(12) UK Patent Application (19) GB (11) 2 454 273 (13) A

(43) Date of A Publication 06.05.2009

(21) Application No: 0725092.1

(22) Date of Filing: 21.12.2007

(30) Priority Data:
(31) 60983970 (32) 31.10.2007 (33) US
(31) 11960948 (32) 20.12.2007

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(51) INT CL:
G05D 13/00 (2006.01) ***B60K 31/00*** (2006.01)
B60L 7/10 (2006.01) ***B60W 10/08*** (2006.01)
B60W 50/08 (2006.01)

(56) Documents Cited:
JP 050122805 A **JP 2004142689 A**
JP 2002058105 A **US 20070022634 A1**

(58) Field of Search:
INT CL **B60K, B60L, B60T, B60W, G05D**
Other: **WPI; EPODOC.**

(54) Abstract Title: **Electric Vehicle with an Operator Performance Setting Switch.**

(57) An operator selectable performance control system and method for an electric vehicle, comprises: a motor 42 structured and operable to provide motive power and regenerative braking forces to the vehicle and preferably a mechanical brake assembly 48 structured and operable to exert mechanical braking forces to the vehicle; a controller 50 operable to control the application of motive power and regenerative braking forces of the motor; an operator selectable switch 54 structured and operable to changeably select one of a plurality of vehicle performance routines executable by the controller for affecting maximum vehicle speed and an amount of regenerative braking implemented during vehicle operation. Preferably the selectable switch is a key switch capable of being locked in position by removing the key. Preferably there are three different performance settings, PS1, PS2, PS3, limiting the vehicles speed within ranges of 13-16 mph, 11-14mph and 15-19 mph. additionally there is a reset button (90, fig.2) for initialising the controller before implementing a performance routine.

