

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

TEXTRON SPECIALIZED VEHICLES INC.

Petitioner

v.

SZ DJI TECHNOLOGY CO. LTD.

Patent Owner

Case IPR2023-01198
U.S. Patent No. 10,640,224

**PETITION FOR *INTER PARTES* REVIEW
OF U.S. PATENT NO. 10,640,224**

Submitted Electronically

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EXHIBIT LIST

Exhibit	Description
1001	U.S. Patent No. 10,640,224 (“the ’224 Patent”)
1002	Declaration of Dr. Regan Zane
1003	File History for the ’224 Patent
1004	Certified English Translation of Japanese Patent Application No. H05-39875 (“Takashi”)
1005	Japanese Patent Application No. H05-39875 (“Takashi”)
1006	Certified English Translation of Japanese Patent Application No. 2011-193653 (“Onishi”)
1007	Japanese Patent Application No. 2011-193653 (“Onishi”)
1008	U.S. Patent No. 8,330,419 (“Kim”)
1009	Complaint, <i>SZ DJI Technology Co. Ltd. v. Textron Specialized Vehicles Inc.</i> , Case No. 1:23-cv-00055 (DE), Dkt. 1, filed January 17, 2023
1010	Defendants’ Opening Brief in Support of its Motion to Dismiss for Failure to State a Claim, <i>SZ DJI Technology Co. Ltd. v. Textron Specialized Vehicles Inc.</i> , Case No. 1:23-cv-00055 (DE), Dkt. 27, filed June 7, 2023
1011	Amended Complaint, <i>SZ DJI Technology Co. Ltd. v. Textron Specialized Vehicles Inc.</i> , Case No. 1:23-cv-00055 (DE), Dkt. 21, filed May 17, 2023
1012	AUSTIN HUGHES, ELECTRIC MOTORS AND DRIVES: FUNDAMENTALS, TYPES AND APPLICATIONS (3 rd ed. 2006)
1013	DAVIDE ANDREA, BATTERY MANAGEMENT SYSTEMS FOR LARGE LITHIUM-ION BATTERY PACKS (2010)

I. INTRODUCTION

Textron Specialized Vehicles, Inc. (“Petitioner”) submits this petition for Inter Partes Review (“IPR”) of Claims 1-17 of U.S. Patent 10,640,224 (the “’224 Patent”). Claims 1 and 12 of the ’224 Patent are directed to the concept of modifying motor control signals by a “compensation amount” based on a determined battery characteristic (such as a battery voltage). The specification of the ’224 Patent explains that the compensation amount may be calculated to modify the motor control signal “such that the control signal of the motor is prevented from fluctuating along with the change of the electrical parameter of the battery.” EX1001, 4:22-29. Claim 9 differs from Claims 1 and 12 in that it specifies a “*voltage* compensation amount” is used to control the *output of a battery* (as opposed to the *input to the motor*) to maintain the output voltage of the battery stable.

The application resulting in the ’224 Patent was not filed until 2016, well after these motor control technologies were developed. Despite that, the ’224 Patent gained allowance without a single office action. *Infra* § V.B. While the Examiner did not locate prior art teaching “a compensation circuit” that has a compensation amount of a control signal or a voltage compensation amount, the prior art presented in this Petition, which was not before the Examiner, discloses all the elements of the challenged claims. EX1003 at 143; *infra* § VI (overview of Takashi, Onishi, and Kim).

As a result, the '224 Patent represents no novel or non-obvious advance over the prior art, and Petitioner respectfully requests institution of IPR and a finding that all challenged claims are unpatentable.

II. MANDATORY NOTICES UNDER 37 C.F.R. § 42.8

A. Real Party-in-Interest Under 37 C.F.R. § 42.8(b)(1)

Textron Specialized Vehicles Inc. is the Petitioner. No other parties exercised or could have exercised control over this Petition and no other parties funded or directed this Petition. Textron Specialized Vehicles Inc. further identifies Textron Inc. and Textron Innovations, Inc. as potential real-parties-in-interest.

B. Related Matters Under 37 C.F.R. § 42.8(b)(2)

SZ DJI Technology Co. Ltd. has asserted the '224 Patent in the following civil action: *SZ DJI Technology Co. Ltd. v. Textron Specialized Vehicles Inc.*, Case No. 1:23-cv-00055 (DE), filed January 17, 2023 (the "Delaware Litigation"). EX1011.

C. Lead and Back-Up Counsel Under 37 C.F.R. § 42.8(b)(3)

Petitioners provide the following designation of counsel.

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D. Service Information Under 37 C.F.R. § 42.8(b)(4)

A copy of this entire Petition, including all Exhibits and a Power of Attorney, is being served by FEDERAL EXPRESS, costs prepaid, to the address of the attorney or agent of record for Patent Owner at the USPTO for the '224 Patent:

Anova Law Group, PLLC
21495 Ridgetop Circle, Suite 300
Sterling, VA 20166

Petitioner consents to electronic service at the e-mail addresses provided above for lead and back-up counsel. A Power of Attorney is filed concurrently herewith under 37 C.F.R. § 42.10(b).

III. FEES

The Office is authorized to charge the fee in 37 C.F.R. § 42.15(a) to Deposit Account No. 02-0384 and any additional fees that are due.

IV. REQUIREMENTS UNDER 37 C.F.R. § 42.104

A. Grounds for Standing

Petitioner certifies that the '224 Patent is eligible for IPR, and that Petitioner is not barred or otherwise estopped.

B. Priority Date

The '224 Patent is a continuation of a PCT Application filed on March 1, 2016. Because all prior art relied on in the instant petition pre-dates March 1, 2016, Petitioner presumes without conceding that it is the priority date for the '224 Patent.

C. Prior Art

Exhibits 1004 and 1005 – Japanese Patent Application No. H05-39875 to Takashi (“Takashi”) was filed March 1, 1993 and published on September 9, 1994. EX1005. Exhibit 1004 is a certified English translation of Takashi, and Exhibit 1005 is the original Japanese version of Takashi. Takashi qualifies as prior art under at least 35 U.S.C. § 102(a)(1).

Exhibits 1006 and 1007 – Japanese Patent Application No. 2011-193653 to Onishi (“Onishi”) was filed on March 15, 2010 and published on September 9, 2011. Exhibit 1006 is a certified English translation of Onishi, and Exhibit 1007 is the original Japanese version of Onishi. Onishi qualifies as prior art under at least 35 U.S.C. § 102(a)(1).

Exhibit 1008 – United States Patent No. 8,330,419 to Kim et al. (“Kim”) was filed on April 9, 2010 and issued on December 11, 2012. Kim claims priority to U.S. Provisional Application No. 61/168,472, filed on April 10, 2009. Kim qualifies as prior art under 35 U.S.C. §§ 102(a)(1) and 102(a)(2).

D. Identification of Challenge and Statement of Precise Relief

Requested

Petitioner requests cancellation of Claims 1-17 (collectively, “Challenged Claims”) of the ’224 Patent, assigned to SZ DJI Technology Co., Ltd. (“Patent Owner” or “PO”) on the following grounds. Submitted with this Petition is a declaration of Dr. Regan Zane (EX1002), a qualified technical expert.

Ground	Claims	Basis for Challenge
1A	1-4, 6-8, 12-17	Claims 1-4, 6-8 and 12-17 are Anticipated by Takashi
1B	1-8, 12-17	Claims 1-8 and 12-17 are Obvious Over Takashi
2A	9-11	Claims 9-11 are Anticipated by Onishi
2B	9-11	Claims 9-11 are Obvious Over Onishi
3A	9-11	Claims 9-11 are Anticipated by Kim
3B	9-11	Claims 9-11 are Obvious Over Kim

E. Institution is Proper Under § 314(a)

The *General Plastic* factors favor institution. This is the first and only petition challenging the ’224 Patent. The *Fintiv* factors also favor institution. Petitioner submits that the Board should not exercise its discretion because the merits of this petition are compelling. Further, Petitioner filed this petition quickly, within six months of DJI filing its complaint in the District of Delaware. EX1009. The Delaware Litigation is just beginning. TSV has yet to answer the complaint and the

Court has yet to decide TSV's pending motion to dismiss. EX1010. Because that litigation is just beginning and the parties have invested minimal resources in the litigation, the *Fintiv* factors favor institution.

F. Institution is Proper Under § 325(d)

The Board should not exercise its discretion under 35 U.S.C. § 325(d). The prior art presented in this petition is materially different from and not cumulative to the prior art involved during examination (none of which was ever used in a rejection of any claim). None of the art presented in this petition was before the Examiner. *Infra* § V.B.

V. OVERVIEW OF THE '224 PATENT

A. Subject Matter of the '224 Patent

The '224 Patent relates to calculating a "compensation amount" that may be used "to prevent the rotation speed of the motor from being changed by the fluctuation of the battery voltage." EX1001, 1:15-16, 5:66-6:3. The '224 Patent explains that "a voltage of the battery continuously decreases during the discharging process. Compared with an original full voltage of the battery, the voltage outputted from the ESC [electronic speed controller] to the motor decreases as the battery voltage decreases, when the ESC receives a same throttle signal. Thus, the rotation speed of the motor decreases." EX1001, 1:28-33.

Claim 1 includes “obtaining a present electrical parameter of a battery [S101], calculating a compensation amount of a control signal of the motor according to the present electrical parameter [S102], and modifying the control signal according to the compensation amount [S103].” Corresponding method claim 12 includes “one or more processors” configured to perform the steps of claim 1.

Claim 9 includes calculation of “a voltage compensation amount of [a] battery according to [a] present electrical parameter” and “compensating an output voltage of the battery according to the voltage compensation amount to maintain the output voltage of the battery stable.” One example of this method claim includes a voltage sensor 24 that detects the output voltage of the battery. EX1001, 7:42-46.

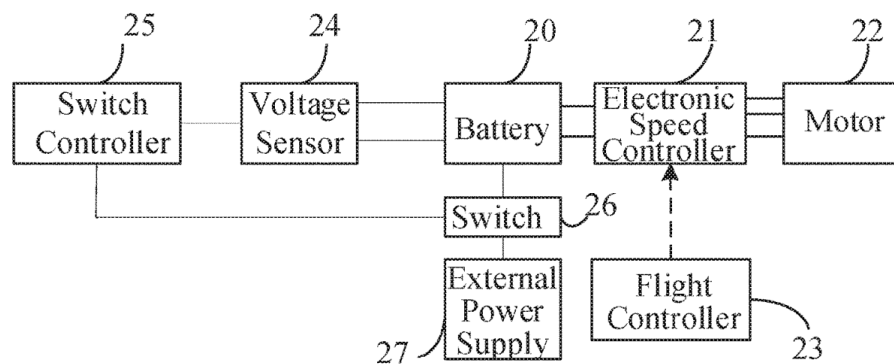


FIG. 7

EX1001, FIG. 7. “[A] magnitude of the present battery voltage may be transmitted to a switch controller 25, and the switch controller 25 may calculate an amplitude drop of the battery voltage.” EX1001, 7:54-61. As the battery voltage drops, the switch controller 25 turns on a switch 26 to electrically couple the battery 20 to the

external power supply 27, which compensates the battery 20 by a voltage that ensures that the output voltage of the battery is held stable. EX1001, 7:65-8:4.

B. '224 Patent Prosecution History

The USPTO Examiner never rejected any claims of the '279 Application. The prosecution history cites to seven U.S. patent documents and eleven foreign patent documents. EX1001 at (56). Nine of the foreign documents are in a foreign language (Chinese or Japanese) and not translated. *Id.* In the NOA, the Examiner commented that “no prior art has taught an identical or a similar method or apparatus of controlling a motor that includes a compensation circuit. The compensation circuit has a compensation control signal to compensate the voltage, or the current, or the charge, or the internal resistance of the battery.” EX1003 at 143. However, as discussed below, prior art that was not considered by the Examiner does in fact teach an identical method and apparatus of controlling a motor as claimed in the '224 Patent.

C. Level of Ordinary Skill in the Art

As of the earliest claimed priority date, a person of ordinary skill in the art (“POSITA”) would be a person with a B.S. degree in electrical engineering, mechanical engineering, computer engineering, or equivalent training or job experience, along with 1-2 years of experience in any of the fields of power electronics, motor control systems, and battery systems for electric motor

applications. EX1002, ¶ 40. Additional education could compensate for less practical experience and vice versa. *Id.*

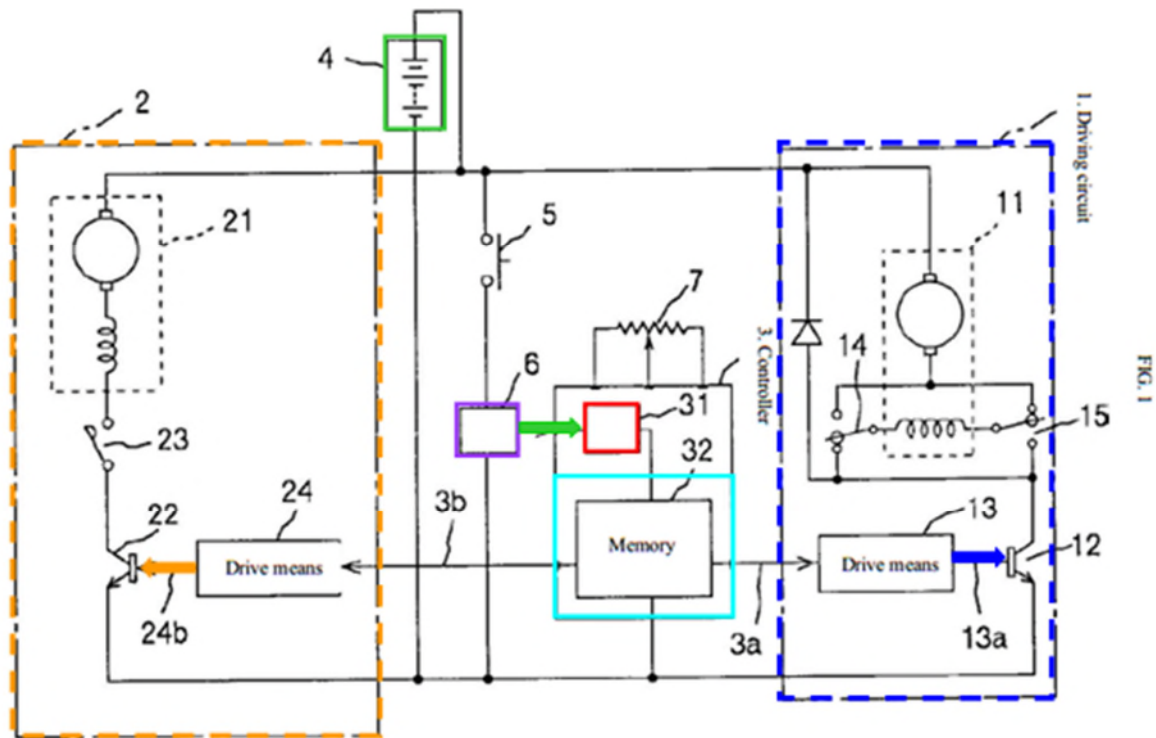
VI. SUMMARY OF PRIOR ART

A. Takashi

Takashi recognizes the same problems as those identified in the '224 Patent, explaining that battery vehicles use motors that are “rotation driven by a chopper circuit intermittently operated by a pulse signal,” and “the rotation speed thereof is controlled using the duty of the pulse signal.” EX1004, [0002]. The “maximum rotational speed of the motor is defined depending on battery voltage and for this chopper control method, the motor maximum rotational speed for a constant duty changes based on voltage” of the battery. EX1004, [0004]. As the battery charge decreases, the voltage decreases as well. *Id.* Takashi resolves these issues in the same way as the '224 Patent.

