

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Patent of: Richard T. Caudill
U.S. Patent No.: 8,035,250
Issue Date: October 11, 2011
Serial No.: 12/357,839
Filing Date: January 22, 2009
Title: System and Method for Load Sharing in Multi-Module Power Supply
Systems

Mail Stop *Ex Parte* Reexam
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**REQUEST FOR *EX PARTE* REEXAMINATION OF
U.S. PATENT NO. 8,035,250 UNDER 35 U.S.C. § 302 AND 37 C.F.R. § 1.510**

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G	United States Patent No. 6,735,704
H	United States Patent Publication No. 2004/0109374
I	Angelo Baggini, Handbook of Power Quality, 13.3.3 (2008)
J	B. Gemmell, J. Dorn, D. Retzmann & D. Soerangr, Prospects of Multilevel VSC Technologies for Power Transmission, in 2008 IEEE/PES Transmission and Distribution Conference and Exposition 1 (Chicago, IL, 2008)
K	J. M. Guerrero, L. Hang & J. Uceda, Control of Distributed Uninterruptible Power Supply Systems, 55 <i>IEEE Transactions on Industrial Electronics</i> 8 (Aug. 2008)
L	NASA Lesson Number 662, Feb. 1, 1999

* All emphasis added unless otherwise noted.

I. INTRODUCTION

Schneider Electric SE and Schneider Electric USA, Inc. (collectively, “Schneider”) hereby request under 35 U.S.C. § 302 and 37 C.F.R. § 1.510 reexamination of claims 1–10 (the “Challenged Claims”) of U.S. Patent No. 8,035,250 (the “’250 patent”) (Appendix A), assigned to Data Power Works, LLC (“DPW” or “Patent Owner”).

This request presents substantial new questions of patentability as to each of the Challenged Claims, identifying prior art references that were not previously substantively considered during any examination of the ’250 patent. As shown in detail below, the Challenged Claims of the ’250 patent were anticipated and obvious as of the (alleged) March 14, 2008 priority date (and much earlier) in view of the prior art discussed herein, and a skilled artisan would have been motivated to incorporate all claimed features together to render the claims of the ’250 patent unpatentable. Because this request presents prior art references that were not previously substantively considered, *ex parte* reexamination should be granted and each of the Challenged Claims should be canceled as unpatentable.

II. THE ’250 PATENT

A. Overview of the ’250 Patent

The ’250 patent is directed to the well-known concept of power sharing amongst power sources, where the load is shifted away from one power source upon occurrence of an “operating event.” The Abstract describes a “load sharing, multi-module power supply system for supplying power to a load.” Appendix A at Abstract. The “system” includes three power supply modules, each with their own “controller” and each with a “per unit capacity.” *Id.* Upon occurrence of an “operating event”—which the specification does not define but includes as an example “an over-temperature condition”—the “controller of the first power supply module ... implement[s] a reduction in an output power.” *Id.* at Abstract, 5:9–13. The first power module does not shut down,

but “remains operating during the [] event [though] at a reduced power output level.” *Id.* at Abstract. The power “shed” by the first power supply module is “accommodate[d]” by at least a “second power supply module.”

Claim 1 is reproduced in its entirety below:

1. A load sharing, multi-module power supply system for supplying power to a load, the system comprising:

a first power supply module having a controller and having a first per unit capacity (pu-c);

a second power supply module having a controller and having a second per unit capacity (pu-c);

a third power supply module having a controller and having a third per unit capacity (pu-c);

said controller of said first power supply module adapted to implement a reduction in an output power of said first power supply module upon the detection of an operating event, where a portion of said load being handled by said first power supply module is shed by a determined percentage, and such that said first power supply module remains operating during said operating event but at a reduced power output level; and

upon the occurrence of said operating event, said controllers of said second and third power supply modules being adapted to increase their respective said power outputs so that each of said second and third power supply modules accommodates a subportion of said portion of said load that has been shed by said first power supply module, and when needed, such that said controllers of said second and third power supplies increase the power outputs of their respective said power supply modules by different amounts, when needed, such that said second and third power supply modules assume different additional percentages of the load that was shed by the first power supply module.

Appendix A at Cl. 1.

1. Applicant’s Admitted Prior Art

A statement by an applicant in the specification identifying the work of another as “prior art” is an admission which can be relied upon for both anticipation and obviousness determinations, regardless of whether the admitted prior art would otherwise qualify as prior art

under the statutory categories of 35 U.S.C. 102. *See Riverwood Int’l Corp. v. R.A. Jones & Co.*, 324 F.3d 1346, 1354 (Fed. Cir. 2003); *Constant v. Advanced Micro-Devices Inc.*, 848 F.2d 1560, 1570 (Fed. Cir. 1988).

The Background of the ’250 patent describes and illustrates “prior art” that meets all limitations of claim 1, other than the limitations regarding keeping the first power supply module online and picking up the load “shed” by the first module in differing amounts. *See e.g.*, Appendix A at Cl. 1 (“said controllers of said second and third power supplies increase the power outputs of their respective said power supply modules by different amounts, when needed, such that said second and third power supply modules assume different additional percentages of the load that was shed by the first power supply module”).

For example, the ’250 Background admits that three-module power supply systems were well-known and constitute applicant admitted prior art (“AAPA”): “FIG. 1 shows a basic block diagram of a prior art multi-module UPS system 100. ***While multi-module UPS system 100 is shown as having two UPS modules 102, it should be understood that multi-module UPS system 100 can have more than two UPS modules 102.***” *Id.* at 1:39–43.

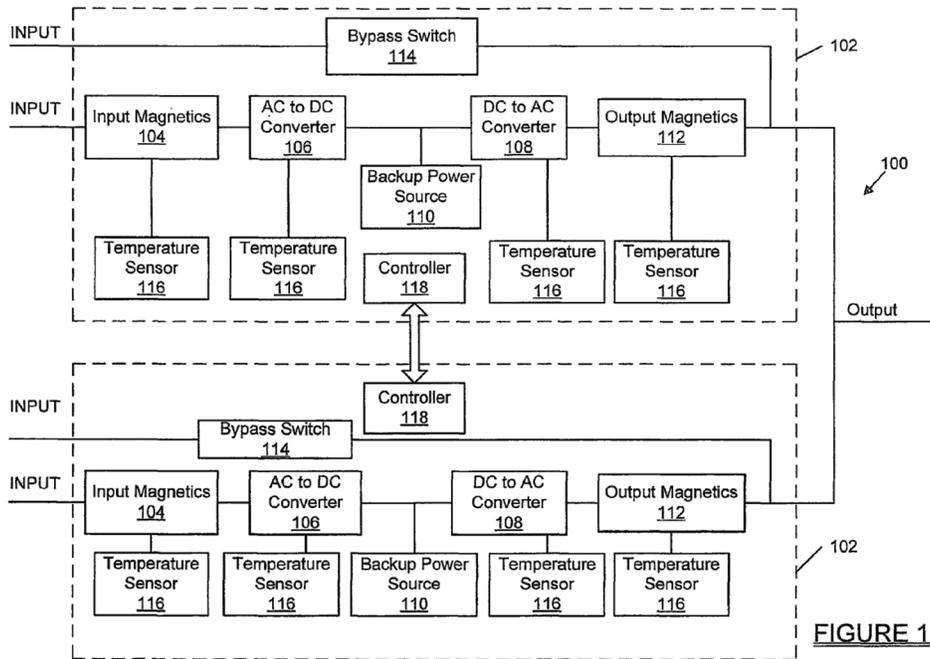
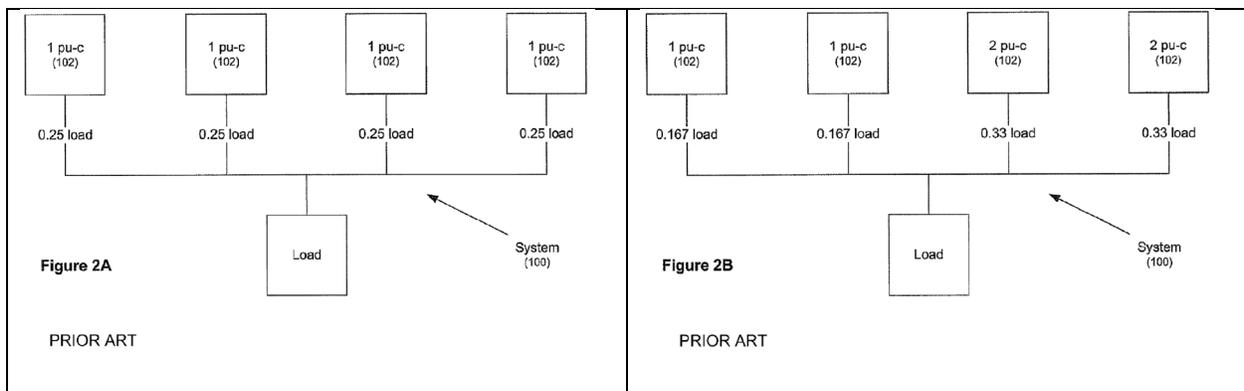


FIGURE 1

Figures 2A and 2B also constitute AAPA. As shown below, Figures 2A and 2B are “basic schematic illustrations of load sharing in prior art multi-module UPS systems.” In Figure 2A, each UPS module 102 of multi-module UPS system 100 has the same capacity, or per-unit rating (“pu-c”). And “[i]n FIG. 2B, two of the UPS modules 102 have a 1 pu-c [(i.e., per-unit rating)] and two have a 2 pu-c. *The system load is shared proportionally among the UPS modules 102 based on their individual pu-c. That is, each UPS module 102 supplies proportionally a percentage of the system load based on its pu-c.*” *Id.* at 2:6–18.

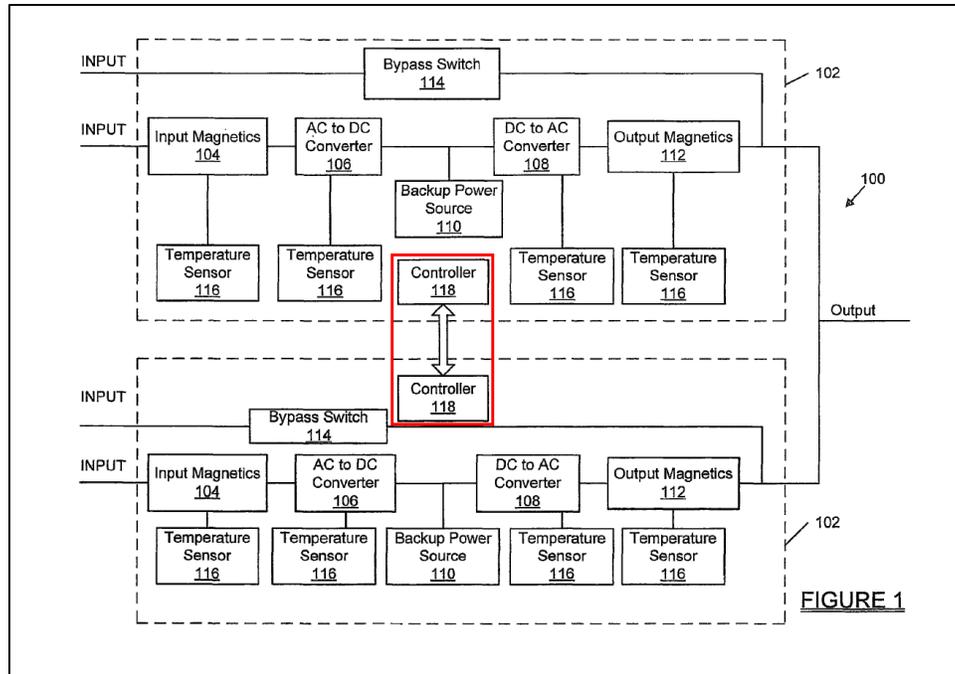


1. Dependent Claims

The dependent claims do not recite anything new. For example, dependent claim 2, which depends from claim 1, provides that an “operating event comprises a temperature increase of a component ... beyond a predetermined threshold level.” Appendix A at Cl. 2. However, the ’250 Background explains that “temperature sensors 116 are coupled to the components 104,106, 108 and 112 of every UPS module 102, as indicated in FIG. 1.” *Id.* at 2:3-5. As discussed below, it was well known that a failure condition may occur when there is excess temperature: “One type [of failure] is referred to as non-urgent failure, such as the excess temperature and the DC bus voltage fault.” Appendix D at [0083].

The subject matter recited by dependent claim 3, which depends from claim 1, was well-known by the ’250 specification’s own admission. The claim requires that the “second and third power supply modules determine a level of said subportion [of the load shed by the first power module] that each will accommodate based in part on their respective per unit capacities.” Appendix A at Cl. 3. But the ’250 Background admits that accommodating a load based on a module’s per-unit capacity was well-known. *See id.* at Fig. 2B, 2:14-18.

The subject matter recited by dependent claim 4, which depends from claim 1, was similarly well-known according to the ’250 specification. Claim 4 requires, “a communications bus for enabling said controllers of said first, second and third power supply modules to communicate with one another.” Notably, Figure 1, which “shows a basic block diagram of a prior art multi-module UPS system 100,” depicts two controllers in communication with each other:



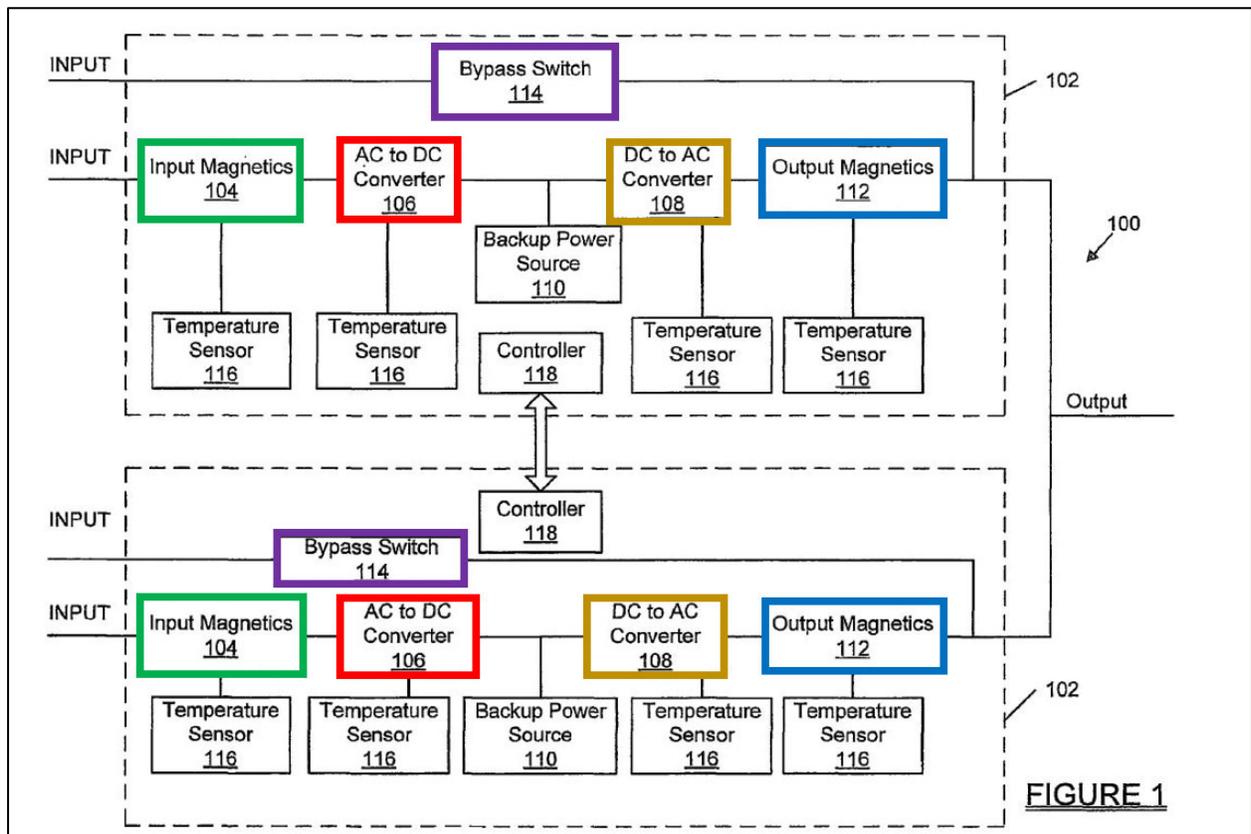
Id. at Fig. 1 (annotated), 1:39–40. Further, the '250 specification expressly indicates that, though Figure 1 depicts two modules, additional modules can be added (*e.g.*, a third): “[w]hile multi-module UPS system 100 is shown as having two UPS modules 102, it should be understood that multi-module UPS system 100 can have more than two UPS modules 102.” *Id.* at 1:40–43.

The subject matter recited by dependent claim 5, which depends from claim 1, was also well-known, by the '250 specification's own admission. Dependent claim 5 requires that “each of said controllers of said power supply modules includes load sharing software for assisting in determining a portion of said load that its respective said power supply module may accommodate.” Appendix A at Cl. 5. But the '250 Background admits that prior art controllers included software to perform their functions: “[c]ontroller 118 may be a *programmable device* such as a microcontroller, computer or the like.” *Id.* at Fig. 1, 2:2–3.

Additionally, claim 6, which depends from Claim 1, recites limitations that were known in the art according to the '250 specification. Claim 6 requires “a plurality of temperature sensors for monitoring a plurality of components thereof; and each of said temperature sensors being in

communication with said controller.” Appendix A at Cl. 6. However, the ’250 Background concedes that in the prior art “[t]emperature sensors 116 may also be coupled to a controller 118 which controls UPS module 102.” *Id.* at Fig. 1 and 1:67–2:2.

Finally, dependent claim 7, which depends from claim 6 (which depends from claim 1), includes only limitations that the ’250 specification admits were in the prior art. Claim 7 requires “each of said power supply module[s] comprises: an input magnetics subsystem; an AC to DC converter; a DC to AC converter; an output magnetics subsystem for generating said output power; and a bypass switch coupled across an input side of said input magnetics subsystem and an output side of said output magnetics subsystem, and controlled by said controller, for bypassing its respective said power supply module.” Appendix A at Cl. 7. However, all of these sub-systems are shown in Figure 1, which, again, “shows a basic block diagram of a prior art multi-module UPS system 100”:



Id. at Fig. 1 (annotated), 1:39–40; *see also id.* at 1:44–2:5 (describing the subsystems). And, again, the '250 specification provides that the disclosures of the two-module system of Figure 1 extend to three-module systems. *See id.* at Fig. 1, 1:40–43.

