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UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

Ex parte XIAOGUANG CHANG, XU WANG, and CHUAN HE

Appeal 2019-004721
Application 15/176,272
Technology Center 2800

Before DEBRA L. DENNETT, LILAN REN, and JANE E. INGLESE, *Administrative Patent Judges*.

DENNETT, *Administrative Patent Judge.*

DECISION ON APPEAL[1]

Pursuant to 35 U.S.C. § 134(a), Appellant[2] appeals from the Examiner's decision to reject claims 1–20 of Application 15/176,272, which constitute all the claims pending in this application. We have jurisdiction under 35 U.S.C. § 6(b).

For the reasons set forth below, we REVERSE.

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[1] In our Decision, we refer to the Specification ("Spec.") of Application No. 15/176,272 filed June 8, 2016 (the "'272 App."); the Final Office Action dated June 29, 2018 ("Final Act."); the Appeal Brief filed Nov. 30, 2018 ("Appeal Br."); the Examiner's Answer dated Mar. 26, 2019 ("Ans."); and the Reply Brief filed May 23, 2019 ("Reply Br.").

[2] We use the word "Appellant" to refer to "applicant" as defined in 37 C.F.R. § 1.42. Appellant identifies the real party in interest as Ford Global Technologies, L.L.C. Appeal Br. 1.

STATEMENT OF THE CASE

The ’272 Application relates to a system for estimating battery capacity for a vehicle traction battery. Spec. ¶ 1. According to the Specification, high-voltage traction batteries in hybrid and electric vehicles provide stored electric energy, but are subject to aging, i.e., their capacity and charge/discharge capability may decrease with time and vehicle usage. *Id.* ¶¶ 2, 25. Battery decay can affect performance and fuel economy of hybrid vehicles if control strategies are not updated to account for battery aging. *Id.* ¶ 25.

The energy supplied to a traction battery is expected to be greater than the energy stored in the traction battery due to heat dissipation during charging. *Id.* ¶ 36. If the battery charge estimate is in error (e.g., indicating that the traction battery stored more energy than was supplied), operation of control strategies that utilize the battery capacity estimate may be altered. *Id.* ¶ 37.

State of charge (SOC) gives an indication of how much charge remains in the traction battery. *Id.* ¶ 22. The traction battery may be charged or discharged according to a target state of charge compared to a present state of charge. *Id.* ¶ 24. A SOC value may be output to inform the driver of how much charge remains in the traction battery, similar to a fuel gauge. *Id.* ¶ 22. The SOC estimate relies on the battery capacity value. *Id.* ¶ 38. A battery energy control module may operate the traction battery within a range of SOC value between a maximum SOC limit and a minimum SOC limit. *Id.* ¶ 39.

For a lithium-ion battery cell, an initial SOC value for a drive cycle may be estimated based on an open-circuit voltage (OCV) measurement before the battery cell is coupled to a load. *Id.* ¶ 23. After a rest period, a terminal voltage of the battery cell and the open-circuit voltage will be equivalent under no-load conditions. *Id.* The state of charge values, SOC_i and SOC_1, may be based on measured voltages sampled over two key-on/key-off cycles. *Id.* ¶ 27. After the battery has been resting a sufficient time, the terminal voltage is approximately equal to the open circuit voltage of the battery. *Id.* The throughput value may be accumulated during each ignition cycle and stored in a non-volatile memory for use in the next ignition cycle. *Id.* Upon power-up in an immediately subsequent ignition cycle, the terminal voltage may be sampled and the battery capacity computed. *Id.*

According to the Applicant, for best results, the voltage measurements should be made when the battery is fully relaxed, but the relaxed condition may occur less frequently in a plug-in hybrid (PHEV) or battery electric vehicle (BEV). *Id.* ¶ 28. With plug-in vehicles, an operator is likely to park the vehicle and immediately plug in a charger to initiate charging, and unplug the charger and begin driving immediately. *Id.* Under these conditions, the traction battery may not achieve a fully relaxed condition for optimal voltage measurement. *Id.* Using the voltages at the start of an ignition cycle may cause estimates of battery capacity to be inaccurate, and over time, the estimated battery capacity may deviate from the true value. *Id.*

If estimated battery capacity is not accurate, the SOC value will not be accurate, and any inaccuracy may affect electric-range determination, charge-time estimation, and power limit determination. *Id.* ¶ 30. The learned battery capacity may diverge from the true capacity value due to factors such as sensor measurement noise and vehicle operating conditions. *Id.* ¶ 31. When the battery capacity value is periodically learned, a method of determining the quality of the estimated capacity value is desirable. *Id.* A battery capacity estimate that is evaluated to be of high quality may then be used for computing related dependent parameters. *Id.* A battery capacity estimate that is evaluated to be of low quality may trigger computation of an updated battery capacity. *Id.*