Like the motor control method and apparatus of claims 1 and 12, Takashi discloses “a motor control device of a battery vehicle and in particular to a device that enables obtaining a constant sense of operation regardless of battery charge state.” EX1004, [0001]. More specifically, Takashi’s “controller 3 has **detecting means 31** for detecting the output of the **constant voltage power supply circuit 6** as the **voltage** of the **battery 4**.” EX1004, [0012]. “Each of the detection values of the detecting means 31 is process[ed] using **duty setting means** for commanding each of

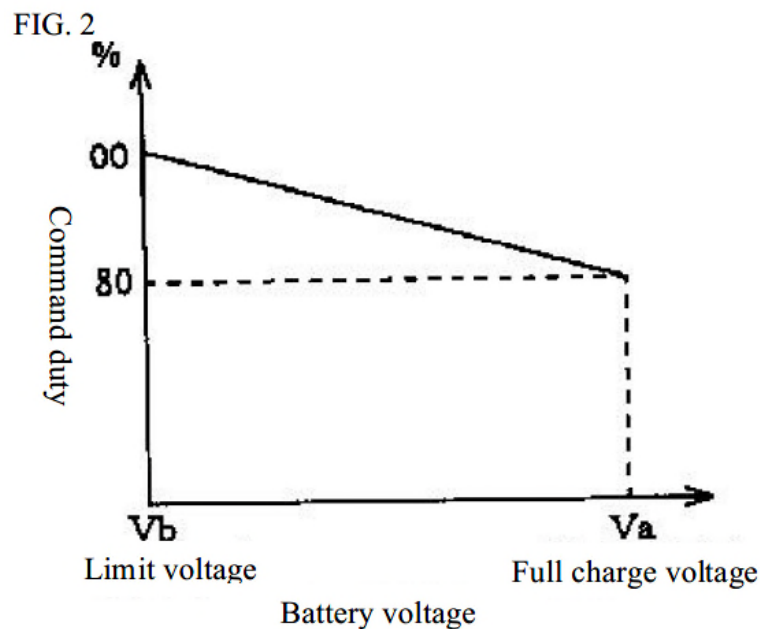
the duties of the pulse signals 13a and 24b in the driving circuit 1 and the cargo handling circuit 2.” EX1004, [0012].



EX1004, FIG. 1 (annotated). “This duty setting means reads and controls from the memory 32, control characteristics (FIG. 2) in which command duty¹ is increased inversely proportional to voltage characteristics where the voltage of the battery 4 drops from fully charged voltage characteristic to the limit voltage at 80%

¹ Takashi uses the terms “command duty” and “duty command” interchangeably. EX1002, ¶ 50; EX1004 [0009] (using a “duty command” from a controller 3), [0012] (setting a “command duty” by a controller).

discharge.” EX1004, [0012].



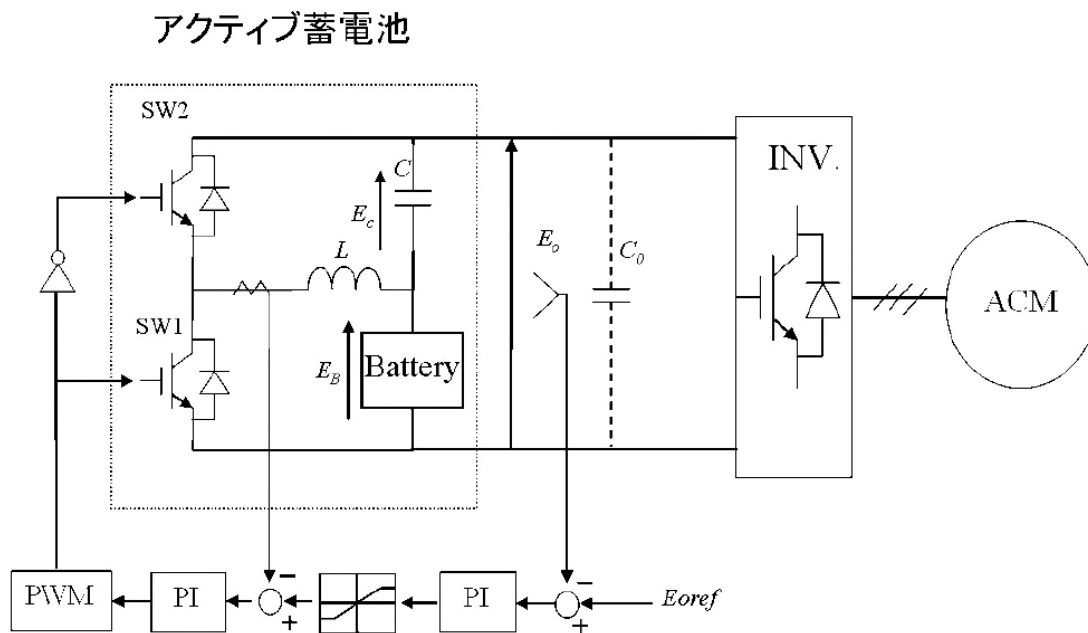
EX1004, FIG. 2.

B. Onishi

Like the method for controlling a battery output voltage disclosed in claim 9, Onishi discloses “a **storage battery system** that maintains a constant terminal voltage until the remaining capacity is exhausted, even if the terminal voltage of the storage battery drops due to advancement of discharge of the storage battery.” EX1006, [0007]. The storage battery system maintains a constant direct current **output voltage** applied to a load 40 by controlling a switching power converting device 30 that performs charging and discharging between the storage battery and a capacitor based on a switching signal from a control block 50. EX1006, [0010].

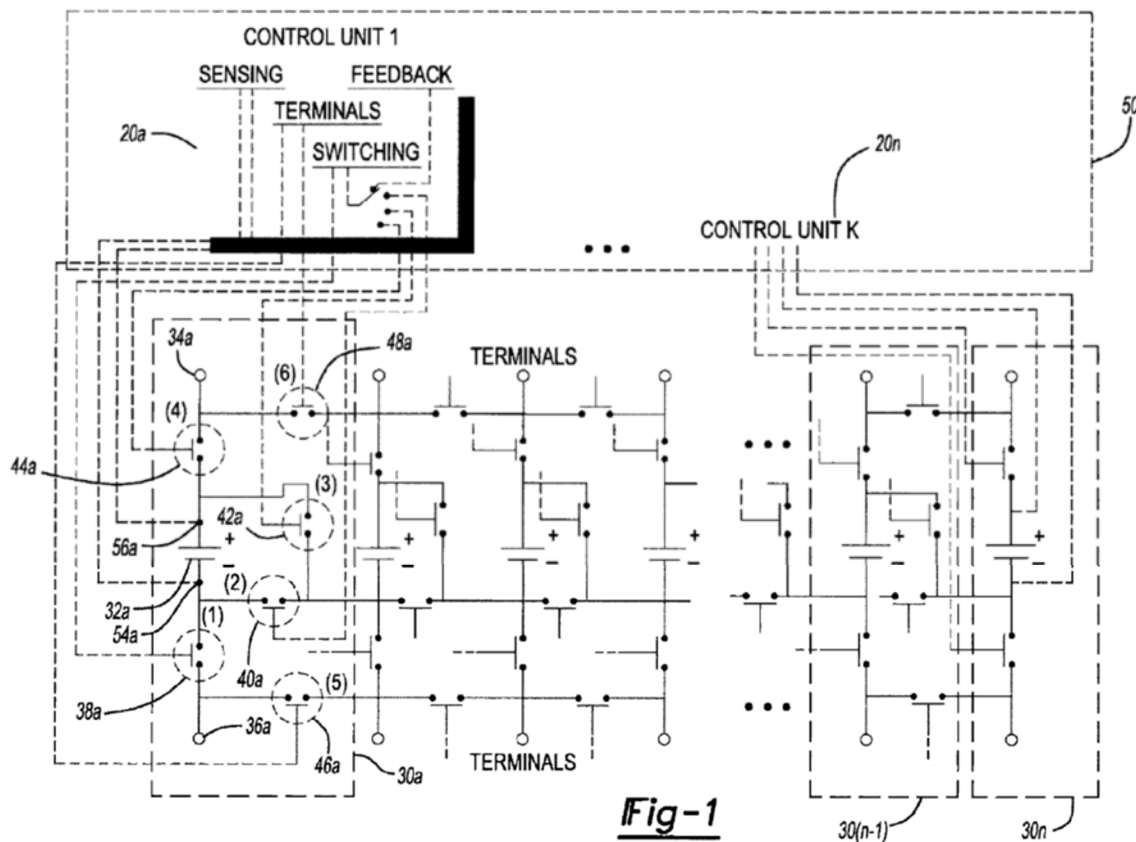
connected in series.” EX1006, [0011]. The storage battery may be used as a power source for driving an electric vehicle motor (ACM). EX1006, [0024], FIG. 7.

【 図 7 】



C. Kim

Kim describes a “reconfigurable battery system” that can be used to control a motor, for example, of an electric vehicle. EX1008, 11:34-44, 12:32-36; *id.* at 1:21-2:5. Kim’s battery system includes a “battery pack” with “battery circuits 30a-30n” each having “an associated control module 20a-20n” and a “battery cell 32a.” *Id.*, 4:22-27, 4:42-67. Control units 20a-20n configure the switches in the plurality of battery circuits to form different circuit arrangements by switching the battery cells in series or parallel with neighboring cells or by bypassing certain cells. *Id.*, 5:1-25.



EX1008, Fig-1.

During operation, a respective control module “monitors changes in the ... voltage of its battery cells via sensing devices 54a-54n and 56a-56n” and “controls switches in the battery circuit in accordance with the operational state.” *Id.*, 5:60-6:16. For example, if the supply voltage of a battery pack is less than a demand voltage, Kim’s battery system may trigger a “reconfiguration event” that “causes a controller to change the topology of the battery circuits” according to “one of two policies.” *Id.*, 6:40-7:10, 8:11-19. If the “constant-voltage keeping policy” is applied, the battery connectivity is reconfigured to compensate for the voltage drop

below the demand voltage or above an upper bounds and keep the supply voltage constant. *Id.*, 6:65-7:42, 8:11-19, 15:45-16:7.

VII. CLAIM CONSTRUCTION

Without conceding that the claims satisfy 35 U.S.C. § 112, Petitioner respectfully submits that the Board need not expressly construe any term because the prior art invalidates the claims under any plausible construction, in accordance with 37 C.F.R. § 41.100(b). EX1002, ¶ 55.

VIII. A REASONABLE LIKELIHOOD EXISTS THAT THE CHALLENGED CLAIMS ARE UNPATENTABLE

Pursuant to 37 C.F.R. § 42.104(b)(4)-(5), all Challenged Claims are unpatentable for the reasons set forth below.

A. Grounds 1A and 1B: Claims 1-8 and 12-17 are (1A) Anticipated by or (1B) Obvious in View of Takashi

1. Claim 1

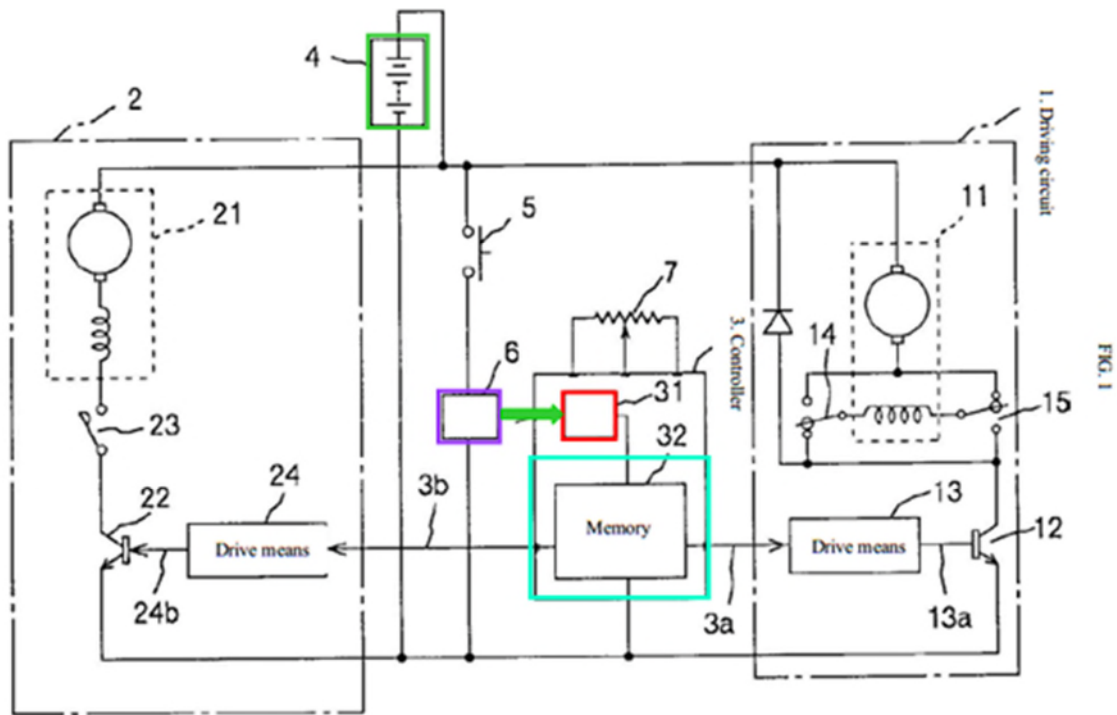
a) 1[pre] A method for controlling a motor comprising:

Takashi discloses the preamble to the extent that it is limiting. EX1002, ¶ 58. Takashi discloses “a motor control device of a battery vehicle and in particular [] a device that enables obtaining a constant sense of operation regardless of battery charge state.” EX1004, [Abstract]. The motor control device of Takashi includes “detecting means for detecting battery voltage and duty setting means for commanding that the duty of the pulse signal be increased inversely proportional to

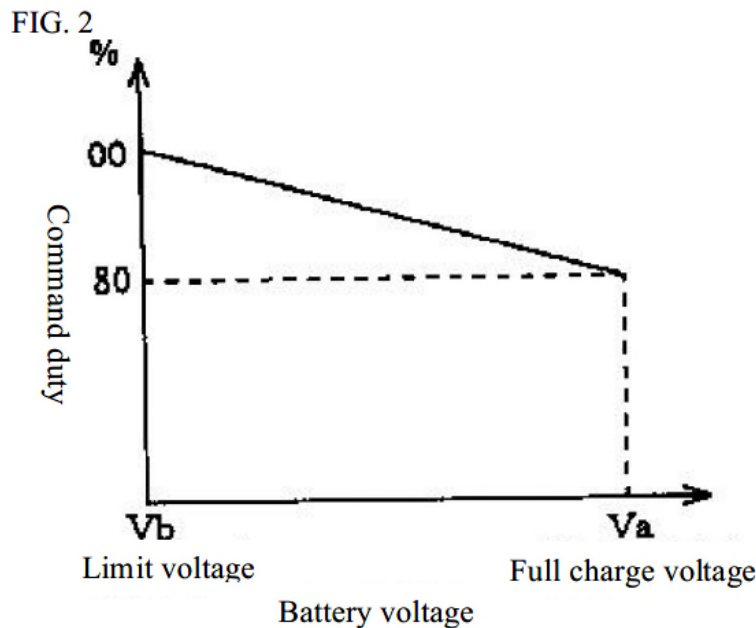
a voltage drop characteristic from the voltage when the battery is fully charged to the limit voltage, based on the detection values from the detecting means.” *Id.*, [0007]. Takashi’s maintenance (*i.e.*, control) of the rotational speed of a motor relative to battery voltage discloses a method of controlling a motor. EX1002, ¶ 58.

b) 1[a] obtaining a present electrical parameter of a battery;

Takashi’s use of a detecting means 31 to detect the current battery voltage is a method of obtaining a present electrical parameter (*i.e.*, voltage) of a battery. Takashi discloses obtaining the electrical parameter of a battery through use of a control apparatus (*i.e.*, the duty setting means of a controller 3) and an electrical parameter sensor (*i.e.*, a detecting means 31). Annotated FIG. 1 of Takashi discloses a motor control device for an electric forklift including a controller 3 and a battery 4:



“The controller 3 is connected to a constant voltage power supply circuit 6 that supplies voltage from the battery 4,” and includes a “detecting means 31 for detecting the output of the constant voltage power supply circuit 6 as the voltage of the battery 4.” EX1004, [0012]. The controller 3 detects a detection voltage V_a when the battery 4 is fully charged and a detection voltage V_b when the battery 4 reaches the limit voltage. EX1004, [0014]-[0015]. The controller 3 additionally “detects the voltage between the detected value V_a to V_b at the resolution defined by the detection capability of the detecting means 31.” *Id.*, [0015], FIG. 2.



