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(54) ELECTRIC VEHICLE WITH REMOTE ACTIVATION

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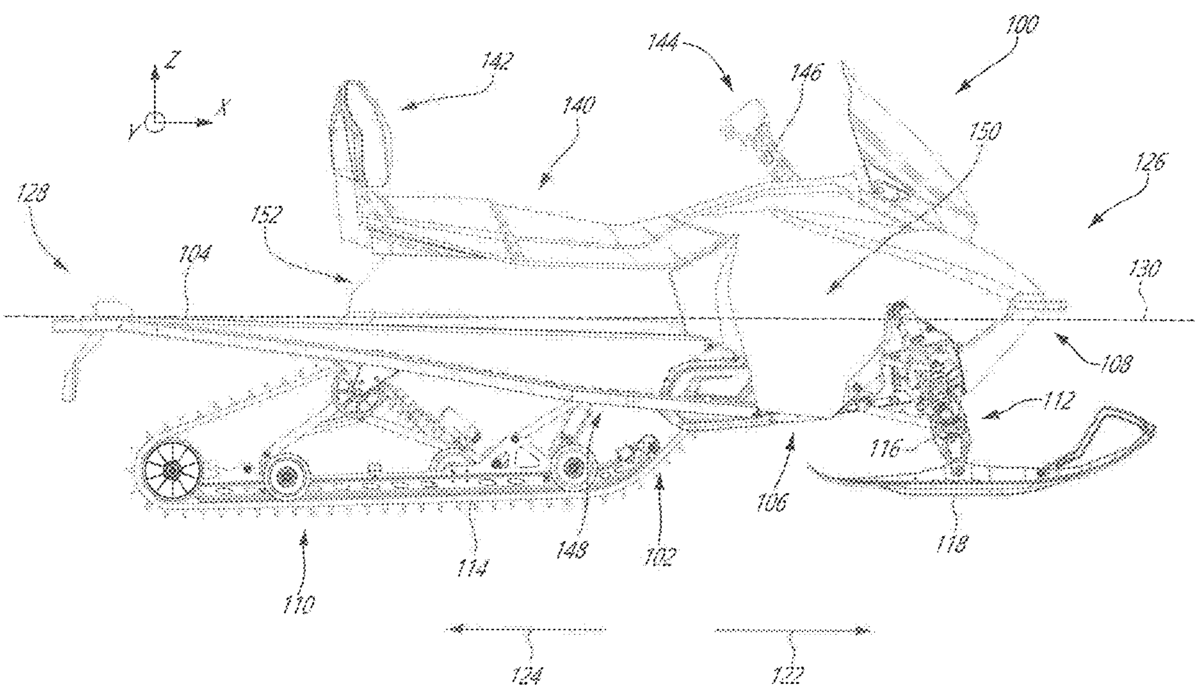
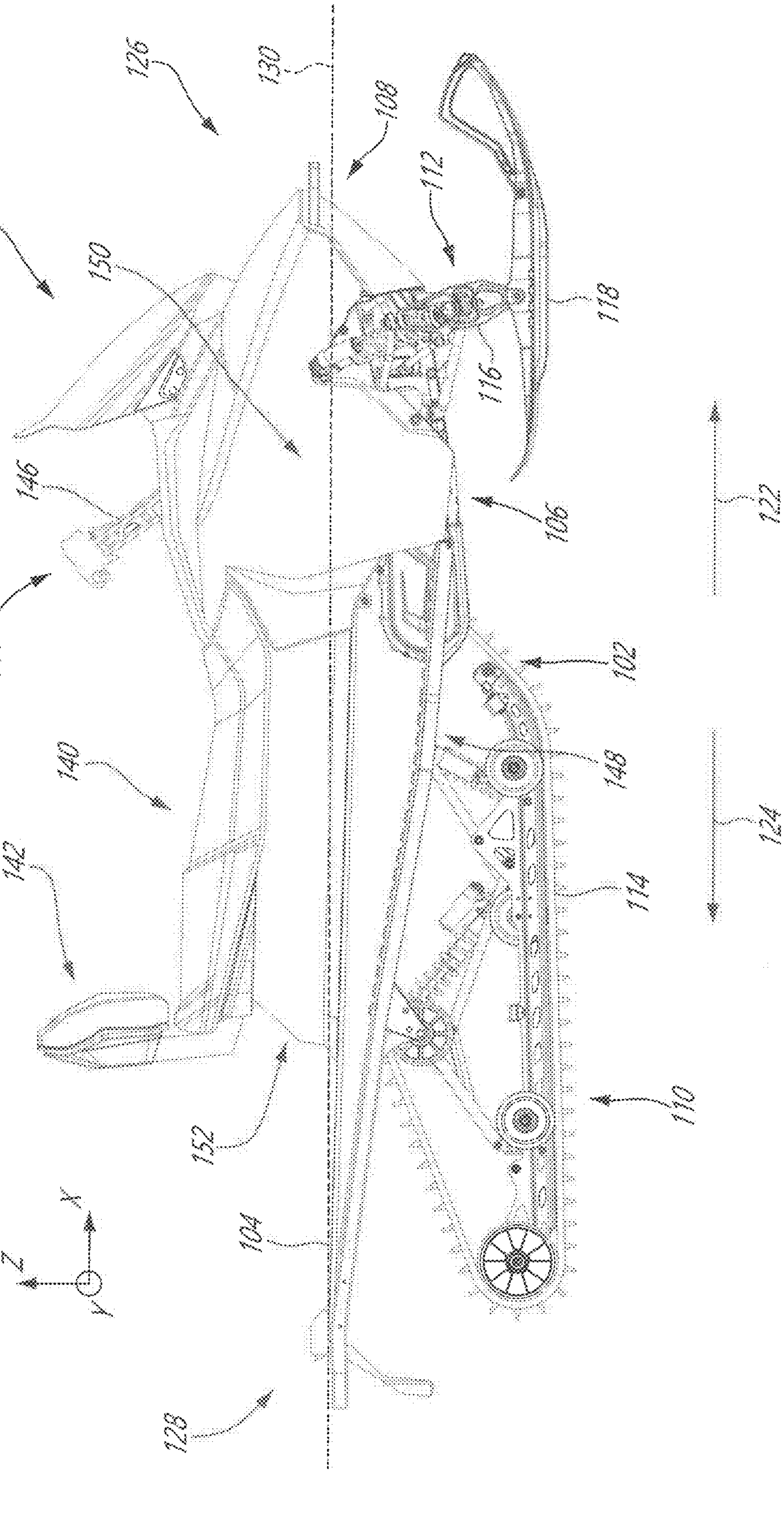
(57) **ABSTRACT**

An electric vehicle including a vehicle controller to control operation of the electric vehicle when the electric vehicle is in an on state and enter a powered-off state when the electric vehicle is in an off state, and an activation controller to store a programmable wake time. The activation controller to switch the vehicle controller to a powered-on state from the powered-off state to wake the electric vehicle from the off state to the on state at the wake time.

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108
110
112
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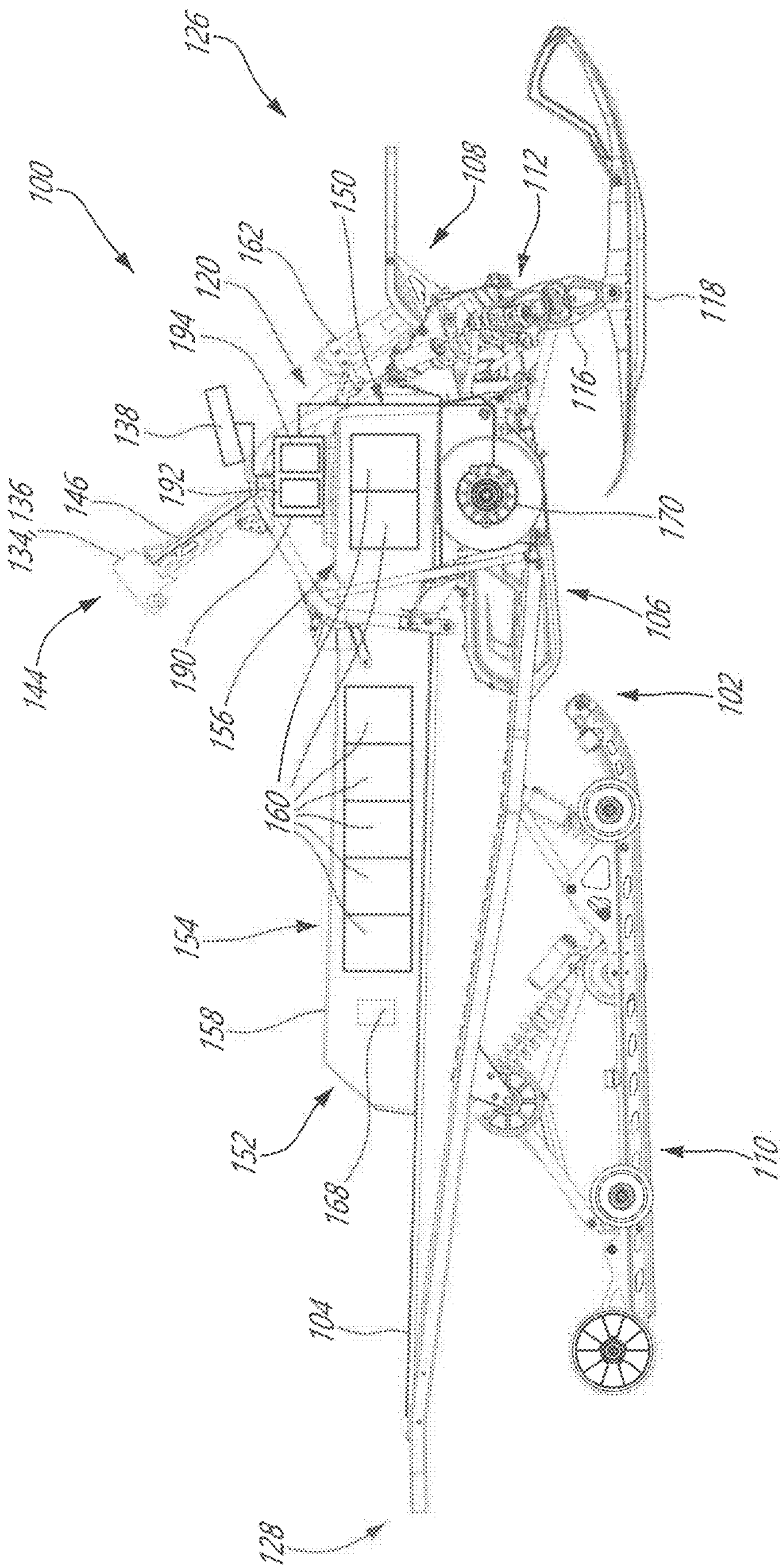
152
X
Y
Z

Fig. 1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106
102
154
158
152
168
104
110
128

