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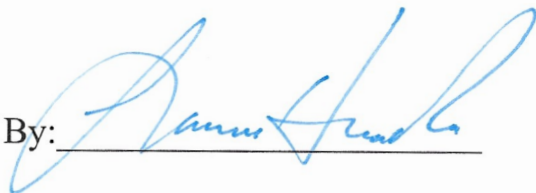
In re Patent of: Koebler
U.S. Patent No.: 9,412,994
Issue Date: August 9, 2016
Appl. Ser. No.: 13/989,273
Filing Date: May 23, 2013
Title: LITHIUM STARTER BATTERY AND SOLID STATE
SWITCH THEREFOR

DECLARATION OF MR. LOUIS HRUSKA

I currently hold the opinions expressed in this declaration. But my analysis may continue, and I may acquire additional information and/or attain supplemental insights that may result in added observations.

I hereby declare that all statements made of my own knowledge are true and that all statements made on information and belief are believed to be true. I further declare 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 the Title 18 of the United States Code.

Date: Mar. 30, 2025

By: 

Louis Hruska

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I. QUALIFICATIONS AND BACKGROUND INFORMATION

1. My education and experience are described more fully in the attached curriculum vitae. For ease of reference, I have highlighted certain information below.

2. I have over forty years of experience in electrochemical energy storage technology, including fundamental research, design, testing, and manufacturing of battery cells and battery systems. I hold over twenty patents, issued in a broad range of battery related technologies with coverage in materials, separators, cell design, electrical controls, circuit communication and software. My work experience includes cell design and process development for Lithium cell manufacturing in the time period preceding the claimed priority date of the patent at issue. Additionally, I was a founder and CTO of an organization that developed battery control circuits and mixed signal controllers for battery management. Finally, I was a General Manager of a division focused on battery controllers at Microchip, a leading semiconductor producer.

3. I have been retained on behalf of SHENZHEN FBTECH ELECTRONICS LTD and SHENZHEN LITIME TECHNOLOGY CO., LTD to offer technical opinions relating to U.S. Patent No. 9,412,994 (“the ’994 Patent”) and prior art references relating to its subject matter. I have reviewed the ’994 Patent (Ex. 1001), and relevant excerpts of the prosecution history of the ’994 Patent (Ex.

1004). I have also reviewed the following references:

- Ex. 1006 - U.S. Patent Publication No. 2013/0101874 (“Pevear”)
- Ex. 1007 – File History of U.S. Provisional Application No. 61/266,724 (“Pevear Provisional”)
- Ex. 1008 - “World Debut: Starter Battery in Lithium-Ion Technology,” dated November 23, 2009 (“Porsche”) (available at: <https://www.porsche.com/usa/aboutporsche/pressreleases/pag/?id=2009-11-23-02>)
- Ex. 1009 – “Porsche Develops Lighter Lithium Ion Starter Battery for 911 Models; Costs \$3k”, Nate Martinez, Motortrend, dated November 23, 2009 (available at: <https://www.motortrend.com/news/porsche-develops-lighter-lithium-ion-starter-battery-for-911-models-costs-3k-5985/>)
- Ex. 1010 – “Porsche Offers New Lightweight Lithium-Ion Battery in 911, Boxster Models “, Steve Diehlman, Motortrend, dated November 24, 2009 (available at: <https://www.motortrend.com/news/porsche-offers-new-lightweight-lithiumion-battery-in-911-boxster-models-1962/>)
- Ex. 1011 - U.S. Patent Publication No. 2007/0145944 (“Poff”)
- Ex. 1012 - U.S. Patent Publication No. 2007/0080662 (“Wu”)
- Ex. 1013 - U.S. Patent Publication No. 2003/0169021 (“Kashine”)
- Ex. 1014 - U.S. Patent Publication No. 2004/0096745 (“Shibano”)

- Ex. 1015 – Declaration of June Ann Munford

4. I have also reviewed various supporting references and other documentation as further noted in my opinions below.

5. Counsel has informed me that I should consider these materials through the lens of one of ordinary skill in the art related to the '994 Patent at the time of the earliest possible priority date of the '994 Patent, and I have done so during my review of these materials. Independent claim 1 recites “a 12 volt to 120 volt operating system” and “a battery pack housing having at least a first portion and a mating second portion.” Independent claim 14 recites “a 1 volt to 120 volt operating system” and “a battery pack housing having at least first and second mating portions.” U.S. Provisional Application No. 61/458,657 (the '657 Provisional), however, fails to disclose numerous claim limitations recited in independent claims 1 and 14 of the '994 Patent, including, for example, the plurality of pairs of solid state switches, the parallel configuration of the pairs, and the connection of drains or sources for switches of each pair. Ex. 1004, pp. 141-163. U.S. Provisional Application No. 61/463,736 (the '736 Provisional) fails to disclose the voltages other than 12 volts in the “12 volt to 120 volt” operating system voltage range. Ex. 1004, pp. 168-186. The '736 Provisional further fails to disclose the “battery pack housing having at least a first portion and a mating second portion” (claim 1) and the “battery pack housing having at least first and second mating portions” (claim 14). The '994

patent claims the benefit of priority to a PCT application filed November 28, 2011 (“the Critical Date”). Counsel has informed me that the Critical Date represents the earliest possible priority date to which the challenged claims of ’994 Patent are entitled, and I have therefore used that Critical Date in my analysis below.

6. I have no financial interest in the parties or in the outcome of this proceeding. I am being compensated for my work as an expert on an hourly basis. My compensation is not dependent on the outcome of these proceedings or the content of my opinions.

7. In writing this declaration, I have considered the following: my own knowledge and experience, including my work experience in the fields of electrochemical engineering, battery design, cell manufacturing, and application engineering, my experience in creating and managing organizations devoted to those subjects, and my experience working with other experts in those fields. In addition, I have reviewed and analyzed various publications and patents, in addition to the materials I cite in this declaration.

8. My opinions, as explained below, are based on my education, experience, and expertise in the fields relating to the ’994 Patent. Unless otherwise stated, my testimony below refers to the knowledge of one of ordinary skill in the art as of the Critical Date, or before. Any figures that appear within this document have been prepared with the assistance of Counsel and reflect my understanding of

the '994 Patent and the prior art discussed below.

II. OVERVIEW OF CONCLUSIONS FORMED

9. This declaration explains the conclusions that I have formed based on my analysis. To summarize those conclusions, based upon my knowledge and experience and my review of the prior art publications listed above, I believe that:

- Claims 1, 4-9, and 11-16, and 18-23 are obvious over Pevear, Porsche, and Poff;
- Claim 2 is obvious over Pevear, Porsche, Poff, and Wu;
- Claim 3 is obvious over Pevear, Porsche, Poff, and Kashine; and
- Claims 10 and 17 are obvious over Pevear, Porsche, Poff, and Shibano.

III. LEVEL OF ORDINARY SKILL IN THE ART

10. A person of ordinary skill in the art ("POSITA") on or before November 28, 2011, would have a minimum of a Bachelor of Science degree in electrical engineering or an equivalent degree, such as chemical engineering or other related engineering, and two or more years of engineering experience in the design of rechargeable Lithium-ion batteries as well as at least some experience in the design of battery management systems for such batteries. An advanced degree in electrical engineering or an equivalent field of study, such as a master's or doctorate, may be substituted for the required experience. Further education could also suffice in lieu of experience in the field or further experience in the field could substitute for formal education. A POSITA is presumed to have knowledge of all relevant prior

art, and would thus have been familiar with each of the references cited herein, as well as the background knowledge in the art, and the full range of teachings they contain.

11. Based on my experience, I have an excellent understanding of the capabilities of one of ordinary skill relevant to this discussion. I have the capabilities of a POSITA at least because I have a master's degree in chemical and materials engineering and at the time of the invention had more than thirty years' experience in the battery industry including more than fifteen years working on the design and development of BMSs. In addition, I have hired, trained, and managed many such persons over the course of my career.

IV. THE '994 PATENT

A. Overview

12. The '994 Patent, relating to secondary lithium ion cells or batteries, discloses a common battery housing containing cells with positive and negative ends connected in series within the housing, and the housing having positive and negative terminals. The '994 Patent purports to disclose that solid state devices with connected sources or drains "allows current to flow in one direction but not the other with an internal diode" is unique. Ex. 1001, 2:46-47. The '994 Patent further purports to disclose that "solid state switches in parallel" used "to increase the

current capabilities” are also unique. Ex. 1001, 9:2-3.

13. Despite this purported discovery, though, the claims of the '994 Patent merely recite what was already well known in the art: a lithium ion battery assembly with a battery protection circuit that used standard components assembled using well established concepts to provide battery protection in a conventional design. Although the '994 Patent appears to assert that this combination leads to unexpected performance characteristics, the examples provided in the Patent merely describe designs that were common in the Li battery industry and would provide entirely predictable performance. A significant body of prior art not only describes the designs detailed in the patent, but also describes improvements to the '994 concepts, as those designs were so common that any real innovation was focused on addressing issues with those standard approaches. By the time this patent was filed, the industry had leapfrogged these outmoded concepts and was working on the type of refinements covered by the prior art discussed in this declaration.

V. PRIOR ART ANALYSIS

A. [GROUND 1] - Claims 1, 4-9, 11-16, and 18-23 are obvious over Pevear in view of Porsche and Poff

1. *Overview of Pevear*

14. Pevear is a National Phase Entry of PCT Application No. PCT/US10/59127, filed December 6, 2010, and claims priority to U.S. Provisional

Application No. 61/266,724, filed December 4, 2009 (“the Pevear Provisional;” Ex. 1007: pp. 4-18 and 23-74).

15. It is my opinion that the chart below explains where disclosure for each claim of Pevear finds sufficient support in the Pevear Provisional.

Pevear Claim Element	Pevear Provisional Support (Ex. 1007)
1. A battery system comprising:	Ex. 1007: p. 5, ¶[0012]: “An automotive battery consists of [...]”
a battery housing with first and second voltage output terminals;	Ex. 1007: p. 6, ¶[0013]: “FIG. 1 shows an automotive battery 100 with a outer case 110, a negative terminal 102 and a positive terminal 104, and a LIN (Local Interconnect Network) management interface 106. Case 110 is molded, and lead-free terminals 102 and 104 are insert-molded in place into the case. The case consists of a top cover that includes the terminals, and an enclosure base.”
a plurality of rechargeable battery cells within the battery housing and having first and second voltage terminals;	Ex. 1007: p.4, ¶[0003]: “A rechargeable battery may be used in terrain, marine, or aeronautic vehicles in various applications. One application is as a starter battery to drive the starter motor of the vehicle. Starter battery applications may require high electrical currents to drive the starter motor, and the ability to be recharged from the vehicle's alternator. Most current

	automotive starter batteries are of lead acid construction. However, lithium-ion (Li-Ion) batteries may be used instead of lead acid batteries. Li-Ion batteries can provide improved power-to-weight ratios, longer cycle lives, and environmental benefits due to the lack of lead.” Ex. 1007: p. 5, ¶[0012]: “[...]an assembly of cell subassemblies, each containing prismatic Li-Ion battery cells, where the cells are electrically connected to the other cells in the module to form the battery.”
a power management system for generating an external control signal and an internal control signal based upon monitored operating parameters of the plurality of rechargeable battery cells, said external control signal for controlling an external power source and/or an external load, said power management system forming an integral part of the battery system; and	Ex. 1007: p. 5, ¶[0012]: “The battery has an integrated power management system that provides passive (through control of components external to the battery) and active (through internal controls) protection against over-charge, over-discharge, over-temperature, and over-current.” Ex. 1007: p. 8, ¶[0020]: “Power management system 400 communicates directly or indirectly to the automobile's alternator to passively control the amount of charge current to the battery. In this manner, the battery pack is able to optimize the amount of current flow to passively control the battery's state of charge. This is accomplished by the power management system internally

	monitoring the voltage, current, temperature, and other relevant parameters of the system. Microprocessor 402 processes this information to determine appropriate charging parameters, and then communicates to and/or controls the alternator to increase or decrease the amount of charge current into the battery pack.” Ex. 1007: p. 8, ¶[0021]: “Power management system 400 communicates with the automobile's body/load controller to control the amount of discharge current to passively control the battery's state of charge. In this manner, the battery pack is able to optimize the amount of current flow to passively control the battery's state of charge. This is also accomplished by the power management system internally monitoring the voltage, current, temperature, and other relevant parameters of the system.” Ex. 1007: p. 9, ¶[0022]: “In addition to the above passive control of the battery's state by controlling the battery's external power sources and loads, power management system 400 also detects and actively prevents excessive current flow through the battery, in order to actively control the state of charge of the battery. Microprocessor 402 internally monitors the voltage, current,
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	temperature, and other relevant parameters of the system. Microprocessor 402 uses this information to control a very high power cutoff switch (described below) to actively control the flow of current through the battery pack.”
a cutoff switch circuit within the battery housing and for making and breaking a conductive path between the first voltage terminal of the plurality of battery cells and the first voltage output terminal of the battery housing in response the internal control signal from the battery management system.	Ex. 1007: p. 9, ¶[0023]: “As part of performing the above functions, the microprocessor 402 is configured to control and monitor a cutoff component 322 that can be used to selectively connect or disconnect the battery from the load(s) connected to its terminals. Cutoff component 322 provides over- voltage, under-voltage, over-current and over-temperature protection. The cutoff component 322 is effectively a bi-directional switch that can be used to control whether the cells in battery cell assembly 320 are electrically connected to the terminals for charging, and separately control this connection for discharging. The cutoff component may also be configured to be a uni-directional switch, used only to control battery charging.
2. The battery system of claim 1, wherein the battery cells are lithium ion cells.	Ex. 1007: p. 5, ¶[0012]: “An automotive battery consists of an assembly of cell subassemblies, each containing prismatic Li-Ion battery cells, where the cells are electrically connected to the other cells in the module to form the battery.”
3. The battery system of claim 1, wherein the cutoff switch comprises a	Ex. 1007: p. 9, ¶[0024]: “Cutoff component 322 includes two groups of

plurality of metal-oxide semiconductor field effect transistors (MOSFETs).	parallel MOSFET devices, each of which the power management system 400 operates as a single, uni-directional switch to selectively allow or disallow current flow to the battery depending on whether the MOSFETs are switched to an ON or OFF state.”
4. The battery system of claim 3, wherein the plurality of MOSFETs are arranged as groups of parallel MOSFETs.	Ex. 1007: p. 10, ¶[0025] and p. 16, FIG. 4: “Each MOSFET is electrically connected in parallel with the other MOSFETS within its group, with its drain and source terminals oriented so that when the MOSFET is in an ON state, current is allowed to flow to charge/discharge the battery. The gate terminals of each MOSFET in a group are connected together to effect a single switching control. The two groups of parallel MOSFETs are electrically connected in series with each other and in series with the battery cells within the battery.”
5. The battery system of claim 3, wherein the plurality of MOSFETs include a first group of MOSFETs connected in parallel with each other and a second group of MOSFETs connected in parallel with each other and wherein the first group is connected in series with the second group.	Ex. 1007: p. 10, ¶[0025] and p. 16, FIG. 4: “Each MOSFET is electrically connected in parallel with the other MOSFETS within its group, with its drain and source terminals oriented so that when the MOSFET is in an ON state, current is allowed to flow to charge/discharge the battery. The gate terminals of each MOSFET in a group are connected together to effect a single switching control. The two groups of parallel MOSFETs are electrically connected in series with each other and in series with the battery cells within the battery.”

