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(54) **SHIFTER ASSEMBLY FOR ELECTRIC VEHICLE**

(71) Applicant: **Ford Global Technologies, LLC**, Dearborn, MI (US)

(72) Inventors: **Jacob Michael Haspiel**, Ann Arbor, MI (US); **Martin Delonis**, Northville, MI (US); **Michael Lozano**, Detroit, MI (US)

(73) Assignee: **Ford Global Technologies, LLC**, Dearborn, MI (US)

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(52) **U.S. Cl.**

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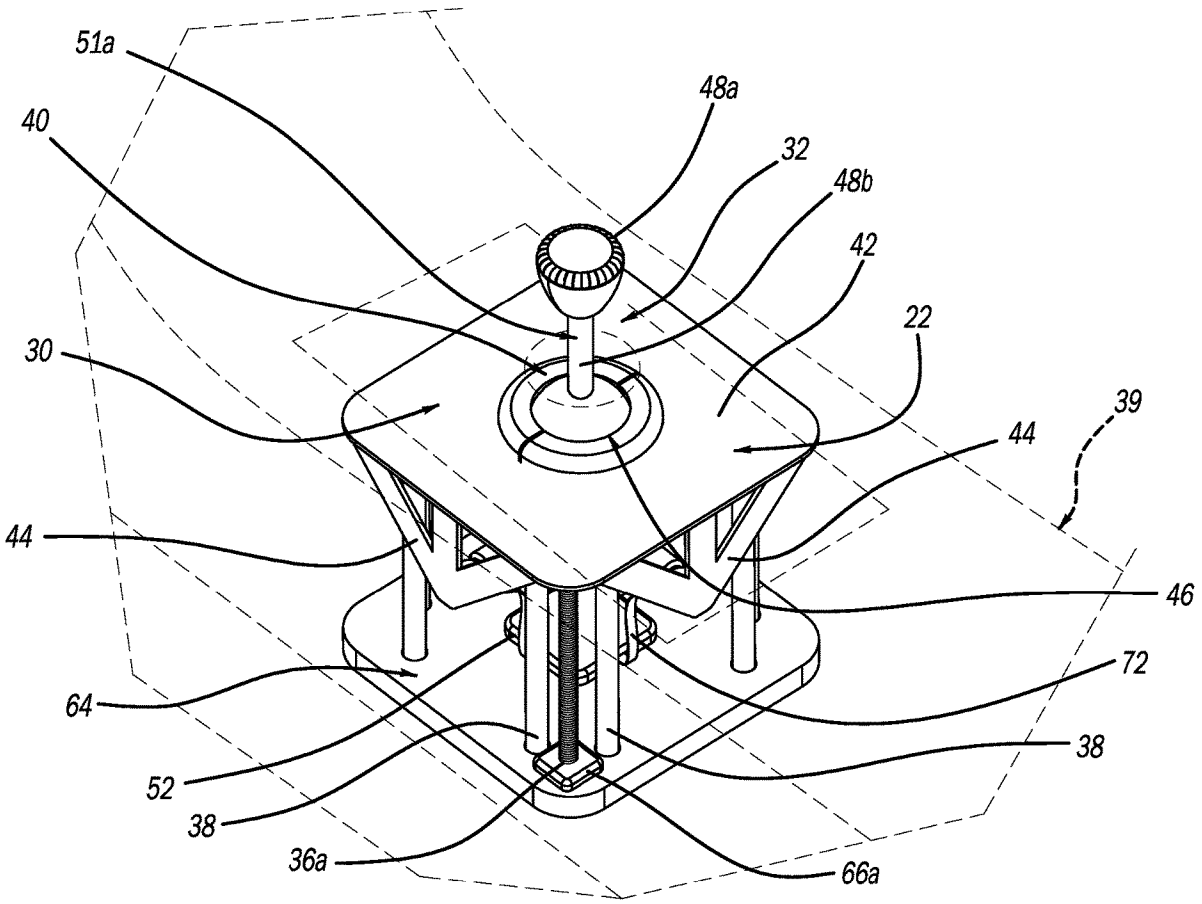
(57) **ABSTRACT**

A shifter assembly for an electric vehicle includes a base, a shifter handle, and a plurality of actuators. The base defines an opening. The shifter handle extends through the opening of the base and is pivotably coupled to the base. Each actuator of the plurality of actuators are pivotably coupled to the base at a first end and pivotably coupled to the shifter handle at a second end that is opposite the first end. The plurality of actuators are configured to permit movement of the shifter handle relative to the base in a predetermined virtual pathway and inhibit movement of the shifter handle relative to the base outside the predetermined virtual path.