Independent Claim 8 is substantively identical to Claim 1, except that it is directed to a method in lieu of a system:

8. A method for load sharing using a multi-module power supply (UPS) system, the method comprising:

using a first power supply module, and having a first per unit capacity (pu-c), to handle a portion of said load;

using a second power supply module having a controller, and having a second per unit capacity (pu-c), to handle a second portion of said load;

using a third power supply module having a controller, and having a third per unit capacity (pu-c), to handle a third portion of said load;

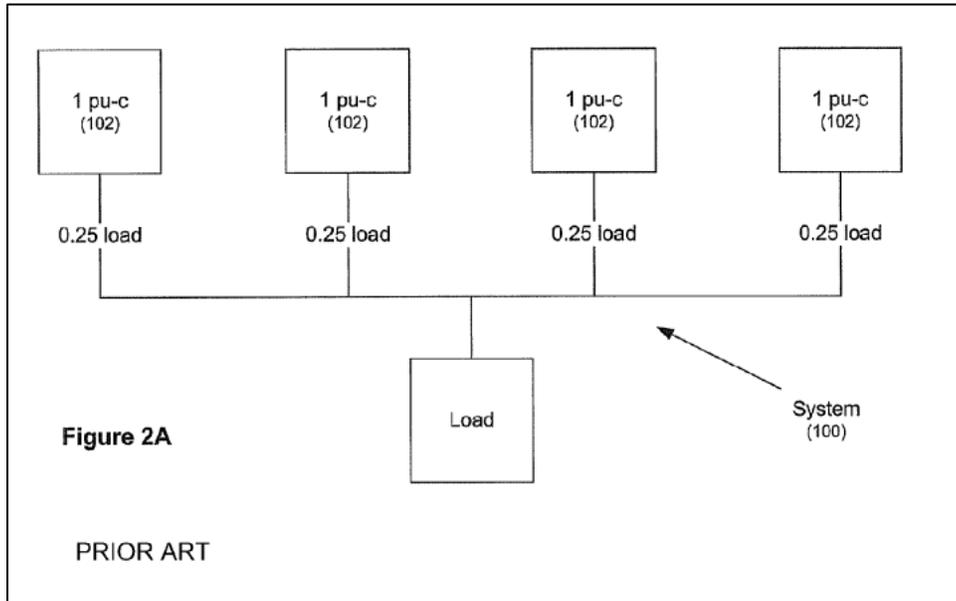
when an operating event is detected by said first power supply module, reducing a power output of said first power supply module so that a percentage of said portion of said load being handled by said first power supply module is shed, but further such that said first power supply module remains operating during said operating event but at a reduced power output level; and

upon the occurrence of said operating event, using said controllers of said second and third power supply modules to increase their respective said power outputs so that each of said second and third power supply modules accommodates a subportion of said portion of said load that has been shed by said first power supply module, and further such that said controllers of said second and third power supply modules increase their respective power outputs by different amounts, when needed, such that said second and third power supply modules assume different additional percentages of the load that was shed by the first power supply module.

Claim 9 depends from claim 8 and requires that “subportions of said load being accommodated by said second and third power supply modules after the occurrence of said operating event are equal subportions.” But, as the '250 Background readily admits, equal sharing of load was well-known in the prior art:

FIGS. 2A and 2B are basic schematic illustrations of load sharing in prior art multi-module UPS systems, such as multi-module UPS system 100. In FIG. 2A, each UPS module 102 of multi-module UPS system 100 has the same capacity, or per-unit rating (“pu-c”). The load on multi-module UPS system 100, referred to as the “system load,” in FIG. 2A is shared equally among the UPS modules 102. That is, each UPS module 102 supplies the same percentage of the system load.

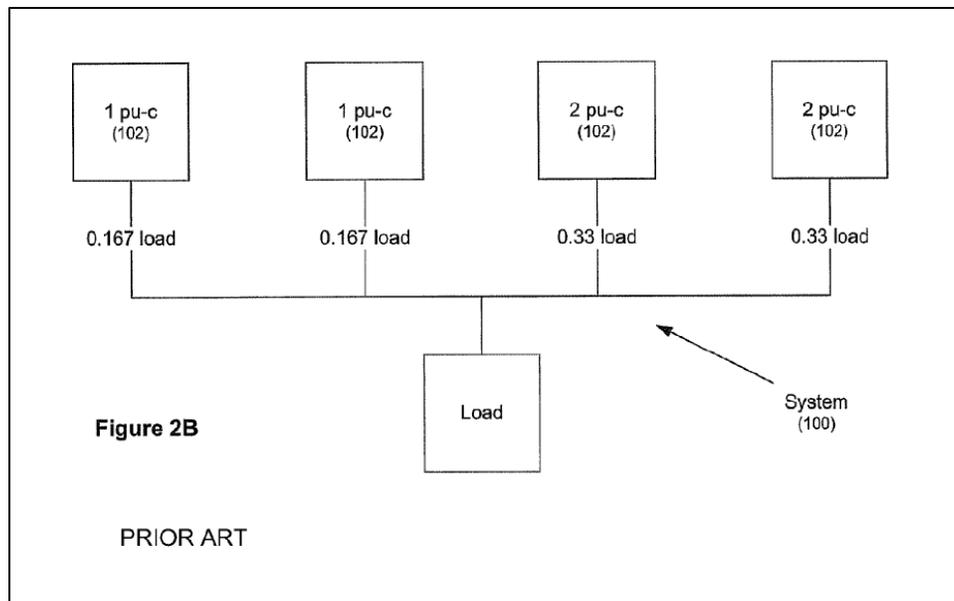
Appendix A at 2:6–13, Figure 2A (below).



Claim 10 also depends from claim 8 and requires that “said controllers of said second and third power supply modules use said per unit capacity ratings of their respective said power supply modules in determining what percentage of said portion of said load being shed by said first power supply module that each of said second and third power supply modules is able to accommodate.” However, as discussed above, the ’250 Background readily admits that use per-unit capacity to determine how much load a power source should take on was well-known in the art:

FIGS. 2A and 2B are basic schematic illustrations of load sharing in prior art multi-module UPS systems ... [i]n FIG. 2B, two of the UPS modules 102 have a 1 pu-c [(i.e., per-unit rating)] and two have a 2 pu-c. ***The system load is shared proportionally among the UPS modules 102 based on their individual pu-c. That is, each UPS module 102 supplies proportionally a percentage of the system load based on its pu-c.***

Id. at 2:6–18, Figure 2B (below).



B. Prosecution History

On March 9, 2011, the examiner rejected originally presented independent claims 10 and 20 as anticipated by U.S. Patent No. 7,668,624 to Heber et al. (“Heber”). Appendix B at 131–33.¹

In response, the applicant amended the last element of claim 10 as follows:

upon the occurrence of said operating event, said controllers of said second and third power supply modules being adapted to increase their respective said power outputs so that each of said second and third power supply modules accommodates a subportion of said portion of said load that has been shed by said first power supply module, and when needed, such that said controllers of said second and third power supplies increase the power outputs of their respective said power supply modules by different amounts, when needed, such that said second and third power supply modules assume different additional percentages of the load that was shed by the first power supply module.

Appendix B at 144–46. The applicant made a substantively identical amendment to originally presented claim 20. *See id.* at 148–49.

Thereafter, the examiner allowed both claims, explaining that Heber does not teach the “when needed, such that said controllers of said second and third power supplies increase the

¹ Citations to file history are to the PDF page number of Appendix B.

power outputs of their respective said power supply modules by different amounts, when needed, such that said second and third power supply modules assume different additional percentages of the load that was shed by the first power supply module” limitation. *See* Appendix B at 165–67.

C. Level of Ordinary Skill in the Art

A person of ordinary skill in the art (“POSA) of the ’250 patent at the time of the alleged invention would have had a B.S. in electrical engineering or a related field, or the equivalent, and two or more years of industry or research experience in power electronics, and/or uninterruptible power system. Appendix C, ¶¶ 34–37. Additional relevant education may compensate for less experience, and vice-versa. *Id.*

D. Claim Construction

The ’250 patent is not expired. Accordingly, the broadest reasonable interpretation standard should be applied to this request. *In re Swanson*, 540 F.3d 1368, 1377–78 (Fed. Cir. 2008).

III. TECHNICAL REQUIREMENTS FOR *EX PARTE* REEXAMINATION UNDER 37 C.F.R. § 1.510

This reexamination request satisfies each requirement for *ex parte* reexamination of the ’250 patent for the reasons set forth below.

A. 37 C.F.R. § 1.510(b)(1): Statement Pointing Out Each Substantial New Question of Patentability

A statement pointing out each substantial new question of patentability (“SNQ”) based on the cited patents and printed publications in accordance with 37 C.F.R. § 1.510 (b)(1) is provided below in Sections IV and V.

B. 37 C.F.R. § 1.510(b)(2): Identification of Every Claim for which Reexamination is Requested

Reexamination is requested for claims 1 through 10 of the ’250 patent in view of the prior art references discussed below.

C. 37 C.F.R. § 1.510(b)(2): Detailed Explanation of the Pertinency and Manner of Applying the Prior Art

A detailed explanation of the pertinency and manner of applying the prior art to every claim for which reexamination is requested in accordance with 37 C.F.R. § 1.510(b)(2) is provided below in Section V.

D. 37 C.F.R. § 1.510(b)(3): Copy of Every Patent or Printed Publication Relied upon or Referred to

Requestors provide a copy of every patent or printed publication relied upon or referred to in this *ex parte* reexamination request as Appendices A–L. For convenience, the cited patents and printed publications are listed on a Form PTO-1449, which is attached.

E. 37 C.F.R. § 1.510(b)(4): Copy of the Entire Patent

Requestors have provided a full copy of the '250 patent as Appendix A in accordance with 37 C.F.R. § 1.510(b)(4).

F. 37 C.F.R. § 1.510(b)(5): Certification of Service

In accordance with 37 C.F.R. § 1.510(b)(5), Requestors provide below (*see* last page of this request) a certification that a copy of the request has been served in its entirety on the patent owner at the address as provided for in § 1.33(c). The name and address of the party served has been indicated.

G. 37 C.F.R. § 1.510(b)(6): Certification by the Third-Party Requester

In accordance with 37 C.F.R. § 1.510(b)(6), Requestors certify that the statutory estoppel provisions of 35 U.S.C. § 315(e)(1) or 35 U.S.C. § 325(e)(1) do not prohibit Requestors from filing this *ex parte* reexamination request.

H. 37 C.F.R. § 1.510(a): Fee for Requesting Reexamination

The Patent and Trademark Office is authorized to charge Deposit Account No. 506092 for the fee set in 37 C.F.R. § 1.510(a) for this Request and further authorizes payment for any additional fees to be charged to this Deposit Account.

I. Identification of Related Matters

Below is a list of prior and pending proceedings involving the '250 patent.

Case Name	Case Number	Jurisdiction	Filed
<i>Data PowerWorks, LLC, v. Schneider Electric SE</i>	2:25-cv-00300-JRG	E.D. Tex.	March 13, 2025

IV. THE PRIOR ART

The prior art discloses systems and methods for shifting power amongst power modules as claimed in the '250 patent, including that each power supply module includes a “controller” that “implement[s] a reduction in an output power of said first power supply module upon the detection of an operating event ... such that said first power supply module remains operating during said operating event but at a reduced power output level.” Additionally, the prior art establishes that “said controllers of said second and third power supply modules being adapted to increase their respective said power outputs so that each of said second and third power supply modules accommodates a subportion of said portion of said load that has been shed by said first power supply module” was well-known in the art as of the earliest effective priority date of the '250 patent. Indeed, Qahoug and Li disclose just such systems and methods. These references when considered alone or in combination with secondary references identified below anticipate and render the Challenged Claims obvious.

A. The Prior Art Raises Substantial New Questions of Patentability

Below is an overview of each of the prior art references that form the basis of the substantial new questions of patentability. None of the references were previously considered during the

original examination, and they disclose the claimed features of the '250 patent in their entirety. In particular, the primary reference Qahoug was not made of record during prosecution of the '250 patent, and Qahoug teaches all the limitations that the Office previously believed were not sufficiently disclosed in the prior art of record. Same with Li.

The new grounds provide noncumulative technological teachings based on Qahoug and Li that were not previously considered and discussed on the record during prosecution of the '250 patent. The new teachings are such that there is substantial likelihood that a reasonable examiner would have considered them important in determining whether or not the Challenged Claims are patentable, which they are not.

1. Qahoug (Appendix E)

U.S. Patent Publication No. 2007/0248877 to Qahoug et al. ("Qahoug") was filed on March 26, 2007 and published on October 25, 2007. Qahoug at Cover. Qahoug thus qualifies as prior art under 35 U.S.C. § 102(e). Qahoug is titled "Gradient non-linear adaptive power architecture and scheme," and relates to "a power module employing multiple power sub-modules." Appendix E at Cover, Abstract.

Qahoug discloses that, upon the occurrence of an operating event such as a change in load or the disabling of a power sub-module, "[t]he enablement and disablement of individual power modules (*e.g.*, power sub-modules 410-430) may further be dynamically controlled to dynamically adapt to changing load requirements," and "the remaining power sub-module or power sub-modules may operate in a power/current range for which they are efficient." Appendix E at [0028]. Furthermore, with reference to Figure 8, Qahoug explains that "the amount of power/current handled by each power sub-module is varied dynamically, or in other words, current/power sharing percentage/ratio is changed dynamically." Appendix E at [0036]. Qahoug further explains that the "non-uniform, non-linear adaptive and dynamic current sharing can be further implemented in

conjunction with the non-linear ON/OFF scheme as illustrated by Table 1,” and provides examples where, for a certain load, “the first power sub-module ... may process 20% of the power/current, the second ... may process 30% ... and the third ... may process 50%,” and when conditions change, “the first power sub-module processes 5% ... the second ... 35% ... and the third ... 60%.” *Id.* Thus, Qahoug explicitly teaches that, upon an operating event, the controllers of the remaining modules increase their outputs by different amounts as needed, so that each assumes a different additional percentage of the load shed by the disabled module, a feature that the Examiner concluded was absent from Heber.

Hence, Qahoug raises at least one SNQ.

2. Li (Appendix F)

U.S. Patent No. 6,166,455 to Li (“Li”) was filed on January 14, 1999 and issued on December 26, 2000. Li thus qualifies as prior art under 35 U.S.C. § 102(b). Li is titled “Load current sharing and cascaded power supply modules” and relates to “[a] modular power supply which distributes responsibility for supplying current to a load among two or more power supply modules having a common output node.” Appendix F at Cover, Abstract.

Li explains that “the relationships among rated power of the power supply modules and the values of the current sensing resistors are preferably inversely proportional.” *Id.* at 6:5-8. For example, Li explains: “assume that the power supply module 100' has a rated capacity that is one-third the rated capacity of the power supply module 100. In such case, the current sensing resistor 122' is preferably three times the value of the current sensing resistor 122.” *Id.* at 5:63-67. As a result, when the first module sheds its share of the load, “each [power supply module] will attempt to provide an appropriate proportion of the total amount of current through the load 136 according to the respective values of their current sensing resistors 122, 122'.” *Id.* at 6:2-5. A POSA would have understood that this arrangement ensures that the second and additional modules will assume

different additional percentages of the load, proportional to their respective capacities, a feature that the Examiner concluded was absent from Heber.

Hence, Li raises at least one SNQ.

3. Butka (Secondary Reference) (Appendix G)

U.S. Patent No. 6,735,704 to Butka et al. (“Butka”) issued on May 11, 2004 from an application filed October 20, 2000. Butka thus qualifies as prior art under 35 U.S.C. § 102(b). Butka is titled “Autonomic Control of Power Subsystems in a Redundant Power System,” and is directed to a modular power system in which each power module is equipped with its own controller, and it describes both the architecture and the operational logic for such a system.

4. Sundar (Secondary Reference) (Appendix H)

U.S. Patent Publication No. 2004/0109374 to Sundar (“Sundar”) was filed on September 8, 2003, and published on June 10, 2004. Sundar thus qualifies as prior art to the ’250 patent under 35 U.S.C. § 102(b). Sundar is titled “Failure tolerant parallel power source configuration,” and is directed to “a configuration of parallel power sources capable of powering a load which is tolerant of failure of individual ones of the power sources.” Appendix H at Cover, [0003].

5. Luo (Secondary Reference) (Appendix D)

U.S. Patent Publication No. 2005/0073783 to Luo et al. (“Luo”) was filed on October 2, 2003, and published on April 7, 2005. Luo thus qualifies as prior art to the ’250 patent under 35 U.S.C. § 102(b). Luo is titled “Parallel redundant power system and the control method for the same,” and is directed to “a power system that utilizes an unbalanced power calculation and a cross current limitation technique to control the response of [an] inverter.” Appendix D at Cover, [0002].

V. SPECIFIC APPLICATION OF PRIOR ART TO CHALLENGED CLAIMS

A detailed application of the prior art references discussed above to each of claims is set forth below. The following table summarizes the substantial new grounds of patentability addressed in this Request:

Ground (SNQ #)	Basis	Claims
1A	Anticipated under § 102 by Qahoug	1-3 and 8-10
1B	Obvious under § 103 in view of Qahoug	1-10
1C	Obvious under § 103 in view of Qahoug and Butka	1-10
1D	Obvious under § 103 in view of Qahoug, Butka and Luo	2 and 7
1E	Obvious under § 103 in view of Qahoug, Butka and Sundar	3, 9, and 10
2A	Obvious under § 103 in view of Li	1, 3-5, and 8-10
2B	Obvious under § 103 in view of Li and Luo	2, 6, and 7
2C	Obvious under § 103 in view of Li and Sundar	9 and 10

In addition to the prior art references themselves, the substantial new grounds of patentability are supported by Appendix C, a Declaration of Dr. R Jacob Baker, and numerous supporting pieces of evidence contained in Appendices A–L.

The prior art references discussed above make up multiple new grounds for non-patentability. These grounds present new technological teachings not found in the prosecution history with new prior art combinations and arguments not previously considered that address the claim element which the Examiner did not find to be in the prior art: “when needed, such that said controllers of said second and third power supplies increase the power outputs of their respective said power supply modules by different amounts, when needed, such that said second and third

power supply modules assume different additional percentages of the load that was shed by the first power supply module.”²

A. Ground 1A (SNQ #1): Claims 1- 3 and 8-10 Are Anticipated by Qahoug

Claims 1 (system) and 8 (method) are both directed to a multi-module power supply systems including first, second, and third power supply modules. Claim 1 indicates that the first, second, and third power supply modules “ha[ve] a controller.” Claim 8 indicates that the second and third power supply modules “ha[ve] a controller.”