Thus, Takashi's use of a detecting means 31 to detect the current battery voltage is a method of obtaining a present electrical parameter (*i.e.*, voltage) of a battery. EX1002, ¶¶ 60-62.

Takashi further discloses that “[e]ach of the detection values of the detecting means 31 is process[ed] using **duty setting means** for commanding each of the duties of the pulse signals 13a and 24b in the driving circuit 1 and the cargo handling circuit 2. This duty setting means reads and controls from the memory 32, control characteristics (FIG. 2) in which command duty is increased inversely proportional to voltage characteristics where the voltage of the battery 4 drops from fully charged voltage characteristic to the limit voltage at 80% discharge....” EX1004, [0013]. Takashi's use of a duty setting means to read the detected battery voltage (*i.e.*,

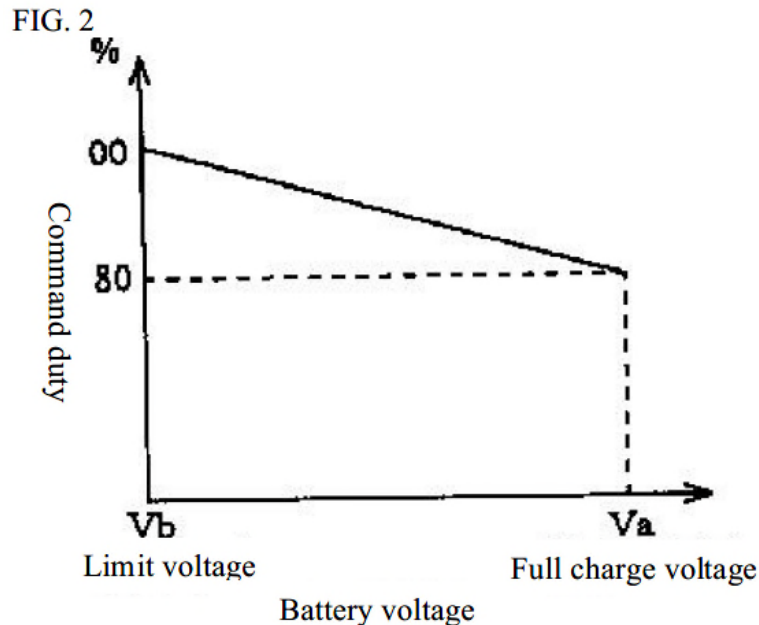
“voltage characteristic”) also discloses a method of obtaining a present electrical parameter (*i.e.*, voltage) of a battery. EX1002, ¶ 63.

c) 1[b] calculating a compensation amount of a control signal of the motor according to the present electrical parameter;

Takashi’s use of the duty setting means to read pre-calculated command duties stored in memory and/or calculate a percent command duty according to the detected battery voltage discloses “calculating a compensation amount.” Takashi explains that in battery-driven vehicles “a DC motor is rotation driven by a chopper circuit intermittently operated by a pulse signal, and the rotation speed thereof is controlled using the duty of the pulse signal. Furthermore, the duty of the pulse signal is commanded by a controller having a central processing function.” EX1004, [0002]. However, Takashi recognizes that “maximum rotational speed of the motor is defined depending on battery voltage and for this chopper control method, the motor maximum rotational speed for a constant duty changes based on voltage within the operating range.” EX1004, [0005]. Thus, Takashi proposes a “detecting means for detecting battery voltage and duty setting means for commanding that the duty of the pulse signal be increased inversely proportional to a voltage drop” of the battery. EX1004, [0007].

Specifically, FIG. 2 of Takashi illustrates a method by which a command duty is increased inversely proportional to battery 4 voltage drop starting with a fully

charged voltage V_a to the limit voltage V_b (in this example, 80% discharge).
EX1004, [0013].



For example, when Takashi's detecting means 31 detects the battery 4 in a fully charged state V_a , "the [duty setting means of] the controller 3 reads data such as 80% as the command duty" and supplies this data "to the drive means 24 as the control signal 3b. Thus, the drive means 24 outputs a pulse signal 24b with a duty of 80% and the transistor 22 supplies current to the DC motor 21 with intermittent operation of 80% ON time." EX1004, [0014]. Similarly, when the battery 4 reaches the limit voltage V_b , "the [duty setting means of the] controller 3 reads data setting command duty to 100% and the control signal 3b based on this data is supplied to the drive means 24 and the DC motor 21 drives the hydraulic pump at a maximum rotational speed corresponding to a duty of 100%." EX1004, [0015]. Takashi discloses that

the duty setting means similarly uses the data read from memory 32 to supply control signal 3a to the drive means 13 of the driving circuit 1. *Id.*, [0013]; EX1002, ¶ 65.

Takashi notes that for some embodiments the “control characteristics of the duty command to the driving circuit 1 are written to the memory 32 in advance” (*i.e.*, the characteristics are calculated in advance) and in other embodiments, “the same control characteristics may be calculated through computation.” EX1004, [0017]. An example of calculating control characteristics includes “calculating each command duty and accelerator depression angle data for the offset setting point O as well as command duty relative to each accelerator depression angle based on the detection value of battery voltage corresponding to duty gradient.” *Id.*

Thus, Takashi’s use of the duty setting means to read pre-calculated command duties stored in memory and/or calculate a percent command duty according to the detected battery voltage discloses “calculating a compensation amount.” As shown in FIG. 2 and described throughout the disclosure, Takashi’s duty setting means calculates a command duty as a percentage amount from 80-100% to compensate for battery discharge according to the detected battery voltage. EX1002, ¶ 67.

Takashi’s command duty is a compensation amount “of a control signal of a motor” because the command duty is used by the duty setting means of the controller 3 to determine control signals 3a and 3b, which are used to drive motors 11 and 21 (with control signals 3a and 3b each being the claimed “control signal,” as explained

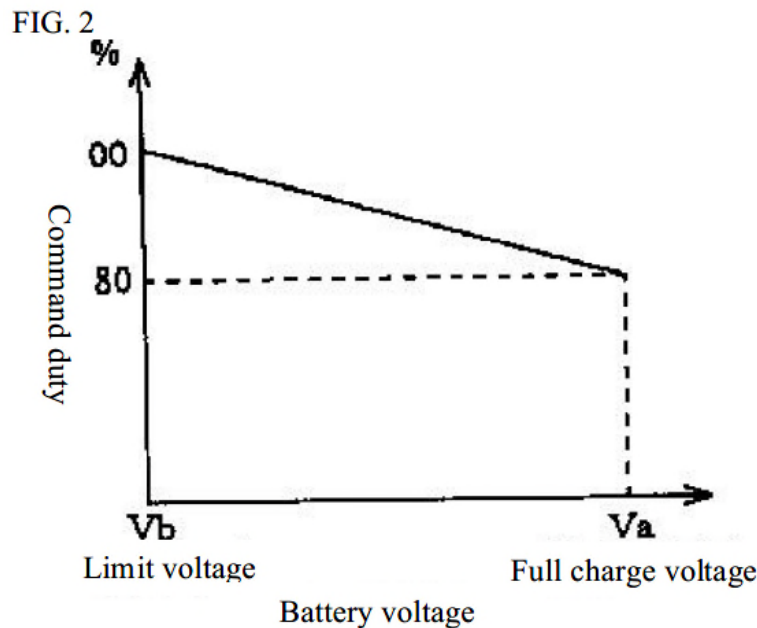
further below for element 1[c]). EX1002, ¶ 68. Finally, the command duty is calculated “according to the present electrical parameter” because, as shown in FIG. 2, the duty setting means calculates the command duty based on the detected battery voltage (*i.e.*, a voltage between V_a to V_b). *Id.*

In addition, and as an alternative, pulse signals 13a and 24b output from the duty setting means each also disclose the claimed “control signal,” as discussed further below for element 1[c]. EX1002, ¶ 69. Takashi explains that the controller 3 reads the percent command duty data and then supplies the percent command duty data to the drive means 24 as the control signal 3b (and similarly provides control signal 3a to the drive means 13). EX1004, [0014]. And as explained above, Takashi further elaborates that the control signals 3a and 3b are “based” on the percent command duty data. *Id.*, [0015]. In this alternative mapping, Takashi’s calculated command duty and the control signals 3a and 3b that result from this calculated command duty serve as a compensation amount of pulse signals 13a and 24b (“a control signal of the motor”) because the control signals 3a and 3b, and the command duty represented in those control signals 3a and 3b, are used to determine the pulse signals 13a and 24b that control motors 11 and 21 (with pulse signals 13a and 24b each being the claimed “control signal” in this alternative mapping, as explained further with respect to element 1[c]). EX1002, ¶ 69. Finally, the control signals 3a and 3b are calculated “according to the present electrical parameter” because the

control signals 3a and 3b are calculated by the duty setting means based on the command duty, which in turn is calculated based on the detected battery voltage (*i.e.*, a voltage between V_a to V_b). EX1002, ¶ 69.

d) 1[c] modifying the control signal according to the compensation amount.

As discussed under element 1[b], Takashi discloses the claimed control signal in two different ways: either as one or both of the control signals 3a and 3b or as one or both of the pulse signals 13a and 24b. With respect to the mapping where control signals 3a and 3b are the claimed control signals, Takashi discloses that the duty setting means of the controller calculates a command duty between 80-100%, in a relationship that is inversely proportional to the detected voltage, which the duty setting means then supplies as control signals 3a and 3b to the drive means 13 and 24. EX1004, FIG. 2, [0014]-[0015].



For example, based on a detected value V_a , the duty setting means of the controller 3 determines an 80% command duty, which it supplies to the drive means 24 as control signal 3b. EX1004, [0014]. In addition, when “the [duty setting means of the] controller 3 reads data setting command duty to 100%,” “the control signal 3b based on this data is supplied to the drive means 24 and the DC motor 21 drives the hydraulic pump at a maximum rotational speed corresponding to a duty of 100%.” EX1004, [0015]. Because Takashi’s duty setting means modifies the control signals 3a and 3b according to the command duty between 80-100%, Takashi discloses this limitation. EX1002, ¶ 70.

With respect to the mapping where pulse signals 13a and 24b are the claimed control signals, the drive means’ modification of the pulse signals according to control signals 3a and 3b (which are themselves determined by the calculated

command duty) discloses this limitation. EX1002, ¶ 71. Takashi discloses that “[d]ata read from the memory 32 is supplied as control signals 3a and 3b that command duties of the drive means 13 of the driving circuit 1 and drive means 24 of the cargo handling circuit.” EX1004, [0013]. For example, “based on the detected value V_a , the controller 3 reads data such as 80% as the command duty,” which “is supplied to the drive means 24 as the control signal 3b,” which causes “the drive means 24 to output a pulse signal 24b with a duty of 80% and the transistor 22 supplies current to the DC motor 21 with intermittent operation of 80% ON time.” *Id.* Because the pulse signals control the transistors’ electrical supply to the motors, a POSITA would also understand the pulse signals to be “control signals.” EX1002, ¶ 71. Thus, the drive means’ modification of the pulse signals according to the control signals from the duty setting means also discloses this limitation. *Id.*

2. Claim 2: The method according to claim 1, wherein the present electrical parameter includes at least one of a present charge quantity of the battery, a present voltage of the battery, a present output electrical current of the battery, or a present internal resistance of the battery.

When a claim, such as this one, recites a list of multiple alternatives (*i.e.*, a “Markush” group), the entire element is disclosed by the prior art if one alternative is disclosed. *Fresenius USA, v. Baxter Int’l*, 582 F.3d 1288, 1297-98 (Fed. Cir. 2009); *Cisco Systems, Inc. v. WSOU Investments Inc.*, IPR2021-01117, Paper 28, 26 (PTAB Jan. 5, 2023). As discussed under element 1[a], the controller 3’s detecting

means and duty setting means obtain the present voltage of the battery 4. EX1004, [0012], [0015], FIG. 2. Takashi thus discloses a present electrical parameter that includes a present voltage of the battery.

3. Claim 3: The method according to claim 2, wherein the control signal includes at least one of a control signal configured to control a rotation speed of the motor or a control signal configured to control an output power of the motor.

As discussed under elements 1[b]-1[c], Takashi discloses the claimed “control signals” in two different ways: as control signals 3a and 3b and as pulse signals 13a and 24b. Each of these signals are configured to control the rotation speed of the motor, one of the two alternatives in the claimed Markush group, and therefore satisfies Claim 3.

Takashi discloses that “[d]ata read from the memory 32 is supplied as control signals 3a and 3b that command duties of the drive means 13 of the driving circuit 1 and drive means 24 of the cargo handling circuit 2.” EX1004, [0018]. Takashi further discloses that “duty commanded is increased with characteristics inverse to battery voltage characteristics within operation limits so maximum rotational speed of the motor dependent on battery voltage is practically constant relative to battery voltage within operation limits, enabling obtaining stable operability regardless of battery state of charge.” EX1004, [0018]; *id.*, [0008]. Takashi further discloses that “a DC motor is rotation driven by a chopper circuit intermittently operated by a pulse

signal, and the rotation speed thereof is controlled using the duty of the pulse signal. Furthermore, the duty of the pulse signal is commanded by a controller...that imparts the rotational speed corresponding to the set operating speed of the” motor. EX1004, [0002]. In short, the calculated command duty is used to generate command signals 3a and 3b, which reflect the command duty, and these command signals are then used by the drive means 13 and 24 to generate pulse signals 13a and 24b that control the rotation speed of the motors. Thus, each of Takashi’s control signals 3a and 3b and its pulse signals 13a and 24b are “at least one of a control signal configured to control a rotation speed of the motor.” EX1002, ¶¶ 73-74.

4. Claim 4

a) **4[pre] The method according to claim 3, wherein:
4[a] the present electrical parameter of the battery includes
the present voltage of the battery; and:**

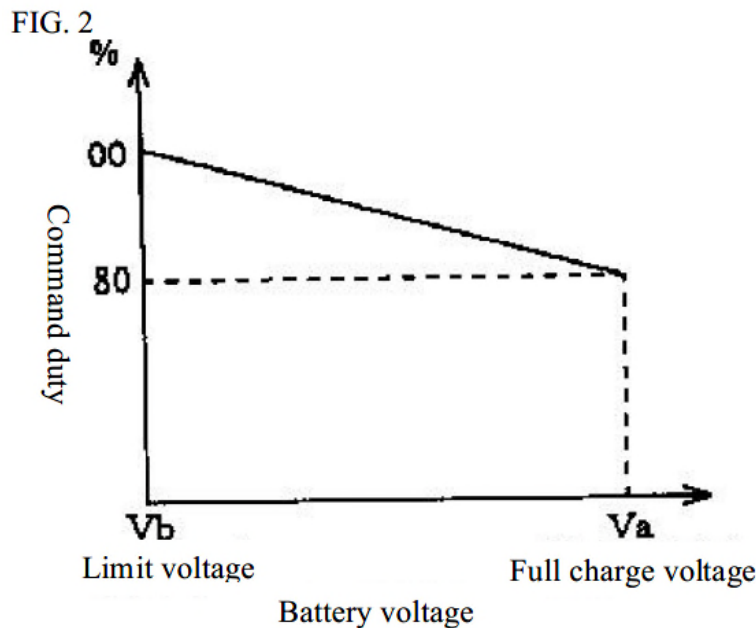
As discussed under claim 2, Takashi discloses a present electrical parameter of a battery that includes the present voltage of the battery. EX1002, ¶ 75.

b) **4[b] calculating the compensation amount includes:
calculating the compensation amount of the control signal of
the motor corresponding to a subsequent time point
according to the present voltage of the battery and a preset
voltage model including one-to-one correspondences between
voltages of the battery and preset compensation amounts.**

The ’224 Patent explains, “[a] compensation amount of the control signal of the motor corresponding to the subsequent time point may be calculated according to a present battery voltage and the preset voltage model. The control signal of the

motor may be modified at the present time point to prevent a drop of the motor rotation speed caused by a drop of the battery voltage at the subsequent time point, thereby improving timeliness of modifying the control signal of the motor.” EX1001, 5:27-35.

