A multi-wheeled vehicle has an electric parking brake (EPB) responsive to a control signal to selectively apply braking following parking of the vehicle. An input element generates a command signal in response to manual actuation by a person outside the parked vehicle. A controller validates the command signal and, if valid, then generates the control signal to temporarily release braking so the vehicle can be moved a short distance in the parking area.
BACKGROUND OF THE INVENTION

The present invention relates in general to mobility of parked motor vehicles, and, more specifically, to exterior access to braking or other vehicle motion controls of a parked vehicle to allow vehicle movement while maintaining security of the interior contents of the vehicle and improved safety during such movement and when left unattended.

The brake shift interlock (BSI) feature, also known as the brake transmission shift interlock (BTSI), is a commonly used rollaway theft prevention feature that locks the automatic transmission shift lever portion of the transmission range selector mechanism in the park position such that it can be released only when the ignition switch is in the run or start position—thereby requiring an ignition key. As further safety against unintended movement, release of the shifter from the park position also requires depression (i.e., activation) of the vehicle brake pedal. Conventional BTSI systems further require the transmission shift lever to be in the park position before allowing the ignition key to be removed from the ignition switch when securing and vacating the vehicle. Such an interlock is required by regulations in many jurisdictions, such as FMVSS 114 in the United States.

A typical BTSI system utilizes a spring-activated, solenoid-returned locking pin in the range selection mechanism that prevents shift lever movement away from (i.e., out of) the park position. Conventional transmission range positions are identified as PRNDL, including park, reverse, neutral, drive, and low. The BTSI interlock solenoid and locking pin selectably inhibit or enable changes from the park position to the out-of-park positions (i.e., R, N, D, and L). In the event of a failure of the electrical system or a malfunction of the solenoid for releasing the locking pin, an
optional, mechanical manual override is permitted by FMVSS 114 and most similar regulations globally, and is usually included by the manufacturer. However, to preserve some of the intended theft prevention attribute and to discourage non-service usage of it by customers, FMVSS 114 and most similar regulations require a manual override design which is only accessible or operable by a tool or a key. Since a "service-only" manual override mechanism is intended to be difficult to access and rarely used, the hardware is usually designed to withstand only infrequent (i.e. low duty-cycle) usage. When accessed frequently or by someone other than trained service personnel, these conventional service manual override mechanisms may be easily damaged.

For economic and complexity management reasons, a vehicle manufacturer typically desires to utilize a single hardware design for a particular vehicle model regardless of the global markets into which that model is sold. However, there are significant regional differences in the needs, associated regulations, and customer behavior associated with some hardware, such as the BTSI system and its mechanical service override. This range of differences extends from jurisdictions that prohibit the inclusion of a mechanical service override to those that require daily usage of the override by many drivers and would prefer BTSI deletion. For example, in some markets in Southeast Asia, rollaway vehicle theft does not often occur. Therefore, no corresponding regulations have been put in place to require a BTSI system.

Furthermore, many urban areas in the region are characterized by chronically inadequate space for vehicle parking. In many such places, it has become customary, and often required, to double park vehicles (i.e., in two parallel rows along the edge of a street and in parking structures) while leaving the blocking cars locked with their transmissions out of park (e.g., in neutral), their parking brakes off, and their wheels aligned straight so that drivers of other vehicles can push them out of the way as needed in order to access a blocked parking spot—either when arriving or departing. Such customs evolved easily since most Southeast Asia vehicles included manual transmissions and have no BTSI or other feature to prevent parking in neutral.
However, this customer behavior has migrated to drivers of the increasing automatic transmissions market segment in the region. Drivers of automatic transmission vehicles equipped with the standard FMVSS 114 compliant BTSI and mechanical service override have been forced to use this override for their "neutral" parking purposes. This has resulted in problems associated with overuse of the manual override which is intended to only support low duty cycle, service-only use. Further, the designed-in inconvenience of the tool or key access mandated by FMVSS 114 has resulted in customer dissatisfaction with its ergonomics and ease of use.

PCT patent application PCT/US 10/21303 discloses a configurable electronic brake shift interlock override wherein the driver of a vehicle can choose during parking of that vehicle whether to leave the vehicle transmission in a state that will allow others to push the vehicle in their absence (i.e., in neutral without a key). After removing the key, the driver is given an opportunity during a timed window to shift the transmission out of park (so the vehicle will be movable). If not done during the timed window, the vehicle will be left in a state requiring use of the ignition key to release the interlock. Thus, when the ability to leave the car movable is not needed (e.g., not being double-parked), full anti-theft protection can be maintained. On the other hand, when it is necessary or desirable to leave the vehicle in a movable state, it can be left in neutral so that the transmission does not prevent movement.