To the extent that the Office concludes that claims 1 and 8 require multiple controllers, Qahoug explains that “each power sub-module ... can have its own independent design parameters” and may “be controlled with a different control scheme including, for example, fixed frequency pulse width modulation (PWM) control, variable frequency PWM control, hysteretic control, and variable frequency resonant control,” indicating the presence of a controller for each sub-module. Appendix E at [0033]. A POSA would have understood from Qahoug that, because each power control module could be controlled with a different control scheme, each power control module was under the control of its own controller. *See* Appendix C, ¶¶ 43–44. However, if an express disclosure of multiple controllers is required by the Office, then Qahoug alone (Ground 1B) and Qahoug in combination with Butka (Ground 1C) renders independent claims 1 and 8 obvious.

² Requesters do not concede that any Challenged Claims satisfy other requirements for patentability that cannot be raised in EPR, including Section 101 and 112.

1. Independent Claim 1

a. Element [1.pre]: “A load sharing, multi-module power supply system for supplying power to a load,”

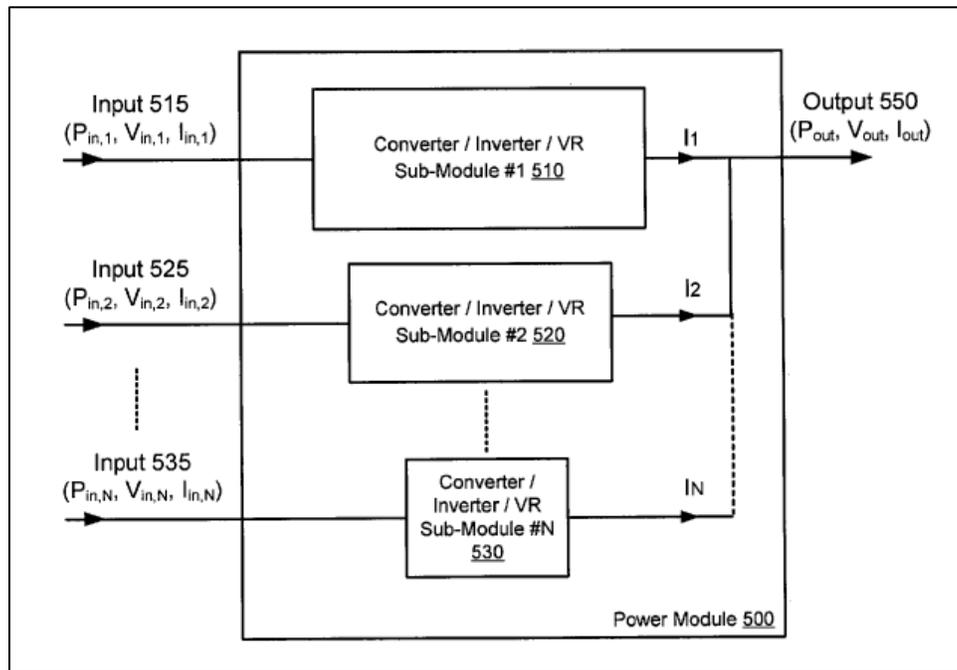
To the extent the preamble is limiting, Qahoug discloses “multiple power sub-modules of varying characteristics to improve the overall efficiency of the power modules ... across varying load currents, power outputs, input voltages, and other operating conditions.” Appendix E at [0014]. The system allows for adaptive, non-linear, and non-uniform current/power sharing among the sub-modules, which “may be individually controlled (*e.g.*, enabled, disabled, or altered) in response to the load current, power required at the power module output, or other operating condition(s),” (*id.*) thereby ensuring that “each individual power sub-module ... may be utilized in its maximum efficiency range.” *Id.* at [0031]. This control arrangement enables the system to “dynamically adapt to changing load requirements” and “improve the overall efficiency of the power module ... across the load power/current range.” *Id.* at [0028].

Thus, Qahoug teaches a load sharing, multi-module power supply system for supplying power to a load.

b. Element [1.1]: “a first power supply module having a controller and having a first per unit capacity (pu-c)”

Figure 5 of Qahoug (below) illustrates a plurality of power control modules including a first power supply module 510. Qahoug explains that “each power sub-module ... can have its own independent design parameters” and “[may] be controlled with a different control scheme including, for example, fixed frequency pulse width modulation (PWM) control, variable frequency PWM control, hysteretic control, and variable frequency resonant control,” indicating the presence of a controller for each sub-module. *Id.* at [0033]. A POSA would have understood from Qahoug that, because each power control module could be controlled with a different control

scheme, each power control module was under the control of its own controller. See Appendix C, ¶¶ 43–44.



Furthermore, Qahoug explains that “each of the power sub-modules ... may have a different size or efficient power/current range so that the first sub-module ... is larger (and efficient at a higher power/current) than the second sub-module,” “the first and second sub-modules are larger (and efficient at a higher power/current) than the third, and so on up to power sub-module N.” Appendix E at [0027]. Qahoug teaches by way of example that “the output 290 current required by a load may range approximately between 0 A and 60 A. Further, the power module 170 of an embodiment may include three parallel power sub-modules 410-430. Power sub-module 410 may be designed for maximum efficiency at 30 A, power sub-module 420 for 20 A, and power sub-module 430 for 10 A for a total efficient current capacity of 60 A.” *Id.* at [0031].

Thus, Qahoug teaches a first power supply module having a controller and having a first per unit capacity.

c. Element [1.2]: “a second power supply module having a controller and having a second per unit capacity (pu-c)”

Figure 5 of Qahoug discloses first (510) **and second (520) power supply modules**. As discussed above, a POSA would have understood from Qahoug that, because each power control module is controllable with a different control scheme, each power control module was under the control of its own controller. Furthermore, Qahoug teaches that “each of the power sub-modules 410-430 may have a different size or efficient power/current range so that the first sub-module 410 is larger (and efficient at a higher power/current) than the second sub-module 420, the first and second sub-modules are larger (and efficient at a higher power/current) than the third, and so on up to power sub-module N,” (Appendix E at [0027]) demonstrating that each module is designed for a distinct capacity. *See also id.* at [0031] (“the output 290 current required by a load may range approximately between 0 A and 60 A. Further, the power module 170 of an embodiment may include three parallel power sub-modules 410-430. Power sub-module 410 may be designed for maximum efficiency at 30 A, power sub-module 420 for 20 A, and power sub-module 430 for 10 A for a total efficient current capacity of 60 A.”).

Thus, Qahoug teaches a second power supply module having a controller and having a second per unit capacity.

d. Element [1.3]: “a third power supply module having a controller and having a third per unit capacity (pu-c)”

Figure 5 of Qahoug discloses first (510), second (520), **and third (530) power supply modules**. As discussed above, Qahoug demonstrates that each module is designed for a distinct capacity. *See id.* at [0027], [0031] (“the output 290 current required by a load may range approximately between 0 A and 60 A. Further, the power module 170 of an embodiment may include three parallel power sub-modules 410-430. Power sub-module 410 may be designed for

maximum efficiency at 30 A, power sub-module 420 for 20 A, and power sub-module 430 for 10 A for a total efficient current capacity of 60 A.”).

Thus, Qahoug teaches a third power supply module having a controller and having a third per unit capacity.

- e. **Element [1.4.a]: “said controller of said first power supply module adapted to implement a reduction in an output power of said first power supply module upon the detection of an operating event”**

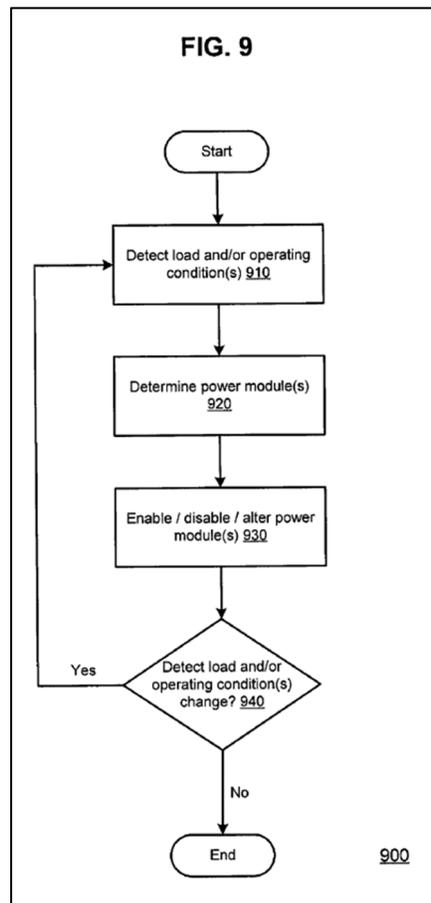
Qahoug explains that “a power module and/or power sub-module may be arranged to selectively and dynamically enable, disable, or alter the current or power sharing ratio among each power sub-module based on at least one of variable conditions, including load conditions, input power condition, temperature variations, component variations, fault condition in part of the circuit, or other suitable conditions, in order to generate an output capable of the operating condition.” Appendix E at [0047]. By way of example, Qahoug explains that:

an embodiment may be implemented by changing the current/power reference for each sub-module dynamically based on load demands and/or other operating conditions. An example of an embodiment is that for a certain load and/or other operating condition(s), the first power sub-module (*e.g.*, power sub-module 430 or 530) may process 20% of the power/current, the second power sub-module (*e.g.*, power sub-module 420 or 520) may process 30% of the power/current, and the third power sub-module (*e.g.*, power sub-module 410 or 510) may process 50% of the power/current. In an embodiment, when load and/or other operating condition(s) change, the power sub-modules 410-430 or 510-530 may be adjusted dynamically so that the first power sub-module processes 5% of the power/current, the second power sub-module processes 35% of the power/current, and the third power sub-module processes 60% of the power/current, and so on.

Id. at [0036].

Qahoug explains that the adjustment can be a reduction in output power as specified in the Figure 9 flowchart: “At 910, a load (for example at output 290 or output 550) and/or other operating condition(s) may be detected. Depending on the load and/or other operating condition(s)

detected, at 920 it is determined which individual power sub-modules, or combination of power sub-modules, is the most efficient for the detected load or other operating condition(s) ... at 930, and in response to the determination at 920, individual power sub-modules are enabled, disabled, or otherwise altered (*e.g.*, by changing the current sharing ratio among multiple enabled power sub-modules) to efficiently support the load and/or other operating condition(s).” *Id.* at Fig. 9 (below), [0037].



This demonstrates that, upon detection of an operating event, such as a change in load, temperature, or a fault, the controller of the first power supply module 510 can reduce its output power by either reducing its share of the load or disabling itself entirely. Qahoug further emphasizes the adaptive nature of the control. Each power module is configured to “dynamically adjust the current or power sharing ratio based on various types of sensed information,” (Appendix E at [0048]) ensuring that

“each individual power sub-module ... may be utilized in its maximum efficiency range” (*id.* at [0031]) and that the overall system “may have a wider total efficiency curve ... compared to power modules not similarly designed.” *Id.* at [0035].

Thus, Qahoug implements a reduction in an output power of said first power supply module upon the detection of an operating event.

f. Element [1.4.b]: “where a portion of said load being handled by said first power supply module is shed by a determined percentage”

Qahoug explains that “the amount of power/current handled by each power sub-module is varied dynamically, or in other words, current/power sharing percentage/ratio is changed dynamically,” (*id.* at [0036]) allowing the system to “dynamically enable, disable, or alter the current or power sharing ratio among each power sub-module based on at least one of variable conditions, including load conditions, input power condition, temperature variations, component variations, fault condition in part of the circuit, or other suitable conditions, in order to generate an output capable of the operating condition.” *Id.* at [0047]. This approach ensures that “[t]he current or power ratio may be dynamically adjusted in an attempt to improve or maximize operating efficiency under all conditions, improve or maximize dynamic performance under all conditions, improve reliability, improve or maximize performance per Watt, and so forth.” *Id.*

Qahoug discloses an example where the first sub-module sheds its load by 15%, from 20% to 5%:

An example of an embodiment is that for a certain load and/or other operating condition(s), ***the first power sub-module (e.g., power sub-module 430 or 530) may process 20% of the power/current***, the second power sub-module (*e.g., power sub-module 420 or 520*) may process 30% of the power/current, and the third power sub-module (*e.g., power sub-module 410 or 510*) may process 50% of the power/current. In an embodiment, ***when load and/or other operating condition(s) change, the power sub-modules 410-430 or 510-530 may be adjusted dynamically so that the first power sub-module processes 5% of the power/current***, the second

power sub-module processes 35% of the power/current, and the third power sub-module processes 60% of the power/current.

Id. at [0036].

Thus, Qahoug teaches that a portion of the load being handled by the first power supply module is shed by a determined percentage.

- g. Element [1.4.c]: “such that said first power supply module remains operating during said operating event but at a reduced power output level”**

Qahoug explains by way of example that “the first power sub-module ... may process 20% of the power/current,” and that, when load and/or other operating condition(s) change, “the power sub-modules ... may be adjusted dynamically so that the first power sub-module processes 5% of the power/current,” thereby allowing the module to continue operating at a lower output rather than being completely disabled. Appendix E at [0036].

Thus, Qahoug teaches that the first power supply module remains operating during the operating event but at a reduced power output level.

- h. Element [1.5.a]: “upon the occurrence of said operating event, said controllers of said second and third power supply modules being adapted to increase their respective said power outputs so that each of said second and third power supply modules accommodates a subportion of said portion of said load that has been shed by said first power supply module when needed”**

Upon the occurrence of an operating event, Qahoug explains that “the amount of power/current handled by each power sub-module is varied dynamically, or in other words, current/power sharing percentage/ratio is changed dynamically,” such that “for a certain load and/or other operating condition(s), the first power sub-module ... may process 20% of the power/current, the second power sub-module... may process 30% of the power/current, and the third power sub-module... may process 50% of the power/current,” and when the load and/or other operating condition(s) change, “the power sub-modules ... may be adjusted dynamically so that the

first power sub-module processes 5% of the power/current, the second power sub-module processes 35% of the power/current, and the third power sub-module processes 60% of the power/current,” thereby enabling the controllers of the second (520) and third (530) power supply modules to increase their respective power outputs and accommodate the subportions of the load shed by the first power supply module (510). *Id.* at [0036].

Thus, Qahoug teaches that, upon the occurrence of an operating event, the second and third power supply modules are adapted to increase their respective power outputs so that each of the second and third power supply modules accommodates a subportion of the portion of the load that has been shed by the first power supply module when needed.

- i. **Element [1.5.b]: “such that said controllers of said second and third power supplies increase the power outputs of their respective said power supply modules by different amounts, when needed, such that said second and third power supply modules assume different additional percentages of the load that was shed by the first power supply module”**

Qahoug discloses that, upon the occurrence of an operating event such as a change in load or the disabling of a power sub-module, “[t]he enablement and disablement of individual power modules (*e.g.*, power sub-modules 410-430) may further be dynamically controlled to dynamically adapt to changing load requirements,” and “the remaining power sub-module or power sub-modules may operate in a power/current range for which they are efficient.” Appendix E at [0028]. Furthermore, with reference to Figure 8, Qahoug explains that “the amount of power/current handled by each power sub-module is varied dynamically, or in other words, current/power sharing percentage/ratio is changed dynamically.” *Id.* at [0036]. Qahoug further explains that “[t]he non-uniform, non-linear adaptive and dynamic current sharing can be further implemented in conjunction with the non-linear ON/OFF scheme as illustrated by Table 1,” and provides examples where, for a certain load, “the first power sub-module ... may process 20% of the power/current,

the second ... may process 30% ... and the third ... may process 50%,” and when conditions change, “the first power sub-module processes 5% ... the second ... 35% ... and the third ... 60%.” *Id.*

Thus, Qahoug teaches that, upon an operating event, the controllers of the remaining modules increase their outputs by different amounts as needed, so that each assumes a different additional percentage of the load shed by the disabled module.

2. Dependent Claim 2

- a. **“The system of claim 1, wherein said operating event comprises a temperature increase of a component of said first power supply module beyond a predetermined temperature threshold.”**

Qahoug discloses that a power sub-module may be “arranged to selectively and dynamically enable, disable, or alter the current or power sharing ratio among each power sub-module based on at least one of variable conditions, including load conditions, input power condition, **temperature variations**, component variations, fault condition in part of the circuit, or other suitable conditions, in order to generate an output capable of the operating condition.” Appendix E at [0047]. A POSA would have known that in order to detect a temperature variation, a predetermined temperature threshold must be set. *See* Appendix C, ¶¶ 46–48.

Thus, Qahoug teaches that the operating event comprises a temperature increase of a component of the first power supply module beyond a predetermined temperature threshold.

3. Dependent Claim 3

- a. **“The system of claim 1, wherein said controllers of said second and third power supply modules determine a level of said subportion that each will accommodate based in part on their respective per unit capacities.”**

With reference to Figure 5 and its corresponding disclosure, Qahoug describes that each power sub-module (*e.g.*, 510, 520, 530) in power module 500 “has a separate input (*e.g.*, inputs 515-535 respectively)” and may be designed for different load capacities, allowing for “additional

flexibility, for example by independently altering the voltages of inputs 525-535, to further improve the overall efficiency of power module 500 across a broader range of loads.” Appendix E at [0032]. Qahoug further explains that “it may be that the power sub-modules designed for small loads (*e.g.*, power sub-module 530) may operate more efficiently at a voltage different than the voltage at which power sub-modules designed for large loads (*e.g.*, power sub-module 510) may operate.” *Id.*

Furthermore, with reference to Figure 4, Qahoug explains that “[e]ach of the power sub-modules (*e.g.*, power sub-modules 410-430) of power module 170 of an embodiment may be selected to operate efficiently at different current/power ranges,” (*id.* at [0028]) and that “the ratio of current sharing among the three power sub-modules may be, for example, 3:2:1 for power sub-modules 410-430 respectively,” with a control scheme where “the appropriate power sub-module 410-430 is turned ON or OFF (*e.g.*, enabled and disabled) depending on the required load current so that each individual power sub-module 410-430 may be utilized in its maximum efficiency range.” *Id.* at [0031]. This further demonstrates that the level of load (subportion) each sub-module accommodates is determined in part by its respective per unit capacity.

Thus, Qahoug teaches that the second and third power supply modules determine a level of the subportion that each will accommodate based in part on their respective per unit capacities.

4. Independent Claim 8

Other than the distinction that claim 1 is directed to a system and claim 8 is directed to a method, there are no substantive differences in the technical content or limitations recited in the two claims. Both claims require a multi-module power supply (or UPS) system comprising three power supply modules, each with a controller and a defined per unit capacity. In both claims, the first module reduces its output upon detection of an operating event, shedding a portion of its load but remaining operational at a reduced output. The controllers of the second and third modules are

then adapted (claim 1) or used (claim 8) to increase their respective outputs to accommodate the shed load, with the possibility that the increases are by different amounts so that the second and third modules assume different additional percentages of the load. The sequence of operations, the functional requirements, and the relationships between the modules and their controllers are the same in both claims. Appendix C, ¶ 84.

