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(54) Title: USER SELECTED CONTROL FEATURES FOR POWERTRAIN MANAGEMENT

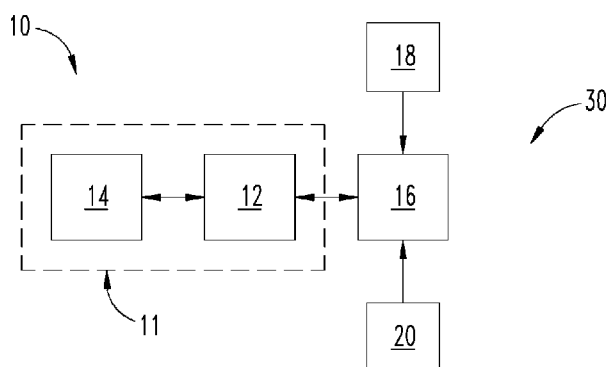


Fig. 1

(57) Abstract: There is disclosed the use of an accelerator pedal position and an associated kickdown status to change a selected performance indicator value associated with a vehicle powertrain in order to activate or inhibit control features which manage the available power to the powertrain for propelling the vehicle. The driver can activate and/or inhibit the powertrain control features without the need for external sensors and without the driver manipulating a switch in the vehicle that requires the driver to divert attention from driving.

USER SELECTED CONTROL FEATURES FOR POWERTRAIN MANAGEMENT

[0001] The present application claims the benefit of the filing date of U.S. Provisional Application Ser. No. 62/585,620 filed on November 14, 2017, which is incorporated herein by reference.

BACKGROUND

[0002] Improving fuel economy for motor vehicles remains an area of interest and continued development. Currently, there are fuel efficiency improvement systems which sense the road load force via external sensors, such as acceleration sensors, vehicle weight sensors, road grade sensors, etc. These systems allow the driver to access more engine power when conditions dictate additional power is required. However, these systems come with increased complexity and higher design and installation costs.

[0003] A lower cost solution can include a driver positioned control switch that is operable to initiate engine control features that can potentially save fuel based on the present route conditions, such as the road load. However, the driver's behaviour can result in the selection switch not being positioned properly according to present route conditions, which can result in keeping the engine in a "power" mode or other less fuel efficient modes when such power requirements are not needed. Therefore, the opportunity to improve fuel economy is lost because the selection of the appropriate control features for the present route conditions is not made. As a result, further improvements in this area are needed.

SUMMARY

[0004] The present disclosure relates to the use of an accelerator pedal position and an associated kickdown status for the accelerator pedal to change a performance indicator value associated with a vehicle powertrain in order to activate or inhibit control features which manage the available power to the powertrain to propel the vehicle. The driver can therefore activate and/or inhibit the powertrain control features by manipulating the accelerator pedal without the need for external sensors and without the driver manipulating a switch in the vehicle that requires the driver to divert attention from driving.

[0005] This summary is not intended to identify key or essential features of the claimed subject matter, nor is it intended to be used as an aid in limiting the scope of the claimed subject matter. Further embodiments, forms, objects, features, advantages, aspects, and benefits shall become apparent from the following description and drawings.

BRIEF DESCRIPTION OF THE FIGURES

[0006] FIG. 1 depicts an embodiment of a vehicle with a powertrain and a control system for controlling a power that is available to the powertrain.

[0007] FIG. 2 depicts a schematic of a control system operable to activate or inhibit one or more engine control features that manage an available power to the powertrain of the vehicle.

[0008] FIG. 3 depicts a chart showing an accelerator pedal kickdown status and an associated performance indicator value over time.

[0009] FIG. 4 depicts a table showing an engine control functions/features for saving fuel and associated performance indicator thresholds.

DETAILED DESCRIPTION OF THE ILLUSTRATIVE EMBODIMENTS

[0010] For the purposes of promoting an understanding of the principles of the invention, reference will now be made to the embodiments illustrated in the drawings and specific language will be used to describe the same. It will nevertheless be understood that no limitation of the scope of the invention is thereby intended. Any alterations and further modifications in the described embodiments, and any further applications of the principles of the invention as described herein are contemplated as would normally occur to one skilled in the art to which the invention relates.

