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(54) **Title**: A SYSTEM AND A METHOD FOR IMPROVED TAKE-OFF OF A VEHICLE

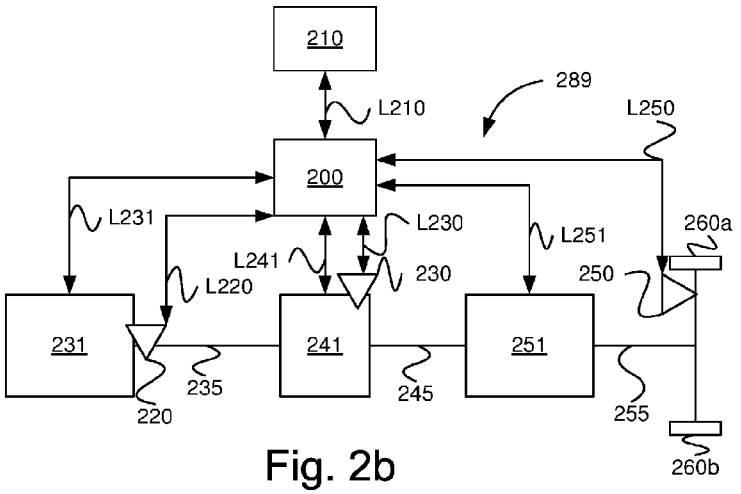

Fig. 2b

(57) **Abstract**: The invention relates to a method for improved take-off of a vehicle (100) having an Otto- engine (231) and a manually actuated clutch (241) of the vehicle transmission, comprising the steps of: - determining (s410) a first set (S1) of condition parameter values, said parameters comprising engine speed (Neng), vehicle speed (V), clutch position (CP), clutch position change rate (CPprim) and engaged gear step (GS) of a gearbox (251) of said transmission; - determining (s410) if said first set (S1) of condition parameter values meet first predetermined conditions; - if said first predetermined conditions of said first set (S1) of condition parameter values are met, activating (s420) a function (F) for providing an additional engine torque during take-off conditions so as to substantially maintain a prevailing engine speed (Neng) during activation of transmission operation. The invention relates also to a computer programme product comprising program code (P) for a computer (200; 210) for implementing a method according to the invention. The invention relates also to a system for improved take-off of a vehicle and a motor vehicle (100) equipped with the system.

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A system and a method for improved take-off of a vehicle

TECHNICAL FIELD

The present invention relates to a method for improved take-off of a vehicle having an Otto-engine and a manually actuated clutch of the vehicle transmission. The invention relates also to a computer program product comprising program code for a computer for implementing a method according to the invention. It relates also to a system for improved take-off of a vehicle having an Otto-engine and a manually actuated clutch of the vehicle transmission and a motor vehicle equipped with the system.

BACKGROUND ART

During take-off by a vehicle being equipped with a manually controlled clutch and gearbox an engine is experiencing peak loads when said clutch is engaging during a gear shifting process. This may result in discomfort of the operator of the vehicle. This may also result in that a prevailing engine speed is decreased abruptly resulting in impaired manoeuvrability and potential stalling. If undesired stalling occurs potentially hazardous situations may be at hand, in particular in city traffic or any other heavy traffic situations.

If the vehicle is operated with an Otto-engine (λ-controlled) supplied air and fuel are associated with some delays because of e.g. response time of vehicle internal components and execution of control functions.

US2012221223 depicts a method of operating a vehicle equipped with a pneumatic booster system. Herein a system for improving vehicle performance e.g. during start is provided, wherein air of a physical reservoir (pressure tank) is used for providing air to an engine complementing a turbo unit thereof.

SUMMARY OF THE INVENTION

An object of the present invention is to propose a novel and advantageous method for improved take-off of a vehicle having an Otto-engine and a manually actuated clutch of the vehicle transmission.

Another object of the invention is to propose a novel and advantageous system and a novel and advantageous computer program for improved take-off of a vehicle having an Otto-engine and a manually actuated clutch of the vehicle transmission.

Another object of the present invention is to propose a novel and advantageous method providing improved manoeuvrability of a vehicle during take-off in a cost efficient way.

Another object of the invention is to propose a novel and advantageous system and a novel and advantageous computer program providing improved manoeuvrability of a vehicle during take-off in a cost efficient way.

Yet another object of the invention is to propose a method, a system and a computer program achieving reduced risk of undesired stalling of a vehicle having an Otto-engine and a manually operated clutch and gearbox of a transmission thereof.

Yet another object of the invention is to propose a method, a system and a computer program providing low strain and avoidance of high peak loading of a transmission during take-off of a vehicle.

Yet another object of the invention is to propose an alternative method, an alternative system and an alternative computer program for improved take-off of a vehicle having an Otto-engine and a manually actuated clutch of the vehicle transmission.

Some of these objects are achieved with a method according to claim 1. Other objects are achieved with a system according to claim 5. Advantageous embodiments are depicted in the dependent claims. Substantially the same advantages of method steps of the innovative method hold true for corresponding means of the innovative system.

According to an aspect of the invention there is provided a method for improved take-off of a vehicle having an Otto-engine and a manually actuated clutch of the vehicle transmission, comprising the steps of:

- determining a first set of condition parameter values, said parameters comprising engine speed, vehicle speed, clutch position, clutch position change rate and engaged gear step of a gear box of said transmission;

- determining if said first set of condition parameter values meet first predetermined conditions;

- if said first predetermined conditions of said first set of condition parameter values are met, activating a function for providing an additional engine torque during take-off conditions so as to substantially maintain a prevailing engine speed during activation of transmission operation.

When certain predetermined conditions of said first set of condition parameter values are met before clutch engagement during take-off said additional engine torque is prepared to be available when said clutch is engaged during gear shifting. Hereby undesired stalling may be avoided. According to an example said additional engine torque is provided if:

- a prevailing engine speed is below a certain threshold value, e.g. below 1000 rpm;

- a vehicle speed is below a certain threshold value, e.g. below 5 km/h;

- said clutch is disengaged to a certain extent, e.g. more than 20% and less than 90% (where 100% indicates a fully open clutch state);

- a clutch position change rate is less than a certain threshold value, which threshold value may be any suitable predetermined clutch position change rate, e.g. -20% per sample (corresponding to a relatively rapid closure of the clutch arrangement, i.e. the clutch arrangement is moving towards a closed state); and

- a gear step other than a neutral gear step is engaged.

These conditions indicate that a gear shifting during take-off conditions is about to be performed. Hereby said additional engine torque is prepared to be available when the operator controls the clutch to be engaged.

Hereby said additional engine torque is provided so as to constitute a stand-by engine torque available when said transmission of said vehicle is activated for operation, i.e. when

said clutch is being engaged and said engine is propelling said vehicle during take-off. Said take-off may be from a state where said vehicle is standing still or a state where said vehicle is freewheeling at low speed.

The method may comprise the steps of:

- changing an ignition timing of the engine for postponing ignition so as to operate the engine less efficiently, and

- increasing a flow of air and fuel to said engine by engine control so as to provide said additional engine torque.

Hereby said additional engine torque is available when said clutch is engaged during gear shifting at take-off while compensated by said postponed ignition. Hereby undesired oscillation of a prevailing engine speed is avoided. An operator of the vehicle will hereby experience a powerful engine during clutch engagement. Hereby undesired stalling is also avoided because of said provision of said additional engine torque.