6. The battery system of claim 3, further comprising a busbar in electrical communication with the plurality of rechargeable battery cells and the plurality of MOSFETs.	Ex. 1007: p. 6, ¶[0014] and p. 14, FIG. 2: “The individual battery cells are electrically connected in parallel and/or series by busbars (described in the Related Application) which connect the cells to one another and to the terminals of the battery. One such busbar 208 is shown in FIG. 2 connecting one respective terminal of each of four different battery cells together. Busbar 208 also connects the four terminals to positive terminal 104.” Ex. 1007: p. 12, ¶[0033] and p. 18, FIG. 6: “The MOSFET devices are chosen in part so that the drain and source terminals are on opposite sides of the device, with each attached to a respective one of the conductors of the busbar 610 or 612.”
7. The battery system of claim 3, further comprising a shunt resistor in electrical communication with the plurality of MOSFETs.	Ex. 1007: p. 10, ¶[0027] and p. 16, FIG. 4: “Cutoff component 322 can provide an indication of the current flow through the component (and thus of the current through the battery) in one of two ways. First, the voltage across a shunt resistor 436 of known resistance can be used to provide a voltage signal proportional to the current, as is shown in FIG. 4.”
8. The battery system of claim 3, further comprising a temperature sensor in thermal communication with the MOSFETs.	Ex. 1007: p. 10, ¶[0028]: “This is accomplished by using temperature measuring devices 438 packaged in close thermal proximity to the MOSFET devices, which are

	themselves packaged in close thermal proximity to each other.”
9. The battery system of claim 1, wherein the battery is an automotive battery.	Ex. 1007: p. 4, ¶[0002]: “The present invention relates to automotive batteries and scalable architectures for manufacturing automotive batteries.”
10. The method of claim 9, wherein the external power source comprises an alternator.	Ex. 1007: p. 8, ¶[0020]: “Power management system 400 communicates directly or indirectly to the automobile's alternator to passively control the amount of charge current to the battery.”
11. The battery system of claim 1, wherein the battery is a telecommunications battery.	Ex. 1007: p. 12, ¶[0034]: “The cutoff component and/or power management system may also be used separately from the battery. Systems of multiple batteries that use just a single series cutoff component and/or power management system may also be used, for example, in telecom applications.”
12. A method for operating a battery system comprising:	Ex. 1007: p. 5, ¶[0012]: “The battery has an integrated power management system that provides passive (through control of components external to the battery) and active (through internal controls) protection against over-charge, over-discharge, over-temperature, and over-current. The battery also includes a scalable battery cutoff component controlled by the power management system.”
monitoring operating parameters of a plurality of rechargeable battery cells within a battery housing;	Ex. 1007: p. 8, ¶[0020]: “This is accomplished by the power management system internally

	monitoring the voltage, current, temperature, and other relevant parameters of the system.” Ex. 1007: p. 8-9, ¶ [0021]: “This is also accomplished by the power management system internally monitoring the voltage, current, temperature, and other relevant parameters of the system.” Ex. 1007: p. 9, ¶[0022]: “Microprocessor 402 internally monitors the voltage, current, temperature, and other relevant parameters of the system.”
generating an external control signal and an internal control signal based upon the monitored operating parameters of a plurality of rechargeable battery cells, said external control signal for controlling an external power source and/or an external load; and	Ex. 1007: p. 5, ¶[0012]: “The battery has an integrated power management system that provides passive (through control of components external to the battery) and active (through internal controls) protection against over-charge, over-discharge, over-temperature, and over-current.” Ex. 1007: p. 8, ¶[0020]: “Power management system 400 communicates directly or indirectly to the automobile's alternator to passively control the amount of charge current to the battery. In this manner, the battery pack is able to optimize the amount of current flow to passively control the battery's state of charge. This is accomplished by the power management system internally

	monitoring the voltage, current, temperature, and other relevant parameters of the system. Microprocessor 402 processes this information to determine appropriate charging parameters, and then communicates to and/or controls the alternator to increase or decrease the amount of charge current into the battery pack.” Ex. 1007: p. 8-9, ¶[0021]: “Power management system 400 communicates with the automobile's body/load controller to control the amount of discharge current to passively control the battery's state of charge. In this manner, the battery pack is able to optimize the amount of current flow to passively control the battery's state of charge. This is also accomplished by the power management system internally monitoring the voltage, current, temperature, and other relevant parameters of the system.”
making or breaking a conductive path between the first voltage terminal of the plurality of battery cells and the first voltage output terminal of the battery housing in response to the internal control signal.	Ex. 1007: p. 9, ¶[0022]: “In addition to the above passive control of the battery's state by controlling the battery's external power sources and loads, power management system 400 also detects and actively prevents excessive current flow through the battery, in order to actively control the state of charge of the battery. Microprocessor 402 internally monitors the voltage, current, temperature, and other relevant

	parameters of the system. Microprocessor 402 uses this information to control a very high power cutoff switch (described below) to actively control the flow of current through the battery pack.”
13. The method for operating a battery system of claim 12, wherein the operating parameters comprise voltage across a shunt resistor within the battery housing.	Ex. 1007: p. 10, ¶[0027]: “Cutoff component 322 can provide an indication of the current flow through the component (and thus of the current through the battery) in one of two ways. First, the voltage across a shunt resistor 436 of known resistance can be used to provide a voltage signal proportional to the current, as is shown in FIG. 4.”
14. The method for operating a battery system of claim 12, wherein the operating parameters comprise temperature and voltage across a plurality of metal-oxide semiconductor field effect transistors (MOSFETs) within the battery housing.	Ex. 1007: p. 10, ¶[0028]: “Second, the current may be measured by determining the voltage across the drain-source resistance in the MOSFET's ON state ($R_{DS(on)}$) using a temperature-compensated resistance measurement. This is accomplished by using temperature measuring devices 438 packaged in close thermal proximity to the MOSFET devices, which are themselves packaged in close thermal proximity to each other.” Ex. 1007: p. 10, ¶[0029]: “Specifically, power management system 400 uses the measured temperature to determine a temperature-calibrated $R_{DS(on)}$, which is the used to convert the voltage measured across the drain-source terminals into a current without the need for a relatively expensive precision current sensor.”

15. The method for operating a battery system of claim 12, wherein the making or breaking a conductive path comprises activating a cutoff switch comprising a plurality of metal-oxide semiconductor field effect transistors (MOSFETs).	Ex. 1007: p. 9, ¶[0024]: “Cutoff component 322 includes two groups of parallel MOSFET devices, each of which the power management system 400 operates as a single, uni-directional switch to selectively allow or disallow current flow to the battery depending on whether the MOSFETs are switched to an ON or OFF state. One MOSFET group controls whether current can flow in a direction that charges the battery, and the second group controls whether current can flow in a direction that discharges the battery.”
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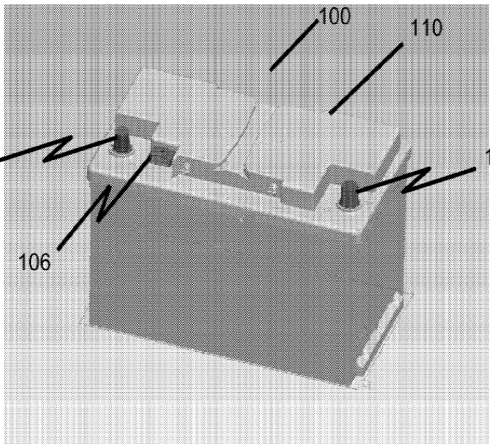
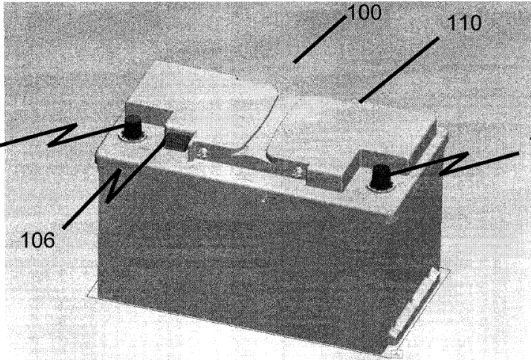
16. Pevear discloses a battery with an integrated power management system and a scalable cutoff component. Ex. 1006: Abstract; Ex. 1007: p. 1, Title. Pevear discloses that the battery may be an automotive battery. Ex. 1006: claim 9; Ex. 1007: p. 1, Title. Pevear specifically discloses rechargeable batteries which may be used as starter batteries to drive the starter motor of the vehicle. Ex. 1006: ¶[0004]; Ex. 1007: p. 4, ¶[0003]. The batteries may be lithium ion batteries which can be used instead of lead acid batteries and provide improved power-to-weight ratios, longer cycle lives, and environmental benefits due to the lack of lead. Ex. 1006: ¶[0004]; Ex. 1007: p. 4, ¶[0003].

17. The battery includes an outer case (110) having a top cover and an enclosure based, with terminals (102, 104) insert-molded in place on the top cover

of the case. Ex. 1006: ¶[0019] and FIG. 1; Ex. 1007: p. 6, ¶[0013] and p. 13, FIG. 1.

18. The drawings from Pevear and the Pevear Provisional are reproduced below. For ease of reading, the Pevear figures, which were elongated in the vertical direction, have been copied here with a corrected aspect ratio to diminish the distortion. The Pevear figures in their original aspect ratio are shown in Ex. 1006.

19.

Pevear's FIG. 1:	Pevear Provisional's FIG. 1:
FIG. 1 	FIG. 1 

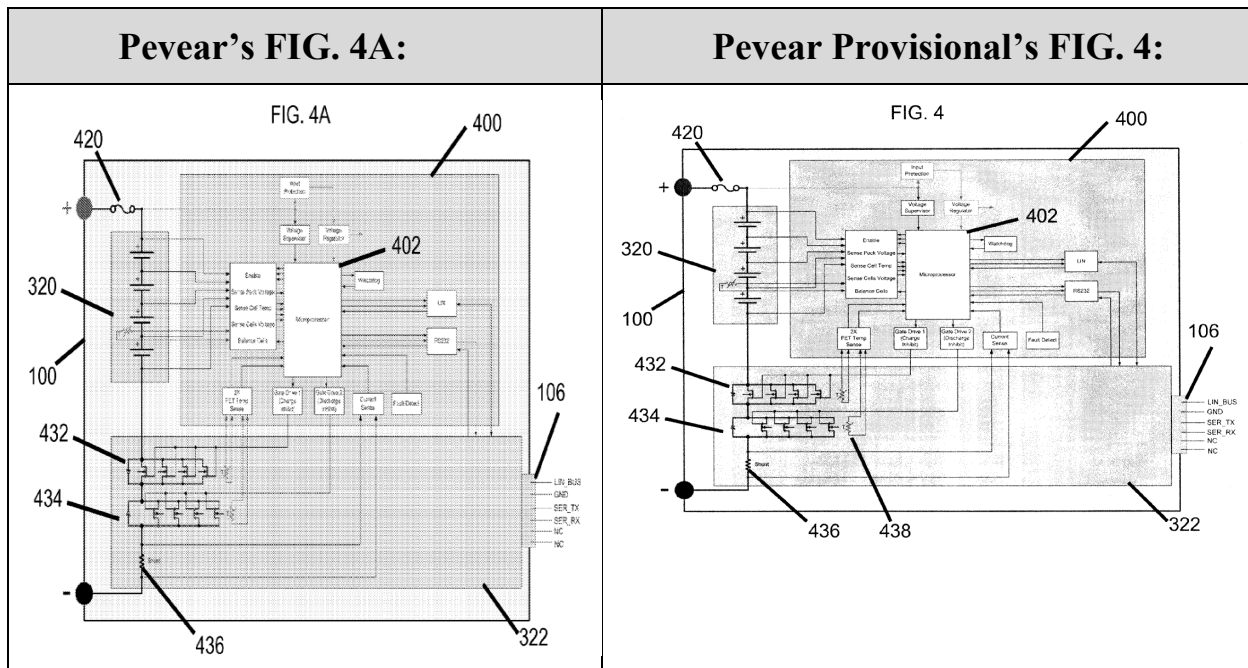
20. The power management system is configured to sense individual battery cell voltages and to balance the voltages of each cell by controlling each cell's connection to small resistive loads placed in parallel with each cell. Ex. 1006: ¶[0031]; Ex. 1007: p. 7-8 [0019]. The power management system includes a microprocessor configured to control and monitor a cutoff component that can be

used to selectively connect or disconnect the battery from the load(s) connected to its terminals. Ex. 1006: ¶[0039]; Ex. 1007: p. 9, [0023]. The cutoff component can effectively be a bidirectional switch that can be used to control charging and discharging separately and which provides over-voltage, under-voltage, over-current, and over-temperature protection for the battery system. Ex. 1006: ¶[0039]; Ex. 1007: p. 9, [0023].

21. The cutoff component includes two groups of parallel arranged MOSFET devices (432, 434) connected in series. Ex. 1006: ¶[0040] and FIG. 4A; Ex. 1007: p. 9, [0024] and p. 16, FIG. 4.

22. The drawings from Pevear and the Pevear Provisional are reproduced below.

23.



