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(71) Applicant (for all designated States except US): **VOLVO LASTVAGNAR AB** [SE/SE]; SE-405 08 Göteborg (SE).

(72) Inventors; and

(75) Inventors/Applicants (for US only): **ERIKSSON, Anders** [SE/SE]; Soldatvägen 2, SE-423 49 Torslanda (SE).
ÖBERG, Niklas [SE/SE]; Älvegårdsvägen 56, SE-423 51 Torslanda (SE).

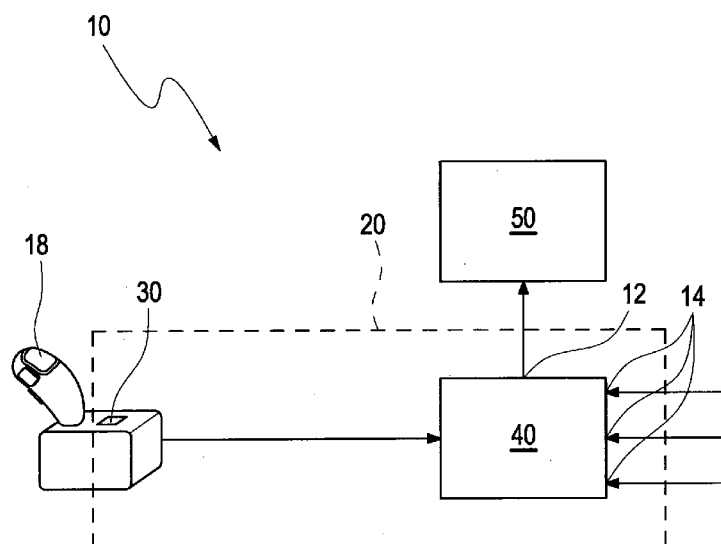
(74) Agent: **FRÖHLING, Werner**; Volvo Technology Corporation, Corporate Patents, 06820, M1.7, SE-405 08 Göteborg (SE).

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(54) Title: ANTI-SLIP SUPPORT SYSTEM AND METHOD FOR IMPROVING TRACTION OF A TRUCK



(57) Abstract: The invention relates to an anti-slip support system (10) for a truck (100) or a construction vehicle comprising an activation device (20) for selecting anti-slip support functionality. The activation device (20) comprises at least two manually selectable positions (22, 24, 26, 28) and that at least one of the positions (22, 24, 26, 28) corresponds to activation of more than one predefined function for improving traction in slippery conditions.

Fig. 1



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DESCRIPTION

Anti-Slip Support System and Method for Improving Traction of a Truck

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TECHNICAL FIELD

The invention relates to a vehicle safety system. More particular, the invention relates to an anti-slip support system for improving traction of a truck and a
10 method for improving traction of a truck or a construction vehicle.

BACKGROUND OF THE INVENTION

It is known in the art that vehicle functions can be provided in a vehicle for
15 improving the traction of the vehicle when a risk of stability-critical driving status occurs. Particularly for a combination of a towing vehicle and a towed vehicle like known for trucks, one is desirous to increase the traction of the truck in critical driving situations when the truck becomes unstable. It is known, for instance, to brake trailer wheels for stabilizing a tractor/trailer combination. Such a security
20 function is, for instance, disclosed in WO 2007/008150 A.

Often the driver has several possibilities to react to a critical driving situation in an appropriate way and to activate a stabilizing function of the truck depending on the actual driving situation. In critical situations, however, the driver may have to
25 decide which function is more appropriate for a certain situation than another function which can delay the activation of the proper stabilizing function.

SUMMARY OF THE INVENTION

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It is an object of the invention to provide a comfortable anti-slip support system which improves the vehicle safety and shortens the reaction time for maintaining or re-establishing the stability of vehicle.

Another object is to provide a method for improving traction of a vehicle.

The objects are achieved by the features of the independent claims. The other claims, the drawing and the description disclose advantageous embodiments of the invention.

An anti-slip support system for a truck or a construction vehicle is proposed comprising an activation device for selecting anti-slip support functionality. The activation device comprises at least two manually selectable positions and at least one of the positions corresponds to activation of more than one predefined function for improving traction in slippery conditions.

The at least two positions may be an "off" position at which the anti-slip support system is deactivated and an "on"-position at which the anti-slip support system is activated. In case there are more positions they may relate to different amounts of requested support by the anti-slip support system. Alternatively or additionally they may relate to anti-slip support on an even road or on an inclined road and the like.

It is of advantage that the driver is supported by activating adequate support functions which are suitable for improving the traction of the truck or construction vehicle. Even in critical situations when many decisions have to be made by the driver in very short time, the driver is at least released from deciding which among several available support functions to choose. The vehicle safety is improved because the driver can concentrate on other tasks associated with driving in a probable critical situation. Favourably, the anti-slip support system combines two or more available support functions in an advantageous way which will ensure a stable drivability of the truck or construction vehicle. The driver can activate the anti-slip support system by selecting one of the available positions corresponding to activation the predefined function for improving traction in slippery conditions without the necessity to think of which actual functions may be available or which function should be activated first. Expediently, the positions may reveal how much of support is needed or requested, for instance, whether maximum support is requested, e.g. on a steep and icy slope, or on muddy ground, or only a small amount of support, e.g. on a wet even road.

According to a favourable embodiment of the invention, the activation device can be coupled to one or more control units providing access to the predefined functions. Favourably, control units which are available in the truck or construction vehicle can be triggered and the respective functions activated by activation of the activation device.

Actual conditions influencing the drivability of the truck or construction vehicle can be considered. In a favourable embodiment of the invention, the activation device can provide an input for operating parameters of the truck or construction vehicle. For instance, weather conditions influencing the road or ground characteristic, such as temperature, presence of water, ice or snow can be input, as well as vehicle speed, load of the truck or construction vehicle, particularly on a towed part of the truck, inclination of the vehicle on a slope, a steering angle, configuration of the truck or construction vehicle such as a presence of a towed trailer or semitrailer and the like.

