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(54) Device and method for damping the reaction of an accelerator pedal signal

(57) A device for damping the reaction of an accelerator pedal signal to changes in the position of an accelerator pedal in a motor vehicle comprises means (10) arranged to send to a unit (8) information about the position of means (6) crucial to the occurrence of disengagement of the vehicle's engine (1) from a gearbox (4) of the vehicle. The unit is arranged to effect said damping in a manner dependent on information about the position of the means.

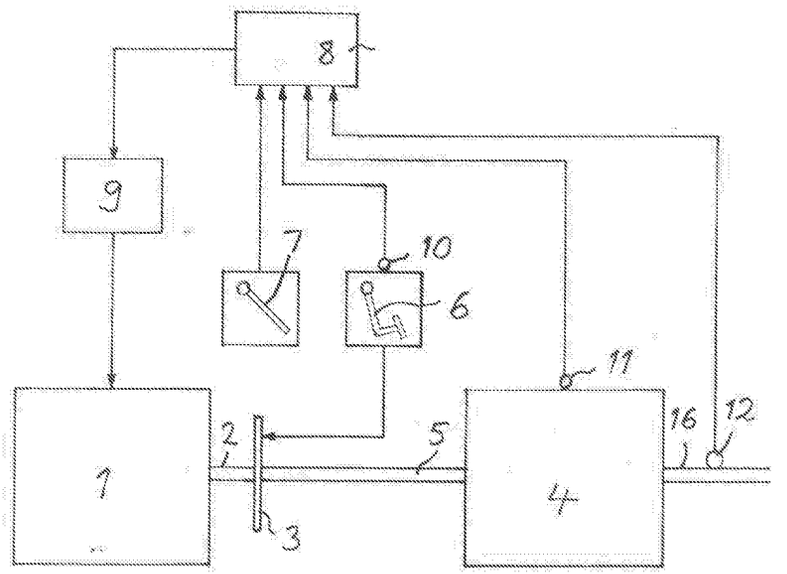

Fig 1

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Description

FIELD OF THE INVENTION

[0001] The present invention relates to a device and method for damping the reaction of an accelerator pedal signal to changes in the position of an accelerator pedal in a motor vehicle, whereby said signals are adapted for being passed on to an arrangement for control of an engine of the vehicle according to commands from the vehicle's driver.

[0002] The motor vehicle may be of any conceivable type, but a passenger car, a truck or a bus may be mentioned as examples.

[0003] Should such damping of the reaction not take place, i.e. should the magnitude of the accelerator pedal signal instantaneously follow a change in the position of an accelerator pedal, it would become extremely difficult for the driver to drive the vehicle without uncomfortable jerking. In addition to such accelerator pedal signal changes induced by the driver, faster smaller accelerator pedal signal transients occur (e.g. due to vibrations of the vehicle) and would also adversely affect the driving characteristics of the vehicle if they were not damped or, so to speak, filtered out.

[0004] Accordingly, a said device is desirable for damping the reaction of an accelerator pedal signal to changes in the position of the accelerator pedal.

[0005] There is a problem, however, in that high damping, i.e. a relatively long delay in the accelerator pedal signal reaching the value which corresponds to a new position of the accelerator pedal is advantageous at medium-high to high speeds of the vehicle, i.e. at times when the vehicle is normally driven in high gears, whereas low damping is desirable when starting and marshalling, situations in which the driver wants quicker and better control of the torque delivered by the engine.

STATE OF THE ART

[0006] A device of the kind defined in the introduction is known from US 6 098 593 which comprises a unit arranged to receive information about at least one operating parameter of the vehicle and to effect said damping according to the magnitude of that parameter. In that case, the unit uses information about the rotation speed of the engine's output shaft and/or about which gear is engaged in the vehicle's gearbox, i.e. the vehicle's transmission ratio. If both kinds of information are used, the vehicle's speed is thus taken into account. Damping according to the magnitude of these parameters can be used to ensure that the damping will be high at medium-high to high speeds of the vehicle, i.e. when the vehicle is running in high gears, and low at low speeds of the vehicle, i.e. when it is running in low gears.

[0007] It should be noted that "damping the reaction of an accelerator pedal signal" in that specification is to be construed as also comprising indirect such damping, i.e. the accelerator pedal signal itself might directly follow the position of the accelerator pedal, but damping of the reaction might be effected by the fact of that signal, upon reaching the arrangement which regulates the engine, being received, as regards changes in it, with a certain sluggishness which corresponds to a said damping, or being subjected to processing corresponding to such a damping due to the arrangement executing instructions contained in, for example, a computer programme.