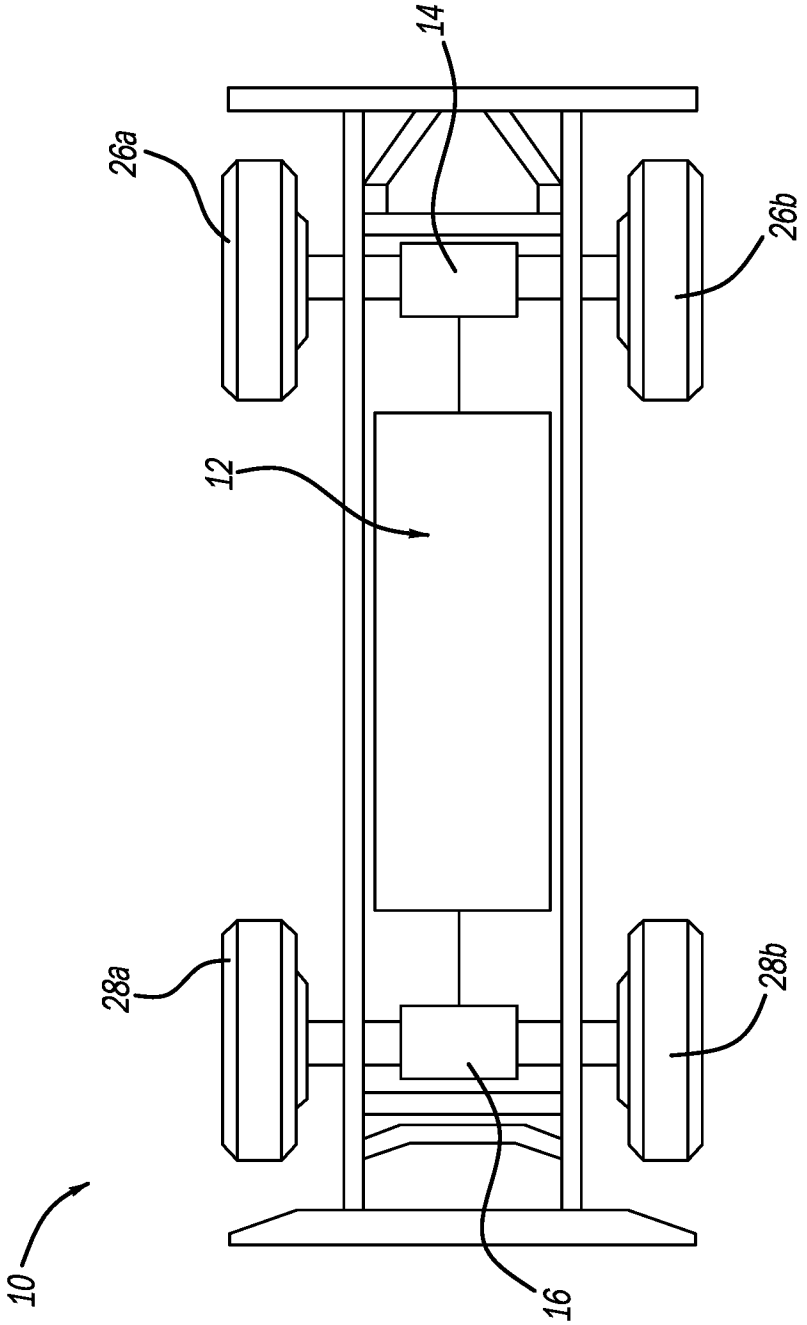


Fig. 1

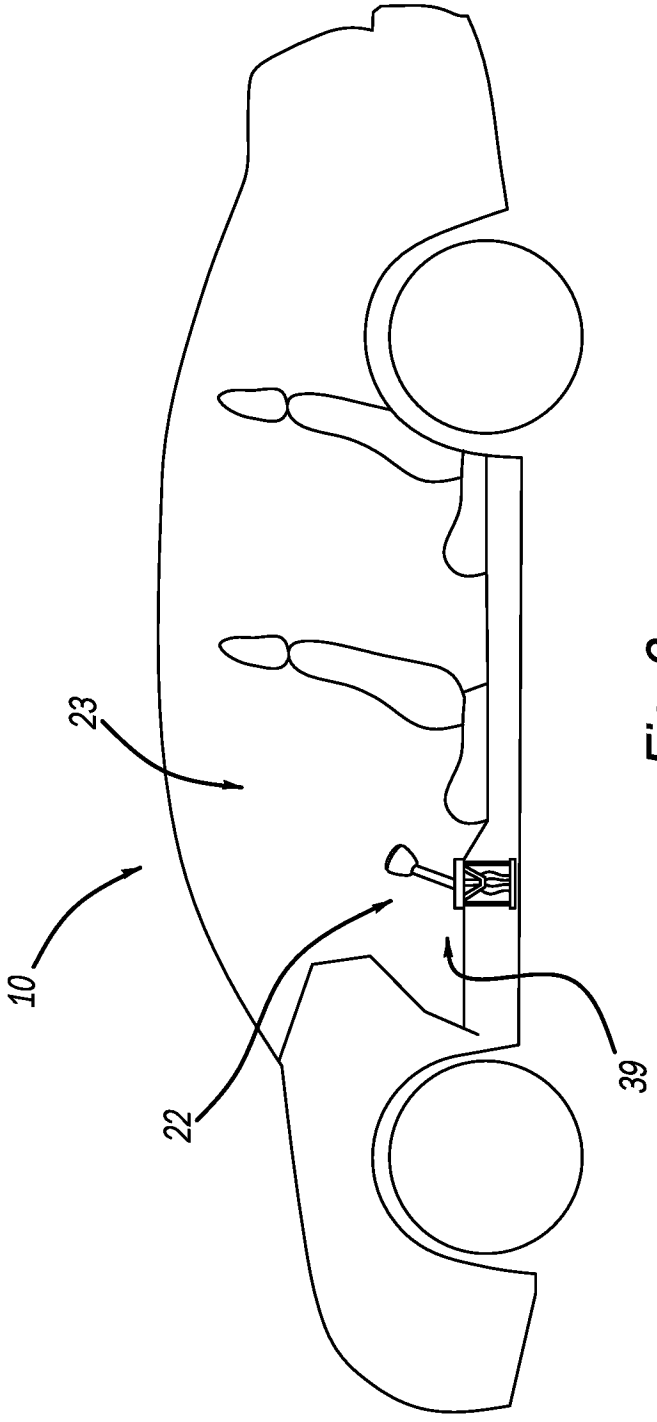
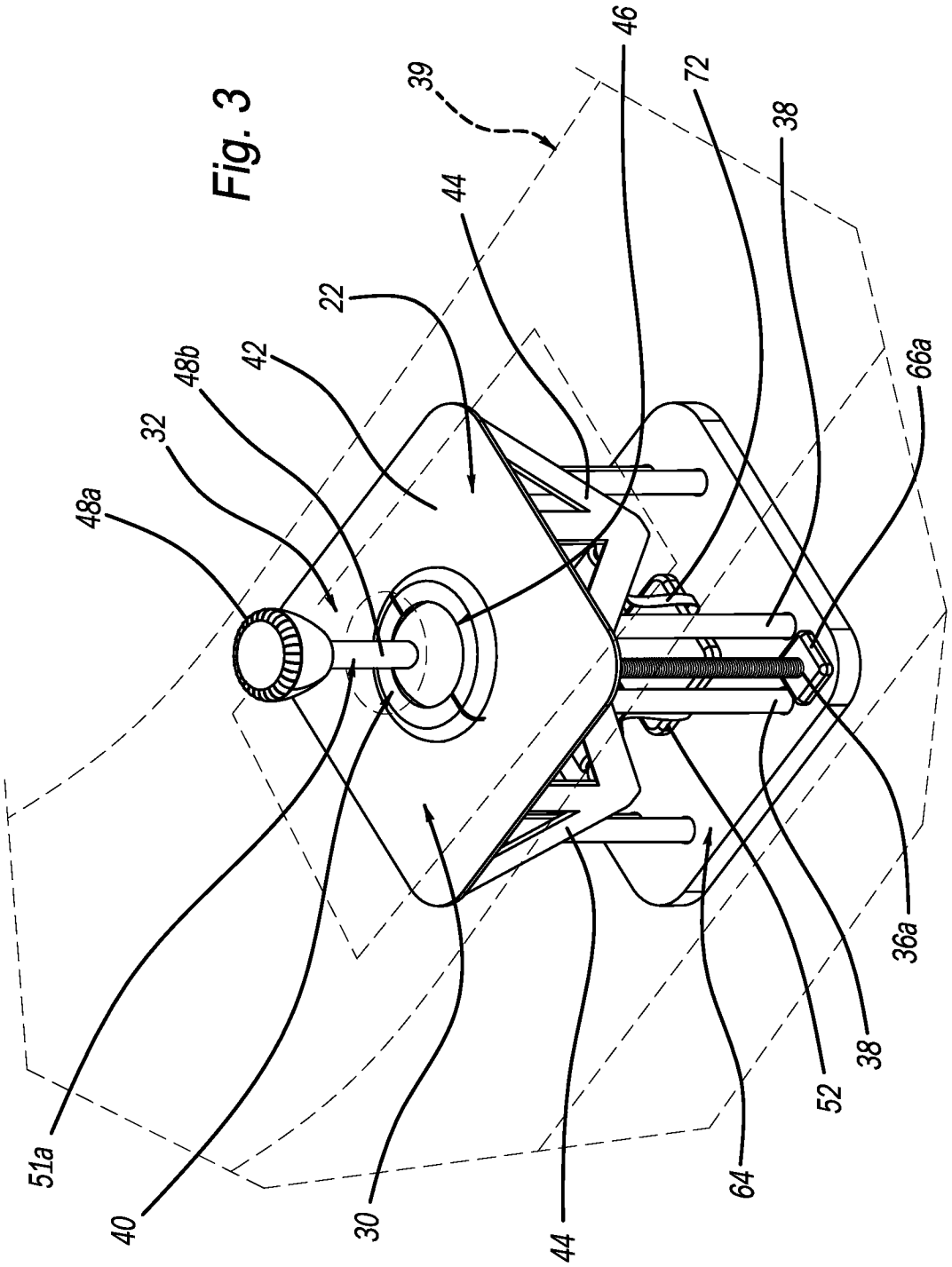