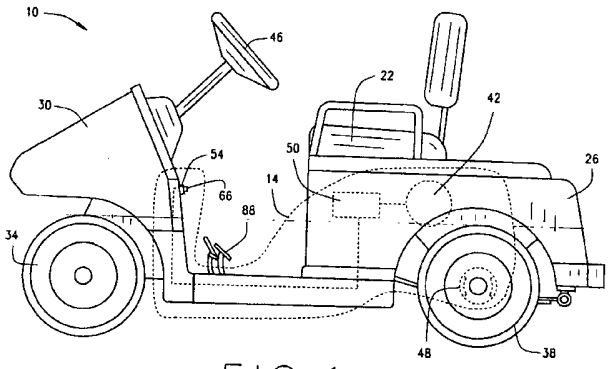

FIG. 1

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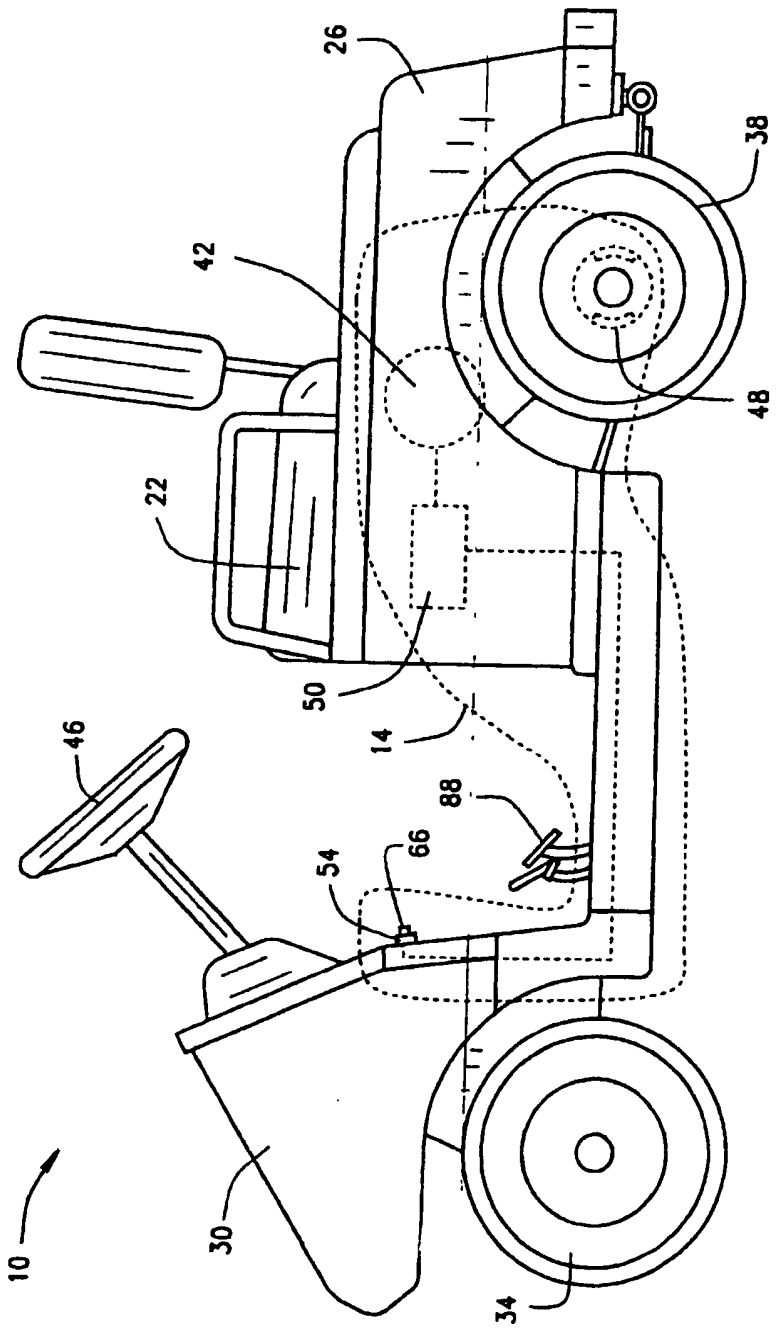

FIG. 1

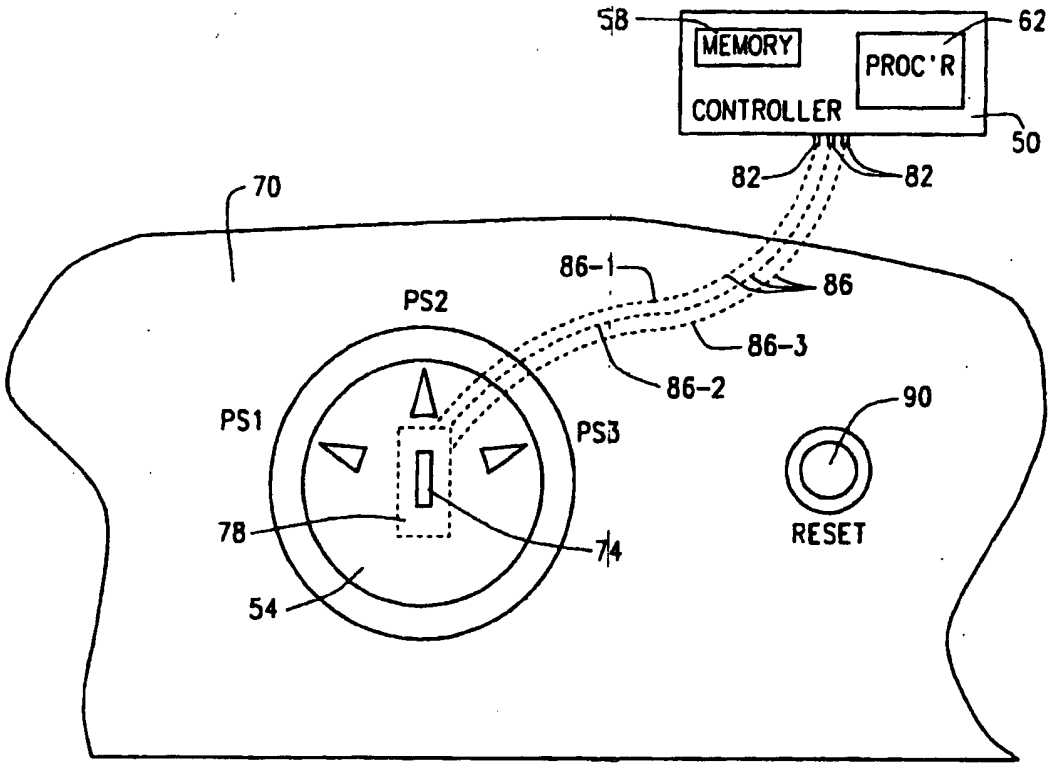
58
MEMORY
PROC'R
62
CONTROLLER
50
82
82
70
86-1
86
PS2
86-3
86-2
PS1
PS3
90
78
74
RESET
54