With the manual override in effect (resulting in the vehicle wheels being free to rotate without being impeded by the transmission), the vehicle driver or owner must consider the possibility of roll-away of the vehicle—both when unattended and when manual movement is attempted. Typically, the driver will only block the wheels when required by the grade (e.g., with a chock of wood, a brick, or other large object) to prevent unintended movement of the parked vehicle. In some circumstances, a manual override may be of limited utility since vehicle weight on steeper slopes makes manual movement difficult or impossible (and blocking the wheels may not prevent movement). Alternatively, the driver may decide to engage the parking brake and leave the vehicle unlocked so that a parking attendant or other person desiring to move
the vehicle can access the parking brake when they need to move the vehicle. Both the blocking of wheels and the parking of the vehicle in an unlocked condition may be undesirable to the driver or owner. Furthermore, appropriate wheel chocks may not always be available when wanted. Moreover, the reblocking of the wheels after movement would be done by someone other than the driver or owner, and may not be done in a satisfactory manner.

SUMMARY OF THE INVENTION

The present invention has the advantage of being able to engage the parking brake while parked with the transmission being in a neutral gear range and the vehicle interior locked while also permitting the parking brake to be released by another person from outside the vehicle without a key and while unattended by the driver.

In one aspect of the invention, a multi-wheel vehicle comprises an electric parking brake (EPB) responsive to a control signal to selectably apply braking following parking of the vehicle. An input element generates a command signal in response to manual actuation by a person outside the parked vehicle. A controller validates the command signal and, if valid, then generates the control signal to temporarily release braking so the vehicle can be moved a short distance in the parking area. In further aspects of the invention, such exterior controls are extended to other "by-wire" systems affecting vehicle mobility—steering, throttle, transmission range control, and electric propulsion—to further enhance parked vehicle mobility and safety.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 is a schematic diagram of a motor vehicle with the remotely-controlled electric parking brake of the present invention.

Figure 2 is a flowchart showing an overall method of the invention.
Figures 3A-3G are timing diagrams showing operation of the invention according to several different embodiments.

Figure 4 is a graph showing a variable brake actuation that is controlled in response to a speed of vehicle movement.

Figure 5 is a flowchart showing a preferred embodiment in greater detail.

Figure 6 is a flowchart showing an alternative embodiment using a supplemental steering control.

Figure 7 is a flowchart showing an alternative embodiment including initiation of a BTSI override.

Figure 8 is a diagram of a vehicle including a drive system that can be used to control limited movement of the vehicle in the present invention.

Figure 9 is a plan view of a keypad according to one embodiment of the invention.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

The present invention employs a novel manner of controlling a conventional device known as the electric parking brake (EPB). Typical activation and deactivation of a parking brake (either the former mechanical parking brake or the newer EPB) is from a single manual actuation interface inside the vehicle such as a brake lever. An EPB can easily be made responsive to other actuation interfaces or switches which can be added very economically. In the present invention, any exteriorly-accessible vehicle electrical switch (such as a numeric security keypad for keyless entry) can be employed in novel ways to control the EPB through relatively straightforward software and hardware changes. If a preexisting exterior switch is not present in a particular vehicle design or if the switches are in undesirable locations or configurations, then dedicated exterior switches can be added for controlling the EPB. Since the exterior switches are accessible to anyone whether the vehicle is locked or unlocked, the vehicles would no longer need to be left in a free rolling state in order to
allow manual movement by others. As added security, EPB activation could be automatically interlocked to the driver door ajar switch and/or a timer when equipped with the exterior controls of this invention—particularly when the vehicle is left in a "neutral" state.

In addition to securing the vehicle from rollaway while unattended, the present invention using an exteriorly-controlled EPB can provide additional enhanced features including 1) progressive, controlled release of the EPB when initiating vehicle movement, 2) automatic EPB re-activation or dithering after reaching a maximum vehicle speed (wherein control logic determines the difference between an unattended rollaway vehicle and intentional manual movement of the vehicle), and 3) EPB reapplication controls to replace the manual stopping effort thereby reducing personal risk and allowing for more precise stopping of the vehicle in a desired position. If the EPB lacks partial engagement control (i.e., can only be either fully on or fully off) for any of these enhanced features, the electric pump and electronic valve controls of the service brakes (commonly included to provide Electronic Stability Control (ESC) system braking) may be employed for these dynamic braking enhancements until the vehicle is brought to rest and the EPB is re-engaged.