5. **Dependent Claim 9**

- a. **“The method of claim 8, wherein said subportions of said load being accommodated by said second and third power supply modules after the occurrence of said operating event are equal subportions.”**

Qahoug explains that “the amount of power/current handled by each power sub-module is varied dynamically, or in other words, current/power sharing percentage/ratio is changed dynamically.” Appendix E at [0036]. For example, Qahoug describes that “[t]he enablement and disablement of individual power modules ... may further be dynamically controlled to dynamically adapt to changing load requirements” (*id.* at [0028]), and that “[t]he current or power ratio may be dynamically adjusted in an attempt to improve or maximize operating efficiency under all conditions.” *Id.* at [0047]. This dynamic adjustment would, in some scenarios, result in equal sharing between two sub-modules—such as the second (520) and third (530)—especially if they have the same per unit capacities and the control logic or lookup table determines that equal sharing is optimal for the detected load or operating condition.

Thus, Qahoug teaches that the subportions of the load being accommodated by the second and third power supply modules after the occurrence of said operating event are equal subportions.

6. **Dependent Claim 10**

- a. **“The method of claim 8, wherein said controllers of said second and third power supply modules use said per unit capacity ratings of their respective said power supply modules in determining what percentage of said portion of said load being shed by said first power supply module that each of said second and third power supply modules is able to accommodate.”**

In the context of Figure 5, Qahoug explains that each power sub-module (510, 520, 530) in power module 500 can have its own independent design parameters and input, allowing for flexible and efficient load sharing based on their per unit capacity ratings. According to Qahoug, “each power sub-module may have a different input voltage, switching frequency, inductor and capacitor values, switch driving voltage and current, and switch parasitics mitigation,” and “[e]ach power sub-module in the power modules 400 and 500 may include a different power processing topology and circuitry that is suited for specific power range.” Appendix E at [0033].

When the first power supply module (510) sheds load, the second (520) and third (530) modules accommodate the load based on their respective capacities and design parameters, ensuring that “each individual power sub-module ... may be utilized in its maximum efficiency range.” *Id.* at [0031]. Thus, the allocation of the shed load among the second and third modules is determined by the per unit capacity and efficiency characteristics of each, as enabled by the independent and flexible architecture illustrated in Figure 5.

Thus, Qahoug teaches that the second and third power supply modules use the per unit capacity ratings of their respective power supply modules in determining what percentage of the portion of the load being shed by the first power supply module that each of the second and third power supply modules is able to accommodate.

B. Ground 1B (SNQ #2): Claims 1–10 Are Obvious in View of Qahoug

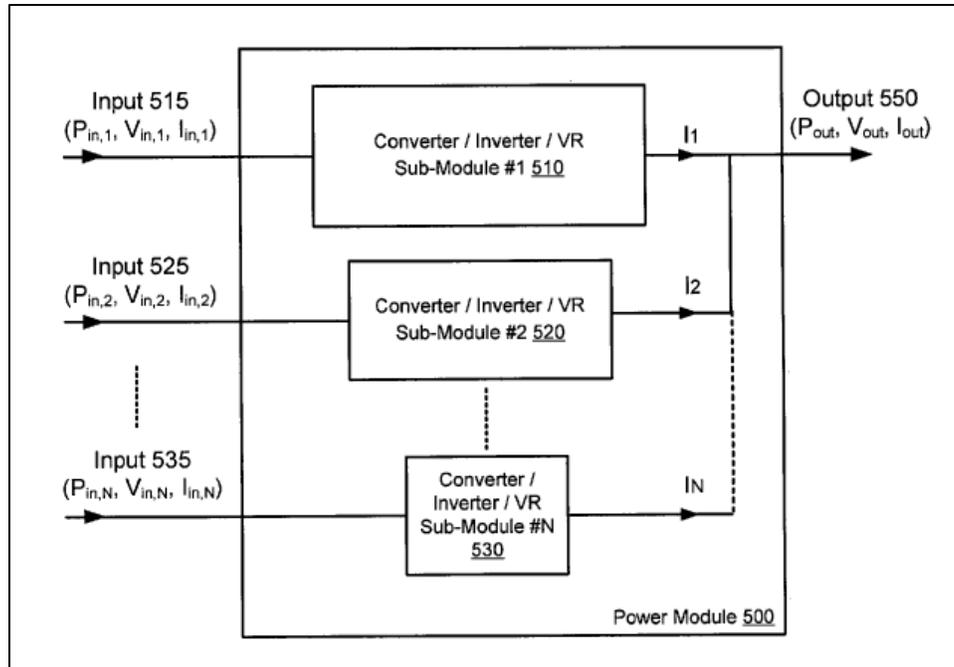
1. Independent Claim 1

a. Element [1.pre]: “A load sharing, multi-module power supply system for supplying power to a load,”

To the extent the preamble is limiting, Qahoug discloses “multiple power sub-modules of varying characteristics to improve the overall efficiency of the power module[s] ... across varying load currents, power outputs, input voltages, and other operating conditions.” Appendix E at [0014]. The system allows for adaptive, non-linear, and non-uniform current/power sharing among the sub-modules, which “may be individually controlled (*e.g.*, enabled, disabled, or altered) in response to the load current, power required at the power module output, or other operating condition(s),” (*id.*) thereby ensuring that “each individual power sub-module ... may be utilized in its maximum efficiency range.” *Id.* at [0031]. This control arrangement enables the system to “dynamically adapt to changing load requirements” and “improve the overall efficiency of the power module ... across the load power/current range.” *Id.* at [0028].

b. Element [1.1]: “a first power supply module having a controller and having a first per unit capacity (pu-c)”

Figure 5 of Qahoug (below) illustrates a plurality of power control modules including a first power supply module 510. Qahoug explains that “each power sub-module ... can have its own independent design parameters” and “[may] be controlled with a different control scheme including, for example, fixed frequency pulse width modulation (PWM) control, variable frequency PWM control, hysteretic control, and variable frequency resonant control,” indicating the presence of a controller for each sub-module. *Id.* at [0033]. A POSA would have understood from Qahoug that, because each power control module could be controlled with a different control scheme, each power control module was under the control of its own controller. *See* Appendix C, ¶ 49.



To the extent that Qahoug is silent whether each power supply module has a controller, it would have been obvious to modify Qahoug’s first power supply module to have such a controller. Qahoug repeatedly discusses the need for dynamic and adaptive control of the power sub-modules, such as enabling, disabling, or altering current sharing among sub-modules “dynamically in response to a change in the operating condition” and “based on at least one of variable conditions including load conditions, input power condition, temperature variations, component variations, or fault condition in part of the circuit.” Appendix E at Cl. 3, 29; Appendix C, ¶ 50.

Furthermore, the AAPA acknowledges that it was well-known in the art to use a controller on a power module or power sub-module. *See* Appendix C, ¶ 51. For example, the ’250 specification describes “prior art multi-module UPS system 100” as having a “[c]ontroller 118 [which] may be a programmable device such as a microcontroller, computer or the like.” Appendix A at 1:39-50, 2:2-3. The ’250 patent also depicts this prior art system with a controller:

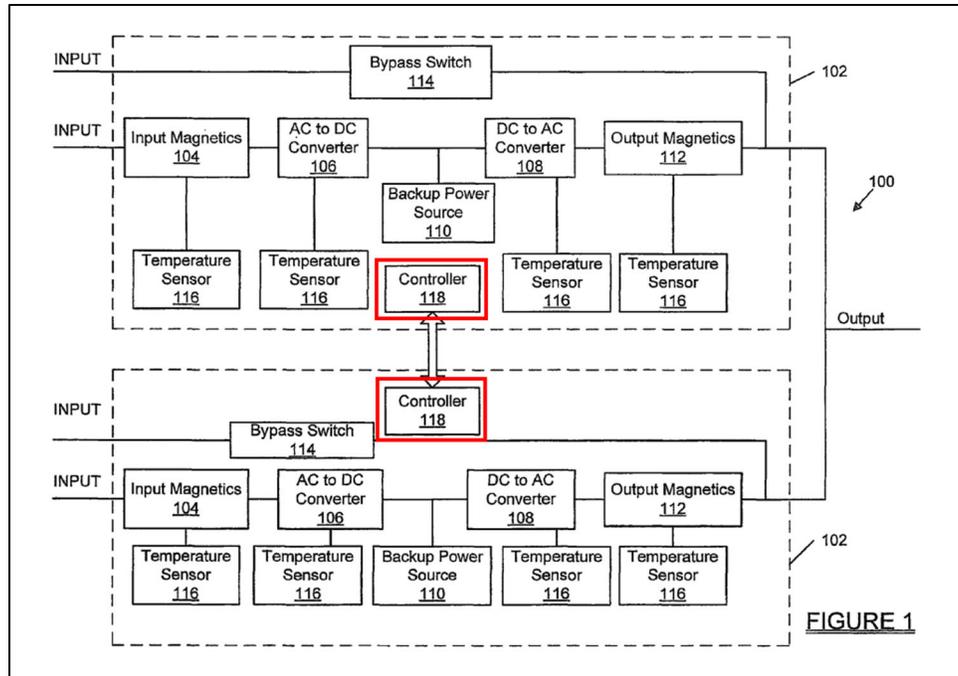


FIGURE 1

Appendix A at Fig. 1 (annotated).

A POSA would have understood that employing a controller would allow each power module to be “dynamically adjusted in an attempt to improve or maximize operating efficiency under all conditions, improve or maximize dynamic performance under all conditions, improve or maximize dynamic performance under all conditions, improve reliability, [and] improve or maximize performance per Watt.” *See* Appendix C, ¶ 52 (citing Appendix E at [0047]). Thus, implementing a controller for each power module would have been an obvious and routine design choice to achieve the adaptive, efficient, and reliable operation explicitly contemplated by Qahoug. *See* Appendix C, ¶ 52.

A POSA would have had a reasonable expectation of success in using a controller to control Qahoug’s first power supply module. Given that controllers were routinely used in the field to implement such adaptive and efficient power management strategies, a POSA would have recognized that integrating a controller would predictably achieve the desired improvements in

efficiency, reliability, and performance as contemplated by Qahoug, and would not encounter any technical obstacles in doing so. Appendix C, ¶ 53.

Furthermore, Qahoug explains that “each of the power sub-modules ... may have a different size or efficient power/current range so that the first sub-module ... is larger (and efficient at a higher power/current) than the second sub-module[,] the first and second sub-modules are larger (and efficient at a higher power/current) than the third, and so on up to power sub-module N.” Appendix E at [0027]. A POSA would have understood this to mean that each sub-module, including the first, is designed with a specific per unit capacity tailored to its optimal efficiency range. *See* Appendix C, ¶ 54.

c. Element [1.2]: “a second power supply module having a controller and having a second per unit capacity (pu-c)”

Figure 5 of Qahoug discloses first (510) and second (520) power supply modules. As discussed above, a POSA would have understood from Qahoug that, because each power control module could be controlled with a different control scheme, each power control module was under the control of its own controller. Moreover, it would have been obvious to modify Qahoug’s second power supply module to have such a controller for the reasons discussed above in Section V.B.1.b.

Furthermore, Qahoug teaches that “each of the power sub-modules 410-430 may have a different size or efficient power/current range so that the first sub-module 410 is larger (and efficient at a higher power/current) than the second sub-module 420, the first and second sub-modules are larger (and efficient at a higher power/current) than the third, and so on up to power sub-module N,” (Appendix E at [0027]) demonstrating that each module is designed for a distinct capacity. Appendix C, ¶¶ 55–56.

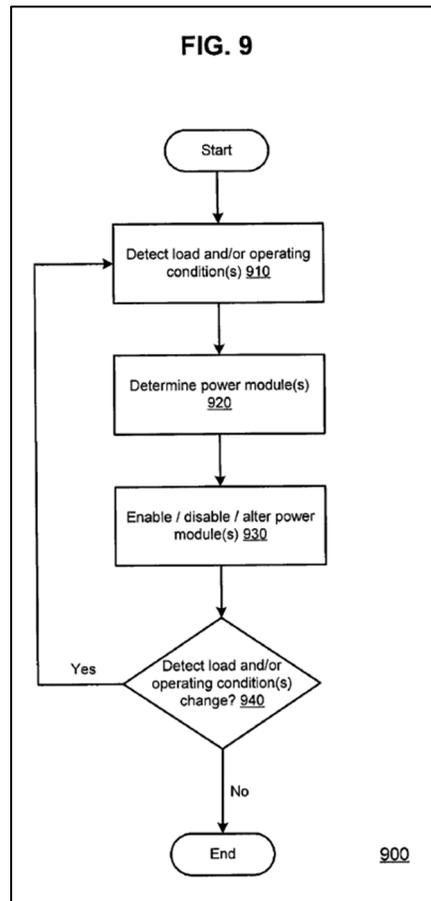
d. Element [1.3]: “a third power supply module having a controller and having a third per unit capacity (pu-c)”

Figure 5 of Qahoug discloses first (510), second (520), and third (530) power supply modules. As discussed above, a POSA would have understood from Qahoug that, because each power control module could be controlled with a different control scheme, each power control module was under the control of its own controller. Moreover, it would have been obvious to modify Qahoug’s third power supply module to have such a controller for the reasons discussed above in Section V.B.1.b. Furthermore, as discussed above, Qahoug teaches that “each of the power sub-modules 410-430 may have a different size or efficient power/current range.” Appendix E at [0027]; Appendix C, ¶ 57.

e. Element [1.4.a]: “said controller of said first power supply module adapted to implement a reduction in an output power of said first power supply module upon the detection of an operating event”

Qahoug explains that “a power module and/or power sub-module may be arranged to selectively and dynamically enable, disable, or alter the current or power sharing ratio among each power sub-module based on at least one of variable conditions, including load conditions, input power condition, temperature variations, component variations, fault condition in part of the circuit, or other suitable conditions, in order to generate an output capable of the operating condition.” Appendix E at [0047]. A POSA would have understood this to mean that each sub-module (*e.g.*, module 510) is specifically adapted to respond to detected operating events by adjusting its output. *See* Appendix C, ¶ 58. Qahoug further explains that the adjustment can be a reduction in output power as specified in the Figure 9 flowchart: “At 910, a load (for example at output 290 or output 550) and/or other operating condition(s) may be detected. Depending on the load and/or other operating condition(s) detected, at 920 it is determined which individual power sub-modules, or combination of power sub-modules, is the most efficient for the detected load or

other operating condition(s) ... at 930, and in response to the determination at 920, individual power sub-modules are enabled, disabled, or otherwise altered (*e.g.*, by changing the current sharing ratio among multiple enabled power sub-modules) to efficiently support the load and/or other operating condition(s).” Appendix E at Fig. 9 (below), [0037].



This demonstrates that, upon detection of an operating event, such as a change in load, temperature, or a fault, the controller of the first power supply module 510 can reduce its output power by either reducing its share of the load or disabling itself entirely. *See* Appendix C, ¶ 59.

Qahoug further emphasizes the adaptive nature of the control. Each power module is configured to “dynamically adjust the current or power sharing ratio based on various types of sensed information,” (Appendix E at [0048]) ensuring that “each individual power sub-module ... may be utilized in its maximum efficiency range” (*id.* at [0031]) and that the overall system “may

have a wider total efficiency curve ... compared to power modules not similarly designed.” *Id.* at [0035]; Appendix C, ¶ 60.

f. **Element [1.4.b]: “where a portion of said load being handled by said first power supply module is shed by a determined percentage”**

Qahoug explains that “the amount of power/current handled by each power sub-module is varied dynamically, or in other words, current/power sharing percentage/ratio is changed dynamically,” (*id.* at [0036]) allowing the system to “dynamically enable, disable, or alter the current or power sharing ratio among each power sub-module based on at least one of variable conditions, including load conditions, input power condition, temperature variations, component variations, fault condition in part of the circuit, or other suitable conditions, in order to generate an output capable of the operating condition.” *Id.* at [0047]. This approach ensures that “[t]he current or power ratio may be dynamically adjusted in an attempt to improve or maximize operating efficiency under all conditions, improve or maximize dynamic performance under all conditions, improve reliability, improve or maximize performance per Watt, and so forth.” *Id.*

Qahoug discloses an example where the first sub-module sheds its load by 15%, from 20% to 5%:

An example of an embodiment is that for a certain load and/or other operating condition(s), ***the first power sub-module (e.g., power sub-module 430 or 530) may process 20% of the power/current***, the second power sub-module (*e.g., power sub-module 420 or 520*) may process 30% of the power/current, and the third power sub-module (*e.g., power sub-module 410 or 510*) may process 50% of the power/current. In an embodiment, ***when load and/or other operating condition(s) change, the power sub-modules 410-430 or 510-530 may be adjusted dynamically so that the first power sub-module processes 5% of the power/current***, the second power sub-module processes 35% of the power/current, and the third power sub-module processes 60% of the power/current.

Id. at [0036].

- g. Element [1.4.c]: “such that said first power supply module remains operating during said operating event but at a reduced power output level”**

Qahoug explains by way of example that “the first power sub-module ... may process 20% of the power/current,” and that, when load and/or other operating condition(s) change, “the power sub-modules ... may be adjusted dynamically so that the first power sub-module processes 5% of the power/current,” thereby allowing the module to continue operating at a lower output rather than being completely disabled. *Id.*

- h. Element [1.5.a]: “upon the occurrence of said operating event, said controllers of said second and third power supply modules being adapted to increase their respective said power outputs so that each of said second and third power supply modules accommodates a subportion of said portion of said load that has been shed by said first power supply module when needed”**

Upon the occurrence of an operating event, Qahoug explains that “the amount of power/current handled by each power sub-module is varied dynamically, or in other words, current/power sharing percentage/ratio is changed dynamically,” such that “for a certain load and/or other operating condition(s), the first power sub-module ... may process 20% of the power/current, the second power sub-module... may process 30% of the power/current, and the third power sub-module... may process 50% of the power/current,” and when the load and/or other operating condition(s) change, “the power sub-modules ... may be adjusted dynamically so that the first power sub-module processes 5% of the power/current, the second power sub-module processes 35% of the power/current, and the third power sub-module processes 60% of the power/current,” thereby enabling the controllers of the second (520) and third (530) power supply modules to increase their respective power outputs and accommodate the subportions of the load shed by the first power supply module (510). *Id.* at [0036].