The SOC may be estimated during a drive cycle based on the initial SOC based on the terminal voltage, the current throughput during the drive cycle, and the estimated battery capacity. *Id.* ¶ 32. During the drive cycle, the battery current may be measured and integrated to obtain the current throughput. *Id.* The present estimate of the battery capacity may be used to determine the change in SOC over the drive cycle. *Id.* The drive cycle may include the period of time from the initiation of an ignition cycle to termination of the ignition cycle. *Id.* At the termination of the ignition cycle, the SOC value may be stored in non-volatile memory for use in a subsequent ignition cycle. *Id.*

At the initiation of the next ignition cycle, the initial SOC may be derived and the ending SOC from the previous ignition cycle may be retrieved from non-volatile memory. *Id.* ¶ 33. A comparison may be made between the initial SOC and the ending SOC from the immediately previous ignition cycle. *Id.*

Claim 1, reproduced below from the Claims Appendix of the Appeal Brief, illustrates the claimed subject matter:

> 1. A vehicle power system comprising:
>
> a controller programmed to operate a traction battery within a first state of charge range and, in response to an amount of energy supplied to the traction battery during a charge cycle being less than an estimated amount of energy stored in the traction battery during the charge cycle, operate

the traction battery within a second state of charge range that is narrower than the first state of charge range.

REFERENCES

The Examiner relies on the following references in rejecting the claims:

Name	Reference	Date
Seo et al. ("Seo")	US 7,649,338 B2	Jan. 19, 2010
Paryani et al. ("Paryani")	US 8,004,243 B2	Aug. 23, 2011
Kusumi	US 8,820,446 B2	Sept. 2, 2014
Chung et al. ("Chung")	US 2015/0115715 A1	Apr. 30, 2015

REJECTIONS

The Examiner rejects claims under 35 U.S.C. § 103 as follows: (1) claims 1, 4, 5, 7–9, 14, and 17–19 over Kusumi in view of Chung; (2) claims 2 and 3 over Kusumi in view of Chung, and further in view of Seo; (3) claim 6 over Kusumi in view of Chung, and further in view of Paryani; (4) claims 10 and11 over Kusumi in view of Chung, and further in view of Seo; (5) claims 12 and 13 over Kusumi in view of Chung, and further in view of Paryani; (6) claims 15 and 16 over Kusumi in view of Chung, and further in view of Seo; and (7) claim 20 over Kusumi in view of Chung, and further in view of Paryani. Final Act. 2–17.

DISCUSSION

We review the appealed rejections for error based upon the issues identified by Appellant and in light of the arguments and evidence produced thereon. *Ex parte Frye*, 94 USPQ2d 1072, 1075 (BPAI 2010) (precedential), (cited with approval in *In re Jung*, 637 F.3d 1356, 1365 (Fed. Cir. 2011)) ("[I]t has long been the Board's practice to require an applicant to identify the alleged error in the [E]xaminer's rejections."). After considering the evidence presented in this Appeal and each of Appellant's arguments, we are persuaded that Appellant identifies reversible error in the Examiner's rejections.

With regard to claim 1, the Examiner finds that Kusumi teaches a vehicle power system comprising a controller programmed to operate a traction battery within a first state of charge range and operate the traction battery within a second state of charge range that is narrower than the first state of charge range. Final Act. 2. The Examiner finds that Kusumi also teaches "the charge ECU [electronic control unit] automatically switches the mode from the mode where the SOC operates in the first SOC range to the mode where the SOC operates in the second SOC range, but does not explicitly teach the conditions, or trigger, for the charge ECU to switch to the different SOC range." *Id.* at 3. The trigger in claim 1 is "in response to an amount of energy supplied to the traction battery during a charge cycle being less than an estimated amount of energy stored in the traction battery during the charge cycle." *See* Appeal Br. 9 (Claims App.). The Examiner finds that Kusumi switches from one SOC control range to another based on a user activation of a switch, but also allows for automatic switching by the charge ECU.

The Examiner initially finds that Chung teaches the limitation "in response to an amount of energy supplied to the battery during a charge cycle . . . being less than an estimated amount of energy stored in the battery during the charge cycle." Final Act. 3 (citing Chung ¶ 64).

In the Answer the Examiner appears to reconsider his finding regarding paragraph 64 of Chung, but finds that Chung's disclosure of a "compensation charge control signal" reads on the trigger in claim 1. Ans.