[0008] Even if the device described in US 6 098 593 with its variable damping results in significantly more acceptable driving characteristics of the vehicle concerned than in the case of constant damping adopted by way of compromise, it is desirable to make the damping still better suited to particular driving situations of the vehicle.

SUMMARY OF THE INVENTION

[0009] The object of the present invention is to provide a device and a method of a kind discussed above which meets the above-mentioned desiderata.

[0010] This object is achieved according to the invention by providing a device and a method according to the respective independent device and method claims.

[0011] By said unit receiving information about the position of a means which is crucial to the occurrence of disengagement of the engine from a gearbox of the vehicle, by said unit using information about the position of that means as an operating parameter, and by damping effected dependent on the magnitude of that parameter, it is possible to achieve varied damping in response to changes in said position, e.g. when changing gear, starting, i.e. setting the vehicle in motion, and the like. It has in fact been found that the position of a said means can affect the optimum damping of the reaction of an accelerator pedal signal to changes in the position of an accelerator pedal.

[0012] According to an embodiment of the invention, said means which is crucial to the occurrence of said disengagement is a clutch pedal or a clutch plate. Thus, according to the invention, damping may be effected in a manner dependent on the position of the clutch pedal, but it is also possible to effect it in a manner dependent on the position of a said clutch plate, which means that the invention is also applicable to motor vehicles with so-called two-pedal systems, i.e. automatic clutch action whereby only acceleration and braking are controlled by pedals. In such cases, said movable clutch plate is controlled by a control unit via, for example, an electropneumatic servo system.

[0013] According to an embodiment of the invention, the unit is arranged to cause the damping of said reaction of the accelerator pedal signal to be low at the time of depression of the clutch pedal and respective withdrawal of the clutch plate from a clutch plate cooperating with it, e.g. when starting or changing gear. This is ad-

vantageous, since the driver wishes to have a quick reaction to changes in the position of the accelerator pedal when the vehicle is being set in motion and changing gear, even at relatively high speeds of the vehicle. It is thus possible to ensure that there is low (i.e. gentle) damping when starting and during gear changes, despite the damping being otherwise high (i.e. severe) at medium-high or high vehicle speeds.

[0014] According to another embodiment of the invention, the unit is adapted to causing said damping of the reaction of the accelerator pedal signal to be low for a period of time from the clutch pedal being depressed lower than a first level to at least when the clutch pedal is released to a second level and from when the respective clutch plate is withdrawn beyond a first point from a clutch plate cooperating with it to at least when it reaches a second point on its way towards a clutch plate cooperating with it. It has been found advantageous for a motor vehicle's driving characteristics if the reaction to depression or release of the accelerator pedal is rapid as regards the effects on engine control during said period of time.

[0015] According to another embodiment of the invention, the unit is adapted to extending such period of time for low damping of the reaction of the accelerator pedal signal to a certain extent after the release of the clutch pedal to higher than said second level, i.e. after the clutch plate reaches the second point. It has been found advantageous, during starting and after gear changes, to have low damping, i.e. rapid reaction to accelerator pedal position changes, during a short period of time after the release of the clutch pedal, i.e. after the clutch plate reaches full engagement with a clutch plate cooperating with it. When, for example, changing up to a higher gear, there is generally a desire for acceleration, often continuing acceleration, of the vehicle, a situation in which high damping of said reaction is not desirable even if the vehicle's speed is high and the gear position is high. It has proved to be advantageous that this extent be 0.01 to 2 seconds, preferably 0.5 to 2 seconds.

[0016] According to another embodiment of the invention, the unit is adapted to effecting damping of the accelerator pedal signal in a manner dependent on at least one further operating parameter, preferably using as such further operating parameter information about the motor vehicle's speed and/or transmission ratio.

[0017] According to another embodiment of the invention, the unit is adapted to causing the damping of said reaction of an accelerator pedal signal to be low where any of said operating parameters prompt such low damping. This means that when the clutch pedal is depressed the damping becomes low whatever the speed and transmission ratio of the vehicle, while the damping will be low if the vehicle's speed and/or transmission ratio so require even if the clutch pedal/clutch plate indicate a situation for high damping on the basis of their position and the amount of time since the latest clutch depression/gear change.

