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(71) Applicant: **VOLVO TRUCK CORPORATION** [SE/SE];
S-405 08 Goteborg (SE).(72) Inventors: **GENTON, David**; 352, chemin de l'Étang, F-01310 Buellas (FR). **ALBERT, Marc**; 123, rue de la Pagère, F-69500 Bron (FR). **FERRANTI, Raphael**; 43, Les Chanturières, F-69360 Communay (FR).(74) Agent: **AMIOT, Franck**; Renault Trucks, VGIP - Patents and I.P. Strategy - TER E70 002, 99, route de Lyon, F-69806 Saint Priest (FR).

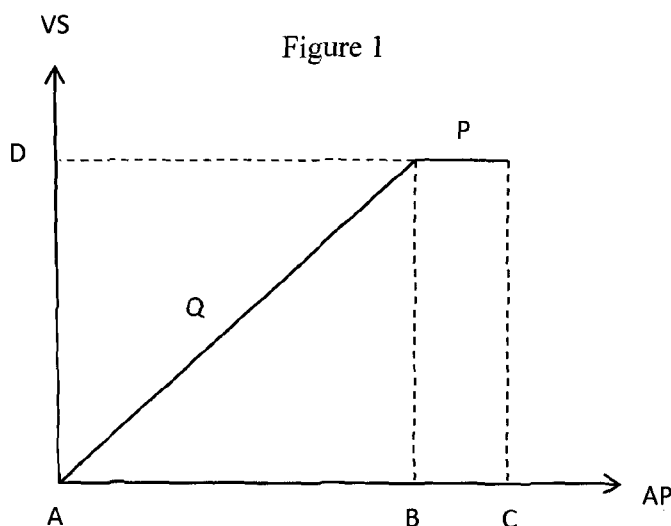
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(54) Title: METHOD OF SELECTING A TRAVELING MODE AND CONTROLLING THE TRAVELING SPEED OF A VEHICLE



(57) Abstract: A method of controlling the traveling speed of a utility vehicle comprising a main motor and at least one auxiliary motor, wherein the main motor may be connected to, or disconnected from, a set of driving wheels and the at least one auxiliary motor may be activated to deliver traction power to a non-driving wheel or deactivated, comprises the steps of: a) Selecting a traveling mode among several possible traveling modes, wherein the main motor is disconnected from the set of driving wheels and the at least one auxiliary motor is activated to deliver traction power to said non-driving wheel, b) Controlling the vehicle speed (VS) and the direction of the utility vehicle by the means of one or more human machine interface device selected from the accelerator pedal, the gearbox stalk and the cruise control switch. The invention is also directed to a utility vehicle comprising auxiliary motors connected to non-driving wheels.

Method of selecting a traveling mode and controlling the traveling speed of a vehicle

Field of the invention

5 The present invention relates to a method of selecting a traveling mode of a vehicle equipped with one or several auxiliary motors and controlling the traveling speed of such a vehicle. The present invention is further directed to a utility vehicle equipped with one or several selection devices to select a traveling mode and to control the traveling speed. More particularly, the selection devices of the present invention are integrated to human machine interface devices
10 already present in the driving space.

Background of the invention

In utility vehicles used in travelling works, it is often necessary to keep a slow traveling mode, which is as regular as possible, while the working tools are running fast or even at their maximal speed. Travelling works may be for example a continuous flow concrete delivery,
15 spreading, road maintenance, side grass cutting, hedges pruning, painting, cleaning or sweeping. Working tools like booms, arms, buckets, pruning shears, mower, or any other rotary machines are usually driven by the main engine of the utility vehicle, which is also used for the traveling of the vehicle. While the engine may need a high speed of rotation to drive the working tools, the travelling of the vehicle shall be kept slow enough and as regular
20 as possible. Beside the commands of the working tools, the user also needs to control the traveling speed of the vehicle. Thus several commands have to be managed at the same time, which requires attention, and sometime discomfort. For instance, US20100042301 discloses a control method wherein the speed of the engine depends on a first pedal and the travelling speed of the vehicle is managed by a second pedal. Also, in the systems commonly used, the
25 traveling torque is transmitted to the driving wheels, either directly by the combustion engine or through a secondary system, like a hydrostatic transmission, which transmits only a ratio of the engine speed to the driving wheels. In these configurations, the traction power is always delivered to the driving wheels.

It is therefore the aim of the present invention to improve the easiness of controlling a utility vehicle during a traveling work. It is in particular an object of the present invention to provide various traveling modes for utility vehicles.

5 Summary of the invention

A utility vehicle according to the present invention is preferably a truck comprising a main motor and at least one auxiliary motor. The main motor may be a traditional internal combustion engine or an electrical motor or a hybrid assembly. The main motor is connected to the driving wheels through a transmission and is also used for driving the working tools
10 connected to the utility vehicle. The main motor can be disconnected from the driving wheels by the means of a clutch, or a converter. The transmission of the utility vehicle may comprise a manual gearbox, a robotized gearbox or an automatic gearbox. The gearbox is advantageously a robotized gearbox or an automatic gearbox.

The auxiliary motor may be of any kind, but advantageously it is a hydrostatic motor, or an
15 electrical motor. An hydrostatic motor is driven by an hydraulic pump, which is driven by the main motor, or by the gearbox or by a transfer case. Alternatively, the hydraulic pump may be driven by an electrical motor or powered by a battery. An electrical auxiliary motor may be driven by a dedicated battery, or by a power system comprising an alternator, a converter, and potentially one or more batteries. The auxiliary motor is independent from the transmission
20 shaft, and from the driving wheels. In particular, the auxiliary motor is not driven by the transmission line downstream the gearbox. The auxiliary motor can be for example driven by a specific output shaft of the gearbox. In case the auxiliary motor is an electrical motor, the supply power system may be driven by a specific output shaft of the gearbox. The auxiliary motor, or the auxiliary power supply system, may be permanently driven by the gearbox or
25 selectively driven by the gearbox when the corresponding output shaft is activated.