The EPB may be released by a single touch of an exterior switch (assuming that the vehicle is not otherwise prevented from moving, such as when the vehicle transmission is in park). Alternatively, a "press and hold" mode may be utilized wherein the manual exterior switch must be held on in order to release and maintain the EPB in the "off" state while the vehicle is being moved. Release of the EPB can also be conditioned on some particular sequence of switch actuations, provided the sequence can be made known to the persons who may desire to move the vehicle.

Reapplication of the EPB after vehicle movement is completed may be initiated by several different methods. For example, a one touch activation by one or more exterior switches can trigger reapplication of the EPB. Alternatively, reapplication of the EPB may be initiated after a predetermined time delay from first release so that excessive movement cannot occur. In another embodiment, an
immediate or time-delayed reapplication can be initiated after release of the original "press and hold" switch activation (i.e., EPB release). Reapplication of the EPB can also be triggered by other events such as those that may be occurring in other vehicle systems, e.g., detection of an object in an object sensing system, excessive speed determined by a speed sensing system, or a global lock command from a remote entry transceiver.

The present invention may also sense the slope of the surface on which the vehicle is parked in order to prevent release of the EPB in a risky situation or to stop further movement by reapplying the EPB if a steep slope is encountered. If the vehicle is equipped with an alarm system with motion sensing, then the alarm algorithms can be automatically disabled whenever the EPB is released in order to avoid tripping the alarm. EPB release can also be coupled with an automatic change of the automatic transmission shift range from park to neutral if the vehicle is equipped with shift by wire controls. EPB release can also be accompanied by activation of an annunciator such as a horn or vehicle parking light in order to provide feedback to the user that the EPB has been released.

A further enhancement overcomes a potential problem wherein the steering column may be locked into a single position while a vehicle is parked. Not all jurisdictions have regulations requiring steering column locks, and in some instances manufacturers are using electric steering column locks. Thus, where the steering column is not locked or where it is electronically locked and can be temporarily unlocked, the present invention adds the possibility of changing the steering angle while manually moving the vehicle. Preferably, this enhanced embodiment employs electric power assisted steering (EPAS) to expand the external keyless vehicle control to allow a user to electrically adjust the steering angle using either existing or added exterior switches or another externally available human-machine interface (HMI). One embodiment includes using two buttons on the numeric security keypad not used for EPB control to function as "press and hold" keys for left and right steering wheel movements. After setting the steering angle to a desired position, the steering angle
could be maintained by continuous application of power to the EPAS system or by reengaging the electric steering column lock (if equipped) when the vehicle is subsequently being moved.

Yet another enhancement of the present invention uses an electric vehicle drive in order to produce powered vehicle fore-aft movement, (i.e., when the vehicle is an electric vehicle, such as a hybrid or a full electric vehicle). Using external controls, battery power can be applied to self-drive the vehicle forward and rearward with externally accessible switches or HMI.

Similarly, a non-electrified or mild-hybrid vehicle could be started and similarly moved via external fore-aft controls if equipped with module controlled engine starter relays, electronic engine throttle control, and "shift-by-wire" transmission range controls. In either of these fore-aft movement embodiments, closed loop control would preferably be incorporated to deliver precise, controllable acceleration and terminal velocity during such movement. Similar to recent usage of EPB as a "hill-hold" device on manual transmission equipped vehicles, automatic EPB activation and release could facilitate powered movement on grades exceeding manual movement capability by preventing vehicle roll between valid command signal inputs.

Any particular vehicle can include any subset of the movement-related features described above, but they are preferably added in the order of braking before steering and/or drive controls. Whatever the subset of the externally controllable vehicle parking features that a particular vehicle includes, such features facilitate a manual, keyless vehicle parking movement. The features are preferably software controlled, so that the OEM/customer/driver/owner of the vehicle can set soft switches in the controller HMI in order to enable or disable any individual feature or group of these features. When parking a vehicle, the driver can thus decide on an appropriate balance between security of the vehicle and its contents during parking and the ability of others to move the vehicle based on the parking situation. Although exterior EPB control could be designed to simultaneously control transmission range selection via shift by wire controls, if equipped, and allow transmission park-lock redundancy to the
EPB when parked, preferably all of the enabled exterior controls of this invention would be turned on and off as a complete bundle based on the range position the vehicle was left in by the driver (e.g., "Park" = off and "Neutral" = on) thereby securing them all with a key in a single easy step.

