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(71) Applicant *(for all designated States except US)*: SCANIA CV AB [SE/SE]; S-151 87 Södertälje (SE).

(72) Inventors; and
(75) Inventors/Applicants *(for US only)*: JUHLIN-DANNFELT, Peter [SE/SE]; Cedergrensvägen 35, S-126 36 Hägersten (SE). BOSTRÖM, Richard [SE/SE]; Tjäderspelsvägen 6B, S-155 30 Nykvarn (SE).

(74) Agent: GARDEMARK, Niklas; Scania CV AB, S-151 87 Södertälje (SE).

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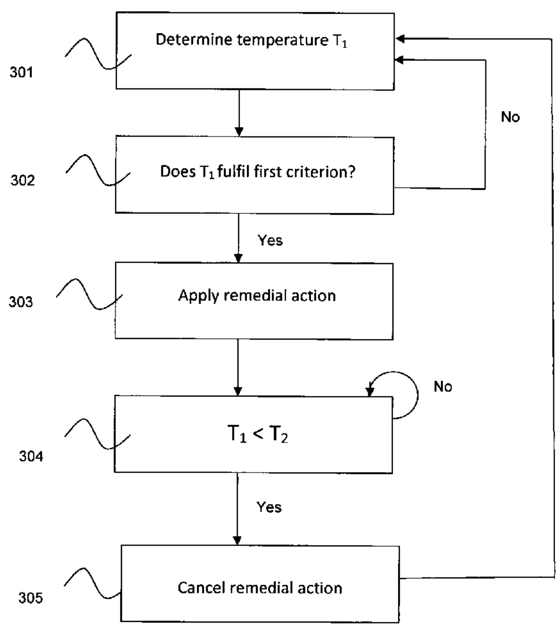
(54) Title: METHOD AND SYSTEM PERTAINING TO AN AUTOMATICALLY CONTROLLED CLUTCH

FIG. 3 300



(57) Abstract: The present invention relates to a method for control of a clutch (106) of a vehicle (100), which clutch is automatically controlled by a vehicle control system, such that opening and/or closing of said clutch (106) is effected by means of a clutch actuator (115) which comprises at least one first clutch actuator component (208, 212, 213, 214). The method comprises : - determining a first temperature value for said at least one first clutch actuator component (208, 212, 213, 214), and - reducing the use of said clutch (106) by the control system during driving of said vehicle (100) when said first temperature value fulfils a first criterion in the form of a temperature limit.

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Method and system pertaining to an automatically controlled clutch

Field of the invention

The present invention relates to a method for use with automatically controlled clutches in vehicles. The invention relates in particular to a method according to the preamble of claim 1 for control of a vehicle's clutch which is controlled by a control system. The invention relates also to a system and a vehicle.

Background to the invention

There are many different variants of power trains for vehicles. It is often desirable that heavy vehicles be drivable as comfortably as possible for the driver. This means, for example, that the gear changes of the gearbox should be executed automatically by the control system usually incorporated in the vehicle. Gearboxes which change gear automatically are therefore also usual in heavy vehicles.

This automatic gear changing is usually effected not by automatic gearboxes in a traditional sense but by gear changes in "manual" gearboxes being controlled by a control system, partly because manual gearboxes are substantially less expensive to make, but also because of their greater efficiency compared with a conventional automatic gearbox. The efficiency of automatic gearboxes of the type usually incorporated in passenger cars is often too low, compared with a manually operated gearbox, for them to be justified.

For this reason, automatically operated "manual" gearboxes are commonly used, particularly for heavy vehicles which are largely used in agriculture or on motorways.

The actual gear change method in such gearboxes may vary, and in one type of method a clutch pedal is only used for setting the vehicle in motion from stationary, whereas gear changes when the vehicle is already in motion are effected by the vehicle's control system without using the clutch, by the torque delivered from the engine being adjusted to a suitable level in order to reduce the torque transmitted at the engagement point of the relevant gears.

Another type of method uses instead a clutch which is automatically controlled during upshifts/downshifts, so the driver has access to only an accelerator pedal and a brake pedal, precisely as in a vehicle with conventional automatic gear changing.

Control of the automatically controlled clutch is conducted by using the vehicle's control system to control a clutch actuator. The clutch actuator may for example comprise one or more pneumatically controlled pistons acting upon a lever, whereby the clutch is opened/closed by a lever movement effected by said pistons.

The clutch actuator may also be of electrical type. A clutch actuator of electrical type affords the advantage that control (opening/closing) of the clutch can be effected more quickly and with greater accuracy. Clutch actuators of electrical type do however have the disadvantage that components may become overheated, possibly causing malfunctions and/or damage to components. There is thus a need for a clutch actuator whereby such problems due to overheating can be reduced and/or completely avoided.

Summary of the invention

An object of the present invention is to propose a method for control of a vehicle's clutch which is controlled by a control system by means of a clutch actuator, such that the risk of overheating of one or more clutch actuator components can be reduced and/or completely avoided.

This object is achieved with a method according to claim 1.

The present invention relates to a method for control of a vehicle's clutch which is automatically controlled by a vehicle control system, such that opening and/or closing of said clutch are effected by means of a clutch actuator which comprises at least one first clutch actuator component, which method comprises:

- determining a first temperature value for said at least one first clutch actuator component, and

- reducing the control system's use of said clutch during driving of said vehicle when said first temperature value fulfils a first criterion.