In another preferred aspect, the auxiliary motor is not driven by the transmission line downstream the main motor. The auxiliary motor may be driven directly by the main motor. In case the auxiliary motor is an electrical motor, the power supply system may be directly driven by the main motor. For instance, the auxiliary motor may be driven by a power take-
30 off of the main motor. The speed of the auxiliary motor is independent from the speed of the main motor. In particular, the speed of the auxiliary motor can continuously vary from zero to

a maximum speed value at a given speed of the main motor. In case of an hydrostatic auxiliary motor, the hydraulic pump is preferably a variable displacement pump. It may be for example a load-sensing pump with axial piston. The hydraulic pump is preferably managed by electronically controlled valves. The hydraulic pump, when driven by the main motor or
5 by the gearbox, delivers already full hydraulic power when the main motor is at low speed. The speed of the auxiliary motor is therefore managed independently from the speed of the main motor.

The auxiliary motor may be permanently driven by the main motor or the gearbox output shaft or any other driving means. In that case, the auxiliary motor is either connected to the
10 non-driving wheel in such a way that it delivers a traction power to this non-driving wheel, or disconnected from the non-driving wheel. Alternatively, the auxiliary motor may be integrated to or permanently connected to the non-driving wheel in such a way that it provides traction power to this non-driving wheel as soon as it is driven by the main motor. In that case, the auxiliary motor can be either connected to the main motor or the gearbox output
15 shaft or any other driving means to be in a running state, or disconnected from the main motor or the gearbox output shaft or any other driving means to be in a standby state. Thus, the auxiliary motor is activated when it is in a state of delivering traction power to the non-driving wheel. When the auxiliary motor is integrated or permanently connected to the non-driving wheels, it is activated by connecting it to the main motor or gearbox or any other
20 driving means, in such a way that it switches from a standby state to a running state. When the auxiliary motor is permanently running, it is activated by connecting it to the non-driving wheel, and deactivated by disconnecting it from the non-driving wheel.

Above and below, the terms "driving wheel" or "driving wheels" denote the wheel or the wheels which are driven by the main motor through the transmission line. In the case of a
25 truck or other utility vehicle, the driving wheels are usually a rear set of wheels and are responsible for the translation of the vehicle.

Above and below, the terms "non-driving wheel" or "non-driving wheels" refer to a wheel or to a set of wheels, which are not connected to the transmission line. Thus, the non-driving wheels are not driven by the main motor through the transmission line. The non-driving
30 wheels are usually the steerable wheels, but encompass all the wheels which are not connected to the transmission line.

The auxiliary motor is connected to or integrated to a wheel which is not a driving wheel. An auxiliary motor can be for example connected to a steered wheel, at the front axle or at a secondary steered axle. An auxiliary motor may also be connected to a wheel at a rear axle, which is neither a steered axle nor a driving axle.

- 5 In a preferred embodiment, the utility vehicle is equipped with two auxiliary motors. In an advantageous mode, both auxiliary motors are connected to the wheels of a same axle. Most preferably, two auxiliary motors are connected to steered wheels of the utility vehicle.

The user can select various traveling modes among a first, a second and a third traveling mode. In a first traveling mode, the main motor is connected to the driving wheels and the
10 auxiliary motors are deactivated, meaning that they are disconnected from the wheels, or not running at all. This first traveling mode may correspond to the normal driving mode, used for regular displacements. The first traveling mode may be set up as the default mode, wherein no specific selection has to be performed by the user.

In a second traveling mode, the main motor is connected to the driving wheels through the
15 gearbox, and the auxiliary motors are also activated, meaning that they provide traction power to the non-driving wheels. In this configuration, the auxiliary motors allow an improved overall traction efficiency. This second traveling mode is adapted to difficult grounds, wherein the usual driving wheels remain insufficient. Such difficult grounds comprise the slurry, snow, icy roads, or any other slippery surfaces.

20 In a third traveling mode, the main motor is disconnected from the driving wheels and the auxiliary motors are activated, meaning that they provide traction power to the non-driving wheels. In this third traveling mode the utility vehicle is exclusively driven by the auxiliary motors. The third traveling mode is particularly adapted for traveling works wherein the main motor is exclusively dedicated to the working tools.

25 The selection of the second and the third traveling modes is performed by the means of one or more human machine interface device. Preferably, the selection of a traveling mode is performed by the means of one or more human machine interface device already present at the driving place of the user. For example, the activation of the auxiliary motors may be performed by a dedicated ON/OFF switch, or by any other stalk or switch already present in
30 the driver's space and used for other functions. For instance, the gearbox stalk may be provided with a position corresponding to the activation of the auxiliary motors. Thus, the

auxiliary motors, used in the second and the third traveling mode, may be directly engaged by the gearbox stalk, thus providing traction power to the non-driving wheels. Such a selection method is particularly convenient when the auxiliary motors are driven by an output shaft of the gearbox. The auxiliary motors can be electrical motors or hydrostatic motors driven by an hydraulic pump. Auxiliary motor may be driven by a dedicated battery or by the main motor. The activation of the auxiliary motors by a human machine interface means that the auxiliary motors are switched on, and that they can deliver power traction to the non-driving wheels. Alternatively, in case the auxiliary motors are permanently active due to their permanent connection to the main motor or to the battery, the activation of the auxiliary motors means that they are mechanically engaged to the non-driving wheels and that they physically transmit traction power to the non-driving wheels.