Fig. 2

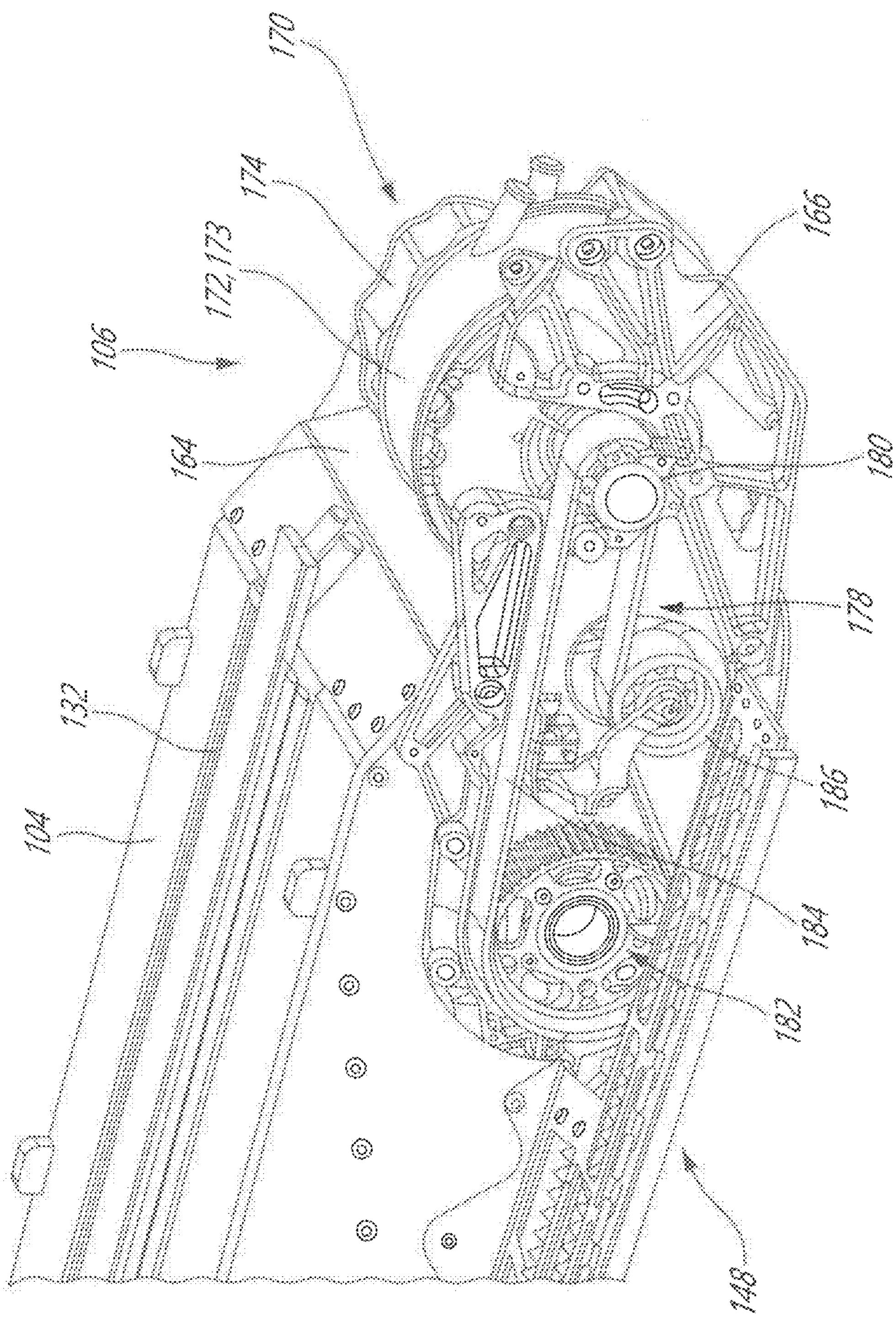


Fig. 3

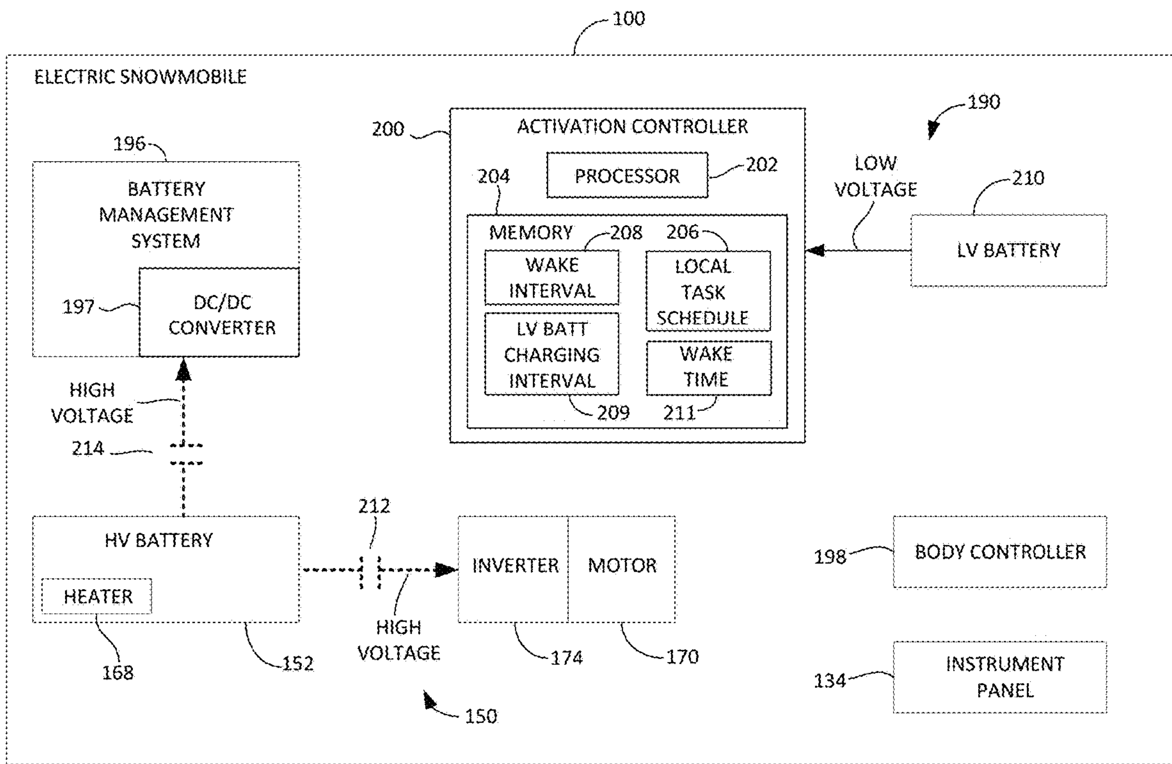

100
ELECTRIC SNOWMOBILE
196
BATTERY MANAGEMENT SYSTEM
197
DC/DC CONVERTER
HIGH VOLTAGE
214
200
ACTIVATION CONTROLLER
PROCESSOR
202
204
MEMORY
208
206
WAKE INTERVAL
LOCAL TASK SCHEDULE
LV BATT CHARGING INTERVAL
WAKE TIME
209
211
190
LOW VOLTAGE
210
LV BATTERY
HV BATTERY
HEATER
168
152
212
HIGH VOLTAGE
INVERTER
MOTOR
174
170
150
198
BODY CONTROLLER
134
INSTRUMENT PANEL

Fig. 4

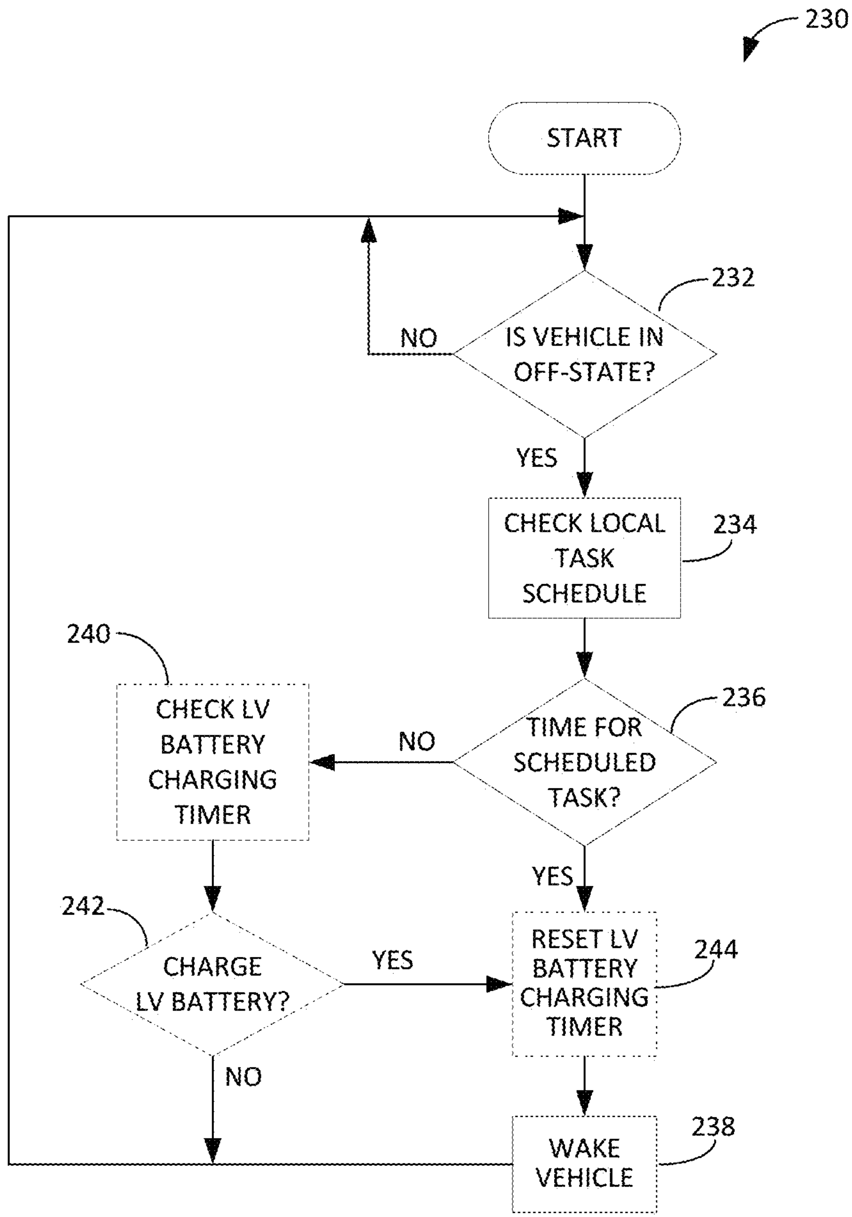

230
START
232
IS VEHICLE IN OFF-STATE?
NO
YES
CHECK LOCAL TASK SCHEDULE
234
240
CHECK LV BATTERY CHARGING TIMER
236
TIME FOR SCHEDULED TASK?
NO
YES
242
CHARGE LV BATTERY?
YES
RESET LV BATTERY CHARGING TIMER
244
NO
WAKE VEHICLE
238

Fig. 5

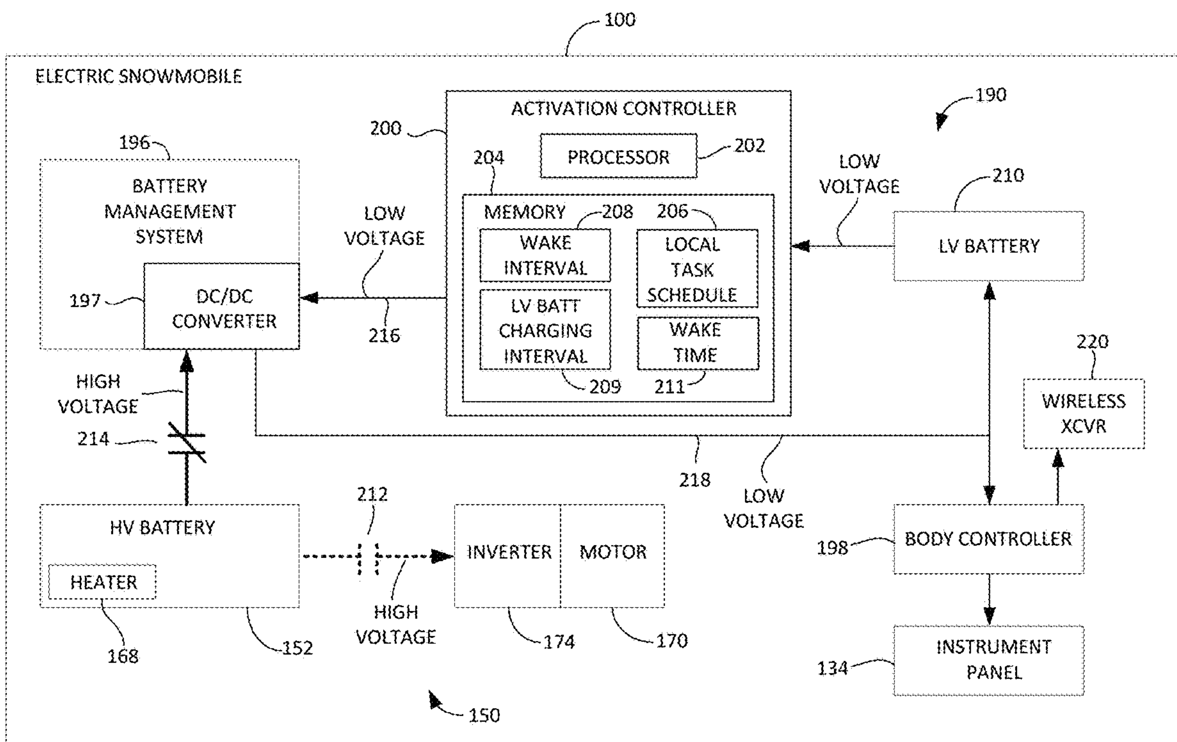

100
ELECTRIC SNOWMOBILE
ACTIVATION CONTROLLER
190
200
PROCESSOR
202
196
204
LOW
VOLTAGE
210
BATTERY
MANAGEMENT
SYSTEM
LOW
VOLTAGE
MEMORY
208
206
LV BATTERY
WAKE
INTERVAL
LOCAL
TASK
SCHEDULE
197
DC/DC
CONVERTER
LV BATT
CHARGING
INTERVAL
216
WAKE
TIME
220
WIRELESS
XCVR
209
211
HIGH
VOLTAGE
214
218
LOW
VOLTAGE
212
HV BATTERY
INVERTER
MOTOR
198
BODY CONTROLLER
HEATER
HIGH
VOLTAGE
174
170
168
152
134
INSTRUMENT
PANEL
150

Fig. 6

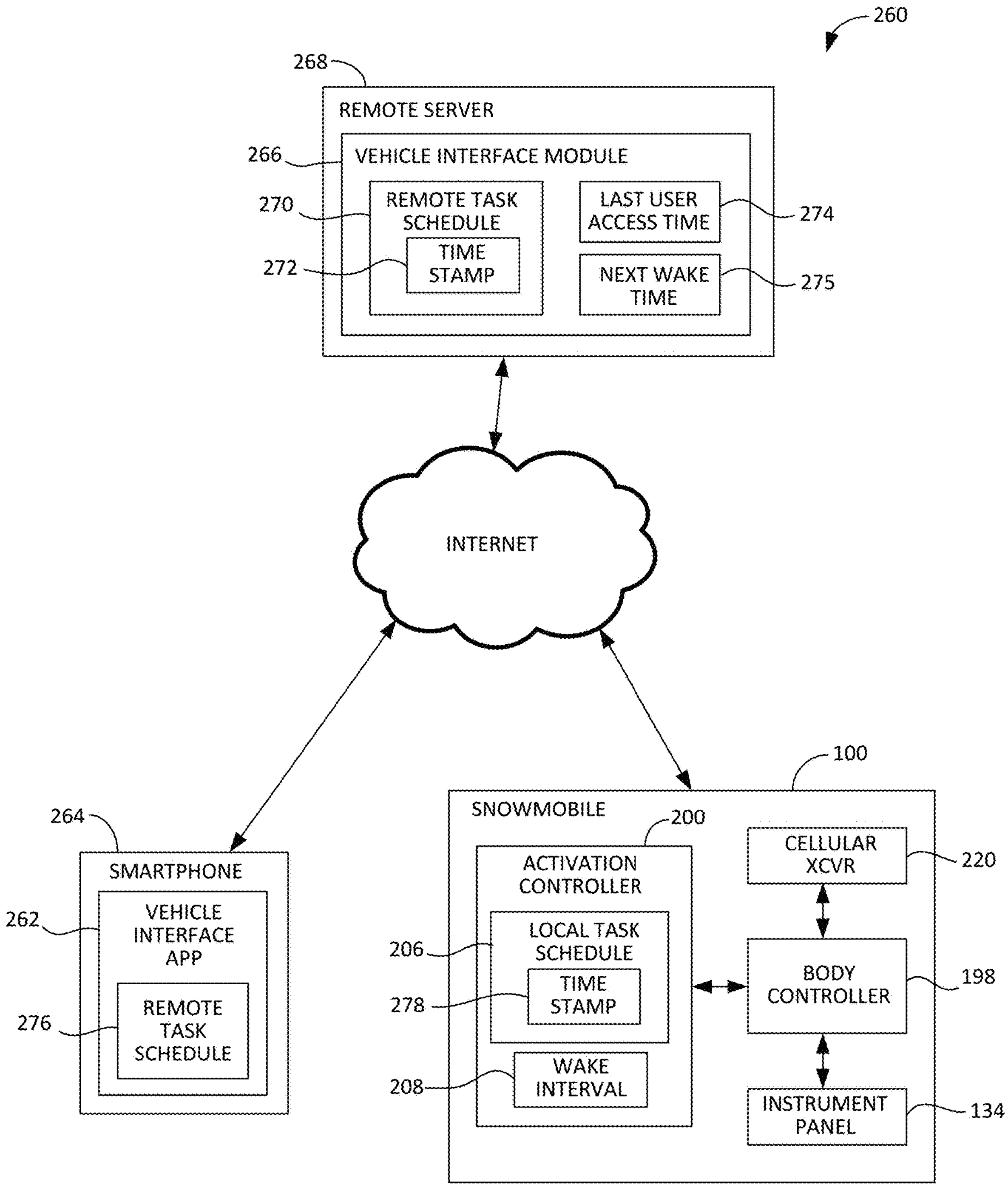

260
268
REMOTE SERVER
266
VEHICLE INTERFACE MODULE
270
REMOTE TASK SCHEDULE
272
TIME STAMP
LAST USER ACCESS TIME
274
NEXT WAKE TIME
275
INTERNET
264
SMARTPHONE
262
VEHICLE INTERFACE APP
276
REMOTE TASK SCHEDULE
100
SNOWMOBILE
200
ACTIVATION CONTROLLER
206
LOCAL TASK SCHEDULE
278
TIME STAMP
208
WAKE INTERVAL
CELLULAR XCVR
220
BODY CONTROLLER
198
INSTRUMENT PANEL
134