FIG. 2

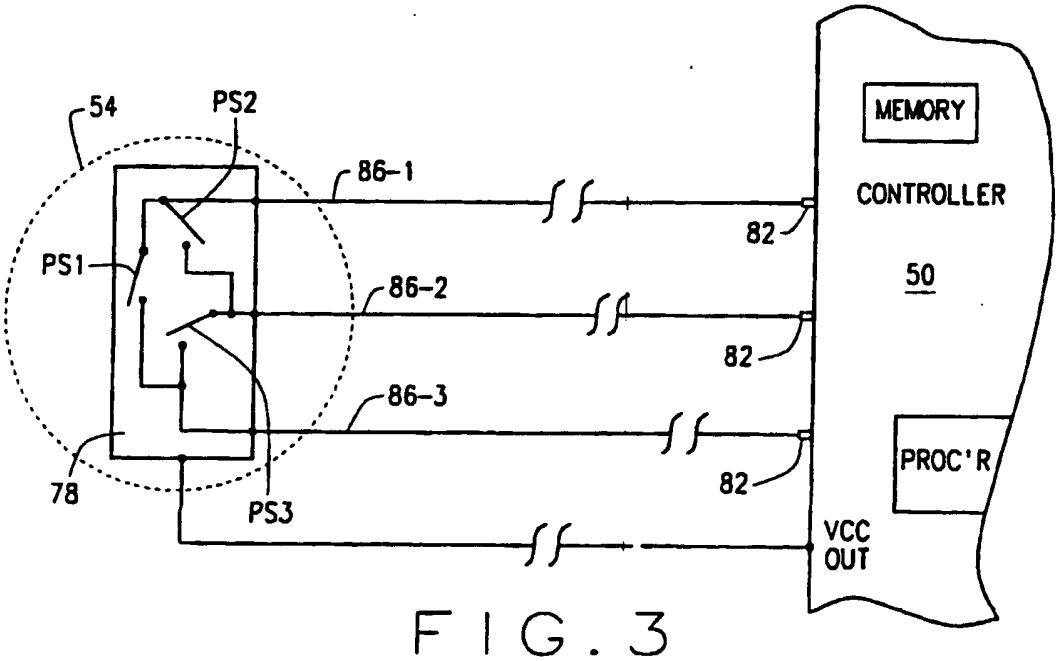
54
PS2
MEMORY
86-1
CONTROLLER
82
PS1
50
86-2
82
86-3
PROC'R
82
78
PS3
VCC
OUT

FIG. 3

OPERATOR SELECTABLE ELECTRIC VEHICLE PERFORMANCE SWITCH

[0001] This application claims the benefit of U.S. Provisional Application No. 60/983,970, filed on October 31, 2007. The disclosure of the above application is incorporated herein by reference in its entirety.

FIELD

[0002] The present teachings relate to control systems for electric vehicles.

BACKGROUND

[0003] The statements in this section merely provide background information related to the present disclosure and may not constitute prior art.