Fig. 2

Fig. 3



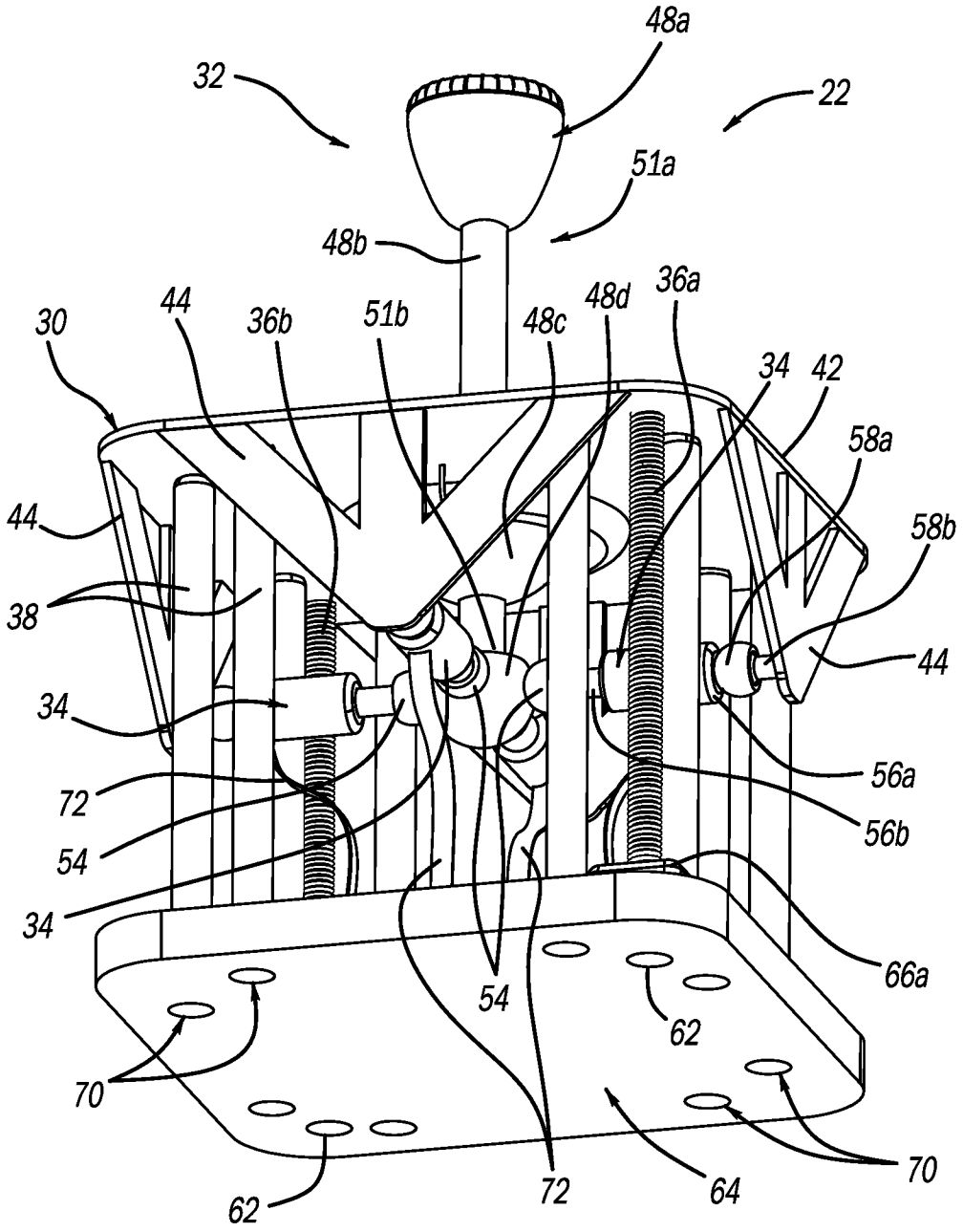
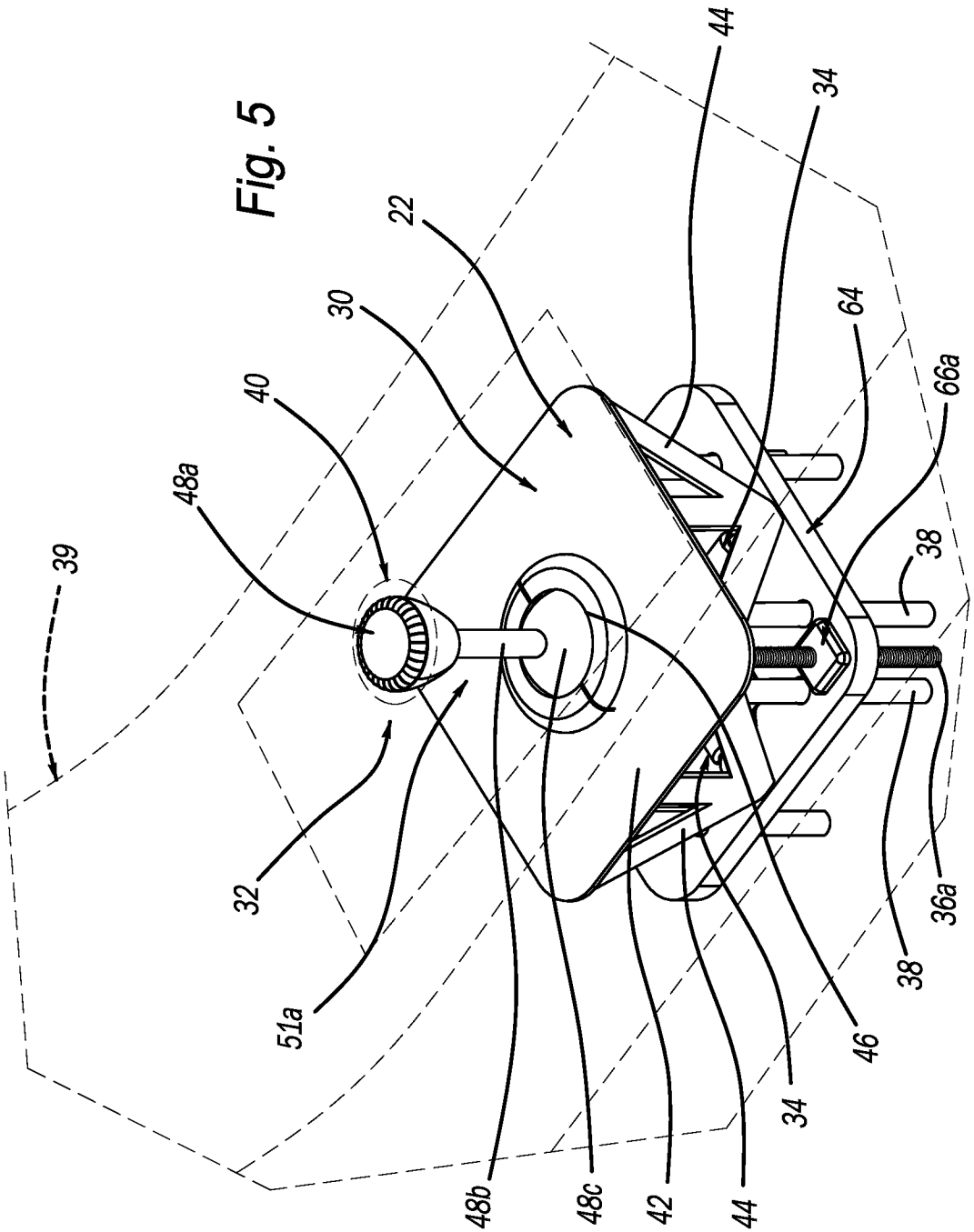

48a
32
22
51a
48b
30
44
36b
51b
48c
48d
36a
34
42
58a
58b
44
38
34
72
54
34
56a
56b
66a
54
62
70
62
72
64
70