Fig. 7

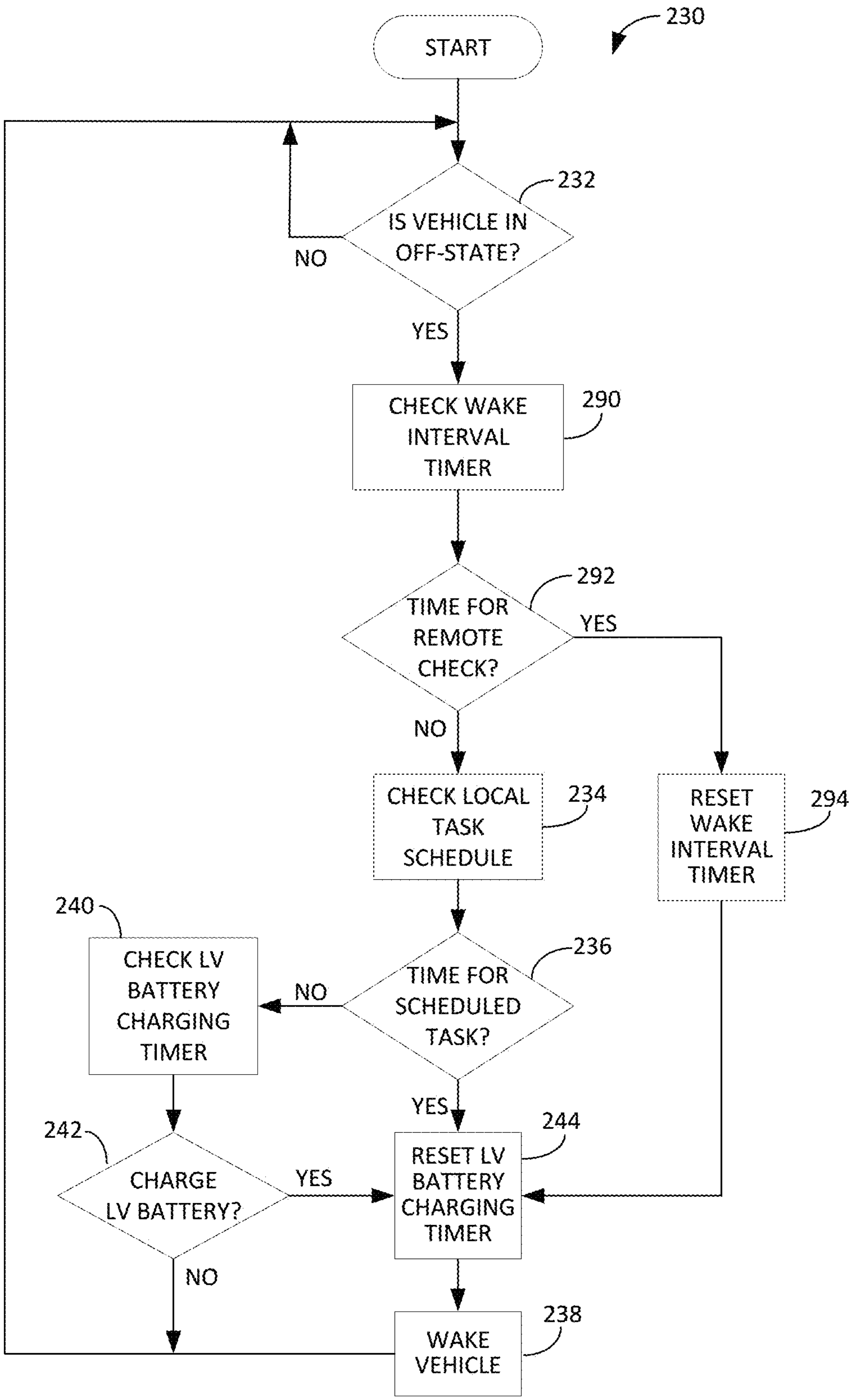

230
START
232
IS VEHICLE IN OFF-STATE?
NO
YES
CHECK WAKE INTERVAL TIMER
290
292
TIME FOR REMOTE CHECK?
YES
NO
CHECK LOCAL TASK SCHEDULE
234
RESET WAKE INTERVAL TIMER
294
240
CHECK LV BATTERY CHARGING TIMER
NO
TIME FOR SCHEDULED TASK?
236
YES
244
242
CHARGE LV BATTERY?
YES
RESET LV BATTERY CHARGING TIMER
NO
WAKE VEHICLE
238

Fig. 8

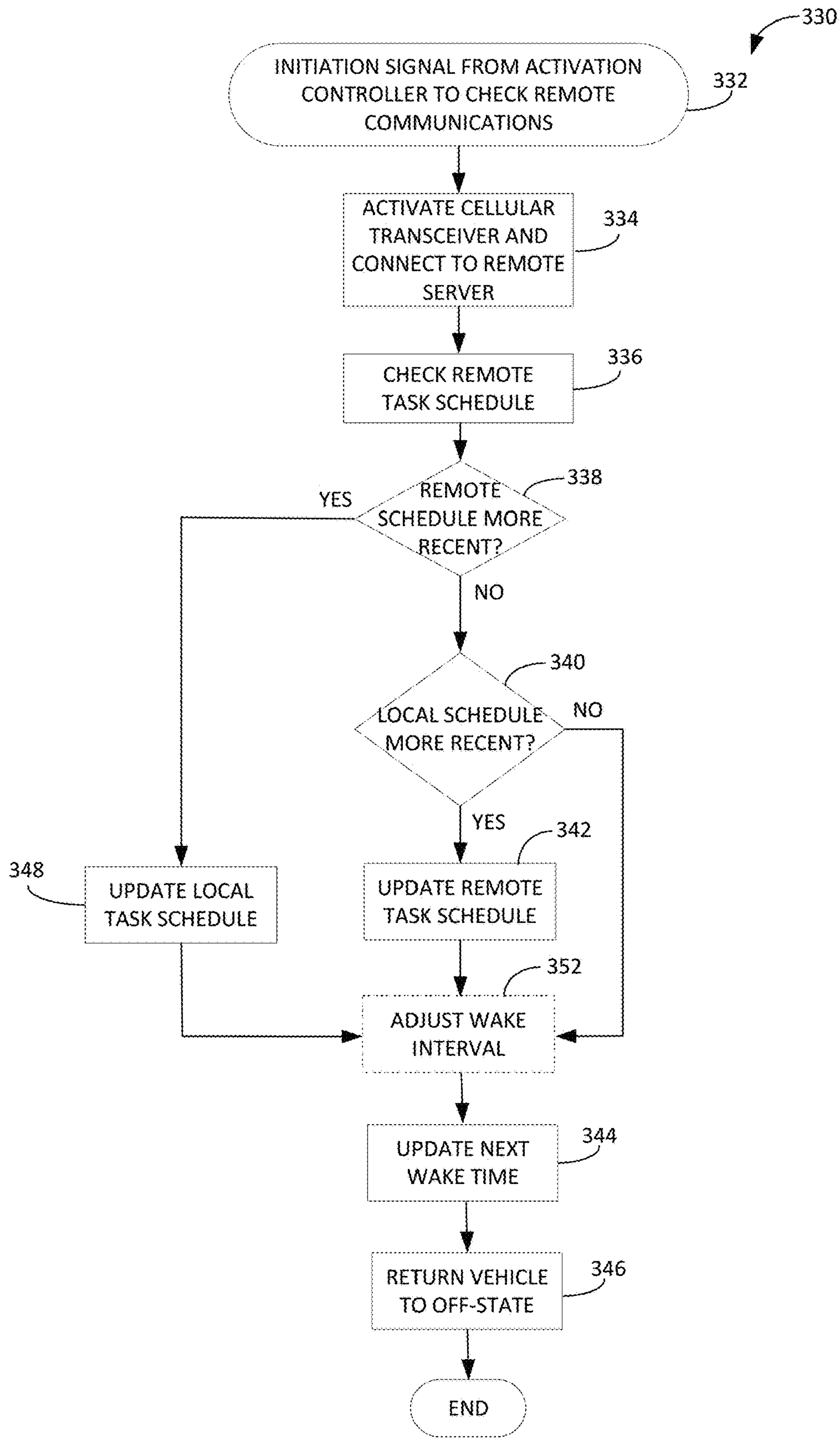

330
INITIATION SIGNAL FROM ACTIVATION CONTROLLER TO CHECK REMOTE COMMUNICATIONS
332
ACTIVATE CELLULAR TRANSCEIVER AND CONNECT TO REMOTE SERVER
334
CHECK REMOTE TASK SCHEDULE
336
REMOTE SCHEDULE MORE RECENT?
338
YES
NO
LOCAL SCHEDULE MORE RECENT?
340
NO
YES
UPDATE REMOTE TASK SCHEDULE
342
348
UPDATE LOCAL TASK SCHEDULE
ADJUST WAKE INTERVAL
352
UPDATE NEXT WAKE TIME
344
RETURN VEHICLE TO OFF-STATE
346
END

