



(43) International Publication Date
25 September 2014 (25.09.2014)

- (51) International Patent Classification:
B65F 1/00 (2006.01) *B65F 3/00* (2006.01)
- (21) International Application Number:
PCT/US2014/026794
- (22) International Filing Date:
13 March 2014 (13.03.2014)
- (25) Filing Language: English
- (26) Publication Language: English
- (30) Priority Data:
61/793,853 15 March 2013 (15.03.2013) US
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- (81) Designated States (unless otherwise indicated, for every kind of national protection available): AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT,

HN, HR, HU, ID, IL, IN, IR, IS, JP, KE, KG, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States (unless otherwise indicated, for every kind of regional protection available): ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, KM, ML, MR, NE, SN, TD, TG).

Declarations under Rule 4.17:

- as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(ii))
- as to the applicant's entitlement to claim the priority of the earlier application (Rule 4.17(iii))
- of inventorship (Rule 4.17(iv))

Published:

- with international search report (Art. 21(3))
- before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments (Rule 48.2(h))

(54) Title: LIFT GATE CONTROLLER SYSTEM

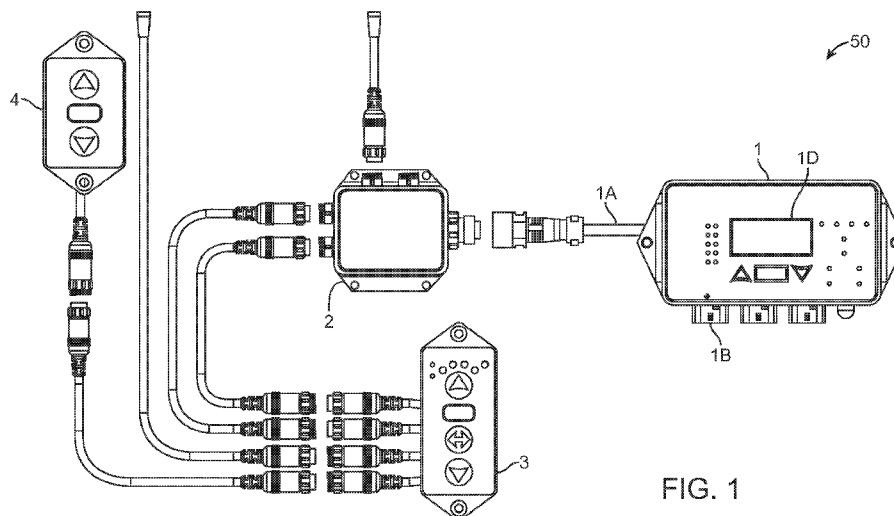


FIG. 1

(57) Abstract: A controller system (50) for controlling a lift gate system. The controller system comprises a controller module (1) configured to control operation of one or more components of the lift gate system, and a control switch module (3, 4) configured to receive operator commands for operation of the lift gate system, and signaling the operator commands to the controller module. The controller module is configured to directly control electrical power from a power source to one or more lift gate components for operation of the lift gate system in response to the operator commands.

LIFT GATE CONTROLLER SYSTEM

CROSS-REFERENCE TO RELATED APPLICATION

[0001] This application claims the priority benefit of U.S. Provisional Patent Application Serial Number 61/793,853 filed March 15, 2013, incorporated herein by reference in its entirety.

FIELD

[0002] The present invention relates to controllers, and in particular to lift gate controllers.

BACKGROUND

[0003] Lift gates are typically mounted at a structure such as the rear of a vehicle to lift payloads on a platform from one level (e.g., ground level) up to another level (e.g., the bed of the vehicle), or vice versa. One type of lift gate employs linkages to maintain the lift platform in a horizontal plane through the lifting range. Hydraulic actuators and/or electric actuators are used to provide lifting force for moving the lift platform. Lift gate controller switches are wired with length wires to lift gate actuators and solenoids for directly controlling electrical power to the actuators and solenoids to control operation of the lift gate.

BRIEF SUMMARY

[0004] In one embodiment, a controller system for controlling a lift gate system comprises a controller module configured to control operation of one or more components of the lift gate system, and a control switch module configured to receive operator commands for operation of the lift gate system, and signaling the operator commands to the controller module. The controller module is configured to directly control electrical power from a power source to one or more lift gate components for operation of the lift gate system in response to the operator commands.

[0005] In one embodiment, the controller system further comprises a microcontroller configured to receive signals from the control switch module and control operation of the lift gate system in response. The microcontroller is further configured to monitor components of the lift gate system and provide related information via a user interface device. The controller module includes connectors for plugging and unplugging electrical connections thereto. The control switch module includes connectors for plugging and unplugging electrical connections thereto. The controller system includes an enclosure for housing one or more lift gate components in close proximity to the controller module. The control switch module is electrically connected to the controller module via lower gage wiring.

[0006] These and other features, aspects and advantages of the present invention will become understood with reference to the following description, appended claims and accompanying figures.

BRIEF DESCRIPTION OF DRAWINGS

[0007] FIG. 1 shows an embodiment of a controller system disclosed herein, which can be utilized with different types of lift gate systems.

[0008] FIG. 2 shows an example architecture of coupling a controller module controller system to operational components of a lift gate system.

[0009] FIG. 3 shows a functional block diagram related to the architecture in FIG. 2, according to one embodiment.

[0010] FIG. 4A shows a perspective view of a main switch module of the controller system, according to one embodiment.

[0011] FIG. 4B shows a plan view of the main switch module of FIG. 4A, according to one embodiment.

[0012] FIG. 5A shows a perspective view of a runner switch module of the controller system, according to one embodiment.

[0013] FIG. 5B shows a plan view of the runner switch module of FIG. 5A, according to one embodiment.

[0014] FIG. 6 shows a plan view of the controller module of the controller system, according to one embodiment.

[0015] FIG. 7 shows a rear perspective view of the controller module of FIG. 6, according to one embodiment.

[0016] FIG. 8 shows an example lift gate system that can be used with the controller system disclosed herein, according to one embodiment.

[0017] FIG. 9 is a high level block diagram showing a circuit useful for implementing one embodiment of the controller system disclosed herein.

[0018] FIG. 10 shows examples of voltage drop off in a lift gate system with a conventional controller switch wiring.

[0019] FIG. 11 shows examples of reduced voltage drop off in a lift gate system utilizing a controller system disclosed herein.

DETAILED DESCRIPTION

[0020] The following description is made for the purpose of illustrating the general principles of the disclosed embodiments of a system, and is not meant to limit the disclosed concepts herein. Further, particular features described herein can be used in combination with other described features in each of the various possible combinations and permutations. Unless otherwise specifically defined herein, all terms are to be given their broadest possible interpretation including meanings implied from the specification as well as meanings understood by those skilled in the art and/or as defined in dictionaries, treatises, etc.

[0021] Embodiments of a controller system for controlling motion/operation of a lift gate by an operator is disclosed herein. In one embodiment, the controller system is configured for connection to actuators and other lift gate components such as electrical solenoids, valves and DC motors, for controlling motion/operation of the lift gate by an operator interacting with controller switches and control interfaces in the controller system, and using information feedback provided by the controller system.

[0022] In one embodiment, a controller system for controlling a lift gate system comprises a controller module configured to control operation of one or more components of the lift gate system, and a control switch module configured to receive operator commands for operation of the lift gate system, and signaling the operator commands to the controller module. The controller module is configured to directly control electrical power from a power source to one or more lift gate components for operation of the lift gate system in response to the operator commands.

[0023] In one embodiment, the controller system further comprises a microcontroller configured to receive signals from the control switch module and control operation of the lift gate system in response. The microcontroller is further configured to monitor components of the lift gate system and provide related information via a user interface device.

[0024] The controller module includes uniquely identifiable connectors for electrical connections thereto. The control switch module includes uniquely identifiable connectors for electrical connections thereto. The controller system includes an enclosure for housing one or more lift gate components in close proximity to the controller module. The control switch module is electrically connected to the controller module via lower gage wiring.

[0025] FIG. 1 shows an embodiment of a controller system 50 disclosed herein, which can be utilized with different types of lift gates. One type of lift gate employs linkages to maintain the lift platform in a horizontal plane through the lifting range. The lift platform is attached to linkages by pivot members, which allow the lift platform to be pivoted. When in the vertical position, operation of the lifting mechanism rotates the lift platform into an inverted, stowed position beneath the vehicle body.

[0026] Hydraulic actuators and electric actuators are used to provide lifting force for moving the lift platform. Another type of lift gate is a rail lift gate. Another type of lift gate is a dual lift system 205 (FIG. 8) comprising a parallel pair of vertically-extending columns 215 attached to rear opening of a vehicle 201, each column 215 having a vertically-disposed actuator (e.g. a hydraulic cylinder) for vertically raising and lowering a load platform 211 carried by the pair of actuators. The pair of actuators are actuated from a source of hydraulic/electric power.

[0027] Referring to FIG. 1, in one embodiment, the controller system 50 comprises a modularized system including a controller module 1, a main switch module 3 and a runner switch module 4, wherein the controller module 1 can be connected to the runner switch module 4 and a main switch module 3 using a junction box module 2 via uniquely identifiable cabling (i.e., cables and associated connectors can be plugged into each other and unplugged easily by hand, without need for soldering, permanent electrical connection, splicing of wires, etc.).