Fig. 4

Fig. 5



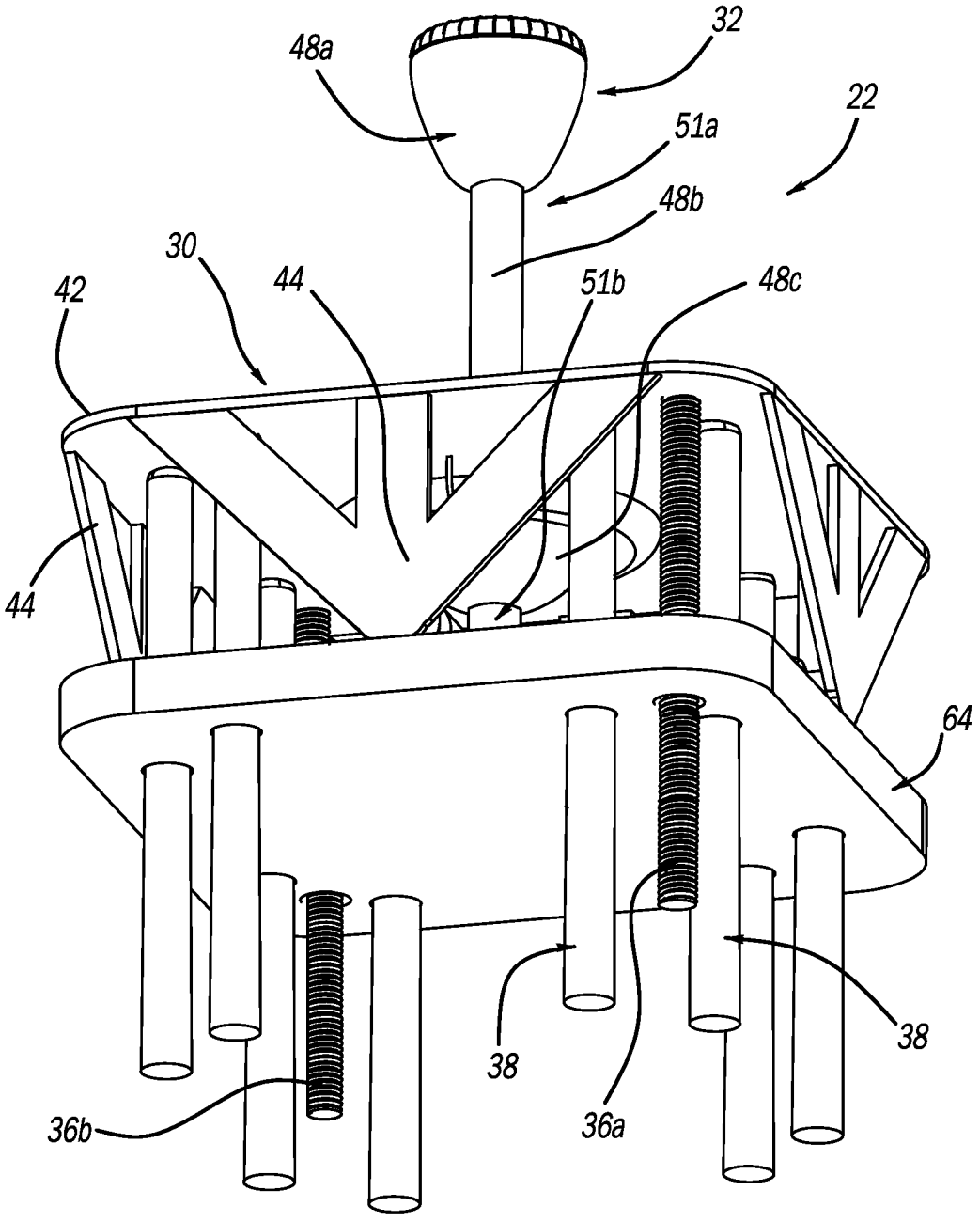


Fig. 6

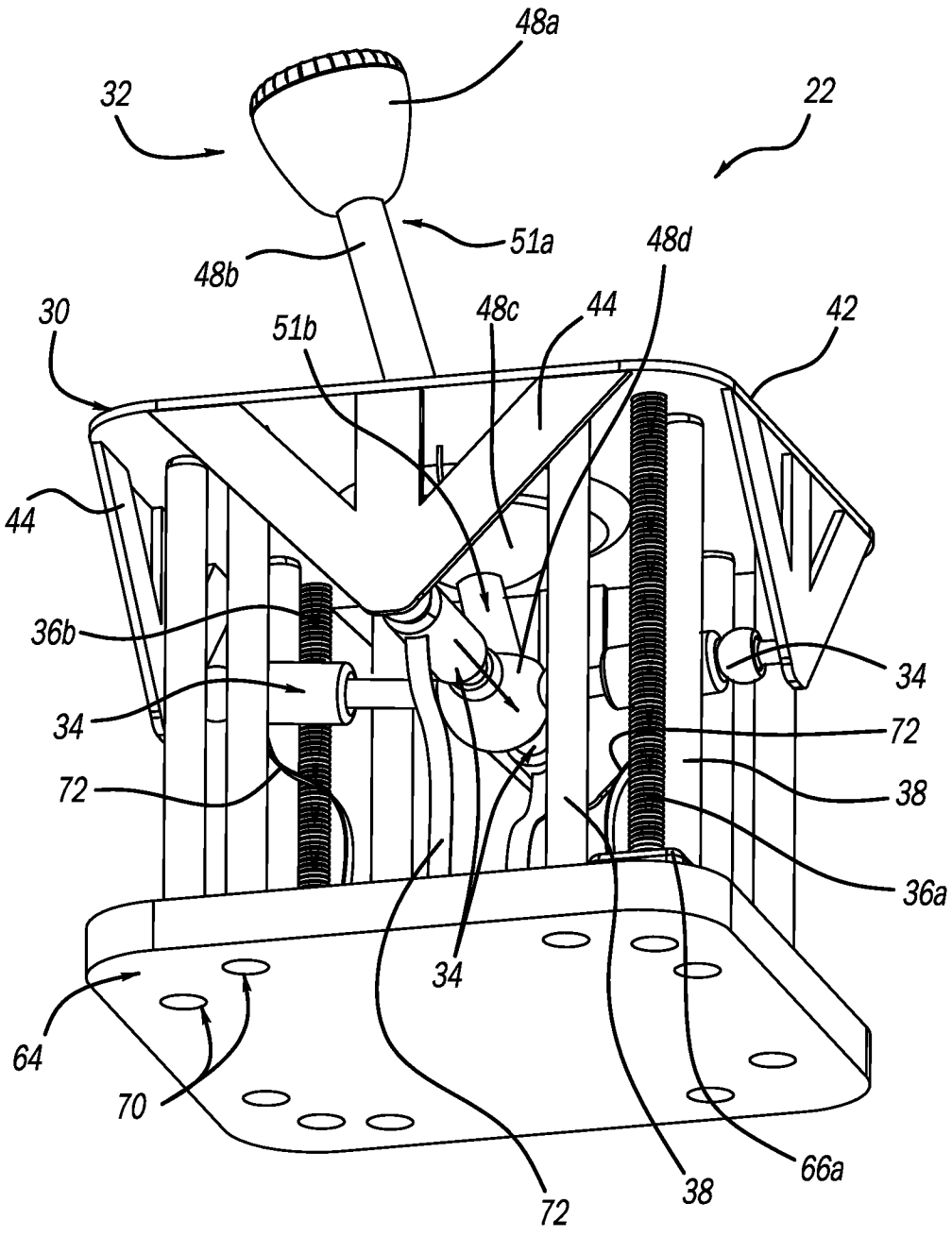

48a
32
22
51a
48d
48b
30
51b
48c
44
42
44
36b
34
34
72
72
38
36a
34
64
70
72
38
66a

Fig. 7

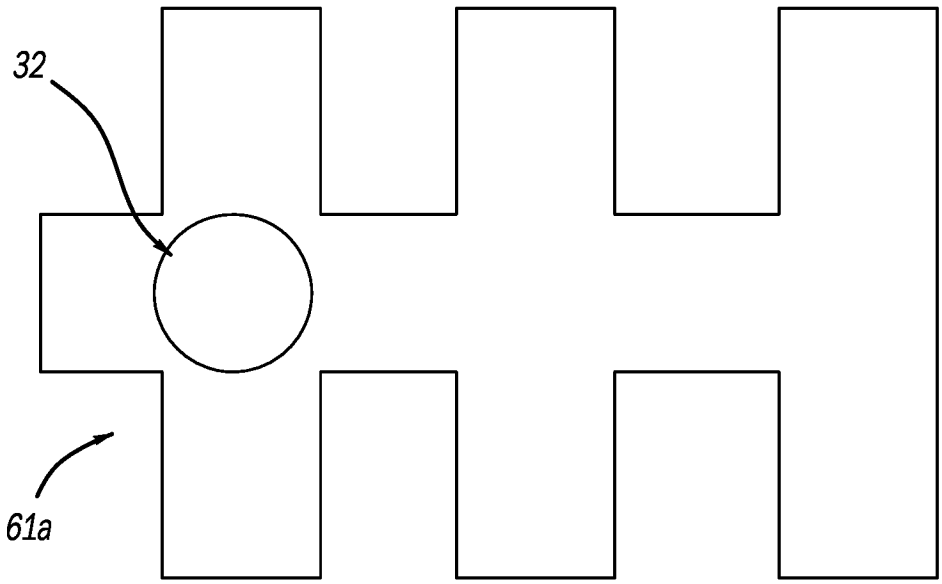


Fig. 8A

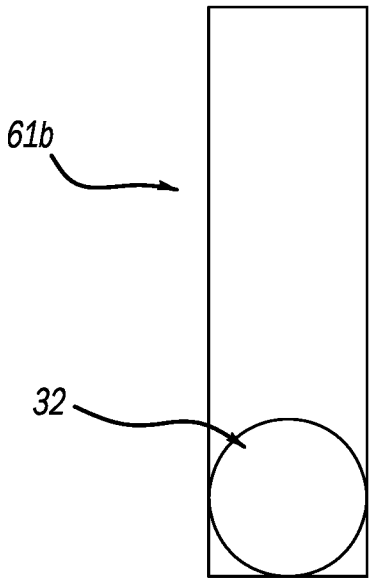


Fig. 8B

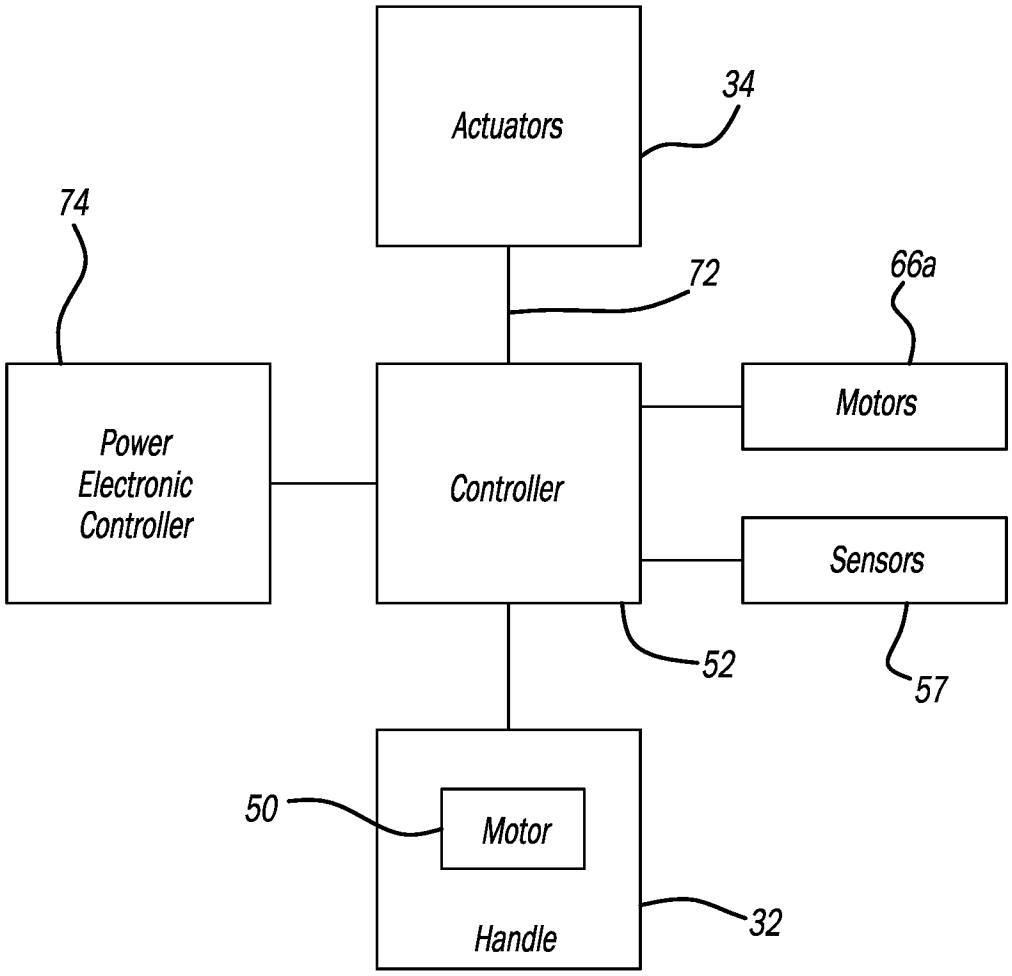

Actuators
34
74
72
66a
Power
Electronic
Controller
Controller
Motors
Sensors
52
57
50
Motor
Handle
32

Fig. 9

SHIFTER ASSEMBLY FOR ELECTRIC VEHICLE

FIELD

[0001] The present disclosure relates to a shifter assembly for an electric vehicle.