Fig. 9

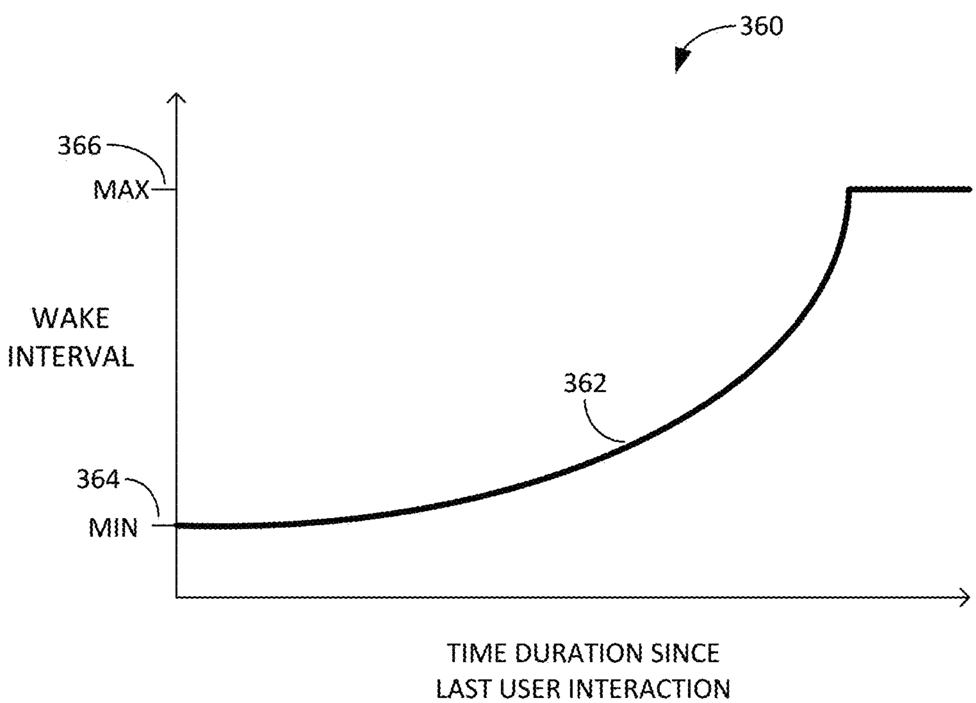

360
366
MAX
WAKE
INTERVAL
362
364
MIN
TIME DURATION SINCE
LAST USER INTERACTION

Fig. 10

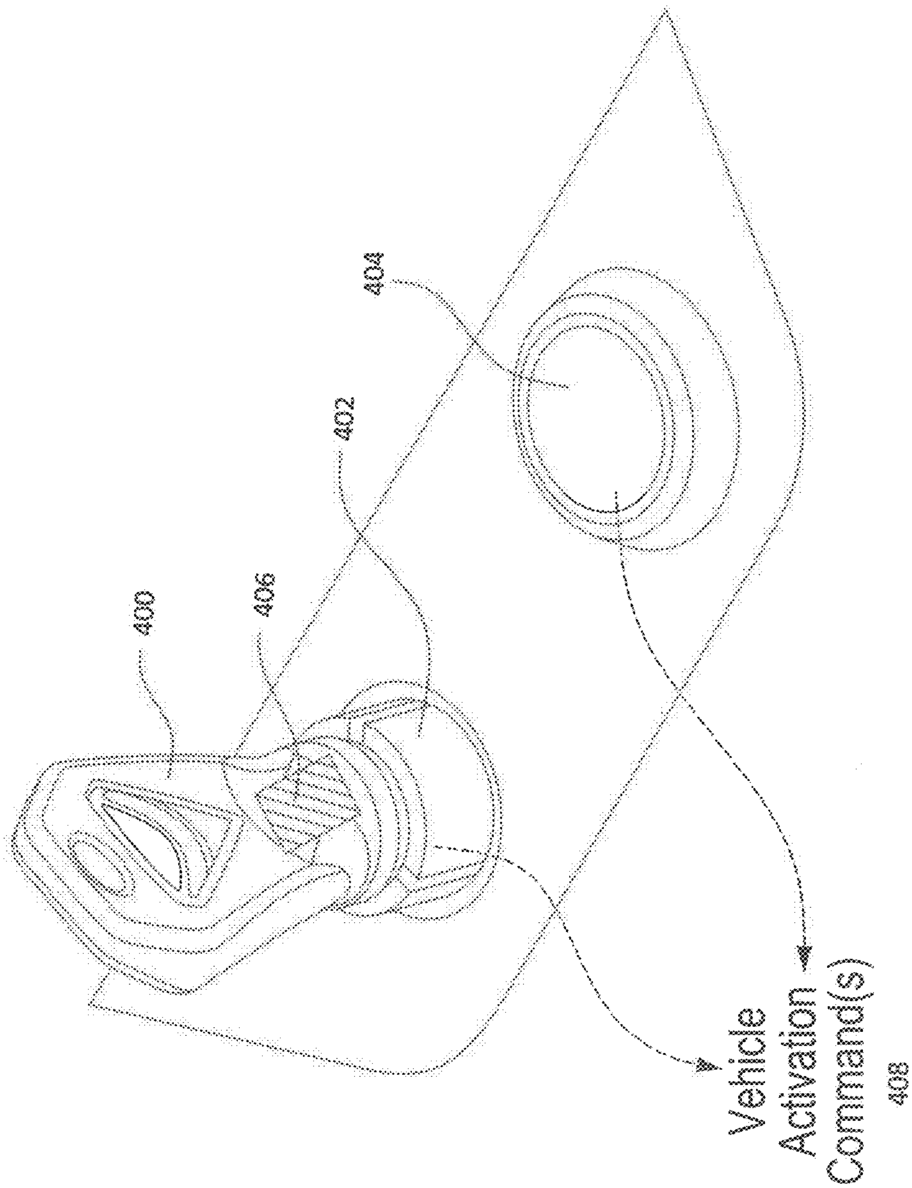


Fig. 11

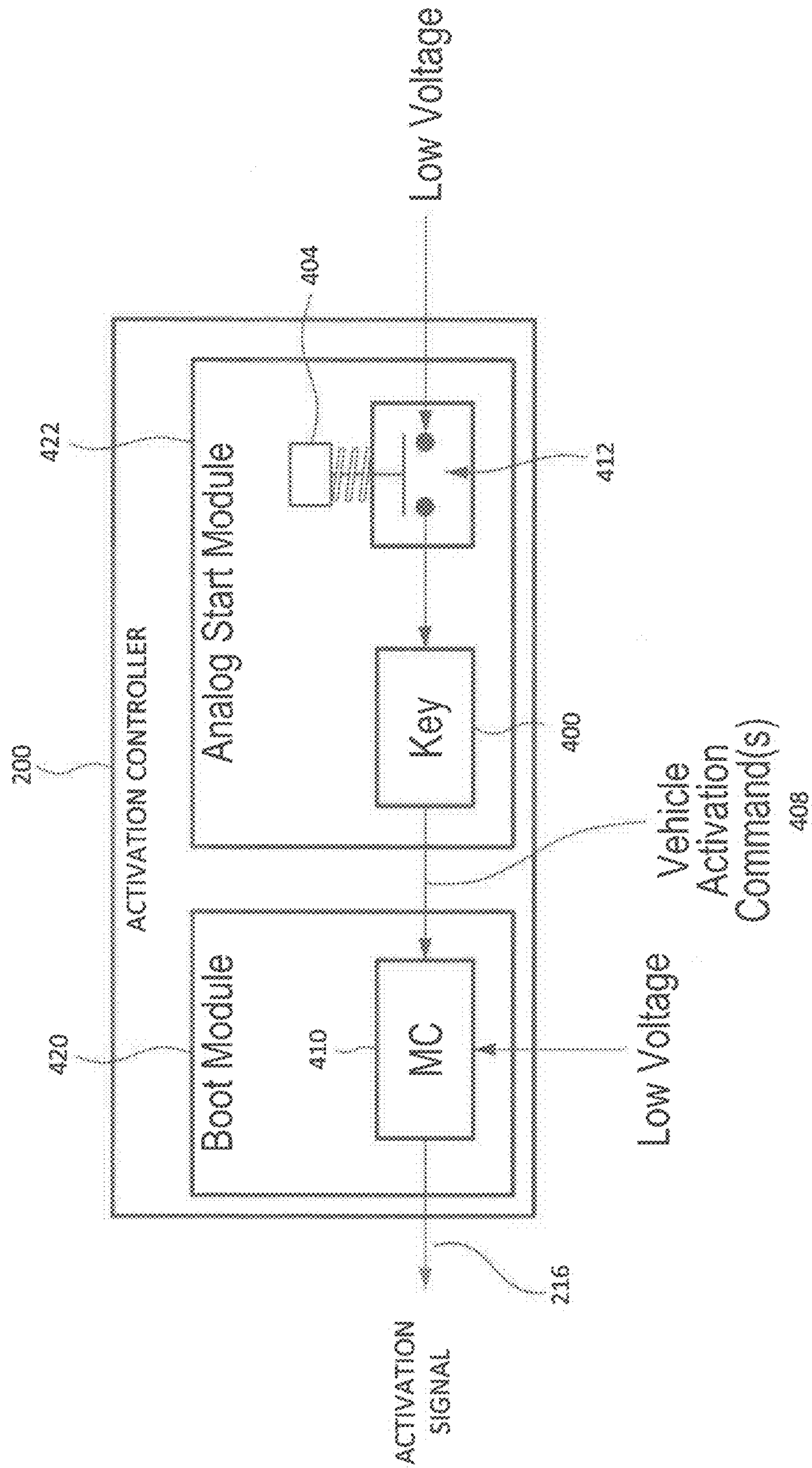
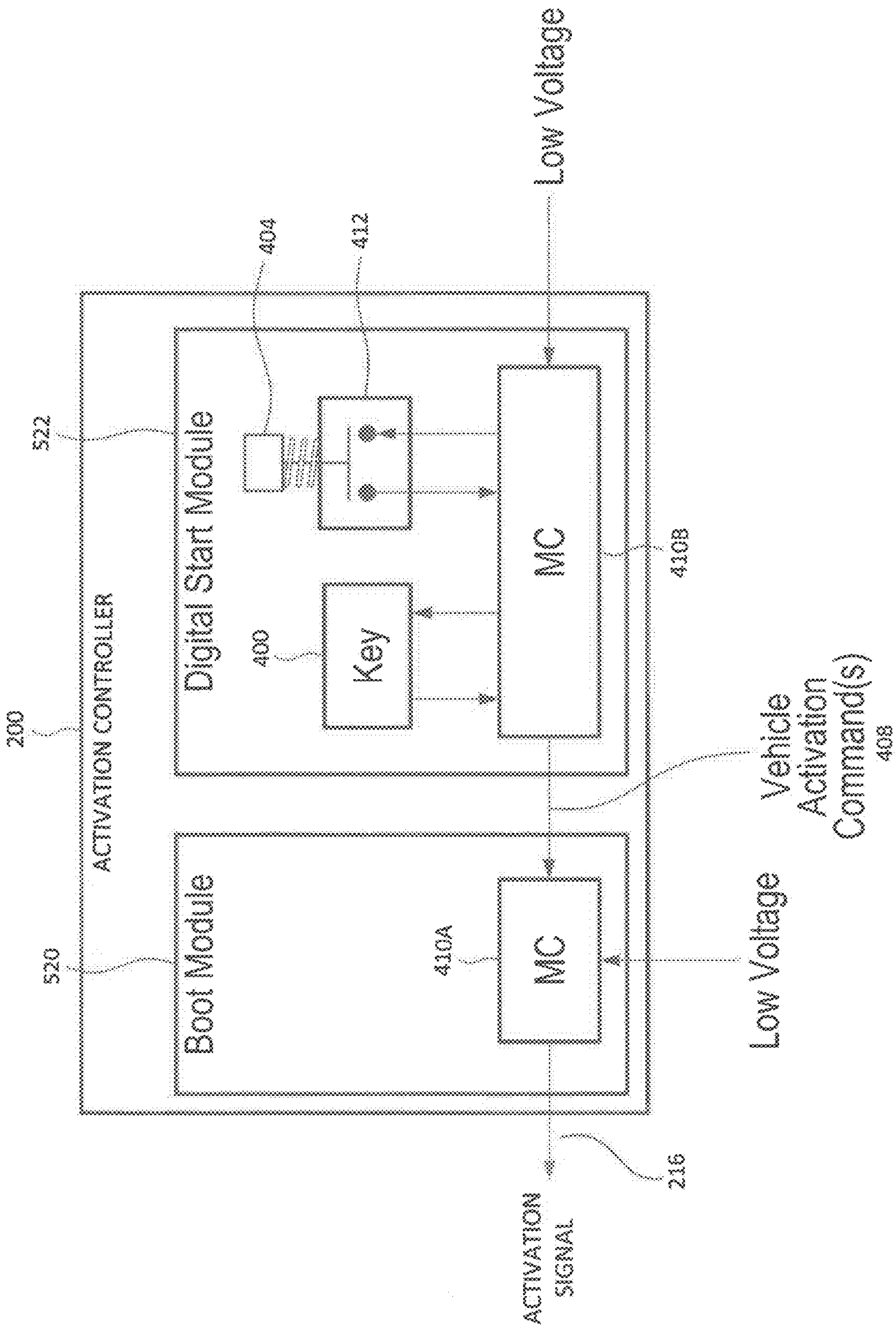

Low Voltage
404
422
Analog Start Module
412
200
ACTIVATION CONTROLLER
Key
400
Vehicle
Activation
Command(s)
408
420
Boot Module
410
MC
Low Voltage
216
ACTIVATION
SIGNAL

Fig. 12


Low Voltage
404
412
522
Digital Start Module
200
ACTIVATION CONTROLLER
400
Key
MC
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Vehicle
Activation
Command(s)
408
Boot Module
520
410A
MC
Low Voltage
216
ACTIVATION
SIGNAL

Fig. 13

ELECTRIC VEHICLE WITH REMOTE ACTIVATION

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application claims priority from U.S. Provisional Patent Application No. 63/433,595, filed Dec. 19, 2022, which is incorporated by reference in its entirety herein.

TECHNICAL FIELD

[0002] The present disclosure relates generally to electric vehicles, including electric powersports vehicles, and, more particularly, to examples of an electrical control system and associated operating methods for an electric vehicle.

BACKGROUND

[0003] Electric vehicles (EVs), including electric powersport vehicles (EPVs), such as snowmobiles, personal watercraft, and side-by-sides, for example, employ rechargeable batteries to store energy to power the vehicle. When not in use, EVs are typically placed in an inactive or standby state, where only limited vehicle functionality is enabled (e.g., door lock operation), in order to minimize power draw from the batteries. During extended periods of vehicle inactivity, which may be common for EPVs, the amount of energy required to provide even limited vehicle functionality may deplete the batteries.

SUMMARY

[0004] One example provides an electric vehicle including a vehicle controller to control operation of the electric vehicle when the electric vehicle is in an on state and enter a powered-off state when the electric vehicle is in an off-state, and an activation controller to store a programmable wake time. The activation controller to turn the vehicle controller to a powered-on state from the powered-off state to wake the electric vehicle from the off state to the on state at the wake time.

[0005] In some embodiments, the wake time is programmable by the vehicle controller.

[0006] In some embodiments, the vehicle controller is a main body controller.

[0007] In some embodiments, the activation controller is the only controller of the electric vehicle which is powered-on when the electric vehicle is in the off state.

[0008] In some embodiments, the wake time is based on a user designated time.

[0009] In some embodiments, the user designated time is specified in a user entry of a local task schedule stored by the activation controller and/or the vehicle controller.

[0010] In some embodiments, where the user entry of the local task schedule includes the user designated time and has a corresponding designated vehicle operation, upon being turned to the powered-on state from the power-off state by activation controller at the wake time, the vehicle controller to perform the corresponding vehicle operation designated by the user entry.

[0011] In some embodiments, wherein the designated vehicle operation comprises a battery preconditioning operation of a high-voltage battery of the electric vehicle.

[0012] In some embodiments, the vehicle controller performs the battery preconditioning operation only if the electric vehicle is powered from external power equipment.

[0013] In some embodiments, the designated vehicle operation comprises a status report of one or more operating parameters of the electric vehicle, including operating parameters of a high-voltage battery of the electric vehicle.

[0014] In some embodiments, the wake time is based on a wake interval.

[0015] In some embodiments, when the electric vehicle is in the off state, upon expiration of the wake interval, the activation controller to turn the vehicle controller to the powered-on state from the powered-off state to wake the electric vehicle from the off state to the on state, and to initiate the vehicle controller to perform a check for remote user communication with the electric snowmobile which was made when the electric vehicle was in the off state.

[0016] In some embodiments, to perform the check for remote user communication, the vehicle controller to download remotely entered user designated times from a memory remote to the electric vehicle to the memory of the activation controller.

[0017] In some embodiments, the wake interval is fixed over time.

[0018] In some embodiments, the wake interval varies over time based on user interactions with the electric vehicle.

[0019] In some embodiments, the electric vehicle further comprises a high-voltage (HV) battery; and a low-voltage (LV) battery, wherein: the activation controller is powered from the LV battery; and the vehicle controller is powered from the HV battery via a direct current to direct current (DC/DC) converter when the electric vehicle is in the on state, and electrically disconnected from the HV battery when the vehicle is in the off state.

[0020] In some embodiments, the activation controller is continuously powered from the LV battery.

[0021] In some embodiments, the LV battery is charged from the HV battery via the DC/DC converter when the electric vehicle is in the on state.

[0022] In some embodiments, the wake time is based on a battery charging interval.

[0023] In some embodiments, when the electric vehicle is in the off state, upon expiration of a battery charging interval, the activation controller to turn the vehicle controller to a powered-on state from a powered-off state to wake the electric vehicle from an off state to an on state, and to initiate the vehicle controller to perform a charging operation of the LV battery from the HV battery.

[0024] In some embodiments, the battery charging interval is reset each time the electric vehicle transitions from the on state to the off state.

[0025] One example provides a method of operating an electric vehicle having an off state and an on-state, the method including storing a programmable wake time in an activation controller of the electric vehicle, switching a vehicle controller of the electric vehicle to a powered-off state to switch the electric vehicle to the off state, and waking the electric vehicle from the off-state to the on-state at the wake time by employing the activation controller to turn the vehicle controller from the powered-off state to the powered-on state.

[0026] In some embodiments, the on-state includes an idle state.

[0027] In some embodiments, the method includes powering only the activation controller when the electric vehicle is in the off state.

[0028] In some embodiments, storing the wake time in the activation controller is performed by the vehicle controller when in the powered-on state.

[0029] In some embodiments, storing the wake time in the activation controller is based on a user designated time.

[0030] In some embodiments, the method includes, upon being turned to the powered-on state by the activation controller at the wake time based on the user designated time, initiating the vehicle controller to perform a vehicle operation corresponding to the user designated time.

[0031] In some embodiments, the vehicle operation comprises a battery preconditioning operation of a high-voltage battery of the electric vehicle.

[0032] In some embodiments, storing the wake time in the activation controller is based on a wake interval.

[0033] In some embodiments, the method includes, upon expiration of the wake interval, the activation controller waking the electric vehicle from the off state to the on state by turning the vehicle controller from the powered-off state to the powered-on state, and initiating the vehicle controller to download to the activation controller user designated times from a memory remote to the electric vehicle, the user designated times entered remotely into the remote memory by a user when the electric vehicle is in the off state.

[0034] In some embodiments, the method includes, adjusting a duration of the wake interval over time based on user interaction with the electric vehicle, wherein the longer a time since a last user interaction with the electric vehicle, the longer the duration of the wake interval.

[0035] In some embodiments, the method includes continuously powering the activation controller from a low-voltage battery; powering the vehicle controller from a high-voltage battery; and charging the low-voltage battery from the high voltage battery when the electric vehicle is in the on state.

[0036] In some embodiments, storing the wake time in the activation controller is based on a battery charging interval.

[0037] In some embodiments, the method includes, upon expiration of the battery charging interval, the activation controller waking the electric vehicle from the off state to the on state by turning the vehicle controller from the powered-off state to the powered-on state, and initiating the vehicle controller to perform a charging operation of the low-voltage battery from the high-voltage battery.

[0038] In some embodiments, the method includes resetting the battery interval each time the electric vehicle transitions from the on state to the off state.

[0039] One example provides an electrical system for an electric vehicle, the electrical system including an electric motor for propelling the vehicle, a vehicle controller for controlling operation of the electric vehicle, a high-voltage (HV) battery to power the electric vehicle, including the electric motor and vehicle controller, a low-voltage (LV) battery having a lower voltage than the HV battery, and an activation controller powered from the LV battery. At a wake time stored by the activation controller, the activation controller to provide an activation signal to transition the electric vehicle from an off-state, in which the HV battery is electrically disconnected from the electric motor and the vehicle controller, to an active state, where at least the vehicle controller is electrically connected to and powered from the HV battery.

[0040] Additional and/or alternative features and aspects of examples of the present technology will become apparent from the following description and the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0041] FIG. **1** generally illustrates a side plan view of an electric snowmobile, according to one example.

[0042] FIG. **2** generally illustrates a side plan view of the electric snowmobile of FIG. **1** with several body panels removed, according to one example.

[0043] FIG. **3** generally illustrates a perspective view of a mid-bay of the electric snowmobile of FIG. **1**, according to one example.

[0044] FIG. **4** is a block and schematic diagram generally illustrating portions of a control system and electric powertrain of an electric snowmobile when in an off-state, according to one example.

[0045] FIG. **5** is a flow diagram generally illustrating a process of operating an activation controller of an electric snowmobile, according to one example.

[0046] FIG. **6** is a block and schematic diagram generally illustrating portions of a control system and electric powertrain of an electric snowmobile when in a neutral state, according to one example.

[0047] FIG. **7** is a block and schematic diagram generally illustrating a system to enable a user to remotely communicate with an activation controller of an electric snowmobile, according to one example.

[0048] FIG. **8** is a flow diagram generally illustrating a process of operating an activation controller of an electric snowmobile, according to one example

[0049] FIG. **9** is a flow diagram generally illustrating a process of operating a body controller of an electric snowmobile, according to one example

[0050] FIG. **10** is a graph generally illustrating a wake duration curve, according to one example.

[0051] FIG. **11** is perspective view generally illustrating a user key and a start button of an electric snowmobile, according to one example.

[0052] FIG. **12** is a block and schematic diagram generally illustrating an activation controller of an electric snowmobile, according to one example.

[0053] FIG. **13** is a block and schematic diagram generally illustrating an activation controller of an electric snowmobile, according to one example.

DETAILED DESCRIPTION

[0054] In the following detailed description, reference is made to the accompanying drawings which form a part hereof, and in which is shown by way of illustration specific examples in which the disclosure may be practiced. It is to be understood that other examples may be utilized and structural or logical changes may be made without departing from the scope of the present disclosure. The following detailed description, therefore, is not to be taken in a limiting sense. It is to be understood that features of the various examples described herein may be combined, in part or whole, with each other, unless specifically noted otherwise.