[0028] The runner switch module 4 can be directly connected to the main switch module 3 via cabling. The controller system 50 is configured for connection to actuators and other lift gate components for controlling motion/operation of the lift gate by an operator interacting with control switches and control interfaces in the

controller system (i.e., operator using one or more of controller module 1, runner switch module 4 and main switch module 3 to provide commands, wherein the controller module 1 operates the lift gate in response to such commands). The modules 1, 3 and 4 comprise electronic circuits and may include logic, programmable microcontroller, and processing elements implementing their respective functions, such as shown in FIG. 9.

[0029] In one embodiment, the controller module 1 includes localized logic for controlling actuator starter solenoids and valve solenoids. Solenoids such as electrical motor starter solenoids are used in lift gate pump electrical motor actuators. A valve solenoid is an integrated device comprising a solenoid which actuates either a pneumatic or hydraulic valve, or a solenoid switch, which employs an electromechanical solenoid to operate an electrical switch.

[0030] The switch controllers (i.e., runner switch module 4 and main switch module 3) of the controller system 50 do not directly receive or directly control battery power to the solenoid coils valves and contacts. Rather, the switch controllers of the controller system 50 receive operator commands and send signals to the controller module 1 (e.g., via junction box 2). The controller module 1 directly receives power from the batteries and based on signals from runner switch module 4 and main switch module 3, directly controls battery power (ON/OFF) to the solenoid coils valves and contacts.

[0031] The switch controls (i.e., runner switch module 4 and main switch module 3) along with wires require a low voltage low current signal to pass through a small gage wire 85% less than conventional wire, to the controller module 1. These signals are processed in the controller module 1 in which will directly switch battery power ON/OFF to the solenoid coils valves and contacts from the battery. The control switch modules 2 and 3 are electrically connected to the controller module 1 via lower gage wiring connectors/cables (e.g., cables/connectors 1A, 3A, 4A) than higher gage wiring (e.g., cables 1W) between the controller module 1 and the components of the lift gate system via ports 1B.

[0032] In one embodiment, solenoid coils valves and contacts are localized within the enclosure 30 in close proximity of the controller module 1, such that in one example the wiring/cabling connection between ports 1B of the controller module 1 and solenoid coils valves and contacts within enclosure 30 are under 20 inches (compared to conventional wiring that typically exceed 30 feet). Therefore, adding multiple switch controllers to the controller module 1 for operation of the lift gate will not require addition of lengthy electrical wires (and additional electrical resistance) for directly controlling battery power to the solenoid coils valves and contacts from such multiple switch controllers. Dispensing with conventional wiring from the battery to the switch controllers, and from the switch controllers to the solenoid coils valves and contacts, reduces resistance on solenoid coils, wherein in one example voltage drop is reduced (e.g., to under 1.0%).

[0033] Conventional direct wiring of switch controller and relays (e.g., runner switch module, main switch module) to a power source such as a battery to energize starter and valve solenoids for lift operation, require long wires. Conventional wiring requires switch controllers to directly turn ON and OFF power to solenoid coils valves and contacts from a battery.

[0034] Typically, a first set of wires are connected from a lift gate battery to the switch controllers which receive operator commands, and a second set of wires are connected from the switch controllers to the solenoid coils valves and contacts. Based on operator commands to the switch controllers, the switch controllers directly ON and OFF to solenoid coils valves and contacts.

[0035] The switch controllers along with wires must hold the total current draw from the solenoid coils. Therefore, with multiple switch controllers located in the lift gate, switches and wires add more electrical resistance to the solenoid coils valves and contacts. The switch controllers and solenoid coils valves and contacts wiring connection typically ranges e.g., 30 to 45 feet in wire length. The added resistance on the solenoid coils due to such wiring cause a significant (e.g., 10% to 15%) voltage drop from the battery to the solenoid coils valves.

[0036] Referring to FIG. 10, Table 1 shows example voltage drop from a conventional main switch module to valve solenoids with conventional direct battery wiring, for lift functions including platform Up/Down and platform Fold/Unfold. Table 2 shows example voltage drop from a conventional runner switch module to valve solenoids with conventional direct battery wiring, for lift functions including platform Up/Down.

[0037] Referring to FIG. 11, Table 3 shows example voltage drop from the main switch module 3 to valve solenoids using the controller module 1 disclosed herein, for lift functions including platform Up/Down and platform Fold/Unfold. Table 4 shows voltage drop from a runner switch module 4 to valve solenoids using the controller module 1 disclosed herein, for lift functions including platform Up/Down.

[0038] Comparing Table 3 to Table 1 for a similar lift gate system, the results in Table 3 show improved power delivery to starter solenoids and valves using the controller module 1 in the lift gate system, providing lower voltage drop than conventional wiring approaches. Comparing Table 4 to Table 2 for a similar lift gate system, the results in Table 4 show improved power delivery to starter solenoids and valves using the controller module 1 in the lift gate system, providing lower voltage drop than conventional wiring approaches.

[0039] In one embodiment, the controller module 1 manages all the input and output function of a lift gate, including: (1) battery voltage level input, (2) current measurement inputs, (3) control switches input through junction box module 2, (4) solenoid coil sensor input and programming change signal input, (5) solenoid coils power output, (6) set condition status update signal output, (7) error signal output, (8) data logger signal output, (9) voltage level signal output, and (10) cycle counter signal output.

[0040] FIG. 2 shows an example architecture 100 of coupling the controller module 1 to operational components of a lift gate system, in close proximity within an enclosure 30 such as a control box. FIG. 3 shows a functional block diagram 150 related to the architecture 100 in FIG. 2, illustrating corresponding interconnection. The architecture 100 includes said control system 50. The junction box 2 can be

coupled to at least one external solenoid valve including hydraulic valve 13A and external coil 10A, via electrical port/connector 2A.

[0041] The main switch module 3 can be coupled to another external solenoid valve including external hydraulic valve 13A and external coil 10A via one of multiple connectors/cables 3A. The junction box 2 can be coupled to the controller 1 via connector 2B. The enclosure 30 houses several lift gate actuation components that may be monitored and controlled via the controller module 1.

[0042] In one embodiment, the enclosure 30 houses components for operating a lift gate system such as shown in the lift gate system in FIG. 8. In one example, the enclosure 30 houses components for operating a lift gate system such as solenoid coils valves and contacts 10, a first DC motor 11 powering a first hydraulic pump 12, a second DC motor 11A powering a first hydraulic pump 12A, and a hydraulic valves 13. The controller module 1 continually monitors lift gate electrical system to determine if operations set condition are met.

[0043] In one embodiment of the controller system 50, the controller module 1 comprises a localized driver for all starter solenoid and valve solenoids. The controller module 1 directs power to the starter solenoids and valve solenoids within close wiring proximity. The localized functions of the controller module 1 reduces the need for long electrical wires between components, and thereby increases power delivery to all starter solenoids and valve solenoids.

[0044] As shown in FIG. 3, the controller module 1 is connected to the solenoid coils valves and contacts 10, and further receives inputs from battery 6, first current sensor 7, second current sensor 9, and battery charging system 8. The external hydraulic valve 13A is controlled by external coils 10A coupled to the junction box 2. The hydraulic valves 13 and 13A power the dual lift gate cylinders 14. Switch controls 5A, 5B and 5C are also coupled to the junction box module 2.

[0045] The junction box module 2 distributes power and the input/output electronic signals using printed circuit board therein. The junction box module 2 is connected between the controller module 1 and other switch controllers of the lift gate electrical system. The junction box module 2 also directs power to external coils 10A, such as solenoids coil valve, solenoid coils contact, and/or relay contacts.

[0046] The main switch module 3 includes a user interface that allows an operator to activate and operate lift gate functions. The main switch module 3 uses low voltage and low current switches to switch signals through junction box module 2 to the controller module 1, wherein as noted controller module 1 controls the lift gate components to execute the intended lift gate function as commanded by an operator via the main switch module 3. The main switch module 3 also receives information signal inputs from the controller module 1 via junction box module 2.

[0047] The information signals are displayed to the operator, and include information such as set conditions, status update, errors, battery voltage, cycle counter, and other lift gate functions that require an indicator display such as power on demand function ON/OFF light. The main switch module 3 includes sensors that activate lights to switches for night time use as deemed necessary. The main switch module 3 further utilizes an infrared transmitter and a receiver to download logged data and upload new programs to the controller module 1.

[0048] The runner switch module 4 includes a user interface that allows an operator to activate and operate lift gate functions in a more limited fashion than the main switch module 3. In one example, the runner switch module 4 allows operating lift gate when moving the lift gate platform UP/DOWN platform. The runner switch module 4 is coupled directly to the main switch module 3. The runner switch module 4 uses low voltage and low current switches to switch signals through main switch module 3 to the controller module 1, wherein as noted the controller module 1 controls the lift gate components to execute the intended lift gate function as commanded by an operator via the runner switch module 4.

[0049] The 2nd switch module 5A includes similar functions as the main switch module 3, and can be coupled to the junction box module 2. The 2nd switch module 5A allows the operator to control the lift gate from a portable location or different stationary location away from the main switch module 3, via the controller module 1. This type of 2nd switch module 5A may have a 2nd control connector for Daisy Chain Connection or Parallel Connection of further runner switch modules such as 3rd switch modules 5B and 5C, as shown.

[0050] Battery 6 supplies electrical power to all lift gate electrical systems via the controller module 1. The controller module 1 senses battery level. A first charging current sensor 7 supplies current measurement to the controller module 1 to determine amount of current charged at a given time frame to charge the lift gate battery 6. The controller module 1 calculates representative values and displays them to the operator on a display 1D, indicating number of possible lift gate operations for every charge.