[0011] With reference to FIG. 1, there is illustrated a schematic view of an example vehicle 10 that includes a powertrain 11 structured to generate power for propelling the vehicle 10. The vehicle 10 is intended to cover a wide range of vehicles such as trucks, tractor-trailers, box trucks, busses, passenger cars, etc. Power train 11 includes a prime mover 12 that is connected to a transmission 14. The prime mover 12 can include an internal combustion engine and/or electric motor/battery system. The prime mover 12 provides power to transmission 14, which is connected to one or more ground engaging wheels (not shown) to propel vehicle 10 along a route.

[0012] Vehicle 10 also includes an exemplary control system 30 including an electronic control unit 16 useful to control various aspects of vehicle 10, including managing the power available for powertrain 11 to propel the vehicle 10. Control system 30 includes an accelerator pedal 18 and a selection switch 20 operably connected to electronic control unit 16. Accelerator pedal 18 and selection switch 20 output driver provided inputs to the electronic control unit 16. The provided inputs may include, for example, accelerator pedal position information, switch position information, and other information

provided by a vehicle operator via one or more vehicle control devices or systems.

Electronic control unit 16 may process the received information to determine additional information including, for example, an accelerator pedal position determination, elapsed time of the accelerator pedal in a position, and selection switch actuation/position information.

[0013] Referring to FIG. 2, there is shown control system 30 in which accelerator pedal 18 is connected with control system 30 and an optional kickdown switch 22. The control system 30 receives an accelerator pedal position signal but does not need to receive a signal from kickdown switch 22 since control system 30 can self-determine the “kickdown” status of accelerator pedal 18 based on accelerator pedal position. For example, kickdown status can be considered “active” in response to the accelerator pedal position being more than 95%. Other thresholds for accelerator pedal 18 can also be used.

[0014] The kickdown switch 22 can provide an indication to the driver that a predetermined position for the accelerator pedal 18 is obtained and maintained, and preventing the driver from unconsciously changing the mode status from inactive to active or vice versa. The kickdown switch 22 need not be connected to electronic control unit 16. In one embodiment, kickdown switch 22 is a detent switch that physically resists accelerator pedal movement when the accelerator pedal position is equal to or greater than a controller calibrated accelerator pedal kickdown threshold amount.

[0015] The accelerator pedal position is an operator selected accelerator pedal position. The accelerator pedal position is provided to electronic control unit 16 via, for

example, a datalink or hardwired connection 32, which records the position and elapsed time in the position. In an exemplary embodiment, a threshold accelerator pedal position is a kickdown position stored in a memory of or communicated to the electronic control unit 16 for comparison to an actual position of the accelerator pedal 18. The kickdown accelerator pedal position is the accelerator pedal position that, when maintained for more than a threshold period of time, enables electronic control unit 16 to override the value of a performance indicator to activate and/or inhibit control features that manage the available power for powertrain 11 to propel vehicle 10.

[0016] In certain embodiments, control system 30 includes selection switch 20 that is operably connected to electronic control unit 16 via a datalink or hardwired connection 34. Selection switch 20 can be an analog or other suitable switch type having at least two positions to allow the driver to manually select a performance indicator value for managing the available power for powertrain 11 during at least certain operating conditions. For example, selection switch 20 can include a fuel economy indicator value and a balanced indicator value. The fuel economy indicator value, when selected, provides an available power for the powertrain that is primarily concerned with providing control operations for fuel efficiency during certain operating conditions, unless overridden by the kickdown of accelerator pedal 18. The balanced indicator value, when selected, provides control operations for an available power for the powertrain that is balanced between performance and fuel efficiency, unless overridden by the kickdown of accelerator pedal 18.

[0017] Referring to FIGs. 3 and 4, an example procedure for managing available power to the powertrain 11 using electronic control unit 16 and accelerator pedal 18 is shown.