As discussed under element 1[b], Takashi discloses “calculating a compensation amount of a control signal of the motor,” where the command duty percentage is a compensation amount and control signals 3a and 3b reflect the compensation amount. *Supra* § VIII.A.1.c). Takashi further discloses that duty setting means calculates the command duty “according to the present voltage of the battery and a preset voltage model including one-to-one correspondences between voltages of the battery and preset compensation amounts,” as recited in element 4[b]. More specifically, FIG. 2 of Takashi is a diagram of the command duties (y-axis) calculated by the duty setting means according to the present voltage of the battery (x-axis):



This diagram is a “voltage model” because it models the inversely proportional relationship between the present voltage of the battery and the command duty (“compensation amounts”). Because the “control characteristics of the duty command to the driving circuit 1 are written to the memory 32 *in advance*,” the voltage model, including the compensation amounts along the y-axis, are “preset” according to the present voltage of the battery along the x-axis. EX1004, [0017] (emphasis added); EX1002, ¶ 77. Because the command duty is a unique value between the voltages of the battery along the x-axis and the preset command duties along the y-axis, the voltage model includes “one-to-one correspondences” between the voltages of the battery and preset compensation amounts. EX1004, [0013]; EX1002, ¶ 77. Because the percent command duty data is supplied to the drive

means 24 as control signals 3a and 3b (*i.e.*, the control signals are “based on” the command duty), the control signals 3a and 3b are also “preset” and include “one-to-one correspondences” between the voltages of the battery. EX1002, ¶ 77; EX1004, [0014]-[0015].

Finally, because the “duty setting means reads and controls from memory 32,” and “[d]ata read from the memory 32 is supplied as control signals 3a and 3b that command duties of the drive means 13” and “drive means 24,” and the controller 3 sets “the command duty of the pulse signal 13a” and “24b,” a POSITA would recognize that the compensation amount of the control signal applied to the motor in Takashi corresponds to “a subsequent time point” relative to the measured (present) value of the battery voltage. EX1004, [0012]-[0013]; EX1002, ¶ 78. Specifically, a POSITA would understand that there is an inherent time delay in Takashi from the time of measuring the battery voltage to the time of applying the compensation amount through the drive signal to the motor because: (1) Takashi’s controller operates by measuring a present voltage of the battery, then reading a compensation value from the preset voltage map that will be applied to the control signals 3a and 3b at a subsequent time point; and (2) the drive means 24 creates an inherent delay as it converts the control signals 3a and 3b that represent 80% to 100% to the pulse signals that have periodic time-domain waveforms with 80% to 100% duty cycles. EX1002, ¶ 78.

To the extent that Takashi does not disclose calculating the command duty “corresponding to a subsequent time point according to the present voltage of the battery,” this limitation would have been obvious to a POSITA in view of Takashi alone. EX1002, ¶ 79. Takashi discloses that the purpose of the invention is to maintain maximum rotational speed of the motor and stable operability regardless of battery state of charge. EX1004, [0018]. Because of signaling and processing delays, a POSITA would have understood that by the time the motor control device calculates a command duty and/or control signals based on a measured battery voltage, the voltage of the battery will have decreased further to a voltage at a subsequent time point and the command duty and/or control signals would be “out of date,” resulting in a drop in rotational speed of the motor and unstable operability. EX1002, ¶ 79. Thus, it would be obvious to shift the duty curve of Figure 2 so that the calculated command duty and/or control signals are increased to compensate for the additional decreased voltage of the battery at the subsequent time point by the time the calculation is performed. *Id.* Such a shift would permit the motor control device to calculate the corresponding command duty and/or control signals in time to prevent a drop in motor rotational speed despite signaling and processing delays. *Id.*

A POSITA would have found such a modification to the duty curve straightforward and achievable with a reasonable expectation of success. Takashi’s

voltage model is preset and the command duties corresponding to the battery voltage at all time points are known in advance. *Supra* 4[c]; EX1004, [0017], FIGS. 2-3. A POSITA would simply shift the command duty curve, such that the command duty calculated according to the present voltage of the battery obtained would be increased to the required command duty at the subsequent time point to account for the voltage drop during the signaling and processing delay and prevent a drop in motor rotational speed. EX1002, ¶¶ 80-81.

5. Claim 5: The method according to claim 4, wherein modifying the control signal includes: modifying, at a present time point, the control signal according to the compensation amount.

As discussed under element 1[c], Takashi discloses that the duty setting means and/or drive means performs the step of “modifying the control signal according to the compensation amount.” *Supra* 1[c] (explaining that (1) the duty setting means modification of control signals 3a and 3b according to the command duty and (2) “the drive means’ modification of the pulse signals according to the control signals from the duty setting means” disclose element 1[c]).

Claim 5 depends on claim 4, and as discussed under claim element 4[c], Takashi renders obvious calculating the compensation amount “corresponding to a subsequent time point according to the present voltage of the battery.” Takashi further renders obvious this step of modifying, at a present time point, the control signal according to the compensation amount calculated under element 4[c]. For the

same reasons discussed under claim element 4[c], a POSITA would have found it obvious to shift the duty curve to compensate for any additional decrease in battery voltage at the subsequent time point by the time the calculation is performed. EX1002, ¶ 83. This modification allows for calculation of a duty curve that “calculat[es] the compensation amount of the control signal of the motor corresponding to a subsequent time point according to the present voltage of the battery” by *a present time point*. *Id.*

Upon calculation of the compensation amount described under element 4[c], a POSITA would have further found it obvious to use the duty setting means and/or drive means to modify the control signals at that point in time according to the compensation amount. EX1002, ¶ 84. As previously noted, Takashi discloses that the purpose of the invention is to maintain maximum rotational speed of the motor and stable operability regardless of battery state of charge. EX1004, [0018]. Furthermore, the particular point in time at which the control signals are actually modified is necessarily the “present time point” when the modification occurs.²

² Claim 5 only makes technical sense if the “present electrical parameter of the battery” in claims 1 and 4 is obtained at time t_1 , the “subsequent time point” in claim 4 is some later time t_2 , and the “present time point” in claim 5 is whatever time the

Thus, a POSITA would have understood that modification of the control signal *at a present time point* according to the compensation amount of the control signal corresponding *to the subsequent time point* would be beneficial to maintain maximum rotational speed of the motor and stable operability by accounting for additional voltage drop during that time it takes for the controller to implement the calculating and modifying steps. EX1002, ¶ 84.

A POSITA would have found such a modification straightforward and achievable with a reasonable expectation of success. A POSITA would need only use the duty setting means and/or drive means to implement the shifted duty curve described under element 4[c] to account for the voltage drop during signaling and processing delays and prevent a drop in motor rotational speed. EX1002, ¶ 85.

6. Claim 6

a) **6[pre] The method according to claim 3, wherein:
6[a] the present electrical parameter of the battery includes
the present voltage of the battery; and:**

As discussed under claim 2, Takashi discloses a present electrical parameter of a battery that includes the present voltage of the battery. EX1002, ¶ 87.

control signal is modified, which is in the “present” whenever the modification is actually made. As an example, the “present time point” could be time t_2 . EX1002, ¶ 84, n.3.

b) 6[b] calculating the compensation amount of the control signal of the motor includes: calculating in real time the compensation amount of the control signal of the motor according to the present voltage of the battery.

As discussed under element 1[b] and claim 2, Takashi discloses that the duty setting means performs the step of “calculating a compensation amount of a control signal of the motor according to the present electrical parameter [(i.e., the present voltage of the battery)].” Element 6[b] includes the additional limitation that the calculation of the compensation amount occurs in real time, which Takashi also discloses.

Takashi explains that control characteristics may be calculated “in advance” but also “calculated through computation.” EX1004, [0017]. For example, “[t]his would be calculating each command duty and accelerator depression angle data for the offset setting point O as well as command duty relative to each accelerator depression angle based on the detection value of battery voltage corresponding to duty gradient.” *Id.* Takashi’s control characteristics “calculated through computation” disclose calculation of the compensation amount in “real time,” because the control characteristics are calculated at the time the battery voltage is measured (*i.e.*, “on the fly”). EX1002, ¶ 89. This may be contrasted with Takashi’s alternative embodiment of calculation of control characteristics “in advance,” where the control characteristics are pre-calculated for every battery voltage ahead of time.

Id. Because Takashi's control signals 3a and 3b are "based" on the command duty (*e.g.*, the command duty is supplied to the drive means as control signals), the controller's real-time calculation of the command duty also results in a calculation of control signals in real time. *Id.*; EX1004, [0014]-[0015].

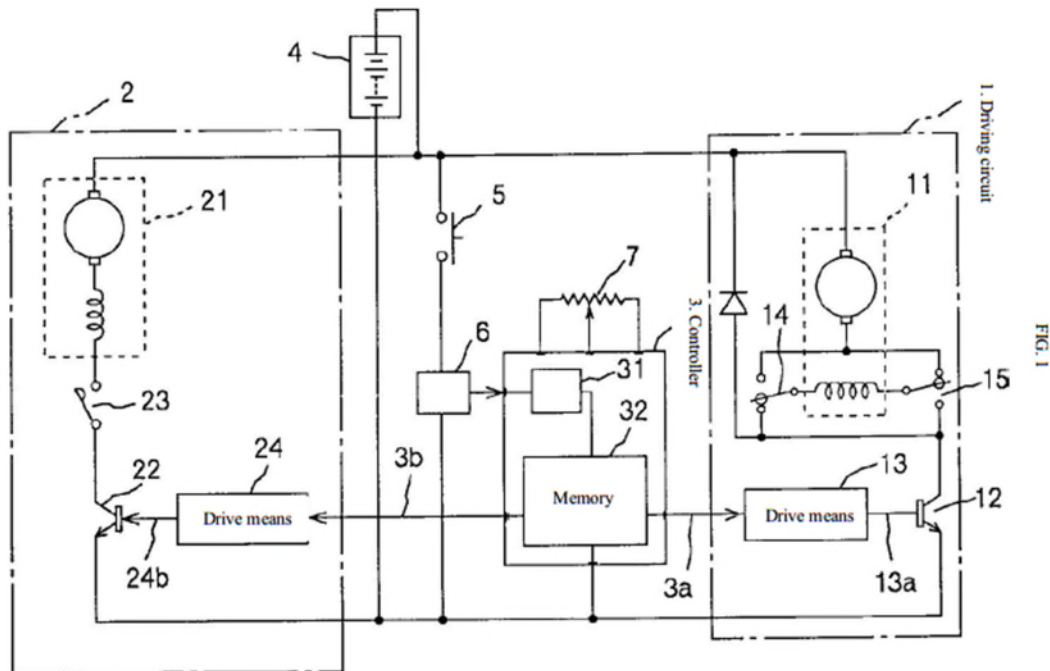
7. Claim 7

a) **7[pre] The method according to claim 6, wherein: 7[a]: calculating in real time the compensation amount of the control signal includes: calculating in real time a compensation amount of a voltage outputted to the motor according to the present voltage of the battery; and**

As discussed under element 1[b] and claim 2, Takashi's calculation of a command duty and/or control signals by the duty setting means discloses "calculating a compensation amount *of a control signal of the motor* according to the present electrical parameter [*i.e.*, the present voltage of the battery]."

Takashi's calculation of a command duty and/or control signals further includes "calculating in real time a compensation amount of a voltage outputted to the motor." Takashi explains that prior art battery vehicles typically implement a motor that is "rotation driven by a chopper circuit intermittently operated by a pulse signal." EX1004, [0002]. "[M]aximum rotational speed of the motor is defined depending on battery voltage" and "maximum rotational speed for a constant duty changes based on the voltage within the operating range." EX1004, [0004]. Takashi's motor control device includes "a motor driven by power supplied from a

battery” and “a chopper circuit [(e.g., transistor 12)] that intermittently supplies battery power to the motor.” EX1004, Cl. 1, [0009], FIG. 1. The sequence of operation of the motor control device begins when the duty setting means of controller 3 reads a command duty based on detected battery voltage and supplies control signals 3a and 3b to drive means 13 and 24 based on the detected value. EX1004, FIGS.1-2. From there, drive means 13 and 24 output pulse signals 13a and 24b to the transistors 12 and 22 to intermittently supply battery power to the motor. EX1004, [0010], [0013]-[0015], FIG. 1.



For example, in response to a fully charged battery V_a , “the [duty setting means of the] controller 3 reads data such as 80% as the command duty” which “is supplied to the drive means 24 as the control signal 3b,” at which point “the drive means 24

outputs a pulse signal 24b with a duty of 80% and the transistor 22 supplies current to the DC motor 21 with intermittent operation of 80% ON time.” EX1004, FIG. 2, [0014]. Because Takashi’s calculation of the command duty and/or control signals includes a calculation of the amount of battery voltage that the chopper circuit outputs to the DC motor in order to maintain maximum rotational speed, Takashi’s calculation of a command duty and/or control signals includes “calculating in real time a compensation amount *of a voltage outputted to the motor.*” EX1002, ¶¶ 91-94. As explicitly noted in Takashi, it was well known to a POSITA at the time of the invention that a chopper circuit controls the rotation of a motor based on the battery voltage outputted to the motor. *Id.*; EX1004, [0002], [0004]; EX1012, 177-178. Takashi’s chopper circuit is merely an on/off switch that controls the amount of voltage outputted from the battery to the motor according to the voltage of the battery such that the maximum rotational speed remains constant. EX1002, ¶ 91-94. Thus, the duty setting means calculates a compensation amount of a voltage output to the motor depending on present voltage of the battery. *Id.*

As discussed under element 6[b], Takashi’s duty setting means calculates the compensation amount of the control signal of the motor (*i.e.*, the command duty and/or control signals) in real time. Because the duty setting means’ real-time calculation of the command duty and/or control signals conveys to the chopper circuit the amount of battery voltage outputted to the motor, Takashi’s real time

calculation of the control signal to the motor includes a real time calculation of the compensation amount of the voltage outputted to the motor. EX1002, ¶ 95; EX1004, [0014]-[0015].

b) 7[b] modifying the control signal includes: modifying an original voltage outputted to the motor according to the compensation amount of the voltage.