Since the need for the invention is driven by market-specific regulatory and user profile differences, a preferred embodiment of the invention carries all sets of related software on-board each affected control module for any particular model of vehicle marketed to all global markets. Control over which of the logic sets to enable is determined by one or more configurable software bits, flags, or codes that can be set to ensure regulatory compliance and, wherever permitted, the customer's preference. Such configuration bits can include a vehicle assembly plant-programmed code for the destination country, the customer's software switches for indicating their own preference (which can be set anywhere in the build/delivery/vehicle use process), and dynamic flags that may be controlled by GPS monitoring of the current jurisdictional location.

Turning now to Figure 1, a vehicle 10 includes an electric parking brake (EPB) actuator 11 coupled to vehicle wheels 12 and 13 for applying a braking force in a conventional manner. A manual control pad 14 is provided inside the vehicle for allowing the driver to apply or release EPB 11, also in a conventional manner. Interior controls 14 may be connected to EPB actuator 11 as shown or may alternatively be connected to a separate control module 15, which then relays control signals to EPB 11.

In this preferred embodiment of the present invention, the EPB actuator 11 is coupled to the exterior switches of keyless entry keypad 16 through the separate control module 15, such as a Body Control Module, to provide exterior access to the EPB function. Thus, control module 15 is coupled to a keyless entry keypad 16 having individual push buttons 17-20 that normally permit manual entry of a security code to unlock the vehicle doors based on a secret button sequence. When in a parked condition, dual use of these buttons by security and EPB functions may be
accomplished by a pre-determined combination of simultaneous button presses that toggle between the two functions (e.g. pressing left/right buttons simultaneously or the fore/aft buttons simultaneously). Since control module 15 normally arbitrates the security keypad function, this embodiment not only avoids the addition of extra wire to the EPB 11 (directly from the keypad 16), but this module is more likely to have existing access to the other necessary signals for validating such exterior control requests. Alternatively or in addition, control module 15 may be coupled to other exterior switches such as a trunk release switch 21 or door handle switches (not shown) so that these other switches can also control the EPB function.

Using new or existing exterior switch(es) and added software in control module 15, the present invention can provide a supplementary control of the conventional EPB module 11 to provide a basic EPB functionality wherein braking can be temporarily released to move the vehicle a short distance within a parking area. Preferably, the controller validates a command signal received from the external switch (i.e., input element) to ensure that the functionality is permitted and the vehicle is in an appropriate state.

Control module 15 may be coupled with other vehicle systems in order to provide various enhanced functionality. For example, a powertrain control module (PCM) 22 is coupled to control module 15 for supplying a vehicle speed data signal. PCM 22 may also be connected to a tilt sensor (not shown) in order to provide control module 15 with an additional tilt data signal for identifying the slope of the vehicle environment. An object detection module 23 uses remote sensing (such as radar) to detect objects and to warn a driver of impending potential collisions. Object information can be provided from module 23 to controller 15 in order to reapply the EPB if an object is encountered, as described below.

Control module 15 is preferably configured to validate command signals based on whether the EPB-only (i.e. in neutral with EPB engaged) parking functionality is permitted in a particular jurisdiction and whether the driver or other person responsible for the vehicle has decided to make available the various parking
related functions such as EPB release. Therefore, a human machine interface (HMI) 24 (which may include a display and manual input switches) is provided to enable a person in the vehicle to configure the various soft switches or flags used in control module 15. In addition, a configuration memory 25 includes flags that may be set in advance by the vehicle manufacturer or distributor to indicate whether the vehicle is in a jurisdiction that allows various functionality. Configuration memory 25 may be located within control module 15 or any other suitable module within the vehicle. It may be further connected to a GPS receiver 26 in order to match a current GPS-determined location of vehicle 10 to a database in configuration memory 25 that correlates permitted functionality with various jurisdictions.

In connection with added steering functionality, a steering actuator 27 is coupled to front wheels 28 and 29. Actuator 27 is under control of a steer by wire controller 30. Steer by wire controller 30 is coupled to external keypad 16, either directly or preferably through control module 15, and is adapted to respond to valid inputs in order to modify the steering angle. The validation of signals can be performed based on software flags from HMI 24 and configuration memory 25. In the event that an electronic column lock 34 is installed, it may be controlled as appropriate by steer by wire controller 30 or control module 15.

