UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

ADC SOLUTIONS AUTO LLC
Petitioner

v.

THE NOCO COMPANY
Patent Owner

Patent No. 11,584,243
Issue Date: February 21, 2023

Title: JUMP STARTING DEVICE WITH USB

Inter Partes Review No. IPR2024-00671

DECLARATION OF C. ARTHUR MACCARLEY, Ph.D., P.E. IN SUPPORT OF PETITIONER'S REPLY TO PATENT OWNER'S RESPONSE

1. I, C. Arthur MacCarley, hereby declare that the following is true and correct. I previously provided a declaration filed as Exhibit 1003 in support of the Petition for *Inter Partes* Review of U.S. Patent No. 11,447,243 ("Petition"). My testimony from my first Declaration remains the same. I am competent to make this Declaration based upon my personal knowledge and technical expertise for the reasons set forth in my first Declaration. If called to testify, I could and would testify honestly, under oath, to the matters set forth herein.

2. For purposes of preparing this Declaration, I have considered all materials filed in this proceeding to date and the additional materials cited herein.

3. I disagree with Patent Owner's expert, Dr. Fayed, that "the peak current the jump starter needs to provide is typically between 1000-4000 amps." EX2014, ¶ 70. As I explained in my deposition, under ordinary circumstances a typical mid-sized automobile would require about 500 peak amps for a jump start. EX2013, 23:8-19. I also explained that a battery for a typical mid-sized vehicle would have a range of capability of 450 to 1,000 peak amps for its output to start the car. EX2013, 23:8-19. Dr. Fayed's statement that 1,000-4,000 peak amps are needed is greatly overstated for two main reasons.

4. First, 1,000-4,000 peak amps would be a range applicable for much larger engines such as those used in Class 7 and 8 commercial vehicles (e.g., semi-trucks, construction or farming vehicles, etc.). As an example, 4,000 amps would

be a massive amount of power if delivered at 24V (a common voltage for the starter of a semi-truck). Specifically, this would be 96 kW or 129 Horsepower, which is even beyond the capability of starters for the largest diesel engines used on earth moving equipment. If this power was applied for a 5-second jump start, it would amount to 133.33 Wh (4,000 Amps x 24 Volts x 0.00139 Hours) = 133.33 Wh). In my experience, the power required for jumping a large semi-truck would be about half this amount or less, approximately 1,500-2,000 amps at 24V, which amounts to 50-66.67 Wh. In fact, Richardson specifies "1400 amps for a short period of time such as 500 ms" or "1000 amps for more than a predetermined period of time such as 15 seconds" as conditions for generating error messages and halting the jump start process. EX1005, ¶ [0042]. A majority of Dr. Fayed's 1,000-4,000 peak amps range would far exceed these levels disclosed in Richardson.

5. Second, Dr. Fayed has relied upon "the specifications of many jump starter devices available in the market" today as opposed to the actual needs of a typical vehicle system as of the time of filing of the '243 patent (July 3, 2014). In my experience, it is common for device manufacturers to compete by attempting to exceed the specifications of their competitors' products, even if that results in capabilities exceeding the needs of the application. In other words, although some devices might be marketed today with 1,000-4,000 peak amps, that does not mean that vehicle systems would require this much current for a jump start. Additionally,

because Dr. Fayed did not identify any specific devices or submit corresponding evidence, there is no way to verify the specific devices that purportedly support his inflated peak amps range. As noted above, 500 amps would be a more reasonable and conservative approach that a PHOSITA would have used for a typical application, which exceeds but generally aligns with the 400 amps example provided in the ’243 patent. EX1001, 4:23-26.

6. I also disagree with Dr. Fayed’s arguments regarding whether USB charging could charge a jump starter’s batteries in a “typical charging time” (EX2014, ¶ 83), a “reasonable amount of time” (EX2014, ¶ 94), or otherwise be “capable of quickly charging high-capacity battery systems like those of jump starters” (EX2014, ¶ 114) as well as any other variations of these assertions. The ’243 patent does not discuss charging rate or provide any criteria for evaluating whether any given charging time is reasonable, unreasonable, typical, atypical, quick, or slow. EX1001, 5:24-26, 7:32-40, claims 1, 57. Dr. Fayed likewise does not identify any relevant criteria, such as market demand, consumer expectations, intended frequency of use, typical time intervals between each use, or when or how often the device would be charged.

