programme according to claim 13 is stored.

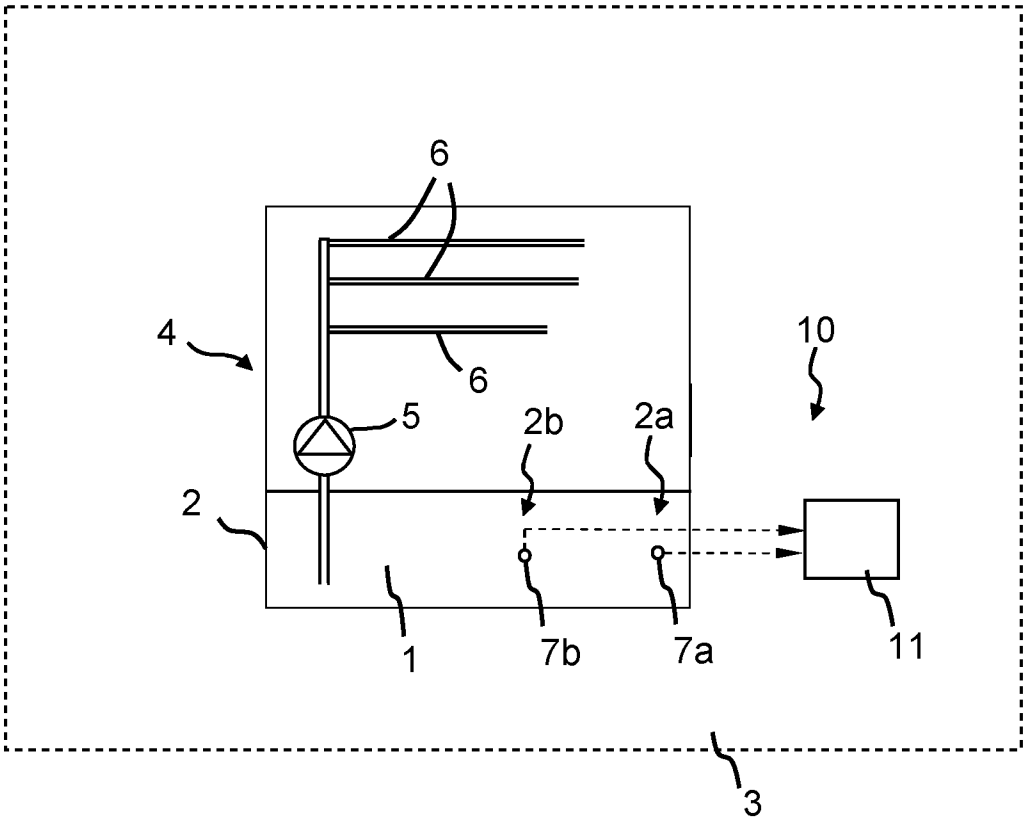

Fig 1

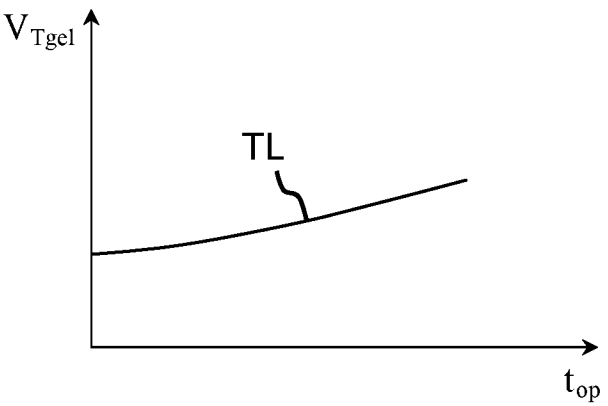

Fig 2

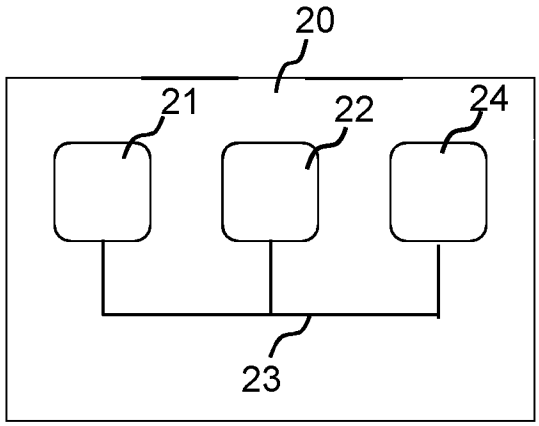

Fig 3