In order to implement the parking assist functionality without making it necessary to override the transmission park setting during the entire time that the vehicle is parked, control module 15 may be coupled to a transmission control module (TCM) 32. When TCM 32 is part of an electronic shift by wire system (i.e., PRNDL range selection by wire), and if the jurisdiction does not require a transmission shift interlock, then an externally generated command can be used to temporarily shift the transmission from the park position to neutral for performing a manual parking movement, or to drive or reverse for power-assisted fore-aft movement.

Control module 15 may be further coupled to a vehicle horn or other annunciator (such as parking lights or any other device for generating a human perceptible signal) in order to provide feedback to a person attempting to push the
vehicle. This perceptible confirmation that the command request has been validated enables the user to correctly anticipate the braking state before making the effort to actually push the vehicle. In the event that vehicle 10 is equipped with a perimeter alarm 34 having motion sensors for generating an alarm when the parked vehicle senses motion, a connection between control module 15 and alarm 34 is provided in order to inhibit the issuance of an alarm during the parking assisted functions.

An overall method of the invention is shown in Figure 2. In step 35, a check is performed by the controller to determine whether any exterior control function is enabled. If not, then the process is done at step 36. Otherwise, the controller waits for a received input in Step 37. Once an input is received it is checked for validity in step 38. If not valid, then the controller waits for the next input signal in step 37. Validation in step 38 may preferably be comprised of checking the input signal from a particular external switch for satisfying a particular condition such as being held in a "press and hold" embodiment of the invention. If valid, then the corresponding command is performed in step 39. Depending upon the particular input elements being used (i.e., whether it is a switch performing multiple functions such as when a push button on the security keypad is used), validation of a signal may include decoding of the command based on the button(s) pressed and any sequence of button presses.

Figure 3 illustrates the relationship between a button signal generating a command signal sent to the control module and the responsive EPB state as controlled by the control module. In Figure 3A, the button signal becomes active at 41. In a "Switch Debounce" embodiment, the button signal must be maintained for a predetermined time \( t_i \) in order to be recognized as a valid command. In Figure 3A, the button is held on until a time 42 which occurs at a time longer than \( t_i \). When \( t_i \) is reached, the EPB state goes from an engaged state to a released state at 43 in Figure 3B. In this embodiment, the braking continues to be released until the next activation of the button signal at 44. At 45, the EPB state is returned to an engaged state simultaneously with the button signal received at 44 (assuming negligible switch de-
bounce and signal processing time).

In an alternative embodiment shown in Figure 3C, the released state of the EPB may be continued for a predetermined time $t_2$. Thus, the EPB state is released at 46 and then automatically reengaged at 47.

In a "press and hold" embodiment, the button signal must be maintained whenever the respective function is active. As shown in Figure 3D, a button press occurs at 41'. At that time, the EPB releases at 43' as shown in Figure 3E and remains released until 45' when the button is released at 42'.

As shown in Figures 3F and 3G, a delay between the times of pressing the external switch until the release of the EPB state can be introduced (i.e., a "Delayed Actuation" mode). Thus, the user presses the button and generates a brake release command at step 48. A predetermined delay time $t_3$ is measured by the control module and then the EPB is released at 49. This delay allows the person to activate the function and then get into position for pushing the vehicle before the EPB is actually released.

The release and/or reapplication of braking may also be performed in a gradual manner. Figure 4 illustrates an embodiment wherein a braking percentage between fully released (0%) and fully engaged (100%) is shown by a curve 50. When the EPB release function is activated, braking generally decreases in brake percentage until reaching zero at 51. The vehicle is manually pushed with an increasing speed shown by a speed curve 52. For safety purposes, a speed threshold 53 may be set at an appropriate value. When speed curve 52 exceeds threshold 53, then braking is automatically reapplied by the controller at 54. The decrease may be performed at gradual steps until the speed is restored to below the threshold. After falling below the threshold by a sufficient amount, the braking can be re-released at 55 and may return to a full 100% release at 56. In response to a timeout of the braking function or in response to other inputs to terminate the release (such as a further switch activation by a person outside the vehicle or input from another vehicle system identifying an obstruction or identifying an excessive slope), full braking is restored at 57.
Alternatively, a gradual reapplication of the EPB can be provided.

A preferred method of the invention is shown in greater detail in Figure 5. In step 60, an "EPB off" or release command is detected in step 60. In step 61, a check is made to determine whether the vehicle environment is too steep in order to safely release the EPB. If it is too steep, then the process ends at step 62. The check in step 61 can further include other conditions such as detection of blocking obstacles. It is assumed in Figure 5 that detection of a command in step 60 includes validation of the command.