24. Paragraph [0040] of Pevear is reproduced below:

[0040] As shown in FIG. 4A, cutoff component 322 includes two groups of parallel arranged MOSFET devices 432 and 434 connected in series. Power management system 400 operates each group to selectively allow or disallow current flow to or from the battery, depending on whether the MOSFETs are switched to an On or Off state. Because the MOSFET groups 432, 434 are arranged in series, the MOSFETs, one MOSFET group controls whether current can flow in a direction that charges the battery, and the second group controls whether current can flow in a direction that discharges the battery. Therefore, the series arrangement of the two groups creates a bi-directional switch. The parallel arrangement of the MOSFETs

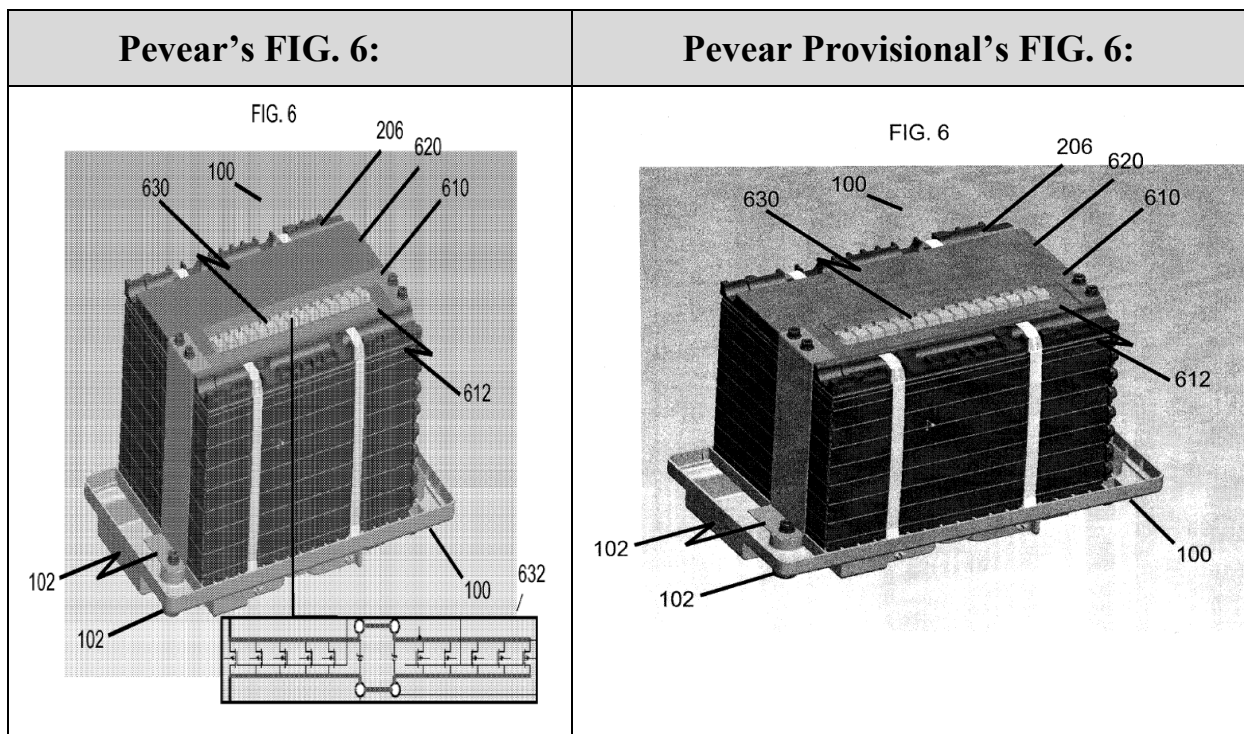
within each group splits the current flow across the MOSFETs, allowing the use of MOSFETs with lower current-carrying ratings than the maximum currents expected for charging and discharging of the battery. Ex. 1006: ¶[0040]; Ex. 1007: p. 9, [0024].

25. Pevear discloses an embodiment with the two groups of MOSFETs (432, 434) connected in series with each other and in series with the cells (320) between the negative terminal (-) of the battery pack and the positive terminal (+) of the battery pack. Ex. 1006: FIG. 4A; Ex. 1007: p. 16, FIG. 4.

26. The MOSFETs (630) may be positioned on a printed circuit board (620) within the case/housing. Ex. 1006: ¶[0053] and FIG. 6; Ex. 1007: pp. 12-13, ¶[0033] and p. 18, FIG. 6.

27. The drawings from Pevear and the Pevear Provisional are reproduced below.

28.



29. Pevear further discloses that the microprocessor processes parameters of the system, such as monitored voltage, current, temperature, etc. to determine appropriate charging parameters and controls the load controller to increase or decrease the discharge current from the battery by selectively connecting or disconnecting loads to/from the battery. Ex. 1006: ¶[0037]; Ex. 1007: p. 8-9, ¶[0021].

30. Pevear also discloses monitoring voltage, current, temperature, and other relevant parameters and using this information to control a power cutoff switch to actively control the flow of current through the battery pack. Ex. 1006: ¶[0038]; Ex. 1007: p. 9, ¶[0022].

2. *Overview of Porsche*

31. Porsche (Ex. 1008) is a press release published and available to the public at large through Porsche's website at least as early as on September 14, 2010. Ex. 1015, ¶¶ 5-8. Thus, I have been informed and understand that Porsche is prior art under at least pre-AIA 35 U.S.C. § 102(b). Two articles from motortrend.com dated November 23, 2009 (Ex. 1009) and November 24, 2009 (Ex. 1010) further corroborate the dissemination of the Porsche reference at least as early as September 14, 2010. A POSITA interested in the lithium ion battery art would have looked to websites of manufacturers using lithium ion batteries (such as Porsche's) to obtain information on the current state of the art, including downloading press releases for commercially available products. Porsche discloses a lithium-ion starter battery weighing 22 pounds less than a conventional lead battery. Ex. 1008: p. 1. The battery has a nominal capacity of 18 Ah. Ex. 1008: p. 1. An advantage of the lithium-ion battery is that it allows a significantly greater number of charging and discharging cycles. Ex. 1008: p. 2. The battery is a lithium-iron-phosphate battery and "consistently guarantees the usual voltage of 12 V in the car's on-board network." Ex. 1008, p. 2. The battery is made up of four cells and integrated control electronics including a battery management system that protects from major discharge and guarantees a consistent charge level within the individual cells. Ex. 1008, p. 2.

3. *Overview of Poff*

32. Poff discloses an enhanced battery pack having an enhanced

protection system. Ex. 1011: Abstract. The enhanced protection system includes a conventional protection circuit and a redundant protection circuit, which are connected in parallel. When an undesirable condition (e.g., overcharge of one of the lithium ion cells) occurs, the conventional protection circuit prevents electrical current from flowing to protect the lithium ion cells and any external devices connected to the battery pack. Ex. 1011: ¶ [0009]. However, this conventional protection system may undesirably detract from the effectiveness of the battery pack when there is a fault in one of the components of the conventional protection system instead of an undesirable internal or external condition that would potentially harm the lithium ion cell(s) or an external device connected to the battery pack. Ex. 1011: ¶ [0011]. Advantageously, the inclusion of the redundant protection circuit allows the battery pack to continue functioning when there is a fault in the conventional protection system but no unsafe internal or external condition. Ex. 1011: ¶ [0017]. “Likewise, if the redundant protection circuit becomes inoperable due to one or more of the components of the redundant protection circuit being faulty, the conventional protection circuit 20 can be used as a backup so that the enhanced battery pack will continue to function while the enhanced protection system continues to protect the enhanced battery pack.” Ex. 1011: ¶ [0017]. The circuit as depicted in FIG. 4 of Poff will cut the current on each parallel leg in half.

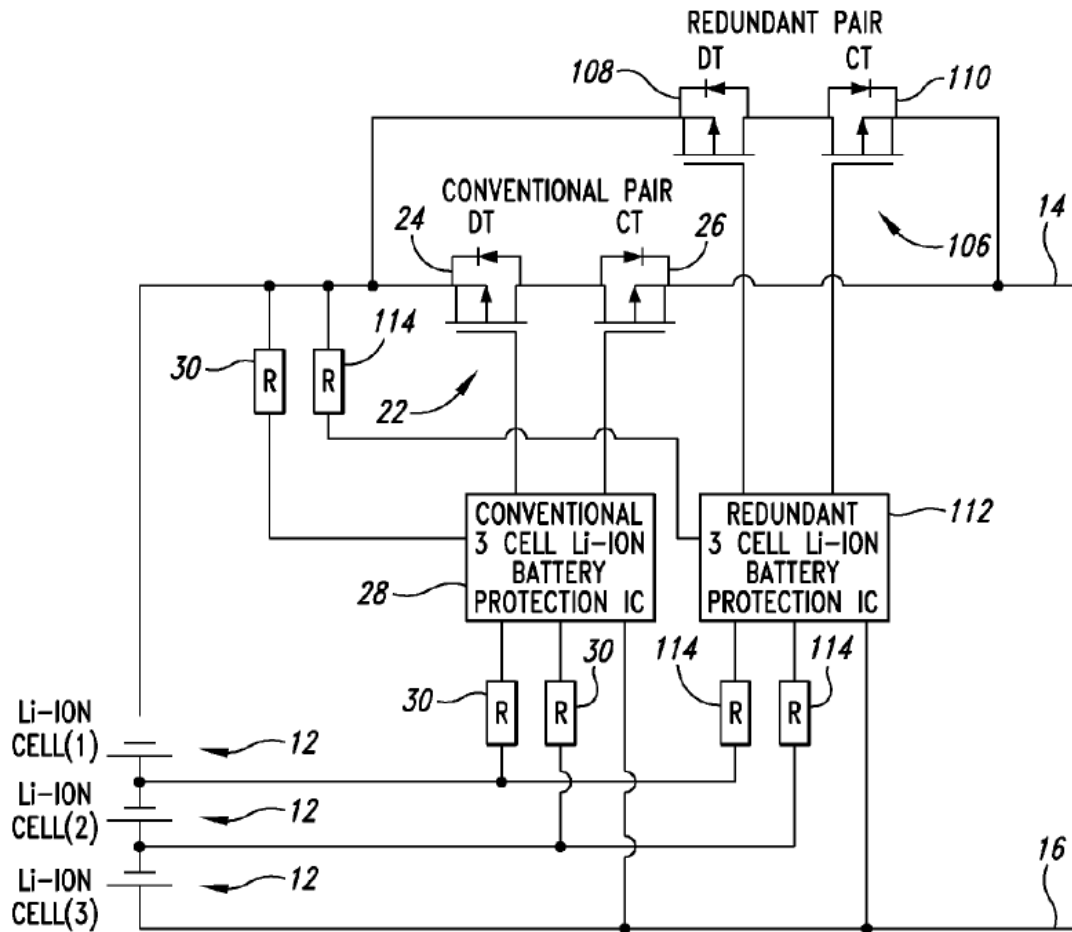


Fig. 4

4. The combination of Pevear, Porsche, and Poff and reasons for the combination

33. A POSITA would have been motivated to use Porsche's lithium-iron-phosphate cells as the lithium ion cells in modified Pevear for at least the following reasons.

34. First, both references deal with automotive batteries with battery management systems and specifically disclose the weight reduction advantages of lithium ion cells. Second, Porsche discloses lithium-iron-phosphate as a known lithium ion cell material for automotive batteries and using a known material for its known purpose to obtain predictable results is obvious. Third, both references disclose batteries with exactly four lithium ion cells in series. Fourth, using Porsche's lithium-iron-phosphate cells would be suitable for a conventional 12 V operating system in the car's on-board network.

35. A POSITA would have been motivated to replace Pevear's cutoff circuitry with Poff's cutoff circuitry having parallel pairs of solid state switches with the two switches in each pair having connected sources or drains for at least the following reasons.

36. First, the cutoff functions of both references utilize field effect transistors which enable independent or bidirectional control of charging and discharging in connection with lithium ion batteries. Second, both references disclose cutoff functions. The modification involving replacing Pevear's cutoff function/circuitry with that of Poff would constitute a simple substitution of one known element for another known element to obtain predictable results and would use a known technique to modify similar devices. Third, there are a finite number of

known solutions for voltage based bidirectional switch and it would have been obvious to try Poff's solution, with a reasonable expectation of success.

5. *Analysis*

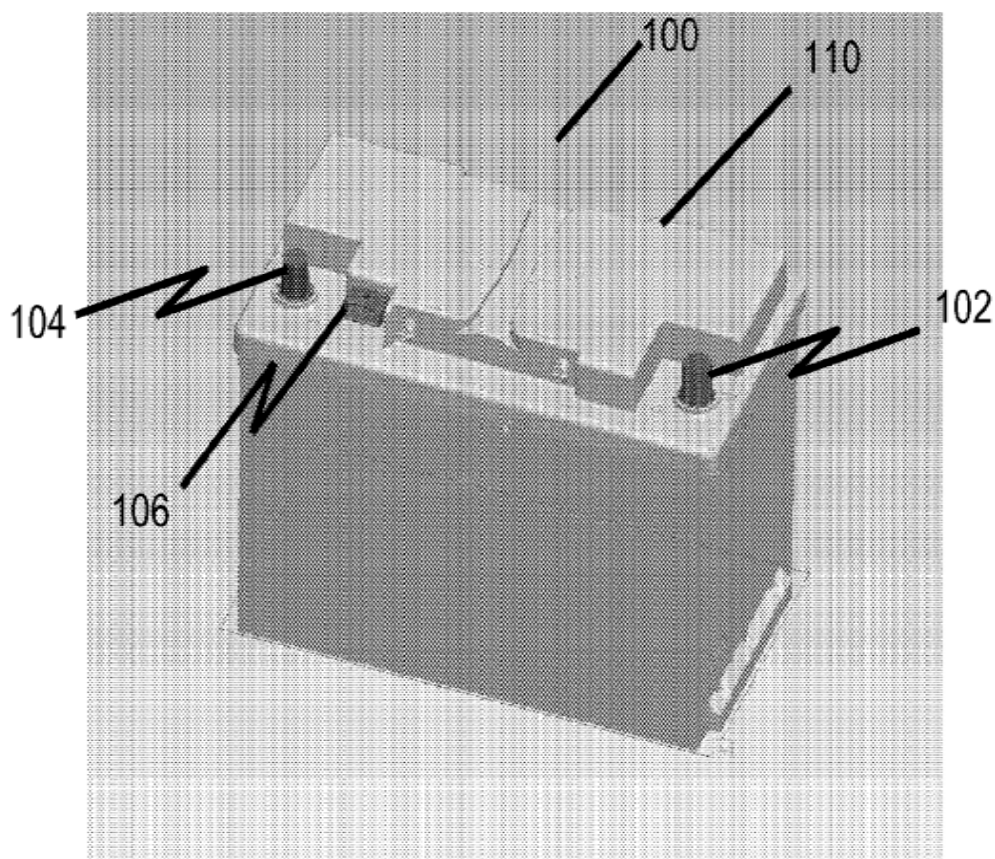
(i) Claim 1

[1pre]: A battery pack for driving an electrical device in a 12 volt to 120 volt operating system, said battery pack having a positive terminal and a negative terminal, comprising

37. The Pevear-Porsche-Poff combination renders obvious a battery pack for driving an electrical device in a 12 volt to 120 volt operating system, said battery pack having a positive terminal and a negative terminal, for the following reasons.

