

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

ADC SOLUTIONS AUTO LLC,
Petitioner

v.

THE NOCO COMPANY,
Patent Owner.

Case IPR2024-00577
U.S. Patent No. 11,447,023

DECLARATION OF DR. AYMAN FAYED

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1. I am making this declaration at the request of The NOCO Company (“Patent Owner” or “NOCO”) in the matter of the *Inter Partes* Review 2024-00577 of U.S. Patent No. 11,447,023 (the “’023 Patent”).

2. I am being compensated for my work in this matter at my usual and customary consulting rate of \$750 per hour for the time I spend in connection with this matter. My compensation in no way depends on the outcome of this case or any other proceeding.

3. In preparing this Declaration, I considered all materials cited in the body of this Declaration, including but not limited to the following:

- a. The ’023 Patent (Ex. 1001) and its file history (Ex. 1002);
- b. Petition for *Inter Partes* Review of the U.S. Patent No. 11,447,023 (“Petition”);
- c. The Declaration of Dr. C. Arthur MacCarley (Ex. 1003);
- d. U.S. Pat. App. Pub. No. 2013/0154543 to Richardson, *et al.* (“Richardson”) (Ex. 1005);
- e. U.S. Pat. No. 9,391,467 to Zhao, *et al.* (“Zhao”) (Ex. 1006);
- f. Chinese Utility Model Pat. No. CN 203211234 U to Yu (“Yu”) (Ex. 1007, 1008);
- g. U.S. Pat. No. 9,219,372 to Paparrizos, *et al.* (“Paparrizos”) (Ex. 1009);

- h. PTAB Decision Granting Institution of *Inter Partes* Review for IPR2024-00577 (Ex. 1014);
- i. U.S. Patent Publication No. 2013/0285596 A1 to Zhou et al. (“Zhou”) (Ex. 1016);
- j. U.S. Patent No. 9,035,599 B2 to Amemiya et al. (“Amemiya”) (Ex. 1017);
- k. Chinese Utility Model Patent No. CN 202512152 U (Ex. 1018);
- l. Certified English Translation of CN 202512152 U (Ex. 1019);
- m. Chinese Utility Model Patent Publication No. CN 201226449Y (Ex. 1020);
- n. Certified English Translation of CN 201226449Y (Ex. 1021);
- o. Battery Charging Specification, Revision 1.0, Mar. 8, 2007 from the Universal Serial Bus Implementers Forum (“USB-IF”) (Ex. 1025);
- p. Deposition Transcript of the deposition of C. Arthur MacCarley, taken on October 29, 2024 (Ex. 2010).

I. PROFESSIONAL BACKGROUND

4. I am a technical expert and have over 26 years of experience in the fields of electrical, computer, and electrical communications engineering. Ex. 2012. My industry and research experience and expertise specifically relevant to the challenged patent includes, but is not limited to, power management and power

electronics integrated circuits, linear and switching power converters, regulators, and modulators, dynamic power supplies, low-noise low-EMI switching power supplies; high-frequency switching power converters, high-efficiency adaptive power regulators, linear and switching battery chargers and battery management systems; and analog and mixed-signal integrated circuits.

5. I received my B.S. degree in Electronics and Electrical Communications Engineering from Cairo University and my M.S. and Ph.D. degrees in Electrical and Computer Engineering from The Ohio State University. I am currently a Professor in the Department of Electrical and Computer Engineering at The Ohio State University.

6. A selected summary of my specific experience relevant to the challenged patents includes my experience in the field as an analog, mixed-signal, and power management/electronics IC (integrated circuit) designer for the Connectivity Department at Texas Instruments in 2000 and 2002-2005. In that role, I designed systems and circuits for the power management/electronics module of single-chip media players in 90nm digital CMOS process with support for multiple battery chemistries and power/charge through USB. This included architecture development and definition, load sharing and distribution strategy, power states definition, and circuit techniques for configurable buck/boost DC-DC converters, Li-Ion switching battery chargers, and linear regulators.

7. My relevant experience also includes my 2005-2008 role as a member of the technical staff and as an analog, mixed-signal, and power management/electronics IC (integrated circuit) designer for the Wireless Terminal Business Unit at Texas Instruments. In that role, I led the system and circuit design of embedded power management/electronics solutions for integrated wireless, RF, and baseband applications in 65nm/45nm digital CMOS technologies. My responsibilities included power system architecture, supply domain definition and specifications, noise and power budgeting, RF-friendly dc-dc converter techniques, ripple suppression and cancellation techniques, and low-leakage circuit techniques for linear and switching power regulators for RF and mixed-signal modules. I have also led the clear spectrum task force at Texas Instruments, where I was responsible for the development of design & verification methodology for power management/electronics modules in large mixed-signal System-on-Chip with multi noise-sensitive RF cores. This encompassed circuit design, power distribution networks, package and board parasitics modeling, communication across supply domains, and power supply isolation.

8. My relevant experience also includes my role as an assistant professor (2009-2014) then associate professor (2014-2015) at Iowa State University), then as an associate professor (2015-2020) then full professor (2020-present) at The Ohio State University, where I supervised the research of 14 Ph.D. students, over 11 M.Sc.

students, who, for example, designed various classes of integrated linear and switching power regulators, low-noise low-EMI power converters for RF circuits, high-frequency switching converters with on-chip outputs, and continuous- and discrete-time signal filters, all in 350nm/65nm/45nm/28nm CMOS technologies.

9. Much of the focus of my professional and research work has been on analog, mixed-signal, and power management/electronics integrated circuits. I have authored or co-authored over 71 technical papers in international journals and conferences and have been an inventor or co-inventor on 8 US and international patents. Much of my published work, including my Master's and Ph.D. research, covers the area of analog, mixed-signal, and power management/electronics integrated circuits.

10. My expertise in and contributions to the field of analog, mixed-signal, and power management/electronics integrated circuits have been recognized in many ways. For example, from 2016 to 2023, I have been serving on the editorial board (as an associate editor) of the IEEE Transactions on Circuits and Systems I, which is the leading journal of the IEEE Circuits and Systems Society. I have also been serving as a member of the Technical Program Committee of many leading IEEE international conferences, such as RF Integrated Circuits Symposium (2011-2021), Applied Power Electronics Conference (2018-present), and International Symposium of Circuits and Systems (2012-present). I am also currently serving as

the chair of the Analog Signal Processing Technical Committee of the IEEE Circuits and Systems Society.

11. I have received the Best Associate Editor Award from IEEE Transactions on Circuits and Systems–I in 2020, 2021 and 2022, and the 2022 IEEE Circuits and Systems Society Outstanding Technical Committee Award. I have also received the 2021 IEEE Transactions on Power Electronics Second Place Prize Paper Award from the IEEE Power Electronics Society, the 2015 Darlington Best Transactions Paper Award from the IEEE Circuits and System Society, the National Science Foundation CAREER Award in 2013, and the Northrop Grumman Chair Professorship from Iowa State University in 2013 and 2014.

12. Based upon on my education, my professional experience from 2000 through the present, my scholarly publications, I am an expert in the relevant field of the challenged patent. Through my education and experience, I am intimately familiar with how a person of ordinary skill in the art (herein “PHOSITA”) would have understood and used the terminology found in the ’023 patent at the time of its claimed priority date.

II. RELEVANT LEGAL STANDARDS

13. I have been asked to provide my opinion as to whether claims 1, 32, 38, 39, 47, 52, and 54 (“the Challenged Claims”) of the ’023 Patent are anticipated by

the prior art or would have been obvious to a person having ordinary skill in the art (“PHOSITA”) at the time of the alleged invention in view of the prior art.

14. I am an engineer by education and profession. The opinions I am expressing in this Declaration involve the application of my engineering knowledge and experience to the evaluation of certain prior art with respect to the ’023 Patent. I am not an attorney or patent agent. I therefore have requested that the attorneys from Jones Day, who represent NOCO, provide me with guidance as to the applicable patent law in this matter. The paragraphs below express my understanding of how I must apply current principles related to patentability.

15. It is my understanding that in determining whether a patent claim is anticipated or obvious in view of the prior art in an *inter partes* review (IPR) proceeding, the Patent Trial and Appeal Board (PTAB) gives claims their ordinary and customary meaning, or the meaning that the term would have to a PHOSITA at the time of the invention in view of the intrinsic record. I understand that the claim language, specification, and prosecution history are relevant to determine the meaning of a claim term. I understand that the prosecution history of a patent provides the record of the examination of a patent application before the U.S. Patent and Trademark Office (PTO). The prosecution history provides evidence of how the patent examiner and the inventors understood the patent application and the claims and can therefore be instructive on how to interpret the claims. My

understanding is that extrinsic evidence may also be used in understanding the meaning of a claim term. Extrinsic evidence includes dictionaries, treatises, expert testimony, and prior art. But it is my understanding that one should first look to the intrinsic evidence in construing claims.

16. My understanding is that there are at least two circumstances where the words in a patent claim may differ from and not be given their plain and ordinary meaning. One circumstance is when the applicants act as their own lexicographer by clearly setting forth a definition of a claim term that may differ from the plain and ordinary meaning it would otherwise possess. Another circumstance is when the applicant includes or provides an intentional disclaimer, or disavowal, of claim scope. My understanding is that an applicant may act as their own lexicographer, or disclaim or disavow claim scope, in either the specification or the prosecution history of the patent. My understanding is also that the applicant may act as a lexicographer, or disclaim or disavow claim scope, by making amendments to the claims during prosecution, or by making assertions to the PTO about the differences between the claimed inventions and the prior art.

17. It is my understanding that a claim is unpatentable under 35 U.S.C. § 102 if each and every element and limitation of the claim is found either expressly or inherently in a single prior art reference.

18. It is my understanding that a claim is unpatentable under 35 U.S.C. § 103 if the claimed subject matter as a whole would have been obvious to a person of ordinary skill in the art at the time of the alleged invention. I also understand that an obviousness analysis considers the scope and content of the prior art, the differences between the claimed subject matter and the prior art, and the level of ordinary skill in the art at the time of the invention.

19. In determining the scope and content of the prior art, it is my understanding that a reference is considered appropriate prior art if it falls within the field of the inventor's endeavor. In addition, a reference is prior art if it is reasonably pertinent to the particular problem with which the inventor was involved. A reference is reasonably pertinent if it logically would have commended itself to an inventor's attention in considering his problem. If a reference relates to the same problem as the claimed invention, that situation supports use of the reference as prior art in an obviousness analysis.

20. To assess the differences between prior art and the claimed subject matter, it is my understanding that 35 U.S.C. § 103 requires that the claimed invention be considered as a whole. I also understand that a finding of obviousness requires more than merely demonstrating that each claim element was known in the prior art. Obviousness requires showing that a person of ordinary skill in the art would have been motivated to combine the teachings of the prior art to achieve the

claimed invention and would have had a reasonable expectation of success in doing so.

21. It is my understanding that the Supreme Court has recognized several rationales for combining references or modifying a reference to show the obviousness of claimed subject matter. Some of these rationales include: combining prior art elements according to known methods to yield predictable results; simple substitution of one known element for another to obtain predictable results; a predictable use of prior art elements according to their established functions; applying a known technique to a known device (method or product) ready for improvement to yield predictable results; choosing from a finite number of identified, predictable solutions, with a reasonable expectation of success; and some teaching, suggestion, or motivation in the prior art that would have led one of ordinary skill to modify the prior art reference or to combine prior art reference teachings to arrive at the claimed invention.

III. THE '023 PATENT

22. I have reviewed the '023 Patent (Ex. 1001), which has a priority date of July 3, 2014, in detail and understand its contents.