7. In my experience, a typical jump starter application would be jumping a vehicle that had been subjected to a large power drain while parked for several hours or days (e.g. headlights left on). Another common application would be

jumping a vehicle battery that has insufficient voltage due to degradation associated with end of life (typical vehicle batteries are designed for at least 3-5 years of typical use). These applications would leave plenty of time for charging (e.g., overnight, over the weekend, or otherwise between uses) before the next need arises. A PHOSITA would have found the power capabilities and charging times available through USB charging to suffice for these applications, particularly given trade-offs such as the benefits of USB, as acknowledged in my first Declaration. EX1003, ¶¶ 90, 141. While Dr. Fayed has not quantified or calculated the charging times which he argues are unreasonable, I have performed calculations to show that these charging times allow more than enough opportunity to recharge the jump starter's batteries when not in active use, in as little as a few hours or less in some applications.

8. As I explained in my deposition, the USB Battery Charging Specification (released March 8, 2007) contemplated maximum amp ratings as high as 1.8 amps as identified in Table 5-2 of the specification. EX2013 at 84:14-85:9; EX1025, p. 29. For my calculations, I have relied upon the 1.5 amp current limit recited in Section 3.5 of the specification, which is also recited in Table 5-2 of the specification. EX1025, pp. 16, 25. I have also relied upon the current limit provided in Revision 1.2 to USB's Battery Charging Specification, which was released March 15, 2012. EX1046, pp. 9-80. It is my understanding that one of the

inventors of the ’243 patent, Rick Stanfield, submitted a declaration in a prior proceeding, IPR2020-00944, attesting to the publication of Revision 1.2 in 2012 as well as submitting a copy. EX1046, pp. 4-5 (¶ 10). In my experience, this specification would have been published and available to the public before July 3, 2014. The 2012 specification maintained the voltage capability of 5 volts, but the current maximum was increased to 5 amps. EX1046, pp. 64 (Table 5-2, titled “Currents”). This increase in current would allow up to 25 Watts of power (5 volts x 5 amps = 25W), which represents an over threefold increase compared to the 7.5 Watts available under the 2007 specification’s current rating of 1.5 amps. However, as I explained in my deposition, there is some power loss associated with DC-DC conversion during the charging process (EX2013, 83:25-84:2), and thus 80 percent efficiency would be a conservative estimate that a PHOSITA would have used for determining the usable power that that can be returned by the jump starter’s battery for charging (although there were also commercially-available DC-DC converters that would have been able to achieve up to 90% efficiency before July 3, 2014). Accordingly, a PHOSITA would have reasonably understood that the 7.5W and 25W of USB power identified above should be reduced to 6W and 20W, respectively, in their calculations if more conservative estimates were desired.

9. To arrive at an understanding of the battery capacity that would be

needed for a typical jump starter, as well as the resulting charging times, a PHOSITA would have calculated the amount of energy that would have been needed for a typical jump starter for the intended application. A PHOSITA would have then been able to determine the appropriate minimum battery capacity needed to store this energy. To calculate the amount of energy needed for the intended jump start, a PHOSITA would have relied on the following equation:

- Equation 1: Output voltage of jump starter batteries (Volts) x Output current of jump starter batteries (Amps) x Duration of jump start (Hours) = Energy discharged by a single jump start (Watt-hours).

Then, to determine charging time—i.e. how long it would take to replenish this energy discharged from the jump starter batteries—a PHOSITA would have relied on the following additional equation:

- Equation 2: Energy discharged (Watt-hours) ÷ Charging power (Watts) = Charging time (Hours).

Dr. Fayed generally agreed with these principles and calculations during his deposition. EX1045, 21:20-26:4, 26:21-27:4. As noted above, the intended application would affect the energy needed for a jump start, including the amount of voltage and peak current needed during discharge of the jump starter's battery as well as the estimated duration of the typical jump start. The amount of available USB power would impact the resulting charging time to replace the energy

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discharged. I have attached Appendix A to this Declaration which shows how various inputs to Equation 1 and Equation 2 would have provided a PHOSITA with an estimate of charging times. For purposes of calculations, the examples in Appendix A rely on the following variables: (1) output voltages of 12V (a typical voltage for a consumer vehicle system) or 48V (the extreme example which Dr. Fayed improperly assumes is a requirement of all Richardson's embodiments), (2) 400 amps (the example in the '243 patent), 500 amps (the more conservative current amount I discussed in deposition) as well as 1,000 or 4,000 amps (the outer bounds of Dr. Fayed's proposed peak current range which I disagree with for reasons stated previously, and (3) 2 or 5 seconds (the outer bounds of the more conservative range that applies to jump start duration as opposed to Dr. Fayed's 20-50ms range). If a PHOSITA wanted to build a device capable of performing multiple jump starts before recharging, then the recharge time would simply be multiplied by the number of desired jump starts.