[0051] Battery charger system 8 comprises a power source such as a vehicle engine alternator, or other battery charging system. Discharging current sensor 9 provides current measurements to the controller module 1 to determine amount of current discharged at a given time frame when the lift gate is used. The controller module 1 calculates representative values and displays them to the operator, indicating number of possible lift gate operations remaining after every lift gate use.

[0052] The controller module 1 uses information from the discharge current sensor 9 to monitor over-current and surge-current draw from lift gate DC motor 11. The values obtained from the discharged current sensor 9 are used by the controller module 1 to determine preset conditions. A DC Motor profile program in the controller module 1 determines: (1) failure of DC motor 11 whereby the controller module 1 switches to the secondary DC motor 11A when available; (2) DC motor life cycle, to alert the operator that the DC motor 11 requires replacement, or may allow manual switching to the secondary DC motor 11A by an operator using a controller program menu.

[0053] The solenoids coil valves and contacts 10 are powered by controller module 1 using the battery 6 for lift gate functions. The power line energizing solenoids coil valves and contacts 10 include a built-in sensor in the controller module 1, which determines if the solenoids coil valves and contacts 10 are connected properly. This allows the operator to quickly troubleshoot a disconnected solenoids coil valves and contacts 10 by monitoring information display from the controller

module 1. The DC motor 11 drives the hydraulic pump 12 which in turn pressurizes the hydraulic valve 13 and external hydraulic valve 13A.

[0054] In one embodiment, the controller module 1 comprises a programmable microcontroller that utilizes low power signals from switch controllers (i.e., runner switch module 4, main switch module 3, other switch controller connected to junction box 2) to drive all valves and pump motor solenoids or solid state relays for a 12V and 24V electrical system of a lift gate system. The controller module 1 includes three input/output connection ports 1B, which in one example has 12 lines (12 pin) in each connection port 1B, for a total of 36 lines. The 36 input/output lines can be configured as an input signal or an output signal with a logic set of transistor transistor logic (TTL) and/or microcontroller.

[0055] In one implementation for a direct current (DC) electric circuit, the controller module 1 utilizes a low 5 volts under 50mA signal from the switch controllers (i.e., runner switch module 4, main switch module 3, other switch controller connected to junction box 2) to drive a higher voltage 12Volt to 24Volt with 5Amp current each line using input/output connection with the battery 6 and lift gate components.

[0056] In one embodiment, the controller module 1 further allows simplified and rapid installation of other functional modules and coupling the controller module 1. Examples of such other functional modules include: (1) low voltage disconnect, (2) cycle counter, (3) current sensors, (4) pressure sensors, and (5) temperatures sensors.

[0057] FIG. 6 shows a plan view of the controller module 1, and FIG. 7 shows a rear perspective view of the controller module 1, according to one embodiment. The controller module 1 comprises a rectangular enclosure 1H for housing electronics components, wiring and keypad/switches as described by example below.

[0058] As described herein in more details, the modules of the controller system 50 (e.g., controller module 1, runner switch module 4, main switch module 3, junction box 2), are configured via cabling (with corresponding multi-pin mating connectors as shown) that allow rapid connect and disconnect which reduces installation complexity for lift gate manufacturing and operator use. The connectors of the

controller module 1, runner switch module 4, main switch module 3, junction box 2, allow simplified plugging and unplugging of the modules to each other, and other lift gate components in the housing 30.

[0059] The controller module 1 is programmed to provide lift gate status and operation diagnostic indicators along with in-depth diagnostic displays. The controller module 1 provides a user interface on a built-in display for enabling changes in lift gate operational parameters such as low voltage setting, pump cycling, etc.

[0060] In one embodiment, the controller module 1 further has an interconnect cable 1A for connection to the junction box module 2. The controller module 1 includes a display device 1D (e.g., LCD) for displaying information to an operator. The controller module 1 provides/displays information for diagnosis of common problems.

[0061] In one embodiment, the controller module 1 is programmed to perform the following functions and provide related information, including: (1) a selector function for automatic pump switchover via controller module 1 for dual pump application with an LED indicator 1K; (2) current protection circuit breaker function and indicator 1M; (3) battery level function and LED indicators 1E; (4) input/output diagnostic function and LED indicators 1F; (5) power down function and LED indicator 1G; (6) DC motor temperature monitoring function and LED indicator 1J; (7) Error code function and LED indicator 1L; and (8) Display information on LCD display 1D with select, up and down scroll buttons 1C.

[0062] In one embodiment, the controller module 1 includes logic control in the microcontroller, for detecting incorrect lift gate function. The controller logic will stop the lift gate from operating in the event one or more operators issue inconsistent or erroneous lift gate operation commands, as determined by programmed logic for proper operation of the lift gate. An example is when operator presses platform down on the main switch module 3 and at the same time another operator presses the platform fold/unfold switch on the runner switch module 2, wherein the controller logic stops the lift gate from operation until proper commands are received. In one example, the controller logic allows lift gate

operation with proper functions in specific scenarios such as for a particular operator or particular application, wherein for example only UP, Down, Fold, and Unfold, and a deviation will cause the controller logic to stop the lift gate from operation.

[0063] In one embodiment, the controller module 1 is further programmed to provide the following functions and provide related information, including: (1) hydraulic pump cycling allowing a second hydraulic pump to cycle 10 times for every 100 cycles with a first hydraulic pump; (2) hydraulic pump cycle counter indicator; (3) DC pump motor operation hour meter; (4) low voltage disconnect with indicator; (5) DC motor current surge fault indicator using a current sensor; (6) DC motor over-current fault indicator using a current sensor; (7) detect unauthorized access to control functions with timeout and lockout; (8) data communication for program change or data collection; (9) count total number of error codes; (10) count total number of low voltage conditions; (11) count total number of DC motor high temperatures conditions; (12) count total number of lift over-current conditions; (13) count number of DC motor current surges; (14) charge time vs. use time (using dual current sensor); (15) user interface via controller interface buttons 1C to select lift gate programs or to change lift gate operation parameters, as needed. The low voltage disconnect uses the voltage of the battery to monitor the state of charge of the battery. The controller module 1 continually monitors the battery voltage and enables or disables the lift gate electrical system once the battery voltage reaches a pre-determined voltage for a pre-determined amount of time.

[0064] In one embodiment, the controller module 1 further provides hydraulic control including using following connections: A 16 pin connector/cable 1A to connect with main switch module 3 and runner switch module 4 and supply power to D valves 13A; and three 12 pin connectors 1B to supply power to all pump solenoids valves and motor with 10.5A rating for each pin. Any of the connectors 1B can be electronically configured as a signal input and output.

[0065] In one embodiment, the controller module 1 is sealed to IP67 rating, is UV resistant, is impact resistant, is chemical resistant (e.g., oil, hydraulic fluid, gasoline, and light corrosive acids such as calcium chloride). The marked and identifying labels on the controller module 1 are etched for prolonged use. In one embodiment, the controller module 1 further includes mounting holes 1N on the rectangular enclosure 1H for installation.

[0066] In one embodiment, the controller module 1 is further programmed to perform the following functions and provide related information, including: (1) battery voltage detection; (2) pump overheating cutoff; (3) display lift rotation status; (4) priority valve start up; and (5) provide power boost to starter solenoids.

[0067] FIG. 4A shows a perspective view of the main switch module 3, and FIG. 4B shows a plan view of the main switch module 3, according to one embodiment. The main switch module 3 comprises a rectangular enclosure 3H for housing electronics components, wiring and keypad/switches as described by example herein. In the example shown in FIGS. 4A-4B, the main switch module 3 includes four individually identifiable (e.g., color coded) connectors/cables 3A for modular interconnect with other modules of the controller system 50. In one embodiment, the main switch module 3 comprises programmable logic and four momentary ON/OFF switches and associated circuitry including: (1) an Up switch 3B for the lift platform rise function, (2) a Power Down (PD) switch 3C to activate/deactivate power down functions when pressed once, (3) a lift platform Fold/Unfold switch 3D to activate the platform fold and unfold with depressing the UP switch for folding and depressing Down switch for unfolding platform, and (4) a Down switch 3E for the lift descent function. The switches of the main switch module 3 may comprise buttons, rubber pad switches, touch switches, etc.

[0068] The main switch module 3 may further include IR emitter/receiver 3G for data communications. The main switch module 3 can include one or more display indicators 3F such as LED or LCD for displaying lift gate information (such as from the controller module 1), including: (1) battery state of charge, including green LED for full state of charge, yellow LED for mid state of charge, amber LED for low state of charge, and red LED for requiring charge; (2) cycle counter flashing,

including: green LED for 10K cycle count, yellow LED for 1K cycle counts, amber LED for 100 cycle counts, red LED for 10 cycle counts; and (3) red LED for error code indicator.

[0069] In one embodiment, the switches of the main switch module 3 may be implemented as a keypad with backlighting circuits responsive to sensor signals. In one embodiment, the main switch module 3 may further include modules that provide night-time visibility functions based signals from sensors 3J such a motion sensor, light sensor, etc., wherein the functions include: (1) switch lights are activated in dark areas only; (2) the switch lights will illuminate by waving a hand up at the main switch module 3; (3) switch lights will remain active at all times when switches are in use; (4) switch lights will switch OFF when switches are idle for e.g. 7 minutes; (5) when the Power Down switch is depressed, that switch changes to red a color to indicate that the lift gate power down circuit is active; (6) Power Down red light remains ON at all times, and OFF when deactivated; (7) Power Down light will turn off only when idle for e.g., 7 minutes, and back on when the keypad is used; and (8) Power Down light will changes light to blue when deactivated.