The method may comprise the steps of:

- determining a second set of condition parameter values, said parameters comprising engine speed, vehicle speed, clutch position, clutch position change rate, engaged gear step of said gear box of said transmission and time during which said function has been activated;

- determining if at least one condition parameter value of said second set of condition parameters meet a respective second predetermined condition; and

- if said at least one respective second predetermined condition of said second set of condition parameter values are met, de-activating said function for providing an additional engine torque during take-off conditions.

Hereby said additional engine torque is only provided when required. The inventive method hereby provides an automatic de-activation of said function when a certain condition parameter meets a predetermined condition. Hereby a reliable and robust method for improved take-off is provided. Hereby a user-friendly and convenient method for improved take-off is provided.

According to an example said function is de-activated if any following condition is met:

- said determined engine speed is larger than a predetermined engine speed threshold value, e.g. larger than 1000 rpm;

- said determined vehicle speed is larger than a predetermined vehicle speed threshold value, e.g. larger than 5 km/h;

- a determined clutch position is larger than a predetermined clutch position, e.g. larger than 80% or 90% (almost completely open clutch arrangement);

- said determined clutch position is less than a predetermined clutch position, e.g. less than 10% or 20%, during at least a predetermined time period, e.g. 2 seconds;

- said determined clutch position change rate is larger than a predetermined clutch position change rate, e.g. 20% per sample (corresponding to a relatively rapid opening of the clutch arrangement, i.e. the clutch arrangement is moving towards a fully opened state);

- said engaged gear step is equal to a neutral gear step;

- a determined time period during which said function has been activated is larger than a predetermined time period, e.g. 1, 3 or 5 seconds.

Said predetermined threshold values relating to de-activation of said function may be based on said certain threshold values for activating said function whereby respective hysteresis is applied. This is advantageous for reasons of robustness of the method. Hereby undesired activation/de-activation of said function is avoided.

The method may comprise the step of:

- de-activating said function for providing an additional engine torque during take-off conditions comprising the step of decreasing said additional engine torque in accordance with a predetermined profile. Hereby an operator of the vehicle may experience a comfortable de-activation of said function.

According to an aspect of the invention there is provided a system for improved take-off of a vehicle having an Otto-engine and a manually actuated clutch of the vehicle transmission, comprising:

- means for determining a first set of condition parameter values, said parameters comprising engine speed, vehicle speed, clutch position, clutch position change rate and engaged gear step of a gear box of said transmission;

- means for determining if said first set of condition parameter values meet first predetermined conditions;

- means for, if said first predetermined conditions of said first set of condition parameter values are met, activating a function for providing an additional engine torque during take-off conditions so as to substantially maintain a prevailing engine speed during activation of transmission operation.

The system may comprise:

- means for changing an ignition timing of the engine for postponing ignition so as to operate the engine less efficiently, and

- means for increasing a flow of air and fuel to said engine by engine control so as to provide said additional engine torque.

The system may comprise:

- means for determining a second set of condition parameter values, said parameters comprising engine speed, vehicle speed, clutch position, clutch position change rate, engaged gear step of said gear box of said transmission and time during which said function has been activated;

- means for determining if at least one condition parameter value of said second set of condition parameters meet a respective second predetermined condition; and

- means for, if said at least one respective second predetermined condition of said second set of condition parameter values are met, de-activating said function for providing an additional engine torque during take-off conditions.

Said means for de-activating said function for providing an additional engine torque during take-off conditions may be arranged for decreasing said additional engine torque in accordance with a predetermined profile.

According to an aspect of the invention there is provided a vehicle comprising a system according to what is presented herein. Said vehicle may be any from among a truck, bus or passenger car. According to an embodiment the system is provided for a marine application or industrial application.

According to an aspect of the invention there is provided a computer program for improved take-off of a vehicle having an Otto-engine and a manually actuated clutch of the vehicle transmission, wherein said computer program comprises program code for causing an electronic control unit or a computer connected to the electronic control unit to perform the steps according to anyone of the claims 1-4, when run on said electronic control unit or said computer.

According to an aspect of the invention there is provided a computer program for improved take-off of a vehicle having an Otto-engine and a manually actuated clutch of the vehicle transmission, wherein said computer program comprises program code stored on a computer-readable medium for causing an electronic control unit or a computer connected to the electronic control unit to perform the steps according to anyone of the claims 1-4.

According to an aspect of the invention there is provided a computer program for improved take-off of a vehicle having an Otto-engine and a manually actuated clutch of the vehicle transmission, wherein said computer program comprises program code stored on a computer-readable medium for causing an electronic control unit or a computer connected to the electronic control unit to perform the steps according to anyone of the claims 1-4, when run on said electronic control unit or said computer.

According to an aspect of the invention there is provided a computer program product containing a program code stored on a computer-readable medium for performing method steps according to anyone of claims 1-4, when said computer program is run on an electronic control unit or a computer connected to the electronic control unit.

According to an aspect of the invention there is provided a computer program product containing a program code stored non-volatile on a computer-readable medium for performing method steps according to anyone of claims 1-4, when said computer program is run on an electronic control unit or a computer connected to the electronic control unit.

Further objects, advantages and novel features of the present invention will become apparent to one skilled in the art from the following details, and also by putting the invention into practice. Whereas the invention is described below, it should be noted that it is not confined to the specific details described. One skilled in the art having access to the teachings herein will recognise further applications, modifications and incorporations in other fields, which are within the scope of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

For fuller understanding of the present invention and its further objects and advantages, the detailed description set out below should be read in conjunction with the accompanying drawings, in which the same reference notations denote similar items in the various diagrams, and in which:

Figure 1 schematically illustrates a vehicle according to an embodiment of the invention;

Figure 2a schematically illustrates a subsystem of the vehicle depicted in Figure 1, according to an embodiment of the invention;

Figure 2b schematically illustrates a subsystem of the vehicle depicted in Figure 1, according to an embodiment of the invention;

Figure 3 schematically illustrates a diagram relating to an embodiment of the invention;

Figure 4a is a schematic flowchart of a method according to an embodiment of the invention;

Figure 4b is a more detailed schematic flowchart of a method according to an embodiment of the invention; and

Figure 5 schematically illustrates a computer according to an embodiment of the invention.

DETAILED DESCRIPTION

Figure 1 depicts a side view of a vehicle 100. The exemplified vehicle 100 comprises a tractor unit 110 and a trailer 112. The vehicle 100 may be a heavy vehicle, e.g. a truck or a bus. It may alternatively be a car.

It should be noted that the inventive system is applicable to various vehicles, such as e.g. a mining machine, tractor, dumper, wheel loader, platform comprising an industrial robot, forest machine, earth mover, road construction vehicle, road planner, emergency vehicle or a tracked vehicle.

It should be noted that the invention is suitable for application in various systems comprising an Otto-engine and thereto associated manually operated clutch and gearbox of a transmission. It should be noted that the invention is suitable for application with any combustion Otto-engine and is therefore not confined to combustion engines of motor vehicles. The innovative method and the innovative system in one aspect of the invention are well suited to other platforms which comprise an Otto-engine system than motor vehicles, e.g. watercraft. The watercraft may be of any kind, e.g. motor boats, steamers, ferries or ships.

The innovative method and the innovative system according to one aspect of the invention are also well suited to, for example, systems which comprise industrial engines and/or engine-powered industrial robots an associated manually controlled transmission.