The actuation device can be used to provide anti-slip support adapted to actual requirements for improving the traction of the truck or construction vehicle. In a favourable embodiment of the invention, the activation device may comprise a selector providing at least two predefined levels of anti-slip support functionality. In this way, more or less anti-slip support can be given which makes the anti-slip support system economic in operation. Particularly, the selector may be coupled to a device for selecting one group of predefined functions, particularly one group among a multitude of function groups, for improving traction in slippery conditions depending on the actual predefined level selected by the selector. Expediently, the available predefined support functions can be merged in predefined function groups in advance. By way of example, in case of a request for maximum anti-slip support a group of functions particularly effective for this situation will be activated. In case of a request for a medium amount of support a group of functions particularly effective for this situation will be activated. In case of a request for a low amount of support a group of functions particularly effective for this situation will be activated. Additionally, it is possible to provide a driving-situation dependent support. For instance, in case of a request for an anti-slip support on a slope a

group of functions particularly effective for this situation will be activated and in case of a request for an amount of support for cornering a group of functions particularly effective for this situation will be activated. The driving-situation dependent support can also be gradated according to the amount of desired support.

The anti-slip support can be adapted to actual situations according to a favourable embodiment of the invention when the predefined functions may be members of a predefined function group wherein an amount of support provided by individual functions of the function group is adapted dependent on one or more operating parameters of the truck or construction vehicle. By this way, the anti-slip support can be optimized for actual driving situations. For instance, functions selected for anti-slip support in winter may be different from functions selected for anti-slip support in autumn, or functions selected for a truck at a steep dry road with an empty towed trailer or semitrailer attached may differ from functions selected for a fully loaded towed trailer at low temperatures on an icy road.

The driver can be provided with a comfortable and clearly laid-out activation device when according to another favourable embodiment of the invention the activation device can be one of a pushbutton, rocker switch, rotary switch, sliding switch, joystick or touch-screen, for instance.

According to another aspect of the invention, a method is proposed for improving traction of a truck or a construction vehicle in slippery conditions comprising the step of automatically selecting two or more predefined functions for improving traction in slippery conditions when anti-slip support functionality is requested. Advantageously, use can be made of available functions in the truck or construction vehicle which can be combined for improving the traction control in an adequate way. The driver is relieved from the necessity of deciding which anti-slip functions are adequate for a certain situation or in which order such predefined functions should be set in action. An improvement of stability of the truck or construction vehicle can be achieved quickly.

According to a favourable embodiment of the invention, a support by the predefined functions is varied depending on one or more actual operation parameters of the truck or construction vehicle. Expediently, the one or more operation parameters of the vehicle may comprise at least one of inclination of the truck or construction vehicle, speed, load of the truck or construction vehicle, weight of the truck or construction vehicle, steering angle, ambient temperature, actual gear setting, kind of truck or construction vehicle, composition of truck or construction vehicle. In this way, the anti-slip support can be adapted to actual conditions efficiently.

According to a favourable embodiment of the invention, the predefined functions may comprise at least one of lifting an axle, e.g. an axle of a bogie, and/or changing axle load, e.g. by means of an air suspension. For instance, a press mode of an axle can be used to distribute weight of the truck or in a way to apply load on an axle required by legal requirements ("legal pressure"). Such predefined functions are particularly useful in a situation where a towed trailer or semitrailer of a truck/trailer combination is fully loaded. For instance, the higher the load on a pair of axles the more can be done in increasing traction for one axle, and the heavier the towed trailer or semitrailer is more tractive force is needed. In a particularly advantageous development, by releasing pressure from a steering tag axle steering can be improved in unfavourable driving conditions even when the axle is not lifted completely. By releasing the pressure, the tag axle can just roll and support a controlled steering of the truck.

According to a favourable embodiment of the invention, the predefined functions can comprise at least one of changing a gear setting and/or locking or unlocking a differential in a drive axle. The torque of the single wheels can be controlled individually for improving the traction of the truck or construction vehicle. If there is less friction on one side, the wheels on this side need to be braked or mechanically locked to wheels on the other side (differential lock) since without a differential lock the possible tractive force would be the same on both sides. A typical example is ice on the outer side of the road.

According to a favourable embodiment of the invention, the predefined functions can comprise steering support from a trailer and/or braking support from a trailer. Steering support from a trailer can help to stabilize going straight ahead with the truck or cornering in a controlled way under critical driving conditions. When the full differential lock is active between wheels on different sides of the truck steering becomes difficult. In this case steering can be improved when the non-driven wheels are braked.

According to another aspect of the invention, a computer program is proposed comprising a computer program code adapted to perform a method or for use in said method when said program is run on a programmable microcomputer. Particularly, the computer program may be adapted to be downloadable to a control unit or one of its components when run on a computer which is connected to the internet. Favourably, the invention can combine available functions in the truck or construction vehicle for an optimized anti-slip support.

Furthermore, a computer program product stored on a computer readable medium is proposed, comprising a program code for use in said method on a computer.

The invention is very expedient for a truck or construction vehicle equipped with three or more axles. The invention can in particular be used with advantage in trucks or construction vehicles with two or more driven axles, for instance for axle combinations like 4x2, 6x2, 6x4 but also for 8x2, 10x4, 4x4, 6x6, 8x6, 8x8, 10x6, 10x8 combinations, wherein the first number indicates the total number of axles and the second number indicates the number of driven axles.

BRIEF DESCRIPTION OF THE DRAWINGS

The present invention together with the above-mentioned and other objects and advantages may best be understood from the following detailed description of the embodiment(s), but not restricted to the embodiments, wherein is shown schematically:

Fig. 1 a simplified representation of an example embodiment of an anti-slip system according to the invention;

Fig. 2a, 2b an example embodiment of selectable groups of predefined function groups for anti-slip support for a 6x2 or 4x2 truck with EBS, ECS air suspension (Fig. 2a), and for a 6x4 truck with EBS, ECS air suspension (Fig. 2b); and

Fig. 3a, 3b in a side view of a truck example embodiments for an anti-slip support function by lifting a bogie front axle of a trailer (Fig. 3a) or of a tractor (Fig. 3b).

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS OF THE INVENTION

In the drawings, equal or similar elements are referred to by equal reference numerals. The drawings are merely schematic representations, not intended to portray specific parameters of the invention. Moreover, the drawings are intended to depict only typical embodiments of the invention and therefore should not be considered as limiting the scope of the invention.