A. Overview Of The State Of The Art

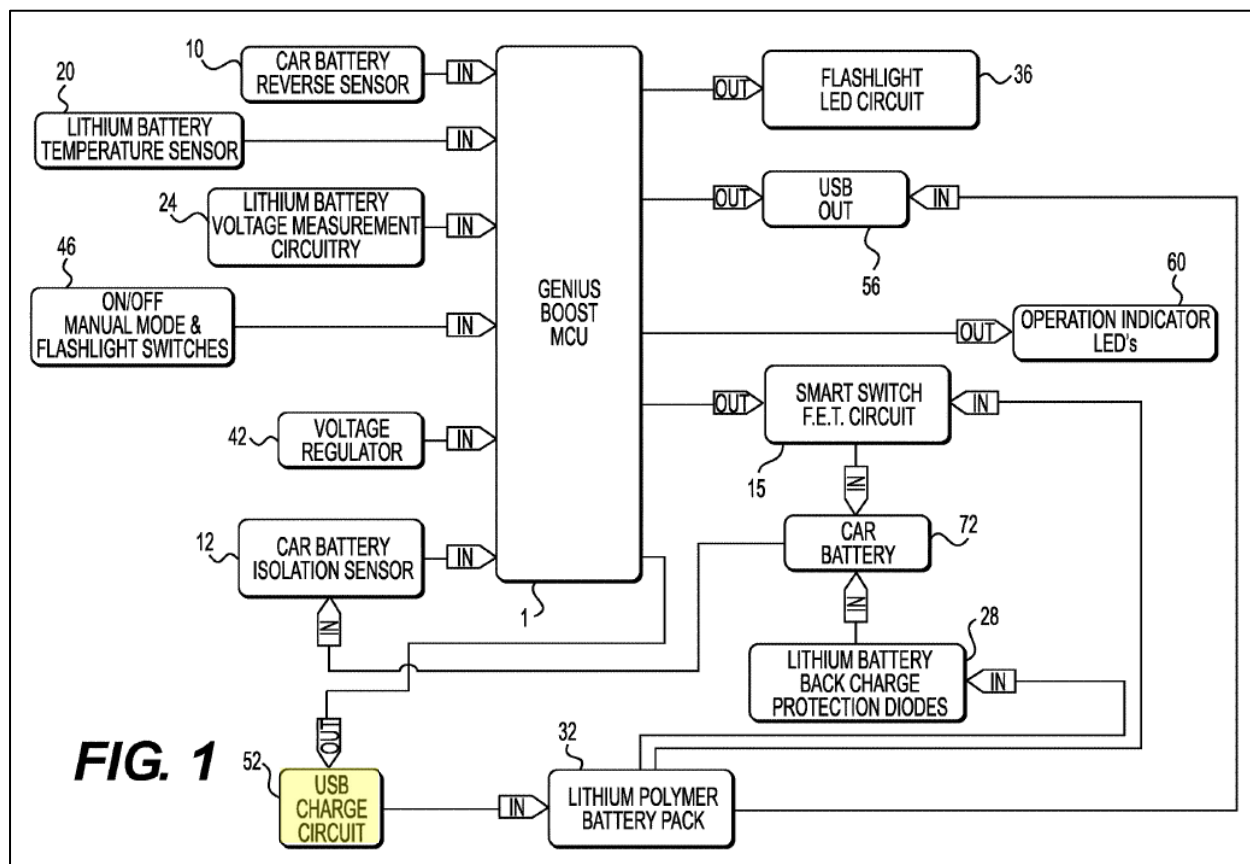
23. As explained in the '023 Patent, portable booster devices, often referred to as jump start devices or jump starters, include a high-discharge rechargeable

battery that can be connected in circuit with a vehicle's battery through a pair of cables in order to jump start the vehicle. *See* Ex. 1001, 1:13-16. Previously, recharging a jump starter powerful enough to jump start a 12-volt car battery relied on a high-power charger through a specialized 12-volt plug connector, such as a barrel charger. While various attempts were made to address problems associated with traditional jump starters (*e.g.*, safety concerns due to improper usage) before the '023 Patent, "each of the prior art solutions suffer[ed] from other shortcomings, either in complexity, cost or potential for malfunction." *Id.*, 3:12-15. Thus, at the time of filing, there remained a need for further improvements to vehicle jump start devices. *Id.*, 1:41-45.

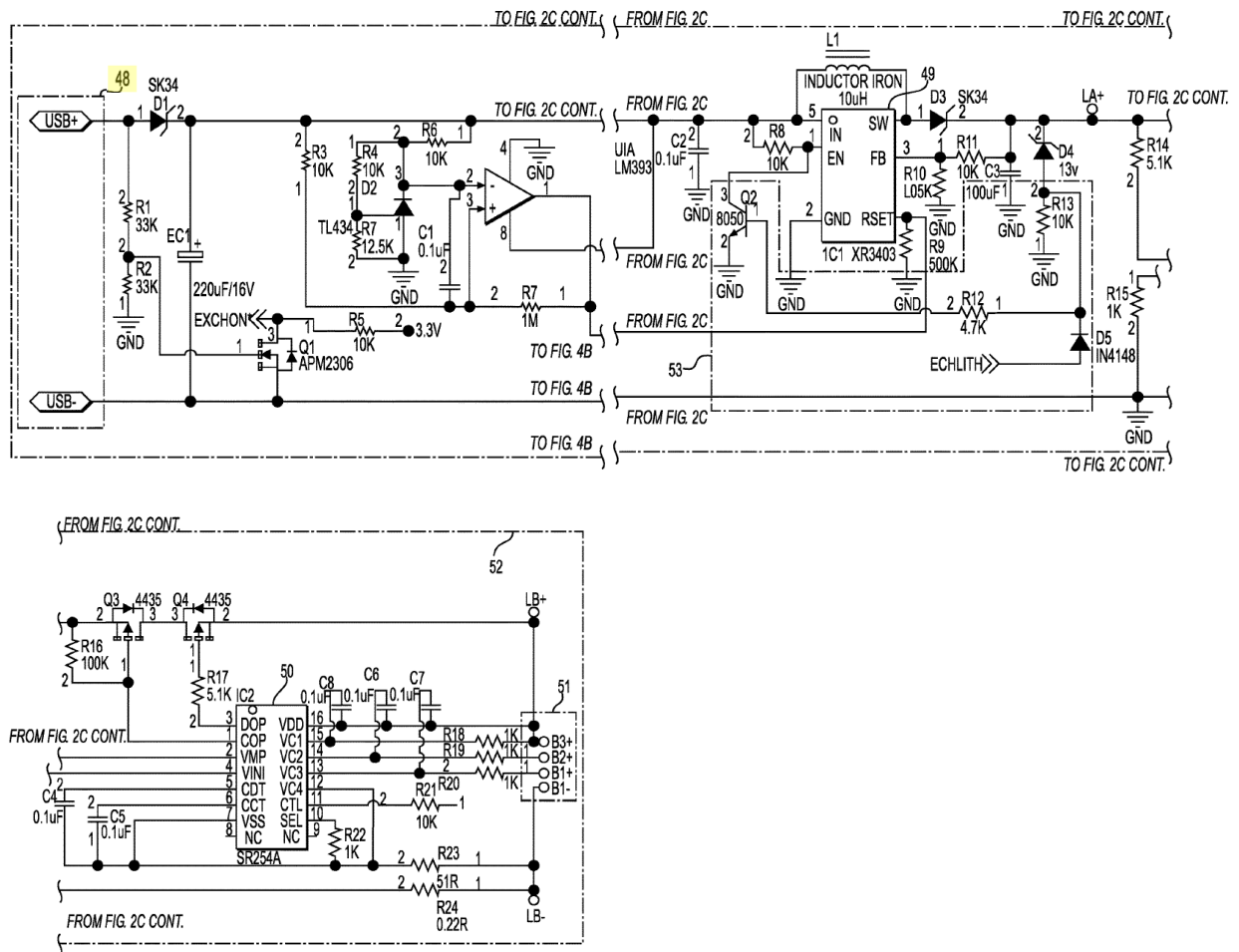
B. The Invention Claimed In The '023 Patent

24. Recognizing the need for improved jump starter devices, NOCO developed a "Portable Vehicle Battery Jump Start Apparatus" that greatly reduced the complexity and potential for malfunction associated with its usage through a variety of included advancements. Ex. 1001, Title. The '023 Patent discloses techniques that, for example, "prevent[] the lithium battery pack from being connected to the vehicle battery 72 when the terminals of the battery 72 are connected to the wrong terminals of the booster device." *Id.*, 4:30-33. As shown in Figure 1 below, the '023 Patent also discloses that a "USB charge circuit 52 converts power from any USB charger power source, charge voltage and current for charging

the lithium battery pack 32,” (*id.*, 5:16-17), as shown in Fig. 1 (color annotation added):



25. Beneficially, “[t]he USB charge circuit 52 allows the internal lithium battery pack 32 to be charged using a standard USB charger.” *Id.*, 7:21-23. In other words, in order to further simplify the user experience, the “charge input uses a standard micro-USB connector 48 allowing standard cables to be used.” *Id.*, 7:23-25. The micro-USB connector (item 48) described in the ’023 Patent for charging the lithium polymer battery pack is included in the USB charge circuit (item 52) depicted by Figure 2C (color annotations added):



26. The jump starter of the '023 Patent relies on the limited charging capabilities of a standard USB charger even though, “[a]t the heart of the handheld battery booster is a lithium polymer battery pack 32, which stores sufficient energy to jump start a vehicle engine served by a conventional 12 volt lead-acid or valve regulated lead-acid battery.” *Id.* 4:5-9. The '023 Patent even illustrates the large size of the battery pack by providing an example configuration: “three 3.7V, 2666 mAh lithium polymer batteries in a 3S1P configuration.” *Id.*, 4:11-12. In order to permit the jump starter to be charged using a USB cable, “[t]he 5V potential provided from standard USB chargers is up-converted to the 12.4 VDC voltage required for

charging the internal lithium battery pack using a DC-DC converter 49.” *Id.*, 7:21-23. The advancement of using a USB type connector to charge a portable jump start device, as well as various components like the DC-DC converter that make this solution possible, are captured in the claims of the ’023 Patent.

C. The Challenged Claims

27. I understand that the Petition challenges claims 1, 32, 38, 39, 47, 52, and 54 of the ’023 Patent. Petition, p. 7. All challenged claims are independent claims with the exception of claim 32, which depends directly from claim 1. *Id.*, 11:4-6. Each independent claim captures a jump starting apparatus or device that, similar to claim 1 above, includes a USB input connector and a USB input circuit configured to increase/up-convert the voltage from the USB input connector to the power supply. *See id.*, 8:39-15:12.

IV. THE ALLEGED GROUNDS OF UNPATENTABILITY

28. The alleged grounds of unpatentability for this trial are:

- Ground 1: Claims 1, 32, 38, 39, 47, 52, and 54 are unpatentable under 35 U.S.C. § 103(a) over U.S. Patent Publication No. 2013/0154543 A1 (“Richardson”) (Ex. 1005) in view of U.S. Patent No. 9,391,467 B2 (“Zhao”) (Ex. 1006).
- Ground 2: Claims 1, 32, 38, 39, 47, 52, and 54 are unpatentable under 35 U.S.C. § 103(a) over Chinese Utility Model Patent No. CN 203211234 U

(“Yu”) (Ex. 1007; Ex. 1008) and U.S. Patent No. 9,219,372 B2 (“Paparrizos”).

29. As further detailed below, none of these references teach or suggest a method or apparatus for charging a jump starter using a USB connection.

A. Overview Of The Asserted Prior Art

30. I have been informed and understand that Richardson, Zhao, Yu, and Paparrizos are prior art to the '023 Patent.

1. Richardson

31. I have reviewed the Richardson prior art reference (Ex. 1005) and understand its contents.

32. Richardson is titled “Method And Apparatus For Providing Supplemental Power To An Engine.” Ex. 1005, p. 1. Richardson was cited and relied upon by the Patent Office as the primary reference in numerous rejections during the prosecution of the '023 Patent. *See, e.g.*, Ex. 1002, pp. 438-463. Richardson discloses a large “supplemental power source (jump starter)” for use in commercial applications. Ex. 1005, ¶ [0014]. Richardson’s jump starter is “useful when starting fleets of vehicles with dead batteries” since the device may be “rapidly recharged to start many vehicles in a row.” *Id.*, ¶ [0055]. While the Petition relies on Richardson to teach numerous elements of claim 1, as recognized numerous times by the Office during prosecution (*see* Ex. 1002, p. 440), Richardson fails to disclose

either the use of a USB input charger or boost conversion of an input charge. *See* Ex. 1005.

2. Zhao

33. I have reviewed the Zhao prior art reference (Ex. 1006) and understand its contents.

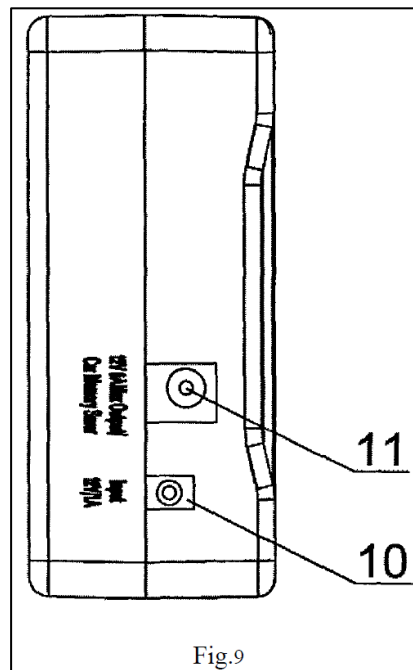
34. Zhao (Ex. 1006) is titled “Step-Up Battery Charging Management System And Control Method Thereof.” Ex. 1006, p. 1. Zhao discloses “a step-up battery charging management system,” (*id.*, 1:14-15), that may “receive DC input voltage V_{in} and may generate an output signal by boosting DC input voltage V_{in} .” *Id.*, 3:1-3. Zhao states that the “DC input voltage V_{in} can be provided to the step-up converter by a universal serial bus (USB) charger, or any other suitable low voltage power supply system.” *Id.*, 3:8-10. Zhao does not teach or suggest applying its techniques to charge a vehicle jump starter or comparable high-power device. *See* Ex. 1006.