FIG. 3 includes a first chart 50 shows an accelerator pedal kickdown status as “0” (inactive) or “1” (active) over a time t . A second chart 60 shows a performance indicator value over time t that is selected in response to the accelerator pedal kickdown status. When the accelerator pedal kickdown status is inactive, the performance indicator value is at a first value. In this condition, the control features for managing the available power to powertrain 11 are either active or inhibited. When the accelerator pedal kickdown status is active, and a threshold period of time t_1 elapses, the performance indicator value is overridden and changed to a second value. In one embodiment, the first value is a predetermined value and the second value is an adjustable value. More than two values for the performance indicator are contemplated as there may be provided multiple fuel saving features activated or inhibited according to various performance indicator thresholds, such as shown in FIG. 4. The control features for managing the available power for powertrain 11 are then changed from being active to inhibited, or from being inhibited to active, while the accelerator pedal kickdown status is active.

[0018] When the accelerator pedal kickdown status is changed from active to inactive, the performance indicator value changes back to the first value after passage of a lag time t_2 after the accelerator pedal 18 is released. When the accelerator pedal kickdown status is inactive, and a lag period of time t_2 elapses, the performance indicator value is re-set to the first value. The control features for managing the available power for powertrain 11 are then changed from being inhibited to being active, or from being active to being inhibited, while the accelerator pedal kickdown status is inactive.

[0019] The threshold time period t_1 is calibratable so that the desired accelerator kickdown time is obtained before the performance indicator value and available power for the powertrain is changed. The lag time period t_2 is also calibratable so the desired lag time is obtained after the accelerator kickdown is released before the performance indicator value and control of the available power is changed. This adjustable lag time (e.g. t_2) allows the driver to continuously access the needed propulsion system power, even if the driver temporarily releases the accelerator pedal for a driving related reason (e.g. for a transmission gear change) with no need for complex controls and associated sensor hardware. The threshold and lag times can be calibrated to maintain the needed vehicle drivability at different driving scenarios (e.g. power down-shifts during up-hill drives or overtaking, etc.) The recorded duration of the accelerator pedal position status can be re-set in response to the accelerator pedal position status being changed.

[0020] In one embodiment, an electronic control system for a vehicle including a powertrain includes an electronic control unit, a selection switch for selecting one or more control features by which the electronic control unit manages an available power to the powertrain in response to a value of a performance indicator, and an accelerator pedal. The electronic control unit is operably connected with the selection switch and the accelerator pedal. In response to a kickdown status of the accelerator pedal and an elapsed time of the accelerator pedal in the kickdown status, the electronic control unit overrides the value of the performance indicator to activate or inhibit the one or more control features of the electronic control unit that manages the available power to the powertrain.

[0021] In various embodiments, the accelerator pedal is engageable to a kickdown switch, and the selection switch is operable to select between a first performance indicator value associated with a fuel efficient mode of operation of the powertrain and a second performance indicator value associated with a less fuel efficient mode of operation of the powertrain.

[0022] In other embodiments, the electronic control unit is configured to record the elapsed time in which the kickdown status of the accelerator pedal is active and override the value of the performance indicator in response to the elapsed time exceeding a threshold. In certain embodiments, the threshold is adjustable and/or the electronic control unit overrides the value of the performance indicator to an override value. In further embodiments, the override value is relinquished in response to the kickdown status being passive or inactive and the passage of a lag time since the kickdown status became passive or inactive, and/or the lag time is adjustable.

[0023] In yet other embodiments, the electronic control unit is configured to re-set the elapsed time in response to the kickdown status of the accelerator pedal being passive or inactive.

[0024] According to another embodiment, a method of controlling a powertrain of a vehicle includes managing an available power to the powertrain in response to a performance indicator value by which one or more control features manage the available power to the powertrain; determining a kickdown status of an accelerator pedal associated with the powertrain and an elapsed time the accelerator pedal is in the kickdown status; and overriding the performance indicator value to activate or inhibit the

one or more control features that manage the available power to the powertrain in response to the kickdown status and the elapsed time.