[0018] According to another embodiment of the invention, the unit is so adapted that low damping results in said reaction being almost instantaneous and in the time between an accelerator pedal signal instigated by the accelerator pedal and the actual arrival of that accelerator pedal signal being, in the case of such low damping, considerably shorter than the corresponding time when the vehicle is running at normal speed, e.g. 50-90 km/hour for a truck, such as 50% to 25% or less than 25% of the time.

[0019] Possible embodiments of the method according to the attached independent method claim, and attendant advantages, are indicated by the device claims and the relating description of the device according to the invention.

[0020] The invention also relates to a computer programme and a computer-readable medium according to the corresponding attached claims. The invention therefore also relates to a computer programme and a computer-readable medium related to said possible embodiments of the method according to the invention. It will readily be appreciated that the method according to the invention which is defined in the attached method claim, and said possible embodiments thereof, are well suited to being executed on the basis of programme instructions from a processor which may be acted upon by a computer programme provided with the relevant programme steps.

[0021] Further advantages of the invention, and advantageous features of it, are indicated by the ensuing description and the other dependent claims.

BRIEF DESCRIPTION OF THE DRAWING

[0022] A device and method according to an embodiment of the invention which are quoted by way of example are described below with reference to the attached drawing, in which:

Fig. 1 is a simplified block diagram illustrating a device and a method according to an embodiment of the invention, and

Fig. 2 is a schematic diagram illustrating a chronological pattern of an accelerator pedal signal in response to change in the position of an accelerator pedal with various degrees of said damping.

DETAILED DESCRIPTION OF AN EMBODIMENT OF THE INVENTION

[0023] Fig. 1 illustrates schematically a device according to the invention and how it is arranged in a motor vehicle. The motor vehicle comprises in a conventional manner an engine 1 and a gearbox 4 which is connected to the engine's output shaft 2 via a clutch 3 and which has an input shaft 5 and an output shaft 16. The clutch 3 may be controlled by interrupting/establishing the con-

nection between the shafts 2 and 5 by operating a clutch pedal 6, so that depressing the clutch pedal causes disengagement of the engine from the gearbox.

[0024] An accelerator pedal depicted schematically at 7 is arranged to send an accelerator pedal signal, the magnitude of which depends on the position of the accelerator pedal, to a schematically depicted unit 8, e.g. an electronic engine control unit, which is arranged so that, after processing described in greater length below, it passes that signal on to an arrangement 9 for control of the vehicle's engine according to commands from the vehicle's driver. The arrangement 9 may also receive from the vehicle's driver commands other than that delivered by operating the accelerator pedal, e.g. via a speed maintaining lever, although nothing of the kind is depicted in Fig. 1.

[0025] The unit 8 is arranged to damp the reaction of an accelerator pedal signal (which is passed on to the arrangement 9) to changes in the position of the accelerator pedal 7, and to effect that damping in a manner dependent on various operating parameters of the vehicle which are received from a detector 10 of the position of the clutch pedal, a detector 11 of the transmission ratio of the vehicle or the gear position of the gearbox, and a detector 12 of the speed of the engine, indicated by detecting the rotation speed of the output shaft 16 of the gearbox 4.

[0026] More specifically, the unit is adapted to causing the damping of the reaction of an accelerator pedal signal to a change in the position of the accelerator pedal to be low if any of the three detectors 10 -12 indicate that it should be low. The unit 8 is arranged so that, all other things being equal, it reduces the damping when the vehicle's speed decreases and/or its transmission ratio decreases. As regards detection of the clutch pedal position via the detector 10, the unit is arranged to cause the damping of the reaction of the accelerator pedal signal to be low during a period of time from when the clutch pedal is depressed to lower than the first level which corresponds to the clutch pedal being depressed by 5 to 15%, preferably about 10%, of its maximum downward travel, to at least when it is released to a second level which corresponds to the clutch pedal being released so that it is still depressed by 10 to 30%, preferably about 20%, of its maximum downward travel. Said period of time for low damping of the reaction of the accelerator pedal signal is preferably extended by about 0.5 to 2 seconds after the release of the clutch pedal to higher than said second level. It is possible for there to be in the unit 8 a file, i.e. pre-calculated values, whereby regulator parameters for control of the engine via the arrangement 9 are derived on the basis of said criteria for vehicle speed, transmission ratio and clutch pedal position, or a model may be used for calculating suitable regulator parameters on the basis of values instantaneously delivered by the various detectors 10-12.