The selection of the third travelling mode may be performed either with the human machine interface device already used for the selection of the second traveling mode, or with another one. For instance, the third traveling mode may be activated when the gearbox stalk is placed in a further different position, thus disconnecting the main motor from the driving wheels, while maintaining the auxiliary motors active, or activating the auxiliary motors to deliver traction power to the non-driving wheels, while disconnecting the main motor from the driving wheels. The selection of the second and the third traveling mode may be either sequential or independent. In a sequential selection, the second traveling mode may be selected in a first step, and the third traveling mode may be the object of a further step. Such a selection sequence thus comprises a first step wherein the auxiliary motors are activated while maintaining the main motor connected to the driving wheels, and a second step wherein the main motor is disconnected from the driving wheels while maintaining the traction power of the auxiliary motors to the non-driving wheels.

The sequential selection may also be performed using two different human machine interface devices. For example, the auxiliary motors may be activated with a ON/OFF switch in a first step, thus inducing the traction of the non-driving wheels in addition to the one of the driving wheels by the main motor. This first step corresponds to the second traveling mode. A second step, consisting of disconnecting the main motor from the driving wheels, can be performed for example with the gearbox stalk or another human machine interface device.

A non-sequential selection mode allows to independently activate the second traveling mode or the third traveling mode. As an example, the switch used for activating the auxiliary motors

may be a three-position switch, or a rocker switch, wherein a first and a second position are independent, and allow to select the second traveling mode or the third traveling mode. The human machine interface device may also be a pulse button on which one brief contact allows to activate one of the second or third traveling mode and two successive contacts allow to
5 activate the other traveling mode.

The first traveling mode is automatically retrieved once the other traveling modes are disconnected. The same human machine interface device may be used to select the second traveling mode, the third traveling mode and to return back to the first traveling mode, which may be considered as the default mode. Thus, when a sequential selection mode is set up, a
10 first human machine interface activation allows the activation of the second traveling mode, a second human machine interface or a second activation of the first human machine interface allows the activation of the third traveling mode, and a third human machine interface or a third activation of the first human machine interface allows deactivate the third traveling mode and retrieve the default traveling mode.

The traveling mode selected by the means of the human machine interface device can be displayed on a screen visible by the user. The traveling mode selection may in addition, or alternatively, be accompanied by an audio signal which alerts the driver that a new traveling mode has been selected. An audio signal may be a brief signal that sounds once at the traveling mode change. It can alternatively be a repeated signal or a continuous signal that
15 sounds as long as a given traveling mode is in operation. In addition, an external audio alert may be activated with one or the other traveling mode in order to alert people eventually surrounding the utility vehicle during the traveling work.

The traveling speed of the utility vehicle is managed according to the selected traveling mode. For instance, the speed of the utility vehicle may be managed by the accelerator pedal as long
25 as the main motor is connected to the driving wheels. This is the case for the first and the second traveling mode. When the third traveling mode is selected, the speed of the utility vehicle may still be managed by the accelerator pedal. In that case, a specific pedal law can be set up in order to guaranty smooth speed variations, in particular under low speed conditions. In that case, selecting the third traveling mode comprises changing the accelerator pedal
30 properties. In particular, the selection of the third traveling mode may induce a shift of the accelerator pedal action from the main motor to the auxiliary motors, or from the driving wheels to the non-driving wheels. The speed of the main motor is therefore no longer

managed by the accelerator pedal but by another human machine interface device, like the engine speed control switches, or the cruise control switches, or any other device used during the driving of the utility vehicle.

5 The traveling speed of the utility vehicle, when the third traveling mode is selected, may be managed by another human machine interface device than the accelerator pedal. Thus, the accelerator pedal may still be used to control the speed of the main engine, even though the main engine is disconnected from the driving wheels. For example, the gearbox stalk may be used to accelerate or slow down the utility vehicle. In a preferred configuration, pushing the gearbox stalk allows to go forward at a speed which is in relation with the position of the
10 gearbox stalk. Pulling the gearbox stalk allows to go backwards at a speed corresponding to the position of the gearbox stalk. Stand still of the utility vehicle is obtained when the gearbox stalk is at the rest position, or at neutral position. Thus, selecting the third traveling mode may comprise changing of the gearbox stalk properties. In particular, the selection of the third traveling mode may comprise a shift of the gearbox stalk action from the driving wheels to
15 the non-driving wheels. This is particularly convenient when the utility vehicle is equipped with a robotized gearbox.

In the present invention, any human machine interface can be used to select one of the traveling modes and/or to control the speed of the utility vehicle. Among the human machine interface devices, an engine speed control switch, the control switch of the auxiliary motors,
20 the cruise control switch, the robotized gearbox control stalk, the steering wheel, and the steering wheel switches, are particularly convenient. Any other switch, stalk or pedal already present in the driving space, around the steering wheel, on the dashboard, on the tunnel or on the header shelves, can be used.

In a first aspect, the present invention is directed to a method of controlling the traveling
25 speed of a utility vehicle comprising a main motor and at least one auxiliary motor, wherein the main motor may be connected to or disconnected from a set of driving wheels and the at least one auxiliary motor may be connected to or disconnected from a non-driving wheel, said method comprising the steps of :

- 30 a) Selecting a traveling mode among several possible traveling modes, wherein the main motor is disconnected from the set of driving wheels and the at least one auxiliary motor is connected to a non-driving wheel in such a way that it provides traction power to said non-driving wheel,

- b) Adjusting the traveling speed of the utility vehicle by the means of a speed control device.