The innovative method and the innovative system according to one aspect of the invention are also well suited to various kinds of power plants, e.g. an electric power plant which comprises an engine-powered generator and an associated manually controlled transmission.

The innovative method and the innovative system are also well suited to various Otto-engine systems, e.g. on a locomotive or some other platform.

The innovative method and the innovative system are also well suited to any system which comprises an Otto type NO_x generator and a manually operated transmission.

The term "link" refers herein to a communication link which may be a physical connection such as an opto-electronic communication line, or a non-physical connection such as a wireless connection, e.g. a radio link or microwave link.

With reference to Figure 2a there is illustrated a subsystem 279 of said vehicle 100 according to an aspect of the invention.

An engine speed sensor 220 is arranged for communication with a first control unit 200 via a link L220. Said engine speed sensor 220 is arranged to continuously or intermittently determine a prevailing engine speed Neng of an engine 231. Said engine speed sensor 220 is arranged to continuously or intermittently send signals S220 comprising information about said detected engine speed Neng to said first control unit 200 via said link L220.

A clutch position sensor 230 is arranged for communication with said first control unit 200 via a link L230. Said clutch position sensor 230 is arranged to continuously or intermittently determine a prevailing clutch position CP of a clutch arrangement 241. Said clutch position sensor 230 is arranged to continuously or intermittently send signals S230 comprising information about said detected clutch position CP to said first control unit 200 via said link L230. Said clutch position CP is herein given in percent (%), wherein 0% refers to a state of said clutch arrangement 241 being in a fully closed position and wherein 100% refers to a state of said clutch arrangement 241 being in a fully open position.

Said first control unit 200 is arranged to continuously or intermittently determine a clutch position change rate CPprim. Said first control unit 200 is arranged to continuously or intermittently determine a time derivative of said determined clutch position CP on the basis of said received signals S230.

An accelerator pedal position sensor 240 is arranged at an accelerator pedal (not shown) of the vehicle 100 and is further arranged for communication with said first control unit 200 via a link L240. Said accelerator pedal is operated by an operator of the vehicle 100, whereby said operator can request an engine torque Tq_demand for propelling said vehicle 100. Said accelerator position sensor 240 is arranged to continuously or intermittently determine a requested engine torque Tq_demand and continuously or intermittently send signals S240 comprising information about said detected requested engine torque Tq_demand to said first control unit 200 via said link L240. Said first control unit 200 is arranged to determine a requested engine torque Tq_demand based upon said signal S240 and/or any other signal comprising information regarding a requested engine torque, e.g. generated by a cruise control function of the vehicle 100. A total sum of requested engine torque is herein denoted Tq_demand.

A vehicle speed sensor 250 is arranged at any suitable position of the vehicle 100, such as at one or more wheels of the vehicle 100. The vehicle speed sensor 250 is further arranged for communication with said first control unit 200 via a link L250. Said vehicle speed sensor 250 is arranged to continuously or intermittently determine a prevailing velocity V of the vehicle 100 and continuously or intermittently send signals S250 comprising information about said detected velocity V of the vehicle 100 to said first control unit 200 via said link L250.

Alternatively said vehicle speed V may be determined by any other suitable means, such as a GPS-unit.

Said first control unit 200 is arranged to determine a selected and activated gear step GS of a gearbox 251. Said gear step GS is manually requested by an operator of the vehicle 100 by any suitable means, such as a gear shifting device 270, e.g. in the form of a gear stick or gear shifting paddles. Said operator may hereby select a gear step and affect said gear stick or gear shifting paddles so as to perform a desired gear shift of said gearbox 251. Said gear shifting device 270 is arranged for communication with said first control unit 200 via link

L270. According to one example said manually operated gear shifting device 270 is arranged to whenever applicable send signals S270 comprising information about said selected gear step to said first control unit 200 via said link L270 for operation of said gearbox 251.

A manually operated clutch pedal 260 is arranged for communication with the first control unit 200 via a link L260. Said clutch pedal 260 is arranged to continuously or intermittently send signals S260 comprising information about a requested clutch position to the first control unit 200 via said link L260. The first control unit 200 is arranged to operate said clutch arrangement 241 in accordance therewith. Alternatively, said manually operated clutch pedal is mechanically connected to said clutch arrangement 241 for adequate operation.

According to an embodiment said first control unit 200 is arranged to activate a function F for providing an additional engine torque during take-off conditions so as to substantially maintain a prevailing engine speed Neng during activation of transmission operation.

By maintaining the engine speed Neng the driver comfort will be increased. This is due to the fact that a change in engine speed Neng usually causes a change in motor sound. A change of motor sound which is not caused by operating a gas or a brake pedal or the like, will often be received as uncomfortable by a driver since the driver cannot relate the change of motor sound to an action which he performs.

According to an embodiment said first control unit 200 is arranged to de-activate said function F for providing an additional engine torque during take-off conditions so as to substantially maintain a prevailing engine speed Neng during activation of transmission operation.

The first control unit 200 is arranged to determine a lapsed time period T running from when said function F is activated. Hereby said time period T indicates a time period from activation of said function F to a current point of time.

The first control unit 200 is arranged to determine a suitable additional engine torque to be provided by means of said activated function F. The first control unit 200 is also arranged to control combustion according to a determined suitable corresponding change of ignition

timing of said engine 231 so as to minimize engine speed change when said function F is activated and said gear shifting is performed.

A second control unit 210 is arranged for communication with the first control unit 200 via a link L210. It may be releasably connected to the first control unit 200. It may be a control unit external to the vehicle 100. It may be adapted to performing the innovative method steps according to the invention. It may be used to cross-load software to the first control unit 200, particularly software for applying the innovative method. It may alternatively be arranged for communication with the first control unit 200 via an internal network on board the vehicle. It may be adapted to performing functions corresponding to those of the first control unit 200, e.g. activating/de-activating said function F for providing an additional engine torque during take-off conditions so as to substantially maintain a prevailing engine speed Neng during activation of transmission operation.

Figure 2b schematically illustrates a subsystem 289 of the vehicle 100 shown in Figure 1, according to an aspect of the invention.

This subsystem 289 is situated in the tractor unit 110 and comprises a combustion engine 231 with an output shaft 235 which is connected to a manually operated clutch arrangement 241. The combustion engine 231 is a so called Otto-engine. Said combustion engine 231 may be powered by gas fuel, such as natural gas or any suitable vaporized fuel. The clutch arrangement 241 may be a manually controlled automated clutch arrangement. This clutch arrangement 241 is also connected to a shaft 245 which is an input shaft to a manually controlled gearbox 251. The gearbox 251 may be configured to comprise any suitable number of gear steps, e.g. 5, 12 or 16. The gearbox 251 has an output shaft 255 to transmit torque to at least one pair of tractive wheels comprising a first tractive wheel 260a and a second tractive wheel 260b.

The engine 231 is arranged to generate torque which can be transmitted to said tractive wheels 260a and 260b so as to propel the vehicle 100. Said torque is hereby transmitted via a transmission of the vehicle comprising the shaft 235, the clutch arrangement 241, the shaft 245, the gearbox 251 and the shaft 255.