[0004] Electric vehicles are commonly used for various different purposes, such as golf cars, utility vehicles, personal vehicles and transport vehicles. Operators of such electric vehicles can encounter or confront various different terrains and driving circumstance that require various different driving procedure or techniques to safely operate and control the vehicle. For example, it may be desirable for owners of golf cars to restrict the maximum speed at which the vehicle can be driven, while owners of utility, personal and transport vehicles may desire a vehicle capable of higher speeds and/or greater regenerative braking for heavy loads.

SUMMARY

[0005] An aspect of the present invention provides an operator selectable performance control system for an electric vehicle. The system includes a motor structured and operable to provide motive power and regenerative braking forces to the vehicle. The system additionally includes a controller operable to control the application of motive power and regenerative braking forces of the motor. The system further includes an operator selectable switch structured and operable to changeably select one of a plurality of vehicle performance routines executable by the controller for affecting maximum vehicle speed and regenerative braking implemented during vehicle operation.

[0005A] Other aspects and preferred features of the invention are as set out in the claims, the substance of each of which is deemed repeated here as a respective consistory clause.

[0006] Further areas of applicability of the present teachings will become apparent from the description provided herein. It should be understood that the description and specific examples are intended for purposes of illustration only and are not intended to limit the scope of the present teachings.

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DRAWINGS

[0007] The drawings described herein are for illustration purposes only and are not intended to limit the scope of the present teachings in any way.

[0008] Figure 1 is a side view of an electric vehicle including an operator selectable performance control system.

[0009] Figure 2 a is partial view of an instrument panel of the vehicle shown in Figure 1, illustrating an operator selectable switch of the operator selectable performance control system, shown in Figure 1, in accordance with various embodiments of the present disclosure.

[0010] Figure 3 is an exemplary schematic of a switch block of the operator selectable switch, shown in Figure 1, in accordance with various embodiments of the present disclosure.

DETAILED DESCRIPTION

[0011] The following description is merely exemplary in nature and is in no way intended to limit the present teachings, application, or uses. Throughout this specification, like reference numerals will be used to refer to like elements.

[0012] Figure 1 illustrates a light-weight electric vehicle 10, such as a small cargo/maintenance vehicle, a shuttle/transport vehicle, a golf car, etc., that can include an operator selectable performance control system (OSPCS) 14, in accordance with various embodiments of the present disclosure. The OSPCS 14 is structured and operable to allow a vehicle operator to select any one of a plurality of vehicle performance setting to thereby selectably control various operation parameters of the vehicle 10, e.g., maximum allowable vehicle speed and ratio of regenerative braking to mechanical braking applied during vehicle braking.

[0013] Generally, the vehicle 10 can include at least one seat assembly 22 mounted to a rear body section 26, a front body section 30 and a pair of front

wheels 34 and a pair of rear wheels 38. At least one of the rear wheels 38 is driven by a prime mover 42, e.g., an induction motor, that provides motive power for propelling the vehicle 10 and regenerative braking forces for decelerating the vehicle 10. The vehicle 10 additionally includes a steering wheel 46 and a mechanical brake assembly 48 for applying mechanical braking forces, i.e., frictional braking forces, to at least one of the rear wheels 38. The vehicle 10 further includes a main controller 50 for controlling various operation parameters of the vehicle 10. For example, the controller 50 can be communicatively connected to the motor 42 and the brake assembly 48 to control motive forces provided by the motor 10, an amount of regenerative braking applied by the motor 10 during a vehicle braking operation, and an amount frictional braking force applied by the braking assembly 48 during a vehicle braking operation.

[0014] In various embodiments, the ϕSPCS 14 includes the motor 42, the mechanical brake assembly 48 and the controller 50 that, as described above, is operable to control the application of motive power and regenerative braking forces of the motor 42, and the application of mechanical braking forces by the brake assembly 48. The OSPCS 14 further includes an operator selectable switch (OSS) 54 that is structured and operable to be positioned by a vehicle operator to one of a plurality of vehicle performance settings.