38. First, Pevear discloses an automotive battery (100) having a positive terminal (104) and a negative terminal (102) insert molded on an outer case (110).
Ex. 1006: ¶[0019] and FIG. 1.

FIG. 1



39. Additionally, Pevear discloses that the battery may be used as a starter battery to drive the starter motor of the vehicle. Ex. 1006: ¶[0004]. The starter motor is an electrical device and nearly all vehicles using a starter battery and motor are 12 volt devices. Pevear also discloses that a battery is designed for used vehicle operating systems, such as a replacement for lead acid batteries in vehicles, that can be charged from the vehicle's alternator and used to provide power for micro-hybrid (start-stop) drive systems, where 12-volt is the standard voltage. Ex. 1006: ¶[0005].

Pevear also discloses four cells in series, which at standard lithium cell voltages is more than 12 Volts. Ex. 1006: FIG. 4A. To the extent it can be argued that Pevear does not disclose the 12 volt to 120 volt operating system voltage, Porsche discloses a lithium iron phosphate starter battery which “consistently guarantees the usual voltage of 12 V in the car’s on-board network.” Ex. 1008: p. 2. 12 V is a standard operating system voltage for car starter batteries as taught by Porsche and known to a POSITA.

[1a]: a battery pack housing having at least a first portion and a mating second portion;

40. Pevear also refers to the case as a housing. Ex. 1006: claim 1. Pevear discloses that the case consists of a top cover and an enclosure base. Ex. 1006: ¶[0019]. The top cover and the enclosure base are a first portion and a mating second portion. Ex. 1006: FIGS. 1 and 2.

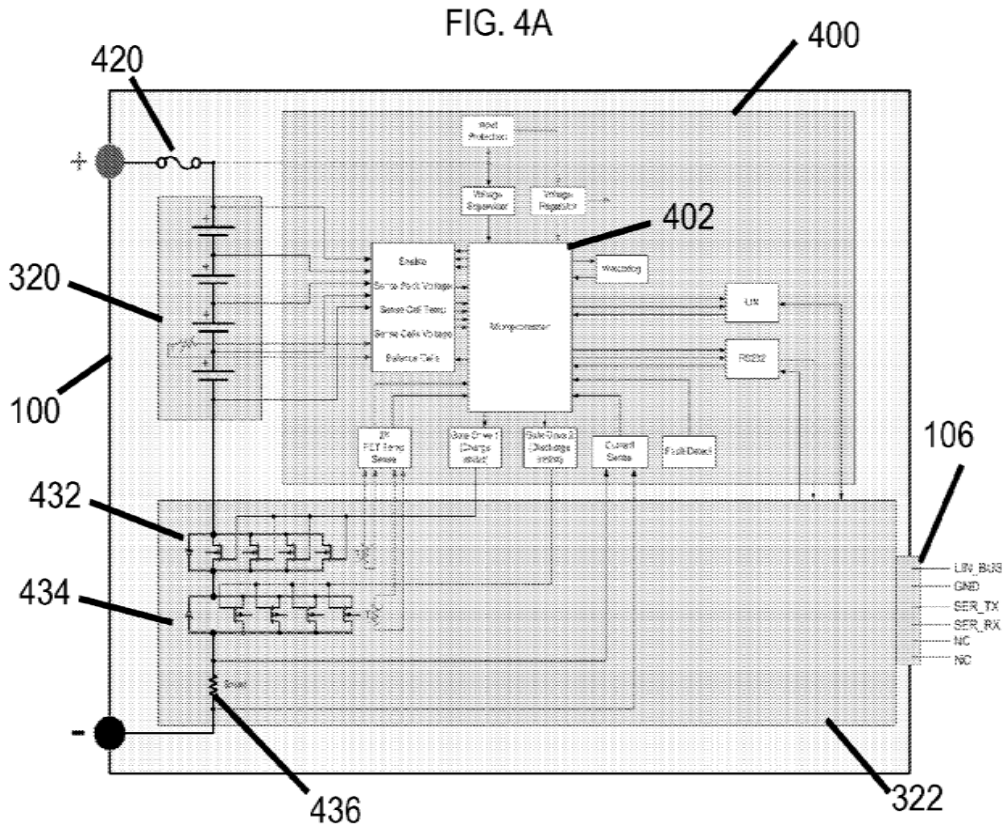
[1b]: at least one lithium-based rechargeable cell within said housing, each such cell having a positive pole and a negative pole;

41. Pevear discloses “a plurality of rechargeable battery cells within the battery housing and having first and second voltage terminals.” Ex. 1006: claim 1. The first and second voltage terminals are positive and negative poles. The cells may be lithium ion cells. Ex. 1006: claim 2

[1c-i]: a circuit board within said housing configured to balance each individual cell within said housing, and having a cutoff function incorporated therein,

42. Pevear discloses an electronic power management system “to maintain balance between individual battery cells.” Ex. 1006: ¶[0022]. The power management system (400) includes a microprocessor (402) and is configured to sense individual battery cell voltages and balance the voltages of each cell. Ex. 1006: ¶¶ [0025], [0030], and [0031] and FIG. 4A. This constitutes balancing each individual cell. The power management system is contained on a circuit board within the housing. Ex. 1006: ¶¶[0024], [0040], [0053], FIG. 4A, Claim 1.

43. The microprocessor (402) is also configured to control and monitor a cutoff component (322) that can be used to selectively connect or disconnect the battery from the load(s) connected to its terminals. Ex. 1006: ¶[0039] and FIG. 4A. This constitutes a cutoff function. The control components can be provided on a printed circuit board or similar substrate. Ex. 1006: ¶[0053].



[1c-ii]: said circuit board including a plurality of pairs of solid state switches with each pair of solid state switches connected in a parallel configuration to another pair of solid state switches,

44. Pevear discloses solid state switches on a circuit board, including a first group of MOSFETs arranged in parallel (432) and a second group of MOSFETs arranged in parallel (434). Ex. 1006: claim 5, ¶¶[0007], [0053], and FIG. 4A. MOSFETs are solid state switches. Pevear uses parallel elements to achieve the reduced current as claimed in the '994 Patent. The first and second groups (432, 434) are in series with each other. Ex. 1006: claim 5, ¶[0007], and FIG. 4A.

45. In the same field, Poff discloses an enhanced protection system for a

battery pack including a conventional protection circuit and a redundant protection circuit. Ex. 1011: Abstract. The protection system may cause an open circuit such that current is not allowed to flow from the battery back when an overvoltage or other undesirable condition occurs “with one or more of the Li ion cells” in the battery pack. Ex. 1011: ¶ [0018]. Stopping current when an undesirable condition occurs is a cutoff function. The conventional protection circuit includes conventional transistor pair (22) having a discharge transistor (24) and a charge transistor (26). Ex. 1011: ¶ [0022]. The redundant protection circuit includes a redundant transistor pair (106) having a discharge transistor (108) and a charge transistor (110). Ex. 1011: ¶ [0023]. The conventional transistor pair (22) and the redundant transistor pair (106) are in parallel in Poff. Ex. 1011: FIG. 4. The transistor pairs are in parallel because the drains and sources of the conventional pair are in parallel with the drains and sources of the redundant pair. As configured, they provide a second current path that can be independently controlled for charge and discharge. The control or gate terminals do not need to be tied together directly - they are tied logically as the controllers will act in concert to control them together. If they were not controlled together, they would not serve the purpose of redundancy. Taking the redundancy all the way back to the controller and the software that determines when the gates are powered does not change the parallel nature of the switches. It does offer a “partial operation” mode if one leg is damaged, or if one controller is not

functioning, and that is the purpose of the redundant controls on top of the redundant power path. Poff provides all the elements of a parallel switch design described in the patent claims and meets the objective of the patent (cutting the current in half on each leg during normal operation). He also gains redundancy in the case of a component failure, and makes the control of the parallel switches redundant all the way back to separate pins on the controller. Redundancy was a further objective of Poff, but not detrimental in any way to the '994 patent's function.

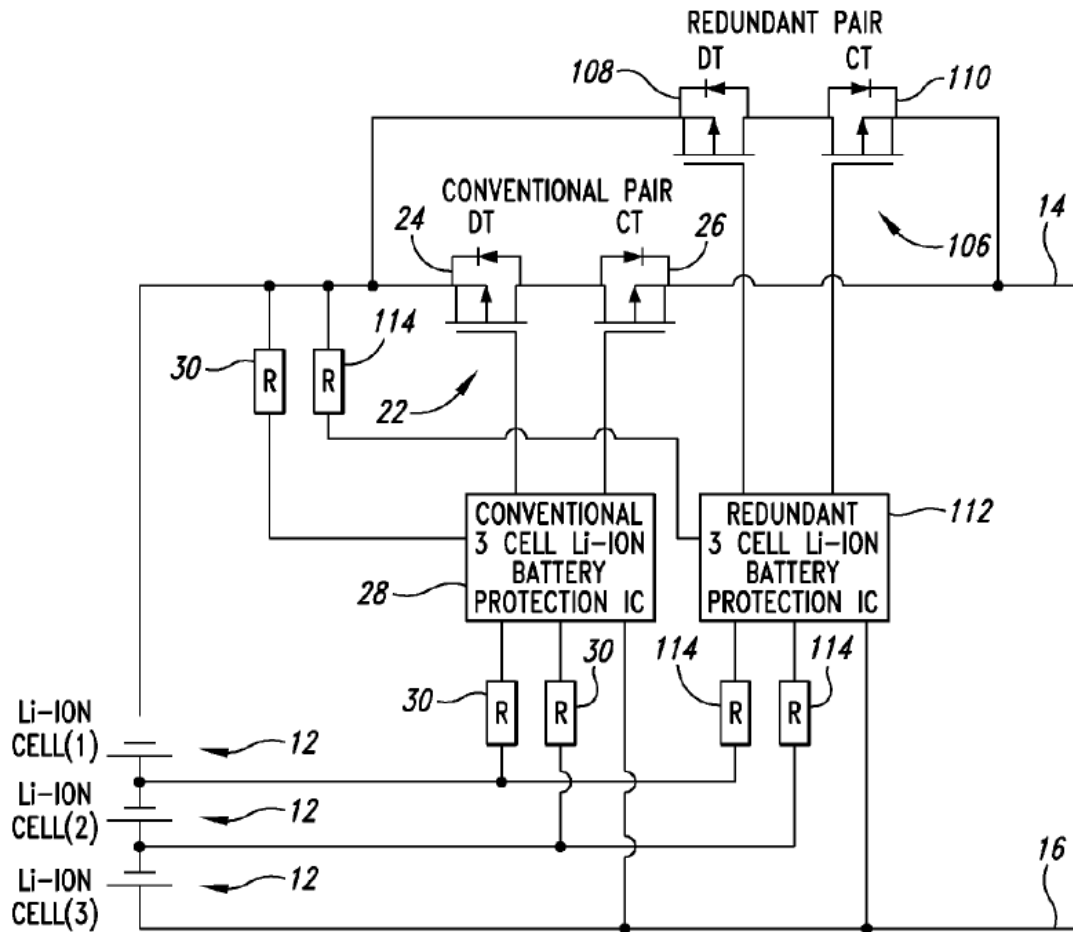


Fig. 4

[1c-iii]: each switch having a source and a drain, the switches of a pair of solid state switches being configured such that either the drains of the switches are connected or the sources of the switches are connected; and

46. For example, in Ex. 1011, Fig. 4, Poff depicts a circuit where both the conventional pair of MOSFETS and the redundant pair of MOSFETS are in the negative leg of the power circuit. This is clear from the diagram illustrating the

connection to the negative side of the battery stack (indicated by the shorter of the paired lines in the battery symbol). Placing the switches in the negative power leg requires the use of N channel MOSFETS. Although not labeled in Fig.4, the three connections to the MOSFETS can be identified. The Gate, or control leg, always connects to the control or protection IC. The Source and Drain can be distinguished by the fact that in an N channel MOSFET, the body diode points to the Drain, and Fig.4 illustrates the body diode pointing away from the connected legs of the paired MOSFETS, so the back to back connection can be identified as the Sources of the switches, meeting the limitation where “either the drains of the switches are connected or the sources of the switches are connected”.

[1d]: said parallel configuration of the plurality of solid state switches being connected in series with said one or more cells between said positive and negative terminals of the battery pack.

47. In Fig. 4, Poff discloses a battery pack circuit that includes multiple lithium-ion cells (12) with a first external (negative) terminal (14) connected to the negative side of the battery stack, indicated by the shorter of the paired lines that depict a power source or battery cell. Ex. 1011. The second external (positive) terminal (16) is similarly connected to the positive side of the stacked battery cells. A single pair of back to back connected MOSFETS would provide both charge and discharge cutoff capability, but Poff adds a second redundant pair of MOSFETS. Parallel pairs (24/26) and (108/110) of MOSFETS are thus placed in a

series between the battery cells negative terminal and the external negative terminal, forming a duplicate path for current to flow between the cells and the external load. By adding this “redundant” pair of transistor switches, Poff provides both a backup current path in the case of a component failure and reduced current (by 50%) in each pair of switches under normal conditions. Ex. 1011: Fig. 4.