The first control unit 200 is arranged for communication with said engine 231 via a link L231 and is adapted for controlling the operation of said engine 231 in accordance with stored control routines. During normal operation the first control unit 200 is arranged to control air and thus fuel supply to said engine according to stored operational routines (λ-controlled). Hereby said first control unit 200 is arranged to, when applicable, activate said function F according to an embodiment of the invention. The first control unit 200 is hereby arranged to, when suitable, change an ignition timing of the engine 231 for postponing ignition so as to operate the engine 231 less efficiently, and increasing a flow of air and fuel to said engine 231 by engine control so as to provide said additional engine torque.

Hereby said first control unit 200 is arranged to de-activate said function F according to an embodiment of the invention. The first control unit 200 is hereby arranged to, when suitable, operating said engine 231 in accordance with normal operating routines.

The first control unit 200 is arranged for communication with said clutch arrangement 241 via a link L241 and is adapted for controlling the operation of said clutch arrangement 241 in accordance with vehicle operator actions. Hereby an operator of the vehicle 100 manually may control said clutch arrangement 241 by means of said clutch pedal 260 for achieving desired gear shifting during operation of said vehicle 100.

The first control unit 200 is arranged for communication with said gearbox 251 via a link L251 and is adapted to controlling the operation of said gearbox 251 in accordance with vehicle operator actions. Hereby an operator of the vehicle 100 manually may control said gearbox 251 by means of said gear shifting device 270 for achieving desired gear shifting during operation of said vehicle 100.

Said shaft 235 is provided with said engine speed sensor 220 to continuously determine a prevailing engine speed Neng of said engine 231. This engine speed sensor 220 is adapted to continuously or intermittently send signals S220 which contain information about said determined prevailing engine speed Neng to the first control unit 200 via said link L220. The first control unit 200 is adapted to continuously receiving said signals S220 and temporarily

storing in a memory in it said information about the prevailing engine speed Neng. Said engine speed sensor 220 may alternatively be situated in any other suitable position for determining a prevailing engine speed Neng of said engine 231, such as at a fly-wheel of said engine 231.

Said clutch arrangement 241 is provided with said clutch position sensor 230 so as to continuously determine a prevailing clutch position CP of said clutch arrangement 241. This clutch position sensor 230 is adapted to continuously or intermittently send signals S230 which contain information about said determined prevailing clutch position CP to the first control unit 200 via said link L230. The first control unit 200 is adapted to continuously receiving said signal S230 and temporarily storing in a memory in it said information about the prevailing clutch position CP. Said clutch position sensor 230 may alternatively be situated in any other suitable position for determining a prevailing clutch position CP of said clutch arrangement 241, such as at said clutch pedal 260.

At least one of said tracked wheels 260a and 260b is provided with said vehicle speed sensor 250 so as to continuously determine a prevailing vehicle speed V. This vehicle speed sensor 250 is adapted to continuously or intermittently send signals S250 which contain information about said determined prevailing vehicle speed to the first control unit 200 via said link L250. The first control unit 200 is adapted to continuously receiving said signal S250 and temporarily storing in a memory in it said information about the prevailing vehicle speed V. Said vehicle speed sensor 250 may alternatively be situated in any other suitable position for determining a prevailing vehicle speed V.

Figure 3 schematically illustrates a diagram presenting indicated torque as a function of time T. The indicated torque is given in Nm and said time T is given in seconds.

Hereby said engine 231 is operated with an indicated torque at a certain level until a first time point T1 where said function F is activated in accordance with the teachings herein. Hereby said additional engine torque is provided. Said additional engine torque is constituted by a so called air torque, which may be provided by increasing a flow of air and

fuel to said engine 231. At a second time point T2 said function F is de-activated in accordance with the teachings herein.

Upon de-activation of said function F said air torque is decreased to any suitable level, e.g. to the same level as before said first time point T1. Said indicated torque comprises said air torque and an ignition torque of said engine. Said ignition torque hereby remains unchanged during the time period defined as T1 to T3.

A time period T during which said function F is activated is herein defined as the time period T1-T2.

During the time period T2 to T3 said air torque is controlled in accordance with a predetermined profile, also referred to as a ramp function. This profile may be stored in a memory of the first control unit 200.

During the time period T1 to T2 said clutch 241 is engaged for operating said transmission of said vehicle 100. Hereby an engine speed value is vaguely affected, or not affected at all. Thus, an engine speed Neng of said engine 231 may be substantially unchanged during said gear shifting process according to an example of the invention.

Figure 4a schematically illustrates a flow chart of a method for improved take-off of a vehicle 100 having an Otto-engine 231 and a manually actuated clutch 241 of the vehicle transmission. The method comprises a first method step s401. The method step s401 comprises the steps of:

- determining a first set S1 of condition parameter values, said parameters comprising engine speed Neng, vehicle speed V, clutch position CP, clutch position change rate CPprim and engaged gear step GS of a gearbox 251 of said transmission;

- determining if said first set S1 of condition parameter values meet first predetermined conditions;

- if said first predetermined conditions of said first set S1 of condition parameter values are met, activating a function F for providing an additional engine torque during take-off

conditions so as to substantially maintain a prevailing engine speed Neng during activation of transmission operation.

After the method step s401 the method ends/is returned.

Figure 4b schematically illustrates a flow chart of a method for improved take-off of a vehicle 100 having an Otto-engine 231 and a manually actuated clutch 241 of the vehicle transmission. The method comprises a first method step s410.

The method step s410 comprises the step of determining a first set S1 of condition parameter values, said parameters comprising engine speed Neng, vehicle speed V, clutch position CP, clutch position change rate CPprim and engaged gear step GS of a gearbox 251 of said transmission.

The method step s410 further comprise the step of determining if said first set S1 of condition parameter values meet first predetermined conditions. This may be determined as depicted below.

Hereby said determined prevailing engine speed Neng is compared with a predetermined first engine speed threshold value Nth1. Said first predetermined engine speed threshold value Nth1 may be e.g. 1000 rpm. If said prevailing engine speed Neng is less than said first predetermined engine speed threshold value Nth1 this predetermined condition is met.

Hereby said determined prevailing vehicle speed V is compared with a first predetermined vehicle speed threshold value Vth1. Said first predetermined vehicle speed threshold value Vth1 may be e.g. 5km/h. If said prevailing vehicle speed V is less than said first predetermined vehicle speed threshold value Vth1 this predetermined condition is met.

Hereby said determined clutch position value CP is compared with a predetermined clutch position value CPth1a (%) and predetermined clutch position value CPth1b (%). Said predetermined clutch position value CPth1a may be e.g. 20% and said predetermined clutch position value CPth1b may be e.g. 90%. If said determined clutch position value CP is larger than said predetermined clutch position value CPth1a and smaller than said predetermined clutch position value CPth1b this predetermined condition is met.

Hereby said determined clutch position change rate CPprim is compared with a first predetermined clutch position change rate CPprim1. Said first predetermined clutch position change rate CPprim1 is any suitable predetermined clutch position change rate (e.g. -20% per sample). If said determined clutch position change rate CPprim is less (e.g. -30% per sample) than said first predetermined clutch position change rate CPprim1 this predetermined condition is met. This corresponds to a relatively rapid closure of the clutch arrangement, i.e. the clutch arrangement is moving towards a closed state.

According to an example embodiment, said determined selected gear step value GS is compared with a predetermined gear step value GS0. Said predetermined gear step value GS0 is 0. If said selected gear step value GS differs from said predetermined gear step value GS0, i.e. that a selected gear step is a gear step allowing propulsion of said vehicle 100, this predetermined condition is met.