[0027] Fig. 2 illustrates schematically what happens to the accelerator pedal signal g during the time t when the accelerator pedal is suddenly depressed from a position I_1 to a position I_2, with 100% on the vertical axis denoting accelerator pedal fully depressed. The broken line shows how the accelerator pedal signal would change if it could instantaneously follow the position of the accelerator pedal. The pattern of the accelerator pedal signal is shown for situations of high damping (A), medium-high damping (B) and low damping (C). Let us imagine the vehicle running at relatively high speed. Said damping will then be high when no gear changes take place, so the ride will be smooth and comfortable. This means that the damping upon changes in the position of the accelerator pedal will in principle follow curve A. If gear disengagement and the engagement of a different gear take place, the clutch pedal position detected will cause the damping of the accelerator pedal signal to become low, as represented by curve C. This means that the engine will in principle react immediately to changes in the position of the accelerator pedal at the time of release of the clutch.

[0028] Fig. 2 shows that the time taken to receive an accelerator pedal signal instigated by the accelerator pedal when the damping is low is considerably shorter than when the damping is high, and in the case illustrated the first-named time is less than 25% of the last-named.

[0029] Low damping thus means that said reaction is almost instantaneous and the time between an accelerator pedal signal instigated by the accelerator pedal and the actual arrival of that accelerator pedal signal is considerably shorter than when the vehicle is running at normal speed (e.g. 50-90 km/hour for a truck), such as 50% to 25% or less than 25% of the time.

[0030] The invention is of course in no way limited to the embodiment described above, since a multiplicity of possibilities for modifications thereof are likely to be obvious to a specialist in the field without thereby having to depart from the basic concept of the invention as it is defined in the attached claims.

Claims

1. A device for damping the reaction of an accelerator pedal signal to changes in the position of an accelerator pedal (7) in a motor vehicle, whereby said signal is adapted for passing on to an arrangement (9) for control of an engine (1) of the vehicle according to commands from the vehicle's driver, and whereby the device comprises a unit (8) arranged to receive information about at least one operating parameter of the vehicle and to effect said damping in a manner dependent on the magnitude of that parameter, **characterised in that** the device also comprises means (10) arranged to send information to the unit about the position of means (6) crucial to the occurrence of disengagement of the engine (1) from a gearbox (4) of the vehicle, and that said unit

is arranged to use information about the position of said means (6) as a said operating parameter.

2. A device according to claim 1, **characterised in that** said means crucial to the occurrence of said disengagement is a clutch pedal (6) or a clutch plate.

3. A device according to claim 2, **characterised in that** the unit (8) is adapted to causing the damping of said reaction of the accelerator pedal signal to be low at the time of depression of the clutch pedal (6) and withdrawal of the clutch plate from a clutch plate cooperating with it, e.g. when the vehicle is being set in motion or changing gear.

4. A device according to claim 2 or 3, **characterised in that** the unit (8) is adapted to causing said damping of the reaction of the accelerator pedal signal to be low during a period of time from when the clutch pedal (6) is depressed to lower than a first level to at least when it is released to a second level, and from when the respective clutch plate is withdrawn beyond a first point from a clutch plate cooperating with it to at least when it reaches a second point on its way towards a clutch plate cooperating with it.

5. A device according to claim 4, **characterised in that** the unit is adapted to extending said period of time for low damping of the reaction of the accelerator pedal signal to a certain extent after the release of the clutch pedal to higher than said second level and the arrival of the respective clutch plate at the second point.

6. A device according to claim 5, **characterised in that** said extent is 0.01 to 2 seconds, preferably 0.5 to 2 seconds.

7. A device according to claim 4, **characterised in that** said first level and first point correspond respectively to the clutch pedal (6) being depressed and the clutch plate being withdrawn from full engagement with a clutch plate cooperating with it, to the extent of 5-15%, preferably about 10%, of the clutch pedal's maximum downward travel and the clutch plate withdrawal distance respectively, and said second level corresponds to the clutch pedal being released so that it is still depressed and the clutch plate still withdrawn from full engagement with a clutch plate cooperating with it, to the extent of 10-30%, preferably about 20%, of the maximum downward travel and the clutch plate withdrawal distance respectively.

8. A device according to any one of the foregoing claims, **characterised in that** the unit (8) is adapted to causing damping of the accelerator pedal signal in a manner dependent on at least one further operating parameter.