Clutch actuators, especially of electrical type, are subject to being warmed in operation not only by heat from the usually very warm surroundings in which the clutch actuator is situated, generally in close association with engine/gearbox, but also by its own temperature rise due to the electric current which passes through the clutch actuator's components when it is active. This internal temperature rise may lead to risk that one or more of the clutch actuator's components may become overheated and thereby be damaged.

The present invention affords the advantage that overheating of the clutch actuator's components can be avoided, with the consequent advantage that temperature-related damage to them can be avoided.

The clutch actuator may further comprise, for example, a microprocessor to control, for example, power circuits to an electric motor. If the microprocessor's temperature becomes too high, it can be switched off by its own protection circuits, which means that the clutch cannot then be used at all until the microprocessor's temperature has dropped to a level at which it can be reactivated. The present invention also makes it possible to avoid such undesirable interruptions.

Further characteristics of the present invention and advantages thereof are indicated by the detailed description set out below of embodiment examples and the attached drawings.

Brief description of the drawings

Fig. 1a depicts a power train in a vehicle in which the present invention may with advantage be used.

Fig. 1b depicts an example of a control unit in a vehicle control system.

Fig. 2 depicts in more detail a clutch and a clutch actuator for the vehicle depicted in Fig. 1a.

Fig. 3 is a flowchart illustrating an example of a method for control of the clutch actuator according to an example of an embodiment of the present invention.

Detailed description of embodiment examples

Fig. 1a depicts an example of a power train in a heavy vehicle 100, e.g. a truck, bus or the like, according to an example of an embodiment of the present invention. The vehicle 100 schematically depicted in Fig. 1a comprises only one axle with powered wheels 113, 114 but the invention is also applicable in vehicles which have more than one axle provided with powered wheels. The power train comprises a combustion engine 101 connected in a conventional way, via an output shaft 102 of the engine 101, usually via a flywheel (not depicted), to an automatically operated gearbox 103 via a clutch 106.

However, heavy vehicles used largely in agriculture or on motorways are usually provided, as mentioned above, not with automatic gearboxes in a traditional sense but with "manual" gearboxes in which gear changes are controlled by a control system. This is partly because manual gearboxes are substantially less expensive to manufacture, but also because of their greater efficiency and consequently lower fuel consumption.

The clutch 106 takes the form of an automatically controlled clutch. The clutch 106 is also of disc type whereby a friction element (disc) 110 connected to a first gearbox element, e.g. the input shaft 118 of the gearbox 103, engages selectively with the engine's flywheel 102 to transmit driving force from the combustion engine 101 to powered wheels 113, 114 via the gearbox 103. The engagement of the clutch disc 110 with the engine's output shaft 102 is controlled by means of a pressure plate 111 which is movable sideways, e.g. by a lever 112, the function of which is controlled by a clutch actuator 115. The influence of the clutch actuator 115 upon the lever 112 is controlled by the vehicle's control system, in this case by means of a control unit 116. The clutch actuator is described in more detail below with reference to Fig. 2.

Control systems in modern vehicles usually consist of a communication bus system comprising one or more communication buses for connecting together a number of electronic control units (ECUs), or controllers, and various components located on the vehicle. Such a control system may comprise a large number of control units, and the responsibility for a specific function may be divided between two or more of them.

For the sake of simplicity, Fig. 1a depicts only two such electronic control units 116, 117 which respectively control in this embodiment the engine 101 and clutch 106 and the gearbox 103 (two or more from among engine, gearbox and clutch may alternatively be arranged to be controlled by one and the same control unit or by other undepicted control units).

Control units of the type depicted are normally adapted to receiving sensor signals from various parts of the vehicle, e.g. from gearbox, engine, clutch and/or other control units or components located on the vehicle. The control of the control units normally depends on signals from other control units, e.g. the control of the clutch actuator 115 by the control unit 116 will probably depend, for example, on information received from, for example, the control unit which is responsible for the function of the gearbox 103, and from the control unit/units which control engine functions, e.g. the control unit 117.

The control units are further adapted to delivering control signals to various parts and components of the vehicle, e.g. engine, clutch and gearbox, for their control. The present invention may be implemented in any of the above control units, or in some other suitable control unit in the vehicle's control system.

The control of various parts and components in the vehicle, e.g. the clutch actuator, is often governed by programmed instructions. These programmed instructions take typically the form of a computer programme which, when executed in a computer or control unit, causes the computer/control unit to effect desired forms of control action, e.g. method steps according to the present invention. The computer programme usually takes the form of computer programme products 109 which are stored on a digital storage medium 121 (see Fig. 1b), e.g. ROM (read-only memory), PROM (programmable read-only memory), EPROM (erasable PROM), flash memory, EEPROM (electrically erasable PROM), a hard disc unit etc., in combination with or in the control unit, and are executed by the control unit. The vehicle's behaviour in a specific situation can therefore be adjusted by altering the computer programme's instructions.

An example of a control unit (the control unit 116) is depicted schematically in Fig. 1b and may comprise a calculation unit 120 which may take the form of substantially any suitable type of processor or microcomputer, e.g. a circuit for digital signal processing (Digital Signal Processor, DSP), or a circuit with a predetermined specific function (Application Specific Integrated Circuit, ASIC). The calculation unit 120 is connected to a memory unit 121 which is situated in the control unit 116 and which provides the calculation unit 120 with, for example, the stored programme code 109 and/or the stored data which the calculation unit 120 needs in order to be able to perform calculations. The calculation unit 120 is also adapted to storing partial or final results of calculations in the memory unit 121.