3. Yu

35. I have reviewed the Yu prior art reference (Ex. 1007, 1008) and understand its contents.

36. Yu (Ex. 1007; Ex. 1008) is titled “Automotive Emergency Starting Device.” Ex. 1008, p. 1. Yu was considered by the Patent Office during prosecution and published on the face of the '023 Patent. Ex. 1001, p. 5. Yu discloses “an

emergency automotive starting device” having various components, including “an internal battery, a charging input interface, a display module, a control module, a relay, input buttons and an output terminal.” Ex. 1008, Abstract. Similar to Richardson, Yu fails to teach or suggest the use of a USB input charging, and instead depicts the use a traditional barrel charger (item 10), as shown in Figure 9:



37. In addition to the barrel charger, Yu discloses a “19V output terminal 9” and a USB port that it describes as “a 5V output terminal 8.” Ex. 1008, ¶ [0028]; *see id.*, Fig. 7 (items 8 and 9).

4. Paparrizos

38. I have reviewed the Paparrizos prior art reference (Ex. 1009) and understand its contents.

39. Paparrizos (Ex. 1009) is titled “Buck Boost Charging For Batteries.” Ex. 1009, p. 1. Paparrizos seeks to solve the problem that “[c]omputer tablets and other mobile devices, such as mobile phones, digital SLR cameras, video recorders, audio devices, and so on are moving to battery packs with two (or more) Li-ion cells in series” but “since a large majority of USB devices are defined at 5V, it may not be possible to charge high voltage (>5V) 2S or 3S battery packs using a typically [sic] USB power source.” *Id.*, 1:9-26. In order to address this issue, Paparrizos discloses that a “buck boost circuit 212 may be operated as a forward boost converter to increase the voltage level that is received at input terminal 102 to produce a suitable voltage level at charging terminal 104 or system terminal 106.” *Id.*, 3:67-4:4. Paparrizos further discloses that the charged device “may be a smartphone, personal data assistant, portable computer, computing tablet, digital imaging devices, audio devices, and so on.” *Id.*, 2:26-29. Paparrizos does not disclose applying its techniques to charge a vehicle jump starter or comparable high-power device. *See* Ex. 1009.

V. THE PROSECUTION HISTORY OF THE '023 PATENT

40. I have reviewed the prosecution history (Ex. 1002) of the '023 Patent and the Final Written Decision in IPR2020-00944 (Ex. 1014) and I understand their contents.

41. It is my opinion that the Petition provides only a limited overview of the prosecution history, dismissing the care taken by the Patent Office and misrepresenting the proceedings in IPR2020-00944, which previously challenged issued claims of a parent application to the '023 Patent. *See* Petition, pp. 12-19.

A. The Parent Application's Claim Related To USB Charging Features Was Held Not Unpatentable In IPR2020-00944

42. I understand that the '023 Patent is a continuation application that claims priority back to, among other applications, U.S. Patent Application No. 14/325,938, which issued as U.S. Patent No. 9,007,015 ("'015 Patent"). During the prosecution of the '023 Patent, it is my understanding that all claims of the '015 Patent were previously challenged in IPR2020-00944, which resulted in a Final Written Decision ("'015-FWD") finding all claims unpatentable (Ex. 1014, p. 2), with the exception of claim 11 (Ex. 1013, 9:1-3):

The apparatus of claim 1, further comprising a USB charging port configured to provide charging power from an external power source to said internal power supply.

43. Specifically, while the secondary references of the prior art applied (which were combined with Richardson) did not include USB charging features and instead used non-USB, 14V 1A input ports, Petitioner still argued that:

It would be *readily apparent* from the references that a USB port, which is simply a different physical plug and socket combination from the round plug and socket used in the Epower-20 and 21 products, *could*

also be incorporated into portable jump starters in place of or in addition to the 14V 1 A input port to charge the internal batteries of jump starter devices. A PHOSITA would be motivated to provide such a USB charging port to provide the added convenience to users of using another commonly used power input for charging the jump starter device.

Ex. 1014, p. 92 (emphasis in original).

44. I understand that the Board rejected this argument, finding that “Petitioner’s articulation of a motivation for one with ordinary skill in the art to incorporate a USB input charging port in Richardson based on Epower-20’s or Epower-21’s disclosure is conclusory.” *Id.* In particular, I understand that the ’015 FWD stated that Petitioner’s expert did “not identify any jump starter device having a USB input charging port.” *Id.*, p. 93. The ’015 FWD continued to explain:

The matter is much more complicated than what Petitioner’s argument makes it out to be. There is insufficient accounting by Petitioner of the expectation at the time of one with ordinary skill in the art about the ease or difficulty in locating a usable source to provide input charge to a USB port on a jump starter.

Id. I understand that, although Patent Owner had submitted “reasons why it would not have been obvious to one with ordinary skill in the art to include in a jump starter a USB input charging port,” the board found that it “need not discuss Patent Owner’s showings with regard to claim 11, because, . . . Petitioner has not established obviousness of claim 11 over the applied references.” *Id.*, p. 94.

45. I further understand that the '015-FWD, including its findings with respect to the USB charging features of claim 11, were subsequently affirmed as patentable by the Federal Circuit. *The NOCO Company, Inc. v. Shenzhen Carku Technology Co., Ltd.*, Appeal Nos. 2022-1646, 2022-1741, 2024 U.S. App. LEXIS 3221 (Fed. Cir. Feb. 12, 2024) (Ex. 1015).

B. The Patent Office Considered Prior Art Related To USB Charging Of Small Electronics Devices Before Allowing The '023 Patent

46. It is my opinion that the prosecution of the '023 Patent was thorough and searching. I understand that the Patent Office considered numerous prior-art references and applied many of them to the claims throughout the lengthy prosecution history. In fact, the file history for the '023 Patent is so extensive—spanning 2,200+ pages—that Petitioner was forced to break it up into eight separate files for filing with the Board.

47. I understand that the '023 Patent issued from U.S. Patent Application No. 16/450,422, which was filed on June 24, 2019. Ex. 1001, p. 1. Dependent claim 11 of the originally-filed application required “a USB charging port configured to provide charging power from an external power source to said internal power supply.” Ex. 1002, p. 41. It is my understanding that multiple preliminary amendments were made to the application (*see id.*, pp. 87-97, 110-127) prior to issuance of the first Office Action on August 12, 2020. *Id.*, pp. 151-186. As part of

the first Office Action, dependent claim 11 was rejected by the Patent Office based on a combination of Richardson and U.S. Pat. No. 9,506,446 (Ex. 2001, “Xinfang”).

48. In response to this Office Action, I understand that Applicant amended all independent claims to include both a “USB charge circuit” and a “USB connector . . . configured for providing charge input.” Ex. 1002, pp. 255-284. While the Petition implies that this choice to amend the claims to add in USB charging features was a reaction to the Board’s findings in the ’015-FWD (*see* Petition, pp. 12-16), it neglects to point out that this amendment occurred on January 12, 2021, more than nine full months *before* the ’015-FWD issued on November 3, 2021, which upheld the patentability of claim 11 of the ’015 Patent. *See* Ex. 1014. In other words, it is my understanding that Applicant could not have made the choice to incorporate USB charging features into the claims based on the board’s decision in IPR2020-00944.

49. I understand that the Patent Office responded to the amendment incorporating the USB charging features by issuing a final Office Action based on the same combination of Richardson and Xinfang. *See* Ex. 1002, pp. 287-319. In particular, the Patent Office stated:

It would have been obvious to one having ordinary skill in the art before the effective filing date of the claimed invention to have incorporate[d] the teachings of Xinfang into the apparatus of Richardson *so as to provide additional convenience to users of using another commonly used power input for charging the jump starter device.*

Id., p. 293 (emphasis added).

50. Following the final rejection, it is my understanding that Applicant submitted an after-final amendment as part of the After-Final Consideration Pilot Program, revising the independent claims to require a “USB input charge circuit” and a “USB input connector.” *Id.*, pp. 359-387.

51. On June 25, 2021, the Patent Office issued a second non-final Office Action, rejecting the independent claims over a combination of Richardson, Xinfang, and Tinaphong. *Id.*, pp. 435-466. Specifically, the Office relied on the teachings of Tinaphong to allegedly cure the deficiencies of Richardson and Xinfang regarding the “USB input charge circuit.” *Id.*, pp. 441-442.

52. In response to this Office Action, I understand that Applicant amended the claims to further distinguish Tinaphong by requiring that the USB input converter “increase” or “up-convert[]” the charge voltage received from a USB charger. *See id.*, pp. 477-507. Applicant explained that Tinaphong cannot practically be used as a jump starter device and that the reference is nonanalogous art:

The apparatus of Tinaphong is an energy harvesting apparatus, and not disclosed as being a jump starter or for use as a jump starting apparatus. Further, the apparatus of Tinaphong cannot be practically used as a jump starting device due to the low voltage output (i.e. 5 volts) of the apparatus (see paragraph [0042]), which is too low to effectively

provide power to a depleted or discharged 12V battery (e.g. *the charging rate would be too slow to charge the 12V vehicle battery to jump start a vehicle*). Thus, Tinaphong is clearly non-analogous prior art, and one skilled in the art would not turn to Tinaphong to attempt to modify and/or improve the jump starter of Richardson.

Id., p. 499 (emphasis added). Applicant also explained that Tinaphong teaches away from the proposed combination with Richardson, because its input voltage is down converted (*i.e.*, changed from 5 volts to 3.7 volts, which is even less suitable for charging a 12 volt battery). *See id.*, p. 499.

53. Following an Applicant-initiated interview, and based on the arguments presented against the combination of Richardson and Tinaphong, I understand that the Patent Office issued a Notice of Allowance. *Id.*, pp. 517-522. Additional information disclosure statements, a request for continued examination, and minor claim amendments were submitted and considered by the Patent Office following the initial notice of allowance. It is my opinion that the Office continued to diligently examine the claims in light of the additional information disclosure statements that were provided after the first notice of allowance. I understand that no other prior-art rejections were made by the Office after the second non-final Office Action and prior to the '023 Patent issuing on September 20, 2022. *Id.*, p. 2233.

VI. CLAIM CONSTRUCTION

54. It is my understanding that the claims of the '023 Patent should be given the plain meaning, which is the meaning understood by a PHOSITA at the time of the invention in view of the patent and file history. I am not aware of any claim constructions put forth by either party for any claim terms, but I reserve the right to amend or supplement my analysis in this report based on future claim constructions proposed by either party.

VII. LEVEL OF SKILL IN THE ART

55. It is my understanding that when interpreting the claims of the '023 Patent, I must do so based on the perspective of the PHOSITA at the relevant priority date. I understand that the priority date for the '023 Patent is July 3, 2014. I will therefore consider July 3, 2014 to be the relevant date to ascertain the perspective of one of ordinary skill in the art.

56. I understand that the Petitioner has proposed that the PHOSITA would have had “at least a bachelor’s degree in electrical engineering or its equivalent and at least two years of experience in the field of electrical engineering including some experience with DC power supply or battery charger design.” I agree with this description of the PHOSITA.

VIII. THE PETITION MISREPRESENTS HOW A PHOSITA WOULD HAVE VIEWED JUMP STARTER DEVICES AND USB CHARGING TECHNIQUES AT THE TIME OF FILING

57. As further detailed below, it is my opinion that the challenged claims are not unpatentable over the combinations of Richardson and Zhao or Yu and Paparrizos.

58. Before addressing Grounds 1 and 2 in detail, I will provide necessary background information relating to a PHOSITA's understanding of jump starter devices and charging techniques at the time.

A. General Battery Performance Metrics And Charging Properties

1. Fundamentals Of Battery Cell Capacity And Internal Resistance

59. Battery cell capacity refers to the amount of electric charge a battery cell can store and deliver after it has been fully charged. Key factors that determine the capacity of a battery cell include the cell type (*e.g.*, lithium-ion, lead acid, nickel–cadmium battery, etc.) and the cell size (*i.e.*, volume). The units used for measuring charge in the International System of Units is the coulomb (C), where 1 coulomb corresponds to the total charge a 1 ampere (A) current delivers in 1 second.