- i. **Element [1.5.b]: “such that said controllers of said second and third power supplies increase the power outputs of their respective said power supply modules by different amounts, when needed, such that said second and third power supply modules assume different additional percentages of the load that was shed by the first power supply module”**

Qahoug discloses that, upon the occurrence of an operating event such as a change in load or the disabling of a power sub-module, “[t]he enablement and disablement of individual power modules (*e.g.*, power sub-modules 410-430) may further be dynamically controlled to dynamically adapt to changing load requirements,” and “the remaining power sub-module or power sub-modules may operate in a power/current range for which they are efficient.” Appendix E at [0028]. Furthermore, with reference to Figure 8, Qahoug explains that “the amount of power/current handled by each power sub-module is varied dynamically, or in other words, current/power sharing percentage/ratio is changed dynamically.” *Id.* at [0036]. Qahoug further explains that “[t]he non-uniform, non-linear adaptive and dynamic current sharing can be further implemented in conjunction with the non-linear ON/OFF scheme as illustrated by Table 1,” and provides examples where, for a certain load, “the first power sub-module ... may process 20% of the power/current, the second ... may process 30% ... and the third ... may process 50%,” and when conditions change, “the first power sub-module processes 5% ... the second ... 35% ... and the third ... 60%.” *Id.*

Thus, Qahoug teaches that, upon an operating event, the controllers of the remaining modules increase their outputs by different amounts as needed, so that each assumes a different additional percentage of the load shed by the disabled module.

2. **Dependent Claim 2**

- a. **“The system of claim 1, wherein said operating event comprises a temperature increase of a component of said first power supply module beyond a predetermined temperature threshold.”**

Qahoug discloses that a power sub-module may be “arranged to selectively and dynamically enable, disable, or alter the current or power sharing ratio among each power sub-module based on at least one of variable conditions, including load conditions, input power condition, **temperature variations**, component variations, fault condition in part of the circuit, or other suitable conditions, in order to generate an output capable of the operating condition.” Appendix E at [0047]. A POSA would have known that in order to detect a temperature variation, a predetermined temperature threshold must be set. Appendix C, ¶ 61.

3. **Dependent Claim 3**

- a. **“The system of claim 1, wherein said controllers of said second and third power supply modules determine a level of said subportion that each will accommodate based in part on their respective per unit capacities.”**

With reference to Figure 5 and its corresponding disclosure, Qahoug describes that each power sub-module (*e.g.*, 510, 520, 530) in power module 500 “has a separate input (*e.g.*, inputs 515-535 respectively)” and may be designed for different load capacities, allowing for “additional flexibility, for example by independently altering the voltages of inputs 525-535, to further improve the overall efficiency of power module 500 across a broader range of loads.” Appendix E at [0032]. Qahoug further explains that “it may be that the power sub-modules designed for small loads (*e.g.*, power sub-module 530) may operate more efficiently at a voltage different than the voltage at which power sub-modules designed for large loads (*e.g.*, power sub-module 510) may operate.” *Id.* A POSA would have understood that this arrangement enables the controllers of the second (520) and third (530) power supply modules to determine the level of the subportion

each will accommodate based in part on their respective per unit capacities as each sub-module can be independently enabled, disabled, or operated at different input voltages to match its optimal efficiency range and capacity for the given load. Appendix C, ¶¶ 62–63.

Furthermore, with reference to Figure 4, Qahoug explains that “[e]ach of the power sub-modules (e.g., power sub-modules 410-430) of power module 170 of an embodiment may be selected to operate efficiently at different current/power ranges,” (Appendix E at [0028]) and that “the ratio of current sharing among the three power sub-modules may be, for example, 3:2:1 for power sub-modules 410-430 respectively,” with a control scheme where “the appropriate power sub-module 410-430 is turned ON or OFF (e.g., enabled and disabled) depending on the required load current so that each individual power sub-module 410-430 may be utilized in its maximum efficiency range.” *Id.* at [0031]. This further demonstrates that the level of load (subportion) each sub-module accommodates is determined in part by its respective per unit capacity. *See* Appendix C, ¶ 64.

To the extent Qahoug is silent regarding accommodating based in part on the power sub-modules respective per unit capacities, Qahoug renders this subject matter obvious. Qahoug places great emphasis on efficiency. *See, e.g.*, Appendix E at [0037] (“Depending on the load and/or other operating condition(s) detected, at 920 it is determined which individual power sub-modules, or combination of power sub-modules, is the most *efficient* for the detected load or other operating condition(s).”). And, as discussed above, Qahoug teaches that power should be split up amongst a three-module system “dynamically.” *See id.* at [0036]. Thus, a POSA reading Qahoug, and considering Qahoug’s example where a second module picks up the load shed by a first module, would have been motivated to split the power amongst the second two modules according to their per-unit capacities. *See* Appendix C, ¶¶ 65–66.

4. **Dependent Claim 4**

- a. **“The system of claim 1, further comprising a communications bus for enabling said controllers of said first, second and third power supply modules to communicate with one another.”**

Qahoug teaches that the power sub-modules are “coupled” to each other: “the parts of multiple power sub-modules may be magnetically coupled, electrically coupled, or non-coupled as desired for a given implementation.” Appendix E at [0044]. Where Qahoug is silent regarding a communication bus, it would have been obvious to include that configuration. *See* Appendix C, ¶ 67. The logic flow described in Figure 9 of Qahoug and its accompanying text contemplates a process where the system “detect[s] load and/or operating condition(s)” and then “determine[s] which individual power sub-modules, or combination of power sub-modules, is the most efficient for the detected load or other operating condition(s),” followed by enabling, disabling, or altering sub-modules accordingly. Appendix E at [0037].

Furthermore, the AAPA “shows a basic block diagram of a prior art multi-module UPS system 100,” and depicts two controllers in communication with each other via a bus. Qahoug’s dynamic, adaptive control would have suggested to a POSA the need for information sharing between power supply modules, and a communications bus was a well-known, conventional means to facilitate such coordination in modular power systems, making its implementation an obvious design choice to a POSA. *See* Appendix C, ¶ 68.

5. **Dependent Claim 5**

- a. **“The system of claim 1, wherein each of said controllers of said power supply modules includes load sharing software for assisting in determining a portion of said load that its respective said power supply module may accommodate.”**

Qahoug describes that a power module may “selectively and dynamically enable, disable, or alter the current sharing among each power sub-module based on at least one of variable

conditions including load conditions, input power condition, temperature variations, component variations, or fault condition in part of the circuit” and that “[t]he current or power ratio may be dynamically adjusted in an attempt to improve or maximize operating efficiency under all conditions.” Appendix E at [0047]. The logic flow in Figure 9 further details a process where the system “detect[s] load and/or operating condition(s)” and then “determine[s] which individual power sub-modules, or combination of power sub-modules, is the most efficient for the detected load or other operating condition(s),” followed by enabling, disabling, or altering sub-modules accordingly. *Id.* at [0037].

It would have been obvious for a POSA to implement such dynamic and adaptive control using software or algorithms, as these were known standard means for executing logic that determines load sharing in response to changing conditions in modern power systems. *See* Appendix C, ¶¶ 69–70.

6. Dependent Claim 6

- a. Element [6.1]: “The system of claim 1, wherein each said power supply module further comprises: a plurality of temperature sensors for monitoring a plurality of components thereof”**

Qahoug discloses that a power module may be “selectively and dynamically enable[d], disable[d], or alter[ed]” based on “variable conditions, including load conditions, input power condition, temperature variations, component variations, fault condition in part of the circuit, or other suitable conditions.” Appendix E at [0047], Cl. 29. The reference to “temperature variations” as a basis for dynamic adjustment indicates the need for temperature monitoring of components within the power supply modules. It would have been obvious to a POSA to implement a plurality of temperature sensors on a power supply module and associated monitoring algorithms, as these are standard and necessary means for detecting temperature variations and protecting power supply components in adaptive power systems. *See* Appendix C, ¶¶ 71–72. Indeed, the AAPA makes clear

that this was well-known in the prior art: “[t]emperature sensors 116 may also be coupled to a controller 118 which controls UPS module 102.” Appendix A at 1:66–2:2 (describing a “prior art” system).

b. Element [6.2]: “each of said temperature sensors being in communication with said controller”

Integrating a plurality of temperature sensors in communication with the controller was an obvious and necessary implementation detail to achieve the temperature-responsive functionality expressly contemplated by Qahoug. *See* Appendix C, ¶ 73. Indeed, the AAPA makes clear that this was well-known in the prior art: “[t]emperature sensors 116 may also be coupled to a controller 118 which controls UPS module 102.” Appendix A at 1:66–2:2 (describing a “prior art” system).

7. Dependent Claim 7

a. Element [7.1]: “The system of claim 6, wherein said plurality of components of each said power supply module comprises: an input magnetics subsystem”

Qahoug discloses that “the parts of multiple power sub modules may be magnetically coupled, electrically coupled, or non-coupled as desired for a given implementation” (Appendix E at [0044]) and further describes that “[i]ndividual power sub-modules may be of varying type depending on their range of operation” (*id.* at [0041]) and may include “components and switches selection, inductor design, switching frequency, gate drive voltage, or different input voltage from a power source.” *Id.* at [0029]. A POSA would have thus understood that Qahoug’s architecture contemplates the use of magnetics—such as inductors or transformers—at the input stage of the power sub-modules, which are essential elements of an input magnetics subsystem, to facilitate power conversion, coupling, and efficiency optimization within the described adaptive power module. *See* Appendix C, ¶¶ 74–75. This is reinforced by the AAPA. Figure 1 of the ’250 patent illustrates prior art power control modules including input and output magnetic systems.

b. Element [7.2]: “an AC to DC converter”

Qahoug explains that a “power supply may include a DC to DC voltage regulator 250, **an AC to DC converter 260**, a DC to AC converter 270, an AC to AC regulator 280 or a combination thereof.” *See* Appendix E at FIG. 2, [0024]. Additionally, Qahoug describes that a power sub-module may be “may be implemented using any number or type of power stages or power processing blocks desired to produce a given output. Examples of such power stages or power processing blocks may include the DC-DC Voltage regulator 250, **the AC-DC converter 260**, the DC-AC converter 270, or the AC-AC voltage regulator 280, as noted with reference to FIG. 2.” *Id.* at [0038].

Indeed, the AAPA acknowledges that such an AC/DC converter was well-known in the art: “prior art multi-module UPS system 100 ... is shown as having two UPS modules 102 ... [which] includes ... **AC/DC converter 106.**” Appendix A at 1:39-2:5.

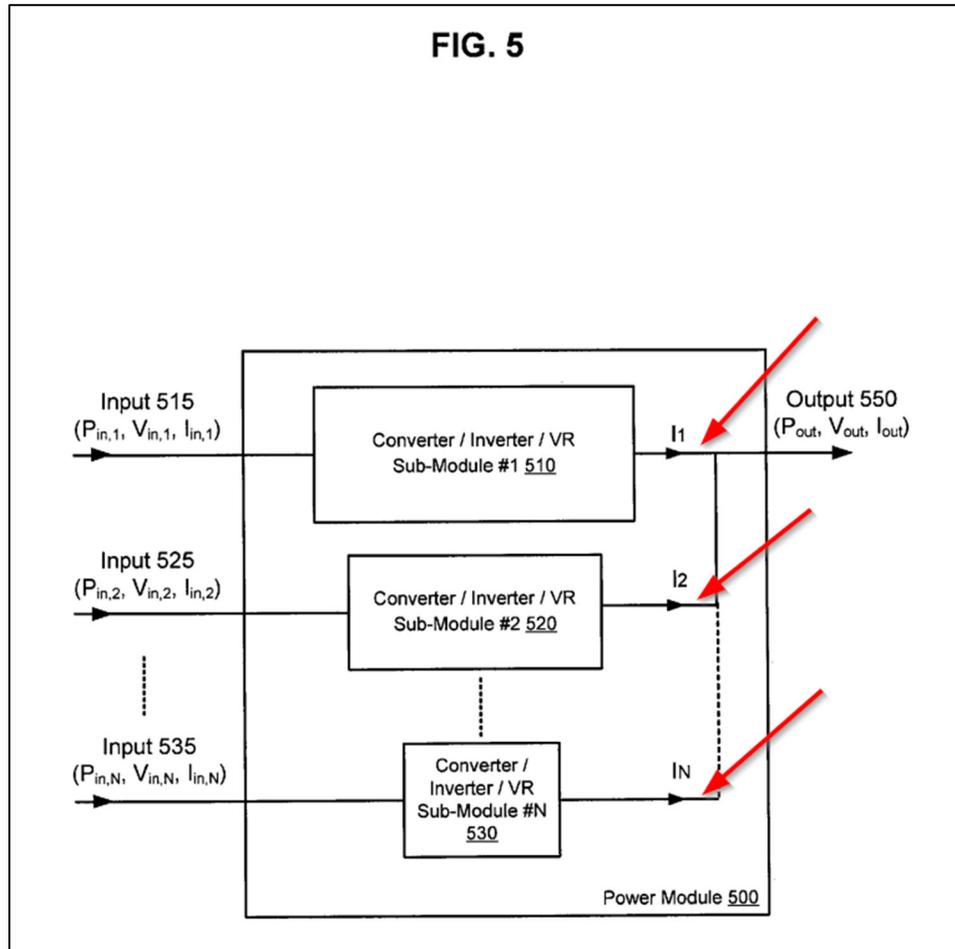
c. Element [7.3]: “a DC to AC converter”

Qahoug explains that “the power supply may include a DC to DC voltage regulator 250, an AC to DC converter 260, **a DC to AC converter 270**, an AC to AC regulator 280 or a combination thereof.” *See* Appendix E at FIG. 2, [0024]. Additionally, Qahoug describes that a power sub-module “may be implemented using any number or type of power stages or power processing blocks desired to produce a given output. Examples of such power stages or power processing blocks may include the DC-DC Voltage regulator 250, the AC-DC converter 260, **the DC-AC converter 270**, or the AC-AC voltage regulator 280, as noted with reference to FIG. 2.” *Id.* at [0038].

Indeed, the AAPA acknowledges that such a DC/AC converter was well-known in the art: “prior art multi-module UPS system 100 ... is shown as having two UPS modules 102 ... [which] includes ... [a] **DC/AC converter 108.**” Appendix A at 1:39-2:5.

d. Element [7.4]: “an output magnetics subsystem for generating said output power”

Qahoug teaches that its power sub-modules each have an output:



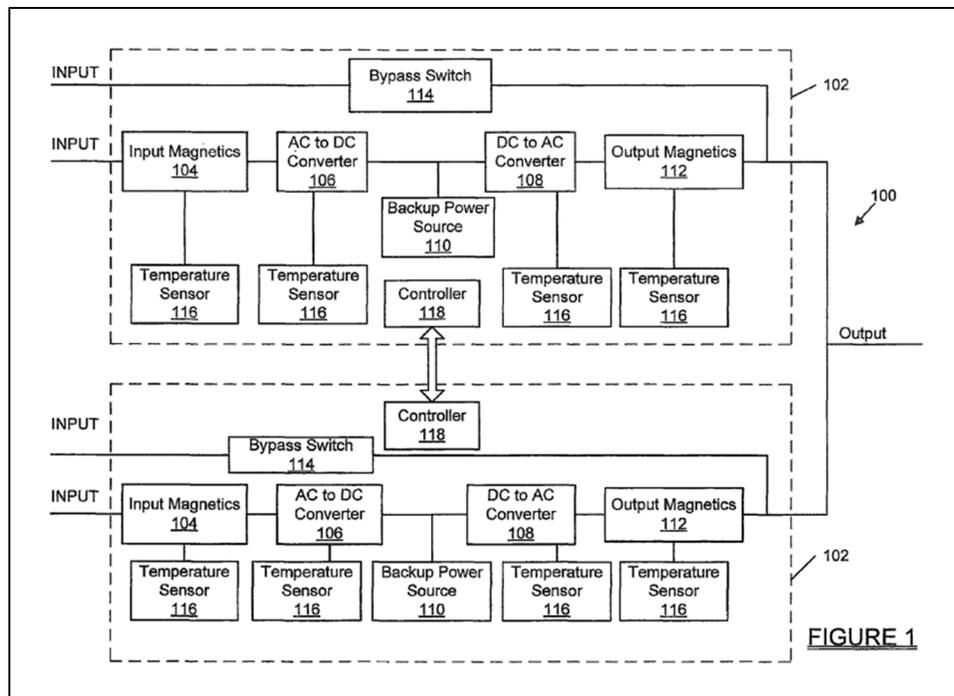
Appendix E at Fig. 5 (annotated). Further, as shown in Figure 5, each power sub-module (*i.e.*, power sub-modules 510-530) can have its own independent design parameters. For example, each power sub-module may have a different input voltage, switching frequency, inductor and capacitor values, switch driving voltage and current, and switch parasitics mitigation. *Id.* at [0033]. Qahoug’s reference to “inductor and capacitor values” directly implicates the use of output magnetics, as inductors are fundamental magnetic components in the output stages of power converters for energy storage and filtering. Additionally, Qahoug notes that “each power sub-module may be a Buck converter, one channel of multiphase Buck converter, or more generally

any power stage,” all of which require output magnetics for proper operation. *Id.* at [0041]. Therefore, Figure 5, through its depiction of sub-modules with customizable inductor design and its description of converter topologies that require output magnetics, discloses an output magnetics subsystem for generating said output power. Appendix C, ¶¶ 76–77. This is reinforced by the AAPA. Figure 1 of the ’250 patent illustrates prior art power control modules including input and output magnetic systems.

- e. **Element [7.5]: “a bypass switch coupled across an input side of said input magnetics subsystem and an output side of said output magnetics subsystem, and controlled by said controller, for bypassing its respective said power supply module”**

Qahoug’s reference to “switch parasitics mitigation” and the ability to “enable, disable, or alter the current sharing among each power sub-module dynamically in response to a change in the operating condition” implies the presence of switching elements that can bypass or isolate portions of the circuit, including across the input and output magnetics subsystems, to optimize efficiency and performance under varying load conditions. Appendix C, ¶ 78–80.

Furthermore, as the AAPA acknowledges, a bypass switch was well-known in the art: “prior art multi-module UPS system 100 ... is shown as having two UPS modules 102 ... [which] includes ... [a] bypass switch 114.” Appendix A at 1:39-2:5. This is depicted in Figure 1:



Id. at Fig. 1.

To the extent Qahoug may be silent regarding a bypass switch, use of a bypass switch would have been well-known and within the knowledge of a POSA. Including a bypass switch in Qahoug’s system would have enabled the selective isolation or bypassing of individual power sub-modules when they are not needed, thereby minimizing unnecessary power losses and improving overall system efficiency across varying load conditions. Appendix C, ¶¶ 81–82.