[0070] In one embodiment, the main switch module 3 further includes mounting holes 3K for installation on a supporting surface. The main switch module 3 further includes uniquely identifiable connector cables 3A which can be easily plugged into and unplugged from other modules (e.g., connectors for pump control in yellow and amber color; connector for valve control in blue color, connector for runner switch module in red).

[0071] In one embodiment, the main switch modules 3, 5A, 5B, 5C are sealed to IP68 and IP69K rating, is UV resistant, is impact resistant, is chemical resistant (e.g., oil, hydraulic fluid, gasoline, and light corrosive acids such as calcium chloride). The marked and identifying labels on the main switch module 3 are etched for prolonged use.

[0072] FIG. 5A shows a perspective view of the runner switch module 4, and FIG. 5B shows a plan view of the runner switch module 4, according to one embodiment. In one embodiment the runner switch module 4 comprises a

rectangular enclosure 4H for housing electronics components, wiring and keypad/switches as described by example below. The switches of the runner switch module 4 may comprise buttons, rubber pad switches, keypads, touch switches, etc. In one embodiment, the runner switch module 4 comprises three momentary ON / OFF switches for functions including: (1) an Up switch 4B, for the lift rise function; (2) a Power Down (PD) switch 4C to activate/deactivate power down function when pressed once; and a (3) Down button 4D, for the lift platform descent function.

[0073] In one embodiment, the switches of the runner switch module 4 may be implemented as a keypad with backlighting circuits responsive to sensor signals. In one embodiment, the runner switch device further includes modules that provide night-time visibility functions, including: (1) all switch lights are activated in dark areas only; (2) switch lights will illuminate by waving a hand up at the runner switch module 4; (3) switch lights will remain active at all times when switches are in use; (4) switch lights will switch OFF when switches are idle for e.g., 7 minutes; (5) when the Power Down switch is depressed it will change to a red color to indicate that the lift gate power down circuit is active; (6) Power Down red light remains ON at all times, and OFF when deactivated; (7) Power Down light will turn off only when idle for e.g., 7 minutes, and back on when keypad is used; (8) Power Down light will change to blue when deactivated. In one embodiment, the switch lights of the runner switch module 4 are controlled by the main switch module 3 light sensor (e.g., photoresistor).

[0074] In one embodiment, the runner switch module 4 further includes mounting holes 4K on the enclosure 4H for installation. In one embodiment, runner switch module 4 further includes a color coded connector 4A to connect with the main switch module 3. In one embodiment, the runner switch module 4 is sealed to IP68 and IP69K rating, is UV resistant, is impact resistant, is chemical resistant (e.g., oil, hydraulic fluid, gasoline, and light corrosive acids such as calcium chloride). The marked and identifying labels on the runner switch module 4 are etched for prolonged use.

[0075] The connections between the modules 1, 2, 3 and 4 are generally electrical connections capable of carrying signals. The cabling/connectors of the modules 1, 2, 3 and 4 are generally electrical cabling/connectors capable of carrying signals, and simplified coupling and uncoupling of the modules.

[0076] FIG. 9 is a high level block diagram showing a circuit 300 useful for implementing one embodiment of the controller system, such as the modules 1, 3, 4, and other functions of the controller system. The computer system includes one or more processors, such as processor 302. The processor 302 is connected to a communication infrastructure 304 (e.g., a communications bus, cross-over bar, or network).

[0077] The computer system can include a display interface 306 that forwards graphics, text, and other data from the communication infrastructure 304 for display on a display unit 308 (e.g., LED, LCD, etc). The computer system also includes a memory 310 (e.g., random access memory (RAM), hard disk drive and/or a removable storage drive, programmable memory). As will be appreciated, programmable memory 318 includes a computer readable medium having stored therein computer software and/or data, to perform functions of the controller system disclosed herein.

[0078] In alternative embodiments, the programmable memory may include means for allowing computer programs or other instructions to be loaded into the computer system. Examples of such means may include a program package and package interface (such as that found in video game devices), a removable memory chip (such as an EPROM, or PROM) and associated socket and interfaces which allow software and data to be transferred to the computer system.

[0079] The computer system further includes operator input device such keypad/switches 314. The computer system further includes electronic circuit 316 which in one embodiment may include digital and/or analog circuits for implementing lighting circuits, sensor processing circuits, IR processing circuits, and other functions of the switch controller functions. The computer system further includes sensors and associated circuitry 322 for implementing functions of the

switch controller functions. In one embodiment, the processor 302 may comprises a programmable microcontroller, application specific integrated circuit, logic circuit, analog circuit, etc.

[0080] The computer system may also include a communication interface 324.

Communication interface 324 allows software and data to be transferred between the computer system and external devices. Examples of communication interface 324 may include a modem, a network interface (such as an Ethernet card), a communication port, or a PCMCIA slot and card, etc. Software and data transferred via communication interface 324 are in the form of signals which may be, for example, electronic, electromagnetic, optical, or other signals capable of being received by communication interface 324. These signals are provided to communication interface 324 via a communication path (i.e., channel) 326. This communication path 326 carries signals and may be implemented using wire or cable, fiber optics, a phone line, a cellular phone link, an RF link, and/or other communication channels.

[0081] In this document, the terms "computer program medium," "computer usable medium," and "computer readable medium" are used to generally refer to media such as main memory and secondary memory, removable storage drive, and a hard disk installed in hard disk drive.

[0082] Computer programs (also called computer control logic) are stored in main memory and/or secondary memory. Computer programs may also be received via communication interface. Such computer programs, when run, enable the computer system to perform the features of the present invention as discussed herein. In particular, the computer programs, when run, enable the processor to perform the features of the computer system. Accordingly, such computer programs represent controllers of the computer system. The processor may comprise a microprocessor, microcontroller, etc.

[0083] Those skilled in the art will appreciate that various adaptations and modifications of the just-described preferred embodiments can be configured without departing from the scope and spirit of the invention. Therefore, it is to be

understood that, within the scope of the embodiments, the controller system may be practiced other than as specifically described herein.

What is claimed is:

1. A controller system (50) for controlling a lift gate system, the controller system comprising:

a controller module (1) configured to control operation of one or more components of the lift gate system; and

a control switch module (2, 3) configured to receive operator commands for operation of the lift gate system, and signaling the operator commands to the controller module;

wherein the controller module is configured to directly control electrical power from a power source (6) to one or more lift gate components for operation of the lift gate system in response to the operator commands.

2. The controller system of claim 1, further comprising a microcontroller configured to receive signals from the control switch module and control operation of the lift gate system in response.

3. The controller system of claim 2, wherein the microcontroller is further configured to monitor components of the lift gate system and provide related information via a user interface device.

4. The controller system of claim 1, wherein the controller module includes connectors for plugging and unplugging electrical connections thereto.

5. The controller system of claim 1, wherein the control switch module includes connectors for plugging and unplugging electrical connections thereto.

6. The controller system of claim 2, further comprising an enclosure (30) for housing one or more lift gate components in close proximity to the controller module.

7. The controller system of claim 2, wherein the control switch module is electrically connected to the controller module via lower gage wiring than that of wiring between the controller module and the components of the lift gate system.
8. The controller system of claim 1, wherein the controller module comprises an enclosure (1H) for housing a microcontroller and a user interface device.