60. Nonetheless, battery cell capacity is hardly ever represented in the units of coulomb. Instead, a more common convention for representing battery cell capacity is in the units of current multiplied by the time, *e.g.*, amp-hours, which still describes charge since charge is nothing but the product of current (rate of charge)

and time. One reason the amp-hours convention is quite common is that it describes battery cell capacity in terms of parameters that are easily understood by the users and more relevant to what they care about when using a battery cell, *i.e.* how much current a battery can deliver and for how long. For example, if a battery cell capacity is presented as 3,600 coulombs, a user will not easily interpret what that number means, while if that same capacity is presented as 1 Ah, a user will easily interpret that the battery cell would last for 1 hour if discharged with 1 A, or for 2 hours if discharged with 0.5 A, and so on.

61. Another reason the amp-hours convention is quite common is that it informs the user of the discharge current at which the reported battery cell capacity has been characterized. This discharge current is often referred to as the nominal discharge current of the battery cell, while the reported capacity at that discharge current is often referred to as the nominal cell capacity. Using the previous example, a battery cell capacity of 1 Ah means that the nominal cell capacity is 1 Ah and that this cell capacity was measured at a discharge current of 1A, which is the nominal discharge current.

62. The simple linear relationship described above between the discharge current and the time the battery would last is only theoretical as it inherently assumes that the battery cell capacity is not a function of the discharge current. This assumption is generally correct for discharge currents that are equal to or lower than

the nominal discharge current. At higher discharge currents, however, the battery cell capacity drops from its nominal value, and the higher the discharge current the larger the drop. This is because the electrochemical process within the battery cell has a finite rate by which it can produce the charge.

63. As a result, when the discharge current (rate of charge extracted from the battery cell) is higher than what the electrochemical process can keep up with, the output voltage of the battery cell will drop below its value at the nominal discharge current. This drop in the voltage of the battery cell with the discharge current is modeled by introducing a series resistance with the battery cell, where the actual voltage delivered to a load is reduced from the battery cell voltage by the product of the discharge current and the series resistance of the battery cell, which is commonly termed “battery cell internal resistance”. Thus, for a given minimum voltage required to operate a load, the duration of which the voltage delivered to that load can be sustained before it drops below the required minimum voltage will be less at higher discharge currents. In other words, the “effective” capacity of the battery cell in the system becomes less than its nominal capacity at higher discharge currents. How much less that “effective” capacity will be is a strong function of how much higher the discharge current is, the minimum acceptable voltage for the load to operate, and the output resistance of the battery cell.

64. Therefore, the size of the battery cell must be increased (thus increasing its nominal capacity and reducing its internal resistance by the same factor) if a certain effective capacity is desired at discharge currents that are higher than the battery cell's nominal discharge current. Consequently, in applications requiring very high discharge currents, the battery cell size and its nominal capacity are often substantially larger than what would have been needed to provide the same capacity at lower discharge currents.

2. Fundamentals Of Battery Charging

65. There are various schemes for charging a battery cell. In general, charging a battery cell is accomplished by transferring charge from an energy source to the battery cell for a period of time until the battery is fully charged. This energy source can be a voltage source applied across the battery cell and has a voltage higher than the cell's voltage, or it can be a current source in series with the battery cell and pushing current through it. In either case, the transfer of charge from the energy source to the battery cell until it is fully charged may be continuous or may be in discrete bursts. Moreover, some charging schemes may use only a voltage source or only a current source, while others may split the charging process between using a voltage source and a current source. The selection of the battery cell charging scheme in a given application is influenced by the battery cell type and size, and the cell's tolerance to voltage and current spikes, overcharging, and charging

current/voltage inaccuracies. The selection will also be influenced by other factors, such as charging circuit complexity, cost, and the power rating of available energy sources.

66. Regardless of the charging scheme employed to charge a battery cell, the goal is to transfer a total charge that is equal to the battery cell's nominal capacity from an energy source to the battery cell (assuming the battery cell is initially fully discharged). Ignoring any losses, the energy that must be provided by the energy source to fully charge the battery cell can be represented as the product of the average battery cell voltage (often referred to as the nominal cell voltage) and the battery cell's nominal capacity. This can be stated mathematically:

$$E_{src} = V_{Cell-nom} \times C_{Cell-nom} \quad (1)$$

where E_{src} is the total energy provided by the energy source (measured in watt-hours), while $V_{Cell-nom}$ and $C_{Cell-nom}$ are the battery cell's nominal voltage (measured in volts) and capacity (measured in amp-hours), respectively.

Furthermore, the total energy provided by the energy source can also be represented as:

$$E_{src} = \int_0^{T_{chrg}} P_{src} \times dt \quad (2)$$

where P_{src} is the power provided by energy source (measured in Watts), while T_{chrg} is the total charging time (measured in hours). This can be simplified if the energy source is providing a constant power to:

$$E_{src} = P_{src} \times T_{chrg} \quad (3)$$

67. Combining (1) and (3), the charging time can be written as:

$$T_{chrg} = \frac{V_{Cell-nom} \times C_{Cell-nom}}{P_{src}} \quad (4)$$

As one would expect, higher nominal battery cell capacity or voltage, as well as lower power rating of the charging energy source will all result in longer charging time. Equation (4) can be further written in terms of the voltage and current ratings of the charging energy source as:

$$T_{chrg} = \frac{V_{Cell-nom} \times C_{Cell-nom}}{V_{src} \times I_{src}} \quad (5)$$

where V_{src} and I_{src} are the voltage and current ratings of the charging energy source. As expected, the lower the voltage rating of the charging source the higher its current rating must be in order to maintain a desired charging time. It is worth noting that in many cases the charging source voltage may be different than battery cell's nominal voltage. Therefore, a power converter (*e.g.*, buck, boost, or buck-boost) can be introduced between the energy source and the battery cell in order to

adapt the charging voltage to the battery cell voltage. In this case, equations (4) and (5) can be modified as:

$$T_{chrg} = \frac{V_{Cell-nom} \times C_{Cell-nom}}{\eta_{src} \times P_{src}} \quad (6)$$

$$T_{chrg} = \frac{V_{Cell-nom} \times C_{Cell-nom}}{\eta_{src} \times V_{src} \times I_{src}} \quad (7)$$

where η_{src} is the power conversion efficiency of the power converter between the charging energy source and the battery cell. As shown in Eqs. (6) and (7), if the power converter's efficiency is less than 100%, the charging time will be longer unless the power rating of the charging source is increased.

68. In applications where the power of a single battery cell is insufficient to support the operation of the device for the desired period, it is common to use multi-cell battery packs instead. Battery packs are simply multiple identical battery cells that are connected in a series or parallel configuration, or a combination of both. In a parallel configuration, the nominal voltage of the battery pack is the same as the nominal voltage of a single battery cell, while the nominal capacity of the battery pack is the product of the nominal capacity of a single battery cell times the number of cells in the pack. In a series configuration, the nominal voltage of the battery pack is the product of the nominal voltage of a single battery cell times the number of cells in the pack, while the nominal capacity of the battery pack is the same as the

nominal capacity of a single battery cell. Therefore, in the ideal case, the total power of the battery pack is always equal to the power of a single cell times the number of cells in the battery pack regardless of the configuration (series or parallel).

69. The charging process of a multi-cell battery pack is very similar to a single battery cell, albeit additional circuitry is usually employed to ensure balancing the charge among the multiple cells (in the series configuration) and preventing over charging. When charging a multi-cell battery pack, the charging time (assuming a fully discharged initial state) can be written as:

$$T_{chg} = \frac{V_{Cell-nom} \times C_{Cell-nom}}{P_{src}} \times N \quad (8)$$

where $V_{Cell-nom}$ and $C_{Cell-nom}$ are the individual cell's nominal voltage (measured in volts) and capacity (measured in amp-hours), respectively, N is the number of cells in the battery pack, and P_{src} is the power provided by the charging energy source (measured in Watts and assumed constant), while T_{chg} is the total charging time of the battery pack (measured in hours). As expected, higher nominal battery cell capacity or voltage, larger number of cells in the pack, and lower power rating of the charging energy source will all result in longer charging time of the battery pack. Equation (8) can be further written in terms of the voltage and current ratings of the charging energy source as:

$$T_{chg} = \frac{V_{Cell-nom} \times C_{Cell-nom}}{P_{src}} \times N \quad (9)$$

where V_{src} and I_{src} are the voltage and current ratings of the charging energy source. Like the single cell case, the lower the voltage rating of the charging source the higher its current rating must be in order to maintain a desired charging time. Moreover, in many cases the charging source voltage may be different than battery pack's nominal voltage, and thus, it is very common that a power converter (*e.g.*, buck, boost, or buck-boost) is introduced between the energy source and the battery pack in order to adapt the charging voltage to the battery pack voltage. In this case, equations (8) and (9) can be modified as:

$$T_{chg} = \frac{V_{Cell-nom} \times C_{Cell-nom}}{\eta_{src} \times P_{src}} \times N \quad (10)$$

$$T_{chg} = \frac{V_{Cell-nom} \times C_{Cell-nom}}{\eta_{src} \times V_{src} \times I_{src}} \times N \quad (11)$$

where η_{src} is the power conversion efficiency of the power converter between the charging energy source and the battery pack. Like the single cell case, a power converter's efficiency that is less than 100% will result in a longer charging time unless the power rating of the charging source is increased.

B. Charging Jump Starter Devices

1. Peak Current Requirements In Jump Starters

70. One of the key performance metrics of a jump starter device is the maximum current it can supply for the duration needed to jump start an engine (approximately 20-50 ms). This maximum current is also known as the peak current of the jump starter. The reason the peak current of a jump starter is so important is that it determines the largest engine displacement or the largest depleted battery of a vehicle that the jump starter can successfully jump. Depending on the target engine size the jump starter is intended for, the peak current the jump starter needs to provide is typically between 1000-4000 amps, which matches the specifications of many jump starter devices available in the market today. The same 1000-4000 amps would have been required as the peak current for jump starting a typical vehicle at the time of filing of the '023 Patent.

71. The peak current of a jump starter is proportional to the peak current that its internal battery pack is able to provide. Although the battery cells comprising a battery pack can in principle be configured in series or in parallel without affecting the total power it can deliver, battery packs in jump starter devices always employ a series configuration. In fact, the number of battery cells connected in series within the battery pack of a jump starter is always such that the nominal voltage of the battery pack is equal to or higher than the nominal voltage of the vehicle's battery

that it is targeting to jump. The reason behind this choice is that it eliminates the need for any intermediate power conversion stage between the jump starter's internal battery pack and the vehicle's battery. This is essential since any intermediate power conversion stage would drastically limit the peak current that can be delivered from the jump starter, and thus renders the jump starter ineffective.

72. Therefore, a typical jump starter device has a peak current that is proportional to the peak current of only one battery cell within its battery pack, regardless of the number of cells in the pack, since all the cells are connected in series and carry the same current. It is important to recognize that, even though the peak current of the pack is the same as one cell, the power delivered by the battery pack is the sum of the power delivered by all the cells since the peak current is delivered at the voltage of the pack, which is the sum of the voltages of all the cells in a series configuration. Moreover, the peak current of the jump starter will also vary with ambient conditions, including the temperature. Therefore, it is common for typical and worst-case peak current values to be reported, such as reporting cold cranking amps at 32° F.

73. The above analysis regarding the peak current requirements of a jump starter has two key implications. First, since the peak current of the jump starter's multi-cell series-connected battery pack is the same as the peak current of only one battery cell, each battery cell must be sufficiently large to provide the needed peak

current on its own. Second, since the peak current is much larger than the nominal discharge current of the battery cell, each battery cell must be sufficiently large to provide the needed peak current while keeping the total voltage of the battery pack above the minimum voltage for the time period needed to jump start the vehicle's engine or battery. These aforementioned factors necessitate that the battery cells (and thus the battery pack) of a jump starter have a substantially larger nominal capacity than what would otherwise be needed in most other electronics applications, which generally require substantially lower peak current.