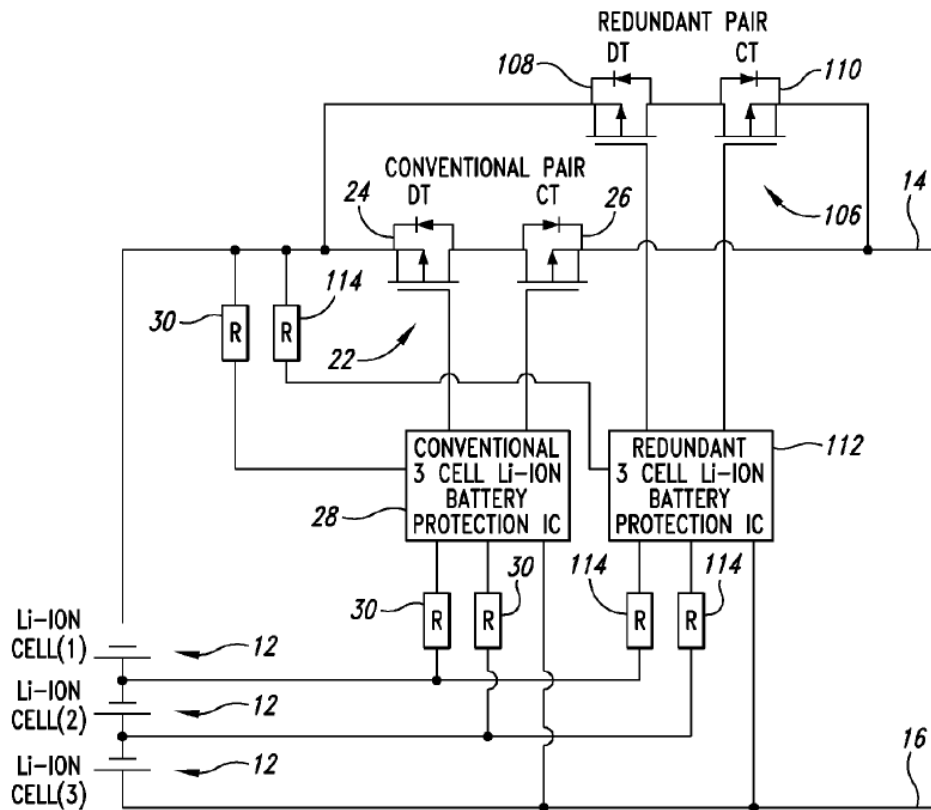


Fig. 4

(ii) Claim 4

[4] The battery pack according to claim 1, wherein said solid state switches are MOSFETs or IGBTs.

48. My analysis of claim 1 applies also to claim 4. Pevear discloses MOSFETs. Ex. 1006: ¶[0007]. Poff also discloses MOSFETs. Ex. 1011: ¶¶[0022]-[0023].

(iii) Claim 5

[5] The battery pack according to claim 1, wherein said solid state switches are transistors, FET, JFET, BJT, CMOS, VMOS, TMOS, vertical DMOS or HEXFET.”

49. My analysis of claim 1 applies also to claim 5. Poff discloses MOSFETs, which are transistors and FETs. Ex. 1011: ¶[0022]-[0023].

(iv) Claim 6

[6] The battery pack according to claim 1, wherein said solid state switches are either n-type or p-type.

50. My analysis of claim 1 also applies to claim 6. Solid state switches, including MOSFETS are inherently either n-type or p-type. When considering Poff’s Fig.4, it is clear that both pairs of switches are in the negative leg of the power circuit. They are in series with the negative pole of the battery cells, indicated by the shorter of the paired parallel lines that depict a battery, and the external connection (14). Poff’s design would therefore utilize n-type transistor switches, meeting the

claim limitation . Ex: 1011: Fig. 4.

(v) Claim 7

[7] The battery pack according to claim 1, wherein said one or more cells are selected from the group consisting of LiFePO , LiFePO_4 , LiFeMgPO_4 , LiFeYPO_4 , LiCoO_2 , LiMn_2O_4 , LiNiCoAlO_2 , LiNiMnCoO_2 , $\text{Li}_4\text{Ti}_5\text{O}_{12}$, lead-acid, NiCd, and nickel metal hydride (NiMH) batteries.

51. My analysis of claim 1 applies also to claim 7. Pevear discloses lithium ion cells but does not specifically disclose any specific lithium ion material. Pevear does disclose that lithium ion batteries can be used instead of lead acid batteries to provide improved power-to-weight ratios. Ex. 1006: ¶[0004]. Pevear also discloses a battery with four lithium ion cells connected in series. Ex. 1006: FIG. 4A. Porsche discloses a lithium ion battery that is 22 pounds lighter than conventional lead batteries. Ex. 1008: p. 1. The battery includes four cells and integrated control electronics. Ex. 1008: p. 2. The cells are made from “lithium-iron-phosphate” and the battery “consistently guarantees the usual voltage of 12 V in the car’s on-board network.” Ex. 1008: p. 2. As used in Porsche, “lithium-iron-phosphate” is LiFePO_4 .

(vi) Claim 8

[8] The battery pack according to claim 1, wherein the lithium-based cell is a lithium iron phosphate cell.

52. My analysis of claim 1 applies also to claim 8. Pevear discloses lithium ion cells but does not specifically disclose any specific lithium ion material. Pevear

does disclose that lithium ion batteries can be used instead of lead acid batteries to provide improved power-to-weight ratios. Ex. 1006: ¶[0004]. Pevear also discloses a battery with four lithium ion cells connected in series. Ex. 1006: FIG. 4A. Porsche discloses a lithium ion battery that is 22 pounds lighter than conventional lead batteries. Ex. 1008: p. 1. The battery includes four cells and integrated control electronics. Ex. 1008: p. 2. The cells are made from “lithium-iron-phosphate” and the battery “consistently guarantees the usual voltage of 12 V in the car’s on-board network.” Ex. 1008: p. 2. As used in Porsche, “lithium-iron-phosphate” is LiFePO_4 .

(vii) Claim 9

[9] The battery pack according to claim 1, wherein the lithium iron phosphate cell is selected from the group consisting of LiFePO , LiFePO_4 , LiFeMgPO_4 , and LiFeYPO_4 cells.

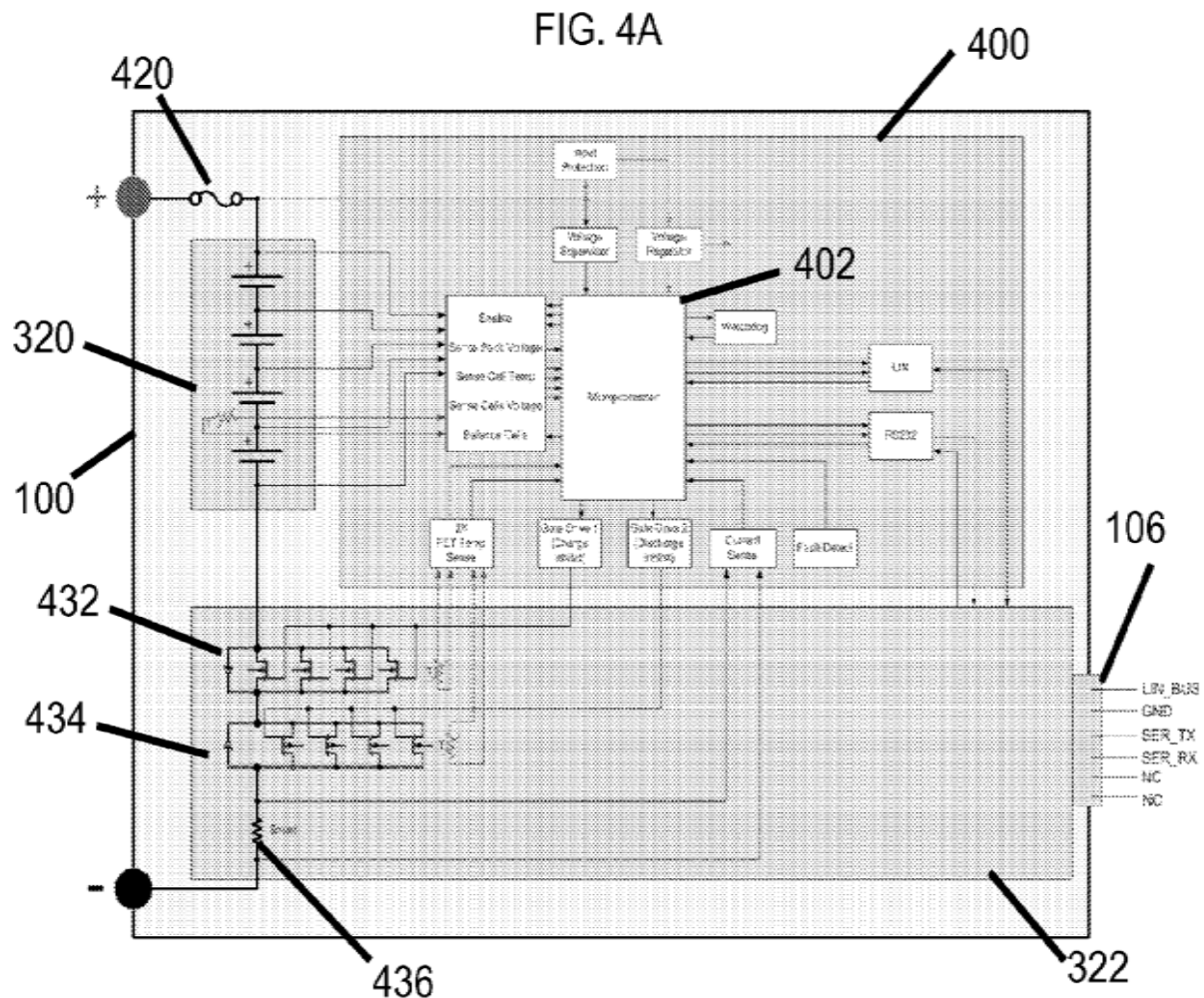
53. My analysis of claim 1 applies also to claim 9. Pevear discloses lithium ion cells but does not specifically disclose any particular lithium ion material. Pevear discloses that lithium ion batteries can be used instead of lead acid batteries to provide improved power-to-weight ratios. Ex. 1006: ¶[0004]. Pevear also discloses a battery with four lithium ion cells connected in series. Ex. 1006: FIG. 4A. Porsche discloses a lithium ion battery that is 22 pounds lighter than conventional lead batteries. Ex. 1008: p. 1. The battery includes four cells and integrated control electronics. Ex. 1008: p. 2. The cells are made from “lithium-iron-phosphate” and the battery “consistently guarantees the usual voltage of 12 V in the car’s on-board

network.” Ex. 1008: p. 2. As used in Porsche, “lithium-iron-phosphate” is LiFePO_4 .

(viii) Claim 11

[11] The battery pack according to claim 1, wherein said battery pack comprises four lithium-based rechargeable cells in series in said housing.

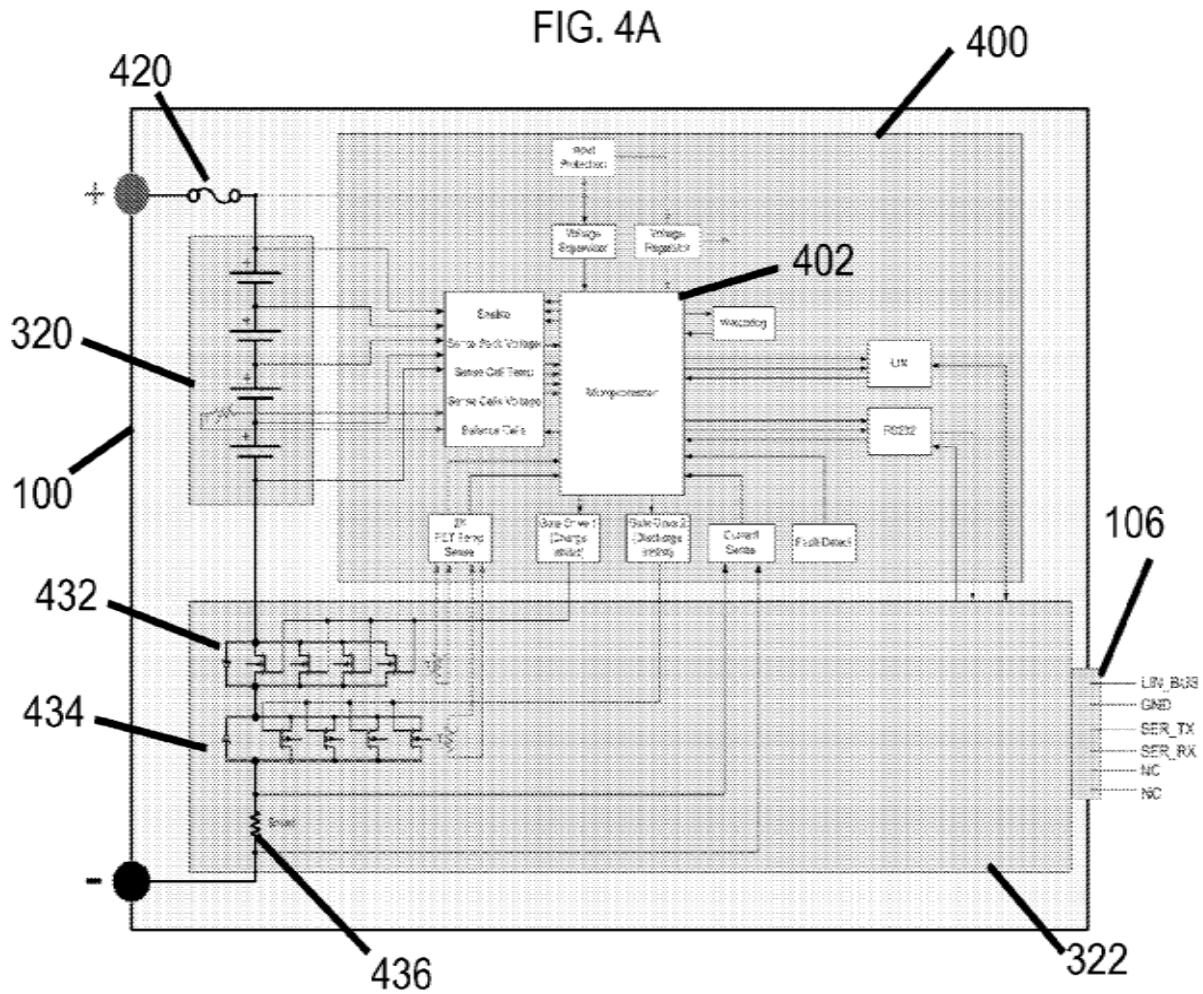
54. My analysis of claim 1 applies also to claim 11. Pevear discloses rechargeable cells within the housing and that the cells are lithium ion cells. Ex. 1006: claims 1 and 2. Pevear further discloses four cells in series in the housing. Ex. 1006: FIG. 4A.



(ix) Claim 12

[12] The battery pack according to claim 1, wherein said battery pack comprises an even number of lithium-based rechargeable cells in said housing.

55. My analysis of claim 1 applies also to claim 12. Pevear discloses rechargeable cells within the housing and that the cells are lithium ion cells. Ex. 1006: claims 1 and 2. Pevear further discloses four cells in series in the housing. Ex. 1006: FIG. 4A.



(x) Claim 13

[13] The battery pack according to claim 1, wherein said circuit board has an associated controller, said controller being adapted to control one of each pair of said solid state switches in parallel separately and independently, whereby said controller has independent control of charging and discharging.