[0015] As described below, each of the performance settings evokes a corresponding one of a plurality of performance routines stored in electronic memory 58 (shown in Figure 2) of the controller 50 and executable by a processor 62 (shown in Figure 2) of the controller 50. Execution of the

performance routines controls the various operation parameters in a particular manner. Thus, the OSS 54 can be changeably positioned by an operator to any of the performance settings to implements a different set of operation parameters that govern the operation of the vehicle 10. More particularly, execution of each respective performance routine implements a different set of operation parameters that govern operation of the motor 42 and the brake assembly 48. For example, in various embodiments, the operation parameters can include a maximum allowable speed of the vehicle, an amount of regenerative braking applied by the motor during a vehicle braking operation and an amount of mechanical braking applied by the brake assembly during the vehicle braking operation. In various embodiments, the OSS 54 can be a key operated switch that utilizes a single key 66 to position the OSS 54 in any of the various performance settings.

[0016] Figure 2 illustrates a portion of an instrument panel 70 of the vehicle 10 including the OSS 54, in accordance with various embodiments of the present disclosure. Although the OSS 54 will be described herein as being in included in the instrument panel 70, the OSS 54 can be located elsewhere on the vehicle 10, e.g., on the rear body portion 26 below the seat 22, and remain within the scope of the present disclosure. Additionally, the OSS 54 will be described herein as including three performance settings PS1, PS2 and PS3, however, it is envisioned that the OSS 54 can include more than three or less than three performance settings and remain with the scope of the present disclosure. The OSS 54 includes a mechanical position selector 74 that is operatively, i.e.,

mechanically or electrically, connected to a switch board 78. The switch board 78 is electrically connected to ports or pins 82 of the controller 50, via wires 86. As described above, in various embodiments, the position selector 74 can comprise a keyed tumbler and aperture for receiving the single key 66 that can be used to position the OSS 54 at any of the performance settings PS1, PS2 or PS3. In such embodiments, the key 66 can be removed at any of the performance settings PS1, PS2 or PS3 such that the OSS 54, and thus, the OSPCS 14, is locked at the respective performance setting.

[0017] Alternatively, in various embodiments, the position selector 74 can be a non-removable tab that can be rotatably positioned to any of the performance settings PS1, PS2 or PS3. In various other embodiments, the position selector can be a three-position push button switch, a security code key pad or any other switching mechanism or device suitable for selecting any of the performance settings PS1, PS2 or PS3.

[0018] The switch board 78 generally includes circuitry and/or mechanical devices operable to connect, i.e., electrically short or jumper, various combinations of two or more of the wires 86. For example, referring to Figure 3, if the OSS 54 is set to the PS1 position wires 86-1 and 86-3 may be shorted together, while if the OSS 54 is set to the PS2 position wires 86-1 and 86-2 may be shorted together, while if the OSS 54 is set to the PS3 position wires 86-2 and 86-3 may be shorted together. Accordingly, each combination of connected wires 86 provides electrical inputs to particular corresponding combination of controller pins 82. In accordance with various embodiments, each combination

of electrical inputs to pins 82 evokes a corresponding one of the performance routines stored in the memory device 58. More particularly, based on the particular combination of electrical inputs sensed by the controller 50, the processor 62 will execute a corresponding one of the performance routines to implement a corresponding set of operation parameters during operation of the vehicle 10.

[0019] More particularly, in various embodiments, based on the performance setting selected, i.e., based on the electrical inputs at pins 82 sensed by the controller 50, the processor 62 will execute a corresponding one of the performance routines to implement a maximum allowable vehicle speed parameter and an amount of regenerative braking applied during vehicle braking operations. The amount of mechanical braking provided by the brake assembly 48 during braking operations is dependent on force applied to a brake pedal 88 (shown in Figure 1) of the vehicle 10. Still more specifically, as a result of executing each particular performance routine the controller 50 will control the motive power generated by motor 42 to limit the speed of the vehicle 10 to a specific maximum limit. Additionally, the controller 50 will control the amount of regenerative braking provided by the motor 10 during vehicle operation, e.g., during vehicle braking operations.