If said first predetermined conditions of said first set S1 of condition parameter values are met a subsequent method step s420 is performed.

The method step s420 comprises the step of activating a function F for providing an additional engine torque during take-off conditions so as to substantially maintain a prevailing engine speed during activation of transmission operation.

The method step s420 may comprise the step of changing an ignition timing of the engine 231 for postponing ignition so as to operate the engine less efficiently. The step s420 may comprise the step of determining a suitable change of ignition timing of the engine 231. According to an example a current ignition timing is changed to a predetermined ignition timing.

The method step s420 may comprise the step of increasing a flow of air and fuel to said engine by engine control so as to provide said additional engine torque. The step s420 may comprise the step of determining a suitable increase of a flow of air and fuel to said engine of the engine 231. According to an example a current flow of air and fuel is changed to a predetermined flow of air and fuel.

After the method step s420 a subsequent method step s430 is performed.

The method step s430 comprises the step of determining a second set S2 of condition parameter values. Said parameters comprising engine speed Neng, vehicle speed V, clutch position CP, clutch position change rate CPprim, engaged gear step GS of said gearbox 251 of said transmission and time T during which said function F has been activated.

The method step s430 comprises the step of determining if at least one condition parameter value of said second set S2 of condition parameters meets a respective second predetermined condition.

The method step s430 comprises the step of determining if said determined engine speed Neng is larger than a second predetermined engine speed threshold value Nth2. Nth2 is a suitable value which is larger than said first engine speed threshold value Nth1. If said determined engine speed Neng is larger than said second predetermined engine speed threshold value Nth2 this predetermined condition is met and the method step s440 is performed.

The method step s430 comprises the step of determining if said determined vehicle speed V is larger than a second predetermined vehicle speed threshold value Vth2. Vth2 is a suitable value which is larger than said first vehicle speed threshold value Vth1. If said determined vehicle speed V is larger than said second predetermined vehicle speed threshold value Vth2 this predetermined condition is met and the method step s440 is performed.

The method step s430 comprises the step of determining if said determined clutch position CP is larger than a second predetermined clutch position CPth2. CPth2 is a suitable, relatively high value, such as 90%. If said determined engine clutch position CP is larger than said second predetermined clutch position CPth2 this predetermined condition is met and the method step s440 is performed.

The method step s430 comprises the step of determining if said determined clutch position CP is less than a third predetermined clutch position CPth3. CPth3 may be e.g. 20%. If said determined engine clutch position CP is less than said third predetermined clutch position

CPth3 during a predetermined time period, e.g. 2 or 3 seconds, this predetermined condition is met and the method step s440 is performed.

The method step s430 comprises the step of determining if said determined clutch position change rate CPprim is larger than a second predetermined clutch position change rate CPprim2, e.g. 20% per sample. If said determined engine clutch position change rate CPprim is larger than said second predetermined clutch position CPprim2 this predetermined condition is met and the method step s440 is performed. This corresponds to a relatively rapid opening of the clutch arrangement, i.e. the clutch arrangement is moving towards a fully opened state.

The method step s430 comprises the step of determining if said engaged gear step GS is equal to said predetermined gear step GS0. If said engaged gear step GS is equal to said predetermined gear step GS0 this predetermined condition is met and the method step s440 is performed.

The method step s430 comprises the step of determining if said determined time period T is larger than a predetermined time period Tth. Tth may be e.g. 2, 5 or 10 seconds. If said determined time period T is larger than said predetermined time period Tth this predetermined condition is met and the method step s440 is performed.

It should be noted that if:

- said determined engine speed Neng is larger than said second predetermined engine speed threshold value Nth2; or

- said determined vehicle speed V is larger than said second predetermined vehicle speed threshold value Vth2; or

- determined clutch position CP is larger than a second predetermined clutch position CPth2; or

- said determined clutch position CP is less than a third predetermined clutch position CPth3 during at least a predetermined time period; or

- said determined clutch position change rate CPprim is larger than a second predetermined clutch position change rate CPprim2 (opening the clutch arrangement); or

- said engaged gear step GS is equal to said predetermined gear step GS0; or

- said determined time period T is larger than a predetermined time period Tth,

said method step s440 is performed.

If said at least one respective second predetermined condition of said second set S2 of condition parameter values are met a subsequent method step s440 is performed.

The method step s440 comprises the step of de-activating said function F for providing an additional engine torque during take-off conditions.

The method step s440 may comprise the step of decreasing said additional engine torque in accordance with a predetermined profile.

After the method step s440 the method ends/is returned.

Figure 5 is a diagram of one version of a device 500. The control units 200 and 210 described with reference to Figure 2 may in one version comprise the device 500. The device 500 comprises a non-volatile memory 520, a data processing unit 510 and a read/write memory 550. The non-volatile memory 520 has a first memory element 530 in which a computer program, e.g. an operating system, is stored for controlling the function of the device 500. The device 500 further comprises a bus controller, a serial communication port, I/O means, an A/D converter, a time and date input and transfer unit, an event counter and an interruption controller (not depicted). The non-volatile memory 520 has also a second memory element 540.

The computer program P comprises routines for improved take-off of a vehicle 100 having an Otto-engine 231 and a manually actuated clutch 241 of the vehicle transmission.

The computer program P may comprise routines for determining a first set S1 of condition parameter values, said parameters comprising engine speed Neng, vehicle speed V, clutch

position CP, clutch position change rate CPprim and engaged gear step GS of said gear box 251 of said transmission.

The computer program P may comprise routines for determining if said first set S1 of condition parameter values meet first predetermined conditions.

The computer program P may comprise routines for, if said first predetermined conditions of said first set S1 of condition parameter values are met, activating a function F for providing an additional engine torque during take-off conditions so as to substantially maintain a prevailing engine speed Neng during activation of transmission operation.

The computer program P may comprise routines for changing an ignition timing of the engine 231 for postponing ignition so as to operate the engine 231 less efficiently. The computer program P may comprise routines for increasing a flow of air and fuel to said engine by engine 231 control so as to provide said additional engine torque.

The computer program P may comprise routines for determining a second set S2 of condition parameter values, said parameters comprising engine speed Neng, vehicle speed V, clutch position CP, clutch position change rate CPprim, engaged gear step GS of said gearbox 251 of said transmission and time T during which said function F has been activated.

The computer program P may comprise routines for determining if at least one condition parameter value of said second set S2 of condition parameters meet a respective second predetermined condition.

The computer program P may comprise routines for, if said at least one respective second predetermined condition of said second set S2 of condition parameter values are met, de-activating said function F for providing an additional engine torque during take-off conditions.

The computer program P may comprise routines for de-activating said function F for providing an additional engine torque during take-off conditions by decreasing said additional engine torque in accordance with a predetermined profile.

The program P may be stored in an executable form or in compressed form in a memory 560 and/or in a read/write memory 550.

Where it is stated that the data processing unit 510 performs a certain function, it means that it conducts a certain part of the program which is stored in the memory 560 or a certain part of the program which is stored in the read/write memory 550.