56. My analysis of claim 1 applies also to claim 13. Pevear discloses a microprocessor configured to provide “control of charging, including over-voltage and over-current protection” and “under-voltage protection.” Ex. 1006: ¶¶[0025]-[0027]. Pevear further discloses selectively allowing current to flow to or from the battery and that one set of MOSFETs controls charging and the other set of MOSFETs controls discharging. Ex. 1006: ¶[0040].

57. Although Poff does not expressly use the term “controller,” the protection circuit necessarily includes a controller. Additionally, Poff illustrates separate connections between the integrated circuit and each MOSFET, indicating independent control thereof. Ex. 1011, Fig. 4.

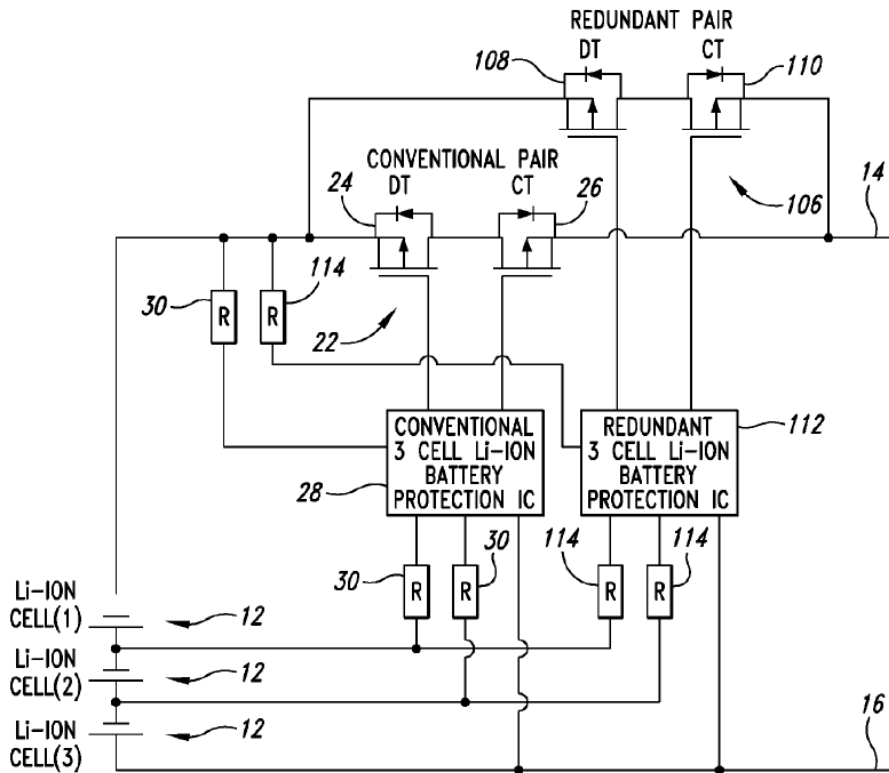


Fig. 4

(xi) Claim 14

[14pre]: A battery pack for driving an electrical device in a 1 volt to 120 volt operating system, said battery pack comprising:

58. The Pevear-Porsche-Poff combination renders obvious a battery pack for driving an electrical device in a 1 volt to 120 volt operating system for the reasons set forth below.

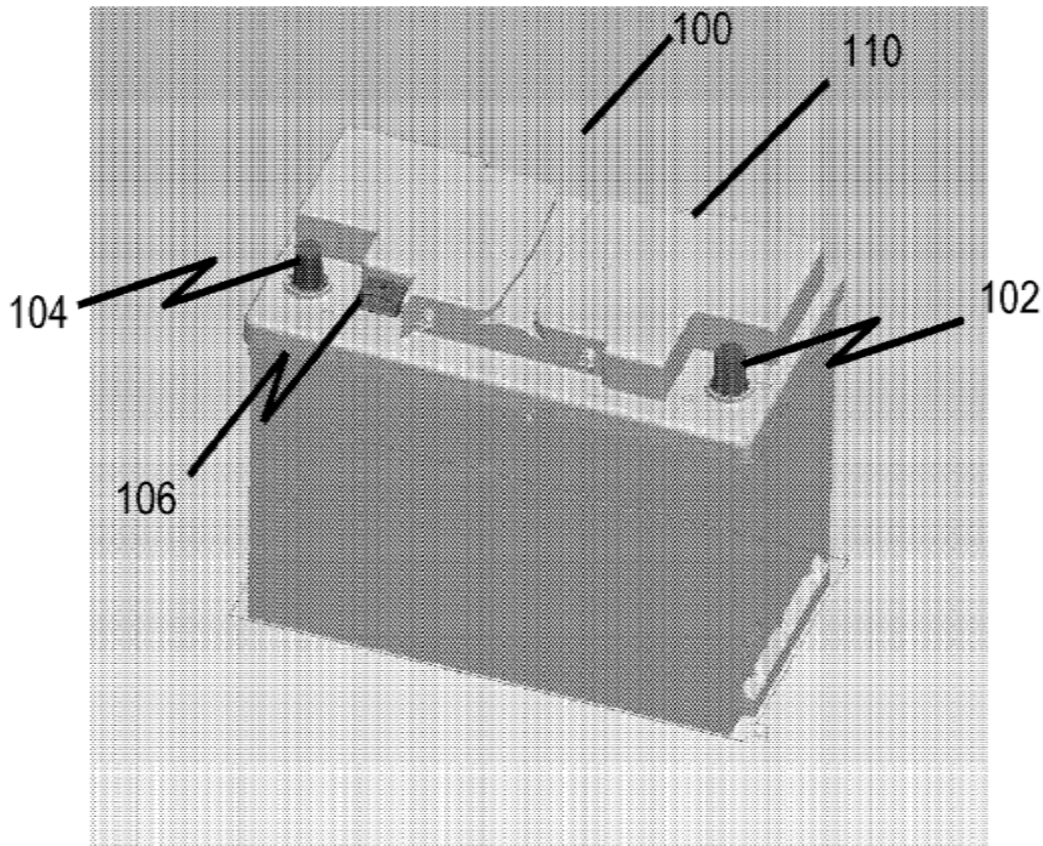
59. Pevear discloses an automotive battery which may be used as a starter battery to drive the starter motor of a vehicle. Ex. 1006: ¶[0004]. The starter motor

is an electrical device. Pevear also discloses that a battery is designed for used vehicle operating systems, such as a replacement for lead acid batteries in vehicles, that can be charged from the vehicle's alternator and used to provide power for micro-hybrid (start-stop) drive systems, where 12-volt is the standard voltage. Ex. 1006: ¶[0005]. Pevear also discloses four cells in series, which at standard lithium cell voltages is more than 12 Volts. Ex. 1006: FIG. 4A. To the extent it can be argued that Pevear does not disclose the 1 volt to 120 volt operating system voltage, Porsche discloses a lithium iron phosphate starter battery which "consistently guarantees the usual voltage of 12 V in the car's on-board network." Ex. 1008: p. 2. And 12 V is a standard operating system voltage for car starter batteries as taught by Porsche and known to a POSITA.

[14a]: a battery pack housing having at least first and second mating portions, said housing having a positive terminal and a negative terminal;

60. Pevear discloses that the case consists of a top cover and an enclosure base. Ex. 1006: ¶[0019]. The top cover and the enclosure base are first and second mating portions. A positive terminal (104) and a negative terminal (102) are insert molded on the outer case (110). Ex. 1006: ¶[0019] and FIG. 1.

FIG. 1



61. Pevear also refers to the case as a housing. Ex. 1006: claim 1.

[14b]: at least one lithium-based rechargeable cell within said housing, said cell having a positive pole and a negative pole;

62. Pevear discloses “a plurality of rechargeable battery cells within the battery housing and having first and second voltage terminals.” Ex. 1006: claim 1. The first and second voltage terminals are positive and negative poles. The cells may be lithium ion cells. Ex. 1006: claim 2

[14c-i]: a circuit board within said housing having a cutoff function incorporated therein,

63. Pevear discloses an electronic power management system including a microprocessor (402) configured to control and monitor a cutoff component (322) that can be used to selectively connect or disconnect the battery from the load(s) connected to its terminals. Ex. 1006: ¶[0039] and FIG. 4A. This constitutes a cutoff function. The control components can be provided on a printed circuit board or similar substrate. Ex. 1006: ¶[0053]. The power management system is contained on a circuit board within the housing. Ex. 1006: ¶[0024], [0040], [0053], FIG. 4A, Claim 1.

[14c-ii]: said circuit board including a plurality of pairs of solid state switches with each pair of solid state switches connected in a parallel configuration to another pair of solid state switches,

64. Pevear discloses solid state switches on a circuit board, including a first group of MOSFETs arranged in parallel (432) and a second group of MOSFETs arranged in parallel (434). Ex. 1006: claim 5, ¶[0007], [0053], and FIG. 4A. MOSFETs are solid state switches. Pevear uses parallel elements to achieve the reduced current as claimed in the '994 Patent. The first and second groups (432, 434) are in series with each other and there is a single connection between the first and second groups (432, 434). Ex. 1006: claim 5, ¶[0007], and FIG. 4A.

65. In the same field, Poff discloses an enhanced protection system for a battery pack including a conventional protection circuit and a redundant protection circuit. Ex. 1011: Abstract. The protection system may cause an open circuit such that current is not allowed to flow from the battery back when an overvoltage or other undesirable condition occurs “with one or more of the Li ion cells” in the battery pack. Ex. 1011: ¶ [0018]. Stopping current when an undesirable condition occurs is a cutoff function. The conventional protection circuit includes conventional transistor pair (22) having a discharge transistor (24) and a charge transistor (26). Ex. 1011: ¶ [0022]. The redundant protection circuit includes a redundant transistor pair (106) having a discharge transistor (108) and a charge transistor (110). Ex. 1011: ¶ [0023]. The conventional transistor pair (22) and the redundant transistor pair (106) are in parallel in Poff. Ex. 1011: FIG. 4. The transistor pairs are in parallel because the drains and sources of the conventional pair are in parallel with the drains and sources of the redundant pair. As configured, they provide a second current path that can be independently controlled for charge and discharge. The control or gate terminals do not need to be tied together directly - they are tied logically as the controllers will act in concert to control them together. If they were not controlled together, they would not serve the purpose of redundancy. Taking the redundancy all the way back to the controller and the software that determines when the gates are powered does not change the parallel nature of the switches. It does offer a

“partial operation” mode if one leg is damaged, or if one controller is not functioning, and that is the purpose of the redundant controls on top of the redundant power path. Poff provides all the elements of a parallel switch design described in the patent claims and meets the objective of the patent (cutting the current in half on each leg during normal operation). He also gains redundancy in the case of a component failure, and makes the control of the parallel switches redundant all the way back to separate pins on the controller. Redundancy was a further objective of Poff, but not detrimental in any way to the '994 patent's function.

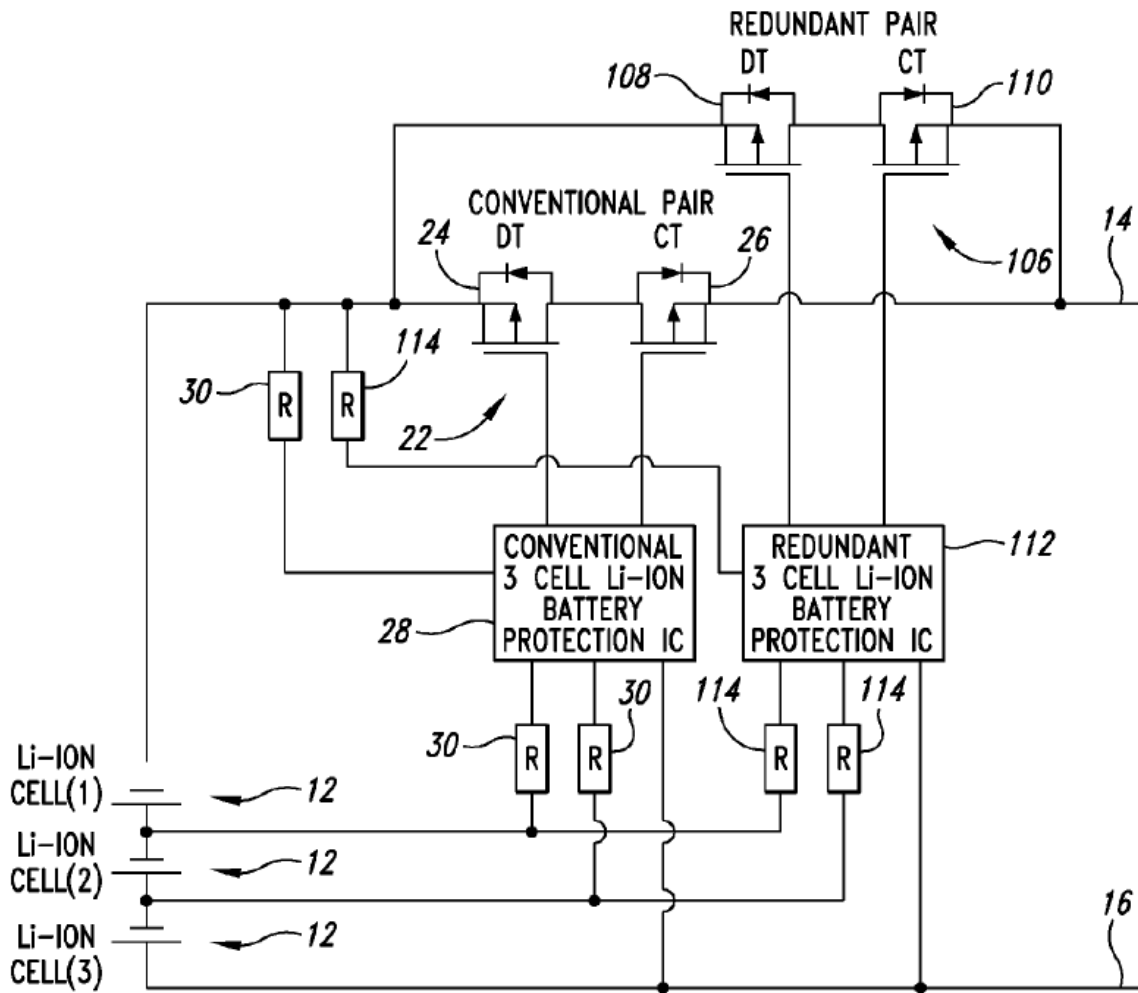


Fig. 4

[14c-iii]: each switch having a source and a drain, the switches of a pair of solid state switchers being configured such that either the drains of the switches are connected or the sources of the switches are connected; and

66. For example, in Ex. 1011, Fig. 4, Poff depicts a circuit where both the conventional pair of MOSFETS and the redundant pair of MOSFETS are in the

negative leg of the power circuit. This is clear from the diagram illustrating the connection to the negative side of the battery stack (indicated by the shorter of the paired lines in the battery symbol). Placing the switches in the negative power leg requires the use of N channel MOSFETS. Although not labeled in Fig.4, the three connections to the MOSFETS can be identified. The Gate, or control leg, always connects to the control or protection IC. The Source and Drain can be distinguished by the fact that in an N channel MOSFET, the body diode points to the Drain, and Fig.4 illustrates the body diode pointing away from the connected legs of the paired MOSFETS, so the back to back connection can be identified as the Sources of the switches, meeting the limitation where “either the drains of the switches are connected or the sources of the switches are connected”. This configuration allows the control system to prevent both over-voltage and under-voltage.