Qahoug teaches that “[t]he enablement and disablement of individual power modules ... may further be dynamically controlled to dynamically adapt to changing load requirements,” (Appendix E at [0028]) and that design parameters may include “components and switches selection” (*id.* at [0029]) as well as “switch parasitics mitigation.” *Id.* at [0033]. By incorporating a bypass switch, Qahoug would have more effectively disconnected inactive sub-modules, reduced conduction losses, mitigated parasitic effects, and ensured that only the most efficient sub-modules are active for a given load. This dynamic adaptability would have enhanced steady-state and

transient performance, optimized power delivery, and extended the useful efficiency range of the power module, especially at low or fluctuating loads. *See* Appendix C, ¶ 82.

A POSA would have had a reasonable expectation of success modifying Qahoug to include a bypass switch because Qahoug expressly contemplates the dynamic enablement and disablement of individual power sub-modules in response to changing load conditions, and discusses the importance of switch selection and parasitic mitigation as part of the design parameters. Qahoug's architecture already supports selective control over sub-modules to optimize efficiency, and the use of switches to control current paths was well-known in the field of power electronics. Incorporating a bypass switch to isolate or bypass inactive sub-modules would have been a straightforward and predictable modification, leveraging established circuit design principles to further reduce losses and improve efficiency, as Qahoug's system is already designed for modular adaptability and dynamic control. *See* Appendix C, ¶ 83.

8. Independent Claim 8

Other than the distinction that claim 1 is directed to a system and claim 8 is directed to a method, there are no substantive differences in the technical content or limitations recited in the two claims. Both claims require a multi-module power supply (or UPS) system comprising three power supply modules, each with a controller and a defined per unit capacity. In both claims, the first module reduces its output upon detection of an operating event, shedding a portion of its load but remaining operational at a reduced output. The controllers of the second and third modules are then adapted (claim 1) or used (claim 8) to increase their respective outputs to accommodate the shed load, with the possibility that the increases are by different amounts so that the second and third modules assume different additional percentages of the load. The sequence of operations, the functional requirements, and the relationships between the modules and their controllers are the same in both claims. Appendix C, ¶ 84.

9. **Dependent Claim 9**

- a. **“The method of claim 8, wherein said subportions of said load being accommodated by said second and third power supply modules after the occurrence of said operating event are equal subportions.”**

Qahoug explains that “the amount of power/current handled by each power sub-module is varied dynamically, or in other words, current/power sharing percentage/ratio is changed dynamically.” Appendix E at [0036]. A POSA would have understood this to mean that, while the system is designed to optimize efficiency and performance by enabling non-uniform sharing, it is also capable of implementing equal sharing if that is determined to be optimal or required by the control logic for a given set of conditions. Appendix C, ¶ 85.

For example, Qahoug describes that “[t]he enablement and disablement of individual power modules ... may further be dynamically controlled to dynamically adapt to changing load requirements” (Appendix E at [0028]), and that “[t]he current or power ratio may be dynamically adjusted in an attempt to improve or maximize operating efficiency under all conditions.” *Id.* at [0047]. This dynamic adjustment would, in some scenarios, result in equal sharing between two sub-modules—such as the second (520) and third (530)—especially if they have the same per unit capacities and the control logic or lookup table determines that equal sharing is optimal for the detected load or operating condition. Appendix C, ¶ 86. However, a POSA would have understood that, when the second (520) and third (530) power supply modules of Qahoug each accommodate equal subportions of a load after an operating event, the system benefits from improved overall efficiency by operating both modules within their optimal efficiency ranges, enhanced thermal management through even distribution of electrical and thermal stress, simplified and predictable control logic due to straightforward load allocation, and increased reliability and redundancy. Appendix C, ¶ 87.

10. Dependent Claim 10

- a. “The method of claim 8, wherein said controllers of said second and third power supply modules use said per unit capacity ratings of their respective said power supply modules in determining what percentage of said portion of said load being shed by said first power supply module that each of said second and third power supply modules is able to accommodate.”**

In the context of Figure 5, Qahoug explains that each power sub-module (510, 520, 530) in power module 500 can have its own independent design parameters and input, allowing for flexible and efficient load sharing based on their per unit capacity ratings. According to Qahoug, “each power sub-module may have a different input voltage, switching frequency, inductor and capacitor values, switch driving voltage and current, and switch parasitics mitigation,” and “[e]ach power sub-module in the power modules 400 and 500 may include a different power processing topology and circuitry that is suited for specific power range.” Appendix E at [0033].

A POSA would have understood this to mean that, when the first power supply module (510) sheds load, the second (520) and third (530) modules accommodate the load based on their respective capacities and design parameters, ensuring that “each individual power sub-module ... may be utilized in its maximum efficiency range.” *Id.* at [0031]. Thus, the allocation of the shed load among the second and third modules is determined by the per unit capacity and efficiency characteristics of each, as enabled by the independent and flexible architecture illustrated in Figure 5. Appendix C, ¶¶ 88–89.

C. Ground 1C (SNQ #3): Claims 1–10 Are Obvious in View of Qahoug and Butka

1. Independent claims 1 and 8; Dependent Claims 2-3, 5-7, 9-10

Butka discloses “a redundant power supply management system that includes a plurality of power subsystems each comprising a power supply and a controller for controlling the activation of each power supply, a power bus coupled to each power supply, a master controller, and a

communications bus coupled to said power subsystem and the master controller.” Appendix G at Fig. 1 (below), 1:60-66. Butka explains that “each [power supply] unit also comprises a controller 18A, 18B ... 18N, respectively, which monitors the state of the respective power supply and the power condition on the power bus 12.” *Id.* at 3:29-33. Butka’s architecture enables autonomous and coordinated operation of the modular power system, ensuring that “a predetermined number of power supplies are coupled to the power bus, even in the event of total or partial communication failure.” *Id.* at Abstract.

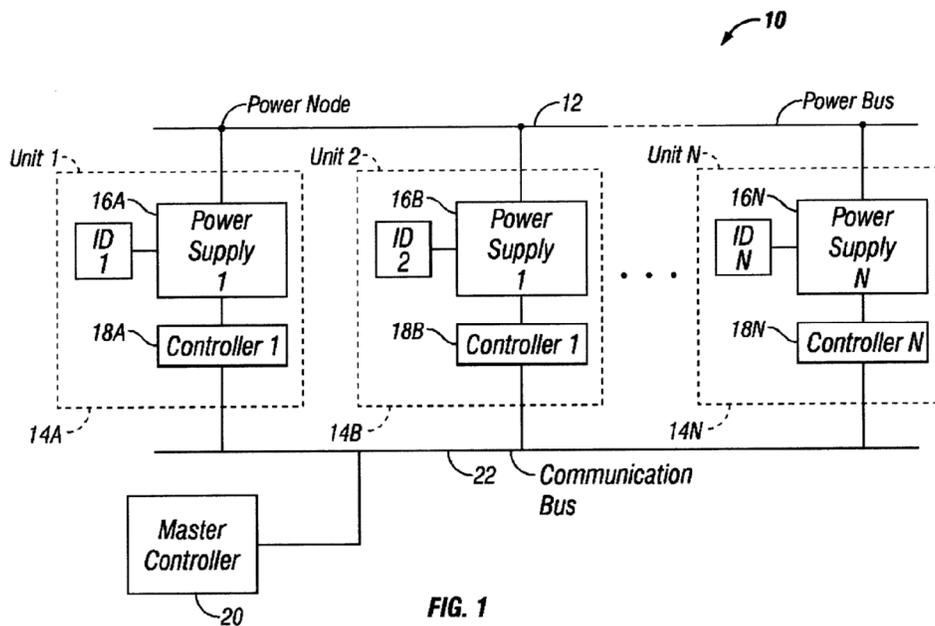


FIG. 1

A POSA would have modified Qahoug to have Butka’s architecture in order to achieve autonomous and coordinated management of the power modules. Appendix C, ¶¶ 90–91. As Butka describes, this architecture allows “each controller for each power supply ... [to] autonomously supply power to the power bus, even in the event of a communication bus failure[,]” (Appendix G at 4:17-20) and ensures that “a predetermined number of power supplies are coupled to the power bus, even in the event of total or partial communication failure.” *Id.* at Abstract. Integrating such controllers into Qahoug’s adaptive, dynamically enabled/disabled power modules would thus have

enhanced system reliability, scalability, and fault tolerance by allowing each module to independently monitor, control, and coordinate its operation within the larger system, as Butka teaches that “[t]he present invention provides management and control of N+M power supplies ... where any one of the power supplies may be capable of supplying power to all the loads of the power subsystems.” *Id.*

A POSA would have had a reasonable expectation of success in modifying Qahoug in view of Butka to provide each power module with a controller as taught by Butka because both references address modular, scalable power systems and explicitly contemplate autonomous control at the module level. The compatibility of these architectures and the explicit teaching in Butka that “the present invention provides management and control of N+M power supplies” would have led a POSA to reasonably expect that integrating such controllers into Qahoug’s modules would have been straightforward and effective, leveraging established control and communication techniques to enhance reliability and scalability. Appendix C, ¶ 92.

For the reasons set forth above in Ground 1B, Qahoug renders obvious all other limitations of claims 1 and 8 as well as dependent claims 2-3, 5-7, and 9-10. *See supra* Part V.B.1–10.

2. Dependent Claim 4

- a. **“The system of claim 1, further comprising a communications bus for enabling said controllers of said first, second and third power supply modules to communicate with one another.”**

Butka discloses that “each unit is coupled to a communications bus 22 to permit communication between each unit, including the status state of each power supply.” Appendix G at 3:33-36. Butka explains that “the communications bus permits the controller 18A, 18B . . . 18N to transmit status messages to the master controller 20 along the communication bus 22,” and that “[t]he status messages can include, for example, status information including the operational status of the communication bus, the operational conditions of the power supply associated with each

controller, failure reports of power supplies, and/or other data associated with the power supplies and/or power subsystems.” *Id.* at 3:41-49.

To the extent that Qahoug is silent regarding a communication bus, modifying Qahoug in view of Butka to include a communications bus enabling the controllers of the first, second, and third power supply modules to communicate with one another would enable coordinated, distributed control and enhanced system reliability. Butka’s communication infrastructure ensures that “each controller is adapted to couple the power supply to the power bus (thereby supplying power on the power bus) in the absence or failure of the communication bus 22.” *Id.* at 4:14-17. Integrating such a communications bus into Qahoug's architecture would allow Qahoug’s power modules to “selectively enable, disable, or alter the current sharing among each power sub-module dynamically in response to a change in the operating condition” (Appendix E at Cl. 3), while also supporting real-time coordination, redundancy management, and rapid response to failures, thereby improving overall system robustness and scalability. Appendix C, ¶¶ 94–95.

A POSA would have had a reasonable expectation of success in modifying Qahoug in view of Butka to include a communications bus because both references independently disclose modular power supply systems with controllers capable of dynamic control, and Butka explicitly teaches the use of a communications bus to coordinate such controllers. Qahoug, meanwhile, already contemplates selective enabling, disabling, and current sharing among sub-modules “dynamically in response to a change in the operating condition[,]” (Appendix E at Cl. 3) which is compatible with the type of inter-controller communication facilitated by Butka’s bus. The technologies are thus complementary, and the integration of a communications bus as taught by Butka would be a straightforward adaptation within the skill of the art, with both references providing clear guidance on implementation and expected functionality. Appendix C, ¶ 96.

D. Ground 1D (SNQ #4): Claims 2 and 7 are Obvious in View of Qahoug, Butka and Luo

1. Dependent Claim 2

- a. “The system of claim 1, wherein said operating event comprises a temperature increase of a component of said first power supply module beyond a predetermined temperature threshold.”**

Luo explains that “[t]he single module failure is the most problematic in the parallel power system and can be further categorized into two types. One type is referred to as non-urgent failure, such as the excess temperature and the DC bus voltage fault” and further clarifies that “[s]ince the output voltage and phase of the power system module are not immediately affected by the non-urgent failure, sufficient time exists to solve this kind of problem by interrupting or isolating the failed UPS module.” Appendix D at [0083]. This demonstrates to a POSA that an increase in temperature beyond a predetermined threshold (*i.e.*, “excess temperature”) of a component is recognized as a specific operating event that triggers protective action within the system. Appendix C, ¶ 97.

To the extent that Qahoug and Butka are silent regarding a predetermined temperature threshold, a POSA would have known that using an increase in temperature beyond a predetermined threshold (*i.e.*, “excess temperature”) of a component as a specific operating event that triggers protective action within the system would improve reliability of the system and prevent damage or failure. Qahoug’s system “selectively enable[s], disable[s], or alter[s] the current sharing among each power sub-module dynamically in response to a change in the operating condition” and thus would benefit from temperature monitoring in order to achieve early detection and enable isolation of overheating modules. A proactive response to excess temperature would increase system stability, extend component lifespan, and reduce the risk of cascading failures. Appendix C, ¶ 98.

A POSA would have had a reasonable expectation of success modifying Qahoug and Butka's system to determine an excess temperature as taught by Luo because Qahoug and Butka's system, which is designed to "selectively enable, disable, or alter the current sharing among each power sub-module dynamically in response to a change in the operating condition," is compatible with such event-driven protective measures. Given the established industry practice of monitoring temperature to prevent damage and the explicit disclosure in Luo that excess temperature can be reliably detected and acted upon to isolate a module without disrupting the system, a POSA would have reasonably expected that integrating this approach into Qahoug's adaptive, modular power architecture would be both technically feasible and effective. *See* Appendix C, ¶ 99.

2. **Dependent Claim 7**

- a. **Element [7.1]: "The system of claim 6, wherein said plurality of components of each said power supply module comprises: an input magnetics subsystem"**

Luo discloses "plural UPS modules each of which having an inverter, wherein the outputs of the inverters are coupled in parallel to supply the power to a load through a bus" (Appendix D at [0009]), and Figs. 3A (shown below) and 3B show that each UPS module includes "an inverter (11), a PWM driver (12) for driving the inverter (11), **an inductor current detector (13)** coupled to the output of the inverter (11), an output voltage detector (14), a load current detector (15) and a control unit (30)." *Id.* at [0038].

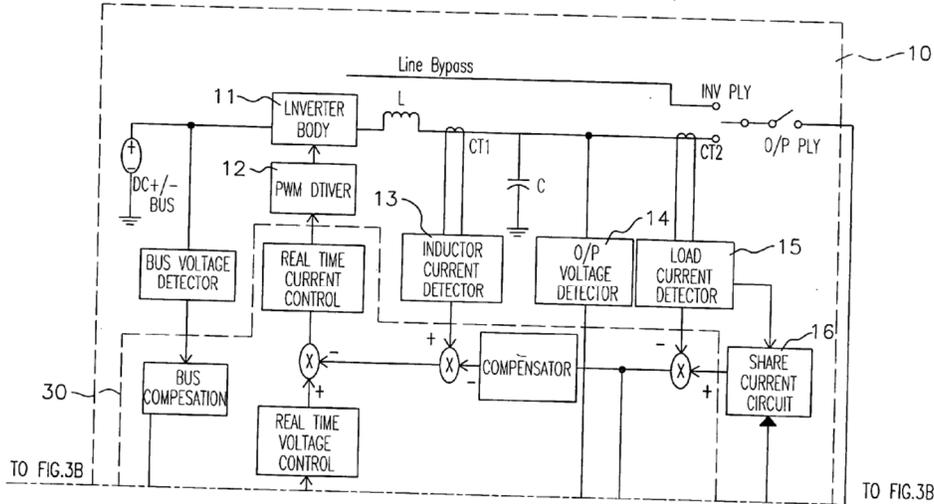


FIG.3A

A POSA would have understood that the presence of an “inductor current detector” in Luo implies the presence of an inductor, which is a magnetic element. In power conversion systems such as UPS modules, inductors are used for filtering, energy storage, and current smoothing. *See* Appendix C, ¶¶ 100–101.

Furthermore, Luo’s system includes “a current sharing circuit, a synchronizing clock signal circuit and a communication circuit coupled among the UPS modules.” Appendix D at C1. 1. Luo’s equivalent circuit diagrams and disclosure reflect that the system’s input stage includes magnetic components, as Luo explains that “each UPS module is simulated as an equivalent ideal AC power source connected with an output impedance Z_{si} ($i=1$ to N),” (*id.* at [0044]) and the current detection and sharing circuits are implemented with “a resistor network (*see* FIG. 6) controlled by the software,” (*id.* at [0080]) which is part of the current load sampling circuits that include magnetic elements for current sensing and filtering. *Id.* at [0044].

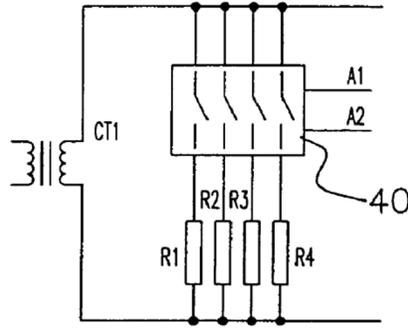


FIG. 6

Consistent with Luo’s teachings, the AAPA makes clear that input magnetics systems were well-known in the prior art: “prior art multi-module UPS system 100 ... is shown as having two UPS modules 102 ... [which] includes input magnetics subsystem 104 (such as an input transformer).” Appendix A at Fig. 1, 1:39-46.

To the extent that Qahoug and Butka are silent regarding an input magnetics system, it would have been obvious to include one in view of Luo. Luo emphasizes the importance of impedance matching and current sampling, explaining that “[t]he generation of the average current is based on the impedance matching of the current sampling circuits among all the UPS modules,” and that “a resistor network (*see* FIG. 6) controlled by the software is reserved in the current load sampling circuits.” Appendix D at [0080]. These current sampling and sharing circuits rely on input magnetic components to sense, filter, and balance currents between modules. *See* Appendix C, ¶¶ 102–104.

Integrating such an input magnetic subsystem into Qahoug and Butka’s architecture would have supported the adaptive, dynamic current sharing and module isolation described by Qahoug—“the parts of multiple power sub-modules may be magnetically coupled, electrically coupled, or non-coupled as desired for a given implementation” (Appendix E at [0044])—and

enabled Qahoug to “selectively and dynamically enable, disable, or alter the current or power sharing ratio among each power sub-module based on at least one of variable conditions.” *Id.* at [0047]. Thus, a POSA would have been motivated to incorporate an input magnetic subsystem as taught by Luo into Qahoug and Butka’s system in order to provide the necessary infrastructure for precise current management, protection, and adaptability in Qahoug’s modular power supply system. *See* Appendix C, ¶ 105.