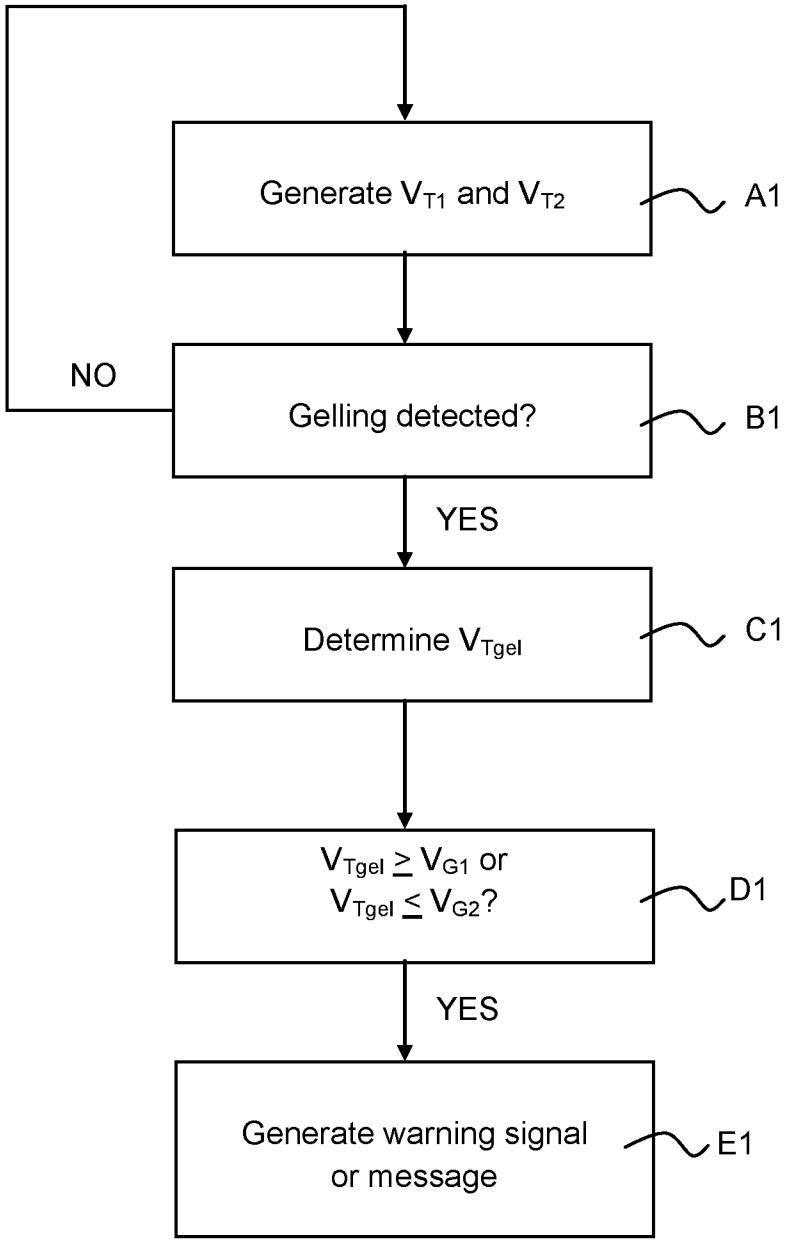
Generate V_{T1} and V_{T2}
A1
NO
Gelling detected?
B1
YES
Determine V_{Tgel}
C1
$V_{Tgel} \geq V_{G1}$ or
$V_{Tgel} \leq V_{G2}$?
D1
YES
Generate warning signal
or message
E1