An anti-slip support system 10 for a truck 100, comprising an activation device 20 for selecting anti-slip support functionality is depicted in a simplified manner in Fig. 1. The activation device 20 comprises at least two manually selectable positions, in a very simple case "on" and "off". A driver can switch the anti-slip support on or off. In case more than two positions are provided, the driver can select for instance a degree of anti-slip support, for instance a low degree, a medium degree or a high degree of anti-slip support in order to improve the traction of the truck.

The activation device 20 may comprise a selector 30 providing at least two predefined levels of anti-slip support functionality. The selector 30 is coupled to a device 40 for selecting one group of predefined functions, particularly for selecting one group of predefined function groups for improving traction in slippery conditions depending on the actual predefined level selected by the selector 30.

The activation device 20 may be arranged in a dashboard or close to a handle 18 for changing transmission gears or at any convenient location in the truck. The activation device 20 may be one of a pushbutton, rocker switch, rotary switch, sliding switch, joystick, touch-screen or the like.

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The activation device 20 is coupled to one or more control units 50 via an output 12 providing access to the predefined functions. In this way, the activation device 20 has access to the available functionality in the truck which may improve the traction of the truck in a probably critical driving situation.

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The activation device 20 provides an input 14 for operating parameters of the truck 100. Operating parameters may be, by way of example, the slope of the road, the truck speed, the load of the truck - for instance of a trailer towed by a tractor - the steering angle and the like. Such parameters are typically available in one or more components or control devices of the truck. For instance, the slope can be measured in a gearbox arranged in the truck.

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The truck can particularly be a combination of a towing vehicle and a towed vehicle. The towed vehicle can comprise one or more trailers, wherein the trailer can be a drawbar trailer ("full trailer") or a semitrailer. Generally, the invention may also be useful for construction vehicles such as an articulated hauler or the like which usually are moved on rough grounds on construction sites such as unsurfaced and uneven roads and steep slopes.

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When the driver activates the activation device 20, e.g. by moving the selector 30 to a specific position requesting a certain degree of anti-slip support, this results in selecting a group of predefined functions (in case the degree of anti-slip support can be selected) which improve the traction of the truck. Particularly, the group of predefined functions can be one group in a multitude of function groups which are available for the selection. The predefined functions and/or predefined function groups may be stored in the device 40. The functions within the individual function groups can by way of example be combined to provide an appropriate degree of anti-slip support which is requested by the driver.

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A variation of the contribution of one or more predefined functions in a group of functions can be provided depending on the input of the operation parameters of the truck. By varying the contribution the anti-slip support can be optimized depending on actual driving conditions.

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Fig. 2a and Fig. 2b illustrate example embodiments of selectable groups of predefined functions for anti-slip support. Fig. 2a depicts an example for a 6x2 or 4x2 truck with EBS (EBS = electronic brake system) and ECS air suspension (ECS = Electrically Controlled Suspension). Fig. 2b depicts an example for a 6x4

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Generally, an electronic brake system provides a dosing of the brake torque for each axle or even each wheel. ECS allows to distribute the weight between the axles. However, it may also be used to distribute the weight between wheels.

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By way of example four manually selectable positions 22, 24, 26, 28 are provided by the selector 30 with position 22 corresponding to an "off"-state of the anti-slip support system, position 24 to a low degree of support request, position 26 to a medium degree of support request and position 28 to a high, or maximum, degree of support request. The driver may see an expedient denotation on the selector 30 for instance "0" (position 22) when the anti-slip support system is switched off, "1" (position 24) for a low degree, "2" for a medium degree (position 26) and "3" (position 28) for a high degree of support.

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Each of the positions 22, 24, 26, 28 of the selector 30 corresponds each to a group of predefined function groups F1, F2, F3, F4, and F5 which can improve the traction of the truck. The individual constituents of the function groups F1, F2, F3, F4, and F5 may vary from one group to another and may vary within one group depending on input of operation parameters of the truck.

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Function group F1 may correspond to lifting one axle of a bogie or a twin axle or having both axles on the ground. In this way it is possible to distribute the weight to a maximum legal drive axle load by lifting or pressing down the axle. The arrows indicated in the drawing associated with F1 in positions 24, 26, 28 mean pressing

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or lifting an axle. The arrow pointing down means pressing down one axle or not lifting an axle (position 24). The arrow pointing upward (positions 26 and 28) means lifting an axle. The axle can also be a bogie axle where the arrow down relates to bogie axle press mode and the arrow up relates to bogie axle lift mode.

- 5 In the "press mode" the weight can be distributed within legal boundaries and in the "lift mode" the axle is completely lifted. Often, the "press mode" provides two possibilities: (a) it is possible to distribute the weight of the truck in order to get a pressure according to the maximum legal pressure on the axle or (b) in the next step one axle receives the maximum technical axle pressure or above, when the
- 10 truck moves with a certain low speed, for instance, between 0-10 km/h or between 0-30 km/h.

- Function group F2 may correspond to a traction control system (TCS). The activation state of an intelligent anti-slip control such as TCS allows detecting slip
- 15 of a wheel. Traction control systems, also known as Anti-Slip Regulation (ASR) on current trucks are typically (but not necessarily) electro-hydraulic systems, designed to prevent loss of traction of the driven road wheels, when excessive throttle is applied by the driver, and the condition of the road surface due to varying factors is unable to cope with the torque applied. As a result, loss of
- 20 control of the truck is prevented.

- Typically, the traction control system shares the electro-hydraulic brake actuator (but does not use the conventional master cylinder and servo), and the wheel speed sensors with the anti-lock braking system. Traction can be controlled by
- 25 various means such as retarding or suppressing the spark to one or more cylinders; reducing fuel supply to one or more cylinders; braking one or more wheels; closing the throttle in case the truck is fitted with drive by wire throttle. In turbo-charged trucks, the boost control solenoid can be actuated to reduce boost and therefore engine power.

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Function group F3 may correspond to an inter axle differential lock, i.e. locking or unlocking the differential between axles. Such a differential arrangement allows for some difference in angular velocity of the drive shafts, but imposes a mechanical bound on the disparity. Using a differential lock between the axles causes the

axes to have the same speed (the central gear) but the drive axles can still have different speeds. The function group F3 is not active or not provided in case of a 6x2 truck with 6 wheels including 2 driven wheels or a 4x2 truck with 4 wheels including 2 driven wheels. In case of a 6x4 truck with 6 wheels including 4 driven wheels, the function group F3 is present and can be activated if required, so as to adjust the speed between a pair of wheels.