[0025] In certain embodiments, the method includes selecting, via a selection switch, the performance indicator value. In other embodiments, the accelerator pedal is engagable to a kickdown switch. In yet other embodiments, the kickdown status is communicated to a driver of the vehicle via a kickdown switch engageable by the accelerator pedal. In other embodiments, the one or more control features include power limits applied to the powertrain.

[0026] In certain embodiments, the method includes recording the elapsed time in which the kickdown status is active and the performance indicator value is overridden in response to the elapsed time exceeding a threshold. In further embodiments, the threshold is adjustable. In yet other embodiments, the overridden performance indicator value is relinquished in response to the kickdown status being passive or inactive and the passage of a lag time since the kickdown status became passive or inactive. On additional embodiments, the method includes resetting the elapsed time in response to the kickdown status of the accelerator pedal being passive or inactive.

[0027] A vehicle system is also contemplated that includes a powertrain operable to propel the vehicle system, an accelerator pedal for operating the powertrain, and a selection switch for selecting a performance indicator value determined by a position of the selection switch. The vehicle system also includes an electronic control unit operably connected to the powertrain, the accelerator pedal and the selection switch. The electronic control unit is configured to manage an available power to the powertrain in response to the performance indicator value. In response to a kickdown status of the

accelerator pedal and a time of the accelerator pedal in the kickdown status, the electronic control unit overrides the performance indicator value to activate or inhibit the one or more control features of the electronic control unit that manages the available power to the powertrain.

[0028] In one embodiment, the selection switch is operable to manually select between a first performance indicator value associated with a fuel efficient mode of operation of the powertrain and a second performance indicator value associated with a less fuel efficient mode of operation of the powertrain.

[0029] In certain embodiments, the electronic control unit 16 forms a portion of a processing subsystem including one or more computing devices having memory, processing, and communication hardware. The electronic control unit 16 may be a single device or a distributed device, and the functions of the electronic control unit 16 may be performed by hardware or software. The electronic control unit 16 may be included within, partially included within, or completely separated from an engine control module (not shown). The electronic control unit 16 is in communication with any sensor or actuator throughout the systems disclosed herein, including through direct communication, communication over a datalink, and/or through communication with other controllers or portions of the processing subsystem that provide sensor and/or actuator information to the electronic control unit 16.

[0030] Electronic control unit 16 includes stored data values, constants, and functions, as well as operating instructions stored on a non-transient computer readable medium. Any of the operations of example procedures described herein may be performed at least partially by the electronic control unit 16. In certain embodiments, the electronic

control unit 16 includes one or more modules structured to functionally execute the operations of the electronic control unit 16. The description herein including modules emphasizes the structural independence of the aspects of the electronic control unit 16, and illustrates one grouping of operations and responsibilities of the electronic control unit 16. Other groupings that execute similar overall operations are understood within the scope of the present application. Modules may be implemented in hardware and/or instructions stored on a non-transient computer readable medium, and modules may be distributed across various hardware or instructions stored on a non-transient computer readable medium. Operations illustrated are understood to be exemplary only, and operations may be combined or divided, and added or removed, as well as re-ordered in whole or in part.

[0031] Certain operations described herein include operations to interpret or determine one or more parameters. Interpreting and/or determining, as utilized herein, includes receiving values by any method known in the art, including at least receiving values from a datalink or network communication, receiving an electronic signal (e.g., a voltage, frequency, current, or pulse-width modulation (PWM) signal) indicative of the value, receiving a software parameter indicative of the value, reading the value from a memory location on a computer readable medium, receiving the value as a run-time parameter by any means known in the art, and/or by receiving a value by which the interpreted or determined parameter can be calculated, and/or by referencing a default value that is interpreted or determined to be the parameter value.

[0032] In addition, the methods and procedures and disclosed herein and related descriptions provide an illustrative embodiment of performing example procedures for

managing an available power to a powertrain of a vehicle. Operations illustrated are understood to be exemplary only, and operations may be combined or divided, and added or removed, as well as re-ordered in whole or part, unless stated explicitly to the contrary herein. Certain operations illustrated may be implemented by a computer executing a computer program product on a non-transient computer readable storage medium, where the computer program product comprises instructions causing the computer to execute one or more of the operations, or to issue commands to other devices to execute one or more of the operations.