[0055] EVs, including EPVs (such as snowmobiles, personal watercraft (PWCs), motorcycles, all-terrain vehicles (ATVs), utility terrain vehicles (UTVs), and side-by-sides (SxS), for example), employ rechargeable batteries to store energy to provide power to propel the vehicle and to power various electrical components and systems. When not in use, in order to minimize power consumption and extend battery life, EVs are typically placed in an inactive or standby state where only a limited vehicle functionality is enabled (e.g., unlocking doors). However, during extended periods of vehicle inactivity, which may be common for some types of EPVs (which tend to be used on a less frequent basis than automobiles, for example), the energy required to provide even limited functionality when in an off-state may unsatisfactorily deplete the batteries (e.g., below a useable level).

[0056] The present disclosure, as will described in greater detail herein, provides examples of an electrical control system and associated operating methods to provide initiation, including user-schedule initiation, of selected functionality for an EV when in an inactive or off-state with limited power draw from the battery. In examples, a low-power controller (an "activation controller") is, at all-times, powered separately from a main battery of the vehicle (e.g., a high-voltage (HV) battery) by an ancillary battery (e.g., a low-voltage (LV) battery). In some examples, with the vehicle in the off-state, where only the activation controller is electrically powered (via the LV battery), the activation controller, in accordance with user entries in a task (or "wake-up") schedule, transitions (or "wakes") the vehicle from the off-state to an active state (e.g., a neutral state) by switching a vehicle controller (see below) from a powered-off state to a powered-on state (where the vehicle controller is powered from the HV battery), and initiates the vehicle controller to perform one or more vehicle operations or tasks designated by the corresponding user entry. In one example, such task may be a battery preconditioning operation where the vehicle controller directs a thermal management system of the vehicle to adjust a temperature of the HV battery to be within a predetermined temperature range.

[0057] In examples, a user may locally program (e.g., input or edit) entries into the task schedule via an instrument panel of the vehicle and/or remotely program entries, such as wirelessly via a cellphone (e.g., using a scheduling application) or other device, for instance. In some examples, the activation controller operates to intermittently wake the vehicle to perform tasks separate from the programmed entries of the task schedule, such as to check for remote communications and/or to charge the LV battery from the HV battery, for example. In other examples, the activation controller may wake the vehicle from the off-state in response to operation of an instrument panel device (such as a push-button or key switch, for example).

[0058] In accordance with the present disclosure, employing a low power activation controller, which is powered separately from the main HV battery by a LV battery, to wake the EV from an off-state based on programmed entries in a schedule or in response to user operation of an instrument panel device provides the EV with off-state functionality with limited power consumption from the HV battery.

[0059] FIGS. **1-3** represent an example of an EV, in this case an EPV, and in particular, an electric snowmobile **100**, employing a low power activation controller and operating methods, in accordance with the present disclosure. FIG. **1** illustrates a side plan view of snowmobile **100**, according to an embodiment, and FIG. **2** illustrates another side plan view of the snowmobile **100** with several body panels and other components removed so that the interior of the snowmobile **100** may be viewed. The snowmobile **100** includes a frame **102**, which may also be referred to as a "chassis" or "body", which provides a load bearing framework for the snowmobile **1060**. In the illustrated embodiment, the frame **102** includes a longitudinal tunnel **104**, a mid-bay **106** (or "bulkhead") coupled forward of the tunnel **104**, and a front sub-frame **108** (or "front brace") coupled forward of the mid-bay **106**. In some implementations, the mid-bay **106** may form part of the front sub-frame **108**.

[0060] The snowmobile **100** also includes a rear suspension assembly **110** and a front suspension assembly **112** to provide shock absorption and improve ride quality. The rear suspension assembly **110** may be coupled to the underside of the tunnel **104** to facilitate the transfer of loads between the rear suspension assembly **110** and the tunnel **104**. The rear suspension assembly **110** supports a drive track **114** having the form of an endless belt for engaging the ground (e.g., snow) and propelling the snowmobile **100**. The rear suspension assembly may include, inter alia, one or more rails and/or idler wheels for engaging with the drive track **114**, and one or more control arms and damping elements (e.g., elastic elements such as coil and/or torsion springs forming a shock absorber) connecting the rails to the tunnel **104**. The front suspension assembly **112** includes two suspension legs **116** coupled to the front sub-frame **108** and to respective ground engaging front skis **118** (only one suspension leg **116** and ski **118** are visible in FIGS. **1** and **2**). Each of the suspension legs **116** may include two A-frame arms connected to the front sub-frame **108**, a damping element (e.g., an elastic element) connected to the front sub-frame **108**, and a spindle connecting the A-frame arms and the damping element to a respective one of the skis **118**. The suspension legs **116** transfer loads between the skis **118** and the front sub-frame **108**. In the illustrated embodiment, the frame **102** also includes an over structure **120** (shown in FIG. **2**), that may include multiple members (e.g., tubular members) interconnecting the tunnel **104**, the mid-bay **106** and/or the front sub-frame **108** to provide additional rigidity to the frame **102**. However, as discussed elsewhere herein, the over structure **120** may be omitted in some embodiments.

[0061] The snowmobile **100** may move along a forward direction of travel **122** and a rearward direction of travel **124** (shown in FIG. **1**). The forward direction of travel **122** is the direction along which the snowmobile **100** travels in most instances when displacing. The rearward direction of travel **124** is the direction along which the snowmobile **100** displaces only occasionally, such as when it is reversing. The snowmobile **100** includes a front end **126** and a rear end **128** defined with respect to the forward direction of travel **122** and the rearward direction of travel **124**. For example, the front end **126** is positioned ahead of the rear end **128** relative to the forward direction of travel **122**. The snowmobile **100** defines a longitudinal center axis **130** that extends between the front end **126** and the rear end **128**. Two opposing lateral sides of the snowmobile **100** are defined parallel to the center axis **130**. The positional descriptors "front", "rear" and terms related thereto are used in the present disclosure to describe the relative position of components of the snowmobile **100**. For example, if a first component of the snowmobile **100** is described herein as being in front of, or forward of, a second component, then the first component is closer to the front end **126** than the second component. Similarly, if a first component of the snowmobile **100** is described herein as being behind, or rearward of, a second component, then the first component is closer to the rear end **128** than the second component. The snowmobile **100** also includes a three-axes frame of reference that is displaceable with the snowmobile **100**, where the Z-axis is parallel to the vertical direction, the X-axis is parallel to the center axis **130**, and the Y-axis is parallel to the lateral direction.

[0062] The snowmobile **100** is configured to carry one or more riders, including a driver (sometimes referred to as an "operator") and optionally one or more passengers. In the illustrated example, the snowmobile **100** includes a straddle seat **140** to support the riders. Optionally, the straddle seat **140** includes a backrest **142**. The operator of the snowmobile **100** may steer the snowmobile **100** using a steering mechanism **144** (e.g., handlebars), which are operatively connected to the skis **118** via a steering shaft **146** to control the direction of the skis **118**. The tunnel **104** may also include or be coupled to footrests **148** (also referred to as "running boards"), namely left and right footrests each sized for receiving a foot of one or more riders sitting on the straddle seat **140**.

[0063] Referring to FIG. **2**, the snowmobile **100** is electrically propelled by an electric powertrain **150**. The powertrain **150** includes an electric battery **152** (also referred to as a "battery pack") and an electric motor **170**. The battery **152** is electrically connected to the motor **170** to provide electric power to the motor **170**. The motor **170**, in turn, is drivingly coupled to the drive track **114** to propel the snowmobile **100** across the ground. In other embodiments, the snowmobile **100** may also or instead be propelled by a powertrain including an internal combustion engine. For example, the motor **170** may also or instead be an internal combustion engine.

[0064] The battery **152** may include a battery enclosure **158** that houses one or more battery modules **160**. The battery enclosure **158** may support the battery modules **160** and protect the battery modules **160** from external impacts, water and/or other hazards or debris. Each battery module **160** may contain one or more battery cells, such as pouch cells, cylindrical cells and/or prismatic cells, for example. In some implementations, the battery cells are rechargeable lithium-ion battery cells. The battery **152** may also include other components to help facilitate and/or improve the operation of the battery **152**, including temperature sensors to monitor the temperature of the battery cells, voltage sensors to measure the voltage of one or more battery cells, current sensors to implement column counting to infer the state of charge (SOC) of the battery **42**, and/or thermal channels that circulate a thermal fluid to control the temperature of the battery cells. In some implementations, the battery **152** may output electric power at a voltage of between 300 and 800 volts, for example. The snowmobile **100** may also include a charger **162** to convert AC to DC current from an external power source to charge the battery **152**. The charger **162** may include, or be connected to, a charging port positioned forward of the straddle seat **140** to connect to a charging cable from an external power source. In some implementations, the charging port is covered by one or more protective flaps (e.g., made of plastic and/or rubber) to protect the charging port from water, snow and other debris.

[0065] In some implementations, the battery **152** may be generally divided into a tunnel battery portion **154** and a mid-bay battery portion **156**. The tunnel battery portion **154** may be positioned above and coupled to the tunnel **104**. As illustrated, the straddle seat **140** is positioned above the tunnel battery portion **154** and, optionally, the straddle seat **140** may be supported by the battery enclosure **158** and/or internal structures within the battery **152**. The mid-bay battery portion **156** extends into the mid-bay **106** and may be coupled to the mid-bay **106** and/or to the front sub-frame **108**. The tunnel battery portion **154** and the mid-bay battery portion **156** may share a single battery enclosure **158**, or alternatively separate battery enclosures. In the illustrated example, the tunnel battery portion **154** and the mid-bay battery portion **156** each include multiple battery modules **160** that are arranged in a row and/or stacked within the battery enclosure **158**.

[0066] It should be noted that other shapes, sizes and configurations of the battery **152** are contemplated. For example, the battery **152** may include multiple batteries that are interconnected via electrical cables. In some embodiments, the battery enclosure **158** may be a structural component of the snowmobile **100** and may form part of the frame **102**. For example, the battery enclosure **158** may be coupled to the front sub-frame **108** to transfer loads between the front sub-frame **108** and the tunnel **104**. The battery enclosure **158** may be formed from a fiber composite material (e.g., a carbon fiber composite) for additional rigidity. Optionally, in the case that the battery enclosure **158** is a structural component of the snowmobile **100**, the over structure **120** may be omitted.

[0067] FIG. **3** is a perspective view of the mid-bay **106** of the snowmobile **100**. As illustrated, the motor **170** is disposed in a lower portion of the mid-bay **106**, below the mid-bay battery portion **156** and forward of a wall **164** defining a front end of the tunnel **104**. The motor **170** may be mounted to a transmission plate **166** that is supported between the tunnel **104** and the front sub-frame **108** to help support the motor **170** within the mid-bay **106**.

[0068] In the illustrated embodiment, the motor **170** is a permanent magnet synchronous motor having a rotor **172** and stator **173**. The motor **170** also includes power electronics module **174** (sometimes referred to as an inverter) to convert the direct current (DC) power from the battery **152** to alternating current (AC) power having a desired voltage, current and waveform to drive the motor **170**. In some implementations, the power electronics module **174** may include one or more capacitors to reduce the voltage variations between the high and low DC voltage leads, and one or more electric switches (e.g., insulated-gate bipolar transistors (IGBTs)) to generate the AC power. In some implementations, the motor **170** has a maximum output power of between 90 kW and 135 kW. In other implementations, the motor **170** has a maximum output power greater than 135 kW.

[0069] In some implementations, the motor **170** may include sensors configured to sense one or more parameters of the motor **170**. The sensors may be implemented in the rotor **172**, the stator **173** and/or the power electronics module **174**. The sensors may include a position sensor (e.g., an encoder) to measure a position and/or rotational speed of the rotor **172**, and/or a speed sensor (e.g., a revolution counter) to measure the rotational speed of the rotor **172**. Alternatively or additionally, the sensors may include a torque sensor to measure an output torque from the motor **170** and/or a current sensor (e.g., a Hall effect sensor) to measure an output current from the power electronics module **174**.

[0070] Other embodiments of the motor **170** are also contemplated. For example, the power electronics module **174** may be integrated into the housing or casing of motor **170**, as shown in FIG. **3**. However, the power electronics module **174** may also, or instead, be provided externally to the housing or casing of motor **170**. In some embodiments, the motor **170** may be a type other than a permanent magnet synchronous motor. For example, the motor **170** may instead be a brushless direct current motor.

[0071] The motor **170** may convert the electric power output from the battery **152** into motive power that is transferred to the drive track **114** via a drive transmission **178**. The drive transmission **178** engages with a motor drive shaft **180** of the motor **170**. The motor drive shaft **180** may extend laterally through an opening in the transmission plate **166**. The drive transmission **178** includes a track drive shaft **182** that extends laterally across the tunnel **104**. The motor drive shaft **180** and the track drive shaft **182** may extend parallel to each other along transverse axes of the snowmobile **100** and may be spaced apart from each other along the longitudinal axis **130**. In the illustrated embodiment, the motor drive shaft **180** is operably coupled to the track drive shaft **182** via a drive belt **184**. Sprockets on the motor drive shaft **180** and the track drive shaft **182** may engage with lugs on the drive belt **184**. A drive belt idler pulley **186** may also be implemented to maintain tension on the drive belt **184**. In other embodiments, another form of linkage such as a drive chain, for example, may operatively connect the motor drive shaft **180** and the track drive shaft **182**.

[0072] In operation, torque from the motor **170** is transferred from the motor drive shaft **180** to the track drive shaft **182** via the drive belt **184**. The track drive shaft **182** includes one or more sprockets (not shown) that engage with lugs on the drive track **114**, thereby allowing the track drive shaft **182** to transfer motive power to the drive track **114**. It will be understood that the motor **170** may be operated in two directions (i.e., rotate clockwise or counter-clockwise), allowing the snowmobile **100** to travel in the forward direction of travel **122** and in the rearward direction of travel **124**. In some implementations, the drive track **114** and the snowmobile **100** may be slowed down via electrical braking (e.g., regenerative braking) implemented by the motor **170** and/or by a mechanical brake (e.g., a disc brake) connected to one of the track drive shaft **182** or the motor drive shaft **180**.

[0073] The snowmobile **100** may include a heat exchanger **132** that is coupled to, or integrated with, the tunnel **104**. The heat exchanger **132** may form part of a thermal management system to control the temperature of the battery **152**, the motor **170** and the charger **162**, for example. The heat exchanger may include channels to carry a thermal fluid along a portion of the tunnel **104**. During operation of the snowmobile **100**, the heat exchanger **132** may be exposed to snow and cold air circulating in the tunnel **104** that cools the thermal fluid. The thermal fluid may then be pumped through thermal channels in the battery **152**, the motor **170** and/or the charger **162**, for example, to cool those components. In some implementations, the thermal management system of the snowmobile **100** may also include a heater **168** (shown in FIG. **2**B) to heat the thermal fluid and warm the battery **152**. Warming the battery **152** may be useful if the snowmobile **100** has been left for an extended period in a cold environment. In such a case, the temperature of the battery cells in the battery modules **160** may fall to a level where high power is limited from being drawn from the battery **152**. Warming the battery **152** may bring the battery cells back into an efficient operating regime. In some implementations, the heater **168** is disposed within the battery enclosure **158**.

[0074] Referring again to FIG. **2**, one or more controllers **190** (referred to hereinafter in the singular) and an instrument panel **134** are part of a control system for controlling operation of the snowmobile **100**. The instrument panel **134** allows an operator of the snowmobile **100** to generate user inputs and/or instructions for the snowmobile **100**. The controller **190** is connected to the instrument panel **134** to receive the instructions therefrom and perform operations to implement those instructions. In the illustrated embodiment, the instrument panel **134** is provided on the steering mechanism **144** and the controller **190** is disposed within the interior of the snowmobile **100**, but this need not always be the case.