Function group F4 may correspond to an intra axle differential lock, i.e. locking or unlocking the differential between wheels on the same axle. As a result, the wheels on one axle can be controlled operates in conjunction with the differential locked or separately with the differential unlocked.

Function group F5 may correspond to an economy/power mode, i.e. may comprise increasing of the gear at start of the truck and increasing a gear for reversing. By increasing the starting gear for forward and reverse driving the force on the wheels can be lowered to avoid spinning of the wheels when slippery conditions are present. Further functions can be provided, e.g. a function of increasing upshift limits of the gearbox, thus avoiding an upshift at partial load, and/or a function for reducing a clutch engagement time at start.

Fig. 2a depicts an example for a 6x2 or 4x2 truck, with EBS and ECS air suspension. When the road is dry and no support is required, position 22 of the activation device 20 is selected.

In case there is very little slip on the road, low support is required and the driver will select position 24 of the activation device 20.

In position 24 the anti-slip support system 10 provides function groups F1 and F2 as a function group. As a result, the weight distribution of the bogie axles is varied so as to increasing the load to the drive axle by pressing down the axle by way of the ECS air suspension, and F2 activates the traction control system. Function group F2 may also include a slower clutch engagement at start. Slower clutch engagement is usually controlled by the gearbox. It can be included in function group F2 if traction control and gearbox functionality can be combined in the

gearbox. Otherwise slower clutch engagement can be included in function group F5.

By selecting position 26 the driver requests a medium degree of support (position 26). The anti-slip support system 10 provides a function group comprising function groups F1, F2, F5. For the medium degree of support, the axle load is increased by lifting one axle of the bogie (function group F1), the traction control system is activated (function group F2) a slower clutch engagement on start is provided, gear upshifts at partial load are prohibited (e.g. by raising upshift limits), a higher gear for starting (normal start gear + 1) is selected and a higher gear for reversing, as well as lowered downshift limits when the accelerator pedal is released for engine braking and no brake program active. A brake program is a gear selection mode in which gears are chosen that results in high engine revolutions in order to maximize the engine braking power. The number of gear shifts is reduced by lowered downshift limits when the accelerator pedal is activated. When driving using the accelerator pedal typically shift speeds are a function of the position of the accelerator pedal. In this example embodiment this function is changed so for a given pedal position the shift speed becomes lower. All engine braking devices together (such as compression brake and exhaust pressure governor) and the retarder, e.g. a driveline retarder, placed on the output shaft of the transmission, of the truck are more gently activated.

In case a high degree of anti-slip support is desired, the driver will select position 28. In this case, the anti-slip support system 10 will activate the function group comprising function groups F1, F2, F4, F5. Additional to the support functions already provided with a medium degree of anti-slip support at position 26, the intra axle differential lock (function group F4) between the wheels of one axle is activated.

Fig. 2b depicts an example for a 6x4 truck with EBS, ECS air suspension.

In case there is very little slip on the road, low support is required and the driver will select position 24 of the activation device 20.

In position 24 the anti-slip support system 10 provides function groups F1, F2 and F3 as a function group. As a result, the weight distribution of the bogie axles is varied so as to increasing the load to the drive axle by pressing down the axle by way of the ECS air suspension, and function group F2 activates the traction control system. Function group F2 may also include a slower clutch engagement at start. Slower clutch engagement is usually controlled by the gearbox. It can be included in function group F2 if traction control and gearbox functionality can be combined in the gearbox. Otherwise slower clutch engagement can be included in function group F5.

By selecting position 26 the driver requests a medium degree of support (position 26). The anti-slip support system 10 provides a function group comprising function groups F1, F2, F3, F5. For the medium degree of support, the axle load is increased by lifting one axle of the bogie (function group F1), the traction control system is activated (function group F2), the inter axle differential lock between two drive axles, a slower clutch engagement on start is provided, gear upshifts at partial load are prohibited (e.g. by raising upshift limits), a higher gear for starting (normal start gear + 1) is selected and a higher gear for reversing, as well as lowered downshift limits when the accelerator pedal is released for engine braking and no brake program active. A brake program is a gear selection mode in which gears are chosen that results in high engine revolutions in order to maximize the engine braking power. The number of gear shifts is reduced by lowered downshift limits when the accelerator pedal is activated. When driving using the accelerator pedal typically shift speeds are a function of the position of the accelerator pedal. In this example embodiment this function is changed so for a given pedal position the shift speed becomes lower. All engine braking devices together (such as compression brake and exhaust pressure governor) and the retarder, e.g. a driveline retarder, placed on the output shaft of the transmission, of the truck are more gently activated.

In case a high degree of anti-slip support is desired, the driver will select position 28. In this case, the anti-slip support system 10 will activate the function group comprising function groups F1, F2, F3, F4, F5. Additional to the support functions already provided with a medium degree of anti-slip support at position 26, the intra

axle differential lock (function group F4) between the wheels of one axle is activated.

Of course, additional or alternative anti-slip support functions can be included into the group of anti-slip support functions of the anti-slip support system 10, some of which are described below.

For instance, an intra axle differential lock based on the wheel brakes can be introduced for adjusting the speed of selected wheels. This kind of differential lock can be activated when the truck is cornering as well as going straight ahead as well as skidding or not. The required speed of each wheel can be determined based on the steering angle of the front wheels, the input of each EBS system regarding the actual speed of each wheel and the wheel base. When the differential lock is activated, the required speed is calculated based in the above-mentioned parameters so that it can be determined which wheel and how much this wheel should be braked.

During cornering, the inner driven wheels can be braked and thereby have a lower speed. This can be done preferably when the both inner and outer wheels have low grip or if only the inner wheel has a low grip. In a worst case, when the outer wheel has a low grip, the outer wheel can be braked thus at least securing the forward movement of the truck.