BACKGROUND

[0002] The statements in this section merely provide background information related to the present disclosure and may not constitute prior art.

[0003] Electric vehicles differ from conventional motor vehicles because they are driven by one or more rechargeable battery packs having lithium-ion batteries, for example, or any other suitable electrical power storage units. As electric vehicles increase in power, operators may desire alternative modes and capabilities of engagement with the electric vehicle. For example, electric vehicles lack operator to vehicle physical feedback that is advantageous in conventional motor vehicles. Integration of alternative modes and capabilities of engagement with electric vehicles can be challenging.

[0004] The teachings of the present disclosure address these and other issues with alternative modes and capabilities of electric vehicles.

SUMMARY

[0005] This section provides a general summary of the disclosure and is not a comprehensive disclosure of its full scope or all of its features.

[0006] In one form, the present disclosure provides a shifter assembly for an electric vehicle. The shifter assembly includes a base, a shifter handle, and a plurality of actuators. The base defines an opening extending therethrough. The shifter handle extends through the opening of the base and is pivotably coupled to the base. Each actuator of the plurality of actuators is pivotably coupled to the base at a first end of that actuator and pivotably coupled to the shifter handle at a second end of that actuator that is opposite the first end. The plurality of actuators are configured to permit movement of the shifter handle relative to the base in a predetermined virtual path and inhibit movement of the shifter handle relative to the base outside the predetermined virtual path.

[0007] In variations of the shifter assembly of the above paragraph, which can be implemented individually or in any combination: the base includes an upper plate defining the opening and a plurality of rigid supports, each rigid support extending downward from a peripheral portion of the upper plate, the first end of each actuator of the plurality of actuators pivotably coupled to a respective rigid support of the plurality of rigid supports; a vertical drive post secured to the upper plate of the base and a motor operatively connected to the vertical drive post and configured to move the base in a vertical direction between a deployed position and a retracted position; a lower plate configured to be secured to a structure of the electric vehicle, the lower plate defining an aperture, the vertical drive post is received in the aperture; a first vertical drive post secured to the base; a first motor operatively connected to the first vertical drive post and configured to move the base in a vertical direction between a deployed position and a retracted position; a second vertical drive post secured to the base; a second motor operatively connected to the second vertical drive post and configured to move the base in the vertical direction between the deployed position and the retracted position; a lower plate configured to be secured to a structure of the electric vehicle and defining a drive post aperture and a plurality of guide post apertures; a plurality of vertical guide posts secured to the base, each vertical guide post of the plurality of vertical guide posts being received in a respective guide post aperture of the plurality of guide post apertures; a vertical drive post secured to the base and received in the drive post aperture; a motor operatively connected to the vertical drive post and configured to move the base and the shifter handle in a vertical direction between a deployed position and a retracted position; a controller in communication with the plurality of actuators and configured to send instructions to the plurality of actuators, the instructions corresponding to the predetermined virtual path; a plurality of wires, each wire of the plurality of wires connected to the controller and a respective actuator of the plurality of actuators; the plurality of wires are ribbon wires; the plurality of actuators are electronic actuators; the plurality of actuators are linear actuators; the shifter handle includes a knob and a shaft, the shaft extending through the opening in the base; and a haptic motor is disposed within the knob.

[0008] In another form, the present disclosure provides a shifter assembly for an electric vehicle. The shifter assembly includes a base, a shifter handle, a plurality of actuators, a plurality of vertical drive posts, a plurality of vertical guide posts, and a plurality of motors. The base includes a plate and at least one rigid support extending downward from a peripheral portion of the plate. The plate defines an opening near a center portion thereof. The shifter handle extends through the opening of the plate and is pivotably coupled to the plate. Each actuator of the plurality of actuators is pivotably coupled to the at least one rigid support at a first end of that actuator and pivotably coupled to the shifter handle at a second end of that actuator that is opposite the first end. The plurality of actuators are configured to permit movement of the shifter handle relative to the base in a predetermined virtual path and inhibit movement of the shifter handle relative to the base outside the predetermined virtual path. The plurality of vertical drive posts are secured to the plate of the base. The plurality of vertical guide posts are secured to the plate of the base. Each motor is operatively connected to a respective vertical drive post of the plurality of vertical drive posts and configured to move the base in a vertical direction between a deployed position and a retracted position.

[0009] In variations of the shifter assembly of the above paragraph, which can be implemented individually or in any combination: the plurality of actuators are pivotably coupled to the shifter handle at a location that is below where the shifter handle is pivotably coupled to the base; a controller in communication with the plurality of actuators and configured to send instructions to the plurality of actuators, the instructions corresponding to the predetermined virtual path; a plurality of wires, each wire of the plurality of wires is connected to the controller and a respective actuator of the plurality of actuators; the plurality of wires are ribbon wires; the plurality of actuators are electronic actuators; the plurality of actuators are linear actuators; the shifter handle

includes a knob and a shaft, the shaft extending through the opening in the plate; and a haptic motor is disposed within the knob.

[0010] In yet another form, the present disclosure provides a shifter assembly for an electric vehicle. The shifter assembly includes a base, a shifter handle, a plurality of electronic actuators, a plurality of vertical drive posts, a plurality of vertical guide posts, a plurality of motors, a lower plate, a controller, and ribbon wires. The base includes an upper plate and a plurality of rigid supports extending downward from a peripheral portion of the upper plate. The upper plate defines an opening near a center portion thereof. The shifter handle extends through the opening of the upper plate of the base and pivotably coupled to the upper plate of the base. Each electronic actuator of the plurality of electronic actuators being pivotably coupled to a respective rigid support of the plurality of rigid supports at a first end of that electronic actuator and pivotably coupled to the shifter handle at a second end of that electronic actuator that is opposite the first end. The plurality of electronic actuators are configured to permit movement of the shifter handle relative to the base in a predetermined virtual path and inhibit movement of the shifter handle relative to the base outside the predetermined virtual path. The plurality of vertical drive posts are secured to the upper plate of the base. The plurality of vertical guide posts are secured to the upper plate of the base. Each motor is operatively connected to a respective vertical drive post of the plurality of vertical drive posts and configured to move the base in a vertical direction between a deployed position and a retracted position. The lower plate is configured to be secured to a support structure of the electric vehicle and defines a plurality of drive post apertures and a plurality of guide post apertures. Each vertical drive post of the plurality of vertical drive posts is received in a respective drive post aperture of the drive post apertures. Each vertical guide post of the plurality of vertical guide posts is received in a respective guide post aperture of the plurality of guide post apertures. The controller is in communication with the plurality of electronic actuators and configured to send instructions to the plurality of electronic actuators. The instructions corresponding to the predetermined virtual path. Each ribbon wire of the plurality of ribbon wires is connected to the controller and a respective electronic actuator of the plurality of electronic actuators. Each rigid support of the plurality of rigid supports engages the lower plate when the base is in the retracted position and is spaced apart from the lower plate when the base is in the deployed position.

[0011] Further areas of applicability 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 disclosure.

DRAWINGS

[0012] In order that the disclosure may be well understood, there will now be described various forms thereof, given by way of example, reference being made to the accompanying drawings, in which:

[0013] FIG. **1** is a schematic view of a vehicle including a battery pack and motors according to the principles of the present disclosure;

[0014] FIG. **2** is a side view of the vehicle of FIG. **1** including a shifter assembly according to the principles of the present disclosure;

[0015] FIG. **3** is a top perspective view of the shifter assembly of FIG. **2** with a base of the shifter assembly in an extended position and a shifter handle of the shifter assembly in an extended state;

[0016] FIG. **4** is a bottom perspective view of the shifter assembly of FIG. **2** with the base of the shifter assembly in the extended position and the shifter handle of the shifter assembly in the extended state;

[0017] FIG. **5** is a top perspective view of the shifter assembly of FIG. **2** with the base of the shifter assembly in a retracted position and the shifter handle of the shifter assembly in the retracted state;

[0018] FIG. **6** is a bottom perspective view of the shifter assembly of FIG. **2** with the base of the shifter assembly in the retracted position and the shifter handle of the shifter assembly in the retracted state;

[0019] FIG. **7** is a bottom perspective view of the shifter assembly of FIG. **2** with the base of the shifter assembly in the extended position and the shifter handle of the shifter assembly in the extended state, and with the shifter handle pivoted relative to the base;

[0020] FIGS. **8**A and **8**B are example virtual pathways based on selected vehicle modes of the shifter assembly of FIG. **2** according to the principles of the present disclosure; and

[0021] FIG. **9** is a block diagram showing components of the shifter assembly of FIG. **2**.