[0075] The instrument panel **134** includes an accelerator **136** (also referred to as a "throttle") to allow an operator to control the power generated by the powertrain **150**. For example, the accelerator **136** may include a lever to allow the operator to selectively generate an accelerator signal. The controller **190** is operatively connected to the accelerator **136** and to the motor **170** to receive the accelerator signal and produce a corresponding output from the motor **170**. In some implementations, the accelerator signal is mapped to a torque of the motor **170**. When the controller **190** receives an accelerator signal from the accelerator **136**, the controller **190** maps the accelerator signal to a torque of the motor **170** and controls the power electronics module **174** to produce that torque using feedback from sensors in the motor **50**. The mapping of the accelerator signal to an output from the motor **170** may be based on a performance mode of the snowmobile **100** (e.g., whether the snowmobile **100** is in a power-saving mode, a normal mode or a high-performance mode). In some examples, the mapping of the accelerator signal to an output from the motor **170** may be based on current operating conditions of the powertrain **150** (e.g., temperature of the battery **152** and/or motor **170**, state of charge of the battery **152**, etc.). In still other examples, the mapping of the accelerator signal to an output from the motor **170** may be user configurable, such that a user may customize an accelerator position to motor output mapping.

[0076] In addition to the accelerator **36**, the instrument panel **34** may include other user input devices (e.g., levers, buttons and/or switches) to control various other functionality of the snowmobile **100**. These user input devices may be connected to the controller **190**, which executes the instructions received from the user input devices. Non-limiting examples of such user input devices include a brake lever to implement mechanical and/or electrical braking of the snowmobile **100**, a reverse option to propel the snowmobile **100** in the rearward direction of travel **124**, a device to switch the snowmobile **100** between different vehicle states (e.g., "off", "neutral" and "drive" states), a device to switch the snowmobile **100** between different performance modes, a device to switch between regenerative braking modes (e.g. "off", "low" and "high" modes) and a device to activate heating of handgrips of the steering mechanism. The snowmobile **100** also includes a display screen **138** connected to the controller **190**. The display screen **138** may be provided forward of the steering mechanism **144**, or in any other suitable location depending on the design of the snowmobile **100**. The display screen **138** displays information pertaining to the snowmobile **100** to an operator. Non-limiting examples of such information include the current state of the snowmobile **100**, the current performance mode of the snowmobile **100**, the speed of the snowmobile **100**, the state of charge (SOC) of the battery **152**, the angular speed of the motor **170**, and the power output from the motor **170**. The display screen **138** may include a liquid crystal display (LCD) screen, thin-film-transistor (TFT) LCD screen, light-emitting diode (LED) or other suitable display device. In some embodiments, display screen **138** may be touch-sensitive to facilitate operator inputs.

[0077] The controller **190** may also control additional functionality of the snowmobile **100**. For example, the controller **190** may control a battery management system (BMS) to monitor the SOC of the battery **152** and manage charging and discharging of the battery **152**. In another example, the controller **190** may control a thermal management system to manage a temperature of the battery **152**, the motor **170** and/or the charger **162** using a thermal fluid cooled by the heat exchanger **132** and/or heated by the heater **168**. Temperature sensors in the battery **152** and/or the motor **170** may be connected to the controller **190** to monitor the temperature of these components.

[0078] The controller **190** includes one or more data processors **192** (referred hereinafter as "processor **192**") and non-transitory machine-readable memory **194**. The memory **194** may store machine-readable instructions which, when executed by the processor **192**, cause the processor **192** to perform any computer-implemented method or process described herein. The processor **192** may include, for example, any type of general-purpose microprocessor or microcontroller, a digital signal processing (DSP) processor, an integrated circuit, an application-specific integrated circuit (ASIC), a field programmable gate array (FPGA), a reconfigurable processor, other suitably programmed or programmable logic circuits, or any combination thereof. The memory **194** may include any suitable machine-readable storage medium such as, for example, an electronic, magnetic, optical, electromagnetic, infrared, or semiconductor system, apparatus, or device, or any suitable combination thereof. The memory **194** may be located internally and/or externally to the controller **190**.

[0079] Although the controller **190** is shown as a single component in FIG. **2**, this is only an example. In some implementations, the controller **190** may include multiple controllers distributed at various locations in the snowmobile **100**. For example, the controller **190** may include a vehicle control unit (also referred to as a "vehicle controller") that is responsible for interpreting the inputs from various other controllers in the snowmobile **100**. Non-limiting examples of these other controllers include a motor controller that is part of the power electronics module **174** and a battery management controller that is part of the BMS of battery **152**. Optionally, separate battery management controllers may be implemented in the each of the battery modules **160** to form a distributed battery management system.

[0080] EVs, including EPVs, such as electric snowmobile **100**, may have a number of different operating states. In examples, electric snowmobile **100** may have operating states including an off state, a neutral state (also referred to as an "idle" state or "wake" state), a drive state, and a charging state, where the neutral, drive, and charging states may together be referred to as "on" or "active" states, and the off state may be referred to as an "inactive" state. In contrast to EVs which are in frequent use, such as electric cars, for example, EPVs, such as electric snowmobile **100**, may be inactive (in an off state) for extended periods of time. With this in mind, according to examples, when electrical snowmobile **100** is in the off state, which may be the lowest power mode (as illustrated by FIG. **4** below), battery **152** is disconnected from all electrical loads, including to electric motor **170**/inverter **174** and controller **190**.

[0081] In examples, when in the neutral state, controller **190** and other electrical components of electric snowmobile **100** may be powered from battery **152**. Electric motor **170** and inverter **174** may, or may not, be powered in the neutral state but, in either case, electric motor **170** is disabled (e.g., will not operate in response to accelerator signals from accelerator **136**). In some examples, when in the neutral state, controller **190** may maintain electric motor **170** in an idle state where capacitors in the inverter **174** are charged by battery **152** but switches in the inverter **174** are not operating, thereby maintaining electric motor **170** in a free-spinning state (e.g., a zero-torque state). In other examples, inverter **174** and motor **170** are not powered when in the neutral state (e.g., the inverter **174** is disconnected from battery **152** by contactors). While controller **190** may receive commands from accelerator **136**, accelerator **136** is inactive in the neutral state (i.e., controller **190** does not respond to accelerator commands).

[0082] In examples, when in the drive state, controller **190**, inverter **174**/electric motor **170**, and all subsystems are activated. Accelerator **136** is active, meaning that commands from accelerator **136** are converted to motor control commands by controller **190** and provided to inverter **174** for control of electric motor **170**.

[0083] In examples, when in the charge state, battery **152** may receive power from external electric vehicle supply equipment (EVSE). Charger **162** may implement the charging (e.g., in the case of level 1 or level 2 charging), or battery **152** may be charged directly from the EVSE (e.g., level 3 or DC fast charging). Electric motor **170** and inverter **174** may, or may not, be powered in the charge state but, in either case, electric motor **170** is disabled (e.g., will not operate in response to accelerator signals from accelerator **136**).

[0084] FIG. **4** is a block and schematic diagram generally illustrating portions of the control system and electric powertrain **150** of electric snowmobile **100** when electric snowmobile **100** is in the off state. Electric powertrain **150** includes battery **152** (also referred to herein as the high voltage (HV) battery **152**), electric motor **170**, and inverter **174**. As described earlier, instrument panel **134** and controller **190** are part the control system for controlling operation of electric snowmobile **100**. As also described earlier, snowmobile **100** may further include a battery management system (BMS), illustrated as battery management system **196**, which may be controlled by controller **190** to monitor the SOC of the battery **152** and manage charging and discharging of the battery **152**. In examples, as illustrated, BMS **196** includes a DC/DC converter **197** to convert a higher DC voltage of HV battery **152** to a lower DC voltage (e.g., 12 volts) which, as described in greater detail below, may be used to power low-voltage electrical components of snowmobile **100** (e.g., see FIG. **5**).

[0085] In accordance with one example, as illustrated, controller **190** is implemented to include at least a body controller **198** and an activation controller **200**, where activation controller **200** includes one or more processors, illustrated as processor **202**, and a memory **204**. In examples, as described below, body controller **198** may be referred to as a main vehicle controller (or simply as vehicle controller **198**).

[0086] In examples, memory **204** stores a local task schedule **206** which, as will be described in greater detail below, includes user-programmed entries, with each entry designating a user requested task or operation to be performed by snowmobile **100** and/or a corresponding time (a "wake" time) at which the designated task is to be performed. In examples, local task schedule **206** might include only a designated wake time for body controller **198**, where the task or operation to be performed is stored at body controller **198**.

[0087] In some examples, as will be described in greater detail below (e.g., see FIGS. **7-10**), memory **204** stores a wake interval (or duration) **208** which is employed by activation controller **200** to intermittently wake electric snowmobile **100** from the off-state to check for remote user communications which may modify local task schedule **206** (e.g., remove and/or modify existing schedule entries, and addition of new schedule entries). In examples, remote schedule modifications may be made via an application installed on any number of various computing devices, such as a cellphone, or personal computer, for example.

[0088] In examples, as illustrated, low-power activation controller **200** is, at all-times, powered from a low-voltage (LV) battery **210** which is separate from HV battery **152**. In examples, LV battery **210** may have a lower voltage than HV battery **152**. LV battery **210** may have a smaller physical size and weight than HV battery **152** and be considered an ancillary battery used to power auxiliary systems or devices of electric snowmobile **100** but not used directly for propulsion of electric snowmobile **100**. LV battery **210** may have a smaller energy storage capacity than HV battery **152**, and may be configured to output electric power at a voltage of 12 volts, for example. LV battery **210** may be a rechargeable lithium-ion, lead acid, or other type of rechargeable battery.

[0089] With continued reference to FIG. **4**, when snowmobile **100** is in the off-state, HV battery **152** is electrically disconnected from any (or all) electric components of electric snowmobile **100**. In one example, disconnecting HV battery **152** from electric motor **170**/inverter **174** is achieved by opening a contactor **212** operatively disposed between HV battery **152** and inverter **174** so as to interrupt a high voltage (HV) connection there between (with the dashed lines indicating that the HV connection is de-energized). In some examples, contactor **212** may be included as part of inverter **174**. In one example, HV battery **152** is electrically disconnected from any (or all) low voltage electrical loads by opening a contactor **214** operatively disposed between HV battery **152** and DC/DC converter **197** of BMS **196** so as to interrupt a high voltage (HV) connection there between (with the dashed lines indicating that the HV connection is de-energized). In some examples, contactor **214** may be included as part of DC/DC converter **197**.

[0090] When in the off-state, activation controller **200** is powered from LV battery **210**, and may be the only (sole) controller (or, more generally, only electric component) of electric snowmobile **100** which is energized. According to examples of the present disclosure, when electric snowmobile **100** is in the off-state, activation controller **200** monitors user entries in local task schedule **206**, where each entry designates an user-scheduled operation (or task) to be performed by snowmobile **100** and/or a corresponding wake time at which the designated operation is to be performed (or a time from which the wake time may be derived). In examples, local task schedule **206** might only store a wake time for body controller **198** and, upon being woken-up, body controller **198** may determine and perform the user-scheduled operation.

[0091] In examples, a user may program (e.g., input and/or edit) entries in local task schedule **206** via instrument panel **134**. In other examples, as described in greater detail below, a user may remotely program entries in local task schedule **206**, such as via an application installed on any number of various computing devices, such as a cellphone, or personal computer, for example. In examples, the user entries in local task schedule **206** may designate or be associated with any number of tasks (operations) that may be performed by electric snowmobile **100**.

[0092] For example, in one case, a user entry may designate a departure time for when the user expects to next use the electric snowmobile **100** (a so-called trip schedule entry). Based on the designated departure time, activation controller **200** may derive a "wake" time (e.g., 20, 30, 40, 50, 60 minutes prior to the user-entered departure time) at which activation controller **200** wakes snowmobile **100** from the off-state and instructs body controller **198** to perform a preconditioning operation to adjust a temperature of HV battery **152** to be within a selected temperature range for improved electrical performance of HV battery **152** at the designated departure time (e.g., heat HV battery **152** via heater **168** of the thermal management system). In another example, a user entry in local task schedule **206** may designate a time at which to perform a battery status check of various operating parameters of HV battery **152** (e.g., SOC, voltage level(s), etc.), where the various operating parameters may be provided to the user(s) by snowmobile **100** via the application installed on the remote device(s).

[0093] FIGS. **5** and **6** generally illustrate an example of the operation of activation controller **200** in transitioning (waking) electric snowmobile **100** from the off state to an active state (e.g., the neutral state) based on user entries in local task schedule **206**. FIG. **5** is a flow diagram generally illustrating a process **230** of operating activation controller **200**, according to one example. FIG. **6** is a block and schematic diagram generally illustrating portions of the control system and electric powertrain **150** of electric snowmobile **100** in an active mode, in this case the neutral state, after being transitioned ("wakened") from the off-state to the neutral state by activation controller **200** based user entries of local task schedule **206**.

[0094] Referring to FIG. **5**, process **230** begins at **232** where activation controller **200** queries whether snowmobile **100** is in the off-state. If the answer is "no", snowmobile **100** is an active state (e.g., neutral, drive, charging), and process

230 continues querying whether snowmobile **100** is in the off state. If the answer is "yes", process **230** proceeds to **234**.

[0095] At **234**, controller **200** checks user entries in local task schedule **206** and proceeds to **236**. At **236**, controller **200** queries whether a designated wake-up time of a user entry in local task schedule **206** coincides with the current time (i.e., the date & time). If the answer is "no", according to one example, process **230** may return to **232** or, optionally, proceed to **240**. If the answer is "yes", meaning that it is time for electric snowmobile **100** to perform a user scheduled task, process **230**, according to one example, proceeds to **238** via **244**, which is described below. At **238**, activation controller **200** provides an activation signal (or "power on" signal) to transition (or "wake") electric snowmobile **100** from the off state to an active state (e.g., the neutral state), whereby body controller **198** is powered on, such as via a low-voltage DC output (e.g., 12 VDC) of DC/DC converter **197** of BMS **196**. Additionally, at **238**, activation controller **200** may provide an initiation signal to body controller **198** to initiate performance of the task corresponding to the user entry. Initiation of the task may instead be determined based on a schedule stored by body controller **198**. In examples, the activation and/or initiation signals may be communicated via a suitable controller area network (CAN) or other type of data bus.

[0096] With reference to FIG. **6**, as described at **238** in FIG. **5**, according to one example, when the response to the query at **236** is "yes", activation controller **200** provides an activation (or "power on") signal **216** to DC/DC converter **197**. In response to activation signal **216**, DC/DC converter is activated and connected to HV battery **152**, such as via closure of contactor **214**, and converts the high voltage output of HV battery **152** to a low voltage DC output **218** which power various components of electric snowmobile **100**. In examples, during the transition from the off state to the neutral state, DC/DC converter **197** may be powered by the LV battery **210**. In examples, once electric snowmobile **100** is transitioned to the active state, DC/DC converter **197** may be powered by its own low voltage output, or continue to be power from LV battery **210**. As illustrated by FIG. **6**, once transitioned to the active state (e.g., the neutral state), low voltage DC output **218** from DC/DC converter **197** powers low voltage components of electric snowmobile **100**, such as body controller **198**, and may be used to charge LV battery **210** (when LV battery **210** is powering activation controller **200** and, in some examples, powering DC/DC converter **197**). In examples, LV battery **210** is charged via low voltage DC output **218** from DC/DC converter **197** each time electric snowmobile **100** is in an active mode. In examples, body controller **198** may additionally connect instrument panel **134** and wireless transceiver device **220** to low voltage DC output **218**.