Another expedient predefined anti-slip support function is based on an asymmetric bogie technique which allows to distribute the weight between the axles of the bogie in a desired way. Normally, an asymmetric bogie is a bogie with different lengths of the front and rear bogie arms. In case the front bogie arm is longer than the rear bogie arm, then the ground pressure is lower on the front axle resulting in an improved agility in forward direction.

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Favourably, the invention can be applied on bogies constituted of two driven axles or two non-driven axles, for instance on a trailer.

The asymmetry can be changed in the same truck dependent in the direction the truck is driving. For instance by checking the position of the gear lever, with help of this information the pressure in the air bellows of the axles can be changed appropriately.

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According to an expedient embodiment of the invention, the asymmetry of the bogie is achieved only artificially in a way that the arms are of equal length but with different air pressure in the respective suspension air bellows. In this way, the ground pressure of a bogie axle can be varied and can be adapted to yield improved agility in forward direction as well as in rear direction.

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According to another expedient embodiment of the invention, a predefined anti-slip support function can be provided by increasing the traction of the truck 100 particularly during cornering and manoeuvring by a load transfer to the outer wheels. By controlled distributing the axle load among the wheels of the axle depending on the agility needed the manoeuvrability of the truck 100 can be improved.

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A further predefined anti-slip support function comprises braking wheels of a trailer to stabilize the tractor-trailer combination in order to avoid a "jack-knife" situation caused by an underbraked trailer. On the other hand, an overbraked trailer can cause a swing out of the trailer. Favourably, when a critical driving situation is detected and the driver activates the actuation device 20 (Fig. 1), an independent operation of the trailer brake system is activated in response to the request of anti-slip support and a brake force avoiding underbraking and overbraking of the trailer can be applied.

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According to another expedient embodiment of the invention depicted in Figs. 3a and 3b, a predefined anti-slip support function for a truck 100 comprising a tractor 110 and a trailer 120 can be provided by controlling a starting aid comprising an electronic control unit by which load sensors on a drive axle 106, 106r of the cab 110 and the axles 124f, 124r of the trailer 120 are connected via a data bus system. Traction is improved by reducing the load on the front axle 124f of the axle pair 122 on the trailer 120. Reducing load on the front axle 124f of the axle pair

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122 will help climbing soft surfaces regardless if the axles 124f, 124r are driven or not. When the axles 124f, 124r would be driven the traction force would be increased when an axle 124f, 124r were lifted. Another effect when lifting the front axle 124f of the axle pair 122 of the trailer 120 is that the load distribution is
5 changed forward so that traction is improved on the truck 100 and/or on a front axle 106f of the axle pair 108 on the tractor 110.

Fig. 3a shows a side view of the truck 100, the truck 100 comprising a non driven front axle 104, a driven front axle 106 and the axle pair 122 on the trailer 120 with
10 a front axle 124f and a rear axle 124r. The trailer 120 is attached to the tractor 110 via a fifth wheel 102. However, the trailer 120 can also be a drawbar trailer (not shown) attached to the tractor 110 with a drawbar. By deflating air bellows associated with the front axle 124f before the fixed rear axle 124r of the trailer 120, the front axle 124f can be lifted (indicated by a curved arrow above the axle pair
15 122) and the load of the rear axle 124r can be increased thus increasing the traction of the axle 124f on the road.

Similarly, as shown in Fig. 3b, the load (and consequently the traction) of the driven rear axle 106r of the axle pair 108 on the tractor 110 can be increased
20 when the front axle 106f of the axle pair 108 of the tractor 110 is lifted (indicated by a curved arrow above the axle pair 108) by deflating the air bellows associated with the front axle 106f in front of the driven axle 106r. If both tractor 110 and trailer 120 comprise a liftable axis, it is expedient to increase the load on the driven axle of the tractor 110 by lifting the liftable axis of the tractor 110 before the liftable
25 tag axle is lifted.

Generally, the predefined functions such e.g. as the functions F1, F2, F3, F4, F5 in Figs. 2a, 2b and the additional anti-slip support functions described above are members of a group of functions wherein an amount of support provided by
30 individual functions of the group is adapted dependent on one or more operating parameters of the truck 100.

In the following some operating parameters are listed which influence the driving conditions, partly due to road conditions subjected to the truck combination, and

which may influence the activation of the anti-slip support system. Such parameters may be:

Ambient temperature:

- 5 If a risk of ice or snow on the road is present due to the ambient temperature, the system is informed of this and if the temperature is below a predetermined limit the system may be allowed activation. A temperature below this threshold limit could itself alone cause an ESP (ESP=electronic stability program, also know as ESC=electronic stability control) operation to be allowed, or such allowability could
- 10 be made dependent on other measurements as well. The ESP operation is well known in the art and comprises an enhanced stability-enhancing system that reduces the risk of rolling over, skidding and jack-knifing. It provides a more stable braking by making it possible to distribute braking force between the axles and/or the wheels, for instance by reducing the engine torque to the driven wheels and
- 15 controlling wheel braking individually.

- Information on the state of the road may be obtained in real time wirelessly by way of example from a transmitter sending information about the state of a current part of the roadway and may be collected for instance from a weather service or
- 20 roadway authorities. With this information it two or more predefined functions can be selected for improving traction in slippery conditions which are appropriate for the actual weather conditions.

Road inclination (slope):

- 25 The computing could be adapted in such a manner that the anti-slip support system provides anti-slip support needed particularly in uphill direction where a certain amount of tractive force is needed to overcome the climbing resistance.

Steering wheel angle:

- 30 In order to avoid the separate trailer braking action to influence the driving path, a limitation in the activation of the operating means may be defined which is dependent on the steering wheel position.

Truck combination weight:

In order to apply a suitable amount of temporary trailer braking, it would be advantageous for the system to have information of the truck combination weight.

Auxiliary braking/deceleration:

- 5 Auxiliary braking of the tractor truck with a braking torque above a predefined limit, such as auxiliary brake usage, such as engine brake and/or retarder, may be detected by measuring the acceleration and in particular the deceleration. This braking torque limit could also be temperature dependent or dependent on other parameters in order to allow for activation of the ESP operation means.

10

Vehicle combination speed:

A limit to the minimum and maximum speed for the allowance of the trailer brake system could be defined to avoid adversely affecting the stability of the truck combination at high speed and to avoid constrains in parking manoeuvres at low or reverse speed.