The data processing device 510 can communicate with a data port 599 via a data bus 515. The non-volatile memory 520 is intended for communication with the data processing unit 510 via a data bus 512. The separate memory 560 is intended to communicate with the data processing unit via a data bus 511. The read/write memory 550 is arranged to communicate with the data processing unit 510 via a data bus 514. The links L210, L230, L240, L250, L260, L270, L231; L241 and L251 for example, may be connected to the data port 599 (see Figure 2a and Figure 2b).

When data are received on the data port 599, they are stored temporarily in the second memory element 540. When input data received have been temporarily stored, the data processing unit 510 will be prepared to conduct code execution as described above.

Parts of the methods herein described may be conducted by the device 500 by means of the data processing unit 510 which runs the program stored in the memory 560 or the read/write memory 550. When the device 500 runs the program, methods herein described are executed.

The foregoing description of the preferred embodiments of the present invention is provided for illustrative and descriptive purposes. It is not intended to be exhaustive, nor to limit the invention to the variants described. Many modifications and variations will obviously suggest themselves to one skilled in the art. The embodiments have been chosen and described in order to best explain the principles of the invention and their practical applications and thereby make it possible for one skilled in the art to understand the invention for different embodiments and with the various modifications appropriate to the intended use.

Claims

1. A method for improved take-off of a vehicle (100) having an Otto-engine (231) and a manually actuated clutch (241) of the vehicle transmission, comprising the steps of:

- determining (s410) a first set (S1) of condition parameter values, said parameters comprising engine speed (Neng), vehicle speed (V), clutch position (CP), clutch position change rate (CPprim) and engaged gear step (GS) of a gearbox (251) of said transmission;

- determining (s410) if said first set (S1) of condition parameter values meet first predetermined conditions;

- if said first predetermined conditions of said first set (S1) of condition parameter values are met, activating (s420) a function (F) for providing an additional engine torque during take-off conditions so as to substantially maintain a prevailing engine speed (Neng) during activation of transmission operation.

2. The method according to claim 1, comprising the steps of:

- if said first predetermined conditions of said first set (S1) of condition parameter values are met, changing (s420) an ignition timing of the engine (231) for postponing ignition so as to operate the engine (231) less efficiently, and

- if said first predetermined conditions of said first set (S1) of condition parameter values are met, increasing (s420) a flow of air and fuel to said engine (231) by engine control so as to provide said additional engine torque.

3. The method according to claim 1 or 2, comprising the steps of:

- determining (s430) a second set (S2) of condition parameter values, said parameters comprising engine speed (Neng), vehicle speed (V), clutch position (CP), clutch position change rate (CPprim), engaged gear step (GS) of said gearbox (251) of said transmission and time (T) during which said function (F) has been activated;

- determining (s430) if at least one condition parameter value of said second set (S2) of condition parameters meet a respective second predetermined condition; and

- if said at least one respective second predetermined condition of said second set (S2) of condition parameter values are met, de-activating (s440) said function (F) for providing an additional engine torque during take-off conditions.

4. The method according to claim 3, comprising the step of:

- de-activating (s440) said function (F) for providing an additional engine torque during take-off conditions comprising the step of decreasing said additional engine torque in accordance with a predetermined profile.

5. A system for improved take-off of a vehicle (100) having an Otto-engine (231) and a manually actuated clutch (241) of the vehicle transmission, comprising:

- means (200; 210; 500) for determining a first set (S1) of condition parameter values, said parameters comprising engine speed (Neng), vehicle speed (V), clutch position (CP), clutch position change rate (CPprim) and engaged gear step (GS) of a gearbox (251) of said transmission;

- means (200; 210; 500) for determining if said first set (S1) of condition parameter values meet first predetermined conditions;

- means (200; 210; 500) for, if said first predetermined conditions of said first set (S1) of condition parameter values are met, activating a function (F) for providing an additional engine torque during take-off conditions so as to substantially maintain a prevailing engine speed (Neng) during activation of transmission operation.

6. The system according to claim 5, comprising:

- means (200; 210; 500) for, if said first predetermined conditions of said first set (S1) of condition parameter values are met, changing an ignition timing of the engine (231) for postponing ignition so as to operate the engine (231) less efficiently, and

- means (200; 210; 500) for, if said first predetermined conditions of said first set (S1) of condition parameter values are met, increasing a flow of air and fuel to said engine (231) by engine control so as to provide said additional engine torque.

7. The system according to claim 5 or 6, comprising:

- means (200; 210; 500) for determining a second set (S2) of condition parameter values, said parameters comprising engine speed (Neng), vehicle speed (V), clutch position (CP), clutch position change rate (CPprim), engaged gear step (GS) of said gearbox (251) of said transmission and time (T) during which said function (F) has been activated;

- means (200; 210; 500) for determining if at least one condition parameter value of said second set (S2) of condition parameters meet a respective second predetermined condition; and

- means (200; 210; 500) for, if said at least one respective second predetermined condition of said second set (S2) of condition parameter values are met, de-activating said function (F) for providing an additional engine torque during take-off conditions.

8. The system according to claim 7, wherein said means (200; 210; 500) for de-activating said function (F) for providing an additional engine torque during take-off conditions is arranged for decreasing said additional engine torque in accordance with a predetermined profile.

9. A vehicle (100; 110) comprising a system according to anyone of claims 5-8.

10. The vehicle (100; 110) according to claim 9, which vehicle is any from among a truck, bus or passenger car.

11. A computer program (P) for improved take-off of a vehicle (100) having an Otto-engine (231) and a manually actuated clutch (241) of the vehicle transmission, wherein said computer program (P) comprises program code for causing an electronic control unit (200; 500) or a computer (210; 500) connected to the electronic control unit (200; 500) to perform the steps according to any of the claims 1-4.

12. A computer program product containing a program code stored on a computer-readable medium for performing method steps according to any of claims 1-4, when said computer program is run on an electronic control unit (200; 500) or a computer (210; 500) connected to the electronic control unit (200; 500).