2. Battery Capacity In Jump Starters

74. Another key performance metric of a jump starter device is its battery capacity. As discussed above, the battery capacity of any battery pack will be directly influenced by its peak current requirements. To gain some insight into how much battery capacity would be needed for a jump starter device in order to provide 1000-4000 amps, we will focus on the peak current and capacity of a single lithium-ion battery cell. This is because series-connected multi-cell battery packs employed in jump starter devices have the same peak current and capacity as a single cell as discussed in the previous section. If we assume each lithium-ion battery cell in the jump starter device has a capacity $C_{cell-nom}$, output resistance $R_{cell-nom}$, and nominal output voltage $V_{cell-nom}$, and considering that the peak current the battery cell can provide is its own voltage divided by its internal resistance (since any load

will be in series with the battery internal resistance and thus reduces the current), then the following simplified relation can be written:

$$I_p = \frac{V_{Cell-nom}}{R_{cell-nom}} \quad (12)$$

where I_p is the battery cell peak current. Assuming a reference size lithium-ion battery cell that has a capacity $C_{cell-ref}$ and output resistance $R_{cell-ref}$, where the size of this reference cell is K times smaller than the size of the battery cells in the jump starter device, then $R_{cell-nom}$ and $C_{cell-nom}$ can be written in terms of the parameters of the reference cell as $(R_{cell-ref}/K)$ and $(K \times C_{cell-ref})$, respectively. This is because increasing the size of a reference battery cell by a factor K increases the capacity (stored charge) and the total charge produced per unit time by the same factor without changing the cell voltage, which is equivalent to the output resistance being reduced by the same factor. Therefore, Eq. (12) can be rewritten as:

$$I_p = \frac{K \times V_{Cell-nom}}{R_{cell-ref}} \quad (13)$$

which can be further rewritten in term of $C_{cell-nom}$ and $C_{cell-ref}$ and rearranged as:

$$C_{cell-nom} = \frac{I_p \times R_{cell-ref} \times C_{cell-ref}}{V_{Cell-nom}} \quad (14)$$

Eq. 14 provides a simple formula to assess the battery cell capacity of a jump starter device in terms of the peak current required to jump start the vehicle and the parameters of a reference size lithium-ion battery cell.

75. As can be seen from Eq. 14, the battery cell capacity $C_{cell-nom}$ is directly related to battery cell peak current I_p which, as discussed above, is required to be very large for any vehicle jump starter, due to the peak current requirements needed to jump start a typical commercial vehicle engine or battery.

3. Requirements For Charging Jump Starters

76. With the previous discussion in mind and by inspecting Eqs. 10 and 14 above, it becomes clear that charging a jump starter device presents a unique challenge compared to any other handheld low-peak-current device. This is because of two reasons. First, the nominal capacity of each battery cell in a jump starter's battery pack is much larger than other low-peak-current applications (*e.g.*, a handheld multimeter). This large nominal capacity requires a high-power charging energy source in order to maintain a reasonable/practical charging time. Second, the typical voltage of a vehicle's battery is 12 volts, which requires the jump starter battery pack voltage to be at least the same.

77. If lithium-ion battery cells are used, this would usually entail using at least four battery cells (which is N in Eq. 10). The number of cells becomes even larger for vehicles that utilize higher than the 12V standard, such as 48V. This again requires an even larger charging energy source to maintain a useful charging time, since the battery cell capacity will be larger. Given consistent charging power, the charging time will essentially quadruple if the internal battery pack of the jump starter is 48V (16 series-connected lithium-ion batteries).

C. The Petition Misrepresents How A PHOSITA Would Have Viewed Jump Starter Devices And USB Charging Techniques At the Time Of Filing

78. Universal Serial Bus (USB) is a digital communication standard that governs both data transmission and power delivery between electronic devices. This includes data rates, power levels, and cable and connector types and specifications. Originally intended for providing power to low-power computer peripherals, the USB standard has evolved over the years in terms of power ratings. Relevant to the '023 Patent, the various USB standards have always defined a specific, limited power rating, including both a maximum current and a maximum voltage that may be utilized when charging a device via a USB connection.

79. I have reviewed Petitioner's exhibit addressing USB charging power limits (Battery Charging Specification, Revision 1.0, Mar. 8, 2007 from the Universal Serial Bus Implementers Forum ("USB-IF") (Ex. 1025)), and I confirm

that the USB-IF document provides an adequate example of the power limitations that might have been associated with a USB charger on the priority date. I understand that Petitioner's expert confirmed that these same "power transfer standards that were established in the rev 1 charging spec were adequate for -- for all of the discussions" provided in these proceedings. Ex. 2010, 74:25-75:2. I also understand that Petitioner's expert testified that USB charging power limitations described in the USB-IF document are limited to a specific power, and that any input charge that is boosted to a higher voltage would be limited to, at best, that same specific charging power. Ex. 2010, 74:25-75:2 ("2.5 watts delivered to your device, if you up convert it to a higher voltage, you will compromise the current such that, at best, you could still provide 2.5 watts after the DC to DC converter."). I confirm the accuracy of these specific statements by Petitioner's expert. Thus, a PHOSITA would have understood that USB charging had limited power at the time, and one would have also understood that boost conversion of any USB charging current would only further reduce that charging power.

80. When addressing the motivation to combine the references in Grounds 1 and 2, the Petition repeatedly argues that "charging a pack rated above 5V with a 5V USB input . . . is a known technique that a PHOSITA would have been motivated to implement in a predictable manner to charge 12V batteries." Petition, p. 31; *see* Petition, p. 60. In my opinion, this reasoning oversimplifies the combination and is

not how a PHOSITA would have actually considered jump starter devices and charging techniques at the time.

81. As explained above, vehicle jump starter devices are high-power tools used to jump start the engines of automobiles and other commercial vehicles. Given this purpose, a key performance metric of a jump starter is the peak current it can supply for the duration needed to jump start an engine (approximately 20-50 ms). The peak current of a jump starter determines the largest engine displacement or the largest depleted battery of a vehicle that the jump starter can successfully jump start. Given the size of typical vehicle engines, jump starters are required to provide a massive peak current in order to properly function, typically between 1000 and 4000 amperes. As confirmed by Petitioner's expert, for larger vehicles and those having diesel engines, the required peak current for a successful engine jump start will be even higher. Ex. 2010, 30:20-31:7 (recognizing that his own diesel truck requires "two batteries in parallel" to start, since such an arrangement "can provide twice the current of one battery").

82. Consistent with the above discussion, a PHOSITA would have understood that the peak current needed to jump start a typical vehicle engine or battery requires jump starter devices to have large-capacity internal battery cells. The peak current of a jump starter is limited by the peak current that its internal battery pack can provide. And for a typical series-connected battery pack, each

individual battery cell in a jump starter must have a large enough capacity to provide the necessary peak current while keeping the total voltage of the battery pack above the minimum required level for the time period needed to successfully jump start a vehicle engine or battery. As a result, the massive peak current requirement needed for vehicle jump starters to properly function requires internal battery cells that have very large individual capacities.

83. Because of the high capacity batteries required in a jump starter, it is my opinion that a PHOSITA would not have considered 2014-era USB to be a viable charging solution. Unlike barrel chargers, a PHOSITA would have known that USB charging had a limited, specified power output. It was also understood that higher nominal battery cell capacity, larger number of cells in the pack, and lower power rating of the charging energy source will all result in longer charging times of a battery pack. Therefore, in order to maintain a typical charging time, a PHOSITA would have recognized that jump starters needed to rely on a high-power charging energy source. Moreover, the inefficiencies associated with boost converting a low voltage would have only added to the discrepancies in charging power between USB and barrel chargers. *See* Ex. 2010, pp. 83:23-84:2 (recognizing that a high-quality DC-DC converter is only “about eighty percent efficient”).

84. As discussed above, unlike digital multimeters, pocket calculators, cellphones, or other small consumer electronic devices that Petitioner uses in its

prior art examples, the high-power functionality of jump starters requires such devices to have large-capacity battery packs. Because of this, vehicle jump starters are more equivalent to those of electric lawnmowers, snowblowers, and other high-power cordless tools. In fact, many jump starter devices have even larger capacity batteries than many power-tools, including electric snow blowers and lawnmowers. This distinction continues to be well understood by many craftsmen and home owners. Even with the advancements of USB charging capabilities, if one walks into any garage in the U.S. today, they are likely to find a barrel charger or proprietary charging unit for one of these high-power electric devices. The use of such “non-standard” chargers, even to this day, is not because of a limited understanding of how to boost convert a low-voltage USB input to charge these high-power devices, but rather because of the power limitations historically associated with USB charging. Thus, while capable of charging most devices if boosted to a sufficient voltage, a PHOSITA would have recognized that USB is not suitable for charging every battery pack.

85. When discussing the motivation to combine the references in Grounds 1 and 2, the Petition never even addresses the fact that jump starter battery packs are required to have larger-capacity battery packs than common consumer electronic devices. Instead, the Petition wrongly narrows its discussion to addressing only charging voltage differences; namely, the desirability of charging higher voltage

batteries with a 5V input. *See* Petition, pp. 31, 60. In doing so, Petitioner wrongly assumes that a boosted USB charge would be suitable to charge any 12 volt battery pack, regardless of its size. But again, overcoming the voltage difference between a USB charger and a jump starter battery pack is not the reason why a PHOSITA would not have applied USB charging techniques to these devices. Indeed, DC-DC boost conversion was known in the art at the time. But the relevant question, and what the Petition fails to address, is whether a PHOSITA would have chosen to charge the large, high-capacity battery pack of a jump starter using the limited power output capabilities of USB at the time. It is my opinion that one would not have done so. And more importantly, they certainly would not have modified the specific vehicle jump starter systems of Richardson and Yu to include USB.

86. In the following, I will provide more detail to support my opinions addressing the specific prior art references included in Grounds 1 and 2.

IX. RICHARDSON AND ZHAO DO NOT RENDER CLAIMS 1, 32, 38, 39, 47, 52, AND 54 OBVIOUS (GROUND 1)

87. As further detailed below, it is my opinion that the challenged claims are not unpatentable over the combination of Richardson and Zhao.

A. A PHOSITA Would Not Have Been Motivated To Modify The Particular System Of Richardson To Have A USB Input Circuit

88. It is my understanding that it is the Petitioner's burden to show with particularity why the '023 Patent it challenges is unpatentable. Here, it is my opinion

that Petitioner has failed to demonstrate that a PHOSITA would have combined the teachings of Richardson and Zhao.

1. Petitioner’s Motivation To Combine Richardson And Zhao Is Deficient

89. The reasoning provided in the Petition does not support modifying a jump starter to include a USB input, much less the specific vehicle jump starter of Richardson. The Petition argues that:

A PHOSITA therefore would have been motivated to modify Richardson in view of Zhao because Zhao is directed to the *known technique of charging a multicell battery pack of series-connected cells of a battery-powered device*—which is the same battery architecture in Richardson’s jump starter—by using a DC-DC booster converter in accordance with its established function of converting a lower voltage input to a higher voltage output. EX1003, ¶ 66. Additionally, Zhao specifically teaches the desirable feature of charging a pack rated above 5V with a 5V USB input, which is a known technique that a PHOSITA would have been motivated to implement in a predictable manner to charge 12V batteries such as those disclosed by Richardson. *Id.*

Petition, p. 31 (emphasis added). It is my understanding that the Petition argues that “charging a pack rated above 5V with a 5V USB input” was a known technique, and that the systems of Richardson and Zhao related to similar devices since they share the “same battery architecture” of a “multicell battery pack of series-connected cells.” Petition, p. 31. By Petitioner’s logic, it would have been obvious to charge

a full-size electric vehicle battery (*e.g.*, a Tesla Model 3's battery) using USB, since it is similarly formed of modules of "multicell battery pack[s] of series-connected cells." But this is not the case, and one cannot simply ignore the capacity of the battery pack being charged.

90. As discussed above, a PHOSITA would not understand the small battery systems contemplated by Zhao and the vehicle jump starter described by Richardson to be similar devices. Zhao discloses a step-up battery charging management system that uses a step-up converter to boost a DC input charging voltage. *See* Ex. 1006, Abstract. But Zhao does not teach or suggest applying its techniques at voltages above 8.4V or to devices having large-capacity batteries. *See, e.g.*, Ex. 1006, 4:39-41 (disclosing how an example "final voltage V_{CV} can be about 8.4V if two lithium batteries"). While the Petition also provides a host of additional references to demonstrate that boosting a 5V USB input to charge higher voltage batteries was known in the art (*see* Petition, pp. 47-50, citing Exs. 1016-1021), these additional references all similarly relate to small electronics devices with low-capacity batteries. *See* Ex. 1019, ¶ [0002] (disclosing a "digital multimeter" device and noting that the batteries for such devices are "usually disposable"); Ex. 1021, p. 1 (addressing the charging of "various electronic devices" connected a "computer's USB interface"); Ex. 1016 (discussing boosting input power to devices such as "a smart phone, a cell phone, a personal digital assistant (PDA), a tablet, a laptop, a

desktop, a portable music player . . .”); Ex. 1017 (“[T]he aforementioned charge circuit is used for mobile electronic devices such as a digital still camera, a digital video camera, digital audio, and portable navigation.”). In view of the above discussion regarding battery capacity, when considering charging techniques, a PHOSITA would have understood that none of these devices are similar to a vehicle jump starter.