[0033] While the invention has been described in connection with what is presently considered to be the most practical and preferred embodiment, it is to be understood that the invention is not to be limited to the disclosed embodiment(s), but on the contrary, is intended to cover various modifications and equivalent arrangements included within the spirit and scope of the appended claims, which scope is to be accorded the broadest interpretation so as to encompass all such modifications and equivalent structures as permitted under the law.

[0034] In reading the claims it is intended that when words such as "a," "an," "at least one" and "at least a portion" are used, there is no intention to limit the claim to only one item unless specifically stated to the contrary in the claim. Further, when the language "at least a portion" and/or "a portion" is used the item may include a portion and/or the entire item unless specifically stated to the contrary.

What is Claimed is:

1. An electronic control system for a vehicle including a powertrain, comprising:
an electronic control unit;
a selection switch operably connected with the control unit, the selection switch for selecting one or more control features by which the electronic control unit manages an available power to the powertrain in response to a performance indicator value determined by a position of the selection switch; and
an accelerator pedal, wherein the electronic control unit is operably connected with the accelerator pedal, and wherein, in response to a kickdown status of the accelerator pedal and a time of the accelerator pedal in the kickdown status, the electronic control unit overrides the value of the performance indicator to activate or inhibit the one or more control features of the electronic control unit that manages the available power to the powertrain.
2. The electronic control system of claim 1, wherein the accelerator pedal is engageable with a kickdown switch that indicates a position of the accelerator pedal to a driver of the vehicle, and the kickdown switch is not connected to the electronic control unit.
3. The electronic control system of claim 1, wherein the electronic control unit is configured to record the time in which the kickdown status is active and override the value of the performance indicator in response to an elapsed time of the kickdown status being active exceeding an elapsed time threshold.

4. The electronic control system of claim 3, wherein the elapsed time threshold is calibratable.
5. The electronic control system of claim 3, wherein the electronic control unit overrides the value of the performance indicator to an override value.
6. The electronic control system of claim 5, wherein the override value is relinquished in response to the kickdown status of the accelerator pedal being inactive and the passage of a lag time since the kickdown status of the accelerator pedal became inactive.
7. The electronic control system of claim 6, wherein the lag time is calibratable.
8. The electronic control system of claim 3, wherein the electronic control unit is configured to re-set the elapsed time in response to the kickdown status of the accelerator pedal being inactive.
9. The electronic control system of claim 1, wherein the selection switch is operable to manually select between a first performance indicator value associated with a fuel efficient mode of operation of the powertrain and a second performance indicator value associated with a less fuel efficient mode of operation of the powertrain.