Fig. 4

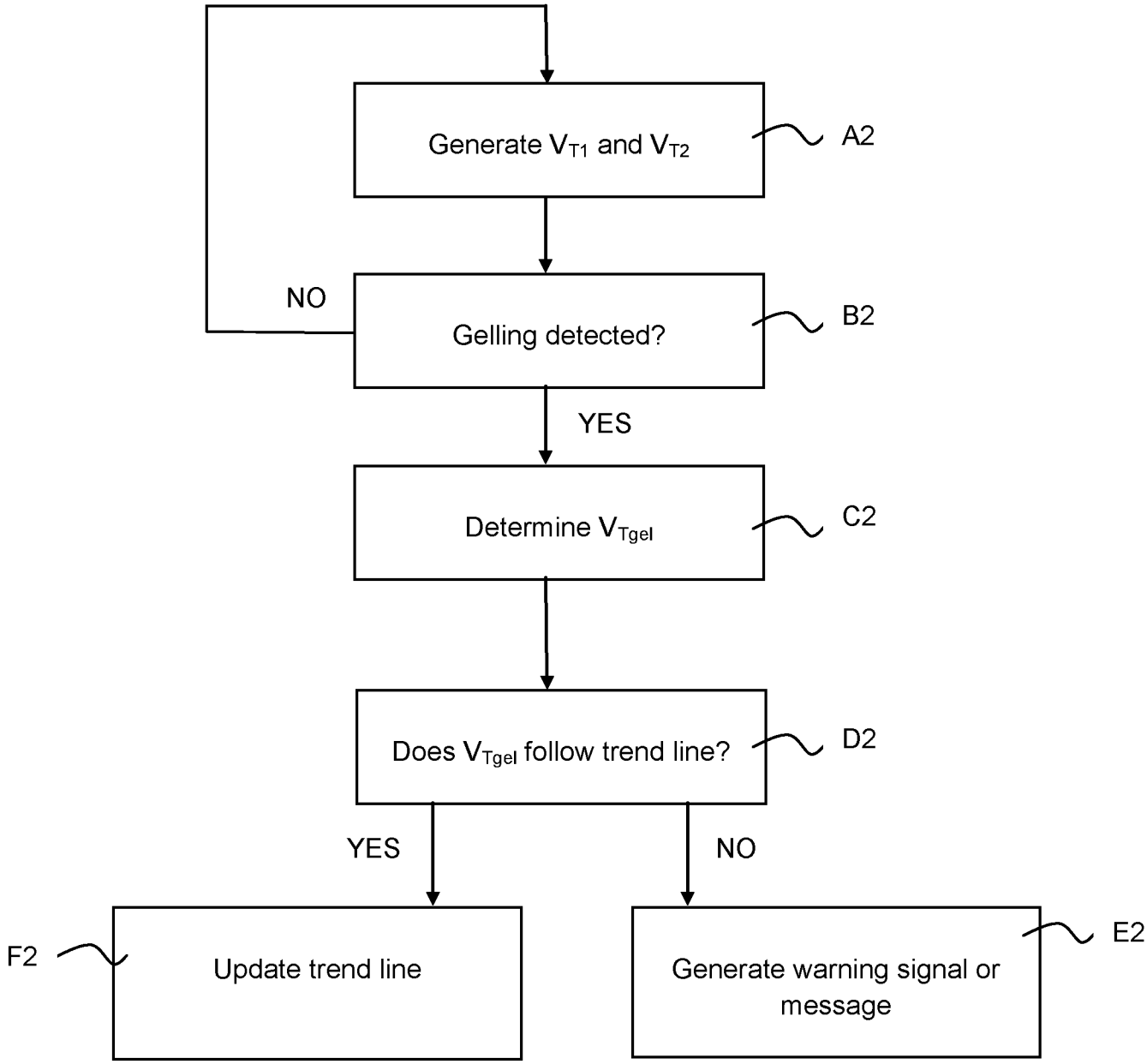
Generate V_{T1} and V_{T2}
A2
NO
Gelling detected?
B2
YES
Determine V_{Tgel}
C2
Does V_{Tgel} follow trend line?
D2
YES
NO
F2
Update trend line
Generate warning signal or message
E2

Fig. 5

INTERNATIONAL SEARCH REPORT

International application No.
PCT/SE2012/050599

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: F01M, F16N, G01N

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, COMPENDEX, sae.org

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	DE 10013590 A1 (PORSCHE AG), 20 September 2001 (2001-09-20); abstract; figures --	1-15
A	EP 2159387 A1 (PFLANZENOELTECHNIK NORD GMBH), 3 March 2010 (2010-03-03); abstract; figures --	1-15
A	US 20050039521 A1 (HAN TAEYOUNG ET AL), 24 February 2005 (2005-02-24); abstract; figures --	1-15
A	GB 1029165 A (SHELL INT RESEARCH), 11 May 1966 (1966-05-11); figures; claims --	1-15

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

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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
10-07-2012	12-07-2012

Name and mailing address of the ISA/SE	Authorized officer
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INTERNATIONAL SEARCH REPORT

International application No.
PCT/SE2012/050599

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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A	US 20110125425 A1 (HALALAY ION C ET AL), 26 May 2011 (2011-05-26); abstract; figures --	1-15
A	US 20100180671 A1 (OKUYAMA YOSUKE ET AL), 22 July 2010 (2010-07-22); abstract; figures --	1-15
A	JP 1195906 A (SUZUKI MOTOR CO), 7 August 1989 (1989-08-07); (abstract) Retrieved from: PAJ database; figures 1-5 --	1-15
A	JP 62284914 A (SUZUKI MOTOR CO), 10 December 1987 (1987-12-10); (abstract) Retrieved from: PAJ database -- --------	1-15

International application No.
PCT/SE2012/050599

Continuation of: second sheet

International Patent Classification (IPC)

F01M 11/10 (2006.01)
F16N 29/00 (2006.01)
G01N 33/30 (2006.01)

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

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				CN	101680318	A	24/03/2010
				EP	2161419	A4	27/07/2011
				WO	2009004973	A1	08/01/2009
JP	1195906	A	07/08/1989	JP	2576563	B2	29/01/1997
JP	62284914	A	10/12/1987	NONE			