The control unit 116 is further provided with respective devices 122, 123, 124, 125 for receiving and sending input and output signals. These input and output signals may comprise waveforms, pulses or other attributes which the input signal receiving devices 122, 125 can detect as information and which can be converted to signals processable by the calculation unit 120. These signals are then supplied to the calculation unit 120. The output signal sending devices 123, 124 are adapted to converting signals received from the calculation unit 120 in order, e.g. by modulating them, to create output signals which can be transmitted to other parts of the vehicle's control system and/or the component/components for which they are intended.

Each of the connections to the respective devices for receiving and sending input and output signals may take the form of one or more from among a cable, a data bus, e.g. a CAN (Controller Area Network) bus, a MOST (Media Orientated Systems Transport) bus or some other bus configuration, or a wireless connection.

The vehicle 100 further comprises drive shafts 104, 105 connected to its powered wheels 113, 114 and driven by an output shaft 107 from the gearbox 103 via a final gear 108, e.g. a conventional differential.

Fig. 2 depicts the clutch actuator 115 in more detail. The clutch actuator depicted in Fig. 2 is merely a non-limitative example of an electrically controlled clutch actuator. As mentioned above, the clutch is operated by the clutch actuator 115 opening/closing it by using the lever 112 to move the pressure plate 111 in axial directions along the gearbox input shaft 118.

The lever pivots about a pivot pin 201 and the movement of the lever is controlled by a piston 202 acting in a hydraulic cylinder 203. The lever is connected to the pressure plate 111 via a disengaging (clutch release) bearing. The disconnecting bearing and the pressure plate are linked together via an intermediate spring (not depicted) such that when the lever draws in the disconnecting bearing (i.e. moves the disconnecting bearing to the right in the diagram, which shows the disconnecting bearing in the extreme right position, i.e. with the clutch fully open) the pressure plate will (via the spring) draw apart (open) the clutch. Conversely, the spring will push the flywheel, the disc and the pressure plate together (i.e. close the clutch) when the force exerted upon the lever by the piston 202 decreases.

The cylinder 203 receives its control pressure from a second hydraulic cylinder 205. The cylinder 205 comprises a movable piston 206, the movement of which is controlled by a threaded rod 210 whose own movement is controlled by an electric motor 208.

The rotation of the electric motor 208 is converted to linear motion of the threaded rod 210 by means of a ball screw (not depicted). The ball screw is rotated by the electric motor 208, making it possible for the threaded rod to be moved to and fro in the direction of the arrows by rotation of the electric motor and hence of the ball screw, and the linear motion of the threaded rod is converted to linear motion of the piston 206.

Movement of the piston 206 into the cylinder 205 (i.e. to the left in the diagram) increases the hydraulic pressure in the pressure chamber 205a and hence also the pressure in the pressure chamber 203a in the cylinder 203, which is connected to the pressure chamber 205a. When the pressure generated by the piston 206 in the pressure chamber 203a (205a) exerts a force on the piston 202 which exceeds the force exerted by the spring between the pressure plate and the disconnecting bearing, the clutch will therefore open as above. When thereafter the pressure in the pressure chamber 203a drops because the direction of rotation of the motor is reversed so that the piston 206 moves to the right in the diagram, the clutch will close once the spring force exceeds the force exerted by the hydraulic fluid.

The electric motor makes it possible to achieve very rapid opening/closing of the clutch while at the same time the position of the lever, and hence of the pressure plate, is controlled with very great precision to effect opening/closing of the power train (by means of the clutch) in such a way as to be as imperceptible to the driver as possible.

The electric motor 208 may be of any suitable type, e.g. in the present example a brushless DC motor. A brushless DC motor is identical in principle with a three-phase permanent magnet motor. The electric motor 208 is powered via power stages 212, with power circuits, e.g. comprising two transistors for each phase winding. Opening/closing of the transistors is controlled by a microprocessor 213 which may be incorporated together with said power stages 212 on a circuit card 214. The microprocessor 213 and the power stages 212 are powered via a power supply 215, and the microprocessor receives control signals 216, e.g. from the control unit 116, for appropriate modulation of said power stages and hence the electric motor to effect desired opening/closing of the clutch.

Owing to the forces involved in, and the rapidity required for, opening/closing of the clutch, the electric motor draws a great deal of current during said opening/closing, leading to warming of both the electric motor 208 and its power stages 212. If said power stages 212 are on the same circuit card 214 as the microprocessor 213 as above, heat is also transferred to the latter. Moreover, the clutch actuator is usually situated on the gearbox, i.e. in the vicinity of the combustion engine, which means that the clutch actuator’s surroundings may be very warm. This leads to its components being warmed not only by use during opening/closing of the clutch but also by thermal radiation from the engine. There is also warming by heat flow through the material of the gearbox.

All this warming may result in one or more of the clutch actuator’s components becoming overheated, e.g. the microprocessor and/or one or more power circuits and/or the electric motor. Overheating of any of the clutch actuator’s components is likely to cause permanent damage possibly necessitating replacement of the clutch actuator. This leads to the vehicle becoming undrivable and needing to be towed to a workshop. The present invention makes it possible to avoid such scenarios.