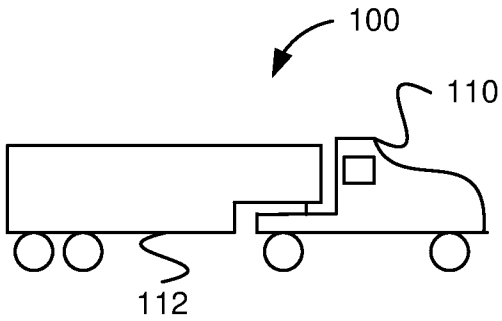
100
110
112

Fig. 1

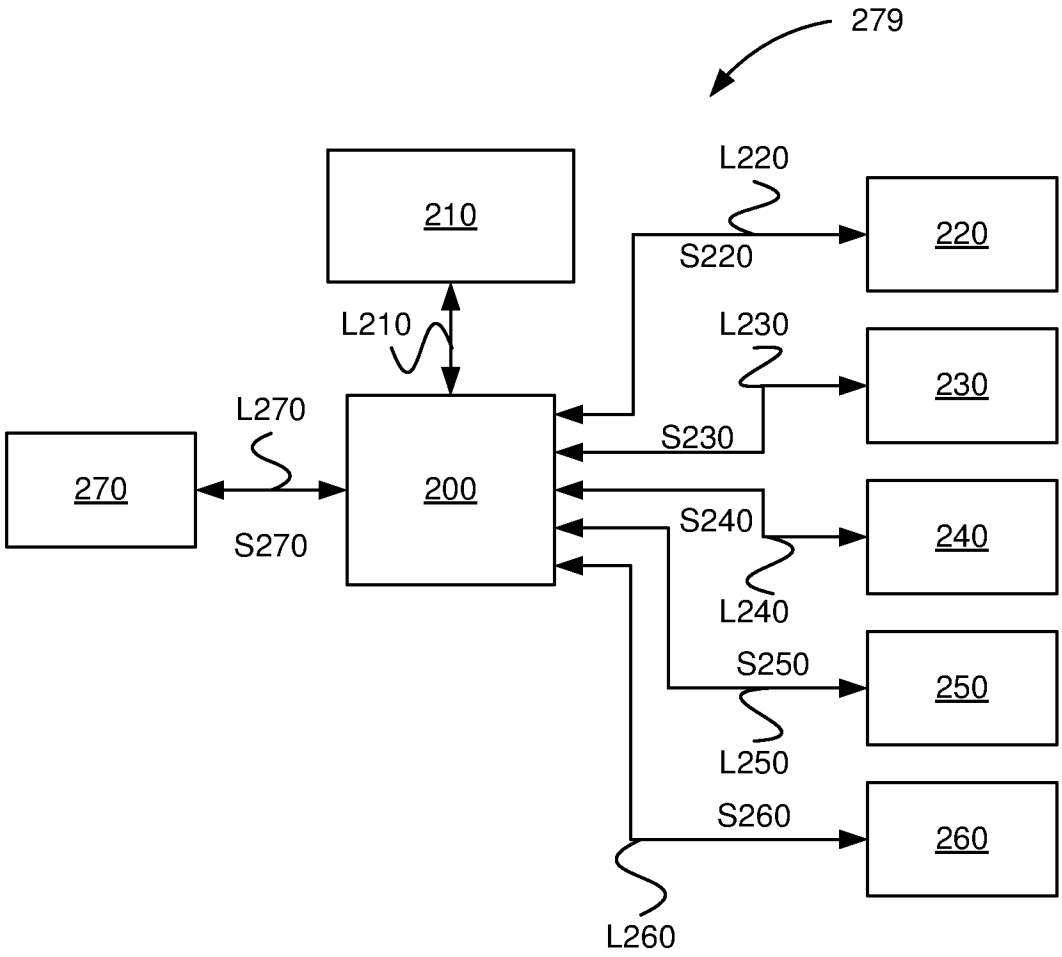
279
210
220
230
240
250
260
270
200
L220
S220
L230
S230
L210
L270
S270
S240
L240
S250
L250
S260
L260

Fig. 2a

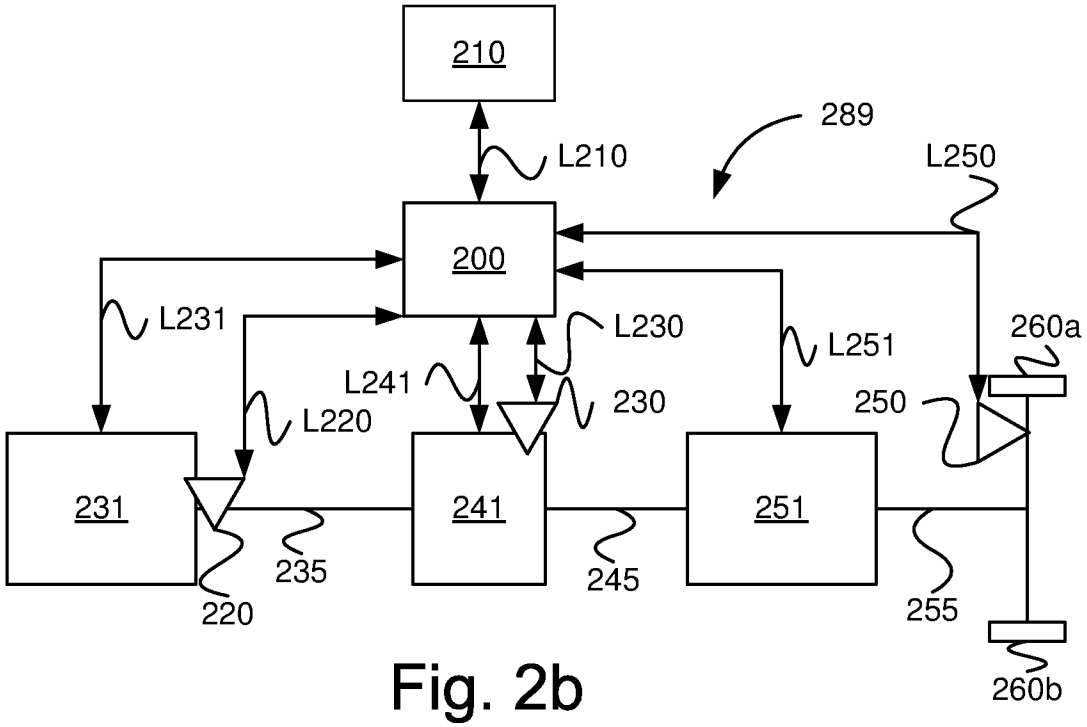
210
289
L210
L250
200
L231
L230
L251
260a
L241
230
250
L220
231
241
251
235
245
255
220
260b

Fig. 2b

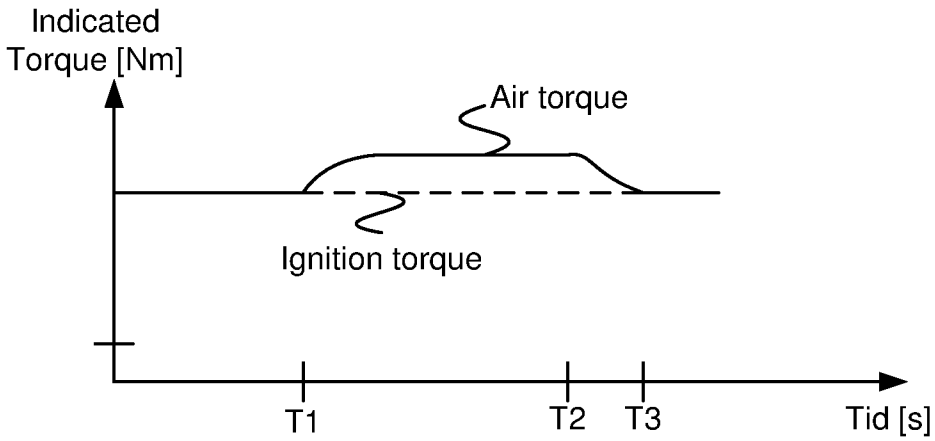
Indicated
Torque [Nm]
Air torque
Ignition torque
T1
T2
T3
Tid [s]