[0020] For example, when the OSS 54 is set to the first performance setting PS1, also referred to herein as the 'Daily Use' setting, the controller 50, i.e., the processor 62, will execute a first performance routine. In various embodiments, the first performance routine will limit the maximum vehicle speed

generated by the motor 42 to approximately 13 to 15 or 16 miles per hour and provide a first amount of regenerative braking by the motor 42 during vehicle operation, e.g., during vehicle braking operations. For example, the first performance routine can provide approximately 0.3 to 0.5 mph/sec, e.g., 0.41 mph/sec, deceleration via regenerative braking by the motor 42 during vehicle operation, e.g., during vehicle braking operations. As described above, mechanical braking provided by the brake assembly 48 during a braking operation is dependent on force applied to a brake pedal 88.

[0021] When the OSS 54 is set to the second performance setting PS2, also referred to herein as the 'Heavy Load' setting, the controller 50, i.e., the processor 62, will execute a second performance routine. In various embodiments, the second performance routine will limit the maximum vehicle speed generated by the motor 42 to approximately 11 or 12 to 14 miles per hour provide a second amount of regenerative braking by the motor 42 during vehicle operation, e.g., during vehicle braking operations. The second amount of regenerative braking being greater than the first amount of regenerative braking. For example, the second performance routine can provide approximately 2.0 to 2.75 mph/sec deceleration via regenerative braking by the motor 42 during vehicle operation, e.g., during vehicle braking operations. Amounts of mechanical braking by the brake assembly 48 during vehicle operation are dependent on force applied to the brake pedal 88.

[0022] When the OSS 54 is set to the third performance setting PS2, also referred to herein as the 'Fast Transport' setting, the controller 50, i.e., the

processor 62, will execute a third performance routine. In various embodiments, the third performance routine will limit the maximum vehicle speed generated by the motor 42 to approximately 15 or 16 to 19 miles per hour and provide no regenerative braking, but rather only mechanical braking by the brake assembly 48 in accordance with the amount of force applied to the brake pedal 88 during vehicle operation, e.g., during vehicle braking operations.

[0023] As illustrated in Figure 2, in various embodiments, the OSPCS 14 can include a reset button 90. The reset button can be used in combination with the OSS 54 to reset the controller 50 upon a change in the performance setting of the OSS 54. More particularly, when the vehicle operator moves the position selector 74 from one of the performance settings PS1, PS2 or PS3 to a different performance setting PS1, PS2 or PS3, the operator must then actuate, e.g., depress, toggle, rotate, slide, etc., reset switch 90 to reset the controller 50. Generally, resetting the controller 50 reinitializes the controller 50 such that the controller will sense which pins 82 are presently receiving electrical signals based on which wires 86 are connected as a result of repositioning the position selector 74 to a different performance setting PS1, PS2 or PS3. Based on the pin 82 inputs, the controller 50 will evoke and execute the corresponding performance routine, as described above.

[0024] Thus, to select a desired performance setting for the vehicle 10, with power to the vehicle 10 turned 'On', i.e., enabled, the operator positions the position selector to a desired performance setting PS1, PS2 or PS3. As described above, each performance setting PS1, PS2 or PS3 will connect a

respective combination of wires 86, which provide electrical inputs to a corresponding combination of controller pins 82. Based on the pin 82 inputs the controller 50 will evoke and execute a respective one of the performance routines corresponding to the selected performance setting. In various embodiments, the performance setting PS1, PS2 or PS3 is implemented by the operator actuating the controller reset switch 90.

[0025] It should be understood that, although the terms first, second, third, etc. may be used herein to describe various elements, components, regions, layers and/or sections, these elements, components, regions, layers and/or sections should not be limited by these terms. These terms may be only used to distinguish one element, component, region, layer or section from another region, layer or section. Thus, a first element, component, region, layer or section discussed below could be termed a second element, component, region, layer or section without departing from the teachings of the example embodiments.