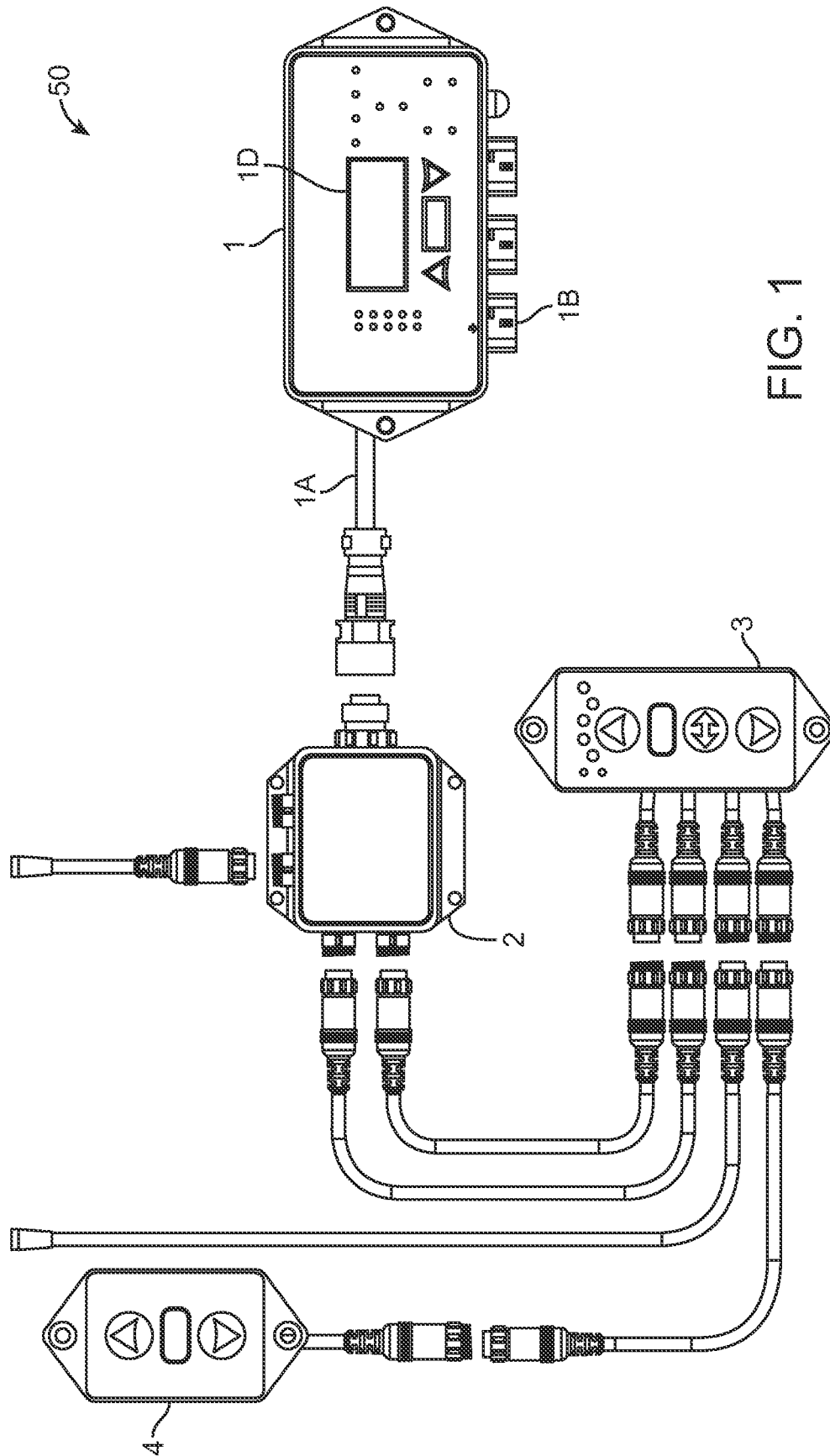


FIG. 1

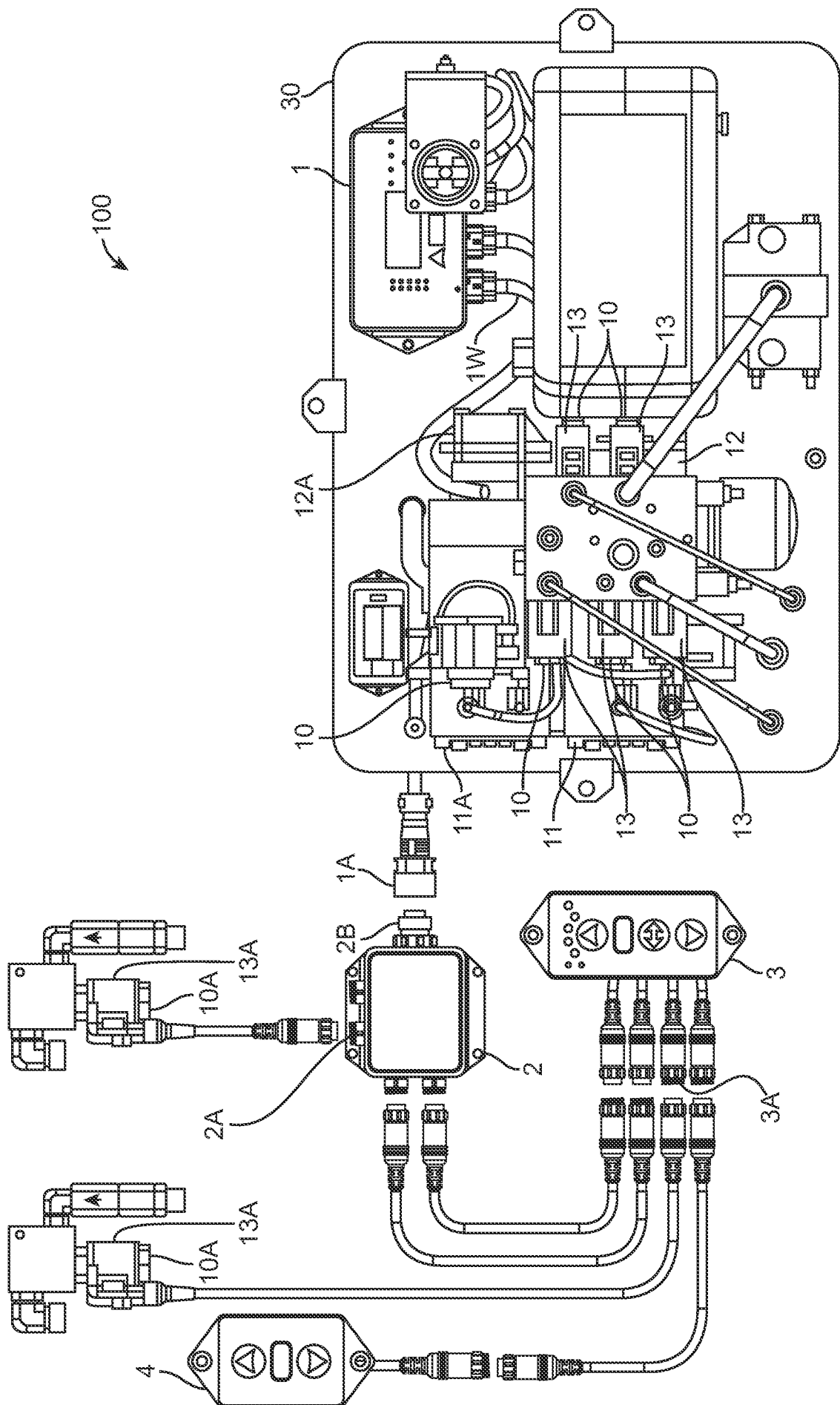


FIG. 2

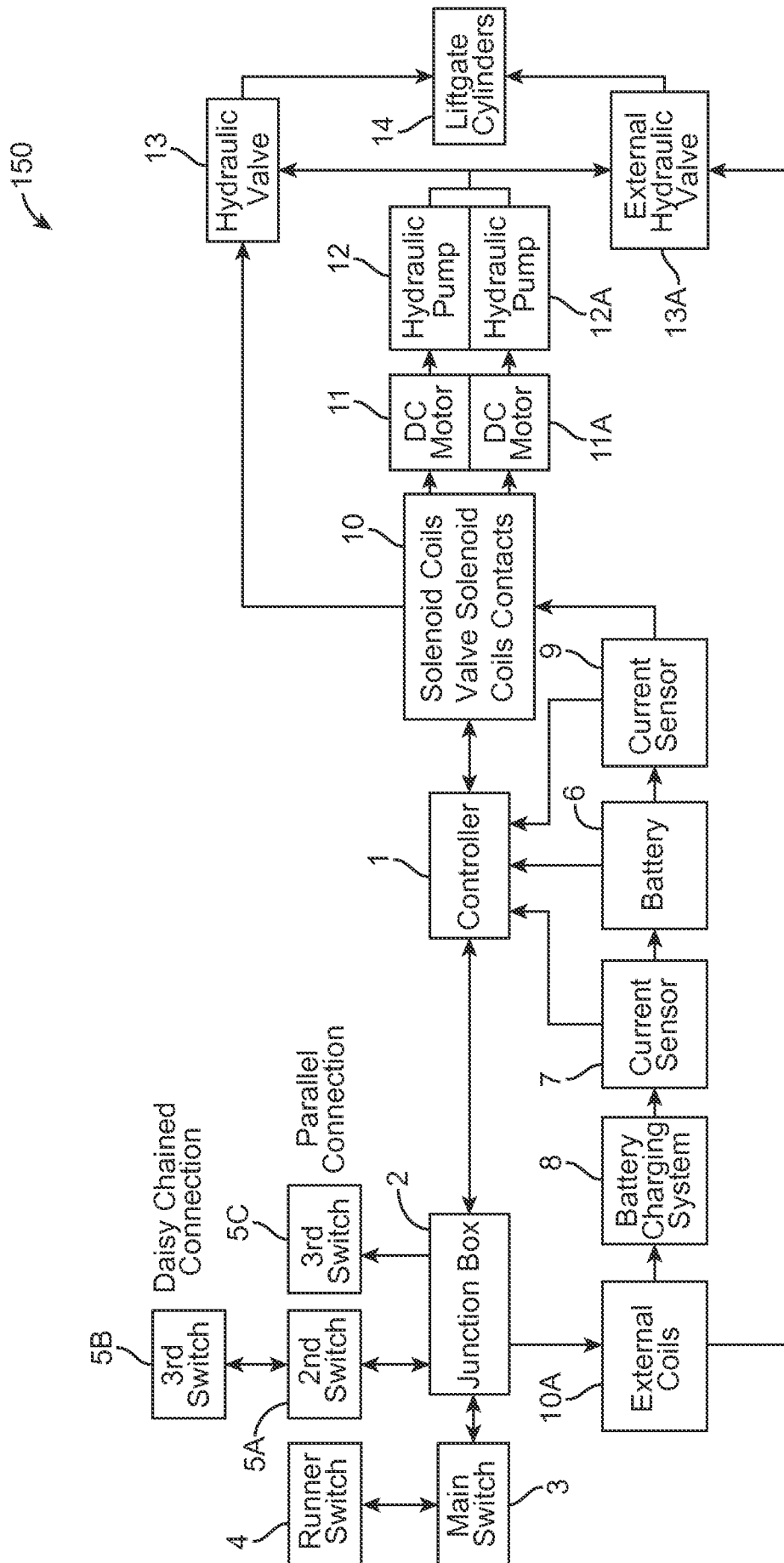


FIG. 3

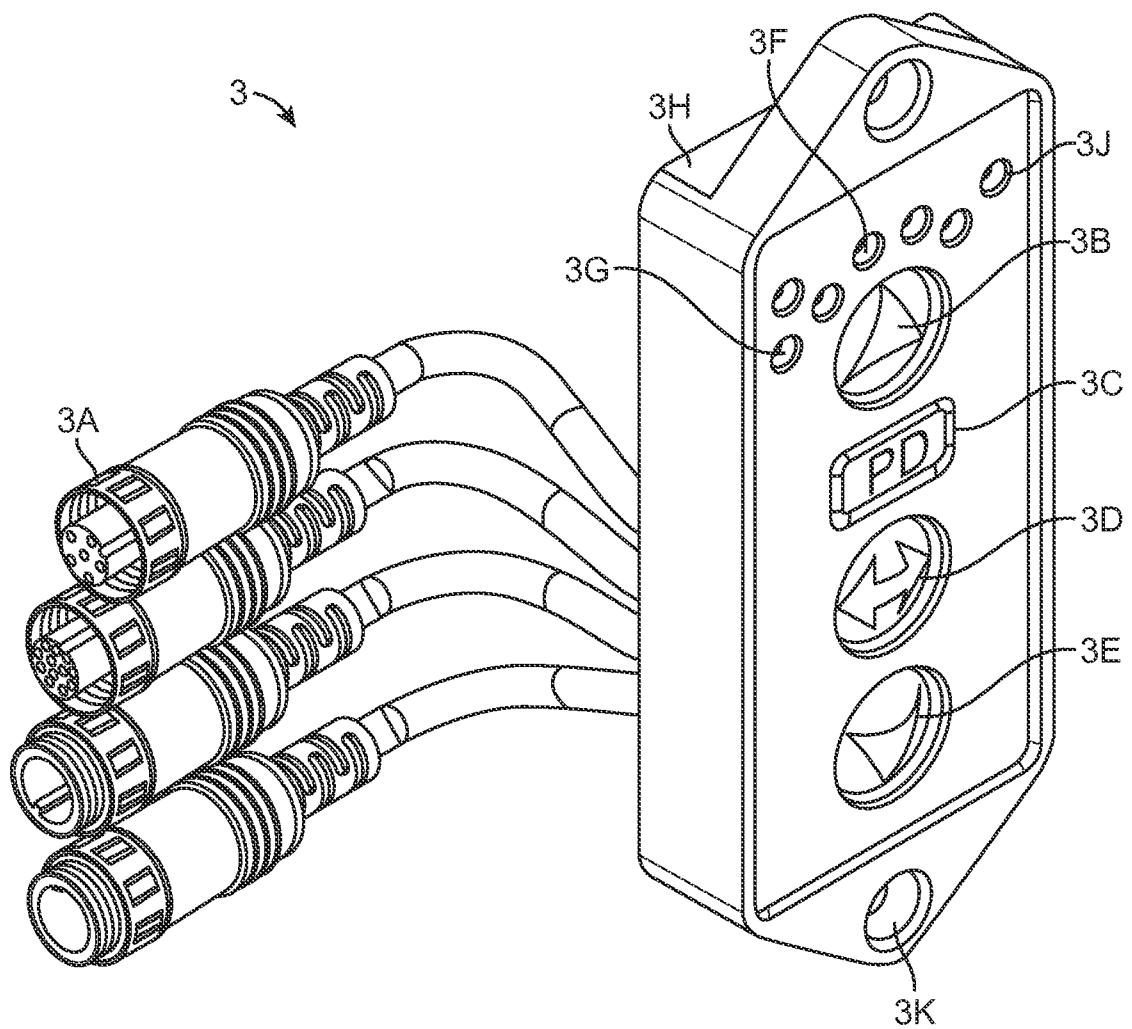


FIG. 4A

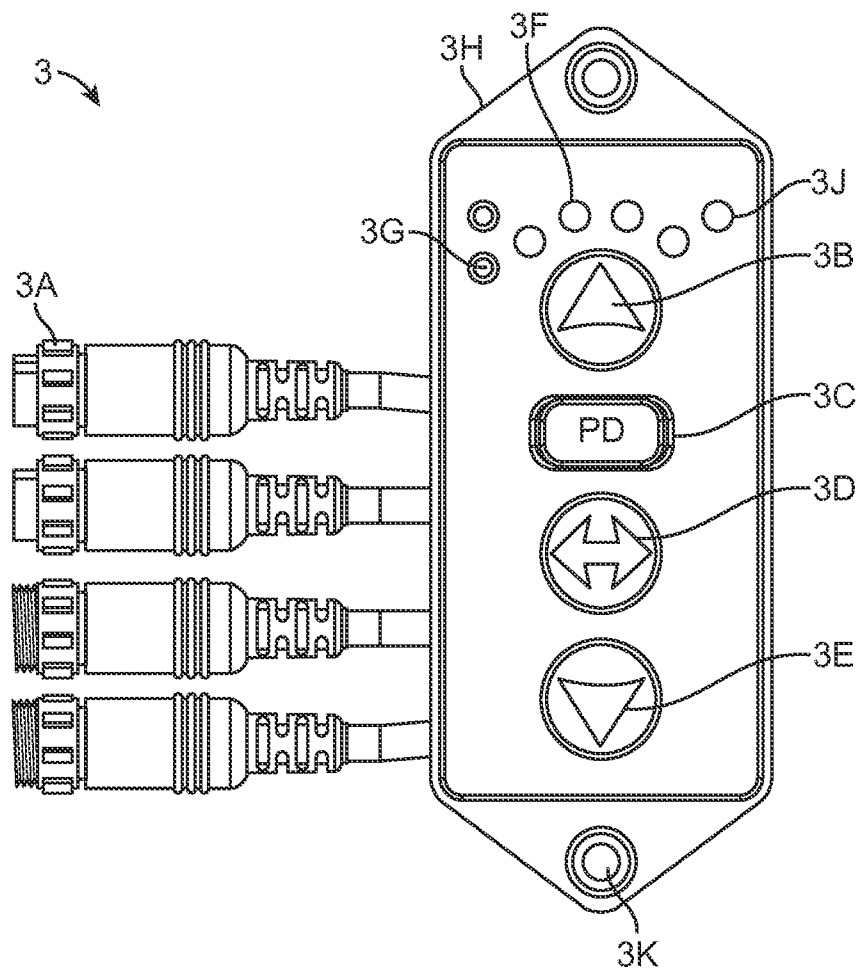


FIG. 4B

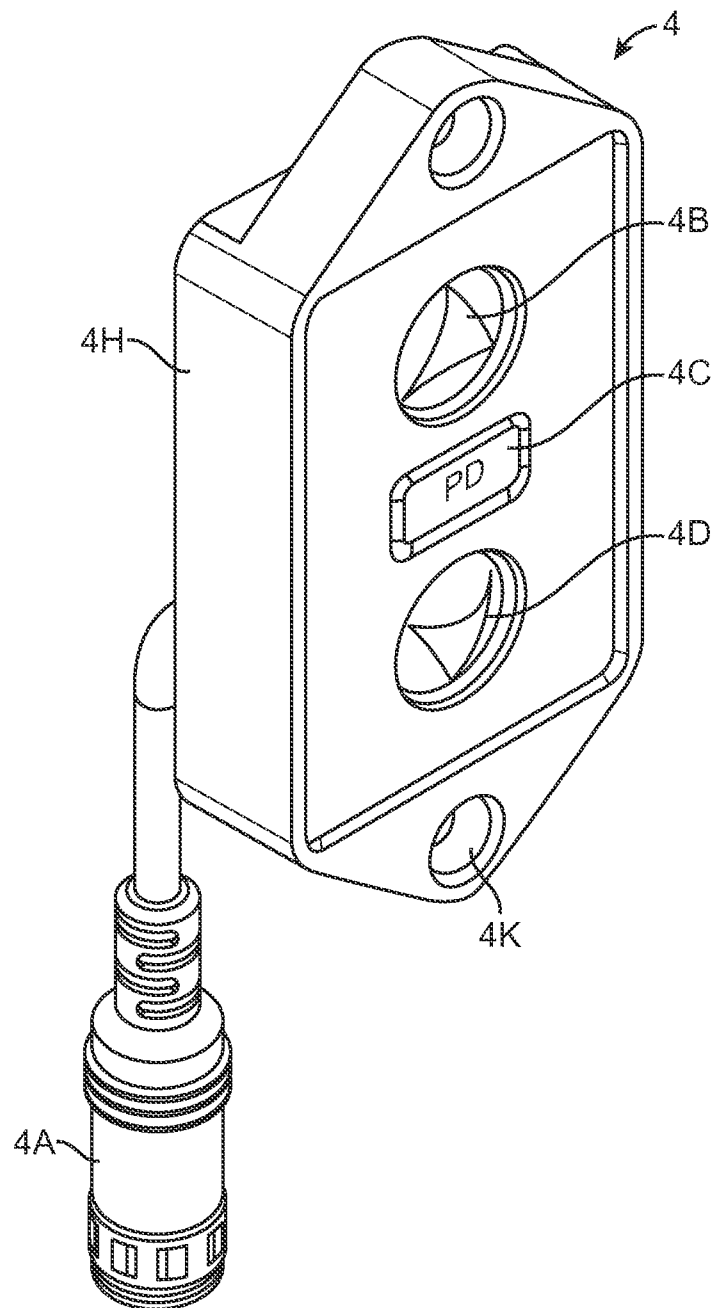


FIG. 5A

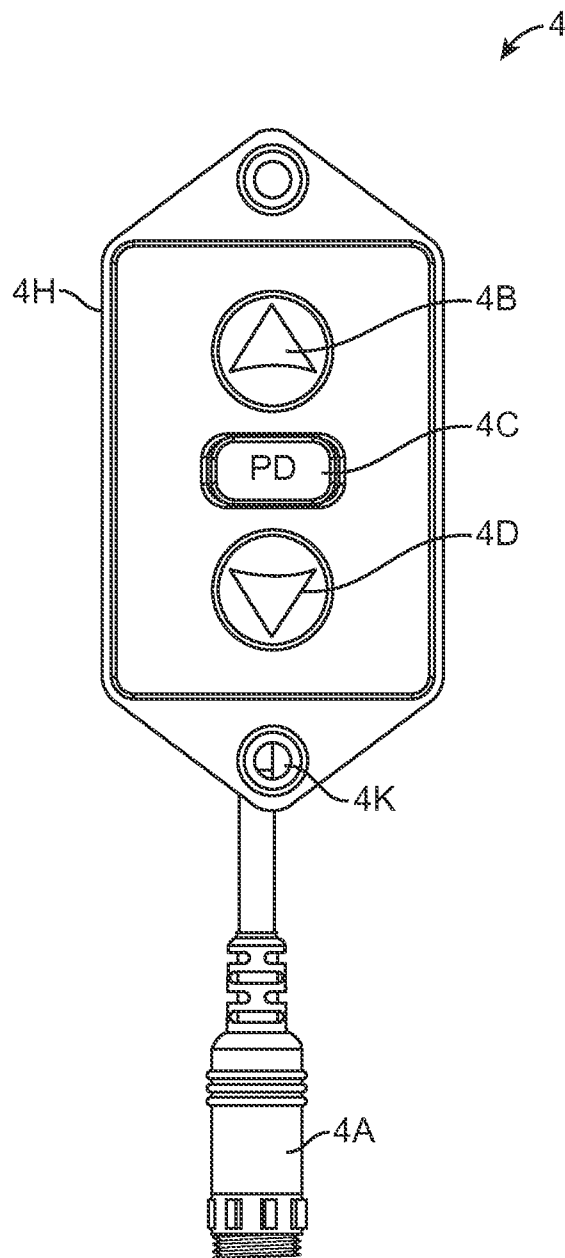


FIG. 5B

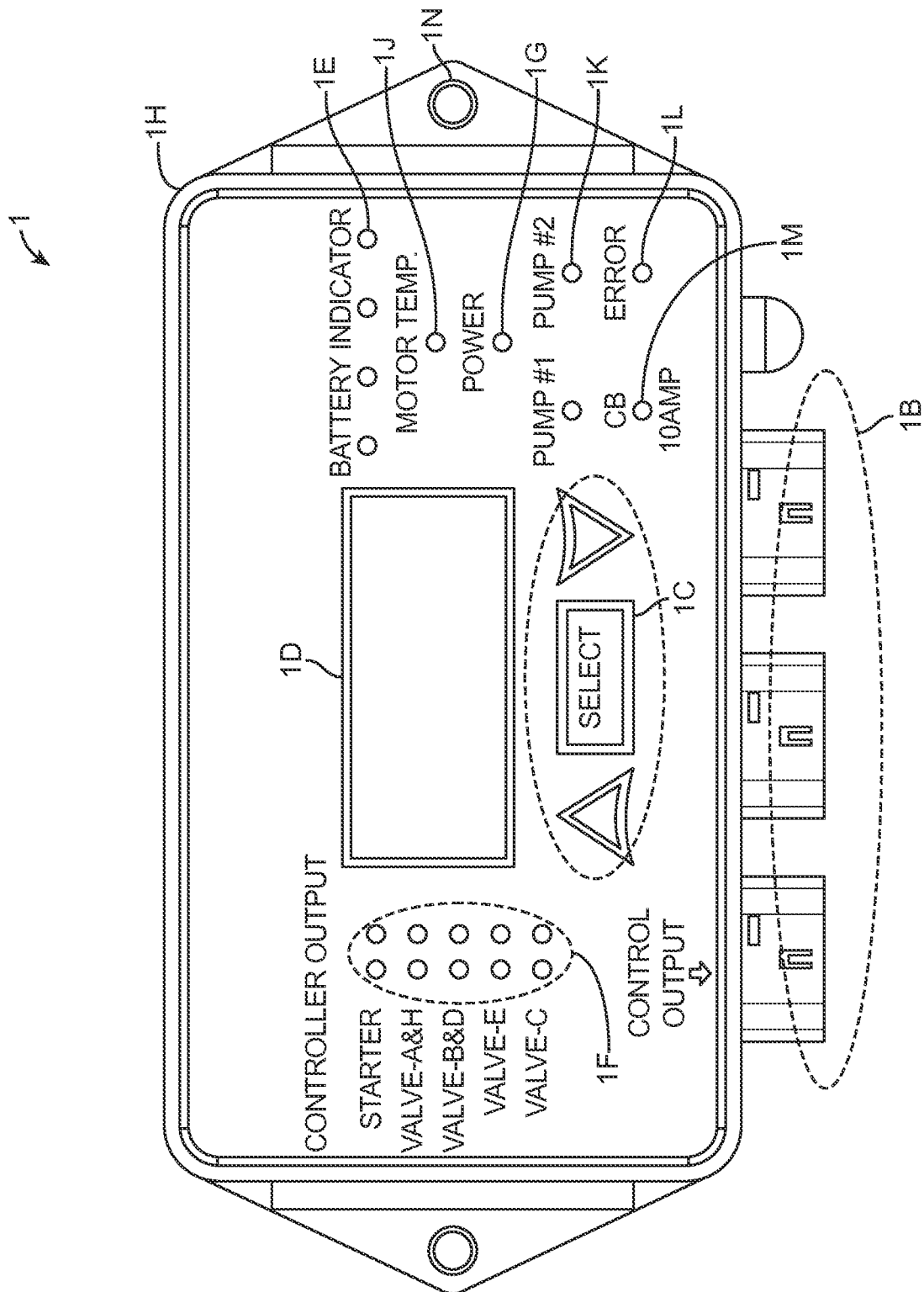


FIG. 6

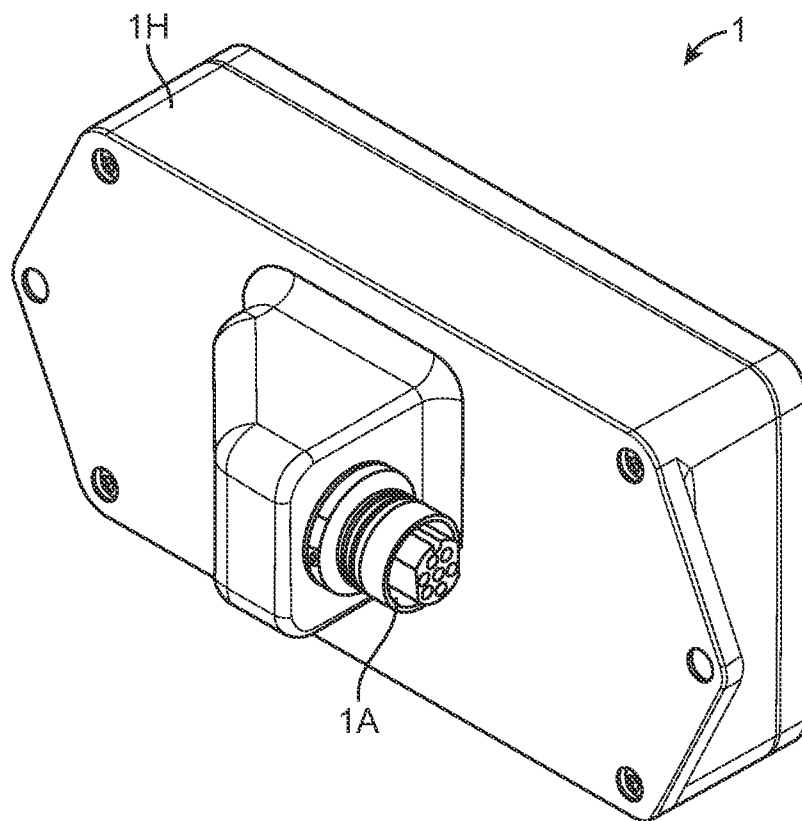


FIG. 7

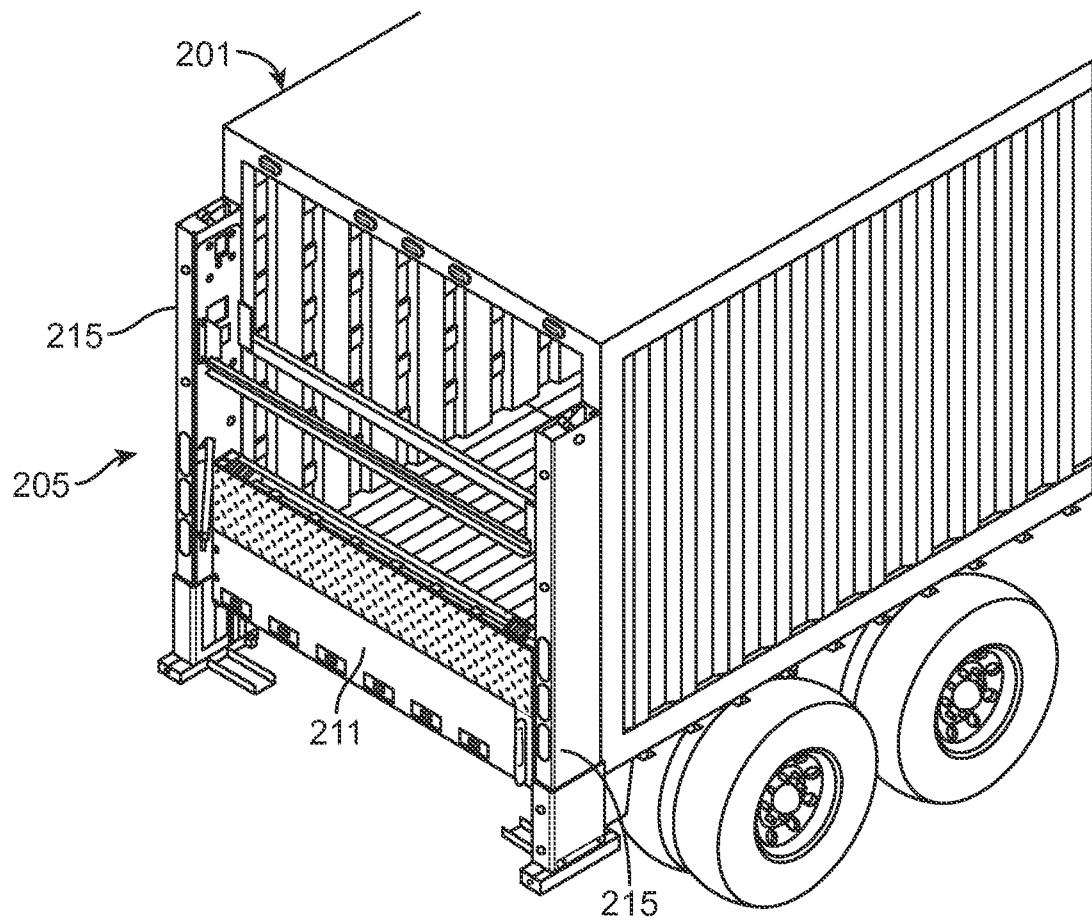


FIG. 8

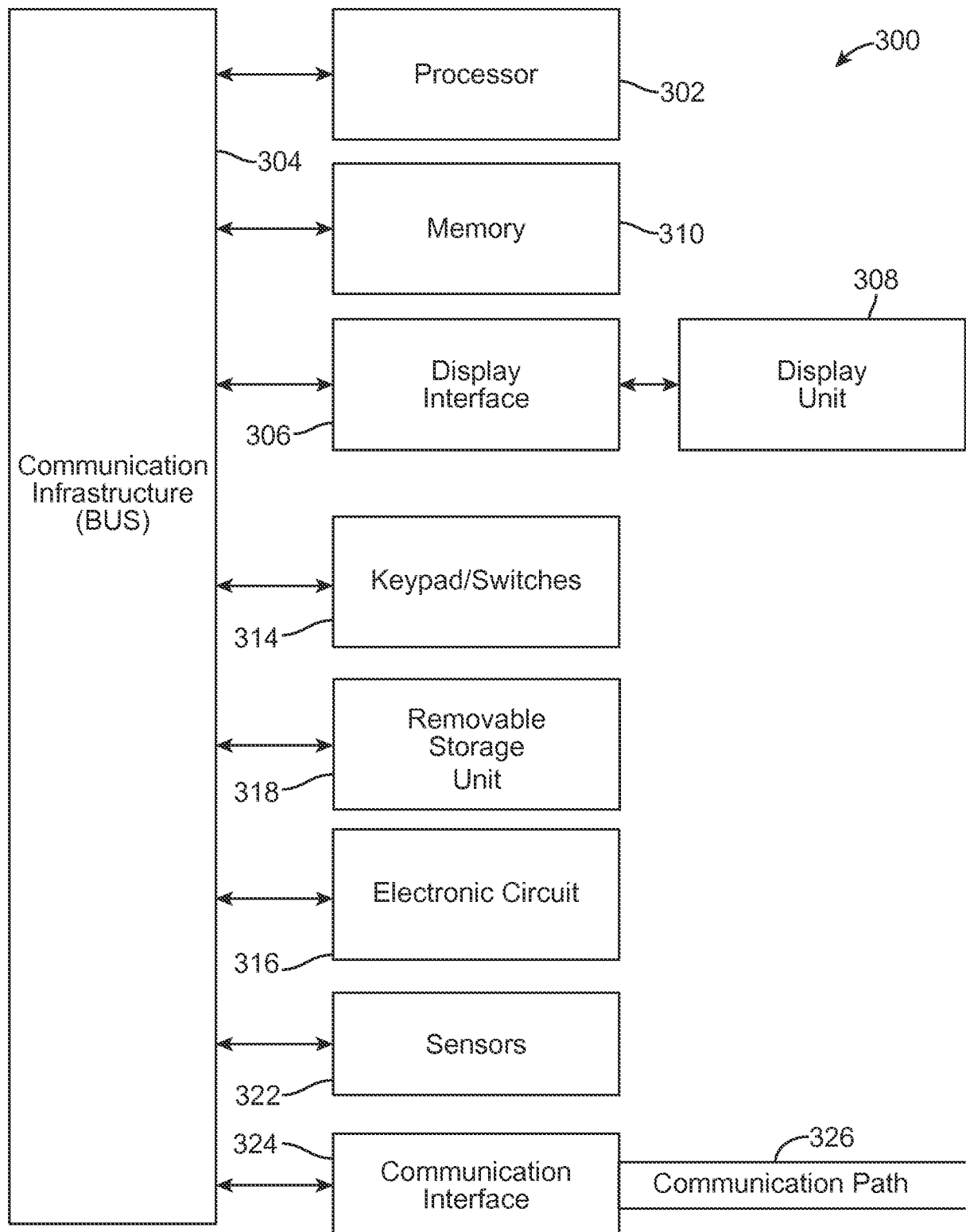


FIG. 9

Table 1

Main Switch	Starter Solenoid voltage drop%	Valves Solenoid voltage drop %					
		A	B	C	D	E	H
Up	3%- 5%	-	-	-	-	-	-
Down	3%- 5%	-	5%-10%	5%-10%	5%-10%	-	-