If conditions are acceptable for release of the EPB, then an acknowledgement is made using an annunciator in step 63 and the security alarm is disabled (preferably only the part of the security system based on motion detection). An optional delay may be introduced in step 64 before releasing braking. In step 65, the amount of braking from the EPB (and/or service brakes) is updated. Thus, braking may be varied in gradual steps between fully released and fully activated. In addition, the braking amount could be dithered up and down under some conditions, if desired.

With EPB braking in a released mode, various checks are made to determine whether braking should be reapplied. Thus, in step 66 the vehicle speed is compared to a speed threshold \( T_s \). If greater than the threshold, then EPB braking is reapplied in step 71. If speed is below the threshold, then a check is made in step 67 to determine whether a maximum time \( T_T \) has been exceeded. If so, then EPB is reapplied in step 71. Otherwise, a check is made in step 68 to determine whether conditions indicate a runaway vehicle. In order to detect runaway, the controller preferably monitors the acceleration, speed, and displaced distance of the vehicle during the temporary release of braking. If any of these exceed predetermined values established for normal manual vehicle movement, then a runaway condition is assumed and EPB braking is reapplied in step 71. If not in a runaway condition, then a check is made in step 69 to determine whether a manual reapply command has been made from an outside switch. If so, then EPB is reapplied in step 71. If not, then any other conditions that may necessitate stopping of the vehicle (such as detection of an obstacle within the vehicle
path with a closing speed that requires associated preventive braking force or acceleration exceeding predetermined levels) are checked in step 70. If these other conditions are not OK, then EPB braking is reapplied in step 71 and the process is completed at step 72. If the other conditions are OK, then a return is made to step 65 for further modification of the braking amount as necessary.

Figure 6 shows an enhanced method for allowing adjustment of the steering angle. In step 75, a valid steering command is detected. In step 76, a check is made to determine whether EPB release is active. If not, then steering adjustment is not necessary and the process is done at step 77. In the event that EPB is active, then the steering lock is released in step 78, if necessary. If step 79, the steering command is checked to determine whether it is valid for the current steering condition (e.g., whether it is in a direction in which further steering is permitted). If valid, then the EPAS is used to execute a change in the steering angle by a predetermined amount, designated as $x^\circ$, for a "momentary" embodiment, or for the time duration of a "press and hold" embodiment. When a valid turn request is no longer present or when a parking assist state is no longer active (i.e., the EPB has been reapplied), then the steering angle is optionally returned to the original position and the steering lock (if equipped) is relocked in step 81 and the process is completed at 82.

In a system not having a BTSI manual override already in place, the transmission shift range can be controlled using a method shown in Figure 7. Thus, an EPB off command is detected in step 85. A check is made in step 86 to determine whether the transmission shift range is in neutral. If so, then the method merely continues to operate as previously described. If the transmission shift range is not in neutral, then a check is made in step 87 to determine whether an override is permitted. A check may depend upon checking software flags set by either the vehicle owner or the manufacturer or distributor as previously described. If override is not permitted then the process is done at step 88. Otherwise, the shift by wire system of the vehicle is used in step 89 to change the gear shift position to neutral. Following the parking assist actions, the shift range would be returned to park (not shown).
In a further enhancement of the invention, a vehicle 90 includes an electric vehicle drive that can be made available to move the vehicle over short distances to provide parking assist functions. An EPB system 91 with an EPB controller 92 responds to an external switch 93. Also connected to switch 93 is an EV drive control 94 that provides electric drive to vehicle wheels 95 and 96. Switch 93 may preferably be comprised of a switch pad as shown in Figure 9. Five individual switches are provided which have conventional numbering shown on each switch as used for a conventional keyless entry keypad. In addition, buttons may be labeled with arrows to indicate forward and backward drive movements, left and right steering adjustments, and EPB brake on and off functions. Specifically for a typical driver door location of such a keypad, a button 100 shows a forward facing arrow for accessing forward drive movements. A button 101 has an up arrow representing the opposite (i.e., right) side of the vehicle and is used for making steering adjustments to the right. Button 102 at the center provides an EPB on-off function. A button 103 shows a downward facing arrow for representing the near (i.e., left) side of the vehicle and is used for making steering adjustments to the left. A button 104 includes a right facing arrow for accessing rearward drive movements.
What is claimed is:

1. A multi-wheel vehicle, comprising:
   an electric parking brake (EPB) responsive to a control signal to selectably apply braking following parking of the vehicle;
   an input element generating a command signal in response to manual actuation by a person outside the parked vehicle; and
   a controller for validating the command signal and, if valid, then generating the control signal to temporarily release braking to move the vehicle a short distance in a parking area.