15

Braking balance between towing vehicle and trailer:

This information can be obtained from the CFC (Coupling Force Control) function of the towing vehicle. If the ratio between the braking torque of the towing vehicle and the braking torque of the trailer is unbalanced, the truck combination may be unstable. The ratio of the brake torque should then preferably be adjusted. An underbraked trailer, i.e. a trailer that is braked less than required, can cause a "jack-knife" situation. This situation would create a signal asking for a more powerful brake actuation of the trailer brake. An overbraked trailer, i.e. a trailer that is braked more than required, can cause a "trailer swing-out" situation. This situation would create a signal asking for less or no brake actuation of the trailer brake.

20

25

Measurements of many of these relevant parameters are already made in most electronic systems installed in trucks and tractors. Therefore, the parameters are available for the anti-slip support system 10. The anti-slip support system 10 may be implemented during the design and manufacture of tractors or mounted subsequently on tractors, trucks and the like.

30

5 Favourably, the driver only needs to request a degree of anti-slip support, while the anti-slip support system automatically selects the appropriate support functions available in the truck, wherein the amount of support provided by the predefined functions may be varied depending on one or more actual operation parameters of the truck.

10 Favourably, the invention can be embodied as hardware or software or comprise both software and hardware. Further, the invention can be embodied as a computer program product which can be accessed from a medium which can be used or read by a computer. Preferably, the medium can provide a program code which can be used in a computer. Particularly, the medium can be a memory, such as a solid state memory, a RAM or a ROM and the like, a magnetic tape, a computer diskette, a magnetic or optical disc, a CD, a DVD, a USB stick etc.

C L A I M S

- 5 1. An anti-slip support system (10) for a truck (100) or a construction vehicle comprising an activation device (20) for selecting anti-slip support functionality characterized in that the activation device (20) comprises at least two manually selectable positions (22, 24, 26, 28) and that at least one of the positions (22, 24, 26, 28) corresponds to activation of more than one predefined function for improving traction in slippery conditions.
- 10 2. The anti-slip support system according to claim 1, characterized in that the activation device (20) is coupled to one or more control units (50) providing access to the predefined functions.
- 15 3. The anti-slip support system according to claim 1, characterized in that the activation device (20) provides an input for operating parameters of the truck (100).
- 20 4. The anti-slip support system according to any preceding claim, characterized in that the activation device (20) comprises a selector (30) providing at least two predefined levels of anti-slip support functionality.
- 25 5. The anti-slip support system according to claim 4, characterized in that the selector (30) is coupled to a device (40) for selecting one group of predefined groups of functions for improving traction in slippery conditions depending on the actual predefined level selected by the selector (30).
- 30 6. The anti-slip support system according to any preceding claim, characterized in that the predefined functions are members of a function group wherein an amount of support provided by individual functions of the function group is adapted dependent on one or more operating parameters of the truck (100).

7. The anti-slip support system according to any preceding claim, characterized in that the activation device (20) is one of a pushbutton, rocker switch, rotary switch, sliding switch, joystick, touch-screen.
- 5 8. A method for improving traction of a truck (100) or a construction vehicle particularly in slippery conditions comprising a step of automatically selecting two or more predefined functions for improving traction in slippery conditions when anti-slip support functionality is requested.
- 10 9. The method according to claim 8, characterized in that an amount of support by the predefined functions is varied depending on one or more actual operation parameters of the truck (100).
- 15 10. The method according to claim 9, characterized in that the one or more operation parameters of the truck comprise at least one of inclination of the truck (100), speed of the truck (100), load of the truck (100), weight of the truck (100), steering angle, ambient temperature of the truck (100), actual gear setting, kind of truck (100), composition of truck (100).
- 20 11. The method according to anyone of the claims 8 to 10, characterized in that the predefined functions comprise at least one of lifting an axle (106f, 124f) and changing axle load.
- 25 12. The method according to anyone of the claims 8 to 11, characterized in that the predefined functions comprise at least one of changing a gear setting, locking or unlocking a differential in a drive axle (106, 106r).
- 30 13. The method according to anyone of the claims 8 to 12, characterized in that the predefined functions comprise at least one of steering support from a trailer (120), braking support from a trailer (120).
14. Computer program comprising a computer program code adapted to perform a method or for use in a method according to at least one of claims 8 to 13 when said program is run on a programmable microcomputer.

15. Computer program according to claim 14 adapted to be downloadable to a control unit or one of its components when run on a computer which is connected to the internet.
- 5 16. Computer program product stored on a computer readable medium, comprising a program code for use in a method according to one of claims 8 to 13 on a computer.
- 10 17. An anti-slip support system for a truck or a construction vehicle comprising an activation device for selecting anti-slip support functionality characterized in that the activation device comprises at least two manually selectable positions and that at least one of the positions corresponds to activation of more than one predefined function for improving traction in
- 15 slippery conditions.
18. The anti-slip support system according to claim 17, characterized in that the activation device is coupled to one or more control units providing access to the predefined functions.
- 20 19. The anti-slip support system according to claim 17, characterized in that the activation device provides an input for operating parameters of the truck.
20. The anti-slip support system according to claim 17, characterized in that the activation device comprises a selector providing at least two predefined
- 25 levels of anti-slip support functionality.
21. The anti-slip support system according to claim 20, characterized in that the selector is coupled to a device for selecting one group of predefined groups of functions for improving traction in slippery conditions depending on the
- 30 actual predefined level selected by the selector.
22. The anti-slip support system according to claim 17, characterized in that the predefined functions are members of a function group wherein an amount

of support provided by individual functions of the function group is adapted dependent on one or more operating parameters of the truck.

23. The anti-slip support system according to claim 17, characterized in that the
5 activation device is one of a pushbutton, rocker switch, rotary switch, sliding switch, joystick, touch-screen.

24. A method for improving traction of a truck or a construction vehicle
particularly in slippery conditions comprising a step of automatically
10 selecting two or more predefined functions for improving traction in slippery conditions when anti-slip support functionality is requested.

25. The method according to claim 24, characterized in that an amount of
support by the predefined functions is varied depending on one or more
15 actual operation parameters of the truck.