In another aspect, the present invention is directed to a utility vehicle equipped with at least one auxiliary motor wherein the main motor is connected to the driving wheels and the auxiliary motor provides traction power to a non-driving wheel.

Brief description of the figures

Figure 1: Vehicle speed (VS) with the accelerator pedal position (AP) wherein the vehicle speed linearly varies with the accelerator position from zero to a maximal vehicle speed.

Figure 2: Vehicle speed (VS) with the accelerator pedal position (AP) wherein the vehicle speed linearly varies from zero to a first threshold speed and from a first threshold speed to a maximal vehicle speed

Figure 3: Vehicle speed (VS) with the accelerator pedal position (AP) wherein the vehicle speed varies non-linearly with the accelerator pedal position.

Figure 4: Vehicle speed (VS) with the gearbox stalk maintenance time (T) wherein the vehicle speed linearly varies with the time of maintenance of the gearbox stalk.

Figure 5: Vehicle speed (VS) with the gearbox stalk impulses (ST)

Detailed description of the invention

Several various possibilities can be applied to select a traveling mode and control the speed of the utility vehicle using the human machine interface devices.

In a first example, the third traveling mode is selected, wherein the auxiliary motors are activated and wherein the main motor is disconnected from the driving wheels. The third traveling mode is preferably selected by the means of a switch or an ON/OFF button. The selection of the third traveling mode provides the change of some human machine interface properties. In particular, the actions of the accelerator pedal, the engine speed control switches and the cruise control switches are modified. Once the third traveling mode is selected, the accelerator pedal no longer influences the speed of the main motor. It rather influences the traction power of the auxiliary motors.

Then, pressing the accelerator pedal allows to increase the traveling speed of the utility vehicle without modifying the speed of the main motor. The vehicle speed (VS) varies according to a linear profile (Q) with the position of the accelerator pedal, as shown in Fig.1. This means that the vehicle speed (VS) linearly increases from zero, to a maximum speed value D, when the accelerator pedal is pressed from a first position A, upward, to a second position B, downward. The first position A may be the original position of the accelerator pedal, at rest. The second position B may be the final position of the accelerator pedal or an intermediate position, preferably close to the final position C. Position B advantageously corresponds to around 80% to 95% of the complete course of the accelerator pedal. In a preferred configuration, position B corresponds to around 88% to 92% of the complete course of the accelerator pedal. Position B may be materialized by a hard point indicating to the driver that a limit is reached. The maximum speed value D may be reached at position B, in such a way that the remaining course (P) of the accelerator, until the position C, does not allows further speed increase of the utility vehicle.

It has to be noted that the maximum vehicle speed (VS) depends on the selected mode. The maximum vehicle speed (VS) when the third traveling mode, or when the second travelling mode, is selected is advantageously around 40 km/h, preferably around 30 km/h, and more preferably between 20 and 10 km/h.

Thus, the course of the accelerator pedal is used for a reduced speed range compared to the speed range available for the first traveling mode. Typically, the course of the accelerator pedal allows a speed variation from zero to around 40 km/h, preferable from zero to around 30 km/h, and more preferably from zero to a speed value comprised between 20 km/h and 10 km/h. The speed variation of the vehicle is therefore less sensitive to the variations of the position of the accelerator pedal, compared to the first traveling mode. This allows keeping a good homogeneity of the vehicle speed, even on an irregular ground, wherein the feet of the driver can move up and down due to the uneven ground.

Alternatively, the vehicle speed (VS) increases according to a first linear profile (Q) from zero to a first speed threshold value E, when the accelerator pedal is pressed from a first position A, upward, to an intermediate position B, downward, and increases according to a second linear profile (R) from the speed threshold value E to a maximal speed value D, when the accelerator is further pressed until the position B', as shown in figure 2. B' may correspond to the final position C of the accelerator. Alternatively, B' corresponds to an intermediate

position between B and C and the remaining course (P) of the accelerator pedal does not allow further speed increase of the utility vehicle.

The speed threshold value E is advantageously comprised between around 5 and 10 km/h. In a preferred configuration, the speed threshold value E is comprised between around 5 and 10 km/h and the maximum vehicle speed value D is comprised between 20 and 15 km/h.

In a more preferred configuration, the speed threshold value E is between 5 and 10 km/h, the maximum vehicle speed value D is comprised between 20 and 15 km/h, and the position B corresponds to around 88% to 92% of the course of the accelerator pedal, preferably around 90%.

From a first linear profile (Q) to a second linear profile (R), the vehicle speed (VS) becomes more sensitive to the variation of the position of the accelerator pedal, meaning that the vehicle speed (VS) varies faster in a second linear profile (R) than in a first linear profile (Q). In particular, the vehicle speed (VS) varies between 5 and 50% faster in the second linear profile (R) compared to the first linear profile (Q). More preferably, the vehicle speed (VS) varies between 10 and 20% faster in the second linear profile (R) compared to the first linear profile (Q). It is contemplated that other positions may be determined for the accelerator pedal, determining further linear speed profile variations, in such a way that the vehicle speed varies faster at higher speed. The vehicle speed variation may vary by around 10% to 20% from one to the other linear profiled. This allows to keep a very good speed homogeneity at low vehicle speed and provide a good reactivity for speed variation at higher speed. Such an accelerator pedal property is particularly adapted when traveling works are spaced from one another. A remote working area can rapidly be reached by pressing down the accelerator pedal, while remaining under the third traveling mode. Releasing the accelerator pedal to slow down the vehicle below the first threshold speed value E, when reaching the second working area, allows retrieving the smooth accelerator pedal action.