According to the present invention, the way the control system uses the clutch (the clutch actuator) is altered when there is such risk of overheating. Fig. 3 is an example of a flowchart of a method example 300 according to the present invention. At step 301 a representation of a temperature T_1 is determined for at least one clutch actuator component. This temperature T_1 may for example be determined for the component which is likely to be the first to become overheated. For example, the various components of the clutch actuator may have different temperature tolerances, so the temperature is determined for the clutch actuator component which most quickly reaches a critical temperature. This component may for example be identified in advance, e.g. on the basis of product specifications and/or actual tests.

Alternatively, a temperature may be determined for two or more of the clutch actuator's components, to reduce the risk of any components inadvertently reaching critical temperatures.

According to an embodiment, the one or more temperatures T_1 are determined directly by means of one or more temperature sensors. For example, temperature sensors may be provided on the circuit card and/or the electric motor. Moreover, microprocessors usually have a built-in temperature sensor, in which case this too may be used in said temperature determination.

Instead of using temperature sensors, it is possible in an alternative embodiment example to use an ambient temperature. This ambient temperature may for example be obtained via the vehicle's control system from any existing temperature sensor situated adjacent to or in the vicinity of the engine and/or the gearbox, in which case temperatures for the clutch actuator's components may then be modelled on the basis of said temperature. For example, the temperatures of the power stages and/or the electric motor may be modelled by means of said ambient temperature determined and the current which has passed through the power stages/the electric motor during a certain time. This current may for example be determined by means of one or more current sensors.

When said one or more temperatures T_1 have been determined at step 301, the method moves on to step 302, where it determines whether said one or more temperatures T_1 determined fulfil a first criterion. This criterion may for example take the form of a temperature limit T_g. This makes it possible to take remedial action if it is found that the temperature determined is above the temperature limit. The temperature limit is set at a lower temperature than the clutch actuator's critical temperature T_k.

This temperature limit T_g may often be relatively close to, e.g. 5° or 10° lower than, the critical temperature. Examples of critical temperatures, e.g. for power circuits, microprocessors and electric motors, are within the range 100-150°, but actual critical temperatures do of course depend on the specific components incorporated in the clutch actuator. As well as the components exemplified above, the clutch actuator may also comprise other temperature-sensitive components.

Instead of being a temperature limit T_g, said first criterion may for example be a temperature derivative. By continuously determining a temperature for one or more clutch actuator components as above, it is possible to determine a derivative and, if the derivative is high, i.e. if the component temperature rises quickly, to take remedial action before a temperature limit is reached as above, in order to be reliably able to take appropriate remedial action before the critical temperature is reached.

If at step 302 it is found that remedial action is necessary, the method moves on to step 303, otherwise it goes back to step 301 to do a further temperature determination. At step 303, remedial action is taken to reduce the temperature of the clutch actuator. This is done according to the present invention by the vehicle, unlike during normal clutch use in the case of normal driving of the vehicle, being driven in such a way that its control system reduces or (in all or certain situations where the clutch actuator is normally used) totally ceases its use of the clutch actuator. This may for example be achieved by the driving of the vehicle being put into a mode for reduced clutch use. Said reduced clutch use is thus activated at step 303 and may comprise one or more forms of remedial action to reduce the temperature of the clutch actuator.

Examples of such remedial action are indicated below. The clutch is normally so arranged that in an uninfluenced state, i.e. when the clutch actuator is not activated, the clutch is kept closed by spring force. Opening the clutch, e.g. during gear changes, results in further heat arising from the current required by the electric motor 208 for operating the lever 211 to open the clutch.

According to an embodiment of the present invention, clutch actuator use during gear changing is reduced not by opening the clutch at each gear change to ensure that there is no torque load on the gearbox during gear changing, but by controlling the torque delivered from the vehicle's engine to a level which results in a power train subject to (substantially) no torque load, making it possible for the current gear to be disengaged and another gear to be engaged without opening the clutch and hence without activation of the clutch actuator and without risk of damage to the vehicle's power train. This type of gear change usually takes place on vehicles in which a clutch pedal is used to set the vehicle in motion from stationary, whereas all subsequent gear changes are effected by the clutch being operated by the vehicle's control system.

This procedure thus makes it possible for all gear changes while the vehicle is in motion to take place without using the clutch, such that the temperature increase in the clutch actuator ceases and the temperature in most cases also begins to drop. Thus reducing or completely eliminating the use of the clutch actuator makes it possible to avoid overheating of its components while still maintaining full drivability and only potentially causing discomfort for the vehicle driver. When remedial action has been taken at step 303, the method moves on to step 304, in which the temperature of the one or more clutch actuator components is continuously monitored. When the temperature T_1 has dropped to some specific level, e.g. 5° or 10° or some other suitable number of degrees below said limit level, the method can move on to step 305, in which the vehicle's driving reverts to normal use of the clutch actuator.

At step 303, further forms of remedial action alternative or additional to the above may be taken. Braking to a halt normally involves opening the clutch so that the vehicle can come to a halt without the engine stalling. Instead of opening the clutch when braking to a halt, neutral gear may be engaged so that the vehicle can come to a halt without opening the clutch.

Alternatively, the amount of time for which the clutch is open with the vehicle stationary may be limited. An example of a solution for limiting the amount of time for which the clutch is open is referred to in the parallel patent application **"Method and system pertaining to a clutch"** (Swedish application number 1050098-1) with the same application date as the present application, and the same applicant.

Moreover, when the gearbox is in a driving state with the vehicle stationary, a gear is normally engaged, in which case the clutch will also be open to make it possible for it to close quickly when the vehicle is to be set in motion again. According to an embodiment example, the gear is instead not engaged until the vehicle is about to be set in motion, which may for example be determined by the driver pressing the accelerator pedal. This leads to the clutch opening only when the driver actually presses the accelerator pedal, making it possible to avoid long standstill times with the clutch open and to give the temperature of the clutch actuator's components time to recover.