A POSA would have had a reasonable expectation of success modifying Qahoug’s power supply module to include an input magnetics subsystem as taught by Luo because both references address parallel power architectures that require precise current sharing and module coordination, and both contemplate the use of magnetic coupling for these purposes. Since both systems are designed for modularity, adaptability, and dynamic current management, and since magnetic subsystems such as current transformers or coupled inductors were well-known in the art for enabling these functions, a POSA would have reasonably expected that integrating Luo’s input magnetic subsystem into Qahoug’s power module would function as intended, supporting “selectively and dynamically enable[ing], disable[ing], or alter[ing] the current or power sharing ratio among each power sub-module based on ...variable conditions” (Appendix E at [0047]), and thus improving current sharing, protection, and system stability without undue experimentation. Appendix C, ¶ 106.

b. Element [7.2]: “an AC to DC converter”

Qahoug explains that a “power supply may include a DC to DC voltage regulator 250, **an AC to DC converter 260**, a DC to AC converter 270, an AC to AC regulator 280 or a combination thereof.” *See* Appendix E at FIG. 2, [0024]. Additionally, Qahoug describes that a power sub-module “may be implemented using any number or type of power stages or power processing blocks desired to produce a given output. Examples of such power stages or power processing

blocks may include the DC-DC Voltage regulator 250, **the AC-DC converter 260**, the DC-AC converter 270, or the AC-AC voltage regulator 280, as noted with reference to FIG. 2.” *Id.* at [0038].

c. Element [7.3]: “a DC to AC converter”

Qahoug explains that “the power supply may include a DC to DC voltage regulator 250, an AC to DC converter 260, **a DC to AC converter 270**, an AC to AC regulator 280 or a combination thereof.” *See id.* at FIG. 2, [0024]. In Qahoug, a power sub-module “may be implemented using any number or type of power stages or power processing blocks desired to produce a given output. Examples of Such power stages or power processing blocks may include the DC-DC Voltage regulator 250, the AC-DC converter 260, **the DC-AC converter 270**, or the AC-AC voltage regulator 280, as noted with reference to FIG. 2.” *Id.* at [0038].

d. Element [7.4]: “an output magnetics subsystem for generating said output power”

Luo explains that “each UPS module is simulated as an equivalent ideal AC power source connected with an output impedance Z_{si} ($i=1$ to N).” Appendix D at [0044]. Luo discloses that “the output voltage values of the UPS modules ... are not the same with each other because of the different output impedances among the UPS modules,” and describes the system as “composed of plural UPS modules each of which having an inverter, wherein the outputs of the inverters are coupled in parallel to supply the power to a load through a bus.” *Id.* at [0049], Cl. 1. A POSA would have thus understood that an output magnetic subsystem (*e.g.*, inductors and associated circuitry) is integral to generating and delivering output power in Luo. Appendix C, ¶¶ 107–108. This is reinforced by the AAPA. Figure 1 of the ’250 patent illustrates prior art power control modules including input and output magnetic systems.

To the extent that Qahoug is silent regarding an output magnetic system, it would have been obvious to include one in view of Luo. Luo explains that “the output voltage values of the UPS modules ... are not the same with each other because of the different output impedances among the UPS modules,” (Appendix D at [0049]) highlighting the importance of output magnetic elements in managing and stabilizing output power. Incorporating such a subsystem into Qahoug would have therefore provided the necessary output impedance and current management, as “the outputs of the inverters are coupled in parallel to supply the power to a load through a bus,” ensuring reliable and efficient delivery of output power, as demonstrated in Luo. Appendix C, ¶ 109.

A POSA would have had a reasonable expectation of success modifying Qahoug to include an output magnetic subsystem as taught by Luo because Luo explicitly demonstrates that output magnetic components, such as inductors, are standard and effective for managing output power in parallel power systems: “each UPS module includes ... an inductor current detector (13) coupled to the output of the inverter (11),” and “each UPS module is simulated as an equivalent ideal AC power source connected with an output impedance Z_{si} ($i=1$ to N),” where the output impedance is implemented by magnetic elements. Luo further explains that these magnetic subsystems are essential for stabilizing and distributing output power, noting that “the output voltage values of the UPS modules ... are not the same with each other because of the different output impedances among the UPS modules.” Given that Qahoug’s architecture already accommodates modular and adaptive power conversion, a POSA would have recognized that integrating an output magnetic subsystem, as routinely practiced in Luo, would predictably provide the necessary output impedance and current management for reliable and efficient power delivery, and thus would have had a reasonable expectation of achieving the intended results. Appendix C, ¶¶ 110–111.

- e. **Element [7.5]: “a bypass switch coupled across an input side of said input magnetics subsystem and an output side of said output magnetics subsystem, and controlled by said controller, for bypassing its respective said power supply module”**

Luo discloses that “[t]he current sharing circuit (16) further comprises a switch element (shown in FIG. 4) that allows the inverter to be independently operated. The inverter can also be isolated simply by switching off the switch element to prevent any influences from surroundings.” Appendix D at [0071]. Luo explains that this switch is positioned such that “if the switching element is switched off, the respective UPS module ... works as an independent inverter,” (*id.* at [0075]) effectively bypassing the module, and that this isolation occurs “without the use of the POD (20)” (*id.* at [0032]), which is the power output distributor. A POSA would have thus understood that the switch is across the input and output sides of the module’s magnetics subsystem and is controlled by the control unit (30), which acts as the controller. Appendix C, ¶ 112.

To the extent that Qahoug is silent regarding a bypass switch, it would have been obvious to include one in view of Luo. Luo’s approach allows a controller to “interrupt[] or isolate the failed UPS module” so that “a single failed UPS module will not, at least not immediately, affect the other UPS modules,” thereby enhancing system robustness. Appendix D at [0083]. Applying this to Qahoug’s architecture would allow selective bypassing of a power sub-module “in response to a change in the operating condition” (Appendix E at Cl. 3), thus maintaining system operation and efficiency even if a sub-module experiences a fault, by “enabl[ing], disabl[ing], or alter[ing] the current or power sharing ratio among each power sub-module” (*id.* at [0047]) and physically bypassing the affected module as needed. Appendix C, ¶ 113.

A POSA would have had a reasonable expectation of success modifying Qahoug to include a bypass switch as taught by Luo because both references address modular power architectures

with provisions for isolating or bypassing individual modules to enhance reliability and maintain system operation during faults. Qahoug's architecture already supports dynamic enabling, disabling, or altering of sub-modules "in response to a change in the operating condition," and is designed for adaptability and efficiency across varying loads. Given this context, a POSA would have recognized that integrating a bypass switch controlled by a controller across the input and output magnetics, as in Luo, would be a straightforward and predictable modification to Qahoug's modular system, leveraging well-understood isolation techniques to further improve fault tolerance and operational flexibility, with no undue technical obstacles. Appendix C, ¶ 114.

E. Ground 1E (SNQ #5): Claims 3, 9 and 10 Are Obvious in View of Qahoug, Butka and Sundar

1. Dependent Claim 3

- a. "The system of claim 1, wherein said controllers of said second and third power supply modules determine a level of said subportion that each will accommodate based in part on their respective per unit capacities."**

Sundar discloses that in a parallel power source system, each power supply module (including second and third modules) determines the level of subportion it will accommodate based on its respective per unit capacity:

the sensing elements E_1, E_2, \dots, E_n are each current sensing elements such as resistors having a resistance which is inversely proportional to the power capacity of the corresponding source. In this implementation, the ratio $I_1:I_2$ of the contributions of load current supplied by any two sources is substantially equivalent to the ratio $P_1:P_2$ of the power capacities of the same two sources. That is achieved because the total load current I_L will divide into branch currents I_1, I_2, \dots, I_n that flow through each corresponding sensing element E_1, E_2, \dots, E_n according to the well-known current divider rule for current flow through parallel resistors. **One skilled in the art will recognize that the inverse relationship of the resistance of each branch to the power capacity of its corresponding source will result in each branch current having a magnitude in direct proportion to its corresponding power capacity.**

Appendix H at [0026], Fig. 1 (below).

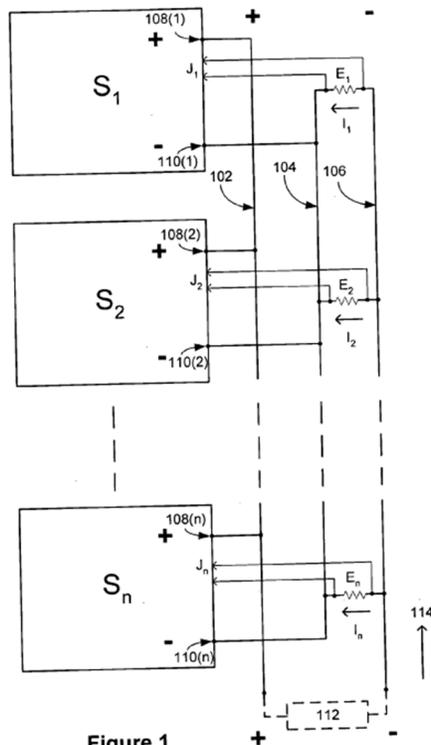


Figure 1

Butka discloses “a redundant power supply management system that includes a plurality of power subsystems each comprising a power supply and a controller for controlling the activation of each power supply, a power bus coupled to each power supply, a master controller, and a communications bus coupled to said power subsystem and the master controller.” Appendix G at 1:60-66, Fig. 1.

It would have been obvious to modify Qahoug and Butka’s architecture with the teachings of Sundar in order to achieve autonomous and coordinated management of the power modules. Butka describes that “each controller for each power supply ... can autonomously supply power to the power bus, even in the event of a communication bus failure.” *Id.* at 4:17-20. Sundar teaches that it was known that “[l]oad balancing may be achieved by adjusting the power supplied by an individual power source according to its power capacity” (Appendix H at [0005]) and that the ratio of the contributions of “load current supplied by any two sources is substantially equivalent to the ratio $P_j:P_k$ of the power capacities of the same two sources.” Appendix H at [0026]. Qahoug

already contemplates adaptive and dynamic current sharing: “the power module may employ an adaptive non-linear and non-uniform current/power sharing among its power sub-modules.” Appendix E at [0014]. Thus, a POSA would have been motivated to incorporate individual controllers for each power module, as in Butka, to enable autonomous and reliable operation while determining each module’s load share based on per unit capacity, as in Sundar, optimizing efficiency and ensuring balanced power delivery across modules of differing capacities. *See* Appendix C, ¶¶ 115–117.

A POSA would have had a reasonable expectation of success modifying Qahoug so that each power control module includes a controller as taught by Butka and the controllers of the second and third power supply modules determine a level of subportion each will accommodate based in part on their respective per unit capacities, as taught by Sundar, because the integration of controllers for autonomous operation and load allocation based on capacity was well known. Qahoug already contemplates adaptive and dynamic current sharing among sub-modules indicating to a POSA that the architecture is amenable to such modifications. Therefore, a POSA would have reasonably expected that combining these teachings would result in a robust, efficient, and predictable system. *See* Appendix C, ¶ 118.

2. **Dependent Claim 9**

- a. **“The method of claim 8, wherein said subportions of said load being accommodated by said second and third power supply modules after the occurrence of said operating event are equal subportions.”**

Sundar discloses that, in the event of a failure of one power source (the “operating event”), the remaining power sources accommodate the load by dividing it into equal subportions. Sundar explains that:

load 112 draws an aggregate load current 114 from sources $S_1, S_2, \dots S_n$, where current 114 is the aggregation of currents $I_1, I_2, \dots I_n$ originating from each of the

respective sources $S_1, S_2, \dots S_n$. Each individual current $I_1, I_2, \dots I_n$ flows through its corresponding power sensing element $E_1, E_2, \dots E_n$. The contribution to the load current 114 from each of the sources $S_1, S_2, \dots S_n$ is controlled by the current regulation means corresponding to each such source, and is determined responsive to the control signal $J_1, J_2, \dots J_n$ corresponding to that source.

Appendix H at [0022].

Sundar further explains that, “[a]ssuming that each such source is configured with a corresponding resistive current sensing element having a resistance inversely proportional to the power capacity of the corresponding power source in accordance with the same sizing standard, each such source will contribute a percentage of the overall load current in direct proportion to the ratio of its capacity to the capacity of the parallel system,” (*id.* at [0030]) and in the case of sources with identical capacities, “the load current I will divide among the sources S_1, S_2, S_3 in proportion to their respective capacities,” resulting in equal subportions. Appendix C, ¶¶ 119–120.

To the extent that Qahoug is silent regarding equal subportions, a POSA would have been motivated to modify Qahoug to have that claimed functionality. Sundar explains that “the load current I will divide among the sources S_1, S_2, S_3 in proportion to their respective capacities,” and in the case of identical sources, this results in equal sharing. Thus, a POSA would have recognized that implementing equal subportion sharing after a failure event, as in Sundar, would enhance load balancing and system robustness in Qahoug’s architecture. Appendix C, ¶ 121.

A POSA would have had a reasonable expectation of success implementing this modification because Sundar explicitly demonstrates that “the load current I will divide among the sources S_1, S_2, S_3 in proportion to their respective capacities,” and for identical sources, this results in equal sharing, which was a well-understood and straightforward principle in parallel power systems. Since Qahoug already contemplates dynamic enabling and disabling of sub-modules and current sharing among them, a POSA would have recognized that implementing Sundar’s equal sharing scheme after a failure event would have been technically feasible using established current

regulation and control techniques, and would predictably yield improved reliability and efficiency without requiring undue experimentation. Appendix C, ¶ 122.

3. Dependent Claim 10

- a. “The method of claim 8, wherein said controllers of said second and third power supply modules use said per unit capacity ratings of their respective said power supply modules in determining what percentage of said portion of said load being shed by said first power supply module that each of said second and third power supply modules is able to accommodate.”**

Sundar discloses that “the sensing elements $E_1, E_2, \dots E_n$ are each current sensing elements such as resistors having a resistance which is inversely proportional to the power capacity of the corresponding source,” and that “the ratio $I_J:I_K$ of the contributions of load current supplied by any two sources is substantially equivalent to the ratio $P_J:P_K$ of the power capacities of the same two sources.” Appendix H at [0026]. Sundar further explains that “the total load current I_L will divide into branch currents $I_1, I_2, \dots I_n$ that flow through each corresponding sensing element $E_1, E_2, \dots E_n$ according to the well-known current divider rule for current flow through parallel resistors,” and that “the inverse relationship of the resistance of each branch to the power capacity of its corresponding source will result in each branch current having a magnitude in direct proportion to its corresponding power capacity.” *Id.* Thus, Sundar teaches that the percentage of the load shed by a first power supply module and accommodated by the second and third modules is determined by their respective per unit capacity ratings.

To the extent that Qahoug and Butka are silent regarding determining the percentage of the portion of the load shed by a first power supply module that each of the second and third power supply modules is able to accommodate, a POSA would have been motivated to modify Qahoug to determine those percentages in light of Sundar’s teachings. Sundar’s approach ensures that, when a first power supply module sheds load, “each source will contribute a percentage of the

overall load current in direct proportion to the ratio of its capacity to the capacity of the parallel system,” thereby achieving “a desirable balancing or distribution of load currents, and contribut[ing] to a situation whereby each power source operates at or near its optimal efficiency range.” Appendix H at [0030]. Applying this approach to Qahoug would have allowed the system to dynamically and efficiently allocate the shed load among remaining modules based on their respective capacities, improving overall system reliability and efficiency. Appendix C, ¶¶ 123–124.

A POSA would have had a reasonable expectation of success modifying Qahoug and Butka to use per unit capacity ratings of respective power supply modules for load redistribution because Qahoug already teaches dynamic enabling, disabling, and current sharing among multiple power sub-modules to optimize efficiency, and Sundar provides a clear method for proportionally allocating load based on module capacity, which is readily applicable to Qahoug’s architecture. Thus, given the compatibility of the control schemes and the well-understood electrical principles underlying Sundar’s approach, a POSA would have reasonably expected that implementing per unit capacity-based load sharing in Qahoug would function as intended, resulting in improved system efficiency and reliability. Appendix C, ¶ 125.

F. Ground 2A (SNQ #6): Claims 1, 3-5, and 8-10 Are Obvious in View of Li

1. Independent Claim 1

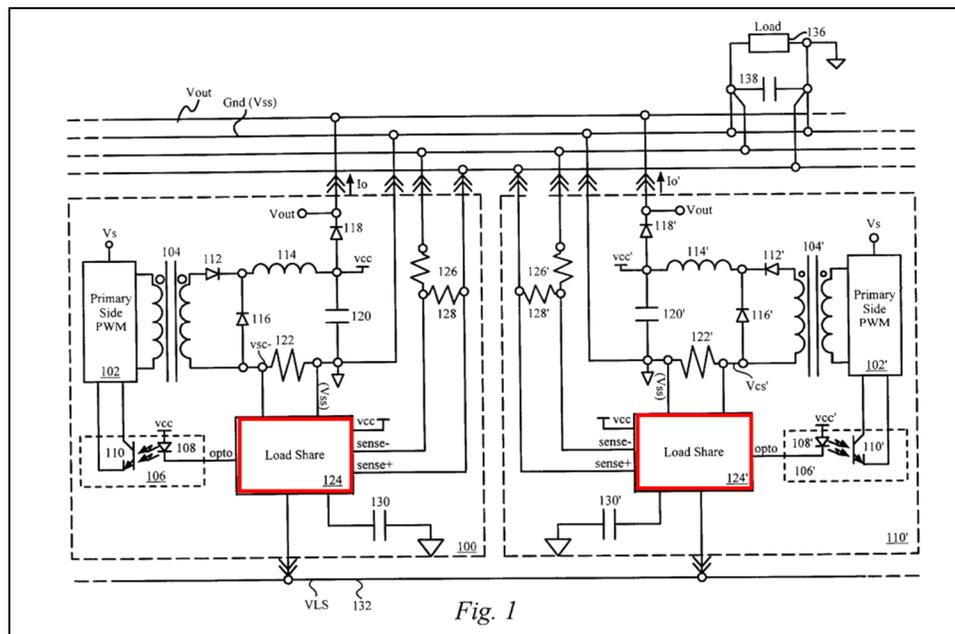
a. Element [1.pre]: “A load sharing, multi-module power supply system for supplying power to a load,”

To the extent the preamble is limiting, Li discloses it: “the present invention relates to electrical power supplies having a plurality of separable power supply modules coupled together so as to jointly share responsibility for supplying current to a load.” Appendix F at 1:7-10.

b. Element [1.1]: “a first power supply module having a controller and having a first per unit capacity (pu-c)”

Li discloses “an exemplary power supply having three power supply modules in a line arrangement, the first power supply module functions as a master relative a second power supply module, while the second power supply module functions as a slave relative the first power supply module and as a master relative a third power supply module. The third power supply module functions only as a slave.” *Id.* at 2:49-56.