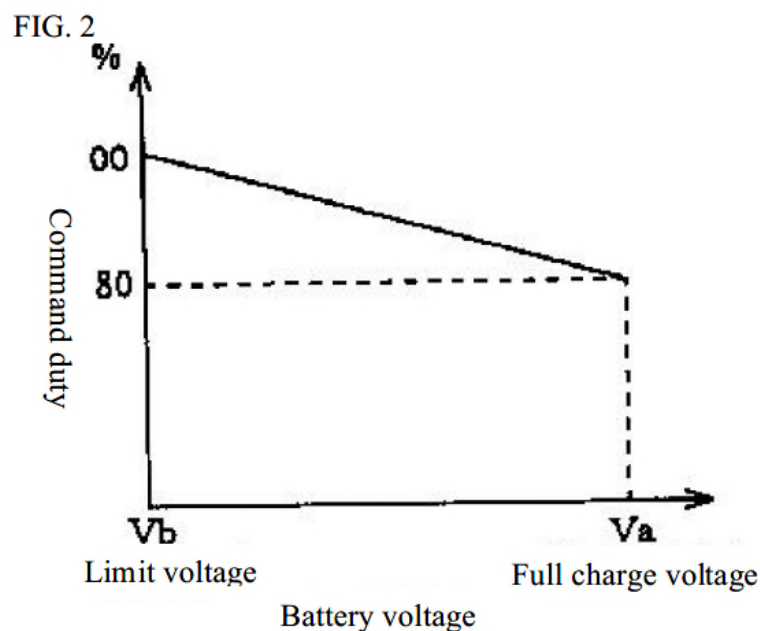
As discussed under element 1[c], Takashi's modification of control signals 3a and 3b by the duty setting means according to the command duty discloses "modifying the control signal." In addition, Takashi's modification of pulse signals 13a and 24b by the drive means according to the control signals 3a and 3b discloses "modifying the control signal." *Supra* 1[c]. As discussed under element 7[a], Takashi's calculation of the command duty and/or control signals includes a calculation of "a compensation amount of a voltage outputted to the motor according to the present voltage of the battery." Takashi's modification of the control signal further includes "modifying an original voltage outputted to the motor according to the compensation amount of voltage."

As more fully explained under element 7[a], a POSITA at the time of the invention would have understood that Takashi's chopper circuit (*i.e.*, transistor) acts as a switch to control the voltage outputted from the battery to the motor, which in turn changes the current. EX1002, ¶¶ 96-97; EX1004, [0002], [0009]-[0011], [0013]. More specifically, the chopper circuit modifies the voltage that would

otherwise be outputted from the battery to the motor by intermittently switching on/off according to an amount communicated by control signals 3a and 3b and pulse signals 13a and 24b. EX1002, ¶ 97. For example, in response to a fully charged battery V_a , “the [duty setting means of the] controller 3 reads data such as 80% as the command duty” which “is supplied to the drive means 24 as the control signal 3b,” at which point “the drive means 24 outputs a pulse signal 24b with a duty of 80% and the transistor 22 supplies current [(i.e., power/current/voltage)] to the DC motor 21 with intermittent operation of 80% ON time.” EX1004, FIG. 2, [0014]; EX1002, ¶ 97. Thus, the chopper circuit’s modification of the voltage that would otherwise be outputted from the battery to the motor according to the control signals 3a and 3b and pulse signals 13a and 24b discloses “modifying an original voltage outputted to the motor according to the compensation amount of voltage.” *Id.* And because the chopper circuit’s modification of the voltage outputted to the battery results from control signals 3a and 3b and pulse signals 13a and 24b, Takashi’s “modif[ication] of the control signal includes[] modifying an original voltage outputted to the motor according to the compensation amount of voltage.” *Id.*

8. Claim 8: The method according to claim 7, wherein the compensation amount of the voltage is determined according to a difference between a full voltage of the battery and the present voltage of the battery.

As discussed under claim 7, Takashi's calculation of the command duty and/or control signals includes a calculation of a compensation amount of the voltage. Takashi further discloses that the voltage outputted by the chopper circuit is determined according to the difference between a full voltage of the battery and the present voltage of the battery.



As shown in FIG. 2 and described throughout Takashi, the command duty and corresponding voltage outputted from the battery to the motor via the chopper circuit is determined according to a relationship that is “inversely proportional to battery voltage drop” (*i.e.*, the difference between the full voltage of the battery and the

present voltage of the battery). EX1002, ¶ 99; EX1004, (57), FIG. 2, [0007]-[0008], [0013], [0016]. Takashi thus further discloses that the calculation of the compensation amount of the voltage is determined according to a difference between a full voltage of the battery and the present voltage of the battery.

9. Claim 12: An apparatus for controlling a motor comprising: one or more processors configured to: obtain a present electrical parameter of a battery; calculate a compensation amount of a control signal of the motor according to the present electrical parameter; and modify the control signal according to the compensation amount.

Apparatus claim 12 recites essentially identical limitations to method claim 1. The only difference between claims 12 and 1 is that claim 12 further requires “one or more processors” that are “configured to” perform the steps of claim 1.

Takashi discloses this additional limitation. As discussed under element 1[a], Takashi’s use of a detecting means 31 of the controller 3 to detect the current battery voltage, is a method of obtaining a present electrical parameter (*i.e.*, voltage) of a battery. In addition, Takashi’s use of a duty setting means of the controller 3 to read the detected battery voltage (*i.e.*, “voltage characteristic”) also discloses a method of obtaining a present electrical parameter (*i.e.*, voltage) of a battery. As discussed under element 1[b], Takashi’s use of the duty setting means of the controller 3 to read a pre-calculated command duty and/or calculate a command duty according to the detected battery voltage is a method of “calculating a compensation amount of a

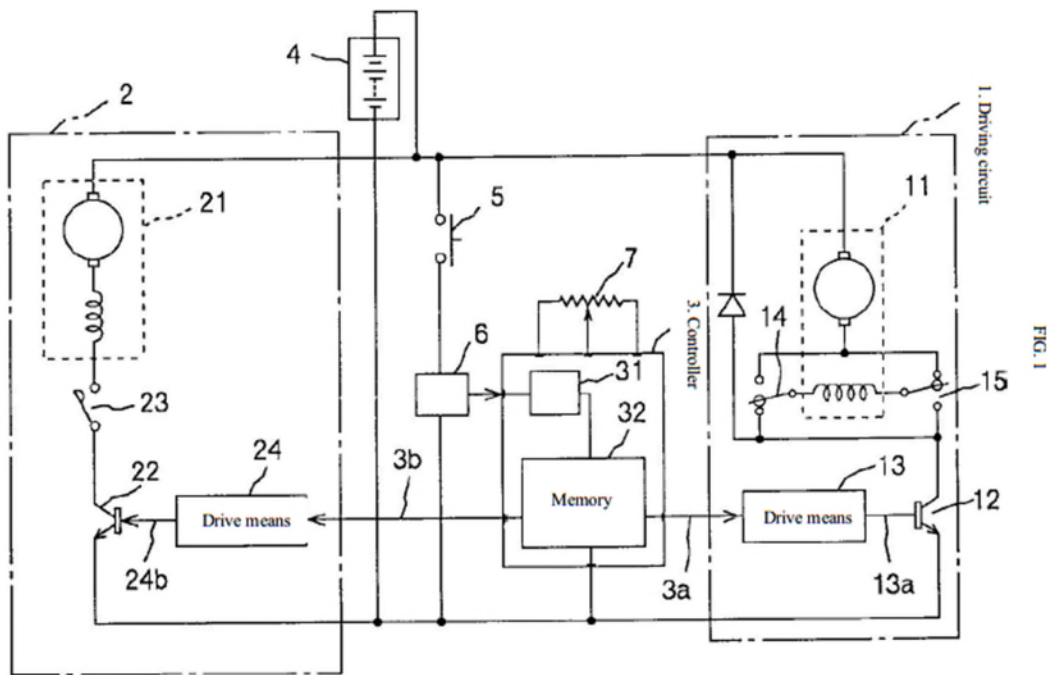
control signal of the motor according to the present electrical parameter,” as is Takashi’s use of the duty setting means to calculate control signals 3a and 3b according to the detected battery voltage. As discussed under element 1[b], Takashi’s use of a duty setting means of the controller 3 to modify the control signals 3a and 3b that are sent to the drive means 24 is a method of “modifying the control signal according to the compensation amount,” as is the drive means’ modification of the pulse signals that are sent to the transistors.

Takashi further discloses that the motor control device is “*configured* to set the current flowing in each of the DC motors 11 and 21 in a driving circuit 1 and a cargo handling circuit 2 using a duty command from a controller 3 as a *central processing unit*.” EX1004, [0010] (emphasis added). The controller includes a detecting means 31 and a duty setting means 32. “Each of the detection values of the detecting means 31 is *process[ed]* using duty setting means....” EX1004, [0013] (emphasis added). “This duty setting means reads and controls from the memory 32, control characteristics (FIG. 2) in which command duty is increased inversely proportional to voltage characteristics where the voltage of the battery 4 drops from fully charged voltage characteristic to the limit voltage at 80% discharge....” EX1004, [0013].

A POSITA would have understood from this disclosure, and at the very least found it obvious, that “controller 3 as a central processing unit” with its detecting

means 31, duty setting means³, and drive means 24 are “processors.” EX1004, [0009]; EX1002, ¶ 103. For example, the detecting means obtains the battery voltage signal and sends it as a signal to the duty setting means. The duty setting means obtains the battery voltage signal from the detecting means and calculates a command duty signal. The duty setting means modifies control signals according to the command duty signal. The drive means calculates pulse signals from control signals and then modifies the pulse signals according to the control signals. Each of these instances of obtaining, calculating, and modifying is an example of signal processing that is performed by a “processor.” EX1002, ¶ 103.

³ Takashi at times refers to the controller’s duty setting means 32 as a memory 32. EX1004, (57), [0013]. However, a POSITA would understand that to access memory, a processor would be used. EX1002, ¶ 103, n.4; EX1004, [0013] (The “duty setting means reads and controls from the memory 32, control characteristics....”). Thus, Takashi’s duty setting means at least includes a processor in addition to a memory. EX1002, ¶ 103.

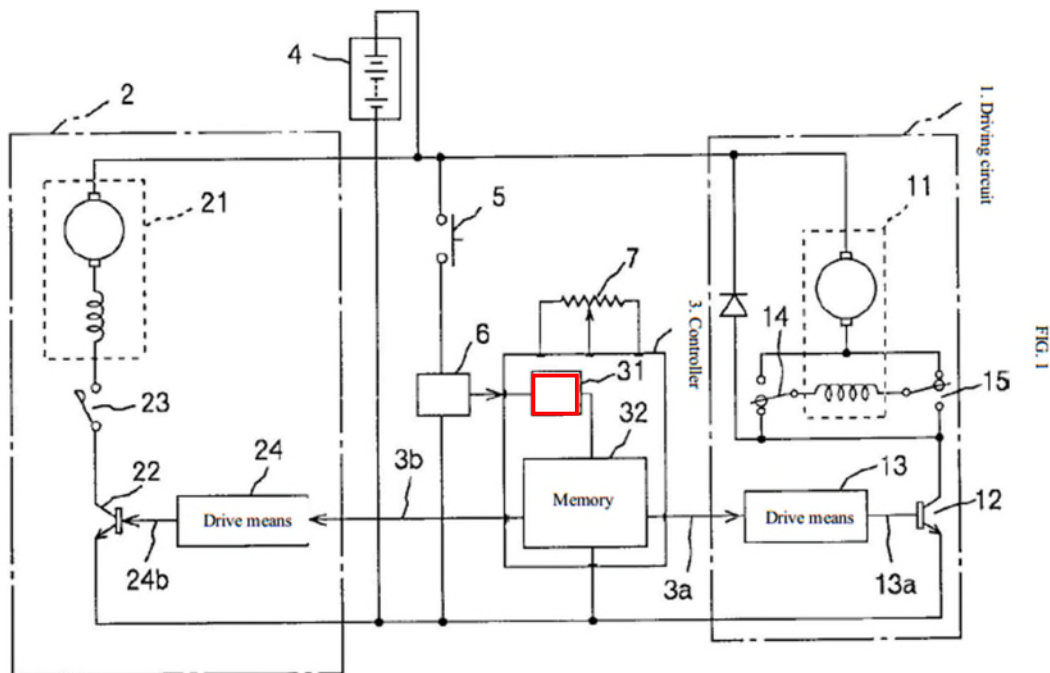


Because the controller 3 and/or drive means 13 and 24 performs each of the claimed steps, Takashi discloses one or more processors that are configured to perform the claimed steps.

10. Claim 13: The apparatus according to claim 12, further comprising: an electrical parameter detection circuit electrically coupled to the one or more processors and configured to detect the present electrical parameter.

As shown in FIG. 1, the detecting means 31 in combination with the power supply circuit 6 is a component of the motor control device circuit. A POSITA would have understood, and at the very least found it obvious, that the “detecting means 31 for detecting the output of the constant voltage power supply circuit 6 as the voltage of the battery 4” would have been implemented as a circuit electrically coupled to both the battery and the processor within controller 3. EX1004, [0013];

EX1002, ¶ 105. At the time of the invention, several types of circuit components for detecting battery voltage were well known to a POSITA, including a resistor divider, an operational amplifier (op-amp), a voltage buffer or filter, and an analog-to-digital (A/D) converter. *Id.*; EX1013, 8-11. Each of these detecting means is a voltage detection circuit and voltage is a type of electrical parameter. EX1002, ¶ 105. Takashi's **detecting means 31** is therefore “an electrical parameter detection circuit.”



EX1004, FIG. 1.

As discussed under claim elements 1[a]/12[b], Takashi's detecting means 31 obtains a present electrical parameter (*i.e.*, voltage) of a battery. The detecting means 31 obtains the present electrical parameter by “detecting the output of the

constant voltage power supply circuit as the voltage of the battery.” EX1004, [0012]. The detecting means 31 is therefore also “configured to detect the present electrical parameter.”

Finally, Takashi’s detecting means 31 is “electrically coupled to the one or more processors.” Takashi explains that “[e]ach of the detection values of the detecting means 31 is process[ed] using duty setting means for commanding each of the duties of the pulse signals 13a and 24b in the driving circuit 1 and the cargo handling circuit 2.” EX1004, [0013]. As discussed under claim 12, Takashi’s duty setting means is a processor. For the duty setting means to process detection values from the detecting means 31, the two components must be electrically coupled. EX1002, ¶ 107. Thus, the detecting means 31 is “electrically coupled” to the duty setting means.

11. Claim 14: The apparatus according to claim 13, wherein the electrical parameter detection circuit includes at least one of a coulometer, a voltage detection circuit, an electrical current detection circuit, or a resistance detection circuit.

As discussed under Claims 2 and 13, Takashi’s detecting means 31 includes a voltage detection circuit and therefore Takashi discloses that alternative of the recited Markush group. *Supra* §§ VIII.A.2, A.10.

12. Claim 15

a) **15[pre] The apparatus according to claim 14, wherein the one or more processors are further configured to: 15[a] calculate the compensation amount of the control signal of the motor corresponding to a subsequent time point according to the present voltage of the battery and a preset voltage model including one-to-one correspondences between voltages of the battery and preset compensation amounts; and 15[b] modify, at a present time point, the control signal according to the compensation amount.**

Claim 15 recites essentially identical limitations to method claims 4 and 5 in the form of an apparatus claim. The only difference between claim 15 and claims 4 and 5 is that claim 15 further requires “one or more processors” that are “configured to” perform the “calculating” and “modifying” steps of claims 4 and 5.

To the extent that claim 15 is not indefinite for lack of antecedent basis, Takashi discloses this additional limitation.⁴ As discussed in claims 4 and 5, Takashi’s duty setting means (*i.e.*, processor) performs the “calculating” and “modifying” steps. *Supra* §§ VIII.A.9. Takashi’s drive means (*i.e.*, a processor) also performs the “modifying step.” *Id.* Because the duty setting means and/or drive

⁴ Claim 15’s “present voltage of the battery” lacks proper antecedent basis. For purposes of this proceeding, Petitioner assumes that claim 15’s “present voltage of the battery” refers to claim 12’s “present electrical parameter.”

means performs the claimed steps, Takashi discloses one or more processors that are configured to perform the claimed steps.

13. Claim 16: The apparatus according to claim 14, wherein the one or more processors are further configured to: calculate in real time the compensation amount of the control signal of the motor according to the present voltage of the battery.