Although this means a certain delay when setting the vehicle in motion, it can still in principle be driven as normal with only slight discomfort.

Control systems in heavy vehicles are also normally arranged to use, for example, road gradient and current vehicle weight as a basis for choosing an appropriate initial gear, i.e. the gear which the vehicle is to slide into by means of the clutch. As high an initial gear as possible is normally chosen to make it possible to quickly accelerate the vehicle to desired speed without frequent gear changes. According to the present invention, what is instead engaged initially is the lowest gear, or at least a low gear, so that sliding of the clutch will take place for as short a time as possible, so that the clutch actuator is activated for as short a time as possible.

As well as the above forms of remedial action, the vehicle's one or more cooling fans may also be run at high or maximum levels to provide components surrounding the clutch actuator with as much cooling as possible and thereby try to reduce their temperature.

Driving the vehicle in said mode for reduced clutch use may involve applying all of the above forms of remedial action or only one of them or any desired combination of two or more of them. After the vehicle (the control system) has reverted at step 305 to normal use of the clutch, the method goes back to step 301 for further temperature determination.

The present invention thus affords the advantage that overheating of clutch actuator components can be avoided, making it also possible to avoid temperature-related damage to the clutch actuator. This also makes it possible to avoid situations in which the vehicle becomes undrivable and has to be towed to a workshop.

The invention is described above in relation to a specific type of electrically controlled clutch, but it should be noted that Fig. 2 depicts merely a schematic example of an electrically controlled clutch actuator and that electrically controlled clutch actuators according to various different principles are described in prior art. The present invention is applicable irrespective of the actual configuration of the clutch actuator, provided that it comprises electrical components with consequent risk of overheating.

Although various embodiments of the present invention are exemplified above, specialists in the particular field will appreciate that variations and modifications are feasible without deviating from the invention. The invention is therefore not limited other than as indicated in the attached claims.

Claims

1. A method for control of a clutch (106) of a vehicle (100), which clutch is automatically controlled by a vehicle control system, such that opening and/or closing of said clutch (106) are effected by means of a clutch actuator (115) which comprises at least one first clutch actuator component (208, 212, 213, 214), **characterised** in that said method comprises:
- determining a first temperature value for said at least one first clutch actuator component (208, 212, 213, 214), and
- reducing the use of said clutch (106) by the control system during driving of said vehicle (100) when said first temperature value fulfils a first criterion in the form of a temperature limit.

2. A method according to claim 1, whereby the control system is put into a temperature-reducing mode when said first temperature value fulfils said first criterion, in which mode the use of the clutch is reduced or totally ceases in at least one first situation as compared with normal clutch use during driving of the vehicle (100).

3. A method according to claim 1 or 2, whereby said clutch actuator (115) comprises a plurality of clutch actuator components (208, 212, 213, 214) and temperature values are determined for said first clutch actuator component (208, 212, 213, 214) and at least one further clutch actuator component (208, 212, 213, 214).

4. A method according to any one of claims 1-3, whereby said one or more temperatures are determined by means of one or more temperature sensors.

5. A method according to any one of claims 1-3, whereby said one or more temperature values are determined on the basis of at least one ambient temperature.

6. A method according to claim 5, whereby said ambient temperature is obtained by means of existing temperature sensors situated adjacent to said engine (101) and/or gearbox (103).

7. A method according to claim 5 or 6, whereby said one or more temperature values are determined by modelling based on said ambient temperature determined.

8. A method according to any one of claims 1-7, whereby a plurality of successive determinations of said first temperature value are done for at least one first said clutch actuator component (208, 212, 213, 214), and said first criterion is determined on the basis of a derivative for said temperature value determinations.

9. A method according to any one of the foregoing claims, further comprising:
- determining a plurality of successive temperature values for said at least one clutch actuator component (208, 212, 213, 214), and
- reverting to normal use of said clutch (106) when said temperature value is below a second temperature limit, said second limit being below said first temperature limit.

10. A method according to any one of the foregoing claims, whereby said clutch actuator (115) takes the form of an electrical clutch actuator.

11. A method according to claim 10, whereby said at least one clutch actuator component (208, 212, 213, 214) takes the form of one or more from among microprocessor (213), power stages for an electric motor (212) and electric motor (208).

12. A method according to any one of the foregoing claims, whereby said reduced use of said clutch (106) is achieved by one or more of the following forms of remedial action:

- changing gear without opening the clutch (106),
- engaging lower gear than normal when setting the vehicle (100) in motion from stationary,
- engaging neutral gear when braking to a halt,
- at standstill, not engaging gear until the vehicle (100) is to be set in motion,
- at standstill, engaging neutral gear and closing the clutch (106) when a first period of time has elapsed.

13. A computer programme which comprises programme code and which, when said programme code is executed in a computer, causes said computer to apply the method according to any of claims 1-12.

14. A computer programme product comprising a computer-readable medium and a computer programme according to claim 13, which computer programme is contained in said computer-readable medium.

15. A system for control of a vehicle's clutch (106) which is automatically controlled by a vehicle control system, such that opening and/or closing of said clutch (106) are effected by means of a clutch actuator (115) which comprises at least one first clutch actuator component (208, 212, 213, 214), **characterised** in that the system comprises:

- means for determining a first temperature value for said at least one first clutch actuator component (208, 212, 213, 214), and
- means for reducing the use of said clutch (106) by the control system during driving of said vehicle (100) when said first temperature value fulfils a first criterion in the form of a temperature limit.