[0097] In the illustrated example, contactor **212** is shown as being open in the neutral state, which disconnects inverter **174** and electric motor **170** from HV battery **152**. Contactor **212** may be closed when electric snowmobile **100** switches to the drive state to provide HV power to inverter **174** and electric motor **170**. In other examples, contactor **212** is closed in the neutral state to connect inverter **174** and electric motor **170** to HV battery **152**.

[0098] Returning to FIG. **5**, in one example, after providing the activation (power on) and initiation signals at **238**, process **230** returns to **232** to continue monitoring local task schedule **206** upon electric snowmobile **100** returning to the off state.

[0099] With continued reference to FIG. **5**, in other examples, in addition to monitoring the user entries of local task schedule **206**, activation controller additionally monitors LV battery charging interval **209** to determine whether LV battery **210** is to be charged. In one example, the LV battery charging interval **209** is a predetermined time duration (e.g., 2 weeks). In one example, LV battery charging interval **209** is a factory set duration (which may be adjustable by certified technicians). In other examples, LV battery charging interval **209** may be a user entered value (e.g., via instrument panel **134**).

[0100] According to such implementation, when the answer to the query at **236** is "no", in lieu of returning **232**, process **230** proceeds to **240**, where activation controller **200** checks a value of a LV charging timer operated by activation controller **200**. Process **230** then proceeds to **242** where it is queried whether LV battery charging interval **209** has been reached. If the answer at **242** is "no", process **230** returns to **232**. If the answer at **242** is "yes", process **230** proceeds to **244**, where the LV charging timer is reset, and then to **238** where, as described above, activation controller **200** provides activation signal **216** to DC/DC converter **197** to wake electric snowmobile **100** from the off state to the active state, and provides an initiation signal to body controller **198**, in this case, to perform a charging operation of LV battery **210**.

[0101] According to such scenario, when the answer at **236** is "yes", process **230** may also reset the LV charging timer at **244** before continuing to **238** where, as described above, activation controller **200** provides activation signal **216** to DC/DC converter **197** and the initiation signal to body controller **198** to perform the task designated by the user entry in local task schedule **206**.

[0102] As mentioned above, in examples, in addition to programming user entries in local task schedule **206** via instrument panel **134**, users may remotely program (e.g., input and/or edit) entries in local task schedule **206**. In examples, such remote user entries may be made via an application installed on any number of various computing devices, such as a cellphone, or personal computer, for example.

[0103] FIG. **7** is a block and schematic diagram generally illustrating a system **260** which enables a user to remotely program user entries in local task schedule **206** of activation controller **200** of electric snowmobile **100**. In one example, in addition to electric snowmobile **100**, system **260** includes a vehicle interface application **262** installed on a computing device, such as smartphone **264**, and a vehicle interface module **266** residing on a remote server **268**. In examples, electric snowmobile **100**, smartphone **264**, and remote server **268** are each connected to, and communicate with one another, via the Internet.

[0104] Vehicle interface application **262**, and the associated functions described herein, may be implemented by computer-readable instructions stored in memory of smartphone **264** and executable by processors of smartphone **264**. Alternatively or additionally, vehicle interface application **262** may be a cloud-based application accessed via an internet browser on smartphone **264**. The vehicle interface module **266** may be implemented by memory and processors residing in remote server **268**, where the memory stores computer-readable instructions that are executed by the processors to perform the functions of the vehicle interface module **266** described herein. Examples of memory and processors are provided elsewhere herein.

[0105] In one example, vehicle interface module **266** includes a remote task schedule **270**, where remote task schedule **270** represents a version of local task schedule **206** residing on activation controller **200**, and includes a time stamp **272** indicating the time of the most recent update of remote task schedule **272**. In one example, vehicle interface module **266** includes a user access log indicating the time of the last access **274** of vehicle interface module **266** by a user (e.g., via a computing device, such as smartphone **264**). Vehicle interface application **262** also includes a version of local task schedule **206**, indicated as remote task schedule **276**. Additionally, local task schedule **206** residing on activation controller **200** includes a time stamp **278** indicating the time of the most recent update of local task schedule **206**. Time stamp **278** may also or instead be stored by body controller **198**.

[0106] In examples, because electric snowmobile **100** might not be continuously connected to remote server **268**, such as when snowmobile **100** is in the off-state, when a user wishes to remotely add a new user entry and/or modify an existing user entry in local task schedule **206** via smartphone **264** (or other computing device), smartphone **264** connects to vehicle interface module **266** residing on remote server **268**. In one example, upon connecting to remote server **268**, the remote task schedule **276** of smartphone **276** is updated with remote task schedule **270** from vehicle interface module **270**, at which point a user is able to make changes to remote task schedule **276** on smartphone **264**. Upon the user completing updates to user entries in remote task schedule **276**, the entries of remote task schedule **276** of smartphone **264** are uploaded to remote server **268** so that remote task schedule **270** of vehicle interface module **266** is synced with remote task schedule **276** of smartphone **264**. In one example, time stamp **272** of remote task schedule **270** of vehicle interface module **266** on remote server **268** is updated to indicate the update time of remote task schedule **270**. In one example, each time a user accesses vehicle interface module **266** via a vehicle interface app (such as vehicle interface app **262**), even if modifications are not made to remote task schedule **270**, vehicle interface module **266** updates the last user access time **274** of the user access log.

[0107] According to examples, to reduce energy consumption from HV battery **152**, when electric snowmobile **100** is in the off-state, activation controller **200** is configured to intermittently wake snowmobile from the off-state to an active state (e.g. the neutral state) to cause body controller **198** to connect to remote server **268** to check for remote user communications that may have been made via vehicle interface app **262** of smartphone **264** to modify user entries of remote task schedule **270**. In one example, if time stamp **272** of remote task schedule **270** is more recent than time stamp **278** of local task schedule **206**, body controller **198** downloads remote task schedule **270** from vehicle interface module **266** to replace local task schedule **206** residing on activation controller **200** and updates time stamp **278** of local task schedule **206** to match time stamp **272** of remote task schedule **270**. Conversely, if time stamp **278** of local task schedule **206** is more recent than time stamp **272** of remote task schedule **270** (e.g., a user may have updated local task schedule **206** via instrument panel **134**), body controller **198** uploads local task schedule **206** from snowmobile **100** to vehicle interface module **266** to replace remote task schedule **270** and updates time stamp **272** of remote time schedule **270** to match time stamp **278** of local task schedule **278**.

[0108] In examples, activation controller **200** intermittently wakes electric snowmobile **100** in accordance with wake interval **208**. In some examples, wake interval **208** may be a fixed time duration (e.g., 1, 2, 4, 6, 12 or 24 hours). In other examples, as will be described in greater detail below (e.g., see FIGS. **9** and **10** below), wake interval **208** may vary over time (e.g., the wake interval may increase in duration with increasing time since a last user interaction with electric snowmobile **100** (e.g., via instrument panel **134** and/or via vehicle interface app **262**).

[0109] In examples, when communicating with vehicle interface module **266** of remote server **268**, body controller **198** uploads the next wake time (as indicated at **275**) at which activation controller **200** will wake electric snowmobile **100** to connect to remote server **268** to check for remote user communications made with vehicle interface module **266** (e.g., modifications to remote schedule **270**). Because activation controller **200** intermittently wakes electric snowmobile **100** to check for remote user communications based on wake up interval **208**, it is possible that a user (via vehicle interface module **266** of remote server **268**) may attempt to remotely add and/or modify a user entry for local task schedule **206** (e.g., via smartphone **264**) that has a corresponding wake time that occurs prior to the next time activation controller **200** is to wake snowmobile **100**, as indicated by the next wake time **275**. In such case, according to examples, vehicle interface module **266** will not allow such modification to made to remote task schedule **270** and notifies the user that the wake time designated by the user entry to perform the corresponding operation is not possible. Additionally, vehicle interface module **266** may notify the user of the earliest time for which an operation can be remotely scheduled based on the next wake time **275**, and also notify the user that such entry may be made to local task schedule **208** at electric snowmobile **100**, such as via instrument panel **134**.

[0110] In some embodiments, when activation controller **200** wakes electric snowmobile **100** (e.g., at **238** in FIG. **5**), interface application **262** may notify the operator via smartphone **264**. For example, a display screen of smartphone **264** may present a message to notify the operator that electric vehicle **100** is in an on state and capable of remote communication. In some implementations, when electric vehicle **100** communicates with server **268**, server **268** may send a communication to smartphone **262** to notify the operator that electric vehicle **100** is in an on state. Alternatively, server **268** may user next wake time **275** to determine when electric vehicle **100** is in an on state and send a communication to smartphone **264** to notify the operator at this wake time. Further, vehicle interface application **262** may also store next wake time **275** and notify the operator when that wake time is reached.

[0111] FIG. **8**, with further reference to FIGS. **5** and **7**, is a flow diagram illustrating process **230** of operating activation controller **200**, according to one example, which further includes intermittently checking for remote user communications which may have modified local task schedule **206**.

The flow diagram of FIG. **8** is the same as that of FIG. **5**, except that processes **290** and **292** are included between processes **232** and **234**.

[0112] As illustrated, if the answer at **232** is "yes", meaning that snowmobile **100** is in the off-state, process **230** proceeds to **290** where activation controller **292** checks a value of a wake interval timer maintained by activation controller **200**. Process **230** then proceeds to **292** where it queries whether wake interval **208** has been reached. If the answer at **292** is "no", process **230** proceeds to **234**, where local task schedule **206** is checked (as described above by FIG. **5**). If the answer at **292** is "yes", process **230** proceeds to **294**, where the wake interval timer is reset. Process **230** then proceeds to **244** where the LV charging timer is reset, and then to **238** where, as described above, activation controller **200** provides activation signal **216** to DC/DC converter **197** to wake electric snowmobile **100** from the off state to the active state, and provides an initiation signal to body controller **198**, in this case, to perform a remote communications check (as illustrated by FIG. **9**).

[0113] In some examples, memory **204** stores a wake time **211** that includes the next date and time when electric snowmobile **100** is scheduled to switch to an active state to perform a task (e.g., perform a user designated task, check for remote communications and/or charge LC battery **210**). Wake time **211** may be programmable or reprogrammable based on the next scheduled wake up. For example, wake time **211** may be the next (closest or soonest) time defined in local task schedule **206**, wake interval **208** and/or LV battery charging interval **209**. The answers at **292**, **236**, **242** of FIG. **8** may each be determined based on wake time **211**. Wake time **211** may correspond to next wake time **275** stored in vehicle interface module **266**.

[0114] Optionally, memory **204** might store wake time **211**, while body controller **198** stores local task schedule **206**, wake interval **208** and/or LV battery charging interval **209**. At each wake up scheduled by wake time **211**, body controller **198** may search local task schedule **206**, wake interval **208** and/or LV battery charging interval **209** to determine which task(s) is/are to be performed at that wake up. Before switching to an inactive state, body controller **198** may confirm that wake time **211** corresponds to the next time a task is scheduled, and reprogram wake time **211** based on times stored in local task schedule **206**, wake interval **208** and/or LV battery charging interval **209** as required. Further, before switching to an inactive state, body controller **198** may confirm that next wake time **275** corresponds to the next time a task is scheduled, and reprogram next wake time **275** based on times stored in local task schedule **206**, wake interval **208** and/or LV battery charging interval **209** as required.

[0115] FIG. **9** is a flow diagram generally illustrating a process **330** of operating body controller **198** to check for remote user communications which may be have occurred to make modifications to local task schedule **206** of activation controller **200**. Process **330** begins at **332** upon receiving from activation controller **200** an initiation signal to check for remote user communications, such as initiated by an answer of "yes" to the query at **292** of process **230** of FIG. **8**. Process **330** then proceeds to **334**, where body controller **198** powers wireless transceiver **220**, in this case, cellular transceiver **220**, and connects to remote server **268**. In other examples, not illustrated, connection to remote server **268** may be made via a WiFi transceiver which connects to the Internet and remote via connection to WiFi local network (such as via a WiFi router, e.g.).

[0116] At **336**, after connecting to remote server **268**, body controller **198** checks remote task schedule **270** of vehicle interface module **266** and proceeds to **338**. At **338**, body controller **198** queries whether time stamp **272** of remote task schedule **270** of vehicle interface module **266** is more recent than time stamp **278** of local task schedule **206** of activation controller **200**. If the answer to the query at **338** is "no", process **330** proceeds to **340**.

[0117] At **340**, body controller queries whether time stamp **278** of local task schedule **206** is more recent than time stamp **272** of remote task schedule **270**. If the answer to the query at **340** is "yes", meaning that local task schedule **206** has been more recently updated than remote task schedule **270** (e.g., via user entries made via instrument panel **134**), process **330** proceeds to **342**. At **342**, body controller **198** uploads local task schedule **206** to remote server **268**, where vehicle interface module **266** replaces remote task schedule **270** with local task schedule **206**, including replacing remote time stamp **272** with local time stamp **278**. In one example, process **330** then proceeds to **344**, where body controller **198**, based on wake interval **208**, updates the next wake time **275** (i.e., the next time activation controller **200** will wake electric snowmobile **100** to check for remote communications). Process **330** then proceeds to **346**, where body controller **198** returns electric snowmobile **100** to the off state.

[0118] If the answer to the query at **338** is "yes", meaning that remote task schedule **270** is more recent than local task schedule **206**, process **330** proceeds to **348**. At **348**, process **330** replaces local task schedule **206** with remote task schedule **270**, including replacing local time stamp **278** with remote time stamp **272**. In one example, process **330** then proceeds to **344** where, as described above, body controller **198** updates the next wake time **275**, and then returns electric snowmobile **100** to the off state at **346**.

[0119] According to one example, process **330** alternatively includes a process **352** (as indicated by dashed lines) which is carried out prior to body controller **198** updating the next wake time **275** stored at remote server **268** by vehicle interface module **266**. In some examples, as described above, wake interval **208** may be a fixed time duration (e.g., 24 hours). According to alternative process **330**, at **352**, body controller **198** may vary the duration of wake interval **208** over time, such as based on a time duration since a user last interacted with electric snowmobile **100**. In examples, such user interaction may be remote user interaction via vehicle interface application **262** (e.g., as logged by the most recent user access **274**), may be direct user interaction via instrument panel **134** (e.g., when a user wakes snowmobile from the off state via actuation of buttons or other device of instrument panel **134**), and/or may be the waking of snowmobile **100** from the sleep state to an active state by activation controller **200** in response to user entries in local task schedule **206**.

[0120] In examples, wake interval **208** may begin at an initial value and be increased in value by body controller **198** based on an increasing time duration since the last user interaction (i.e., the longer the time duration since the last user interaction, the greater the value of wake interval **208**). In one example, upon the next user interaction with snowmobile **100**, body controller **198** may reset the value of wake interval **208** to the initial value.

[0121] FIG. **10** is a graph **360** illustrating a wake duration curve **362** representing one example of how body controller **198** may vary the value of wake interval **208** over time based on a time duration since a last user access of snowmobile **100**. In one example, wake interval **208** begins with an initial/minimum value, as indicated at **364**. As the time duration since the last user interaction increases in value, body controller increases the value of wake interval **208** until a maximum wake interval value **366** is reached. In one example, each time a user interaction occurs, body controller **198** resets the value of wake interval **208** to the initial value. In examples, the minimum and maximum wake interval values **364** and **366** may be fixed values (e.g., factory determined values) and/or user entered values (such as via instrument panel **134**, for example). It is noted that any suitable technique, in addition to that described by FIG. **10**, may be employed to vary the value (increase and/or decrease) of wake interval **208** over time. Extending the wake interval **208** may help save power for the snowmobile **100**.