Claim 16 recites essentially identical limitations to method claim element 6[b] in the form of an apparatus claim. The only difference between claim 16 and element 6[b] is that claim 16 further requires “one or more processors” that are “configured to” perform the “calculating” step of element 6[b].

To the extent that claim 16 is not indefinite for lack of antecedent basis, Takashi discloses this additional limitation.⁵ As discussed in claim 6, Takashi’s duty setting means (*i.e.*, processor) performs the “calculating” step. *Supra* § VIII.A.9 (explaining that the duty setting means is a processor). Because the duty setting means performs this step, Takashi discloses one or more processors that are configured to perform the step.

⁵ Claim 16’s “present voltage of the battery” lacks proper antecedent basis. For purposes of this proceeding, Petitioner assumes that claim 16’s “present voltage of the battery” refers to claim 12’s “present electrical parameter.”

14. Claim 17: The apparatus according to claim 16, wherein the one or more processors are further configured to: calculate in real time a compensation amount of a voltage outputted to the motor according to the present voltage of the battery; and modify an original voltage outputted to the motor according to the compensation amount of the voltage outputted to the motor.

Claim 17 recites essentially identical limitations to method claim elements 6[b], 7[a], and 7[b] in the form of an apparatus claim. The only difference between claim 17 and elements 6[b], 7[a], and 7[b] is that claim 17 further requires “one or more processors” that are “configured to” perform the “calculating” and “modifying” steps of these elements.

To the extent that claim 17 is not indefinite for lack of antecedent basis, Takashi discloses this additional limitation.⁶ As discussed in claims 6 and 7, Takashi’s duty setting means (*i.e.*, processor) performs the “calculating” and “modifying” steps. *Supra* § VIII.A.9 (explaining that the duty setting means and drive means are processors). Takashi’s drive means (*i.e.*, a processor) also performs the “modifying step.” *Id.* Because the duty setting means and/or drive means

⁶ Claim 17’s “present voltage of the battery” lacks proper antecedent basis. For purposes of this proceeding, Petitioner assumes that claim 17’s “present voltage of the battery” refers to claim 12’s “present electrical parameter.”

perform these steps, Takashi discloses one or more processors that are configured to perform these steps.

B. Grounds 2A and 2B: Claims 9-11 are (2A) Anticipated by or (2B) Obvious in View of Onishi

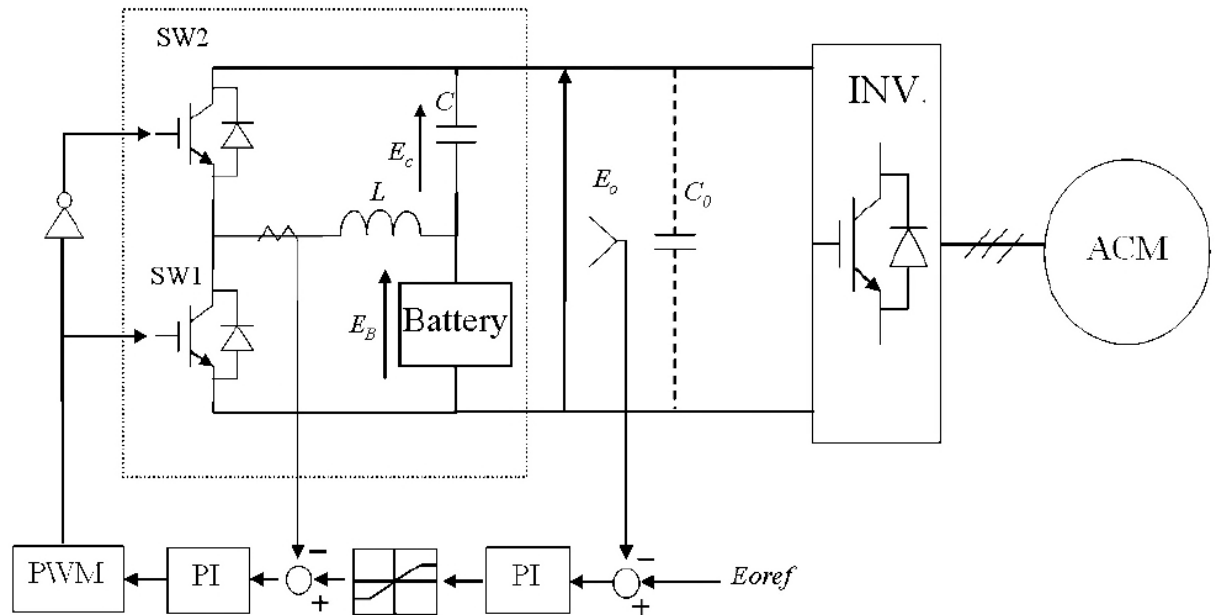
1. Claim 9

a) 9[pre] A method for controlling a motor comprising:

To the extent the preamble is argued to be limiting, it is nonetheless disclosed by Onishi. Onishi discloses a storage battery system for electric vehicles that includes a storage battery. EX1006, [0024], FIG. 7. The storage battery “is used as a power source to drive an alternating current motor via an inverter....” *Id.* When “the discharge of the storage battery progresses and the terminal voltage drops, the terminal voltage can be kept constant until the remaining capacity is exhausted, and the battery can be used to the final discharge voltage.” *Id.*

【 図 7 】

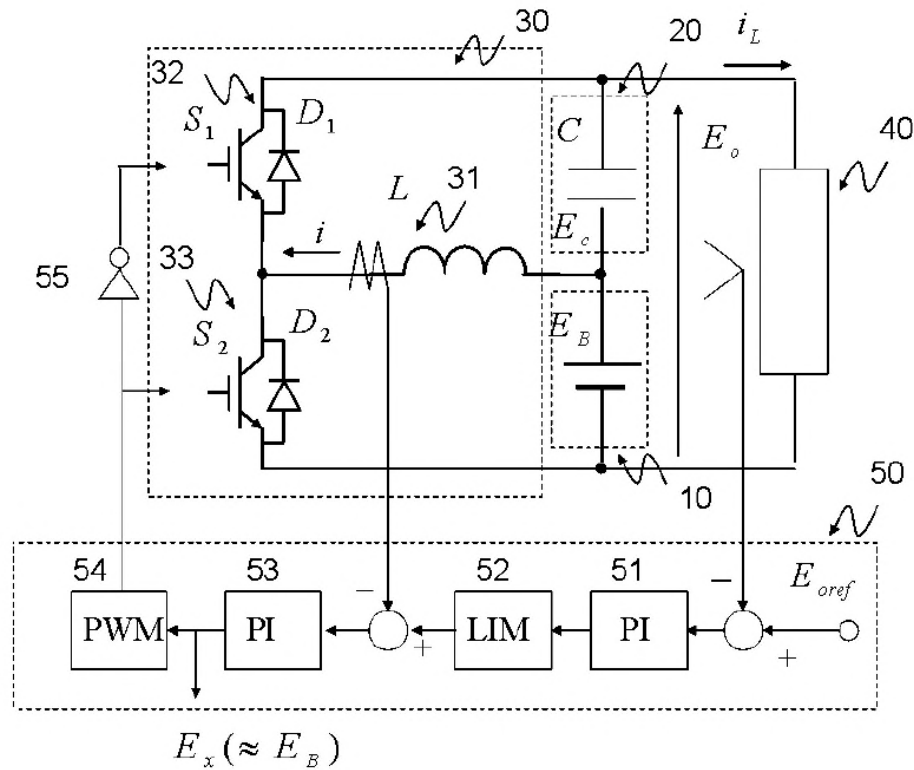
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Id., FIG. 7. Onishi notes that the storage battery can be used “without affecting the performance of the device used, even if the voltage of the battery drops.” EX1006, [0026]. The storage battery control system compensates for the voltage fluctuations caused by charging and discharging of the battery by actively charging and discharging a capacitor. *Id.* More specifically, the storage battery control system “maintains a constant direct current output voltage to a load 40 (e.g., a motor) by controlling a capacitor 20 voltage by controlling a switching power converting device 30 that performs charging and discharging between the storage battery 10 and

the capacitor 20 based on a switching signal from a control block 50.” EX1006, [0010], FIG. 1.

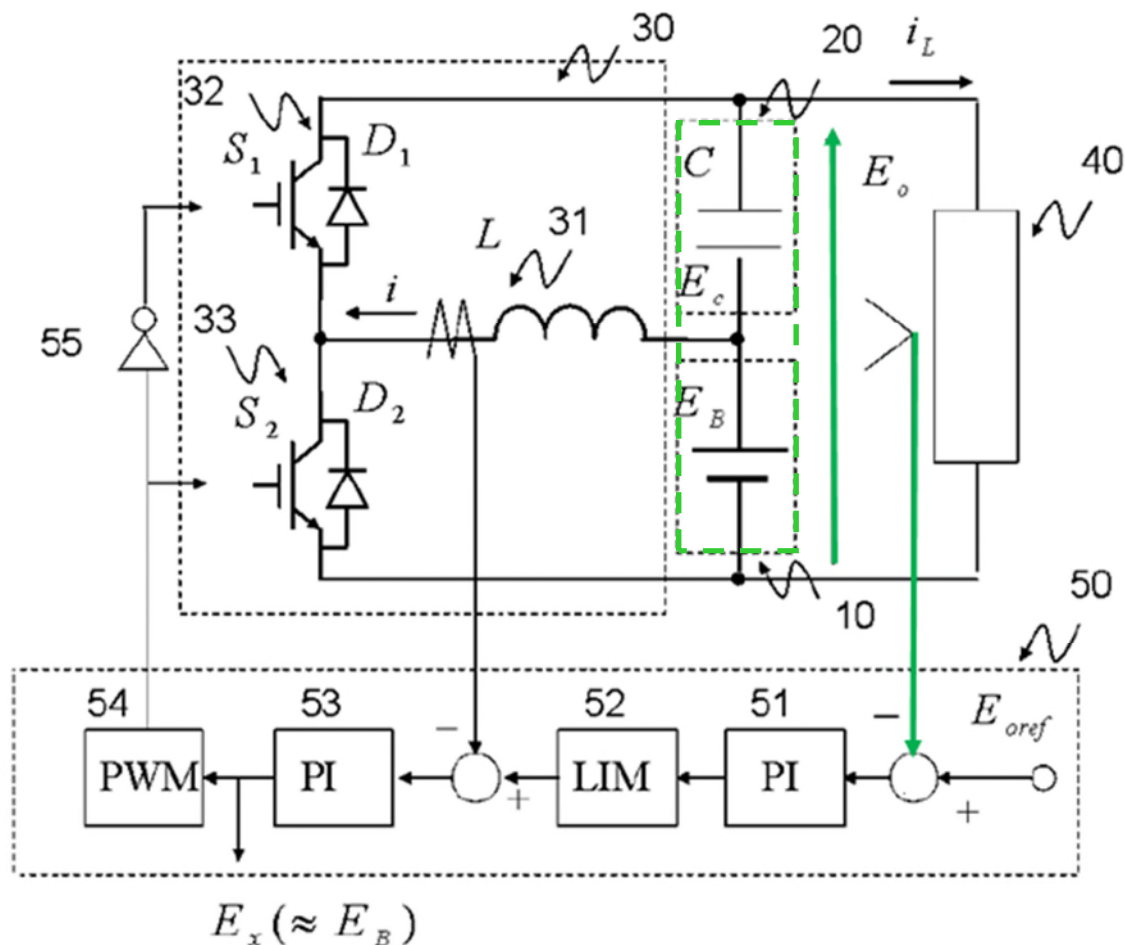
【 図 1 】



Onishi’s use of a storage battery control system to control a capacitor in series with a storage battery and a switching power converting device in order to maintain a constant direct current output voltage (*e.g.*, E_o) from the storage battery system to a load (including an electric vehicle motor) discloses a method of controlling a motor. EX1002, ¶ 118.

b) 9[a] obtaining a present electrical parameter of a battery;

The storage battery system of Onishi obtains a present electrical parameter of a battery. For example, as shown in annotated Figure 1 below, the control block 50 of Onishi measures the current value of voltage E_o (which is the output voltage of the battery system formed by the series voltage of the storage battery 10 and capacitor 20 (voltage E_b + voltage E_c)).



EX1006, FIG. 1; *see also id.* at [0010], [0016], [0026]; EX1002, ¶ 119. The current output voltage E_o of the battery system is the claimed “present electrical parameter.” EX1001, 3:50-54; EX1002, ¶ 119.

A POSITA would understand that the overall battery system of Onishi (*i.e.*, storage battery 10, capacitor 20, switching power converter 30, and control block 50)—and not just the storage battery cells 10—is the claimed “battery” of Claim 9. EX1002, ¶ 120. Onishi explicitly defines the “**storage battery system**” as comprising “a storage battery and a capacitor connected in series” and states that the voltage of the “entire storage battery system integrating the storage battery and the capacitor is kept constant.” EX1006, Cl. 1, [0009].

Onishi also states that since the output voltage is “actively kept constant ... the storage battery system of the present invention is called an “**active control storage battery**.” *Id.*, [0016]. Thus, it is clear that the battery voltage in Onishi that is kept constant is that of the storage battery system at E_o , which is the battery voltage applied to the load such as an “alternating current motor via an inverter.” *Id.*, [0024]; EX1002, ¶ 121. Onishi further states that “[a]s an example of application to secondary batteries, the present invention is highly useful as an **active storage battery** for electric vehicles.” EX1006, [0026]. This is consistent with the use of the terms in Claim 9, where the term “output voltage of the battery” refers to the output voltage that is maintained to be “stable.” EX1001, 14:56-62; *see also id.* at 8:19-33;

EX1002, ¶ 121. Thus, a POSITA would understand that the claimed “output voltage of the battery” of the ’224 Patent that is maintained stable refers to the output of the battery system. EX1002, ¶ 121. A POSITA would recognize that such a battery system will be made up of a combination of battery cell(s) and additional components. *Id.*

c) 9[b] calculating a voltage compensation amount of the battery according to the present electrical parameter; and

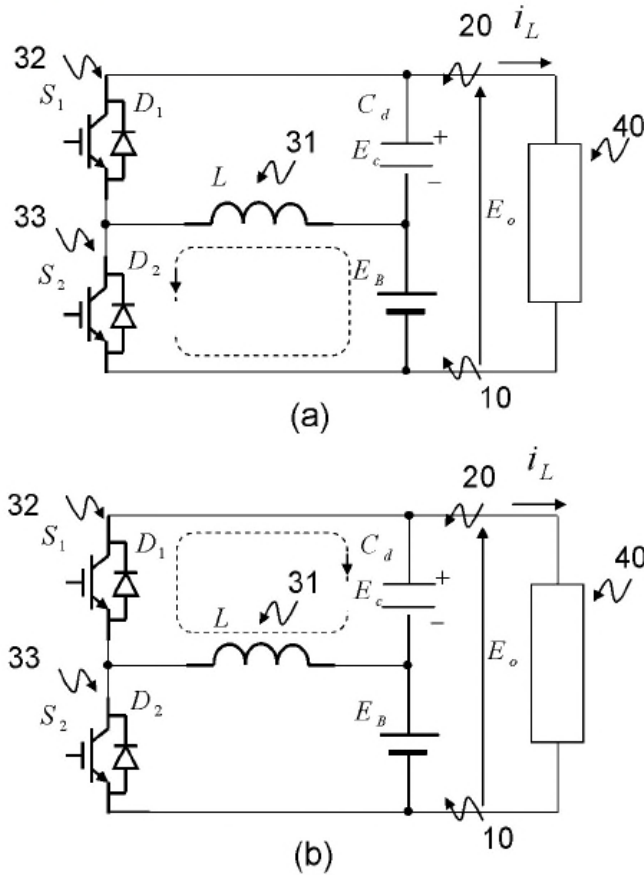
Onishi discloses calculating a voltage compensation amount of the battery according to the present electrical parameter (*e.g.*, value of voltage E_o). As explained above, Onishi’s storage battery system measures the current value of battery system output voltage E_o . *Supra* § VIII.B.1.b. As would be understood by a POSITA, the control block 50 of Onishi’s storage battery system then compares the obtained value of voltage E_o to the full/reference voltage E_{oref} to calculate a voltage compensation amount of the battery (*e.g.*, the difference between voltages E_o and E_{oref} , which is input into the voltage-controlled PI controller block 51 of control block 50). EX1006, [0001], [0010]-[0011], [0014], [0018], [0021]; EX1002, ¶ 123.

d) 9[c] compensating an output voltage of the battery according to the voltage compensation amount to maintain the output voltage of the battery stable.