91. The Petition discloses no prior art examples of USB being used to charge a battery with a comparable capacity to that required for a vehicle jump starter. Moreover, the Petition never even discusses why a PHOSITA would have applied the low-power charging technique of traditional USB to an electronic system with a battery having a high capacity. As explained above, charging such a large-capacity battery with USB was counterintuitive, not because boost converting an input voltage was not understood in the art, but instead because it was well understood that the limited charging current that traditional USB provided was not capable of quickly charging high-capacity battery systems. By failing to even address the primary reason—battery capacity, not voltage—that a PHOSITA would not have applied a USB charging circuit to a jump starter system like that of Richardson, Petitioner has fallen short of demonstrating that a skilled artisan would have made the proposed combination.

2. Richardson’s Commercial Jump Starter System Requires A Larger Internal Battery Capacity Than A Typical Vehicle Jump Starter And Would Therefore Greatly Suffer From A Switch To USB Charging

92. In addition to the above, the Petition fails to consider the actual system of Richardson that it sought to modify in light of Zhao’s teachings. For instance, the Petition states that:

A PHOSITA would understand Zhao’s system is suitable for use with a variety of pack configurations and battery chemistries, such as a 3S pack of lithium-ion cells rated at 11.1V or a 4S pack of lithium-ion cells rated at 14.8V (*both of which would be well-suited for starting a traditional lead-acid vehicle starter battery rated at 12V*). See, e.g., EX1006, 3:6-11. Thus, the disclosure of Zhao provides an explicit teaching, suggestion, or motivation to implement Zhao’s USB input circuit *with a system like Richardson’s jump starter*.

Petition, pp. 44-45 (emphases added). But the system of Richardson is not a traditional portable jump starter, but rather a heavy-duty jump starter with very powerful internal batteries that, despite their large charge capacity demands, can be recharged in a short period of time and then used to jump a fleet of vehicles, such as a commercial truck fleet. See Ex. 1005, ¶¶ [0007], [0055]. As evidence, Richardson states that “[n]ormal vehicle charging voltages fall within certain ranges for 12, 18, 24, 30, 36, 42 and **48 volts systems**.” *Id.*, ¶ [0054] (emphasis added). And Richardson further explains how its jump starter has to be powerful enough to accommodate the demands of batteries up to 48 volts by appropriately configuring

the batteries in the jump starter and selecting voltage outputs. *Id.*, ¶¶ [0034]-[0035], [0054]. Therefore, the system of Richardson differs dramatically in design, configuration, purpose, and performance relative to the vehicle jump starter recited in the challenged '023 Patent.

93. As discussed in detail above, a 48 volt battery pack would require four times the number of series-connected battery cells of a typical 12V vehicle charger, assuming peak current is maintained. *See* Ex. 2010, 66:24-67:4 (confirming there would be “four times [the] energy storage capacity”). As a result, and because the current in a series-connected battery pack is equal to the current in every battery cell in the pack, Richardson contemplates a battery pack with a capacity that is at least four times larger than that of a standard 12 volt vehicle charger. In connection with my prior involvement with the related ITC proceeding involving the '023 Patent and the Richardson prior art reference, I have personally viewed the commercial embodiment of Richardson, which is quite large. In fact, the commercial embodiment of Richardson is roughly the size of a suitcase and had wheels so that a user could roll it from vehicle to vehicle. Charging Richardson's system would therefore take at least four times longer than a jump starter designed to jump start only 12 volt vehicle batteries, assuming the same peak current requirements.

94. The high power requirements that would be needed to charge Richardson's jump starter in a reasonable amount of time is the main reason why

Richardson relies on charging its jump starter directly through the vehicle's electrical system (the vehicle's battery or alternator). Commercial vehicle alternators at the time would have generated between 720 and 960 watts of power, given their typical 12 volt output and output current of between 60 and 80 amps. *See* Ex. 2010, 35:21-36:5 (confirming that vehicle a alternator "generally produces 60 to 80 amps"). This massive power output would have dwarfed the power output of a common USB charger many times over. A PHOSITA would have understood that Richardson relied on the vehicle's electrical system rather than on a barrel charger (let alone a USB charger) due to its large output power that allows for the charging of the jump starter in a reasonable amount of time. Therefore, a PHOSITA would have recognized that it would have been nonsensical to charge Richardson's massive internal battery with USB, as it would have drastically increased the charging time of the device. In fact, Petitioner's expert confirmed that the current that USB could have provided would be reduced proportionally when boosted from 5 volts to 48 volts (*see* Ex. 2010, 84:3-13), which would entail reducing the current by more than 9 times from its already-limited value.

95. Based solely on the size of Richardson's jump starter battery, a PHOSITA would not have modified its device to include a USB input circuit.

3. Richardson's System Is Focused On Rapid Recharging

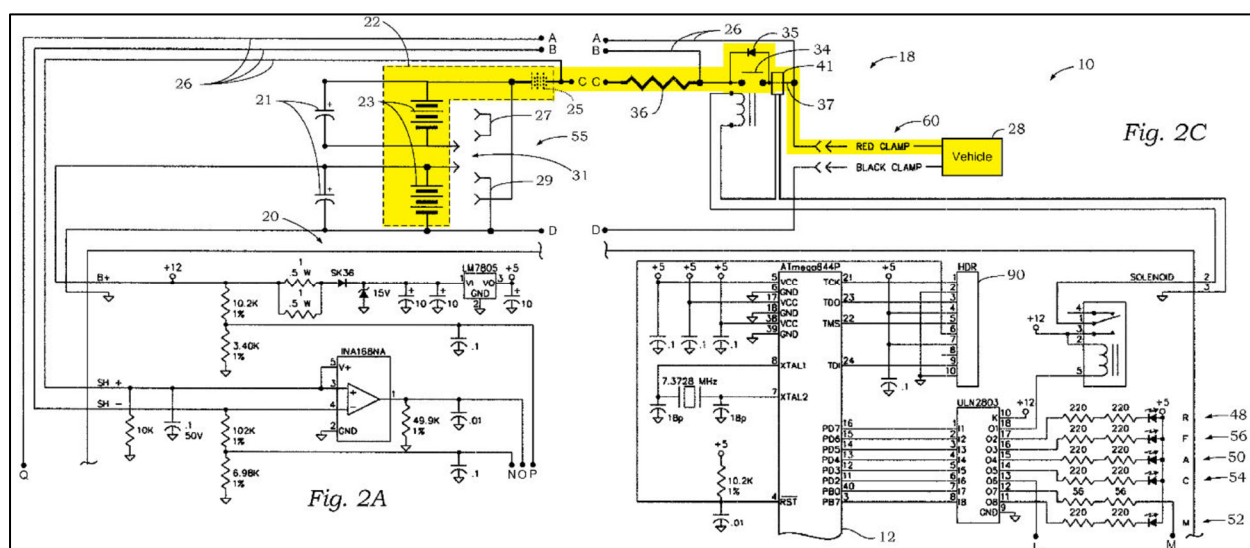
96. Even though Richardson's system includes a huge battery pack, a main focus of the disclosure is to provide a jump starter that may be rapidly recharged. By permitting rapid recharging of its large-capacity batteries from a vehicle charging system (*i.e.*, a vehicle alternator), Richardson states that its system would be "useful when starting fleets of vehicles with dead batteries," since the device may be "rapidly recharged to start many vehicles in a row." Ex. 1005, ¶ [0055]. Richardson emphasizes the importance of rapidly recharging the device in such a situation, stating that this functionality "allows the capacitors 21 and jump starter batteries 22 to be fully recharged in about *1 to 5 minutes* and can therefore start many vehicles in a row without becoming discharged." *Id.* (emphasis added). Petitioner's expert confirmed that the 1 to 5 minute charging time was a goal of Richardson and that it is "very useful when starting fleets of vehicles." Ex. 2010, 36:24-37:5. Moreover, Richardson notes that "[t]he jump starter batteries 22 only need to reach a 50% charge in order for the system to attempt to start the vehicle," thereby further emphasizing the importance that Richardson places on fast recharging of its system. *Id.*, ¶ [0029].

97. Given the focus of Richardson on rapid recharging, the Petition fails to demonstrate that a PHOSITA would have modified Richardson's jump starter to

include a traditional USB charger which, again, had much lower power capabilities than other charging options available at the time.

4. Richardson Has No Existing Charging Input Circuitry

98. In addition to overlooking the nature of Richardson, the Petition also mistakenly interprets Richardson's disclosed system as having existing charging input circuitry. Petition, p. 45 ("A PHOSITA would have been motivated to modify the design of Richardson's jump starter to either (1) *replace the existing charging circuitry* with Zhao's step-up charging system . . ."). See Ex. 1005, ¶ [0029]. But Richardson's only disclosed method for recharging the internal batteries involves using its red and black shunt cable ports. Richardson's schematics do not show any other way to charge the batteries 22 other than the highlighted path from the vehicle 28 through the jumper cables 60:



Ex. 1005, Figures 2A, 2C (color annotations added). There is no charging port of any kind described or depicted in Richardson's device, nor does the Petition point to any. Therefore, Petitioner's first proposed modification of "replacing the existing charging circuitry" of Richardson simply does not make any sense.

99. As to Petitioner's second proposed modification of "add[ing] Zhao's step-up charging system . . . as an additional and alternative pathway for charging the jump starter batteries" (Petition, p. 45), such an alteration would add additional cost and complexity to the device. Indeed, while any electronic device (*e.g.*, cell phone) may theoretically benefit from having multiple different kinds of charging ports, it would have been a less-common design choice, and one that would have required additional circuitry to address the safety risk of a user plugging in two chargers at the same time. A well-known issue in such designs is the short circuit condition between the two power sources that are plugged into the device since power from both sources is routed to the same destination (*i.e.* the battery). That short circuit condition can be catastrophic and poses a major safety risk, not just in terms of damaging the devices involved, but in terms of the safety of the user due to the explosion or fire that may result from the condition. Therefore, such multicharger systems must employ a combination of additional power switches, diodes, current/voltage sensors, and control circuitry to ensure that plugging more than one power source at the same time is properly and immediately detected and to

ensure that only one power path is activated (*i.e.*, a path from one of power sources to the battery). Due to the large power levels involved, the additional power switches and diodes must be rated accordingly and are typically bulky and expensive. Moreover, additional circuits must be employed to select which of the power sources that are plugged in is to be utilized for charging, which is typically based on charging power capability.

100. The Petition provides no discussion or examples of jump starters or any other devices configured to have multiple input charging ports. The system of Richardson is already capable of being recharged either by connecting its red and black shunt cable ports to a vehicle battery or to a battery charger. *See* Ex. 1005, ¶¶ [0055], [0028]. This existence of an existing charging path weakens the reasoning provided for this proposed combination.

101. More importantly, even if a PHOSITA decided to add a separate charging circuit, the Petition still fails to address why they would have chosen a USB port over other much-faster charging arrangements, especially given the large-capacity battery of Richardson and the reference's focus on quick recharging, as explained above.

102. Thus, the combination of Richardson with Zhao is detached from the actual prior-art system being relied on, and the motivation to make the asserted combination is deficient. It is my opinion that Petitioner has ignored Richardson's

teachings and has failed to demonstrate that a PHOSITA would have modified Richardson to include a USB input circuit.

B. The Petition Fails To Show, With Particularity, How A PHOSITA Would Have Combined Richardson and Zhao

103. In addition to the deficiencies in the motivation to combine Richardson and Zhao, it is my opinion that Petitioner also fails to demonstrate *how* the step-up converter of Zhao would allegedly be incorporated into the Richardson's jump starter.

1. Ground 1 Fails To Explain How Zhao's Teachings Would Have been Incorporated Into Richardson's Jump Starter, Which Describes No Input Charging Circuitry Outside Of Its Shunt Cable Ports

104. The Petition provides no explanation as to how a PHOSITA would have actually incorporated Zhao's step-up charging system into Richardson's jump starter. Instead, Petitioner superficially states that:

A PHOSITA would have been motivated to modify the design of Richardson's jump starter to either (1) replace the existing charging circuitry with Zhao's step-up charging system and connect the output to Richardson's jump starter batteries, or (2) add Zhao's step-up charging system and connect the output to Richardson's jump starter batteries as an additional and alternatively [sic] pathway for charging the jump starter batteries.

Petition, p. 45.

105. As detailed above, Richardson’s schematics do not show any other way to charge the batteries 22 other than the path through the jumper cables 60. *See* Ex. 1005, Figures 2A, 2C. Because there is no charging port of any kind described or depicted in Richardson’s device, the first proposed modification makes little sense and fails to provide an understandable explanation of the specifics of the patentability challenge of Ground 1.