Alternatively, the vehicle speed (VS) varies according a non-linear profile (S), wherein the sensitivity of the vehicle speed continuously increases along the course of the accelerator pedal from a first position A, upward, to a second position B, downward. As described above, the first position A may be the original position of the accelerator pedal, at rest. The second position B may be the final position of the accelerator pedal or an intermediate position, preferably close to the final position C. Position B advantageously corresponds to around 80% to 95% of the complete course of the accelerator pedal. In a preferred configuration, position

B corresponds to around 88% to 92% of the complete course of the accelerator pedal. Position B may be materialized by a hard point indicating to the driver that a limit is reached. The maximum speed value D may be reached at position B, in such a way that the remaining course (P) of the accelerator, until the position C, does not allow further speed increase of the utility vehicle. Alternatively, B can correspond to the final position C of the accelerator pedal.

A combination of the above speed profiles can also be envisaged. For example, the vehicle speed (VS) can vary according to a linear profile until a first speed threshold value and vary according to a non-linear profile above such first speed threshold value.

Once the desired speed is reached, using the accelerator pedal, the cruise control switch may be activated to maintain the vehicle speed regular. Under these conditions, the selection of the third traveling mode involves the modification of the action of the cruise control device, which controls the auxiliary motors instead of the main motor.

While selecting the third traveling mode, the action of the gearbox stalk is also modified. The gearbox stalk is used to go forward, rearward or simply standstill. For instance, pushing the gearbox stalk allows going forward, pulling the gearbox stalk allows going rearward, and letting the gearbox stalk at a rest position allows keeping the vehicle at standstill or even stopping it.

Alternatively, the gearbox stalk may be activated by impulses. It can be pushed once to instruct going forward, and then let returning back to its rest position. Then, the brake pedal can be used for braking the utility vehicle. The gearbox stalk can be pulled once to instruct going rearward, and let returning back to its rest position. Thus, the sense of the utility vehicle movement is selected by the gearbox stalk while the speed of the vehicle is controlled by the accelerator pedal.

The speed of rotation of the main motor, used for the working tools, may be adjusted with the engine speed control switches.

Thus, the method of the present invention comprises the steps of

- Selecting a traveling mode among several possible traveling modes,
- Controlling the vehicle speed (VS), independently of the speed of the main motor, using the accelerator pedal, wherein the speed varies according to a linear profile or a non-linear profile,

- Controlling the direction of the translation of the vehicle using the gearbox stalk, wherein the direction is determined either by maintaining the gearbox stalk at one of its forward or rearward position, or by pulsing it forward or rearward,
- Potentially maintaining the vehicle speed (VS) using the cruise control switch.

5 In a second example, the third traveling mode is selected, wherein the auxiliary motors are activated and wherein the main motor is disconnected from the driving wheels. The third traveling mode is preferably selected by the means of a switch or an ON/OFF button. Upon selection of the third traveling mode, the action of the gearbox stalk is modified in such a way that the gearbox stalk can be used for going forward or rearward and to accelerate and
10 decelerate. The vehicle speed (VS) varies according to a linear profile (Q1) with maintenance time (T) of the gearbox stalk in one of its forward or rearward position, as shown in figure 4.

The vehicle speed (VS) increases according to a linear profile (Q1) from zero to a maximal speed value D, as long as the gearbox stalk is maintained to its forward position. The vehicle speed (VS) remains constant when the gearbox stalk is let going back to its rest position.

15 When the gearbox stalk is pushed forward during a time T1 and let going back to its rest position, the vehicle speed (VS) reaches the speed value E1, and remains at this speed value. When the gearbox stalk is pulled rearward to its rest position and maintained, the vehicle speed decreases according to the same linear profile (Q1) until it stops. From standstill, pulling the gearbox stalk rearward to its rest position allows backing the vehicle. During
20 backing, the vehicle speed increases in accordance to the linear profile (Q1) as long as the gearbox stalk is maintained at its rearward position, until the maximal speed D is reached. Pushing the gearbox stalk back to its rest position and maintaining it allows the vehicle slowing down according to the same linear profile (Q1) until it stops.

Alternatively, similar effect of the gearbox stalk may be obtained by moving said gearbox
25 stalk up and down rather than forward and rearward. Also, combination of movements can be used between up, down, forward and rearward.

The maximum speed value D is reached after a time Tm. Further maintenance (P) of the gearbox stalk at its position, either forward or rearward, after the time Tm has been reached does not provide further speed increase of the utility vehicle. Tm may be a time comprised
30 between 10 seconds and 90 seconds, depending on which acceleration profile is desired. A compromised may be found between a good reactivity and a good speed homogeneity. For example, a maintenance time Tm comprised between 50 and 90 seconds is particularly

adapted for smooth accelerations. A maintenance time T_m comprised between 15 and 30 seconds allows a better reactivity during the vehicle speed variation.

As mentioned above, the maximum vehicle speed (VS) when the third traveling mode is selected is advantageously around 40 km/h, preferably around 30 km/h, and more preferably
5 between 20 and 10 km/h. Thus, the maintenance time T_m allows a speed variation from zero to around 40 km/h, preferable from zero to around 30 km/h, and more preferably from zero to a speed value comprised between 20 km/h and 10 km/h.

Although the same linear profile (Q1) is used for the two directions, it is possible to set two different linear profiles, one is applied when the utility vehicle is going forward and the other
10 one is applied when the utility vehicle is going backward. Also, the maximum speed value may be different when the vehicle is going forward and when it is going backward. For example, the maximum vehicle speed during backing operations may be limited to a value between 10 to 15 km/h.

Although the linear profile (Q1) is shown on figure 4, a non-linear profile wherein the vehicle
15 speed (VS) varies continuously faster with the maintenance time of the gearbox stalk is also possible.