26. The method according to claim 25, characterized in that the one or more
operation parameters of the truck comprise at least one of inclination of the
truck, speed of the truck, load of the truck, weight of the truck, steering
20 angle, ambient temperature of the truck, actual gear setting, kind of truck, composition of truck.

27. The method according to claim 24, characterized in that the predefined
functions comprise at least one of lifting an axle, changing axle load.
25

28. The method according to claim 24, characterized in that the predefined
functions comprise at least one of changing a gear setting, locking or
unlocking a differential in a drive axle.

30 29. The method according to claim 24, characterized in that the predefined
functions comprise at least one of steering support from a trailer, braking
support from a trailer.

30. Computer program comprising a computer program code adapted to perform a method or for use in a method according to claim 24 when said program is run on a programmable microcomputer.
- 5 31. Computer program according to claim 30 adapted to be downloadable to a control unit or one of its components when run on a computer which is connected to the internet.
- 10 32. Computer program product stored on a computer readable medium, comprising a program code for use in a method according to claim 24 on a computer.

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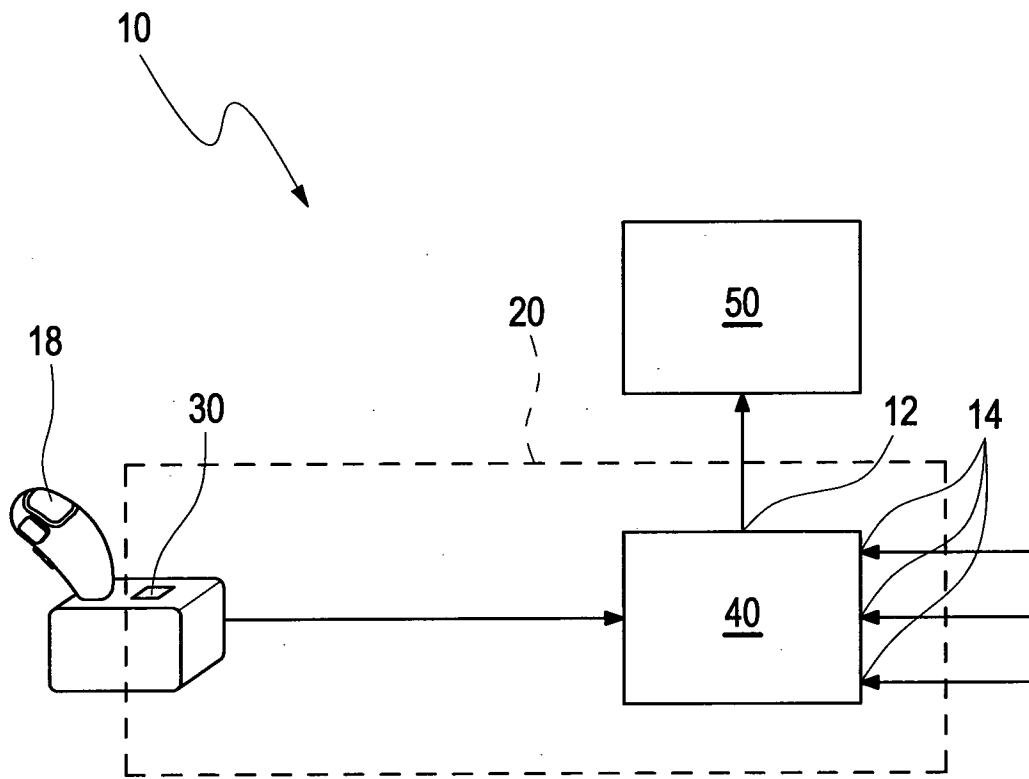


Fig. 1

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	22	24	26	28
30 →	0	1	2	3
F1	-	↓	↑	↑
F2	-	+	+	+
F3	-	-	-	-
F4	-	-	-	+
F5	-	-	G +1 Rev	G +1 Rev

Fig. 2 a

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	22	24	26	28
30 →	0	1	2	3
F1	-	↓	↑	↑
F2	-	+	+	+
F3	-	+	+	+
F4	-	-	-	+
F5	-	-	G +1 Rev	G +1 Rev

Fig. 2 b

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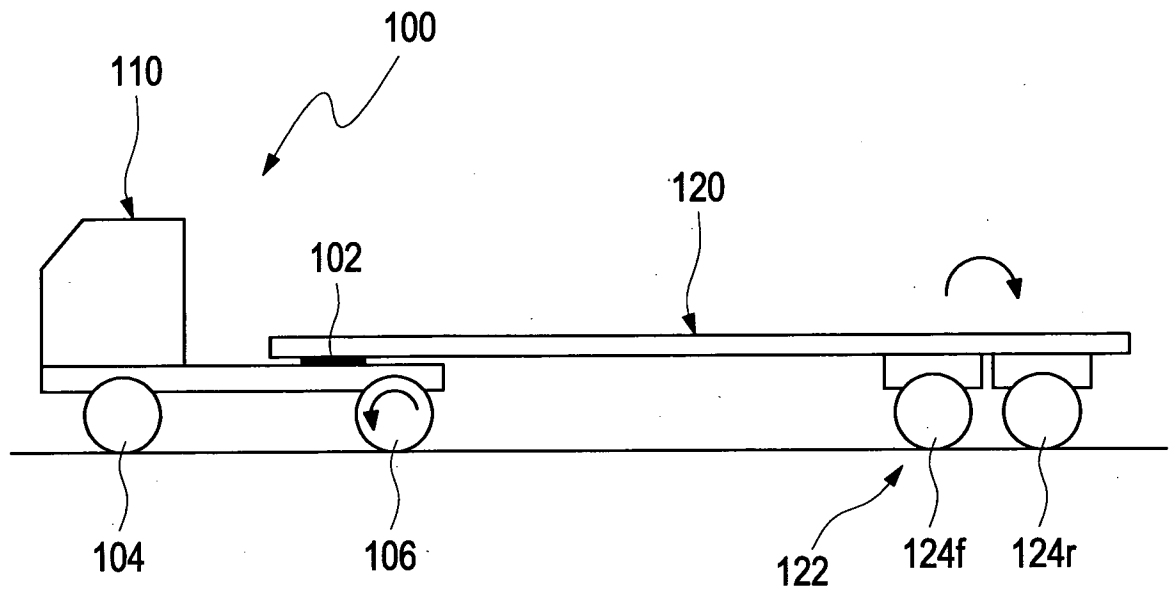