16. A vehicle **characterised** in that it comprises a system according to claim 15.

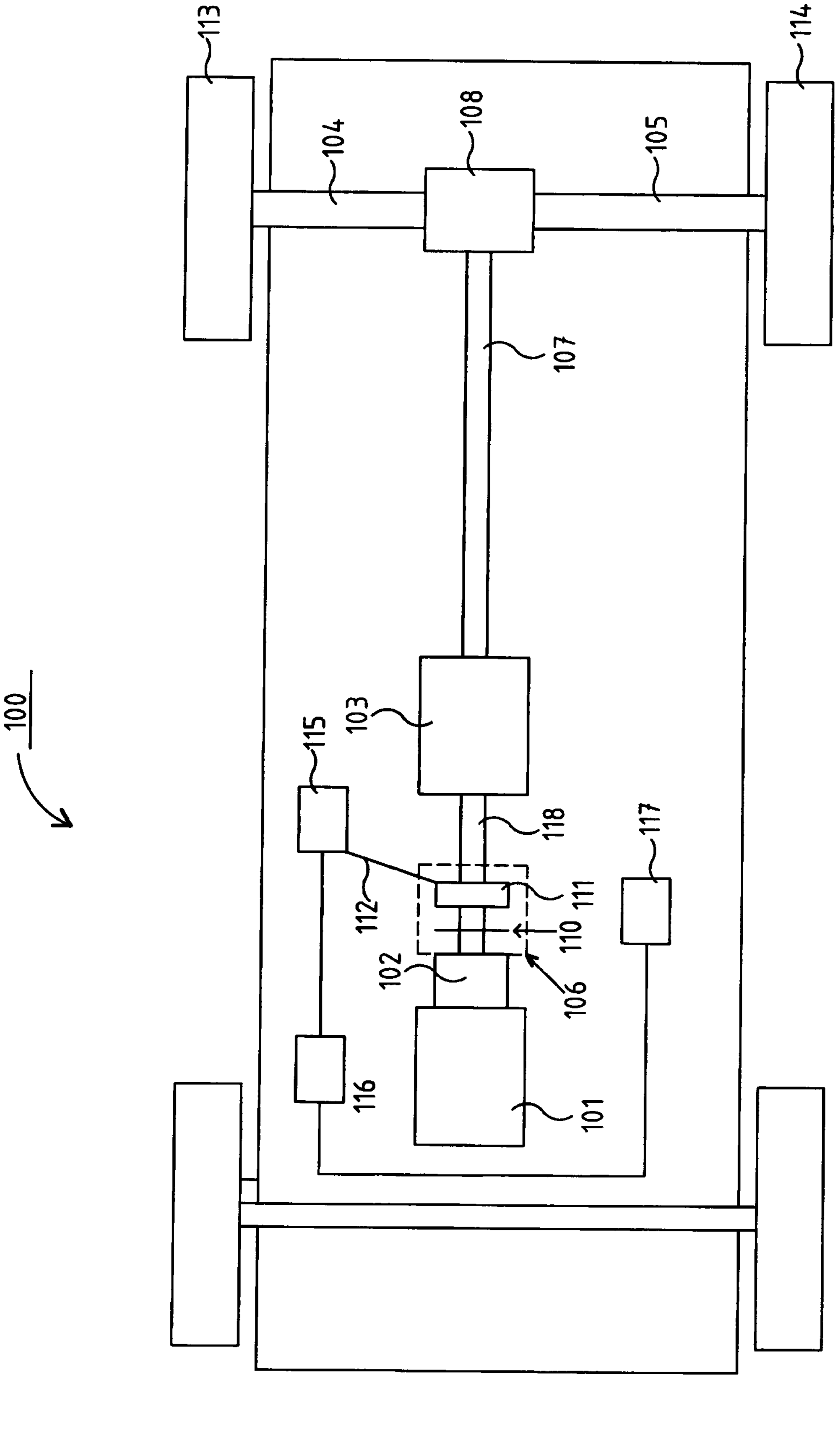
113
114
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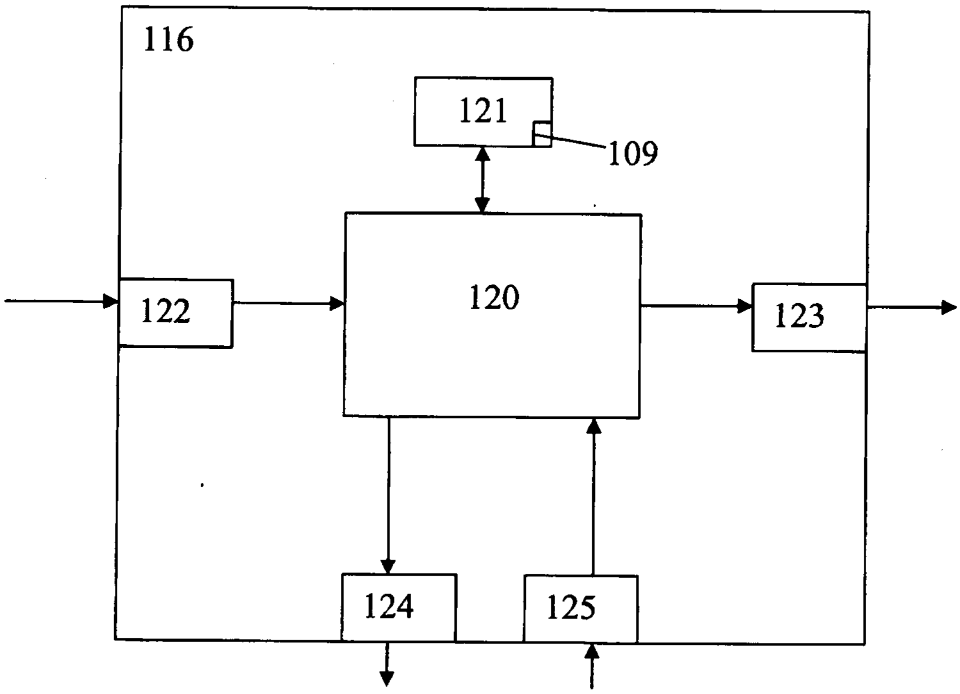
FIG. 1a