10. I disagree with Dr. Fayed that the duration of a jump start would be 20-50ms. EX2014, ¶ 70. In my experience, a more realistic estimated cranking duration for a cold engine with a weak or dead battery would be 2-5 seconds (2000-5000 ms). In the very best case of an engine that is already fully warmed up (unlikely since it had a dead battery), the cranking duration could be as short as 500ms.

11. I disagree with Dr. Fayed that the jump starter described by Richardson's teachings would require a 48V output, as opposed to the traditional 12V output for jump starting a typical mid-size consumer vehicle. Richardson contemplates configuring the batteries for several different voltage levels, but does not restrict all applications to provide up to 48V (which is not used by any conventional gasoline or diesel vehicles in the USA or Europe). Still, I have performed calculations showing how the peak amps and voltage output asserted by Dr. Fayed would impact charging times, even though I maintain that Dr. Fayed's opinions are incorrect regarding these values.

12. In my experience, none of the charging times shown in Appendix A would have discouraged a PHOSITA from using USB to charge a jump starter, particularly given industry-wide pressure at the time to standardize on USB power delivery. This is especially true for combinations where a USB charging pathway is implemented as an alternative to another pathway such as one using a barrel connector.

13. I also disagree with Dr. Fayed's argument that "Richardson's only disclosed method for recharging the internal batteries involves using its red and black shunt cable ports" and that "[t]here is no charging port of any kind described or depicted in Richardson's device, nor does the Petition point to any." EX. 2014, ¶ 98. As I explained in my first Declaration, citing to paragraph [0029] of

Richardson, "Richardson is not explicit regarding the type of input connector utilized for charging the jump starter batteries." EX1003, ¶ 86. My first Declaration also relied on a PHOSITA's understanding that Richardson's jump starter would typically require a "proprietary charger or other type of AC 'power brick'" (EX1003, ¶¶ 91, 144), such as "a specialized 12-volt plug connector, such as a barrel charger" suggested by Dr. Fayed. EX2014, ¶ 23. As I further explained in my deposition, with reference to paragraph [0028] of Richardson, there are numerous points in the circuitry disclosed by Richardson where a charging pathway from an external battery charger (e.g. the "battery charger" that Richardson explains is "not shown", EX1005, ¶ [0028]) could be connected to charge Richardson's batteries. EX2013, 52:3-54:5. Any of these connection points would be a trivial modification of Richardson's embodiment. A PHOSITA would have understood how to implement this type of well-known configuration of an external battery charger and associated charging circuitry, which would have been as simple as wiring connections to the terminal anode and cathode of the batteries. The simplicity of this connection is why it is not surprising that Richardson describes such a pathway and leaves it "not shown" in the figures.

14. I also disagree with Dr. Fayed's argument that the optional feature described in paragraph [0055] for one embodiment of Richardson would require "a huge battery pack" or "rapid recharging" of Richardson's batteries. EX2014, ¶ 96.

While Richardson contemplates one version of this optional feature may rely on power from both the batteries and capacitors, Richardson also teaches the capacitors alone would be rapidly recharged and capable of jump starting vehicle batteries. EX1005, ¶ [0055]. Further, a PHOSITA would have understood Richardson's teachings as contemplating *supercapacitors* (aka *ultracapacitors*) in a configuration that would be suitable for rapid recharging and jump starting without supplemental power output from the batteries, EX1005, ¶ [0015] (explaining the capacitors "may include energy storage modules containing six or more ultra-capacitor cells" and that the capacitors "may be connected in series to obtain higher operating voltages or in parallel to provide additional energy storage"). Accordingly, a PHOSITA would have understood that the optional feature in paragraph [0055] does <u>not</u> require massive increases in battery capacity as a configuration of supercapacitors could readily perform the feature described as "useful when starting fleets of vehicles with dead batteries." EX1005, ¶ [0055].