[0122] In some implementations, if a wireless signal is not available at the location of electric snowmobile **100**, then cellular transceiver **220** might not be able connect to remote server **268**. In such a case, then electric snowmobile **100** may attempt a direct connection to smartphone **264** via Bluetooth®, for example. Local task schedule **206** may then be updated based on operator input to vehicle interface application **262**. In some implementations, electric snowmobile **100** may attempt a direct connection to smartphone **264** via Bluetooth® in addition to a connection to remote server **268**.

[0123] As illustrated by FIGS. **11-13** below, in some examples, in addition to waking electric snowmobile **100** in response to user entries in local task schedule **208**, in response to the expiration of wake interval **208** (for checking for remote user communications), and/or in response to expiration of battery charging interval **209** (for charging of LV battery **210**), activation controller **200** may permit operation of electric snowmobile **100** (e.g., transition snowmobile **100** from the off-state to an on-state, such as the neutral state) in response to local user inputs (e.g., via instrument panel **134**). In this way, activation controller **200** may automatically wake up electric snowmobile **100** at a scheduled time and wake up electric snowmobile **100** when a user manually interacts with instrument panel **134**. By performing both of these functions, activation controller **200** may be the sole controller active in the off state.

[0124] As shown in FIGS. **11-13**, activation controller **200** may permit operation of electric snowmobile **100** in response to a user key **400** being received into a key receptacle **402** of electric snowmobile **100** (e.g., as part of instrument panel **134**), or when key **400** is in sufficient proximity to electric snowmobile **100**. Engagement of key **400** with receptacle **402** or the proximity of key **400** to electric snowmobile **100** may be communicated to activation controller **200** and/or to body controller **198** (when body controller **198** is activated) so that activation controller **200** and/or body controller **198** may authorize the activation and/or operation of electric snowmobile **100**. The presence of key **400** in receptacle **402** or in proximity to electric snowmobile **100**, and key **400** being valid, may indicate that the operation of electric snowmobile **100** is authorized.

[0125] Alternatively or in addition to the use of key **400**, the presence of the user in proximity to electric snowmobile **100** and/or the authorization of the user to operate electric snowmobile **100** may be established by detecting the presence of a portable electronic device (PED), such as smartphone **264**, which may be carried by the user. Such PED may be in wireless data communication (e.g., paired via Bluetooth®) with body controller **198** and/or with activation controller **200** to inform body controller **198** and/or activation controller **200** of the proximity of the user via the PED as a proxy. The use of key **400** and/or PED may be associated with a user identification and permit an authentication of the user to establish the user's authorization to operate electric snowmobile **100**. Alternatively or in addition, the user's authorization to operate electric snowmobile **100** may be established by way of an authorization code or password that may be manually entered by the user via instrument panel **134** of electric snowmobile **100**, or via a PED in communication with electric snowmobile **100**, permitting the user to interact with and provide inputs to electric snowmobile **100**.

[0126] A user interface of electric snowmobile **100**, such instrument panel **134**, may include one or more widgets for receiving input from the user. Such widgets may, for example, include rotary switches, toggle switches, push buttons, knobs, dials, etc. The widgets may include one or more physical (hard) devices and/or one or more graphical objects on a graphical user interface provided on a touch-sensitive display screen of electric snowmobile **100**.

[0127] The user interface of electric snowmobile **100** may include start button **404** (e.g., a physical push button) or other input device(s) (e.g., rotary switch(es), multiple push buttons, receptacle **402** and key **400**) suitable for generating one or more vehicle activation commands for transitioning electric snowmobile **100** from an inactive (i.e., off) state to an active (e.g., wake or ready) state explained further below. Start button **404** may be disposed on or close to handlebar **24** or at another suitable location that is accessible by the user. In some embodiments, a rotary switch (and optionally a key) may be suitable for generating a vehicle activation command for activating electric snowmobile **100** after a period of inactivity. Such rotary switch may include different angular positions corresponding to the different states of electric snowmobile **100** described herein.

[0128] FIG. **11** shows an exemplary representation of key **400** and of start button **404** associated with electric snowmobile **100**. In some embodiments, key **400** may be part of a radio-frequency identification (RFID) system of electric snowmobile **100**. Key **400** may include RFID tag **406** which may store data identifying key **400** or a specific user associated with key **400**. When triggered by an electromagnetic interrogation pulse from a RFID reader device associated with electric snowmobile **100**, RFID tag **406** may wirelessly transmit the data stored on RFID tag **406** and the data may be used by activation controller **200** and/or body controller **198** to authenticate key **400** and either permit or prevent the operation of electric snowmobile **100** based on the data. In some embodiments, key **400** may interact with a first software-based or physical/mechanical hardware-based switch disposed within receptacle **402** so that the insertion and withdrawal of key **400** into and out of receptacle **402** may cause key **400** to interface with and actuate such switch, and signal to activation controller **200** and/or body controller **198** the user's authorization to use electric snowmobile **100**. In some embodiments, electric snowmobile **100** may include a (e.g., rotary) switch that is actuatable with key **400**.

[0129] Start button **404** may be disposed in proximity to receptacle **402**. Start button **404** may be operatively connected to activation controller **200** and may be used to generate one or more vehicle activation commands **408** that may be received at activation controller **200** and cause activation controller **200** to generate a suitable activation signal **216** for transitioning electric snowmobile **100** from the off-state to an active state, such as the neutral state, for example.

[0130] FIG. **12** is a schematic diagram of another exemplary activation controller **200**. Activation controller **200** may include elements previously described with like elements being identified using like reference numerals. It is noted that for clarity of explanation, local task schedule **206** is not illustrated in FIG. **12** (nor in FIG. **13**), but operates in addition to the operation of user key **400** and the example implementations of FIGS. **12** and **13**. Activation controller **200** may include a boot module **420** operatively connected to an analog start module **422**. Boot module **420** may include MC **410** (which may include or be in addition to processor **202**) configured to monitor for the receipt of vehicle activation command **408** from analog start module **422**. However, boot module **420** may instead have an analog implementation. In response to vehicle activation command **408**, MC **410** may output activation signal **216** to cause transition of electric snowmobile **100** from the off-state to an active state, such as the neutral state. The single MC **410** may be the sole controller or sole electric load powered by LV battery **210** when electric snowmobile **100** is in the inactive state.

[0131] Vehicle activation command **408** may include a change from a lower voltage (e.g., zero volt) to a higher voltage (e.g., 12 volts) sensed at MC **410**. Vehicle activation command **408** may be generated by analog start module **422** (which, in some examples, may be separate from activation controller **200**). Analog start module **422** may function to establish an electrical connection between MC **410** and LV battery **210** when one or more conditions are met. For example, switch **412** may be operatively disposed between LV battery **210** and boot module **420**. Switch **412** may be biased toward a normally-open configuration and may be actuatable by the user via start button **404** or other widget with which the user may interact (e.g., manipulate, actuate) to provide a user input. For example, start button **404** may be spring-loaded so that the momentary pressing of start button **404** may cause momentary closing of switch **412** to provide electric communication across switch **412**.

[0132] In some embodiments, the presence of key **400** in receptacle **402** may be another condition to be met in order to generate vehicle activation command **408**. The presence of key **400** in receptacle **402** may cause the closing of another switch (not shown) to establish electric communication between LV battery **210** and boot module **420**. Alternatively, electric communication may be established across key **400** when key **400** is received in receptacle **402**. Together, the presence of key **400** in receptacle **402** and the closing of switch **412** may provide an electric connection between LV battery **210** and MC **410** of boot module **420**.

[0133] In examples, as described above, activation signal **216** generated by boot module **420** may initiate the operation of DC/DC converter **197**. In some embodiments, MC **410** may also monitor the initiation of DC/DC converter **197** and may implement a timeout criterion where activation signal **216** is discontinued if DC/DC converter **197** did not start properly within a threshold time period. Discontinuing activation signal **216** may cease the initiation of DC/DC converter **197**. In such situation, the transition of electric snowmobile **100** to the on state may be aborted and a suitable annunciation may optionally be provided to the user. In such situation, boot module **420** may then continue or resume monitoring for vehicle activation command **408**.

[0134] Instead of, or in addition to start button **404** and key **400**, one or more other (e.g., proximity) sensors, switches, relays, timers, and/or other devices may be included in analog start module **422** to implement various conditions to be met before issuing vehicle activation command **408** to boot module **420**. The transition of electric snowmobile **100** from the off state to an active state (such as the neutral state) may be prevented if the applicable conditions are not met.

[0135] FIG. **13** is a schematic diagram of another exemplary activation controller **200** that may be incorporated into the control system of electric snowmobile **100**. Activation controller **200** may include elements previously described with like elements being identified using like reference numerals. Activation controller **200** may include a boot module **520** operatively connected to a digital start module **522**. Boot module **520** may include first MC **410**A configured to monitor for the receipt of vehicle activation command **408**. In response to vehicle activation command **408**, first MC **410**A may output the digital power-on signal to cause the transition of electric snowmobile **100** from the off state to an active state. First MC **410**A may be powered by LV battery **210** when electric snowmobile **100** is in the inactive state.

[0136] Vehicle activation command **408** may include a digital signal transmitted to first MC **410**A via a data bus (e.g., CAN bus) for example. Vehicle activation command **408** may be generated by digital start module **522**, which may be separate from or part of activation controller **200**. Digital start module **522** may function to generate vehicle activation command **408** in digital form when one or more conditions are met. For example, digital start module **522** may include second MC **410**B in data communication with first MC **410**A of boot module **520**. Second MC **410**B may be configured to monitor for one or more conditions such as user's authorization to operate electric snowmobile **100** and/or an user input received via a widget of the user interface (e.g., instrument panel **134**) of electric snowmobile **100**, and generate the vehicle activation command **408** in digital form in response to the conditions being met. For example, second MC **410**B may be configured to monitor for the pressing of start button **404** and/or the presence of key **400** in receptacle **402**.

[0137] Instead of, or in addition to start button **404** and key **400**, second MC **410**B may monitor for other conditions to implement various conditions to be met before issuing vehicle activation command **408**. Such other conditions may include the proximity of key **400** to electric snowmobile **100**, the pairing of a user's PED with electric snowmobile **100**, and/or the receipt of a wireless signal indicative of a request to start electric snowmobile **100** from an authorized or recognized communication device. In some embodiments, second MC **410**B may implement the battery timer to issue vehicle activation command **408** at a predetermined time and/or intermittently to charge a LV battery **210** during extended periods of inactivity (e.g., during an off-season for an electric powersports vehicle).

[0138] Second MC **410**B may be powered by LV battery **210**. In some embodiments, as described above, activation controller **200**, including first MC **410**A and second MC **410**B, may be the only electrical load powered by LV battery **210** when electric snowmobile **100** is in the inactive state.

[0139] Systems and methods are described and shown in the present disclosure in relation to the snowmobile **100**, but the present disclosure may also be applied to other types of vehicles, including other types of off-road and powersport vehicles.

[0140] Although specific examples have been illustrated and described herein, a variety of alternate and/or equivalent implementations may be substituted for the specific examples shown and described without departing from the scope of the present disclosure. This application is intended to cover any adaptations or variations of the specific examples discussed herein.

1. An electric vehicle comprising:
- a vehicle controller to control operation of the electric vehicle when the electric vehicle is in an on state and enter a powered-off state when the electric vehicle is in an off state; and
- an activation controller to store a programmable wake time, the activation controller to switch the vehicle controller to a powered-on state from the powered-off state to wake the electric vehicle from the off state to the on state at the wake time.

2. The electric vehicle of claim **1**, wherein the wake time is programmable by the vehicle controller.

3. The electric vehicle of claim **1**, wherein the vehicle controller is a main body controller.

4. The electric vehicle of claim **1**, wherein the activation controller is the only controller of the electric vehicle which is powered-on when the electric vehicle is in the off state.

5. The electric vehicle of claim **1**, wherein the wake time is based on a user designated time.

6. The electric vehicle of claim **5**, wherein the user designated time is specified in a user entry of a local task schedule stored by the activation controller or the vehicle controller.

7. The electric vehicle of claim **6**, where the user entry of the local task schedule includes the user designated time and has a corresponding designated vehicle operation, upon being turned to the powered-on state from the power-off state by activation controller at the wake time, the vehicle controller to perform the corresponding vehicle operation designated by the user entry.

8. The electric vehicle of claim **7**, wherein the designated vehicle operation comprises a battery preconditioning operation of a high-voltage battery of the electric vehicle.

9. The electric vehicle of claim **8**, where the vehicle controller performs the battery preconditioning operation only if the electric vehicle is powered from external power equipment.

10. The electric vehicle of claim **7**, where the designated vehicle operation comprises a status report of one or more operating parameters of the electric vehicle, including operating parameters of a high-voltage battery of the electric vehicle.

11. The electric vehicle of claim **1**, wherein the wake time is based on a wake interval.

12. The electric vehicle of claim **11**, when the electric vehicle is in the off state, upon expiration of the wake interval, the activation controller to turn the vehicle controller to the powered-on state from the powered-off state to wake the electric vehicle from the off state to the on state, and to initiate the vehicle controller to perform a check for remote user communication with the electric vehicle which was made when the electric vehicle was in the off state.

13. The electric vehicle of claim **12**, to perform the check for remote user communication, the vehicle controller to download remotely entered user designated times from a memory remote to the electric vehicle to the memory of the activation controller.

14. The electric vehicle of claim **11**, wherein the wake interval is fixed over time.

15. The electric vehicle of claim **11**, wherein the wake interval varies over time based on user interactions with the electric vehicle.

16. The electric vehicle of claim **1**, further comprising:
- a high-voltage (HV) battery; and
- a low-voltage (LV) battery, wherein:
  - the activation controller is powered from the LV battery; and
  - the vehicle controller is powered from the HV battery via a direct current to direct current (DC/DC) converter when the electric vehicle is in the on state, and electrically disconnected from the HV battery when the vehicle is in the off state.

17. The electric vehicle of claim **16**, wherein the wake time is based on a battery charging interval.

18. The electric vehicle of claim **17**, when the electric vehicle is in the off state, upon expiration of a battery charging interval, the activation controller to turn the vehicle controller to a powered-on state from a powered-off state to wake the electric vehicle from an off state to an on state, and to initiate the vehicle controller to perform a charging operation of the LV battery from the HV battery.

19. A method of operating an electric vehicle having an off state and an on-state, the method comprising:
- storing a programmable wake time in an activation controller of the electric vehicle;
- switching a vehicle controller of the electrical vehicle to a powered-off state to switch the electric vehicle to the off state; and
- waking the electric vehicle from the off state to the on state at the wake time by employing the activation controller to turn the vehicle controller from the powered-off state to a powered-on state.

20. An electrical system for an electric vehicle, the electrical system comprising:
- an electric motor for propelling the vehicle;
- a vehicle controller for controlling operation of the electric vehicle;
- a high-voltage (HV) battery to power the electric vehicle, including the electric motor and vehicle controller;
- a low-voltage (LV) battery having a lower voltage than the HV battery; and
- an activation controller powered from the LV battery, at a wake time stored by the activation controller, the activation controller to provide an activation signal to transition the electric vehicle from an off-state, in which the HV battery is electrically disconnected from the electric motor and the vehicle controller, to an

active state, where at least the vehicle controller is electrically connected to and powered from the HV battery.

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