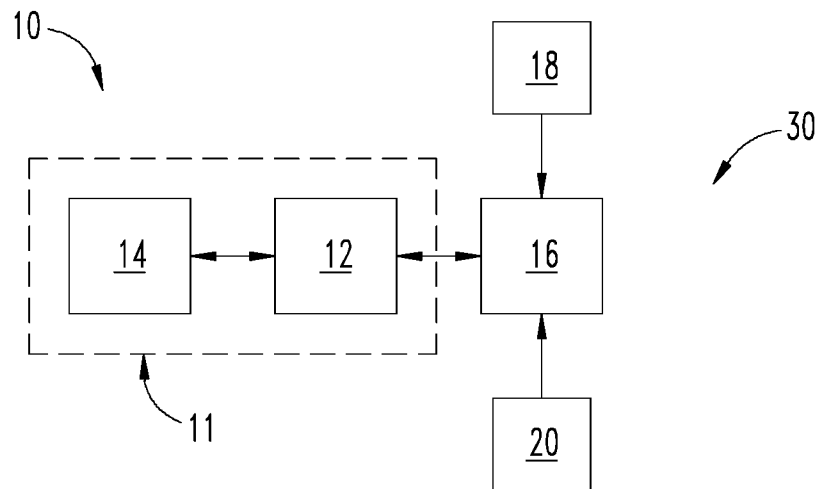
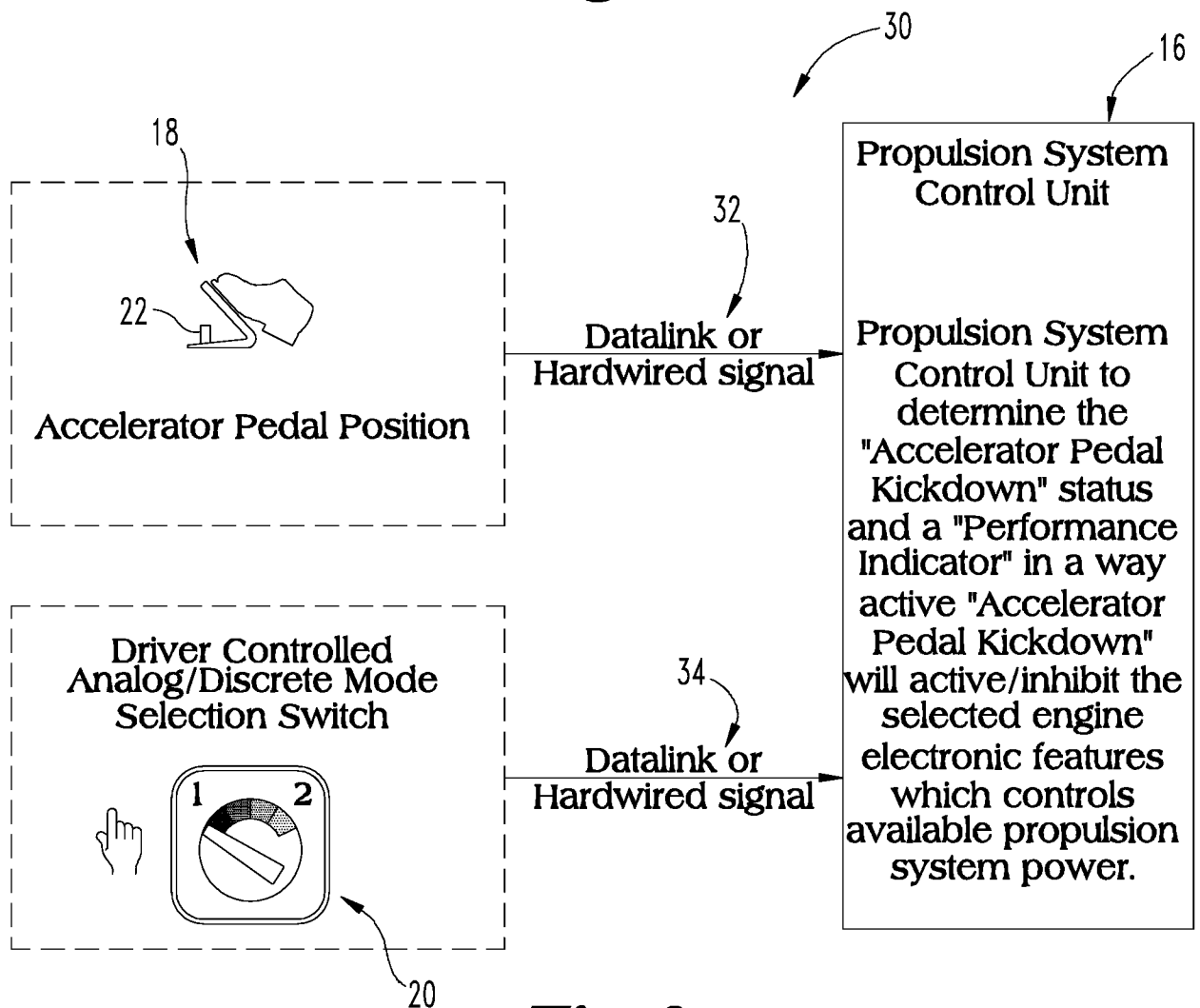
10. A method of controlling a powertrain of a vehicle, comprising:
 - managing an available power to the powertrain in response to a selected performance indicator value by which one or more control features manage the available power to the powertrain;
 - determining a kickdown status of an accelerator pedal associated with the powertrain and an elapsed time the accelerator pedal is in the kickdown status; and
 - overriding the performance indicator value to activate or inhibit the one or more control features that manage the available power to the powertrain in response to the kickdown status and the elapsed time.
11. The method of claim 10, further comprising manually selecting, via a selection switch, the performance indicator value.
12. The method of claim 10, wherein the accelerator pedal is engageable to a kickdown switch that provides an indication to a driver of the vehicle of an accelerator position relative to a kickdown threshold position of the accelerator pedal.
13. The method of claim 10, further comprising recording the elapsed time in which the kickdown status of the accelerator pedal is active and the performance indicator value is overridden in response to the elapsed time exceeding a threshold.
14. The method of claim 13, wherein the threshold is calibratable.