2. The vehicle of claim 1 wherein the controller generates the control signal after a predetermined delay.

3. The vehicle of claim 1 wherein the EPB responds to the control signal by gradually releasing the braking.

4. The vehicle of claim 1 wherein the temporary release of braking is discontinued after a predetermined period of time.

5. The vehicle of claim 1 wherein the temporary release of braking is discontinued and braking is reapplied in response to a further command signal generated in response to manual actuation by the person located outside the vehicle.

6. The vehicle of claim 5 wherein the braking is gradually reapplied.

7. The vehicle of claim 1 further comprising a motion sensor coupled to the controller, wherein the temporary release of braking is discontinued or dithered in response to sensing a speed greater than or equal to a threshold speed or a distance
greater than or equal to a threshold distance.

8. The vehicle of claim 1 further comprising a motion sensor coupled to the controller, wherein the controller monitors acceleration, speed, and distance of the vehicle during the temporary release of braking to detect a runaway condition, and wherein the temporary release of braking is discontinued in response to the runaway condition.

9. The vehicle of claim 1 further comprising a collision warning system for detecting obstacles in close proximity in the path of the vehicle, wherein the temporary release of braking is discontinued in response to sensing an obstacle in the path of the vehicle.

10. The vehicle of claim 1 wherein the controller validates the command signal according to a stored identifier of the jurisdiction where the vehicle resides.

11. The vehicle of claim 1 wherein the controller validates the command signal according to a stored user configuration.

12. The vehicle of claim 1 wherein the vehicle further comprises a brake transmission shift interlock having a manual override, and wherein the controller validates the command signal according to whether the manual override is active.

13. The vehicle of claim 1 wherein the temporarily release of braking continues only during continued manual actuation of the input element.

14. The vehicle of claim 1 wherein the vehicle further comprises a slope detector, and wherein the controller inhibits validation of the command signal when detecting a slope greater than or equal to a predetermined slope.
15. The vehicle of claim 1 wherein the input element is comprised of a push button switch included in a keyless entry keypad.

16. The vehicle of claim 1 further comprising an annunciator coupled to the controller for generating a perceptible acknowledgement in response to validation of the command signal.

17. The vehicle of claim 1 further comprising:
   an electric steering system including an actuator for varying a steering angle of the vehicle;
   wherein the controller is adapted to receive steering command signals in response to manual actuation by a person located outside the vehicle to selectably modify the steering angle.

18. The vehicle of claim 17 wherein the vehicle further includes a steering input element for being manually actuated to generate the steering command signals.

19. The vehicle of claim 1 further comprising:
   a drive system including a motor for driving the vehicle forward and backward;
   wherein the controller is adapted to receive drive command signals in response to manual actuation by a person located outside the vehicle to selectably move the vehicle forward or backward.

20. The vehicle of claim 19 wherein the vehicle further includes a drive input element for being manually actuated to generate the drive command signals.
1. A multi-wheel vehicle, comprising:
an electric parking brake (EPB) responsive to a control signal to selectably
apply braking following parking of the vehicle;
an input element generating a command signal in response to manual
actuation by a person outside the parked vehicle without a vehicle key; and
a controller for validating the command signal and, if valid, then generating
the control signal to temporarily release braking to move the vehicle a short distance in
a parking area while unattended by the driver.

2. The vehicle of claim 1 wherein the controller generates the control signal
after a predetermined delay.

3. The vehicle of claim 1 wherein the EPB responds to the control signal by
gradually releasing the braking.

4. The vehicle of claim 1 wherein the temporary release of braking is
discontinued after a predetermined period of time.

5. The vehicle of claim 1 wherein the temporary release of braking is
discontinued and braking is reapplied in response to a further command signal
generated in response to manual actuation by the person located outside the vehicle.

6. The vehicle of claim 5 wherein the braking is gradually reapplied.

7. The vehicle of claim 1 further comprising a motion sensor coupled to the
controller, wherein the temporary release of braking is discontinued or dithered in
response to sensing a speed greater than or equal to a threshold speed or a distance
greater than or equal to a threshold distance.

8. The vehicle of claim 1 further comprising a motion sensor coupled to the controller, wherein the controller monitors acceleration, speed, and distance of the vehicle during the temporary release of braking to detect a runaway condition, and wherein the temporary release of braking is discontinued in response to the runaway condition.