15. I also disagree with Dr. Fayed's argument that Zhao's teachings are limited to a boost converter that could not provide a sufficient output voltage to properly function with Richardson's jump starter. EX2014, ¶ 108. While Dr. Fayed is correct that commercially available boost converters, like any electronic power supply devices, are limited to some maximum output voltage, it is incorrect that a PHOSITA would not have been able to implement Zhao's teachings with voltages

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above 8.4V. Figure 1 of Zhao shows the output of Charging Control Circuit 201 connected to a pack of at least three cells, along with an ellipsis demonstrating that even more cells could be included in the pack. These teachings of Zhao encompass a quantity of series-connected cells that would correspond to any of Richardson's embodiments, whether a 12V pack, a 48V pack, or anything in between. For the higher voltage configurations, a PHOSITA would have been capable of, and motivated to, select commercially-available components for the boost converter which would provide appropriate voltage ratings and switching capabilities to ensure an effective voltage boost from 5V up to the voltage of the pack. A PHOSITA would have been well-equipped to configure or select a boost converter with these capabilities—indeed, there are prior art examples where even a 3V to 48V conversion is disclosed as achieved with conventional electrical circuit components. EX1047, 4:3-32. I note that Dr. Fayed does not claim that these conversions to higher voltages would be difficult, as he implicitly recognizes that a PHOSITA would have understood it would have merely required selecting components with higher voltage ratings and switching capabilities. EX2014, ¶ 108.

16. I also disagree with Dr. Fayed's argument that adding a USB charging pathway as an additional and alternative charging pathway would add enough cost and complexity to a device to prevent a PHOSITA from pursuing this type of combination. EX2014, ¶¶ 99, 122. As Dr. Fayed acknowledges, potential issues

stemming from the possible scenario where a user plugs in two chargers at the same time could be mitigated or avoided altogether by commercially available switches, diodes, current/voltage sensors, and/or control circuitry. EX2014, ¶ 99. For example, a PHOSITA would have a variety of options, some as simple as the use of a blocking diode along each charging pathway which would readily prevent current from the higher voltage charger from "back-charging" the lower voltage charger. This would address what Dr. Fayed appears to describe as a "short circuit condition," using electrical components that, in my experience, would have relatively low expense (less than a dollar in this application). Additionally, a PHOSITA would have been readily capable of implementing a current-limiting circuit to ensure that the charging current does not exceed some desired threshold.

* * *

I understand that this declaration will be filed as evidence in a contested case before the Patent Trial and Appeal Board of the United States Patent and Trademark Office. I also understand that I may be subject to cross-examination concerning this declaration, and I will appear for cross-examination, if required of me, during the time allotted for cross-examination.

I hereby declare that all of the statements made herein of 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 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.

Executed on this 14th day of February, 2025.

C. Arthur MacCarley, Ph.D., P.E

APPENDIX A – Exemplary Estimated Charging Times

- Equation 1: Output voltage of jump starter batteries (Volts) x Output current of jump starter batteries (Amps) x Duration of jump start (Hours) = Energy discharged by a single jump start (Watt-hours).
- Equation 2: Energy discharged (Watt-hours) ÷ Charging power (Watts) = Charging time (Hours).

Example	Output Voltage (V)	Output Current (A)	Duration (s)	Energy Discharged (Wh)[1]	Charging Time at 7.5W (h)[2]	Charging Time at 25W (h)[3]
1	12	400	2	2.67	0.36	0.11
2	12	500	2	3.33	0.44	0.13
3	12	1,000	2	6.67	0.89	0.27
4	12	4,000	2	26.67	3.56	1.07
5	12	400	5	6.67	0.89	0.27
6	12	500	5	8.33	1.11	0.33
7	12	1,000	5	16.67	2.22	0.67
8	12	4,000	5	66.67	8.89	2.67
9	48	400	2	10.67	1.42	0.43
10	48	500	2	13.33	1.78	0.53
11	48	1,000	2	26.67	3.56	1.07
12	48	4,000	2	106.67	14.22	4.27
13	48	400	5	26.67	3.56	1.07
14	48	500	5	33.33	4.44	1.33
15	48	1,000	5	66.67	8.89	2.67
16	48	4,000	5	266.67	35.56	10.67

[1] Values in this column calculated with Equation 1.
[2] Values in this column calculated with Equation 2, using the 7.5W available under the 2007 USB Charging Specification (EX1025).
[3] Values in this column calculated with Equation 2, using the 25W available under the 2012 USB Charging Specification (EX1046, pp. 8-81).