15. The method of claim 13, wherein the overridden performance indicator value is relinquished in response to the kickdown status being passive and the passage of a lag time since the kickdown status became passive.
16. The method of claim 13, further comprising resetting the elapsed time in response to the kickdown status of the accelerator pedal being passive.
17. The method of claim 10, wherein the kickdown status is communicated to a driver of the vehicle via a kickdown switch engageable by the accelerator pedal.
18. The method of claim 10, wherein the one or more control features include power limits applied to the powertrain.
19. A vehicle system, comprising:
- a powertrain operable to propel the vehicle system;
 - an accelerator pedal for operating the powertrain;
 - a selection switch for selecting a performance indicator value determined by a position of the selection switch; and
 - an electronic control unit operably connected to the powertrain, the accelerator pedal and the selection switch, the electronic control unit configured to manage an available power to the powertrain in response to the performance indicator value, and wherein, in response to a kickdown status of the accelerator pedal and a time of the accelerator pedal in the kickdown status, the electronic control unit overrides the

performance indicator value to activate or inhibit the one or more control features of the electronic control unit that manages the available power to the powertrain.

20. The vehicle system of claim 19, wherein the selection switch is operable to manually select between a first performance indicator value associated with a fuel efficient mode of operation of the powertrain and a second performance indicator value associated with a less fuel efficient mode of operation of the powertrain.