Onishi discloses compensating an output voltage of the battery according to the voltage compensation amount to maintain the output voltage of the battery stable. In particular, the voltage compensation amount (*e.g.*, the difference between voltages E_o and E_{oref}) is used by control block 50 (including the voltage and current controlled PI controllers 51 and 53, saturation function block 52, and PWM switch signal generating circuit 54) to generate the control signal that controls the timing of the switching between switches 32 and 33 of the switching power converting device 30, which in turn controls the charging and discharging between the storage battery 10 and capacitor 20 to compensate E_o back to the reference voltage level. EX1006, [0009], [0013] (“The control input amount [to the control block 50] that generates the PWM control signal (i.e., switching control signal) for the switches 33 and 32 has a value that is proportional to the voltage of the storage battery 10”), [0015] (“The control block 50 similarly generates a PWM control signal for the switches 33 and 32 of the switching power converting device 30 and can monitor the voltage of the storage battery from the signal of the control circuit because the control input level that generates the PWM control signal to the switches 33 and 32 is a value proportional to the voltage of the storage battery 10”); EX1002, ¶ 124.

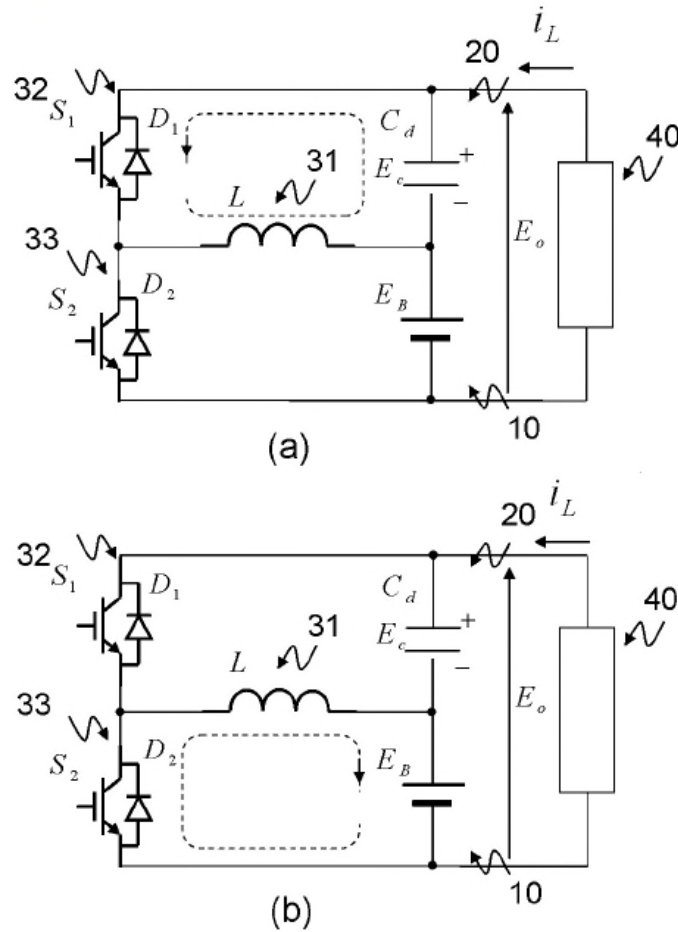
For example, as shown in FIG. 2, when the output voltage E_o of the battery storage system drops below the reference voltage E_{oref} due to discharge to the load, “the energy of the storage battery 10 is transferred to the capacitor 20 by the switching power converting device 30, and the drop is compensated by the charging voltage of the capacitor 20 that is connected in series.” EX1006, [0011]. FIG. 2 shows the “compensation circuit operation when the output voltage of the battery storage system drops below a reference value.” *Id.*, [0019]. From the controller block 50 in FIG. 1, the compensation amount calculated when E_o drops below E_{oref} is negative. EX1002, ¶ 125. This will cause the PI controller 51 to request current to be drawn from the storage battery E_B , which transfers energy from E_B to the inductor L of the DC-DC converter as shown in FIG. 2(a). *Id.*; EX1006, FIG. 2(a)-2(b), ¶¶ [0011]-[0013]. The energy in the inductor is then transferred to the capacitor C_d as shown in FIG. 2(b). *Id.* This sequence is repeated by operating at least switch S_2 on and off from the pulse-width-modulator (PWM) 54 until the control block 50 calculates that the compensation amount has been returned to zero and the battery system output voltage E_o is at the target voltage level E_{oref} . *Id.*

【 図 2 】



On the other hand, when the output voltage E_o of the battery storage system (e.g., the series voltage of the storage battery 10 and the capacitor 20) rises above the reference voltage due to, for example, regenerative current from the load, “the load terminal voltage can be kept constant by transferring the energy of the capacitor 20 to the storage battery 10 by the switching power converting device 30, and performing discharge voltage control of the capacitor 20.” EX1006, [0014]-[0015]. FIG. 3(a)-3(b) shows the “compensation circuit operation when the output voltage of the battery storage system is above a reference value.” *Id.*, [0019].

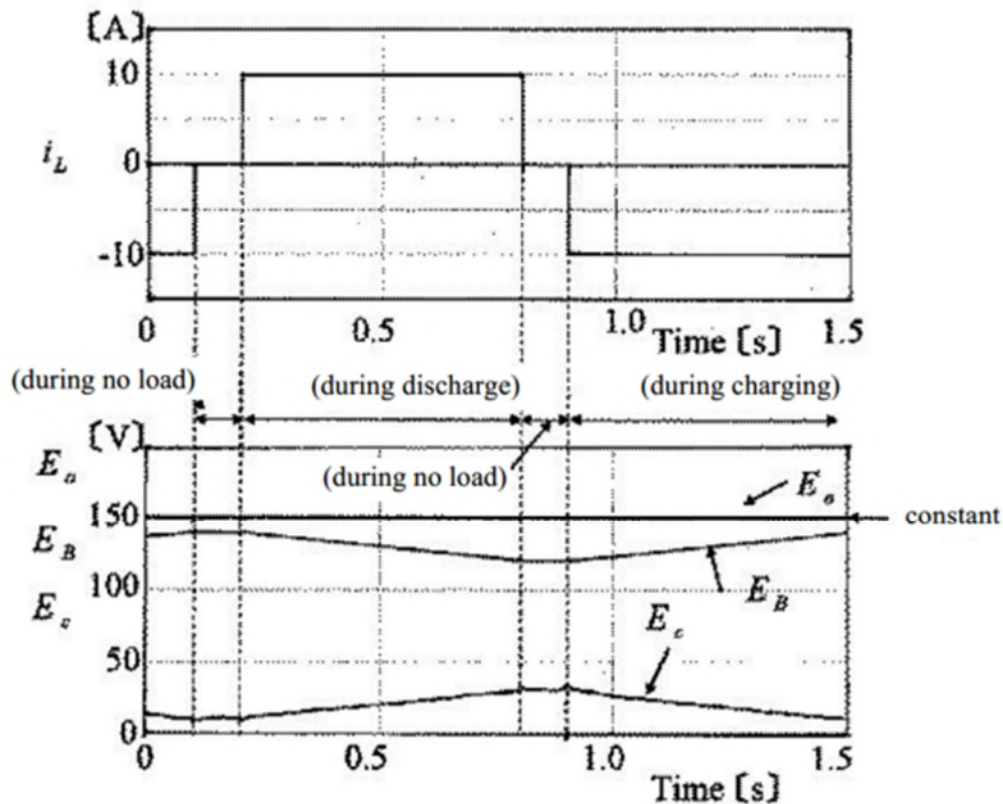
【 3 】



In sum, the voltage compensation amount of the battery (*e.g.*, the difference between E_o and E_{oref}) is used to compensate for battery system output voltage fluctuations due to the charging and discharging of the storage battery 10 by: (1) operating switch circuit 33 and transferring energy from the storage battery 10 to the capacitor 20 during discharge (*e.g.*, when E_o is below E_{oref}) to increase the value of voltage E_c and compensate for the amount of voltage drop in E_o ; and (2) operating switch circuit 32 and transferring energy from the capacitor 20 to the storage battery

10 during charging (*e.g.*, when E_o is above E_{oref}) to decrease the value of voltage E_c and compensate for the amount of voltage above the reference voltage. *Supra* § VI.B; EX1006, [0009]-[0016], [0021]; EX1002, ¶ 127. Through this process of charging and discharging capacitor 20 based on the calculated compensation amount, Onishi's storage battery system maintains the output voltage E_o of the battery system stable. *Id.* FIG. 5 of Onishi illustrates how the compensating of the output voltage E_o according to the difference between E_o and E_{oref} maintains the output voltage of the battery stable. As shown in the figure, the battery system output voltage E_o is maintained stable over time despite variations in E_B during charging and discharging by controlling an equal and opposite voltage variation E_c in the capacitor. EX1006, FIG. 5; EX1002, ¶ 127. Onishi states that “[a]s a result, the voltage fluctuation caused by charging and discharging of the battery can be compensated actively by charging and discharging the capacitor.” EX1006, [0026].

[FIG. 5]



2. Claim 10: The method according to claim 9, wherein the present electrical parameter of the battery includes at least one of a present charge quantity of the battery, a present voltage of the battery, a present output electrical current of the battery, or a present internal resistance of the battery.

As discussed under element 9[a], Onishi's control block 50 obtains the present voltage of the storage battery. EX1006, FIG. 1, [0010], [0016], [0026]. Onishi thus discloses a present electrical parameter that includes a present voltage of the battery. EX1002, ¶ 129.

3. Claim 11

- a) **11[pre] The method according to claim 10, wherein: 11[a] the present electrical parameter of the battery includes the present voltage of the battery; and:**

As discussed under claim 10 in Ground 2, Onishi discloses a present electrical parameter of a battery that includes the present voltage of the battery. EX1002, ¶ 130.

- b) **11[b] calculating the voltage compensation amount of the battery includes:**
c) **11[c] calculating the voltage compensation amount of the battery according to the present voltage of the battery and a full voltage of the battery, the voltage compensation amount being equal to a difference between the full voltage and the present voltage**

As discussed under claim 9[b] and 10, Onishi discloses calculating the voltage compensation amount of the battery according to the present electrical parameter of the battery (*e.g.*, present voltage of the battery). *Supra* §§ VIII.B.1.c, B.2. More specifically, the control block 50 calculates the difference between voltage E_o and a reference voltage E_{oref} . EX1006, FIG. 1, [0010]-[0011], [0014]; EX1002, ¶ 131. Furthermore, Onishi discloses calculating this voltage compensation amount according to a full voltage of the battery because a POSITA would have understood that E_{oref} corresponds to the full voltage of the battery system. EX1002, ¶ 131. Onishi “provide[s] a storage battery system that maintains a constant terminal voltage until the remaining capacity is exhausted, even if the terminal voltage of the

storage battery drops due to advancement of discharge of the storage battery, and which can be used until the final discharge voltage.” EX1006, [0007]. Because Onishi’s storage battery system maintains a constant terminal/output voltage and this is performed through a control loop that keeps that terminal voltage at or near E_{oref} , it would have been understood by a POSITA that the reference voltage E_{oref} is the full voltage of the battery system because that is where the output voltage of the system is when operation begins. EX1002, ¶ 131.

To the extent it is argued that E_{oref} could be set to some voltage other than the full battery system voltage, it would have at least been obvious to a POSITA to set E_{oref} as the full voltage of the battery system—*i.e.*, the battery system output voltage when the storage battery 10 is fully charged—because any other reference value would cause unnecessary voltage E_c to be built up on the capacitor (for a larger reference value) or underutilization of the storage battery (for a lower reference value). EX1002, ¶ 132. Higher voltages on the capacitor would mean more voltage stress on components leading to higher cost and lower efficiency. *Id.* An underutilized storage battery would lead to a larger, heavier, and more expensive battery system. *Id.* Thus, a POSITA would expect to maintain only the necessary capacitor voltage to compensate for the drop in the storage battery voltage as it is discharged. *Id.* This is consistent with the operation as described in Onishi and

depicted in FIG. 5, showing the capacitor voltage dropping close to zero as the storage battery voltage E_B approaches the target reference voltage E_{oref} . *Id.*

C. Grounds 3A and 3B: Claims 9-11 are (3A) Anticipated by or (3B) Obvious in View of Kim

1. Claim 9

a) 9[pre] A method for controlling a motor comprising:

To the extent the preamble is argued to be limiting, it is nonetheless disclosed by Kim. Kim discloses a “dynamically reconfigurable battery framework for management of a large-scale battery system” for, *e.g.*, powering the motor of electric vehicles (“EVs”). EX1008, Abs., 1:21-2:20, 2:15-16, 11:34-44, 12:32-36. “The framework monitors, reconfigures, and controls large-scale battery systems” and “is built upon a topology-based bypassing mechanism that provides a set of rules for changing the battery-pack configuration, and a semantic bypassing mechanism by which the battery-cell connectivity is reconfigured to recover from a battery-cell failure.” *Id.*, Abs. The “semantic bypassing mechanism implements a constant-voltage-keeping policy” that “is effective in preventing unavoidable voltage drops during the battery lifetime.” *Id.*; *see also id.*, 6:65-7:19, 8:11-19, 15:29-35. More specifically, the “constant-voltage-keeping policy is applied to keep the supply voltage above or equal to the demand voltage while the supply voltage is being monitored.” *Id.*, 15:45-66. For example, “when the [monitored] supply voltage drops below V_d ” (*e.g.*, demand voltage requirement), the battery pack connectivity

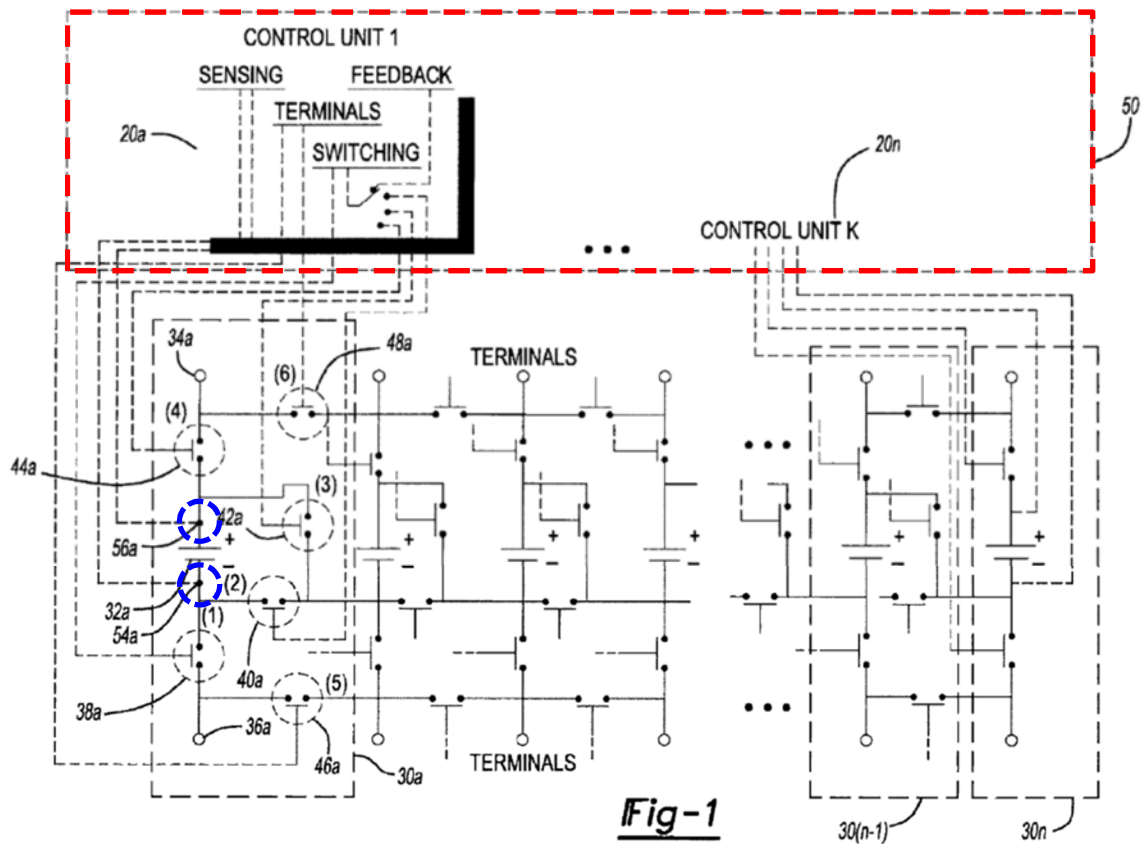
is reconfigured (*e.g.*, by reconfiguring/rotating battery cells in a series chain via switches) to compensate for the voltage drop and keep the output supply voltage constant. *Id.*, 2:37-43, 7:10-42, 8:11-9, 11:34-44, 15:45-66.