Fig. 1b



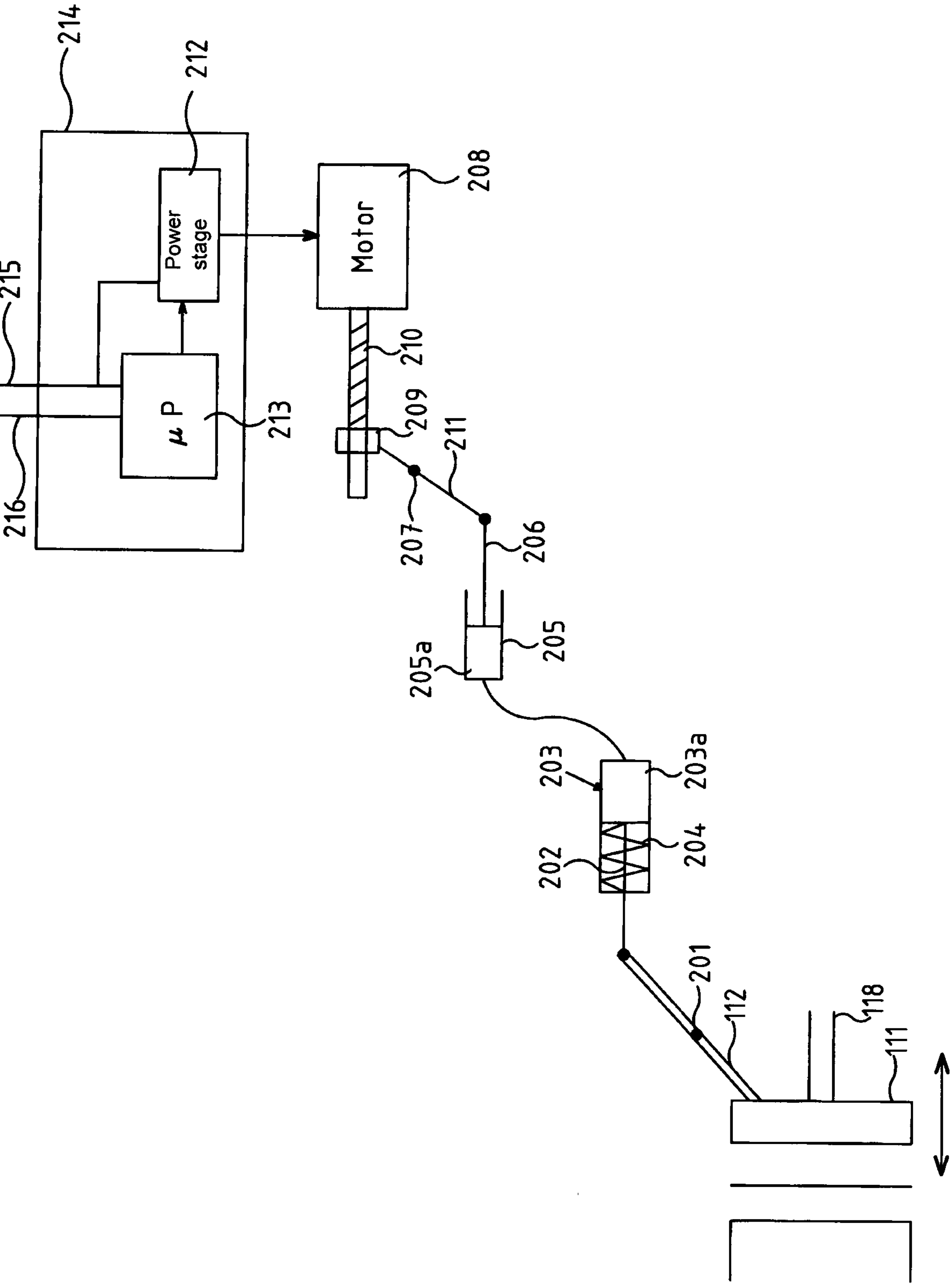
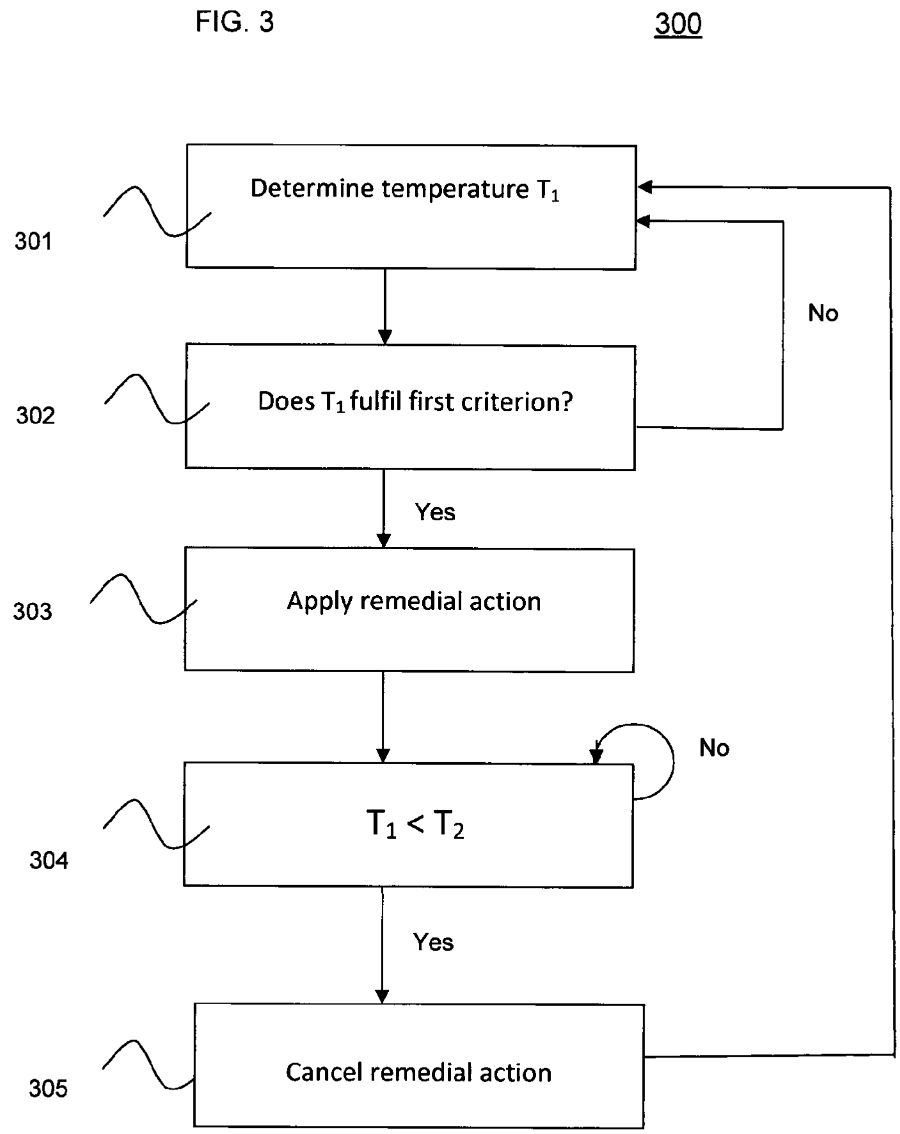