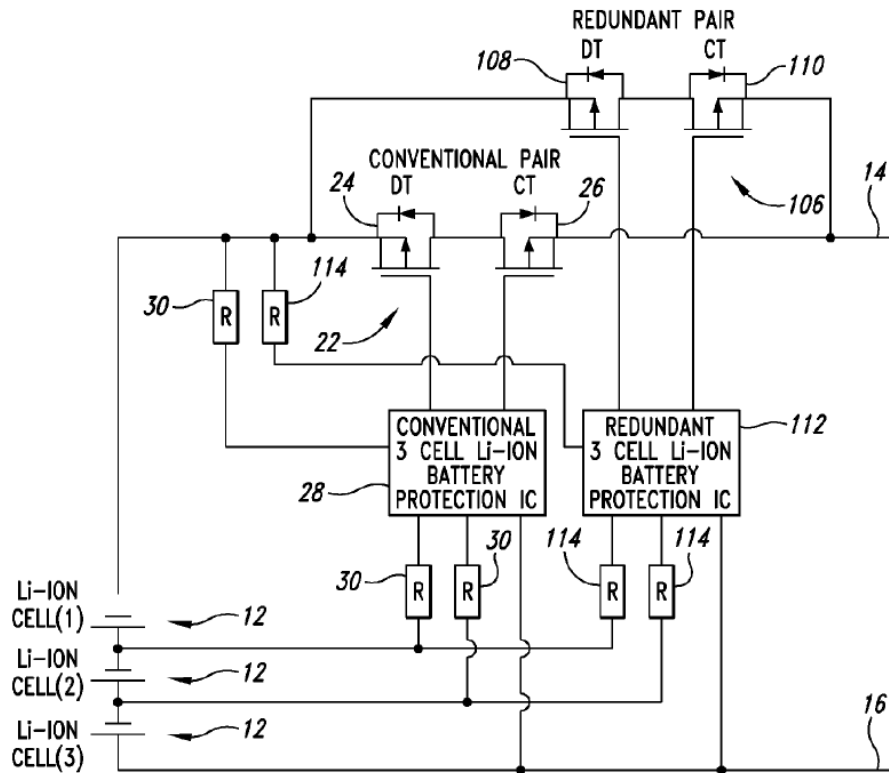


Fig. 4

[14d]: said parallel configuration of the plurality of solid state switches being connected in series with said one or more cells between said positive and negative terminals of the battery pack.

67. In Fig. 4, Poff discloses a battery pack circuit that includes multiple lithium-ion cells (12) with a first external terminal (14) connected to the negative side of the battery stack, indicated by the shorter of the paired lines that depict a power source or battery cell. Ex. 1011. The second external terminal (16) is similarly

connected to the positive side of the stacked battery cells. A single pair of back to back connected MOSFETS would provide both charge and discharge cutoff capability, but Poff adds a second redundant pair of MOSFETS. Parallel pairs (24/26) and (108/110) of MOSFETS are thus placed in a series between the battery cells negative terminal and the external negative terminal, forming a duplicate path for current to flow between the cells and the external load. By adding this “redundant” pair of transistor switches, Poff provides both a backup current path in the case of a component failure and reduced current (by 50%) in each pair of switches under normal conditions. Ex. 1011: Fig. 4.

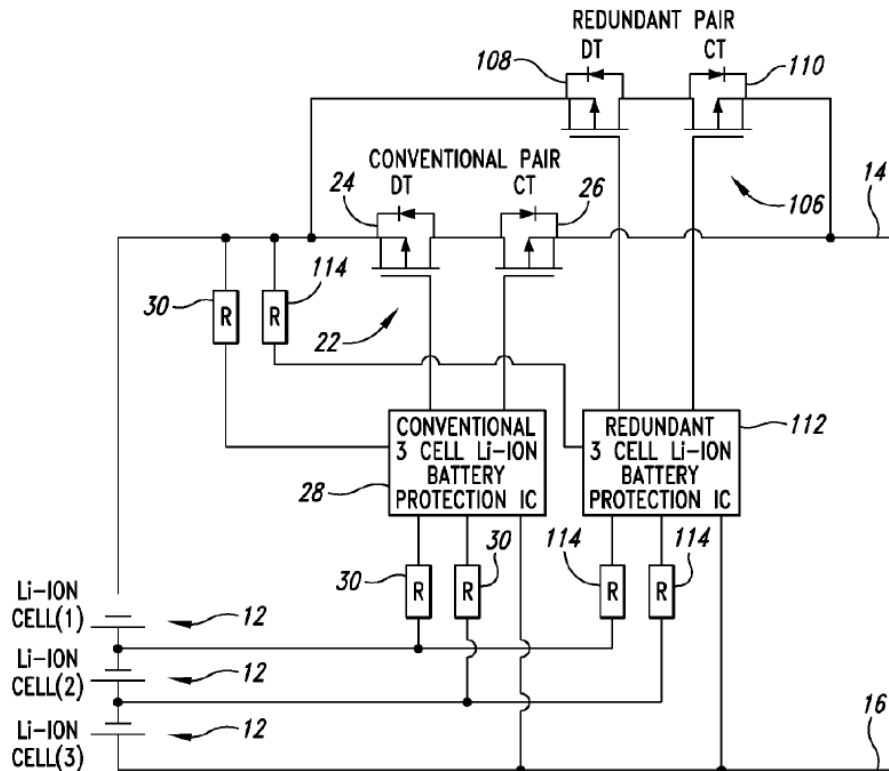


Fig. 4

(xii) Claim 15

[15] The battery pack according to claim 14, wherein the lithium-based cell is a lithium iron phosphate cell.

68. My analysis of claim 14 applies also to claim 15. Pevear discloses lithium ion cells but does not specifically disclose any particular lithium ion material. Pevear discloses that lithium ion batteries can be used instead of lead acid batteries to provide improved power-to-weight ratios. Ex. 1006: ¶[0004]. Pevear also discloses a battery with four lithium ion cells connected in series. Ex. 1006: FIG.

4A. Porsche discloses a lithium ion battery that is 22 pounds lighter than conventional lead batteries. Ex. 1008: p. 1. The battery includes four cells and integrated control electronics. Ex. 1008: p. 2. The cells are made from “lithium-iron-phosphate” and the battery “consistently guarantees the usual voltage of 12 V in the car’s on-board network.” Ex. 1008: p. 2. As used in Porsche, “lithium-iron-phosphate” is LiFePO_4 .

(xiii) Claim 16

[16] The battery pack according to claim 14, wherein the lithium iron phosphate cell is selected from the group consisting of LiFePO , LiFePO_4 , LiFeMgPO_4 , and LiFeYPO_4 cells.

69. My analysis of claim 14 applies also to claim 16. Pevear discloses lithium ion cells but does not specifically disclose any particular lithium ion material. Pevear discloses that lithium ion batteries can be used instead of lead acid batteries to provide improved power-to-weight ratios. Ex. 1006: ¶[0004]. Pevear also discloses a battery with four lithium ion cells connected in series. Ex. 1006: FIG. 4A. Porsche discloses a lithium ion battery that is 22 pounds lighter than conventional lead batteries. Ex. 1008: p. 1. The battery includes four cells and integrated control electronics. Ex. 1008: p. 2. The cells are made from “lithium-iron-phosphate” and the battery “consistently guarantees the usual voltage of 12 V in the car’s on-board network.” Ex. 1008: p. 2. As used in Porsche, “lithium-iron-phosphate” is LiFePO_4 .

(xiv) Claim 18

[18] The battery pack according to claim 14, wherein said battery pack comprises four lithium-based rechargeable cells in series in said housing.

70. My analysis of claim 14 applies also to claim 18. Pevear discloses rechargeable cells within the housing and that the cells are lithium ion cells. Ex. 1006: claims 1 and 2. Pevear further discloses four cells in series in the housing. Ex. 1006: FIG. 4A.

(xv) Claim 19

[19] The battery pack according to claim 14, wherein said battery pack comprises an even number of lithium-based rechargeable cells in said housing.

71. My analysis of claim 14 applies also to claim 19. Pevear discloses rechargeable cells within the housing and that the cells are lithium ion cells. Ex. 1006: claims 1 and 2. Pevear further discloses four cells in series in the housing. Ex. 1006: FIG. 4A.

(xvi) Claim 20

[20] The battery pack according to claim 14, wherein said solid state switches are MOSFETs or IGBTs.

72. My analysis of claim 14 applies also to claim 20. Pevear discloses MOSFETs. Ex. 1006: ¶[0007].

(xvii) Claim 21

[21] The battery pack according to claim 14, wherein said solid state switches are transistors, FET, JFET, BJT, CMOS, VMOS, TMOS, vertical DMOS or HEXFET.

73. My analysis of claim 14 applies also to claim 21. Pevear discloses MOSFETs which are transistors and FETs. Ex. 1006: ¶[0007]. Poff also discloses MOSFETs. Ex. 1011: ¶¶[0022]-[0023]. MOSFETs are both transistors and FETs as recited in claim 5 of the '994 Patent.

(xviii) Claim 22

[22] The battery pack according to claim 14, wherein said solid state switches are either n-type or p-type.

74. My analysis of claim 14 applies also to claim 22. Solid state switches, including MOSFETS are inherently either n-type or p-type. When considering Poff's Fig.4, it is clear that both pairs of switches are in the negative leg of the power circuit. They are in series with the negative pole of the battery cells, indicated by the shorter of the paired parallel lines that depict a battery, and the external connection (14). Poff's design would therefore utilize n-type transistor switches, meeting the claim limitation . Ex. 1011: [0022] [0023].

(xix) Claim 23

[23] The battery pack according to claim 14, wherein said one or more cells are selected from the group consisting of LiFePO, LiFePO₄, LiFeMgPO₄,

LiFeYPO₄, LiCoO₂, LiMn₂O₄, LiNiCoAlO₂, LiNiMnCoO₂, Li₄Ti₅O₁₂, lead-acid, NiCd, and nickel metal hydride (NiMH) batteries.

75. My analysis of claim 14 applies also to claim 23. Pevear discloses lithium ion cells but does not specifically disclose any particular lithium ion material. Pevear discloses that lithium ion batteries can be used instead of lead acid batteries to provide improved power-to-weight ratios. Ex. 1006: ¶[0004]. Pevear also discloses a battery with four lithium ion cells connected in series. Ex. 1006: FIG. 4A. Porsche discloses a lithium ion battery that is 22 pounds lighter than conventional lead batteries. Ex. 1008: p. 1. The battery includes four cells and integrated control electronics. Ex. 1008: p. 2. The cells are made from “lithium-iron-phosphate” and the battery “consistently guarantees the usual voltage of 12 V in the car’s on-board network.” Ex. 1008: p. 2. As used in Porsche, “lithium-iron-phosphate” is LiFePO₄.

B. [GROUND 2] – Claim 2 is obvious over Pevear in view of Porsche, Poff, and Wu

1. *Combination of Pevear, Porsche, Poff, and Wu and reasons for the combination*

76. My analysis for the motivation to combine Pevear, Poff, and Porsche with respect to claim 1 applies also to claim 2.

77. Wu discloses a Master Control Module for controlling the battery back which includes a controller having di-electrical impedance detection circuitry, a fuse

that can disconnect power to the battery pack when the battery pack is short-circuited, and the capability of switching on/off a high voltage bus in response to a command or power on signal. Ex. 1012: ¶¶[0070]-[0073]

78. The POSITA would have been motivated to further incorporate Wu's impedance detection functionality into the protection circuit of Pevear-Porsche-Poff and had a reasonable expectation of success because the references all deal with protecting lithium ion batteries and Pevear uses various measured parameters to determine whether a switch should be turned on or off, thereby turning on, or off, power to an electrical device.

(i) Claim 2

[2] The battery pack according to claim 1, wherein said circuit board has an associated controller within said housing, said controller having associated means for periodically measuring a load to detect a change in load impedance, and a switch within said housing between said battery pack and said electrical device, and means for turning on said switch to provide power to the electrical device to restart the device

79. My analysis of claim 1 applies also to claim 2.

80. Pevear further discloses that the microprocessor processes parameters of the system, such as monitored voltage, current, temperature, etc. to determine appropriate charging parameters and controls the load controller to increase or decrease the discharge current from the battery by selectively connecting or

disconnecting loads to/from the battery. Ex. 1006: ¶[0037]; Ex. 1007: [0021]. Although Pevar discloses monitoring parameters such as voltage and current and using the parameters for control purposes and to connect and disconnect loads (i.e., switch on or off an electrical device), there is no express disclosure of “periodically measuring a load to detect a change in load impedance.”

81. In the field of battery pack modules, Wu discloses a Master Control Module, or MCM 102, within a lithium ion battery pack 1a. Ex. 1012: [0042] and FIG. 1(a).