Alternatively, the action of the gearbox stalk may be modified in such a way that the vehicle speed (VS) varies step by step, by providing pulsations on the gearbox stalk, as shown in figure 5. Thus, each pulsation (SI) on the gearbox stalk increases or decreases the vehicle
20 speed by a predetermined amount. In particular, each pulsation on the gearbox stalk forward increases the speed by a predetermined amount of around 1 to 5 km/h, and each pulsation on the gearbox stalk rearward decreases the speed by a predetermined amount of around 1 to 5 km/h. The vehicle speed variation may be regular from zero to a maximal speed D. The maximal vehicle speed (VS) is reached after a maximum number of stalk impulsions (SI_m). It
25 is also contemplated that below a predetermined speed threshold E, each pulsation (SI) on the gearbox stalk varies the vehicle speed by around 1 or 2 km/h, and above the predetermined speed threshold value E, each pulsation (SI) on the gearbox stalk varies the vehicle speed by around 3 to 5 km/h. The predetermined threshold speed value E may be advantageously comprised between around 8 and 15 km/h. E is preferably around 10 km/h. Thus, the speed
30 increases faster above a speed threshold E. The maximum stalk impulsion (SI_m) is advantageously comprised between 5 and 30. A compromise between a good speed homogeneity and a good reactivity may be found by optimizing the SI_m and the speed

variation for each gearbox stalk impulsion. For example, a good reactivity in speed variation is possible by limiting SIm to around 10 pulsations. In that case, the speed variation for each impulsion (SI) is significant. In case the speed variation needs to be smoother, the number SIm can be increased. More comfortable speed variations will be obtained when SIm is
5 comprised between 20 and 30.

Using the gearbox stalk impulsion is particularly convenient to maintain a homogenous and regular vehicle speed. Alternatively, similar effect of the gearbox stalk may be obtained by moving said gearbox stalk up and down rather than forward and rearward. Also, combination of movements can be used between up, down, forward and rearward.

10 The speed of the main engine may be controlled by the cruise control switches. Thus the accelerator pedal has no longer influences on the speed of the vehicle or the speed of the main motor. Alternatively, the speed of the main motor may be controlled by the accelerator pedal, following the same law as in the first traveling mode. In such a way, the speed of the working tools may be managed by the accelerator pedal.

15 Thus, the method of the present invention comprises the steps of :

- Selecting a traveling mode among several possible traveling modes,
- Controlling the vehicle speed (VS), independently of the speed of the main motor, and the direction of the translation of the vehicle, using the gearbox stalk, wherein the speed varies according to a linear profile or a non-linear profile, and according to the
20 time maintenance of the gearbox stalk or a number of pulsations on the gearbox stalk.

It is to be understood that the methods exemplified above are not intending to limit the claimed subject-matter.

The present invention also encompasses a utility vehicle, equipped as mentioned above, wherein a traveling mode can be selected among several traveling modes, and wherein the
25 vehicle speed (VS) and the vehicle direction are controlled according to the methods above described.

Claims

1. A method of controlling the traveling speed of a utility vehicle comprising a main motor and at least one auxiliary motor, wherein the main motor may be connected to, or disconnected from, a set of driving wheels and the at least one auxiliary motor may be activated to deliver traction power to a non-driving wheel or deactivated, said method comprising the steps of :
 - a) Selecting a traveling mode among several possible traveling modes, wherein the main motor is disconnected from the set of driving wheels and the at least one auxiliary motor is activated to deliver traction power to said non-driving wheel,
 - b) Controlling the vehicle speed (VS) and the direction of the utility vehicle by the means of one or more human machine interface device selected from the accelerator pedal, the gearbox stalk and the cruise control switch.
2. Method according to claim 1 wherein the traveling mode is selected by the means of one or more human machine interface device selected from an ON/OFF button for activating the auxiliary motor and the gearbox stalk.
3. Method according to any one of claims 1 or 2, wherein the vehicle speed (VS) is controlled by the accelerator pedal and the direction of the vehicle is controlled by the gearbox stalk, and wherein the vehicle speed (VS) increases according to a linear profile (Q) from zero to a maximum speed value D when the accelerator pedal is pressed from a first position A, upward, to a second position B, downward.
4. Method according to any one of claim 1 or 2, wherein the vehicle speed (VS) is controlled by the accelerator pedal and the direction of the vehicle is controlled by the gearbox stalk, and wherein the vehicle speed (VS) increases according to a first linear profile (Q) from zero to a first speed threshold value E when the accelerator pedal is pressed from a first position A, upward, to an intermediate position B, and increases according to a second linear profile (R) from the speed threshold value E to a maximal speed value D, when the accelerator is further pressed until the position B'.

5. Method according to any one of claims 1 or 2, wherein the vehicle speed (VS) is controlled by the accelerator pedal and the direction of the vehicle is controlled by the gearbox stalk, and wherein the vehicle speed (VS) varies according to a non-linear profile (S).
6. Method according to any one of claims 1 to 5, wherein the direction of the vehicle is determined by maintaining the gearbox stalk at one of its forward or rearward position.
7. Method according to any one of claims 1 or 2, wherein the vehicle speed (VS) and the direction of the vehicle are both controlled by the gearbox stalk.
8. Method according to claim 7, wherein the vehicle speed (VS) varies according to a linear profile (Q1) with the maintenance time (T) of the gearbox stalk at one of its forward or rearward position.
9. Method according to claim 7, wherein the vehicle speed (VS) varies according to a non-linear profile with the number of pulsations (SI) on the gearbox stalk.
10. Method according to any one of the preceding claims wherein the driving wheels are connected to the main motor through a robotized gearbox.
11. Method according to any one of the preceding claims wherein the auxiliary motor is a hydrostatic motor connected to a hydraulic pump driven by the main motor.
12. Method according to any one the preceding claims wherein said utility vehicle comprises two auxiliary motors connected to the wheels of a steered axle.
13. A utility vehicle comprising a main motor and at least one auxiliary motor, wherein the main motor may be connected to, or disconnected from, a set of driving wheels and the at least one auxiliary motor may be activated to deliver traction power to a non-driving wheel or deactivated, characterized in that a traveling mode may be selected wherein the main motor is disconnected from the driving wheels and the at least one auxiliary motor provides traction power to a non-driving wheel.