214
212
Power stage
215
216
μP
213
Motor
208
210
209
211
207
206
205
205a
203
203a
204
202
201
112
118
111

FIG. 2

FIG. 3


300
Determine temperature T_1
301
Does T_1 fulfil first criterion?
302
No
Yes
Apply remedial action
303
$T_1 < T_2$
304
No
Yes
Cancel remedial action
305

INTERNATIONAL SEARCH REPORT

International application No.
PCT/SE2011/050095

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: F16D, B60K, B60W

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.
A	WO 2010007271 A2 (RENAULT S.A.S), 21 January 2010 (21.01.2010), figures 1-3, abstract --	1-16
A	EP 1783393 A2 (TOYOTA JIDOSHA KABUSHIKI KAISHA), 9 May 2007 (09.05.2007), figures 1-6, abstract --	1-16
A	GB 2233729 A (MITSUBISHI DENKI KABUSHIKI KAISHA), 16 January 1991 (16.01.1991), figures 1-5, abstract --	1-16
A	DE 102004023581 A1 (ADAM OPEL AG), 8 December 2005 (08.12.2005), figure 1, abstract --	1-16

[X] Further documents are listed in the continuation of Box C. [X] See patent family annex.

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"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

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Date of the actual completion of the international search	Date of mailing of the international search report
11 April 2011	13-04-2011

Name and mailing address of the ISA/	Authorized officer
Swedish Patent Office Box 5055, S-102 42 STOCKHOLM Facsimile No. +46 8 666 02 86	Jan-Axel Ylivainio / EÖ Telephone No. +46 8 782 25 00

INTERNATIONAL SEARCH REPORT

International application No.
PCT/SE2011/050095

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 6095946 A (MAGUIRE, JOEL MICHAEL ET AL), 1 August 2000 (01.08.2000), figures 1-4, abstract --	1-16
A	WO 2008036014 A1 (VOLVO LASTVAGNAR AB), 27 March 2008 (27.03.2008), figures 1, 2, abstract --	1-16
A	JP 2001045743 A, OGURA CLUTCH CO LTD, 2001-02-16; (abstract) Retrieved from: PAJ database; Original document: Figures 1-3 -- --------	1-16

International patent classification (IPC)
F16D 48/06 (2006.01)
B60K 23/02 (2006.01)

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

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				JP	2007126040	A	24/05/2007
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US	6095946	A	01/08/2000	NONE			
WO	2008036014	A1	27/03/2008	CN	101517260	A	26/08/2009
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				JP	2010503811	T	04/02/2010
				US	20100075804	A	25/03/2010