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**Fig. 1****Fig. 2**

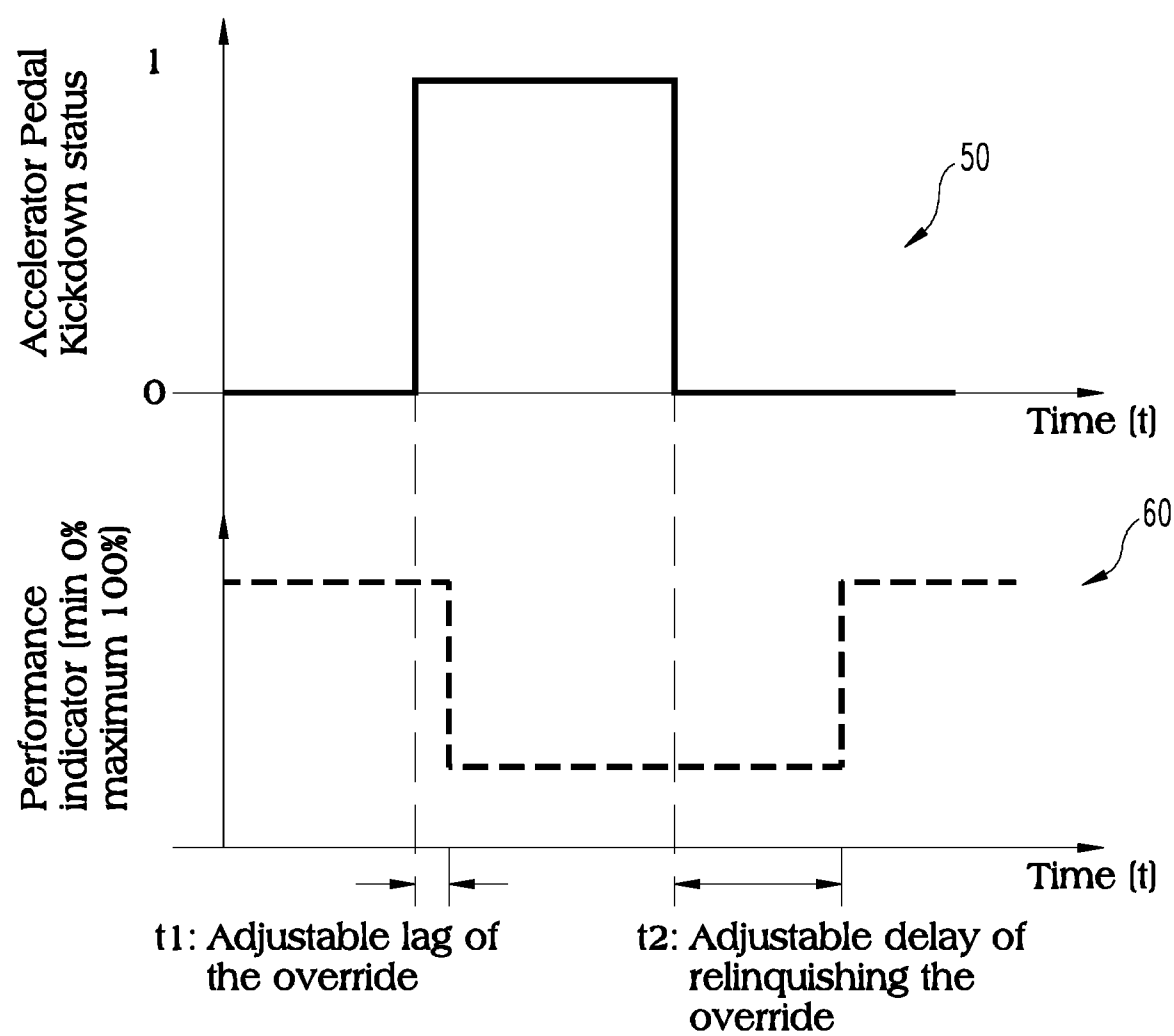


Fig. 3

The Engine electronic features/functions that provide fuel savings by managing available engine power and vehicle performance.	The individual Performance Indicator Threshold (%) to active/Inhibit the associated Feature Function
Feature/Function#1	Performance Indicator Threshold#1
Feature/Function#2	Performance Indicator Threshold#2
Feature/Function#3	Performance Indicator Threshold#3
Feature/Function#n	Performance Indicator Threshold#n

Fig. 4

INTERNATIONAL SEARCH REPORT

International application No.

PCT/US 18/54566

A. CLASSIFICATION OF SUBJECT MATTER

IPC(8) - B60W 30/188 (2018.01)

CPC - B60W 20/40; B60W 30/00; B60W 30/18; B60W 30/18027; B60W 30/18181; B60W 30/1819; B60W 50/00

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)

See Search History Document

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

See Search History Document

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

See Search History Document

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X --- A	US 2015/0006064 A1 (Jaguar Land Rover Limited) 01 January 2015 (01.01.2015), para [0069]-[0071], [0082]-[0084], [0086], [0088]-[0090], [0124], [0138]-[0140], [0143], [0147]-[0149].	1-3, 5, 8-13, 16-20 ----- 4, 6-7, 14-15
A	US 2012/0303228 A1 (Oyama) 29 November 2012 (29.11.2012), entire document.	1-20
A	US 2010/0280728 A1 (Labuhn et al.) 04 November 2010 (04.11.2010), entire document.	1-20
A	US 2009/0069155 A1 (Dickinson) 12 March 2009 (12.03.2009), entire document.	1-20
A	US 5,754,968 A (Hedstrom) 19 May 1998 (19.05.1998), entire document.	1-20

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

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Date of the actual completion of the international search

25 November 2018

Date of mailing of the international search report

31 DEC 2018

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