14. A utility vehicle according to claim 13 wherein the vehicle speed (VS) of said utility vehicle is controlled with one or several human machine interface device selected from the accelerator pedal, the gearbox stalk, and the cruise control switches.

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15. A utility vehicle according to claim 13 or 14, wherein the vehicle speed (VS) is controlled by the accelerator pedal and wherein the vehicle speed (VS) of said utility vehicle varies according to a linear profile (Q) from zero to a maximum speed (D).

10

16. A utility vehicle according to claim 14 or 15, wherein the human machine interface device is the accelerator pedal and wherein the vehicle speed (VS) of said utility vehicle increases according to a first linear profile (Q) from zero to a first speed threshold value E, and according to a second linear profile (R) above said speed threshold value E.

15

17. A utility vehicle according to any one of claims 14 to 16, wherein the vehicle speed (VS) is controlled by the accelerator pedal and wherein the speed of said utility vehicle increases according to a non-linear profile (S) from zero to a maximum speed value (D).

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18. A utility vehicle according to any one of claims 14 to 17, wherein the at least one auxiliary motor is a hydrostatic motor driven by a hydraulic pump connected to the main motor.

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10

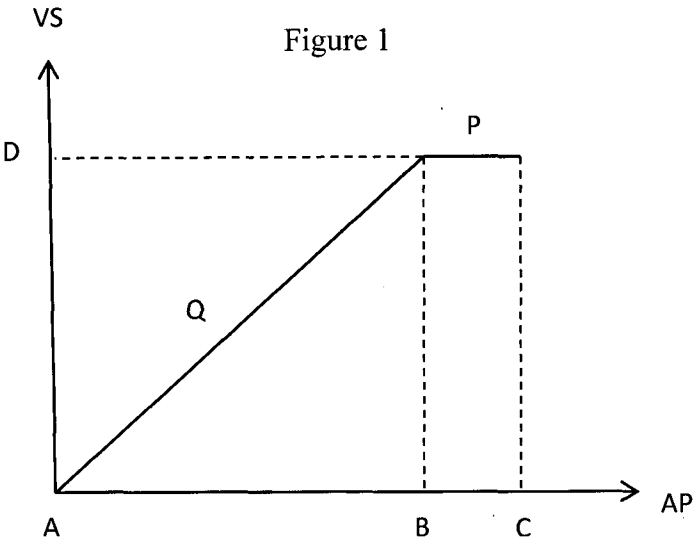


Figure 2

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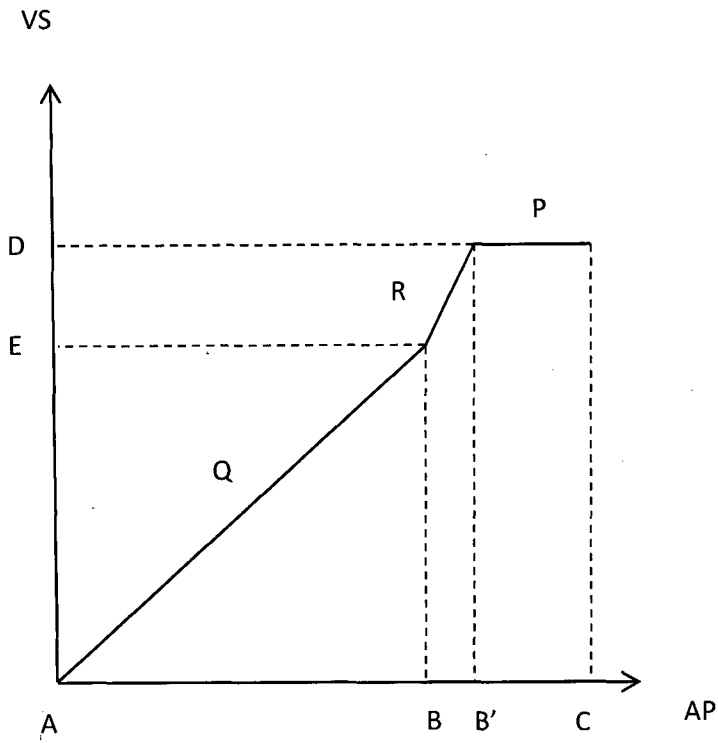