Unfold	3%- 5%	10%-15%	-	-	-	10%-15%	10%-15%
Fold	3%- 5%	-	-	-	-	3%-5%	-

Table 2

Runner Switch	Starter Solenoid voltage drop%	Valves Solenoid voltage drop %					
		A	B	C	D	E	H
Up	5%- 10%	-	-	-	-	-	-
Down	5%- 10%	-	10%-15%	10%-15%	5%-10%	-	-

FIG. 10

Table 3

Main Switch	Starter Solenoid voltage drop%	Valves Solenoid voltage drop %					
		A	B	C	D	E	H
Up	Under 0.2%	-	-	-	-	-	-
Down	Under 0.2%	-	Under 0.3%	Under 0.3%	Under 2.0%	-	-
Unfold	Under 0.2%	Under 0.2%	-	-	-	Under 0.2%	Under 0.2%
Fold	Under 0.2%	-	-	-	-	Under 0.2%	-

Table 4

Runner Switch	Starter Solenoid voltage drop%	Valves Solenoid voltage drop %					
		A	B	C	D	E	H
Up	Under 0.2%	-	-	-	-	-	-
Down	Under 0.2%	-	Under 0.3%	Under 0.3%	Under 2.0%	-	-

FIG. 11

INTERNATIONAL SEARCH REPORT