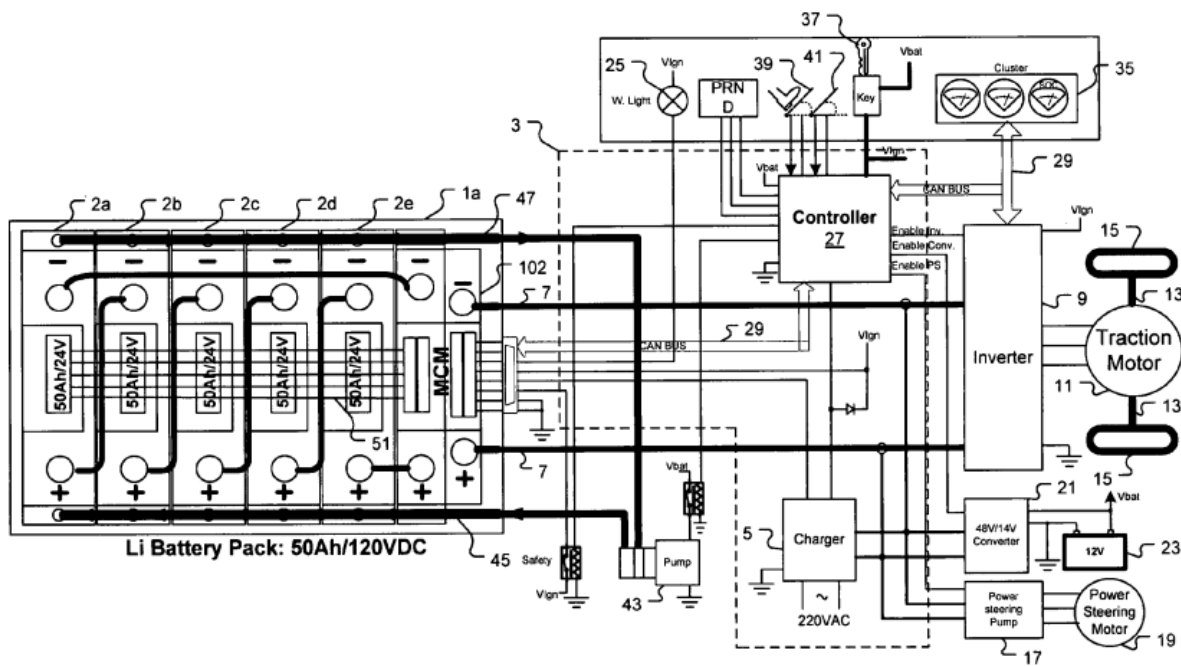


FIG. 1(a)

82. The MCM has a controller that includes di-electrical impedance

detection circuitry, and optionally a fuse that disconnects power to the battery pack when the battery pack is short-circuited. Ex. 1012, [0073]. The MCM can switch on/off a high voltage bus using a command or power on signal. Ex. 1012, [0073].

C. [GROUND 3] – Claim 3 is obvious over Pevear, Porsche, Poff, and Kashine

1. *Combination of Pevear, Porsche, Poff, and Kashine and reasons for the combination*

83. My analysis for the motivation to combine Pevear, Porsche, and Poff with respect to claim 1 applies also to claim 3.

84. Kashine relates to secondary battery protection devices. Ex. 1013, Title. Kashine discloses that, when an excess current is generated in a power supply circuit, an output can be generated by a current detection means and a sense amplifier. Ex. 1013, [0021]. The output is input to a latch and an output of the latch is inputted to a logic circuit having an output which turns off a switching element, thereby shutting off the path of the battery. Ex. 1013, [0021].

85. In the field of battery protection devices, Kashine discloses that, when an excess current is generated in a power supply circuit, an output can be generated by a current detection means and a sense amplifier. Ex. 1013, [0021]. The output is input to a latch and an output of the latch is inputted to a logic circuit having an output which turns off a switching element, thereby shutting off the path of the

battery. Ex. 1013, [0021].

86. The POSITA would have been motivated to incorporate Kashine's components for monitoring current and preventing overcharging and had a reasonable expectation of success because the references all deal with protecting batteries, Pevear discloses current monitoring and a cutoff switch to turn off current when an undesirable event occurs, and Kashine discloses a particular current detection and control mechanism that constitutes one of a finite number of predictable solutions for monitoring and managing current flow.

(i) Claim 3

[3] The battery pack according to claim 1, wherein said circuit board has an associated controller within said housing, said battery pack being connected to a current monitor, said current monitor being connected to a current comparator and a set-reset latch, whereby upon the occurrence of a short circuit, the set-reset latch will turn off an associated switch.

87. My analysis for claim 1 applies also to claim 3. Pevear discloses monitoring voltage, current, temperature, and other relevant parameters and using this information to control a power cutoff switch to actively control the flow of current through the battery pack. Ex. 1006: ¶[0038]. Pevear does not expressly disclose that the "current monitor is connected to a current comparator and a set-reset latch, whereby upon the occurrence of a short circuit, the set-reset latch will turn off an associated switch."

88. In the field of battery protection devices, Kashine discloses that, when an excess current is generated in a power supply circuit, an output can be generated by a current detection means and a sense amplifier. Ex. 1013: [0021]. The output is input to a latch and an output of the latch is inputted to a logic circuit having an output which turns off a switching element, thereby shutting off the path of the battery. Ex. 1013: [0021].

D. [GROUND 4] – Claims 10 and 17 are obvious over Pevear, Poff, Porsche, and Shibano

1. Combination of Pevear, Porsche, Poff, and Shibano and reasons for the combination

89. My analysis for the motivation to combine Pevear, Porsche, and Poff with respect to claim 1 applies also to claims 10 and 17.

90. Shibano discloses lithium ion conductors for rechargeable batteries. Ex. 1014, Title. Shibano teaches that preferred positive electrode materials include “transition metal oxides such as LiCoO_2 , LiNiO_2 , LiMn_2O_4 , $\text{LiNi}_{0.4}\text{Mn}_{1.6}\text{O}_4$, $\text{LiCo}_{0.3}\text{Ni}_{0.7}\text{O}_2$, V_2O_5 and MnO_2 ” and “olivine oxides such as LiCoPO_4 , LiFePO_4 , LiCoPO_4F and LiFePO_4F .” Ex. 1014, [0030].

91. The POSITA would have been further motivated to replace lithium iron phosphate, as disclosed by Porsche, with LiCoO_2 , LiMn_2O_4 , or $\text{Li}_4\text{Ti}_5\text{O}_{12}$ as taught by Shibano because Shibano teaches these materials and LiFePO_4 are suitable

positive electrode materials in rechargeable batteries and the simple substitution of one known element for another to obtain predictable results would have been obvious. Further, Pevear discloses lithium ion batteries and of all lithium ion chemistries, a four-cell series LiFePO₄ battery most closely matches the charge/discharge values of Lead Acid, so a POSITA would naturally consider that type of lithium ion battery.

(i) Claim 10

[10] The battery pack according to claim 1, wherein the lithium-based cell is selected from the group consisting of LiCoO₂, LiMn₂O₄, LiNiCoAlO₂, LiNiMnCoO₂, and Li₄Ti₅O₁₂ cells.

92. My analysis for claim 1 applies also to claim 10. Porsche discloses lithium ion cells made from “lithium-iron-phosphate.” Ex. 1008: p. 2. As used in Porsche, “lithium-iron-phosphate” is LiFePO₄. Pevear, Porsche, and Poff do not disclose the specific materials recited in claim 10 or the ’994 Patent. Shibano, however, discloses that LiFePO₄, LiCoO₂, LiMn₂O₄, and Li₄Ti₅O₁₂ are preferred materials for positive electrodes in rechargeable batteries. Ex. 1014: [0030].

(ii) Claim 17

[17] The battery pack according to claim 14, wherein the lithium-based cell is selected from the group consisting of LiCoO₂, LiMn₂O₄, LiNiCoAlO₂, LiNiMnCoO₂, and Li₄Ti₅O₁₂ cells.

93. My analysis for claim 14 applies also to claim 17. Porsche discloses

lithium ion cells made from “lithium-iron-phosphate.” Ex. 1008: p. 2. As used in Porsche, “lithium-iron-phosphate” is LiFePO_4 . Pevear, Porsche, and Poff do not disclose the specific materials recited in claim 10 or the '994 Patent. Shibano discloses that LiFePO_4 , LiCoO_2 , LiMn_2O_4 , and $\text{Li}_4\text{Ti}_5\text{O}_{12}$ are preferred materials for positive electrodes in rechargeable batteries. Ex. 1014: [0030].

VI. LEGAL STANDARDS

A. Terminology

94. I have been informed by Counsel and understand that the best indicator of claim meaning is its usage in the context of the patent specification as understood by one of ordinary skill. I further understand that the words of the claims should be given their plain meaning unless that meaning is inconsistent with the patent specification or the patent's history of examination before the Patent Office. Counsel has also informed me, and I understand that, the words of the claims should be interpreted as they would have been interpreted by one of ordinary skill at the time of the invention was made (not today). Because I do not know at what date the invention as claimed was made, I have used the earliest possible priority date of the '994 Patent as the point in time for claim interpretation purposes (the Critical Date).

B. Legal Standards for Anticipation

95. I have been informed by Counsel and understand that documents and materials that qualify as prior art can render a patent claim unpatentable as anticipated. I am informed by Counsel and understand that all prior art references are to be looked at from the viewpoint of a person of ordinary skill in the art.

96. I am informed by Counsel and understand that a challenged claim is unpatentable as "anticipated" under 35 U.S.C. § 102 if it is determined that all the

limitations of the claim are described in a single prior art reference.

97. I am informed by Counsel and understand that, to anticipate a claim, a prior art reference must disclose, either expressly or inherently, each and every limitation of that claim and enable one of ordinary skill in the art to make and use the invention.

98. I have been informed by Counsel and understand that in an inter partes review, “the petitioner shall have the burden of proving a proposition of unpatentability,” including a proposition of anticipation, “by a preponderance of the evidence.” 35 U.S.C. §316(e).

C. Legal Standards for Obviousness

99. I have been informed by Counsel and understand that documents and materials that qualify as prior art can render a patent claim unpatentable as obvious. I am informed by Counsel and understand that all prior art references are to be looked at from the viewpoint of a person of ordinary skill in the art at the time of the invention, and that this viewpoint prevents one from using his or her own insight or hindsight in deciding whether a claim is obvious.

100. I have been informed by Counsel and understand that a claim is unpatentable for obviousness under 35 U.S.C. § 103 (in the pre-AIA form of that statute that applies to the '994 Patent) “if the differences between the subject matter

sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains.” I am informed by Counsel and understand that obviousness may be based upon a combination of references. I am informed by Counsel and understand that the combination of familiar elements according to known methods is likely to be obvious when it does no more than yield predictable results. However, I am informed by Counsel and understand that a patent claim composed of several elements is not proved obvious merely by demonstrating that each of its elements was, independently, known in the prior art.

101. I am informed by Counsel and understand that when a patented invention is a combination of known elements, a court must determine whether there was an apparent reason to combine the known elements in the fashion claimed by the patent at issue by considering the teachings of prior art references, the effects of demands known to people working in the field or present in the marketplace, and the background knowledge possessed by a person having ordinary skill in the art.

102. I am informed by Counsel and understand that a patent claim composed of several limitations is not proved obvious merely by demonstrating that each of its limitations was independently known in the prior art. I am informed by

counsel for the Patent Owner and understand that identifying a reason those elements would be combined can be important because inventions in many instances rely upon building blocks long since uncovered, and claimed discoveries almost of necessity will be combinations of what, in some sense, is already known. I am informed by Counsel and understand that it is improper to use hindsight in an obviousness analysis, and that a patent's claims should not be used as a "roadmap."

103. I am informed by Counsel and understand that an obviousness inquiry requires consideration of the following factors: (1) the scope and content of the prior art; (2) the differences between the claims and the prior art; (3) the level of ordinary skill in the pertinent art; and (4) any objective indicia of non-obviousness, such as commercial success, long-felt but unresolved need, failure of others, industry recognition, copying, and unexpected results. I understand that the foregoing factors are sometimes referred to as the "Graham factors."

104. I have been informed by Counsel and understand that an obviousness evaluation can be based on a combination of multiple prior art references. I understand that the prior art references themselves may provide a suggestion, motivation, or reason to combine, but that the nexus linking two or more prior art references is sometimes simple common sense. I have been informed by Counsel and understand that obviousness analysis recognizes that market demand, rather than

scientific literature, often drives innovation, and that a motivation to combine references may be supplied by the direction of the marketplace.

105. I have been informed by Counsel and understand that if a technique has been used to improve one device, and a person of ordinary skill at the time of invention would have recognized that it would improve similar devices in the same way, using the technique is obvious unless its actual application is beyond his or her skill.

106. I have been informed by Counsel and understand that practical and common sense considerations should guide a proper obviousness analysis, because familiar items may have obvious uses beyond their primary purposes. I have been informed by Counsel and understand that a person of ordinary skill looking to overcome a problem will often be able to fit together the teachings of multiple prior art references. I have been informed by Counsel and understand that obviousness analysis therefore takes into account the inferences and creative steps that a person of ordinary skill would have employed at the time of invention.

107. I have been informed by Counsel and understand that a proper obviousness analysis focuses on what was known or obvious to a person of ordinary skill at the time of invention, not just the patentee. Accordingly, I understand that any need or problem known in the field of endeavor at the time of invention and

addressed by the patent can provide a reason for combining the elements in the manner claimed.

108. I have been informed by Counsel and understand that a claim can be obvious in light of a single reference, without the need to combine references, if the elements of the claim that are not found explicitly or inherently in the reference can be supplied by the common sense of one of skill in the art.

109. I have been informed by Counsel and understand that secondary indicia of non-obviousness may include (1) a long felt but unmet need in the prior art that was satisfied by the invention of the patent; (2) commercial success of processes covered by the patent; (3) unexpected results achieved by the invention; (4) praise of the invention by others skilled in the art; (5) taking of licenses under the patent by others; (6) deliberate copying of the invention; (7) failure of others to find a solution to the long felt need; and (8) skepticism by experts. I understand that evidence of secondary indicia of non-obviousness, if available, should be considered as part of the obviousness analysis.

110. I have been informed by Counsel and understand that there must be a relationship between any such secondary considerations and the invention, and that contemporaneous and independent invention by others is a secondary consideration supporting an obviousness determination.

111. In sum, my understanding is that prior art teachings are properly combined where one of ordinary skill having the understanding and knowledge reflected in the prior art and motivated by the general problem facing the inventor, would have been led to make the combination of elements recited in the claims. Under this analysis, the prior art references themselves, or any need or problem known in the field of endeavor at the time of the invention, can provide a reason for combining the elements of multiple prior art references in the claimed manner.

112. I have been informed by Counsel and understand that in an inter partes review, “the petitioner shall have the burden of proving a proposition of unpatentability,” including a proposition of obviousness, “by a preponderance of the evidence.” 35 U.S.C. §316(e).

VI. CONCLUSION

113. I reserve the right to supplement my opinions to address any information obtained, or positions taken, based on any new information introduced throughout this proceeding.

114. I declare under penalty of perjury that the foregoing is true and accurate to the best of my ability.