9. The vehicle of claim 1 further comprising a collision warning system for detecting obstacles in close proximity in the path of the vehicle, wherein the temporary release of braking is discontinued in response to sensing an obstacle in the path of the vehicle.

10. The vehicle of claim 1 wherein the controller validates the command signal according to a stored identifier of the jurisdiction where the vehicle resides.

11. The vehicle of claim 1 wherein the controller validates the command signal according to a stored user configuration.

12. The vehicle of claim 1 wherein the vehicle further comprises a brake transmission shift interlock having a manual override, and wherein the controller validates the command signal according to whether the manual override is active.

13. The vehicle of claim 1 wherein the temporarily release of braking continues only during continued manual actuation of the input element.

14. The vehicle of claim 1 wherein the vehicle further comprises a slope detector, and wherein the controller inhibits validation of the command signal when detecting a slope greater than or equal to a predetermined slope.
15. The vehicle of claim 1 wherein the input element is comprised of a push button switch included in a keyless entry keypad.

16. The vehicle of claim 1 further comprising an annunciator coupled to the controller for generating a perceptible acknowledgement in response to validation of the command signal.

17. The vehicle of claim 1 further comprising:
   an electric steering system including an actuator for varying a steering angle of the vehicle;
   wherein the controller is adapted to receive steering command signals in response to manual actuation by a person located outside the vehicle to selectably modify the steering angle.

18. The vehicle of claim 17 wherein the vehicle further includes a steering input element for being manually actuated to generate the steering command signals.

19. The vehicle of claim 1 further comprising:
   a drive system including a motor for driving the vehicle forward and backward;
   wherein the controller is adapted to receive drive command signals in response to manual actuation by a person located outside the vehicle to selectably move the vehicle forward or backward.

20. The vehicle of claim 19 wherein the vehicle further includes a drive input element for being manually actuated to generate the drive command signals.
STATEMENT UNDER ARTICLE 19 (1)

Applicant herewith submits replacement sheets numbered 17 through 19 to replace sheets numbered 17 through 19, originally filed for this application.

In respect of each claim appearing in the international application based on the replacement sheets submitted herewith, and in accordance with PCT Section 205, claim 1 has been amended in order to specify that manual actuation of the input element by a person outside the parked vehicle is achieved without a vehicle key, and that the vehicle is moved a short distance in a parking area while unattended by the driver. Claims 2-20 are unchanged.

Respectfully submitted,

Date: 11 June 2010

Mark L. Mollon
U.S. Reg. No. 31,123

MacMillan, Sobanski & Todd, LLC
3/5

60. Detect EPB-Off Command

61. Too Steep?
   Y. 
   62. Done
   N.

63. Generate Acknowledgement And Disable Security Alarm

64. Optional Delay

65. Update Braking Amount (Steps, Dither)

66. Speed > T_s?
   Y. 
   67. Time > T_1?
      Y. 
      68. Runaway?
         Y. 
         69. EPB Reapply Command?
            Y. 
            70. Other Conditions OK?
               Y. 
               71. Reapply EPB
                  72. Done
               N. 
               70. Other Conditions OK?
                  N. 
                  71. Reapply EPB
                     72. Done
                  Y.
INTERNATIONAL SEARCH REPORT

A. CLASSIFICATION OF SUBJECT MATTER

IPC(8) - B60T 13/00 (2010.01)
USPC - 303/20

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC(8) - B60T 13/00 (2010.01)
USPC - 303/20; 340/426.13, 5,61; 477/906, 907

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)

MicroPatent, Google Patent, GoogleScholar

C. DOCUMENTS CONSIDERED TO BE RELEVANT

<table>
<thead>
<tr>
<th>Category</th>
<th>Citation of document, with indication, where appropriate, of the relevant passages</th>
<th>Relevant to claim No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Y</td>
<td>US 6,406,102 B1 (ARNOLD) 18 June 2002 (18.06.2002) entire document</td>
<td>9, 12, 13</td>
</tr>
</tbody>
</table>

Further documents are listed in the continuation of Box C.

* Special categories of cited documents:
  "A" document defining the general state of the art which is not considered to be of particular relevance
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  "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

Date of the actual completion of the international search
29 March 2010

Date of mailing of the international search report
13 APR 2013

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Authorized officer:
Blaine R. Copenhagen

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PCT OSP: 571-272-7774

Form PCT/ISA/2/10 (second sheet) (July 2009)