[0022] The drawings described herein are for illustration purposes only and are not intended to limit the scope of the present disclosure in any way.

DETAILED DESCRIPTION

[0023] The following description is merely exemplary in nature and is not intended to limit the present disclosure, application, or uses. It should be understood that throughout the drawings, corresponding reference numerals indicate like or corresponding parts and features.

[0024] With reference to FIGS. **1** and **2**, a vehicle **10** such as an electric vehicle is provided. In the example provided, the electric vehicle is a battery electric vehicle (BEV). In other examples, the electric vehicle may be a hybrid electric vehicle (HEV), a plug-in electric vehicle (PHEV), or a fuel cell vehicle, among others. The vehicle **10** includes a battery pack or battery structure **12** (FIG. **1**), a first or rear motor **14** (FIG. **1**) such as an electric motor, a second or front motor **16** (FIG. **1**) such as an electric motor, and a shifter assembly **22** (FIG. **2**). The battery pack **12** may be rechargeable and may include lithium-ion batteries or any other suitable electrical power storage units. The battery pack **12** may be disposed at various locations of the vehicle **10** and may be mounted to a vehicle frame. In this way, the battery pack **12** is supported by the vehicle frame and is remote from a passenger cabin (not shown) and cargo compartments (not shown) of the vehicle **10**, therefore, not occupying space that would otherwise be available for passengers or cargo. The battery pack **12** powers the rear motor **14** to drive a set of rear wheels **26***a*, **26***b* via a rear axle. Similarly, the battery pack **12** powers the front motor **16** to selectively drive a set of front wheels **28***a*, **28***b* via a front axle. In other forms, not specifically shown, the vehicle **10** may only include the front motor **16** or the rear motor **14**.

[0025] With reference to FIG. **2**, the shifter assembly **22** is disposed at a center console **39** located in a front row **23** of the vehicle **10**. The shifter assembly **22** may be mounted to

a stationary structure of the vehicle **10** such as a vehicle floor, for example. With reference to FIGS. **3** and **4**, the shifter assembly **22** includes a base **30**, a shifter handle **32**, a plurality of actuators **34** (FIG. **4**), one or more vertical drive posts **36***a*, **36***b*, and one or more vertical guide posts **38**. One or more components or parts of the shifter assembly **22** may be located within a transmission tunnel of the vehicle **10** such that the components are hidden from view and inaccessible by occupants located in an occupant cabin of the vehicle **10**. For example, the shifter handle **32** is the only part of the shifter assembly **22** accessible by an occupant in the occupant cabin and the base **30**, the plurality of actuators **34**, the vertical drive posts **36***a*, **36***b* and the vertical guide posts **38** may be hidden and inaccessible by an occupant in the occupant cabin.

[0026] With additional reference to FIGS. **5** and **6**, the base **30** is moveable vertically between a retracted position in which the shifter handle **32** is located at least partially within an opening **40** (FIG. **5**) of the center console **39**, and an extended position (FIGS. **3** and **4**) in which the shifter handle **32** extends through the opening **40** (FIG. **3**) of the center console **39**. It should be understood that the shifter handle **32** is accessible by an occupant within the occupant cabin when the base **30** is in the retracted position and the extended position. The base **30** includes a plate **42** and a plurality of supports **44**. In the example illustrated, the plate **42** includes an opening **46** (FIG. **5**) extending therethrough. The opening **46** extends through the plate **42** near or at a center portion of the plate **42**. The opening **46** is vertically aligned with the opening **40** of the center console **39** and is configured to receive the shifter handle **32**. In the example illustrated, the plate **42** has a square shape when viewed from the top. In some forms, the plate **42** may have a rectangular shape, a circular shape, or any other suitable shape.

[0027] In the example illustrated, each support **44** has a triangular shape when viewed from a corresponding side of the shifter assembly **22**. The supports **44** are positioned around a periphery of the plate **42** and extend downward from the periphery of the plate **42**. In some forms, the supports **44** may have a semi-circular shape, a rectangular shape, or any other suitable shape. The supports **44** are rigid so as to not be able to bend or be forced out of shape when a force is applied by the operation of the actuators **34** and the shifter handle **32** via the actuators **34**. In some forms, one support (not shown) may extend downward from and around the periphery of the plate **42** instead of a plurality of rigid supports **44** extending downward from and disposed around the periphery of the plate **42**.

[0028] The shifter handle **32** extends through the opening **46** of the plate **42** and is coupled to the plate **42**. In this way, the shifter handle **32** moves with the base **30** as the base **30** moves vertically between the retracted position and the extended position. That is, when the base **30** is in the retracted position, the shifter handle **32** is in the retracted state (FIGS. **5** and **6**), and when the base **30** is in the extended position, the shifter handle **32** is in the extended state (FIGS. **3** and **4**). With reference to FIG. **7**, the shifter handle **32** is pivotably coupled to the plate **42** such that the shifter handle **32** may move relative to the base **30** in a predetermined virtual pathway, which is described in more detail below. The shifter handle **32** includes a knob **48***a*, a shaft **48***b*, base pivot portion **48***c*, and an actuator pivot portion **48***d*.

[0029] The knob **48***a* is disposed at an upper end **51***a* of the shaft **48***b* and is configured to be graspable by a driver of the vehicle **10**. In some forms, a motor **50** (FIG. **9**) is disposed within the knob **48***a* of the handle **32** and is configured to provide tactical feedback to the knob **48***a* by using vibrations, thereby providing an enhanced user experience to the driver based on an operating mode of the vehicle **10**. In one form, the motor **50** is a haptic motor, for example. In some forms, the knob **48***a* includes an electronic display device (not shown). A controller **52** (FIG. **9**) may be configured to instruct the electronic display device to display a visual indicator that corresponds to the selected operating mode. One example of such a shifter handle including a knob having an electronic display device is disclosed in the U.S. Patent Application titled "SYSTEM AND METHOD FOR OPERATING AN ELECTRIC VEHICLE," which is filed concurrently with this application and is commonly owned with the present application and the contents of which are incorporated herein by reference in its entirety.

[0030] With continued reference to FIGS. **5** and **6**, the base pivot portion **48***c* is located within the opening **46** of the plate **42** and is disposed along the shaft **48***b* at a location between the knob **48***a* and the actuator pivot portion **48***d*. The base pivot portion **48***c* is also pivotably coupled to the plate **42** such that the shifter handle **32** may move in a predetermined virtual pathway relative to the plate **42**. In the example illustrated, the base pivot portion **48***c* has a spherical shape so as to form a ball joint mechanism with the plate **42**. The actuator pivot portion **48***d* is disposed at a lower end **51***b* (FIGS. **4** and **7**) of the shaft **48***b* and is configured to be pivotably coupled to the plurality of actuators **34**. In the example illustrated, the actuator pivot portion **48***d* has a semi-spherical shape. In some forms, the actuator pivot portion **48***d* may have a spherical shape, for example, or any other suitable shape that permits a pivoting connection to the actuators **34**. With reference to FIG. **4**, a plurality of sockets **54** are disposed around the actuator pivot portion **48***d* and are configured to receive respective actuators **34** of the plurality of actuators **34**.

[0031] The plurality of actuators **34** are pivotably coupled to the supports **44** of the base **30** at a first end and pivotably coupled to the actuator pivot portion **48***d* of the shifter handle **32** at a second end that is opposite the first end. The plurality of actuators **34** are configured to permit movement of the shifter handle **32** relative to the base **30** in a predetermined virtual pathway. In the example illustrated, the actuators **34** are electronic, linear actuators. In the example illustrated, when the shaft **48***b* is in a vertical position as shown in FIGS. **3-6**, two of the actuators **34** are positioned substantially parallel to each other and substantially perpendicular to two other actuators **34** of the plurality of actuators **34**, though other configurations can be used. Each actuator **34** of the plurality of actuators **34** are also positioned between the shifter handle **32** and a respective support **44** of the base **30**. It should be understood that the actuators **34** may be positioned in various directions between the support **44** and the shifter handle **32**.