Kim's technique of reconfiguring, for example, the connection of battery cells in a given series chain to maintain a constant output supply voltage satisfies the claimed "method of controlling a motor." EX1002, ¶ 135. In particular, as would be understood by a POSITA, the output voltage of the battery is used to "power" the motor of an electric vehicle and thus affects the operation of the motor. EX1008, 11:34-44. A POSITA would therefore understand that Kim's controlling of the output voltage is a method of controlling the motor powered by and connected to the battery output voltage. EX1002, ¶ 135.

b) 9[a] obtaining a present electrical parameter of a battery;

Kim's reconfigurable battery system obtains a present electrical parameter of a battery. For example, each "battery pack" (*e.g.*, a battery) of the reconfigurable battery system includes "battery circuits 30a-30n" each having "an associated control module 20a-20n" and a "battery cell 32a." EX1008, 4:22-27, 4:42-67. "During operation, the control unit for a given battery circuit monitors an operational state of the battery cell in the battery circuit and controls switches in the battery circuit in accordance with the operational state." *Id.*, 5:60-63. "For example, **control**

unit 20a-20n monitors changes in the state of charge (SOC) and voltage of its battery cells via sensing devices 54a-54n and 56a-56n.” *Id.*, 5:66-6:1.



Id., Fig-1 (annotated). Then, at periodic monitoring intervals, the controller 50 measures the supply voltage (*e.g.*, the average voltage V_a multiplied by the number of battery cells connected in series n_s) of the battery pack (*e.g.*, obtains a present electrical parameter of a battery). *Id.*, 5:48-50, 6:40-46, 15:45-66. A POSITA would therefore understand Kim to disclose element 9[a]. EX1002, ¶ 136.

c) 9[b] calculating a voltage compensation amount of the battery according to the present electrical parameter; and

Kim's battery system calculates a voltage compensation amount of the battery according to the present electrical parameter. As explained above, the controller 50 of Kim's battery system obtains the supply voltage of the battery pack (*e.g.*, the present electrical parameter of the battery). EX1008, 5:48-50, 6:40-46, 15:45-66. As illustrated by the below equation in Kim, the controller 50 then compares the measured supply voltage (*e.g.*, $V_a * n_s$) of the battery pack to a demand voltage V_d and calculates the difference between the supply voltage and demand voltage. EX1008, 6:40-47, 15:45-66; EX1002, ¶ 137.

$$V_d \leq V_a * n_s < V_d + \alpha$$

EX1008, (4). This equation can be rewritten as " $0 \leq V_a * n_s - V_d < \alpha$ " by subtracting V_d from all three terms. A POSITA would understand that the calculated difference between $V_a * n_s - V_d$ is "a voltage compensation amount of the battery according to the present electrical parameter." EX1002, ¶ 137.

If the supply voltage is less than the demand voltage V_d ($V_a * n_s - V_d < 0$) or greater than the sum of the demand voltage and alpha ($V_a * n_s - V_d > \alpha$)—"where α specifies an upper bounds of voltage unbalancing"—the battery pack connectivity is reconfigured (*e.g.*, by bypassing faulty cells and connecting healthy battery cells in a series chain) to compensate for the difference (*e.g.*, $V_a * n_s - V_d$) below zero or

above α (*e.g.*, a voltage compensation amount of the battery) and thereby keep the supply output voltage constant. EX1008 at 6:40-54, 6:65-7:42, 8:12-19, 15:45-16:7, Figs. 8A-8D; EX1002, ¶ 138. A POSITA would therefore understand that Kim discloses calculating a voltage compensation amount of its battery pack according to the present electrical parameter. EX1002, ¶ 138.

d) 9[c] compensating an output voltage of the battery according to the voltage compensation amount to maintain the output voltage of the battery stable.

Kim's battery system compensates an output voltage of the battery according to the voltage compensation amount to maintain the output voltage of the battery stable. For example, as would be understood by a POSITA, Kim's battery system compensates the supply voltage (*e.g.*, the output voltage of the battery) based on the difference between the supply voltage— $V_a * n_s$ —and the demand voltage V_d (*i.e.*, $V_a * n_s - V_d$ is the voltage compensation amount). EX1008, 6:40-48, 15:45-16:7; EX1002, ¶ 140. Specifically, if the supply voltage is less than the demand voltage V_d ($V_a * n_s - V_d < 0$) or greater than the sum of the demand voltage and alpha ($V_a * n_s - V_d > \alpha$), the battery pack connectivity is reconfigured to compensate for the difference below zero or above α (*e.g.*, a voltage compensation amount of the battery) and thereby keep the supply voltage constant (*e.g.*, maintain the output voltage of the battery stable). EX1008 at 6:40-54, 6:65-7:42, 8:12-19, 15:45-16:7, Figs. 8A-8D; EX1002, ¶ 140.

The output voltage is compensated according to the voltage compensation amount (*e.g.*, $V_a * n_s - V_d$) by reconfiguring the battery cells in a series chain (*e.g.*, by removing or adding battery cells) such that the output supply voltage is “above or equal to the demand voltage” and below the sum of the demand voltage and alpha (*e.g.*, $0 \leq V_a * n_s - V_d < \alpha$). EX1008, (4), 6:40-54, 6:65-7:42, 8:11-19, 15:45-66; *see also id.* at 2:37-43; EX1002, ¶ 141.

The results of Kim’s voltage compensation process are illustrated in, for example, Fig-8B. EX1008, Fig-8B, 15:55-66; EX1002. ¶ 142. A POSITA would understand that the process illustrated in Fig-8B represents compensation of the output voltage of the battery according to the compensation amount to maintain the output voltage of the battery stable (*e.g.*, near 600 volts despite decreasing cell voltages as the battery is discharged). EX1002, ¶ 142.

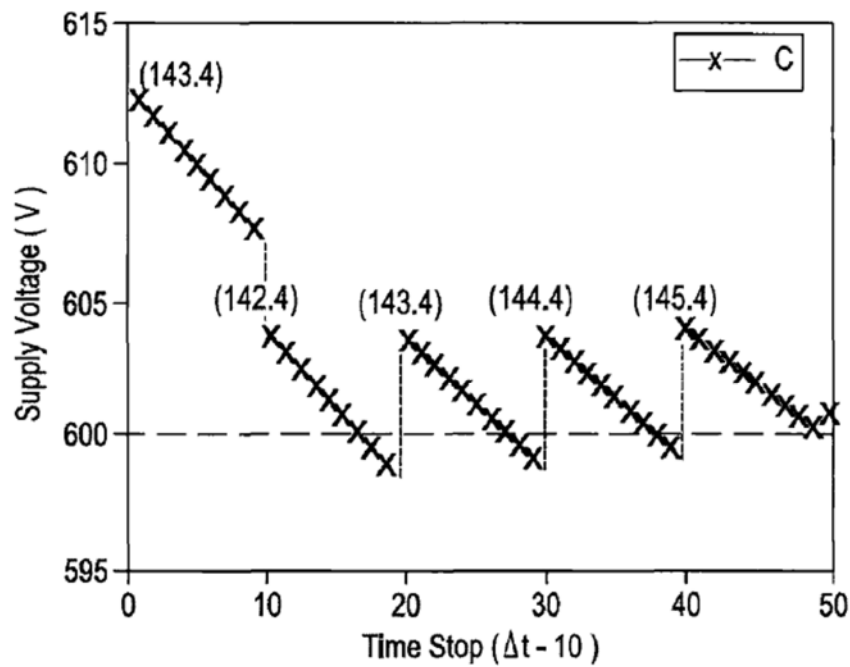


Fig-8B

2. **Claim 10:** The method according to claim 9, wherein the present electrical parameter of the battery includes at least one of a present charge quantity of the battery, a present voltage of the battery, a present output electrical current of the battery, or a present internal resistance of the battery.

As discussed with respect to element 9[a], Kim's battery system obtains the present voltage of the battery cells in a battery pack. EX1008, 5:48-50, 6:40-46, 15:45-66. Kim therefore discloses a present electrical parameter that includes a present voltage of the battery. EX1002, ¶ 144.

3. Claim 11

- a) **11[pre] The method according to claim 10, wherein: 11[a] the present electrical parameter of the battery includes the present voltage of the battery; and:**

As discussed with respect to claims 9 and 10 above, the present electrical parameter of Kim's battery system that is obtained includes the present voltage of the battery. EX1002, ¶ 145.

- b) **11[b] calculating the voltage compensation amount of the battery includes:**

11[c] calculating the voltage compensation amount of the battery according to the present voltage of the battery and a full voltage of the battery, the voltage compensation amount being equal to a difference between the full voltage and the present voltage

As discussed above with respect to element 9[b] and claim 10, Kim's battery system calculates the voltage compensation amount of the battery according to the present electrical parameter of the battery (*e.g.*, present voltage of the battery). *Supra* §§ VIII.C.1.c, VIII.C.1. In particular, the controller 50 compares the output supply voltage (*e.g.*, $V_a * n_s$) to the output demand voltage V_d and calculates the difference between the supply voltage and demand voltage (*e.g.*, $V_a * n_s - V_d$). EX1008, 6:40-47, 15:46-16:7. Kim emphasizes that “the more steeply does the supply voltage drop, the larger the difference between the supply and demand voltages.” EX1008, 16:1-3. The difference between the supply and demand voltages (*i.e.*, $V_a * n_s - V_d$) corresponds to the voltage compensation amount. Kim

states that the compensation can be improved by “reducing the monitoring interval” between voltage compensation events. EX1008, 6:40-47, 15:45-66, 16:1-6; EX1002, ¶ 146.

Furthermore, Kim discloses calculating this voltage compensation amount according to a target demand voltage V_d of the battery pack. A POSITA would understand the target demand voltage V_d to correspond to a “full voltage” of the battery pack. EX1002, ¶ 147. A POSITA would recognize that the “full voltage” of a cell within a battery pack is a target voltage indicative of when a battery cell is considered fully charged. *Id.* A POSITA would further recognize that the full voltage of a battery cell would rarely be set as the absolute maximum voltage that the battery cell can achieve to avoid damaging the cell *Id.* Thus, a POSITA would recognize the demand voltage V_d of Kim to represent a safe target voltage that the battery pack can reasonably maintain constant over the full life of the pack when the battery cells are fully charged. *Id.* As shown in Fig-8D and described in Kim, the battery voltage is maintained constant (meaning stable) at the target full voltage within a small margin above and/or below that target (as determined by the parameter alpha). *Id.*

To the extent it is argued that V_d could be set to some voltage other than the full battery system voltage, it would have at least been obvious to a POSITA to set V_d as the full voltage of the battery system—*i.e.*, the output supply voltage when the

battery pack is considered fully charged. This is because a lower target voltage would result in underutilization of the battery pack by failing to fully charge the cells within that pack. EX1002, ¶ 148. An underutilized storage battery would lead to a larger, heavier, and more expensive battery system because the physical size and cost of a battery is related to its capabilities when fully charged. *Id.* Additionally, Kim considers applications such as EVs where multiple voltages may be required to support different components. EX1008, 2:14-20, 11:34-40, 12:32-36. In these cases, the battery system of Kim is configured into multiple battery packs with multiple output voltages, and each output would have a target “full voltage” that is maintained within a small margin above and/or below that target. EX1002, ¶ 148.

Moreover, to the extent it is argued that Kim does not expressly disclose calculating a voltage compensation amount that is equal to a difference between the full voltage and the present voltage, it would have nevertheless been obvious over Kim. EX1002, ¶ 149. For example, given Kim’s disclosure of reconfiguring battery connectivity such that the supply voltage satisfies the below equation, a POSITA would have found it obvious to calculate the difference between $V_a * n_s$ and V_d to determine whether the equation is satisfied.

$$V_d \leq V_a * n_s < V_d + \alpha$$

EX1008, (4).

First, Kim specifically states that “the more steeply does the supply voltage drop, the larger the difference between the supply and demand voltages” when teaching methods to improve the constant-voltage keeping policy. EX1008, 16:1-3. This would cause a POSITA to consider solutions that calculate “the difference between the supply and demand voltages” when evaluating the equation. EX1002, ¶ 150. To simplify visualizing the calculation, a POSITA could easily rearrange equation (4) to show the difference as $0 \leq V_a * n_s - V_d < \alpha$ by subtracting V_d from both sides of the inequality. *Id.*

Further, Kim describes that “since the voltage drop is unavoidable, the constant-voltage-keeping policy is applied to keep the supply voltage above or equal to the demand voltage while the supply voltage is being monitored” and illustrates this process in Fig-8B. EX1008 15:45-65, Fig-8B. This description and illustration would indicate to a POSITA that the demand and supply voltages are being evaluated relative to the difference between them. EX1002, ¶ 151. A POSITA would recognize in considering Fig-8B common solutions to evaluate the relative difference between the two values, such as using a difference calculation in a digital processor or using the positive and negative inputs in an operational amplifier in an analog circuit. This difference can be used as taught in Kim to determine when to reconfigure the battery pack in order to keep the difference within a small margin around zero. *Id.*

IX. CONCLUSION

Petitioner respectfully requests that *inter partes* review of the '224 Patent be instituted and that the Challenged Claims be cancelled as unpatentable under 35 U.S.C. § 318(b).

July 17, 2023

Respectfully submitted,

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**CERTIFICATE OF COMPLIANCE WITH TYPE-VOLUME
LIMITATION, TYPEFACE REQUIREMENTS, AND TYPE STYLE
REQUIREMENTS**

This Petition complies with the type-volume limitations as mandated in 37 C.F.R. § 42.24, totaling less than 13,965 words. Counsel has relied upon the word count feature provided by Microsoft Word.

Respectfully submitted,

Date: July 17, 2023

/s/ Brian W. Oaks

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CERTIFICATE OF SERVICE

The undersigned hereby certifies on this July 17, 2023, a true and correct copy of the foregoing **Petition for *Inter Partes* Review of U.S. Patent No. 10,640,224**, Exhibits 1001-1013, and Powers of Attorney were served to the following parties via electronic mail and Federal Express:

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