106. As to Petitioner’s second proposed modification of adding Zhao’s step-up charging system as an “additional and alternative pathway,” the Petition fails to explain *how* Zhao’s step-up converter would have been specifically incorporated into Richardson’s jump starter device. It is unclear where Petitioner is proposing that the step-up charging system be added to Richardson’s circuitry. Additionally, it is unclear whether Ground 1 is using Zhao’s step-up charging system to charge each of Richardson’s internal batteries simultaneously, or individually. *See* Ex. 1005, Figures 2A (depicting two distinct battery packs). These considerations matter, since the required capabilities of the added step-up converter are directly related to the battery pack to be charged. And as explained above, adding a second input charging port creates safety considerations that require additional circuitry. Because of Petitioner’s cursory attempt at describing the proposed combination, Patent Owner has been denied the ability to fully address the patentability challenge of Ground 1.

2. Ground 1 Fails To Demonstrate That Zhao's Step-up Converter Could Be Used To Charge Richardson's Jump Starter

107. In addition to providing no explanation as to how Zhao's step-up converter would be implemented in Richardson's jump starter, the Petition provides no evidence demonstrating that Zhao's system could be successfully implemented into Richardson's specific jump starter system. Richardson's large internal battery pack enables jump starting of vehicle batteries up to 48 volts, and therefore contemplates an internal battery pack with at least 48 volts in some configurations. *See* Ex. 1005, ¶¶ [0034]-[0035]. The Petition fails to address whether Zhao's boost convert could have boosted a 5V input voltage to a voltage suitable to charge a 48 volt battery. Petitioner has simply stated, without evidence, that Zhao's step-up converter is capable of being implemented into Richardson's device.

108. Commercially-available step-up converters are typically limited to having a maximum output voltage, which operates as the upper limit that an input voltage may be boosted to. That upper limit is a function of a variety of factors, including the voltage rating of the converter's power and control circuits, the maximum switching frequency and/or switching duty cycle the converter can support, the expected input voltage range, and the targeted efficiency and transient response requirements of the converter. In fact, the only relevant evidence that Petitioner provides shows that boost converters had limited output voltage

capabilities. Specifically, the Petition points to the example XR3403 identified in the '023 Patent, but that boost converter is only “capable of providing an output voltage up to 26V.” Ex. 1012, p. 1. Given this restriction, and given that Zhao only describes boosting an input voltage up to “8.4 volts,” it was unreasonable for Petitioner to simply assume that Zhao’s step-up converter could properly function in Richardson’s jump starter. Without an explanation of how Zhao’s teachings are being incorporated into Richardson’s device, and without any evidence demonstrating the boost conversion capabilities of Zhao’s circuit, Petitioner has not articulated specific reasoning for the proposed combination.

109. Thus, it is my opinion that Petitioner has failed to show, with particularity, how a PHOSITA would have made the proposed combination of Ground 1.

X. YU AND PAPARRIZOS DO NOT RENDER CLAIMS 1, 32, 38, 39, 47, 52, AND 54 OBVIOUS (GROUND 2)

110. As further detailed below, it is my opinion that the challenged claims are not unpatentable over the combination of Yu and Paparrizos.

A. A PHOSITA Would Not Have Been Motivated To Modify The Particular System Of Yu To Have A USB Input Circuit

111. Similar to Ground 1 discussed above, the Petition fails to address why a PHOSITA would have modified a jump starter system having a large-capacity battery to include a USB charging input. Petitioner also completely ignores

teachings in Yu that weaken the proposed combination. In doing so, Petitioner has failed to demonstrate that a PHOSITA would have combined the specific teachings of Yu and Paparrizos.

1. Petitioner's Motivation To Combine Yu And Paparrizos Is Deficient

112. The reasoning provided in the Petition does not support modifying Yu's jump starter to include a USB. The Petition argues that:

A PHOSITA therefore would have been motivated to combine Yu and Paparrizos with predictable results because Paparrizos is directed to the *known technique* of charging a 12V battery from a 5V USB source using a DC-DC boost converter in accordance with its established function of converting a lower voltage input to a higher voltage output. EX1003, ¶ 151. Additionally, Paparrizos specifically teaches the desirability of charging higher voltage batteries with a 5V input, which is a known technique a PHOSITA would have been motivated to implement predictably to charge Yu's battery. EX1003, ¶ 151.

Petition, p. 60 (emphasis added). Just like for Ground 1, it is my understanding that this reasoning follows a typical obviousness rationale of a known technique used to improve similar devices in the same way. Specifically, the Petition argues that a PHOSITA would have applied the "*known technique* of charging a 12V battery from a 5V USB source using a DC-DC boost converter" to Yu's system.

113. But as discussed above, a PHOSITA would not understand the small battery systems contemplated by Paparrizos and the vehicle jump starter described

by Yu to be “similar devices.” *KSR*, 550 U.S. at 417. Paparrizos discloses a battery charging circuit that can operate in a boost mode to step up a DC input charging voltage. *See* Ex. 1009, 1:30-39. But just like Zhao, Paparrizos does not teach or suggest applying its techniques beyond small electronics devices known to have low-capacity batteries. *See* Ex. 1009, 2:26-29. Paparrizos’ techniques relate to charging of “[c]omputer tablets and other mobile devices, such as mobile phones, digital SLR cameras, video recorders, audio devices” (*id.*, 2:26-29), with battery packs that “typically range from 3.0V to 8.4V,” not to charging jump starters or comparable devices. *Id.*, 1:13-15. In fact, Paparrizos expressly notes that “the USB specification imposes current limits for various devices that can be connected to the battery charging circuit,” which further confirms that its charging circuit is not intended for charging large-capacity battery systems. *Id.*, 4:48-58. When considering charging techniques, a PHOSITA would understand that these small electronics devices are not similar to a vehicle jump starter.

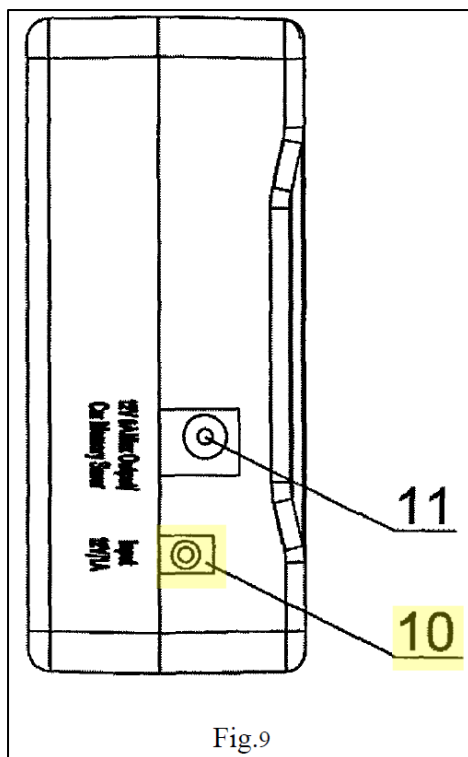
114. Suffering from the same deficiency as Ground 1, the Petition never discusses why a PHOSITA would have applied the low current charging technique of traditional USB to an electronic system with a battery having a high battery capacity. As explained above, it was well understood that the limited charging current that traditional USB provided was not capable of quickly charging high-capacity battery systems like those of jump starters. By failing to recognize that a

PHOSITA would not have added a USB charging circuit to a jump starter system like that of Yu, Petitioner has fallen short of demonstrating that a skilled artisan would have made the proposed combination.

2. Yu Already Contemplated USB Charging And Boost Conversion, Yet Still Chose To Rely On A Barrel Charger

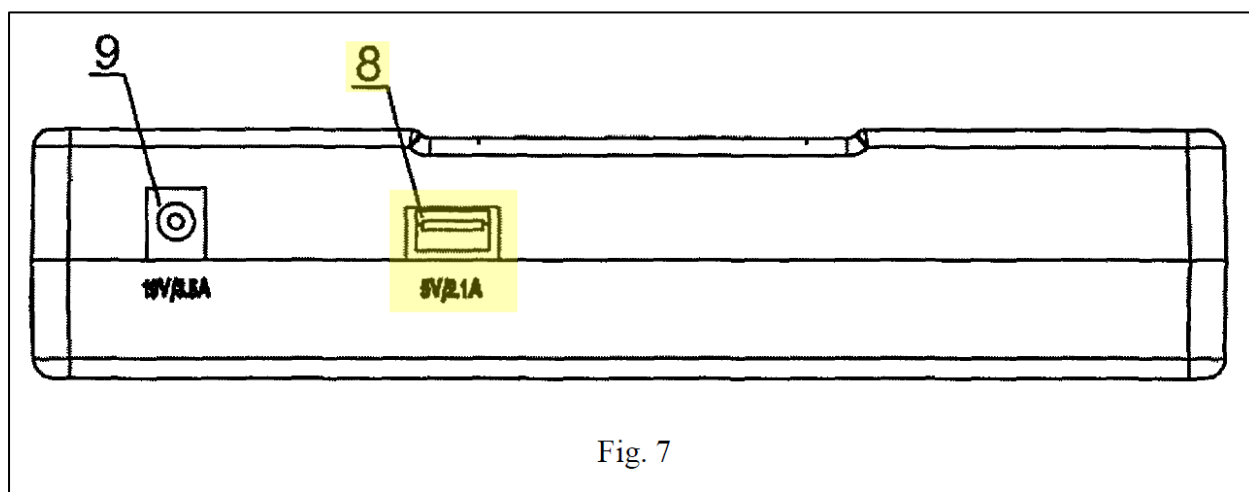
115. Yu itself is perhaps the best evidence against Petitioner's Grounds. The Petition essentially argues that, had a PHOSITA known about Yu's systems and the USB boost conversion techniques of Paparrizos, then they would have naturally arrived at the claimed invention. The problem with this reasoning, however, and what the Petition fails to mention, is that Yu already contemplates and incorporates both USB output charging and DC-DC boost conversion. Specifically, Yu's system already contains both a USB port and a DC-DC boost converter. Despite this, and likely for the disadvantages associated with charging jump starters via USB discussed above, Yu's inventors chose to include a separate barrel charger and incorporated USB only as an output port to charge other smaller devices from the jump starter battery. This choice is strong evidence that a PHOSITA would not, in fact, have made the proposed combination suggested in Ground 2.

116. Yu discloses a female barrel charging port for use with a traditional barrel charger (item 10):

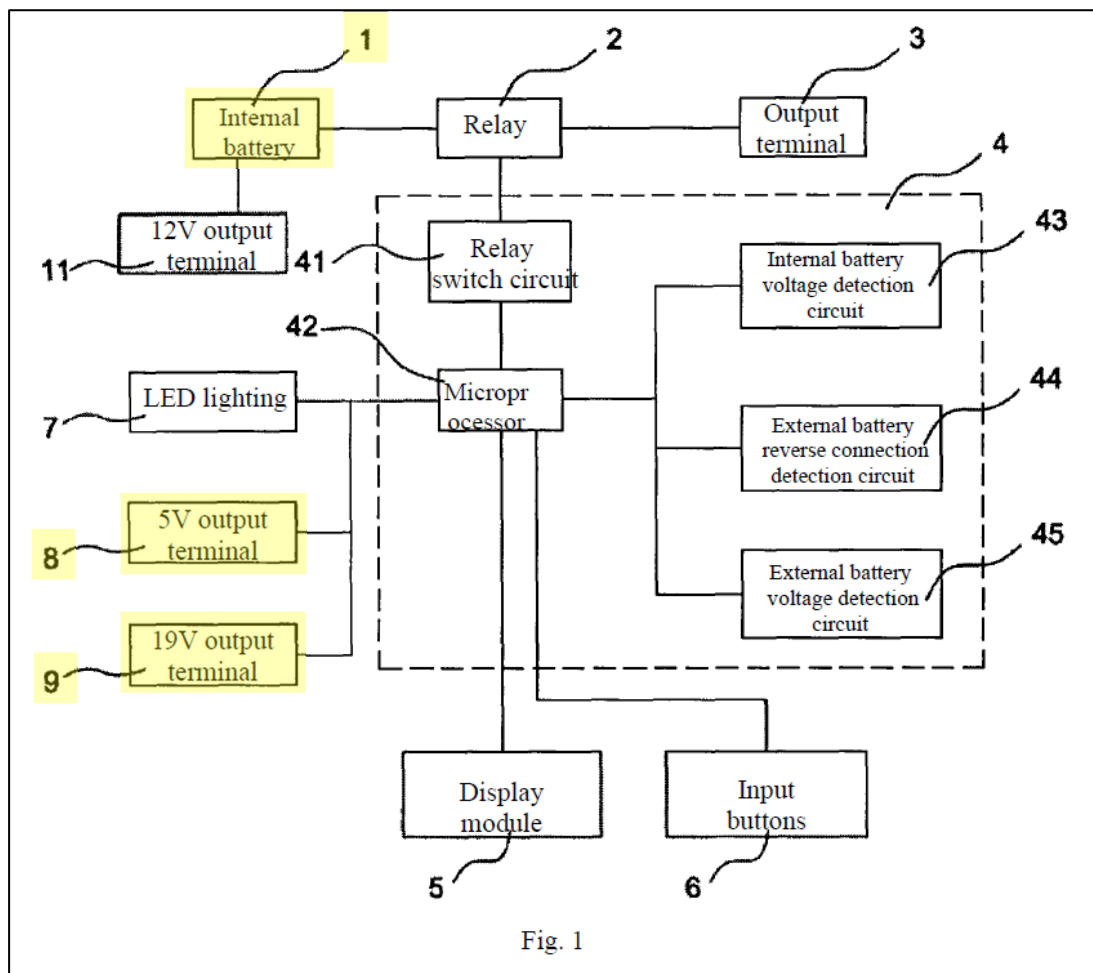


Ex. 1008, Fig. 9. Petitioner’s expert stated that Yu’s input charging port “appears to be a barrel connector” or a similar type of power input port. Ex. 2010, 68:20-69:1.