4–5. Specifically, the Examiner finds that Chung discloses that a power control unit outputs a compensation charge control signal when the amount of power compensation is determined, and the compensation charge control signal is the trigger used to change the SOC range. Ans. 5 (citing Chung ¶ 73). The Examiner acknowledges that Chung uses the signal for a task that differs from the claimed task, but finds that the signal "nonetheless triggers [Chung's] system to make a change to the SOC range, thus the reason why it reads on this portion of the independent claims." *Id.*

The Examiner determines:

> It would have been obvious to a person having ordinary skill in the art to use the monitoring and comparing of the amount of energy supplied to the amount of energy estimated to trigger an operation as explicitly taught in Chung in the automatic version of the state of charge changing system of Kusumi since it is known in the art that the state of charge of a battery is affected by degradation factors such as number of charge/discharge cycles and would be an appropriate method of triggering the state of charge range changing of Kusumi from SOC range 1 to SOC range 2, although implied but not explicitly detailed in the disclosure of Kusumi.

Final Act. 3.

Appellant argues, *inter alia*, that Chung does not teach or suggestion the claimed trigger condition. Reply Br. 2; *see* Appeal Br. 5. We agree that the record before us does not support the Examiner's finding.

Claim 1 requires a controller programmed to "operate the traction battery within a second state of charge range that is narrower than the first state of charge range" "in response to an amount of energy *supplied* to the traction battery during a charge cycle being *less than* an estimated amount of energy *stored* in the traction battery during the charge cycle." Appeal Br. 9 (Claims App.) (emphasis added). Appellant accurately points out that

Chung discloses that "an actual amount of energy stored in the secondary battery 121 is smaller than an amount of supplied energy," or, in other words, an amount of energy supplied is *greater than* an amount of energy stored, the opposite of claim 1's requirement. Appeal Br. 5 (quoting Chung ¶ 64); Reply Br. 2. Thus, Chung does not disclose the trigger limitation recited in claim 1.

Appellant persuades us that the Examiner also errs in finding that Chung's disclosure of a compensation charge control signal teaches or suggests the claimed trigger condition. Reply Br. 2–3; *see* Ans. 5. The record before us does not support the Examiner's finding that Chung's compensation charge control signal reads on the trigger element of claim 1.

During prosecution, an application's claims are given their broadest reasonable scope consistent with the specification. *In re Am. Acad. of Sci. Tech. Ctr.*, 367 F.3d 1359, 1364 (Fed. Cir. 2004). The words used in a claim must be read in light of the specification, as it would have been interpreted by one of ordinary skill in the art at the time of the invention. *Id.*

The Specification relates that the battery energy control module may implement a control strategy for adjusting SOC window limits between a maximum SOC limit and a minimum SOC limit. Spec. ¶ 39. The SOC range may be configured to balance battery life with an operating range that is as large as possible. *Id.* According to the Specification, during operation the battery capacity may be expected to decrease, and the battery capacity estimate may become larger than the actual value over time, resulting in the estimated computed change in SOC being lower than the actual change in SOC, and the estimated SOC changes being less than the actual SOC changes. *Id.* ¶ 40. The decrease in the actual battery capacity relative to the estimated battery capacity may cause operation outside of the first SOC window. *Id.*

To compensate for the decrease, the SOC operating window may be changed to a second SOC window defined by a second maximum SOC and a second minimum SOC, such that the traction battery is operated at a reduced (narrower) range of SOC values when compared to the first SOC window in response to determining that the battery capacity is no longer accurate. *Id.* ¶ 41. The operating SOC window may be narrowed until the battery capacity is estimated again. *Id.*

In light of the Specification, the Examiner's reading of the trigger limitation of claim 1 is overly broad. The trigger requires that the battery operate within a narrower state of charge range "in response to an amount of energy supplied to the traction battery during a charge cycle being less than an estimated amount of energy stored in the traction battery during the charge cycle." Appeal Br. 9 (Claims App.). Chung's disclosure of a signal that can change the SOC range—reasonably interpreted—is insufficient to teach the claimed limitation.

We do not sustain the rejection of claim 1 over Kusumi in view of Chung. Because the other pending claims also rely on identical findings by the Examiner in relation to Chung, we also do not sustain the rejection of claims 2–20.

DECISION SUMMARY

In summary:

Claims Rejected	**35 U.S.C. §**	**Reference(s)/Basis**	**Affirmed**	**Reversed**
1, 4, 5, 7–9, 14, 17–19	103	Kusumi, Chung		1, 4, 5, 7–9, 14, 17–19
2, 3	103	Kusumi, Chung, Seo		2, 3
6	103	Kusumi, Chung, Paryani		6
10, 11	103	Kusumi, Chung, Seo		10, 11
12, 13	103	Kusumi, Chung, Paryani		12, 13
15, 16	103	Kusumi, Chung, Seo		15, 16
20	103	Kusumi, Chung, Paryani		20
Overall Outcome				1–20

REVERSED