Fig. 3 a

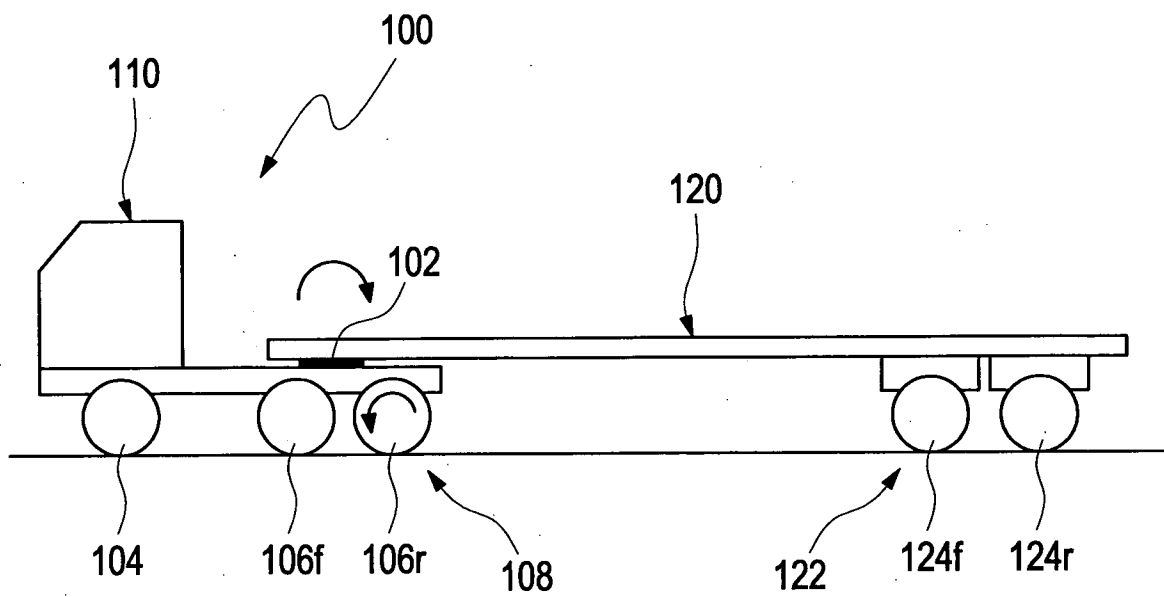


Fig. 3 b

INTERNATIONAL SEARCH REPORT

International application No.

PCT/SE2009/000529

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

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Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-INTERNAL, WPI DATA, PAJ

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	EP 1355209 A1 (FORD GLOBAL TECHNOLOGIES, LLC), 22 October 2003 (22.10.2003), figures 4-6,13, abstract, paragraphs (0014)-(0021),(0046), (0052)-(0053),(0075)-(0084),(0096)	1-10,12, 14-26,28, 30-32
Y	--	10-11,13,26, 27,29
X	EP 0321893 A2 (FUJI JUKOGYO KABUSHIKI KAISHA), 28 June 1989 (28.06.1989), column 1, line 1 - line 14; column 4, line 32 - line 39, abstract	1,17
	--	

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

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Swedish Patent Office
Box 5055, S-102 42 STOCKHOLM
Facsimile No. +46 8 666 02 86

Authorized officer

Johan Ahman / JA A
Telephone No. +46 8 782 25 00

INTERNATIONAL SEARCH REPORT

International application No.

PCT/SE2009/000529

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	WO 0000360 A1 (ALLIEDSIGNAL INC.), 6 January 2000 (06.01.2000), page 6, line 37 - page 7, line 22, abstract --	10-11,13, 26-27,29
Y	US 4999778 A (RUHL ET AL), 12 March 1991 (12.03.1991), column 3, line 60 - line 68, abstract --	10-11,13, 26-27,29
Y	DE 102004022022 A1 (DAIMLERCHRYSLER AG), 1 December 2005 (01.12.2005), abstract, paragraphs (0015),(0021),(0033) --	11,13,27,29
Y	US 20050218719 A1 (HATIPOGLU ET AL), 6 October 2005 (06.10.2005), figure 7, abstract, paragraphs (0009),(0074) --	13,29
A	US 20080264709 A1 (FENKER ET AL), 30 October 2008 (30.10.2008), abstract, paragraph (0081) --	1-32
A	US 20040032162 A1 (ZIEGLER ET AL), 19 February 2004 (19.02.2004), abstract, paragraphs (0013),(0014),(0032) --	1-32
A	DE 102008001879 A1 (ZF FRIEDRICHSHAFEN AG), 26 November 2009 (26.11.2009), claim 1, abstract -- -----	12,28

International patent classification (IPC)**B60K 28/16** (2006.01)**B60K 37/06** (2006.01)**B60W 30/02** (2006.01)**G05G 1/00** (2006.01)**Download your patent documents at www.prv.se**

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INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/SE2009/000529

EP	1355209	A1	22/10/2003	US	7349776 B	25/03/2008
				US	20030200016 A	23/10/2003
EP	0321893	A2	28/06/1989	DE	3869368 D	23/04/1992
				JP	1168554 A	04/07/1989
				US	4936404 A	26/06/1990
WO	0000360	A1	06/01/2000	CA	2336119 A	06/01/2000
				EP	1091860 A	18/04/2001
				JP	2002519231 T	02/07/2002
US	4999778	A	12/03/1991	DE	3741248 C	01/06/1989
				FR	2624070 A,B	17/01/1992
				GB	2213289 A,B	11/09/1991
				IT	1227637 B	23/04/1991
				JP	1200031 A	11/08/1989
				JP	1814209 C	18/01/1994
				JP	5022055 B	26/03/1993
				SE	461717 B,C	12/07/1990
				SE	8804339 A	30/11/1988
DE 102004022022	A1	01/12/2005	WO	2005108147 A	17/11/2005	
US 20050218719	A1	06/10/2005	NONE			
US 20080264709	A1	30/10/2008	NONE			
US 20040032162	A1	19/02/2004	NONE			
DE 102008001879	A1	26/11/2009	WO	2009141181 A	26/11/2009	