117. Yu also discloses a USB port which it describes as a “5V output terminal 8” (Ex. 1008, ¶ [0025]):



Id., Fig. 7 (color annotations added). This 5V terminal of Yu is depicted as a USB Type A port configured to receive a USB cable connected to an external device or power source, as confirmed by Petitioner’s expert. Ex. 2010, 69:16-18 (“Yes, that’s a USB-A port.”). The “19V output terminal 9” also shown above in Figure 7 (*see id.*, ¶ [0025]) and the 5V USB terminal of Yu are both connected to a 12V “internal battery 1”:



Id., Fig. 1 (color annotations added). As shown, the internal battery 1 may directly supply output power to a “12V output terminal 11” (*see id.*, ¶ [0025]) and may also

indirectly provide output power to the USB output terminal and the 19V output terminal through a relay switch circuit and a microprocessor. *See id.*, Fig. 1. A PHOSITA would have understood that, in order to provide an output voltage of 19 volts, any charge provided by Yu's 12 volt internal battery would have to be boost converted from 12 volts up to 19 volts. So, in addition to disclosing the 5V USB port, Yu inherently discloses a DC-DC boost converter as well.

118. Therefore, the authors of Yu's disclosure were already contemplating USB output charging and boost conversion techniques at the time, and still chose to rely on a separate barrel charger over a USB outlet for its input charging. In my opinion, this choice, even when possessing the knowledge of Zhao's teachings, is strong evidence that a PHOSITA would not have modified Yu's system to rely on USB input charging.

119. Thus, Ground 2 of the petition fails to appreciate how a PHOSITA would have viewed the actual system of Yu, including recognizing how its already-existing USB port and DC-DC boost converter weaken the proposed combination. For these reasons, and in addition to the above, a PHOSITA would not have added a USB charging circuit to Yu's specific jump starter device.

B. The Petition Fails To Show, With Particularity, How A PHOSITA Would Have Combined Yu and Paparrizos

120. In addition to the deficiencies in the motivation to combine Yu and Paparrizos, Petitioner also fails to demonstrate *how* the battery charging circuit of Paparrizos would allegedly be incorporated into the system of Yu.

121. Yu does not specify its internal battery type, and provides very limited disclosure of its charging input circuit, beyond the use of a barrel charger. *See*, Ex. 1008, Fig. 8, ¶ [0028]. Similar to the deficiencies associated with Ground 1, nowhere does Petitioner attempt to show how Yu’s system, depicted in the circuit diagrams of Figures 1-5, would have been modified to include Paparrizos’ complex charging circuit. In fact, Paparrizos’ charging circuit includes numerous operating modes—many of which would be useless to the system of Yu (*e.g.*, reverse boost mode, forward buck mode)—and relies on a “configuration detector 216 [to] generate suitable signals 222 that are used to configure the buck boost circuit 212 to operate accordingly.” Ex. 1009, 4:42-47.

122. The Petition provides no explanation for how the PHOSITA allegedly would have integrated Paparrizos’ configuration detector into Yu’s circuit to ensure that the correct operating mode (*i.e.*, forward boost mode) is applied. Moreover, for the situation where Paparrizos’ charging circuit is added as an additional input circuit, Petitioner fails to address the added complexity and the safety risks associated with adding a second input charging circuit, including the modifications that would need

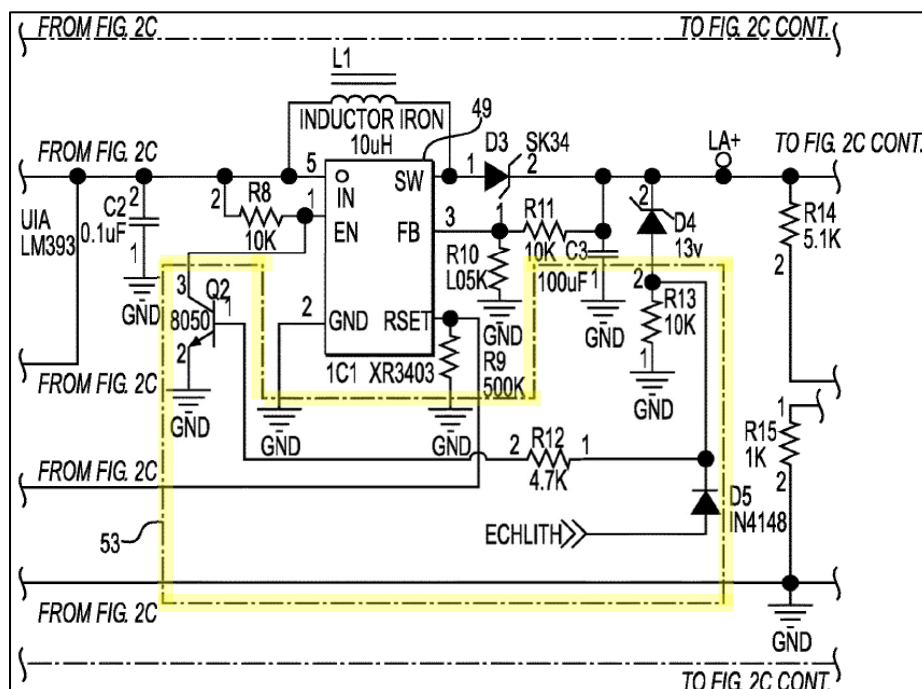
to be made to Paparrizos' system to account for the possibility that a user attempts to hook up multiple chargers simultaneously. As discussed above, adding multiple input charging ports to any electronic device has serious and complex design implications to address the safety risk of a user plugging in two chargers at the same time. A short circuit condition between the two power sources that are plugged into the device can be catastrophic and poses a major safety risk and, therefore, such systems must employ a combination of additional power switches, diodes, current/voltage sensors, and control circuitry to ensure that plugging of more than one power source at the same time is properly and immediately detected and ensure that only one power path is activated. Nowhere does the Petition address these additional design considerations that would have been required when adding in a second input charging pathway.

123. Petitioner's conclusory attempt to combine these two prior-art systems therefore falls short of showing unpatentability with particularity.

C. Ground 2 Fails To Render Claims 32 And 52 Obvious Since Neither Yu Nor Paparrizos Disclose A DC-DC Converter Being Turned On And Off By A Microprocessor

124. In addition to the deficiencies surrounding Ground 2 discussed above, it is my opinion that the Petition's flawed attempts to show the obviousness of claims 32 and 52 are particularly erroneous. Both of these claims require the additional limitation wherein "the DC-DC converter can be turned on and off" by a

microprocessor or microcontroller, and independent claim 52 further specifies that it be an “output from the microcontroller” that produces this ON/OFF functionality. Ex. 1001, 11:4-6, 14:11-45. The specification of the ’023 Patent relatedly explains how “[t]he DC-DC converter 49 can be turned on and off via circuit 53 by an output from the microcontroller” (*id.*, 7:28-29):



Id., Fig. 2C (color annotations added). Similar to how the ’023 Patent allows its output circuit “to be turned on and off by software control to prevent the internal lithium battery getting too low in capacity,” turning off the DC-DC converter via circuit 53 prevents overcharging of the jump starter battery. *Id.*, ¶ [0028]. This important safety feature helps to prevent the overheating, fires, and explosions that may result from overcharging an internal battery. To understand this, it is important to note that when a battery becomes fully charged, it becomes unable to store any

additional energy provided to it by the charger. If the charger continues to charge the battery (*i.e.*, overcharging), this additional energy has no place to go other than being dissipated in the form of heat. This process raises the ambient temperature around the battery and may cause a thermal runaway condition where the temperature rises until the battery catches on fire and explodes. It is also worth noting that some battery chemistries are more sensitive than others to this overcharging risk (*i.e.*, more susceptible to overheating and thermal runaway). In particular, lithium-ion batteries are known to be extremely sensitive to thermal runaway conditions, and thus the feature of preventing overcharging is essential in devices that use this battery chemistry.

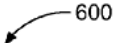
125. When addressing this limitation in Ground 2, the Petition argues that the ON/OFF controller limitation of claims 32 and 52 is taught by Paparrizos:

Figure 5 of *Paparrizos* discloses a “workflow” which a *PHOSITA* would understand to be best implemented by a microprocessor. EX1009, FIG. 5; EX1003, ¶ 167. Otherwise, a PHOSITA would need to implement various configurations in hardware which are not explicitly described in Paparrizos for performing the workflow of Figure 5. EX1003, ¶ 167. Additionally, *a PHOSITA would understand a microprocessor would be one of the most effective, reliable, and cost-effective choice for implementing control of the ON/OFF state of the buck boost circuit 212*. EX1009, FIG. 6; EX1003, ¶ 167. Accordingly, Paparrizos teaches or renders obvious the use of a buck-

boost step-up converter that can be turned on and off by a microprocessor or microcontroller. EX1003, ¶ 167.

Petition, pp. 69-70. In other words, Petitioner admits that Paparrizos does not describe using any microprocessor at all, but argues that a PHOSITA would understand that one of its workflows would be “best implemented by a microprocessor.” *Id.* However, Petitioner fails to demonstrate that a PHOSITA would have arrived at such an understanding.

126. More importantly, beyond failing to adequately demonstrate that one would have implemented Paparrizos’ techniques on a microprocessor, Petitioner never demonstrates that Paparrizos actually teaches or suggests controllably turning its buck boost converter between on and off states. Petitioner’s statement that “a microprocessor would be one of the most effective, reliable, and cost-effective choice for implementing control of the ON/OFF state of the buck boost circuit 212” is conclusory. Nowhere does the Petition point to where Paparrizos actually teaches or suggests controllably turning its buck boost converter on and off. While the Petition cites to Figure 6 of Paparrizos, that drawing depicts only “different *operational* configurations of a buck boost circuit,” (Ex. 1009, 2:6-7 (emphasis added)):



operation mode	PWM module 312a	PWM module 312b	HS1	LS1	HS2	LS2	boot cap refresh signal 314a	boot cap refresh signal 314b
forward boost conversion	HI	duty _{r1}	ON	OFF	switching	switching	LO	LO
reverse buck conversion	HI	duty _{r2}	ON	OFF	switching	switching	LO	LO
forward buck conversion	duty _{r3}	HI	switching	switching	ON	OFF	LO	LO
reverse boost conversion	duty _{r4}	HI	switching	switching	ON	OFF	LO	LO

Fig. 6

Ex. 1009, Fig. 6. While some of the transistors (HS1, LS1, HS2, and LS2) in Figure 6 are identified as “OFF” in certain operational modes, all four of the rows in this table are identifying different modes where the buck boost converter of Paparrizos is functioning in an “ON” state. In other words, in none of these operation modes would the DC-DC converter be “turned off.” Nor does the Petition assert that Paparrizos elsewhere discloses controllably turning its circuit on and off by, for example, turning off both HS1 and LS1 simultaneously. Thus, Petitioner’s assertion that “Paparrizos teaches or renders obvious” this claim limitation is completely unsupported by Paparrizos itself. Petition, p. 70.

127. Petitioner has taken a reference that does not disclose either: (1) a microprocessor, or (2) controlling the ON/OFF state of a DC-DC converter, and has

somehow relied on that reference to teach a “DC-DC converter [that] can be turned on and off by an output from the microcontroller.” Ex. 1001, 14:44-45. Petitioner’s conclusory statements about Paparrizos do not demonstrate that the limitations of claims 32 and 52 were taught by the prior art combination of Ground 2.

XI. CONCLUSION

128. For at least the above reasons, it is my opinion that claims 1, 32, 38, 39, 47, 52, and 54 of the ’023 Patent are not unpatentable.

XII. DECLARATION

I declare that all statements made herein on my own knowledge are true and that all statements made on information and belief are believed to be true, and further, that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code.

Dated: November 21, 2024

By: _____

Ayman Fayed, Ph.D.