[0026] Additionally, the terminology used herein is for the purpose of describing particular example embodiments only and is not intended to be limiting. As used herein, the singular forms "a", "an" and "the" may be intended to include the plural forms as well, unless the context clearly indicates otherwise. It will be further understood that the terms "comprises" and/or "comprising," when used in this specification, specify the presence of stated features, integers, steps, operations, elements, and/or components, but do not preclude the presence or

addition of one or more other features, integers, steps, operations, elements, components, and/or groups thereof.

[0027] Furthermore, the description herein is merely exemplary in nature and, thus, variations that do not depart from the gist of that which is described are intended to be within the scope of the teachings. Such variations are not to be regarded as a departure from the spirit and scope of the teachings.

Each feature disclosed in this specification (which term includes the claims) and/or shown in the drawings may be incorporated in the invention independently of other disclosed and/or illustrated features. In particular but without limitation the features of any of the claims dependent from a particular independent claim may be introduced into that independent claim in any combination.

Statements in this specification of the "objects of the invention" relate to preferred embodiments of the invention, but not necessarily to all embodiments of the invention falling within the claims.

The text of the abstract filed herewith is repeated here as part of the specification.

CLAIMS

1. An operator selectable performance control system for an electric vehicle, said system comprising:

a motor structured and operable to provide motive power and regenerative braking forces to the vehicle;

a controller operable to control the application of motive power and regenerative braking forces of the motor;

an operator selectable switch structured and operable to changeably select one of a plurality of vehicle performance routines executable by the controller for affecting maximum vehicle speed and an amount of regenerative braking implemented during operation of the vehicle.

2. The system of Claim 1 further comprising a reset switch operable to reset the controller to execute a selected performance routine.

3. The system of Claim 1 or Claim 2 wherein the operator selectable switch comprises a key operated switch structured and operable to utilize a single key to position the switch at any of a plurality of performance settings, each performance setting corresponding to a respective one of the performance routines.

4. The system of Claim 3, wherein the key is removable at any of the performance settings such that the system is locked at the respective performance setting.

5. The system of any preceding claim, wherein the operator selectable switch is structured and operable to select any of a plurality of performance settings, each setting connecting two or more of a plurality of wires connected to the controller to command the controller to execute a respective one of the performance routines corresponding to the selected performance setting.

6. The system of any preceding claim, being configured also to control a mechanical brake assembly structured and operable to exert mechanical braking forces to the vehicle.

7. The system of Claim 6, wherein the performance routines include a routine executable by the controller to limit the maximum vehicle speed generated by the motor to approximately 13 to 16 miles per hour and to provide regenerative and mechanical braking during a vehicle braking operation.

8. The system of Claim 7 wherein the routine is configured to provide approximately 0.3 to 0.5 mph/sec deceleration via regenerative braking by the motor during vehicle operation.

9. The system of Claim 6, 7 or 8, wherein the performance routines include a routine executable by the controller to limit the maximum vehicle speed generated by the motor to approximately 11 to 14 miles per hour and provide regenerative braking and mechanical braking during vehicle operation.

10. The system of Claim 9 wherein the routine is configured to provide approximately 2.0 to 2.75 mph/sec deceleration via regenerative braking by the motor during vehicle operation.

11. The system of any of Claims 6 to 10, wherein the performance routines include a routine executable by the controller to limit the maximum vehicle speed generated by the motor to approximately 15 to 19 miles per hour.

12. The system of Claim 11 wherein the routine is configured to provide only mechanical braking during vehicle operation.

13. An electric vehicle comprising the system of any of Claims 1 to 12.

14. A method for controlling a plurality of operations of an electric vehicle, said method comprising:

positioning an operator selectable switch to one of a plurality of vehicle performance routines executable by a vehicle controller,

executing the selected vehicle performance routine to implement a corresponding one of a plurality of sets of operation parameters;

controlling a maximum allowable speed of the vehicle based on the operation parameters corresponding to the selected performance routine; and

controlling an amount of regenerative braking provided by a motor of the vehicle during a vehicle braking operation based on the operation parameters corresponding to the selected performance routine.