Figure 3

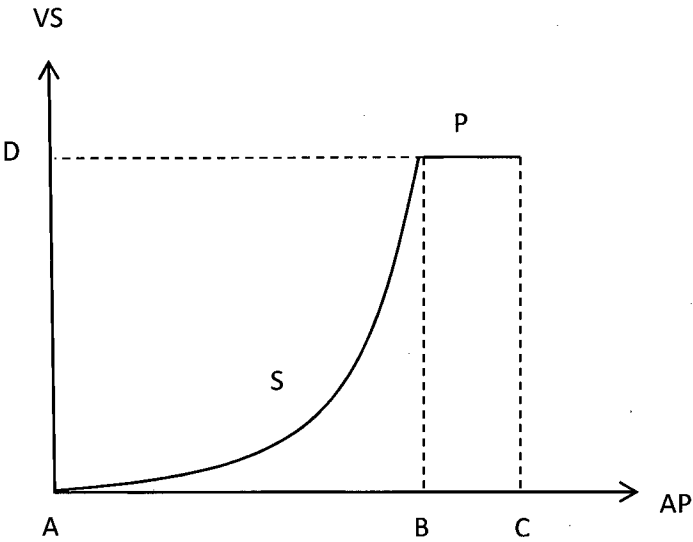


Figure 4

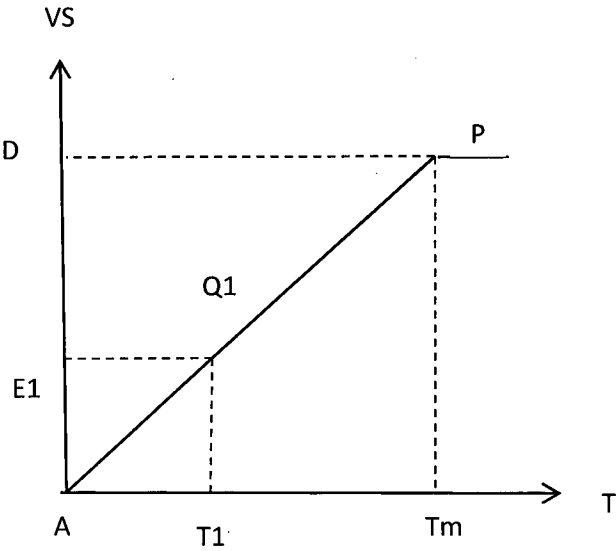
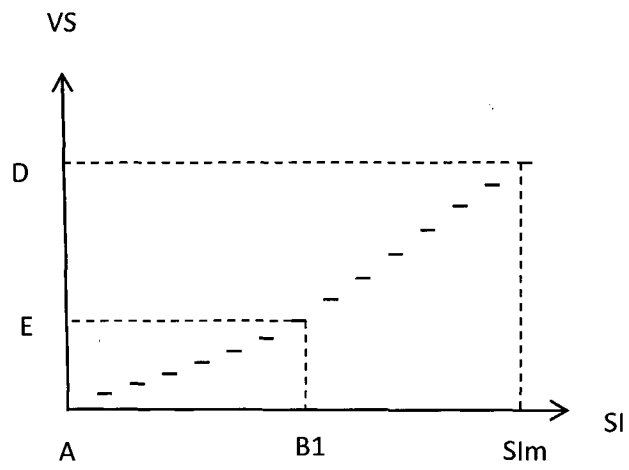


Figure 5



INTERNATIONAL SEARCH REPORT

International application No

PCT/IB2015/000813

A. CLASSIFICATION OF SUBJECT MATTER INV. B60K17/356 B60W50/08 B60W30/14 B60W30/18 B60W50/10 F16H61/462 ADD. B60K26/04 B60K23/08 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) B60K B60W F16H Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched Electronic data base consulted during the international search (name of data base and, where practicable, search terms used) EP0-Internal, 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	WO 2013/167145 A1 (VOLVO LASTVAGNAR AB [SE]; LARSSON LENA [SE]; OEBERG JAN [SE]; ALM FILI) 14 November 2013 (2013-11-14)	1,2,6,7, 10-14,18
Y	page 3, line 17 - page 4, line 18 page 11, line 8 - page 13, line 24	3-5,8,9, 15-17
Y	DE 10 2012 209788 A1 (ZAHNRADFABRIK FRIEDRICHSHAFEN [DE]) 12 December 2013 (2013-12-12) paragraphs [0002], [0009], [0010], [0026] - [0030]	3-5,8,9, 15-17
X	EP 0 230 022 A1 (BAYERISCHE MOTOREN WERKE AG [DE]) 29 July 1987 (1987-07-29) page 13, line 25 - page 15, line 13 -/-	1,2, 10-14
☒ 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
1 December 2015		11/12/2015
Name and mailing address of the ISA/ European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016		Authorized officer Nielles, Daniel

INTERNATIONAL SEARCH REPORT

International application No

PCT/IB2015/000813

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2006/065465 A1 (LUNZMAN STEPHEN V [US] ET AL) 30 March 2006 (2006-03-30) paragraphs [0016], [0017] -----	1,2, 10-14
A	DE 10 2010 000238 A1 (AMAZONEN WERKE DREYER H [DE]) 18 August 2011 (2011-08-18) paragraphs [0010] - [0012] -----	1-18
A	EP 1 609 659 A2 (KANZAKI KOKYUKOKI MFG CO LTD [JP]) 28 December 2005 (2005-12-28) paragraphs [0071] - [0074] -----	1-18
A	"MAN HydroDrive. Mehr Traktion. Mehr Flexibilität. Mehr Sicherheit.", 22 January 2015 (2015-01-22), XP055232162, Retrieved from the Internet: URL: http://www.truck.man.eu/man/media/de/c ontent_medien/doc/business_website_truck_m aster_1/MAN_HydroDrive.pdf [retrieved on 2015-11-30] the whole document -----	1-18

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/IB2015/000813

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 2013167145 A1	14-11-2013	NONE	
DE 102012209788 A1	12-12-2013	NONE	
EP 0230022 A1	29-07-1987	DE 3545481 A1 EP 0230022 A1	02-07-1987 29-07-1987
US 2006065465 A1	30-03-2006	CN 1754715 A JP 2006097897 A US 2006065465 A1	05-04-2006 13-04-2006 30-03-2006
DE 102010000238 A1	18-08-2011	NONE	
EP 1609659 A2	28-12-2005	EP 1609659 A2 JP 2006007819 A US 2005282682 A1	28-12-2005 12-01-2006 22-12-2005