International application No.

PCT/US14/26794

A. CLASSIFICATION OF SUBJECT MATTER

IPC(8) - B65F 1/00, 3/00 (2014.01)

USPC - 701/50; 414/539, 545

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC(8): B60P 1/00; B60R 22/00; B65F 1/00, 3/00; G06F 7/70, 11/30, 19/00 (2014.01)

USPC: 414/538, 539, 540, 545, 546, 812; 701/49, 50, 99; 702/182

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

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

MicroPatent (US-G, US-A, EP-A, EP-B, WO, JP-bib, DE-C,B, DE-A, DE-T, DE-U, GB-A, FR-A); ProQuest; IEEE; Google/Google Scholar; lift*, gate*, controller*, operator*, command*, switch*, user*, plug*, unplug*, connector*

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X ----- Y	US 2012/0218092 A1 (ABLABUTYAN, K) 30 August 2012, Abstract, Figures 1-6, Paragraphs [0006], [0018]-[0024], [0026]-[0028], [0041], [0045]-[0047].	1-3, 6-8 ----- 4, 5
Y	US 2011/0113174 A1 (FANG, W et al.) 12 May 2011, Abstract, Figures 6, 7, Paragraphs [0006], [0015], [0016], [0019].	4, 5
A	US 2009/0240402 A1 (LUGASH, C et al.) 24 September 2009, entire document.	1-8
A	US 2010/0322751 A1 (BARK, P et al.) 23 December 2010, entire document.	1-8

☐ Further documents are listed in the continuation of Box C.

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"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search

07 July 2014 (07.07.2014)

Date of mailing of the international search report

19 AUG 2014

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