[0032] With continued reference to FIG. **4**, each actuator **34** includes, inter alia, an outer housing **56***a* and an inner sleeve or rod **56***b* that is slidably engaged with the outer housing **56***a*. The controller **52** may be programmed to control the actuators **34** such that the rod **56***b* of each actuator **34** is permitted to travel a predetermined distance relative to the outer housing **56***a* in response to a vehicle

mode selected, thereby allowing the shifter handle **32** to be moved in a predetermined virtual pathway. For example, if the vehicle mode selected corresponds to a **6**-speed transmission mode, then each rod **56***b* of the actuators **34** is permitted to travel a predetermined distance relative to the outer housing **56***a* (i.e., the rod **56***b* is permitted to go in and out of the outer housing **56***a* a predetermined distance) depending on a position of the shifter handle **32** to permit the shifter handle **32** to be moved from that position along the virtual pathway **61***a* shown in FIG. **8**A, while inhibiting the shifter handle **32** from moving outside the virtual pathway **61***a*. The position of the shifter handle **32** can be determined in any suitable manner. In one form, the position of the shifter handle **32** along the virtual pathway **61***a* may be determined by one or more sensors **57** (FIG. **9**) that is in communication with the controller **52**. In another form, the position of the shifter handle **32** can be determined based on the relative positions of the actuators **34**. In another example, if the vehicle mode selected corresponds to an over boost mode or a sequential shifting mode, then each rod **56***b* of the actuators **34** is permitted to travel a predetermined distance relative to the outer housing **56***a* to permit the shifter handle **32** to be moved in the virtual pathway **61***b* shown in FIG. **8**B, while inhibiting the shifter handle **32** from moving outside the virtual pathway **61***b*. The actuators **34** are programmed to provide for a plurality of vehicle modes being selected. Examples of such vehicle modes are disclosed in the U.S. Patent Application titled "SYSTEM AND METHOD FOR OPERATING AN ELECTRIC VEHICLE," which is filed concurrently with this application and is commonly owned with the present application and the contents of which are incorporated herein by reference in its entirety.

[0033] In the example illustrated, the outer housing **56***a* has a cylindrical shape and is pivotably coupled to a respective support **44**. Stated differently, an end of the outer housing **56***a* includes a socket **58***a* that is secured to a protrusion **58***b* extending from the respective support **44**. In this way, the socket **58***a* and the protrusion **58***b* form a ball joint mechanism. The respective support **44** is rigid such that it is not forced out of shape or bent as the rod **56***b* slides in and out of the outer housing **56***a*. Although the present disclosure discloses the socket **58***a* as part of the outer housing **56***a* and the protrusion **58***b* as part of the support **44**, it should be understood that the socket **58***a* may be part of the support **44** and the protrusion **58***b* may be part of the outer housing **56***a* without departing from the scope of the present disclosure. In the example illustrated, the rod **56***b* is pivotably coupled to a respective socket **54** of the shifter handle **32**. Stated differently, an end of the rod **56***b* is coupled to the respective socket **54** of the shifter handle **32**. In this way, the respective socket **54** and the end of the rod **56***b* form a ball joint mechanism. The end of the rod **56***b* may have a spherical shape, for example. Although the present disclosure discloses the socket **54** as part of the shifter handle **32**, it should be understood that the socket **54** may be part of the rod **56***b* without departing from the scope of the present disclosure.

[0034] The vertical drive posts **36***a*, **36***b* are located at and secured to an underside of the plate **42** of the base **30**. In the example illustrated, the vertical drive post **36***a* is secured to one corner of the plate **42** and the vertical drive post **36***b* is secured to another corner of the plate **42** that is diagonal to the vertical drive post **36***a*. In some forms, the vertical drive posts **36***a*, **36***b* may be located at other positions of the plate **42** such as near a center portion of the plate **42** or at a location between corners of the plate **42**. Each vertical drive post **36***a*, **36***b* is threaded along a length thereof and is received in a respective drive post aperture **62** of a plate **64** spaced apart from plate **42** (i.e., the plate **64** is located below the plate **42** of the base **30**). It should be understood that although the shifter assembly **22** of the present disclosure includes two vertical drive posts **36***a*, **36***b*, the shifter assembly **22** of the present disclosure may include one vertical drive post or more than two vertical drive posts without departing from the scope of the present disclosure.

[0035] Motors **66***a* (only one shown in the figures) are associated with the plate **64** (e.g., disposed on a top surface of the plate **64**) and are operatively coupled to respective vertical drive posts **36***a*, **36***b*. In the example illustrated, the motor **66***a* is operatively coupled to the vertical drive post **36***a* and another motor (not shown) is operatively coupled to the vertical drive post **36***b*. Each motor **66***a* is configured to rotate a gear assembly (not shown), which, in turn, drives the vertical drive post **36***a*, **36***b*. In this way, the base **30** moves in a vertical direction between the extended position and the retracted position. When the base **30** is in the retracted position, the supports **44** may engage the plate **64** to inhibit further downward movement of the base **30**. When the base **30** is in the extended position, the supports **44** are spaced apart from the plate **64**. When the shifter handle **32** is in the retracted state, the knob **48***a* is located within the opening **40** of the center console **39** (FIG. **5**). When the shifter handle **32** is in the extended state, the shaft **48***b* of the shifter handle **32** extends partially through the opening **40** of the center console **39** so that the knob **48***a* is located above the opening **40** of the center console **39** (FIG. **3**). In some forms, each motor **66***a* may be covered by a cover (not shown). In an alternative form (not shown) a single motor **66***a* may be configured to drive more than one or all of the drive posts **36***a*, **36***b*, such as being coupled to each drive post **36***a*, **36***b* via gears, a pulley mechanism, or a chain and sprocket mechanism for example.

[0036] The guide posts **38** are located at and secured to the underside of the plate **42** of the base **30**. In the example illustrated, two guide posts **38** are secured at a respective corner of the plate **42**. In some forms, the guide posts **38** may be located at other positions of the plate **42** such as near a center portion of the plate **42** or at a location between corners of the plate **42**. The two guide posts **38** located at a respective corner of the plate **42** where one vertical drive post **36***a*, **36***b* is located is positioned on opposing sides of the vertical drive post **36***a*, **36***b* (i.e., the vertical drive post **36***a*, **36***b* is located between the two guide posts **38**). The guide posts **38** assist in stabilizing the base **30** as the base **30** moves between the retracted position and the extended position. In the example illustrated, each guide post **38** is unthreaded and configured to be received in a respective guide post aperture **70** of the plate **64**. It should be understood that although the shifter assembly **22** of the present disclosure includes eight guide posts **38**, the shifter assembly **22** of the present disclosure may include one guide post or any number of guide posts without departing from the scope of the present disclosure.

[0037] With reference to FIGS. **3** and **9** the controller **52** is in communication with the plurality of actuators **34** and the motors **66***a*, and may operate the actuators **34** and the motors **66***a*. That is, the controller **52** may provide power

and/or send instructions (i.e., data) to each actuator **34** including power or instructions corresponding to the predetermined distance that the rod **56***b* is permitted to travel relative to the outer housing **56***a* in response to a vehicle mode selected and the position of the shifter handle **32**, thereby allowing the shifter handle **32** to be moved in a predetermined virtual pathway and inhibiting the shifter handle **32** from moving outside the predetermined virtual pathway. The controller **52** may be in wired or wireless communication with the actuators **34**, and if included, the sensors **57**. In the example illustrated, a plurality of wires **72** are connected to the controller **52** and the actuators **34**, thereby permitting the controller **52** to power and/or send instructions to the actuators **34**. In the example illustrated, the wires **72** are ribbon wires, which provides flexibility as the base **30** moves between the retracted position and the extended position. It should be understood that the wires **72** may be any suitable wire that may power and/or provide instructions to the actuators **34** such as a cylindrical extrusion wire, for example.

[0038] In the example illustrated, the controller **52** is located on the upper side of the plate **64**. In some forms, the controller **52** may be located on another part of the shifter assembly **22** (e.g., the base **30**) or may be located remote from the shifter assembly **22** such as near or at a location housing a power electronic controller **74** (FIG. **9**) of the vehicle **10**. The power electronic controller **74** manages the flow of electrical energy delivered by the battery pack **12**, controlling the speed of the motors **14**, **16** and the torque each motor **14**, **16** produces. The controller **52** may be in communication with the power electronic controller **74** and may send a signal to the power electronic controller **74** to control and/or adjust the speed of the motors **14**, **16** and the torque each motor **14**, **16** produces based on a position of the shifter handle **32** in the predetermined virtual pathway. An example of the controller **52** sending signals to the power electronic controller **74** to control and/or adjust the speed of the motors **14**, **16** and the torque each motor **14**, **16** produces based on a position of the shifter handle **32** in the predetermined virtual pathway is disclosed in U.S. Patent Application titled "SYSTEM AND METHOD FOR OPERATING AN ELECTRIC VEHICLE," which is filed concurrently with this application and is commonly owned with the present application and the contents of which are incorporated herein by reference in its entirety.