Fig. 3

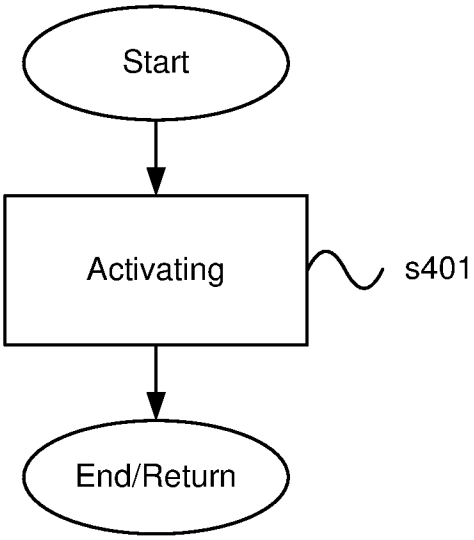
Start
Activating
s401
End/Return

Fig. 4a

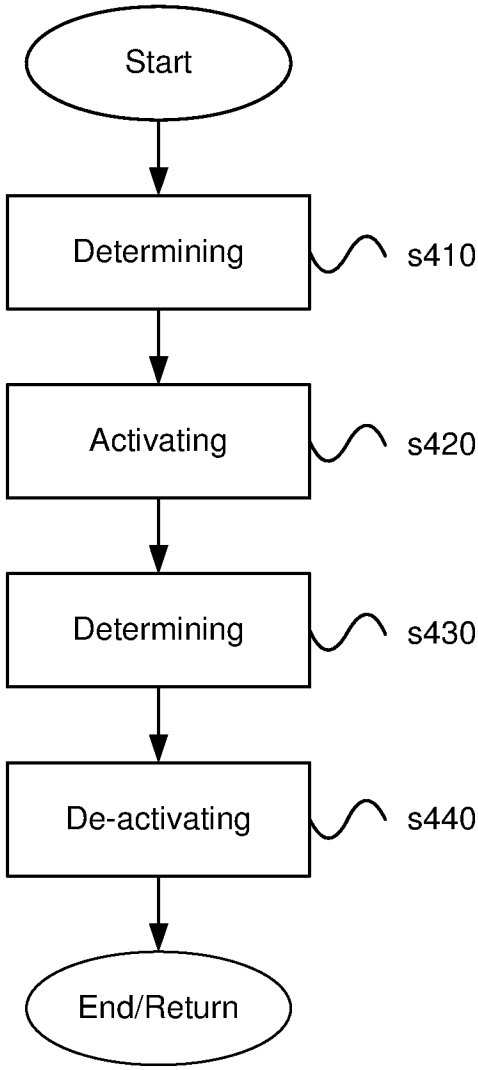
Start
Determining
s410
Activating
s420
Determining
s430
De-activating
s440
End/Return

Fig. 4b

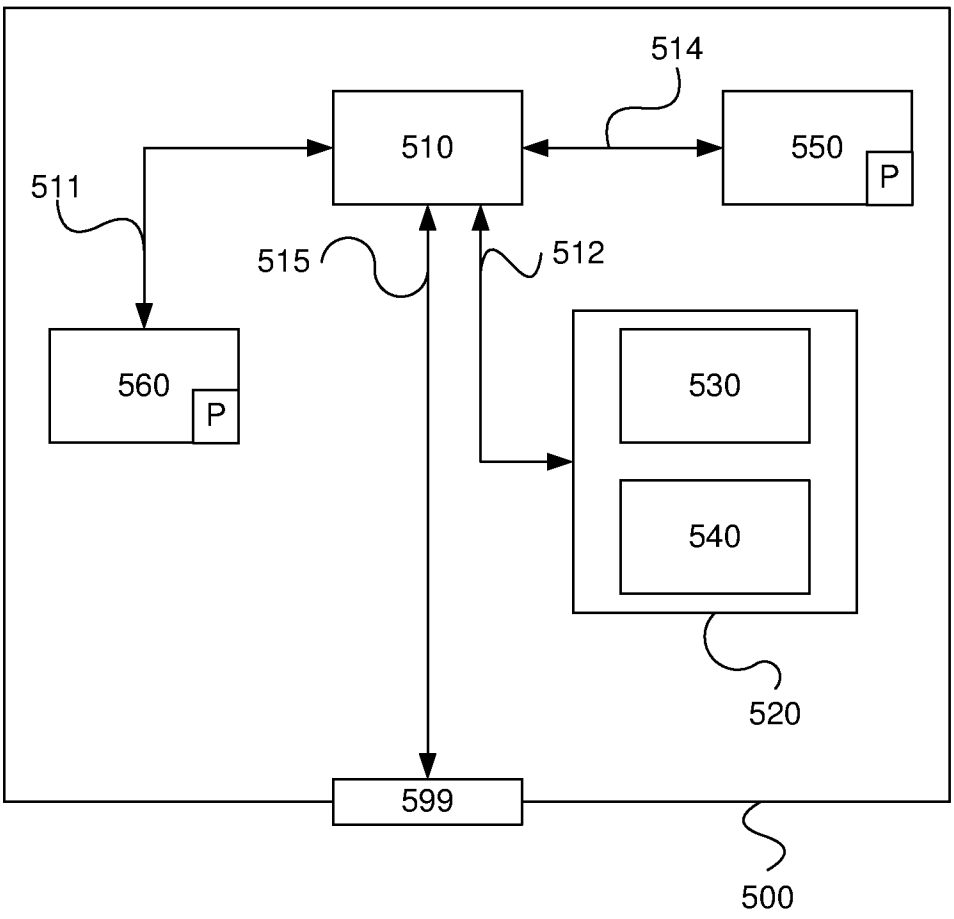

Fig. 5

INTERNATIONAL SEARCH REPORT

International application No.
PCT/SE2016/051275

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: B60W, F02D

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 6131546 A (VOGT BERNHARD ET AL), 17 October 2000 (2000-10-17); column 1, line 43 - column 2, line 13; column 3, line 17 - line 43; column 4, line 47 - column 5, line 27; figures; claim 2 ---	1-12
X	WO 2012019995 A1 (CONTINENTAL AUTOMOTIVE GMBH ET AL), 16 February 2012 (2012-02-16); page 4, line 13 - line 18; page 6, line 20 - page 9, line 34; page 10, line 36 - page 11, line 5; figures 2-4; claim 1 ---	1-12
A	DE 102005058864 A1 (BOSCH GMBH ROBERT), 14 June 2007 (2007-06-14); paragraphs [0003], [0010], [0015], [0027], [0034], [0036], [0046]; figures 1, 4; claims 1,5,9 ---	1-12

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

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

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

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
28-02-2017	28-02-2017

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/SE2016/051275

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	DE 102004011938 A1 (VOLKSWAGEN AG), 29 September 2005 (2005-09-29); paragraphs [0002], [0004]-[0007], [0012]-[0014]; figures 2-3; claims 1-2,7,9	1-12
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A	EP 0930424 A2 (VOLKSWAGEN AG), 21 July 1999 (1999-07-21); column 5, line 13 - line 19; figure 1; claims 1,5,8	1-12
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A	US 5010863 A (ISHIDA TETSURO ET AL), 30 April 1991 (1991-04-30); abstract; figures 2-3; claims 1-2,11	1-12
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A	WO 2010047652 A1 (SCANIA CV ABP ET AL), 29 April 2010 (2010-04-29); abstract; figures	1-12
	--	

International application No.
PCT/SE2016/051275

Continuation of: second sheet

International Patent Classification (IPC)

B60W 30/188 (2012.01)
B60W 30/18 (2012.01)
F02D 41/02 (2006.01)
B60W 10/06 (2006.01)

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				IT	1307680	B1	14/11/2001
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				KR	930012227	B1	24/12/1993
WO	2010047652	A1	29/04/2010	BR	PI0914534	A2	15/12/2015
				CN	102224045	A	19/10/2011
				EP	2349800	A1	03/08/2011
				RU	2482988	C2	27/05/2013
				RU	2011120453	A	27/11/2012
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				SE	0850044	A1	22/04/2010