15. The method of Claim 14, further comprising providing mechanical braking in accordance with an amount of pressure applied to a vehicle brake pedal.

16. The method of Claim 15 or 16 further comprising activating a reset switch to reset the controller to execute a selected performance routine upon selection of the respective performance routine.

17. The method of Claim 15, 16 or 17, wherein positioning an operator selectable switch comprises utilizing a single key to position a key switch at any of a plurality of performance settings, each performance setting corresponding to a respective one of the performance routines.

18. The method of Claim 17, wherein positioning an operator selectable key switch further comprises removing the key from the key switch upon selection of the respective performance setting such that the key switch is locked at the respective performance setting.

19. The method of any of Claims 14 to 18, wherein executing the selected vehicle performance routine comprises connecting two or more of a plurality of wires connected to the controller as a result of positioning the switch to one of vehicle performance setting, each performance setting connecting a different combination of the two or more wires, thereby commanding the controller to execute a respective one of the performance routines corresponding to the selected performance setting.

20. The method of any of Claims 14 to 19, wherein controlling the maximum allowable speed and amount of regenerative braking comprises limiting the maximum vehicle speed generated by the motor to approximately 13 to 16 miles

per hour and providing a first amount of regenerative braking by the motor during vehicle operation when the switch is positioned to a first performance setting.

21. The method of Claim 20, wherein controlling the maximum allowable speed, amount of regenerative braking and mechanical braking comprises limiting the maximum vehicle speed generated by the motor to approximately 11 to 14 miles per hour and providing a second amount of regenerative braking by the motor during vehicle operation when the switch is positioned to a second performance setting, the second amount of regenerative braking being greater than the first amount of regenerative braking.

22. The method of Claim 15 or any of Claims 16 to 21 where dependent therefrom, wherein controlling the maximum allowable speed, amount of regenerative braking and mechanical braking comprises limiting the maximum vehicle speed generated by the motor to approximately 16 to 19 miles per hour and providing no regenerative braking during vehicle operation.

23. A system, a vehicle or a method substantially as herein described with reference to the accompanying drawings.

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Application No: GB0725092.1 **Examiner:** Mr Tyrone Moore

Claims searched: 1-23 **Date of search:** 1 March 2008

Patents Act 1977: Search Report under Section 17

Documents considered to be relevant:

Category	Relevant to claims	Identity of document and passage or figure of particular relevance
X	1, 14	JP 2002058105 A (FUJI HEAVY IND LTD) See EPODOC, WPI abstracts and figures. AN-2002-299885 [34]. Describes a regenerative brake controller of an electric vehicle with a drive mode selector switch.
A	-	JP 2004142689 A (HITACHI CONSTRUCTION MACHINERY) See EPODOC, WPI abstracts and figures. AN-2004-357386 [33]. Describes a slope-descending speed control device for a vehicle having a setting selection switch capable of selecting a plurality of preset target speeds.
A	-	JP 05122805 A (HONDA MOTOR CO LTD) See EPODOC abstract and figures. Describes an electric vehicle with the operator being able to select the amount of regenerative braking.
A	-	US 2007/022634 A1 (HONDA MOTOR CO LTD) See whole document. An example of a vehicle with electric motor drive and a plurality of operator selectable modes.

Categories:

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.

Field of Search:

Search of GB, EP, WO & US patent documents classified in the following areas of the UKC^{X} :

Worldwide search of patent documents classified in the following areas of the IPC

B60K; B60L; B60T; B60W; G05D

The following online and other databases have been used in the preparation of this search report

WPI; EPODOC.

International Classification:

Subclass	Subgroup	Valid From

17

Subclass	Subgroup	Valid From
G05D	0013/00	01/01/2006
B60K	0031/00	01/01/2006
B60L	0007/10	01/01/2006
B60W	0010/08	01/01/2006
B60W	0050/08	01/01/2006