9. A device according to claim 8, **characterised in that** the unit (8) is adapted to using information about the motor vehicle's speed as a said other operating parameter and to decreasing the damping of said reaction of an accelerator pedal signal in response to decreasing speed of the vehicle.

10. A device according to claim 8 or 9, **characterised in that** the unit (8) is adapted to using information about the current transmission ratio of the vehicle's gearbox (4) as a further said operating parameter and to decreasing the damping of said reaction of an accelerator pedal signal in response to decreasing transmission ratio.

11. A device according to any one of claims 8-10, **characterised in that** the unit (8) is arranged to cause the damping of said reaction of an accelerator pedal signal to be low if any of said operating parameters prompt such low damping.

12. A device according to any one of the foregoing claims, **characterised in that** the unit (8) is so adapted that low damping means that said reaction is almost instantaneous and the time between an accelerator pedal signal being instigated by the accelerator pedal and being actually received is, at such low damping, considerably shorter than when the vehicle is running at normal speed, e.g. 50-90 km/hour for a truck, such as 50% to 25% or less than 25% of the time.

13. A method for damping the reaction of an accelerator pedal signal to changes in the position of an accelerator pedal (7) in a motor vehicle, whereby said signal is adapted for passing on to an arrangement (9) for control of an engine (1) of the vehicle according to commands from the vehicle's driver, and whereby said damping is effected in a manner dependent on the magnitude of at least one operating parameter of the vehicle, **characterised in that** the position of means, e.g. a clutch pedal (6) or clutch plate, crucial to the occurrence of disengagement of the engine from a gearbox of the vehicle is detected, and that information about the position of said means is used as a said operating parameter.

14. A computer programme directly loadable into the internal memory of a computer which comprises computer software for controlling the steps of the method according to claim 13 when the programme is run on the computer.

15. An electronic engine control unit provided with a computer programme with software for controlling

the steps according to claim 13.

16. A computer-readable medium with a computer programme recorded on it which is intended to cause a computer to control the steps of the method according to claim 13.

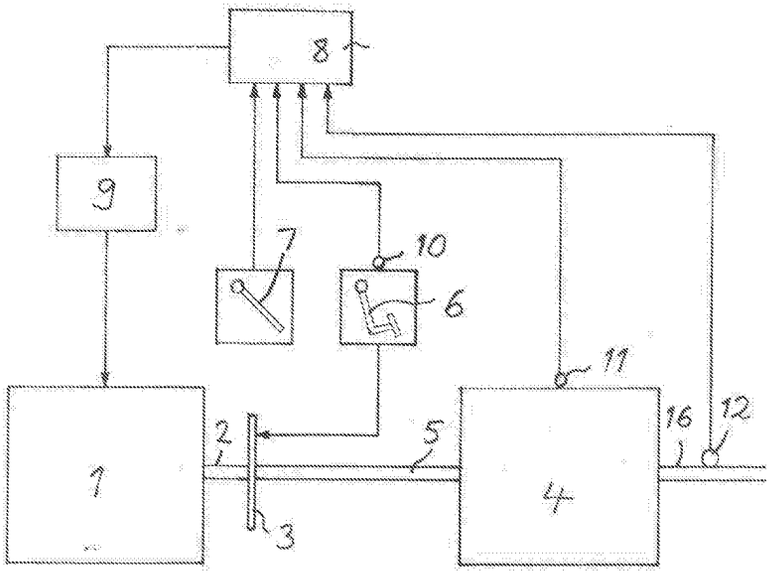

Fig 1

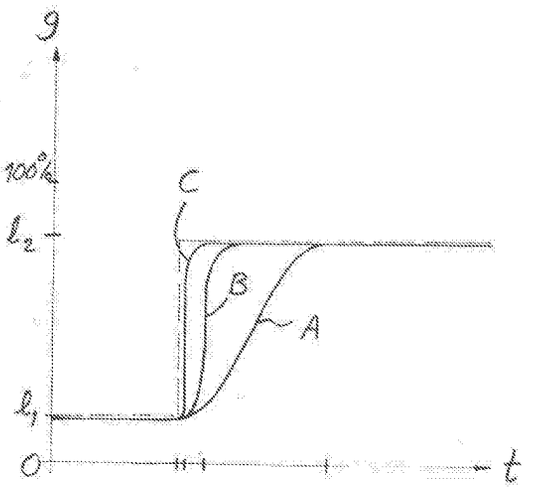

Fig 2