[0039] Unless otherwise expressly indicated herein, all numerical values indicating mechanical/thermal properties, compositional percentages, dimensions and/or tolerances, or other characteristics are to be understood as modified by the word "about" or "approximately" in describing the scope of the present disclosure. This modification is desired for various reasons including industrial practice, material, manufacturing, and assembly tolerances, and testing capability.

[0040] As used herein, the phrase at least one of A, B, and C should be construed to mean a logical (A OR B OR C), using a non-exclusive logical OR, and should not be construed to mean "at least one of A, at least one of B, and at least one of C."

[0041] In this application, the term "controller" and/or "module" may refer to, be part of, or include: an Application Specific Integrated Circuit (ASIC); a digital, analog, or mixed analog/digital discrete circuit; a digital, analog, or mixed analog/digital integrated circuit; a combinational logic circuit; a field programmable gate array (FPGA); a processor circuit (shared, dedicated, or group) that executes code; a memory circuit (shared, dedicated, or group) that stores code executed by the processor circuit; other suitable hardware components (e.g., op amp circuit integrator as part of the heat flux data module) that provide the described functionality; or a combination of some or all of the above, such as in a system-on-chip.

[0042] The term memory is a subset of the term computer-readable medium. The term computer-readable medium, as used herein, does not encompass transitory electrical or electromagnetic signals propagating through a medium (such as on a carrier wave); the term computer-readable medium may therefore be considered tangible and non-transitory. Non-limiting examples of a non-transitory, tangible computer-readable medium are nonvolatile memory circuits (such as a flash memory circuit, an erasable programmable read-only memory circuit, or a mask read-only circuit), volatile memory circuits (such as a static random access memory circuit or a dynamic random access memory circuit), magnetic storage media (such as an analog or digital magnetic tape or a hard disk drive), and optical storage media (such as a CD, a DVD, or a Blu-ray Disc).

[0043] The apparatuses and methods described in this application may be partially or fully implemented by a special purpose computer created by configuring a general-purpose computer to execute one or more particular functions embodied in computer programs. The functional blocks, flowchart components, and other elements described above serve as software specifications, which can be translated into the computer programs by the routine work of a skilled technician or programmer.

[0044] The description of the disclosure is merely exemplary in nature and, thus, variations that do not depart from the substance of the disclosure are intended to be within the scope of the disclosure. Such variations are not to be regarded as a departure from the spirit and scope of the disclosure.

1. A shifter assembly for an electric vehicle, the shifter assembly comprising:

a base defining an opening extending therethrough;

a shifter handle extending through the opening of the base and pivotably coupled to the base; and

a plurality of electronic actuators, each electronic actuator of the plurality of electronic actuators being pivotably coupled to the base at a first end of that electronic actuator and pivotably coupled to the shifter handle at a second end of that electronic actuator that is opposite the first end, wherein the plurality of electronic actuators are configured to permit movement of the shifter handle relative to the base in a predetermined virtual path and inhibit movement of the shifter handle relative to the base outside the predetermined virtual path.

2. The shifter assembly of claim **1**, wherein the base includes:

an upper plate defining the opening; and

a plurality of rigid supports, each rigid support extending downward from a peripheral portion of the upper plate, the first end of each electronic actuator of the plurality of electronic actuators pivotably coupled to a respective rigid support of the plurality of rigid supports.

3. The shifter assembly of claim **2**, further comprising:

a vertical drive post secured to the upper plate of the base; and

a motor operatively connected to the vertical drive post and configured to move the base in a vertical direction between a deployed position and a retracted position.

4. The shifter assembly of claim **3**, further comprising a lower plate configured to be secured to a structure of the electric vehicle, the lower plate defining an aperture, wherein the vertical drive post is received in the aperture.

5. The shifter assembly of claim **1**, further comprising:

a first vertical drive post secured to the base;

a first motor operatively connected to the first vertical drive post and configured to move the base in a vertical direction between a deployed position and a retracted position;

a second vertical drive post secured to the base; and

a second motor operatively connected to the second vertical drive post and configured to move the base in the vertical direction between the deployed position and the retracted position.

6. The shifter assembly of claim **1**, further comprising a lower plate configured to be secured to a structure of the electric vehicle and defining a drive post aperture and a plurality of guide post apertures.

7. The shifter assembly of claim **6**, further comprising:

a plurality of vertical guide posts secured to the base, each vertical guide post of the plurality of vertical guide posts being received in a respective guide post aperture of the plurality of guide post apertures;

a vertical drive post secured to the base and received in the drive post aperture; and

a motor operatively connected to the vertical drive post and configured to move the base and the shifter handle in a vertical direction between a deployed position and a retracted position.

8. The shifter assembly of claim **1**, further comprising:

a controller in communication with the plurality of electronic actuators and configured to send instructions to the plurality of electronic actuators, the instructions corresponding to the predetermined virtual path; and

a plurality of wires, each wire of the plurality of wires connected to the controller and a respective electronic actuator of the plurality of electronic actuators.

9. The shifter assembly of claim **8**, wherein the plurality of wires are ribbon wires.

10. (canceled)

11. The shifter assembly of claim **1**, wherein the plurality of electronic actuators are linear actuators.

12. The shifter assembly of claim **1**, wherein:

the shifter handle includes a knob and a shaft, the shaft extending through the opening in the base; and

a haptic motor is disposed within the knob.

13. A shifter assembly for an electric vehicle, the shifter assembly comprising:

a base including a plate and at least one rigid support extending downward from a peripheral portion of the plate, the plate defining an opening near a center portion thereof;

a shifter handle extending through the opening of the plate and pivotably coupled to the plate;

a plurality of actuators, each actuator including a housing and a sleeve slidably engaged with the housing, one of the housing and the sleeve of each actuator of the plurality of actuators being pivotably coupled to the at least one rigid support at a first end of that actuator and the other of the housing and the sleeve of each actuator of the plurality of actuators being pivotably coupled to the shifter handle at a second end of that actuator that is opposite the first end, wherein the plurality of actuators are configured to permit movement of the shifter handle relative to the base in a predetermined virtual path and inhibit movement of the shifter handle relative to the base outside the predetermined virtual path.

14. The shifter assembly of claim **13**, wherein the plurality of actuators are pivotably coupled to the shifter handle at a location that is below where the shifter handle is pivotably coupled to the base.

15. The shifter assembly of claim **13**, further comprising:

a controller in communication with the plurality of actuators and configured to send instructions to the plurality of actuators, the instructions corresponding to the predetermined virtual path; and

a plurality of wires, each wire of the plurality of wires is connected to the controller and a respective actuator of the plurality of actuators.

16. The shifter assembly of claim **15**, wherein the plurality of wires are ribbon wires.

17. The shifter assembly of claim **13**, wherein the plurality of actuators are electronic actuators.

18. The shifter assembly of claim **13**, wherein the plurality of actuators are linear actuators.

19. The shifter assembly of claim **13**, wherein:

the shifter handle includes a knob and a shaft, the shaft extending through the opening in the plate; and

a haptic motor is disposed within the knob.

20. A shifter assembly for an electric vehicle, the shifter assembly comprising:

a base including an upper plate and a plurality of rigid supports extending downward from a peripheral portion of the upper plate, the upper plate defining an opening near a center portion thereof;

a shifter handle extending through the opening of the upper plate of the base and pivotably coupled to the upper plate of the base;

a plurality of actuators, each actuator of the plurality of actuators being pivotably coupled to a respective rigid support of the plurality of rigid supports at a first end of that actuator and pivotably coupled to the shifter handle at a second end of that actuator that is opposite the first end, wherein the plurality of actuators are configured to permit movement of the shifter handle relative to the base in a predetermined virtual path and inhibit movement of the shifter handle relative to the base outside the predetermined virtual path;

a plurality of vertical drive posts secured to the upper plate of the base;

a plurality of vertical guide posts secured to the upper plate of the base;

a plurality of motors, each motor operatively connected to a respective vertical drive post of the plurality of vertical drive posts and configured to move the base in a vertical direction between a deployed position and a retracted position;

a lower plate configured to be secured to a support structure of the electric vehicle and defining a plurality of drive post apertures and a plurality of guide post apertures, wherein each vertical drive post of the plurality of vertical drive posts is received in a respective drive post aperture of the plurality of drive post apertures, wherein each vertical guide post of the plurality

of vertical guide posts is received in a respective guide post aperture of the plurality of guide post apertures;

a controller in communication with the plurality of actuators and configured to send instructions to the plurality of actuators, the instructions corresponding to the predetermined virtual path; and

a plurality of ribbon wires, each ribbon wire of the plurality of ribbon wires connected to the controller and a respective actuator of the plurality of actuators,

wherein each rigid support of the plurality of rigid supports engages the lower plate when the base is in the retracted position and is spaced apart from the lower plate when the base is in the deployed position.

21. The shifter assembly of claim **20**, wherein the plurality of actuators are electronic actuators.

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