Li teaches that each of these power supply modules includes a controller. Specifically, Li discloses that “[i]n the preferred embodiment, the load share control circuit 124 is implemented as an integrated circuit chip having eight pins” (*Id.* at 8:43-45) and explains that “control circuit 124” resides on an individual power module. Figure 1 of Li (below) depicts “[a] pair of power supply modules 100 and 100’.” *Id.* at 3:41-44. Although not illustrated, Li explains that “one or more additional power supply modules can be added.” *Id.* at 5:15-22. Figure 1 illustrates that each power supply module has its own control circuit (“Load Share”) 124 and 124’:



Id. at Fig. 1 (annotated).

Li teaches that each power supply module has a per-unit capacity: “As another example, assume that the power supply module 100' has a rated capacity that is one-third the rated capacity of the power supply module 100.” *Id.* at 5:63-65. Li further teaches that each power supply module has a “sensing resistor” that “forms a voltage signal” which is “proportional to a current” that is “supplied to the load [] by the power supply module.” *Id.* at 5:4-14. These “sensing resistor[s]” are connected to the “control circuit 124” which uses the voltage across the “sensing resistor” to control the output of the power module. *See id.*

c. Element [1.2]: “a second power supply module having a controller and having a second per unit capacity (pu-c)”

Figure 1 of Li illustrates two power supply modules (101 and 101'), each with a controller and a per-unit capacity, as described above in connection with Element [1.1]. Each power supply module 101 has its own control circuit (“Load Share”) 124 and 124'.

d. Element [1.3]: “a third power supply module having a controller and having a third per unit capacity (pu-c)”

Although Figure 1 (above) illustrates two power supply modules 101 and 101', Li explains that “one or more additional power supply modules can be added.” *Id.* at 5:15-22. Each power supply module includes a control circuit (“Load Share”) 124 and a per-unit capacity, as described above in connection with Element [1.1].

e. Element [1.4.a]: “said controller of said first power supply module adapted to implement a reduction in an output power of said first power supply module upon the detection of an operating event”

Li discloses that “the load share control circuit 124 implements two feedback loops. The first feedback loop controls the voltage applied to the load 136 (FIG. 1) while the second feedback loop controls the proportion of current supplied to the load 136 by the power supply module 100[,]” (*id.* at 8:36-41) and further explains that “[i]f the master should fail such that the current supplied

to the load 136 (FIG. 1) by the master is uncontrolled, one of the slaves assumes the role of master. In response, the new master reduces the amount of current supplied by itself and all the remaining power supply modules.” *Id.* at 7:43-48. Thus, controller 124 is adapted to implement a reduction in output power of the first power supply module upon the detection of an operating event, such as a failure condition.

f. Element [1.4.b]: “where a portion of said load being handled by said first power supply module is shed by a determined percentage”

Li describes that “[t]he current I_{FB} controls the output current of the slave such that the slave attempts to nearly match the level of current supplied by the master. The 25 mV offset provided by the offset circuit 206 generally prevents the level of current provided to the load 136 by the slave from falling below the level of current supplied by the master.” *Id.* at 7:34-41. This mechanism ensures that “each slave adjusts its respective output current to a level that is a predetermined amount above a level of current supplied by the master,” thereby shedding a portion of the load handled by the first power supply module by a determined percentage. *Id.* at Cl. 1.

To the extent that Li is silent that a portion of the load being handled by the first power supply module is shed by a determined percentage, it would have been obvious to do so. Li explains that “the relationships among rated power of the power supply modules and the values of the current sensing resistors are preferably inversely proportional.” *Id.* at 6:5-8. Li further indicates that “the predetermined proportional relationship is adjusted according to a proportional relationship between a rated capacity of the first power supply module and a rated capacity of the second power supply module.” Appendix F at Cl. 21.

A POSA would have thus understood that Li contemplates proportional (*i.e.*, percentage-based) relationships in current sharing, as the system is designed to allow modules of different capacities to share load in proportion to their ratings. Therefore, it would have been obvious to a

POSA to implement a scheme in Li in which a portion of the load handled by a first power supply module is shed by a determined percentage, as this was a straightforward application of the proportional sharing principles which could be implemented with a reasonable expectation of success. *See* Appendix C, ¶¶ 126–128.

g. Element [1.4.c]: “such that said first power supply module remains operating during said operating event but at a reduced power output level”

Li explains that, in the event of a failure or operating event, the system is designed so that “the master controls the remaining slaves to reduce their output, thereby compensating for the failed power supply module,” (Appendix F at 2:28-30) and further specifies that “[i]n response, the new master reduces the amount of current supplied by itself.” *Id.* at 7:46-48. A POSA would have understood this to mean that during such an operating event, the first power supply module (whether master or slave) “remains the master in absence of a failure condition” and continues to operate, but “reduces the amount of current supplied”—*i.e.*, it remains operating at a reduced power output level rather than shutting down entirely. Appendix C, ¶ 129.

h. Element [1.5.a]: “upon the occurrence of said operating event, said controllers of said second and third power supply modules being adapted to increase their respective said power outputs so that each of said second and third power supply modules accommodates a subportion of said portion of said load that has been shed by said first power supply module when needed”

When a failure occurs in Li—specifically, if the master fails such that its output current becomes uncontrolled or drops out—“one of the slaves assumes the role of master. In response, the new master reduces the amount of current supplied by itself and all the remaining power supply modules. This response is in contrast to prior techniques where such a ‘run away’ failure mode occurring in any power supply results in the failed power supply becoming the master which would

then increase the current supplied by all the slaves as they attempt to match the uncontrolled output current of the master.” Appendix F at 7:43-53.

However, once the system stabilizes, “the remaining modules adapt to maintain an appropriate level of current to the load.” *Id.* at 17:3-7. A POSA would have understood this to mean that the output of the remaining modules increases to accommodate the load previously supplied by the failed module, but in a controlled manner that avoids instability. *See* Appendix C, ¶¶ 130–131.

- i. **Element [1.5.b]: “such that said controllers of said second and third power supplies increase the power outputs of their respective said power supply modules by different amounts, when needed, such that said second and third power supply modules assume different additional percentages of the load that was shed by the first power supply module”**

As disclosed by Li, “[e]ither the power supply module 100 or the power supply module 100' can be the master and each will attempt to provide an appropriate proportion of the total amount of current through the load 136 according to the respective values of their current sensing resistors 122, 122'.” Appendix F at 5:67-6:5. Thus, each module increases its output by an amount determined by its own rated capacity and the configuration of its current sensing circuitry.

Li explains that “the relationships among rated power of the power supply modules and the values of the current sensing resistors are preferably inversely proportional.” *Id.* at 6:5-8. For example, “assume that the power supply module 100' has a rated capacity that is one-third the rated capacity of the power supply module 100. In such case, the current sensing resistor 122' is preferably three times the value of the current sensing resistor 122.” *Id.* at 5:63-67. As a result, when the first module sheds its share of the load, “each [power supply module] will attempt to provide an appropriate proportion of the total amount of current through the load 136 according to the respective values of their current sensing resistors 122, 122'.” *Id.* at 5:67-6:5. A POSA would

have understood that this ensures that the second and additional modules will assume different additional percentages of the load, proportional to their respective capacities. Appendix C, ¶¶ 132–134.

2. Dependent Claim 3

- a. “The system of claim 1, wherein said controllers of said second and third power supply modules determine a level of said subportion that each will accommodate based in part on their respective per unit capacities.”**

In Li, the controllers of the second and third power supply modules determine the level of the subportion of load each will accommodate “according to a proportional relationship between a rated capacity of the first power supply module and a rated capacity of the second power supply module” such that “the predetermined proportional relationship is adjusted according to a proportional relationship between a rated capacity of the first power supply module and a rated capacity of the second power supply module.” Appendix F at Cl. 21. This ensures that Li’s system provides load sharing control proportional to an individual source’s power supplying capacity (*i.e.* on a per unit basis) allowing each module to “adjust[] its respective output current to a level that is a predetermined amount above a level of current supplied by the master” (*Id.* at Cl. 1), thereby distributing the load according to their respective per unit capacities.

3. Dependent Claim 4

- a. “The system of claim 1, further comprising a communications bus for enabling said controllers of said first, second and third power supply modules to communicate with one another.”**

Li discloses “[a] common load share bus which interconnects all the power supply modules is driven by the master with a signal representative of the level of current supplied by the master.” *Id.* at 2:5-8. And since each of the modules can be a master (*see id.* at 5:34-36, 7:38-48), a POSA

would have understood Li to teach that the bus allows each of the modules to communicate with the other modules. *See* Appendix C, ¶ 135.

4. **Dependent Claim 5**

- a. **“The system of claim 1, wherein each of said controllers of said power supply modules includes load sharing software for assisting in determining a portion of said load that its respective said power supply module may accommodate.”**

Li discloses load control circuitry 124. Li explains that control circuit 124 determines the portion of the load that its respective power supply module may accommodate:

the load share control circuit 124 monitors the voltage across the load 136 via the SENSE- and SENSE+ terminals of the load share control circuit 124. The resistors 126 and 128 form a resistive divider which provides a voltage across the SENSE- and SENSE+ terminals that is proportional to the voltage across the load 136. In addition, **the load share control circuit 124 monitors a current I_O supplied to the load 136 by the power supply module 100.** For this purpose, the current sensing resistor 122 converts the current I_O into a voltage V_{CS-} at the CS-terminal of the load share control circuit 124. **The load share control circuit 124 also monitors a control voltage V_{LS} on the load share bus 132** via the LS_BUS terminal of the load share control circuit 124. **Based upon these monitored signals, the load share control circuit 124 forms a control signal** which is applied to the cathode of the diode 108 via the OPTO terminal of the load share control circuit 124.

Appendix F at 4:51-67.

It would have been obvious for a POSA to implement such dynamic and adaptive control using software or algorithms, as these were known and standard means for executing logic that determines load sharing in response to changing conditions in modern power systems. *See* Appendix C, ¶ 136–137.

5. **Independent Claim 8**

Other than the distinction that claim 1 is directed to a system and claim 8 is directed to a method, there are no substantive differences in the technical content or limitations recited in the two claims. Both claims require a multi-module power supply (or UPS) system comprising three

power supply modules, each with a controller and a defined per unit capacity. In both claims, the first module reduces its output upon detection of an operating event, shedding a portion of its load but remaining operational at a reduced output. The controllers of the second and third modules are then adapted (claim 1) or used (claim 8) to increase their respective outputs to accommodate the shed load, with the possibility that the increases are by different amounts so that the second and third modules assume different additional percentages of the load. The sequence of operations, the functional requirements, and the relationships between the modules and their controllers are the same in both claims. Appendix C, ¶ 138.

6. Dependent Claim 9

- a. “The method of claim 8, wherein said subportions of said load being accommodated by said second and third power supply modules after the occurrence of said operating event are equal subportions.”**

Li discloses that, “[s]hould one or more of the modules ... fail such that it no longer supplies current to the load[], or such that it supplies more than its proportionate share of current to the load, the remaining modules adapt to maintain an appropriate level of current to the load[.]” Appendix F at 17:3-7. Thus, Li’s system is designed to share load equally among functioning modules, and after a failure the remaining modules “attempt to provide a level of current to the load that is nearly equal or proportionate to the level of current being supplied by the master.” *Id.* at 5:46-51.

To the extent that Li is silent regarding equal subportions, configuring the controllers to seek equal proportions would have been obvious to a POSA because equal load sharing was a well-known and desirable objective in parallel power supply systems. Equal sharing minimizes the risk of overloading any single module, maximizes system reliability, and extends the operational life of the modules. Appendix C, ¶¶ 139–140.

The feedback and control mechanisms described by Li are already designed to “attempt to provide a level of current to the load that is nearly equal or proportionate” (Appendix F at 5:46-51) and the system includes features such as current sensing, feedback loops, and adaptive control that support equalization. Thus, a POSA would have found it obvious to configure the controllers to seek equal proportions after a failure, as this would have been a straightforward application of established engineering principles (*e.g.*, feedback loops) to achieve balanced and reliable operation in the event of a module failure. *See* Appendix C, ¶ 141.

7. **Dependent Claim 10**

- a. **“The method of claim 8, wherein said controllers of said second and third power supply modules use said per unit capacity ratings of their respective said power supply modules in determining what percentage of said portion of said load being shed by said first power supply module that each of said second and third power supply modules is able to accommodate.”**

In one example in Li, it is assumed that:

the power supply module 100' has a rated capacity that is one-third the rated capacity of the power supply module 100. In such case, the current sensing resistor 122' is preferably three times the value of the current sensing resistor 122. Either the power supply module 100 or the power supply module 100' can be the master and each will attempt to provide an appropriate proportion of the total amount of current through the load 136 according to the respective values of their current sensing resistors 122, 122'. It will be apparent, therefore, that the relationships among rated power of the power supply modules and the values of the current sensing resistors are preferably inversely proportional.

Appendix F at 5:63-6:8.

A POSA would have understood from this passage that a predetermined proportional relationship between a current sensed for the first power supply module and a current sensed for the second power supply module is adjusted according to a proportional relationship between a rated capacity of the first power supply module and a rated capacity of the second power supply module. *See* Appendix C, ¶¶ 142–143.

G. Ground 2B (SNQ #7): Claims 2, 6, and 7 Are Obvious in View of Li and Luo

1. Dependent Claim 2

- a. “The system of claim 1, wherein said operating event comprises a temperature increase of a component of said first power supply module beyond a predetermined temperature threshold.”**

Luo explains that “[t]he single module failure is the most problematic in the parallel power system and can be further categorized into two types. One type is referred to as non-urgent failure, such as the excess temperature and the DC bus voltage fault” and further clarifies that “[s]ince the output voltage and phase of the power system module are not immediately affected by the non-urgent failure, sufficient time exists to solve this kind of problem by interrupting or isolating the failed UPS module.” Appendix D at [0083]. This demonstrates that an increase in temperature beyond a threshold (*i.e.*, “excess temperature”) of a component is recognized as a specific operating event that triggers protective action within the system. Appendix C, ¶¶ 144–145. Further, the AIPA confirms that in “prior art multi-module UPS system 100,” “the temperature of critical components, inlet air and exhaust air of each UPS module 102 are monitored to determine if that UPS module 102 is operating within an acceptable range of temperatures.” Appendix A at Fig. 1, 1:39-40, 2:19-23.

A POSA would have been motivated to use a temperature increase of a component of Li’s first power supply module beyond a predetermined threshold as the basis of an operating event, as taught by Luo, because Luo explicitly recognizes excess temperature as a “non-urgent failure” that should trigger protective action: “The single module failure is the most problematic in the parallel power system and can be further categorized into two types. One type is referred to as non-urgent failure, such as the excess temperature and the DC bus voltage fault.” Appendix D at [0083]. Luo further explains that “sufficient time exists to solve this kind of problem by interrupting or isolating

the failed UPS module. That is to say, a single failed UPS module will not, at least not immediately, affect the other UPS modules.” *Id.* This teaching provides a clear rationale for monitoring temperature and using its increase beyond a threshold as an operating event, since it allows the system to preemptively isolate or protect modules before more severe failures occur, thereby enhancing system reliability and safety. Appendix C, ¶ 146.

A POSA would have had a reasonable expectation of success using a temperature increase of a component of Li’s first power supply module beyond a predetermined temperature threshold as the basis of an operating event, as taught by Luo, because Luo explicitly identifies excess temperature as a recognized and manageable failure mode in parallel power systems. This clear recognition of temperature as a trigger for protective action would assure a POSA that implementing such a threshold-based event would function as intended, providing a predictable and reliable means to detect and address potential module failures. *See* Appendix C, ¶ 147.

2. Dependent Claim 6

- a. Element [6.1]: “The system of claim 1, wherein each said power supply module further comprises: a plurality of temperature sensors for monitoring a plurality of components thereof”**

The AAPA confirms that in “prior art multi-module UPS system 100,” “the temperature of critical components, inlet air and exhaust air of each UPS module 102 are monitored to determine if that UPS module 102 is operating within an acceptable range of temperatures.” Appendix A at Fig. 1, 1:39-40, 2:19-23. AAPA (Figure 1) illustrates a plurality of temperature sensors 116 for monitoring a plurality of components of a power source module.

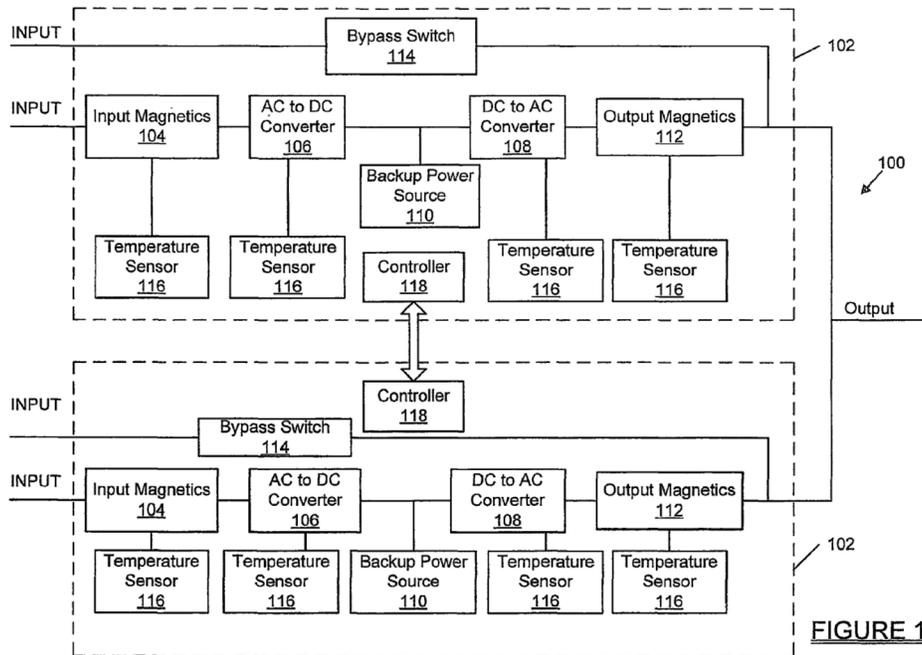


FIGURE 1

The use of a plurality of temperature sensors on a power source module, as illustrated by the AAPA (Figure 1), would enable comprehensive and localized monitoring of the thermal conditions of various critical components within the module. This distributed temperature monitoring allows for early detection of abnormal temperature rises in specific components, which may indicate localized faults, excessive power dissipation, or impending failures. By identifying such issues promptly, the system can initiate protective actions—such as reducing load, isolating the affected module, or triggering alarms—before the fault escalates to a level that could compromise the reliability or safety of the entire power system. Additionally, distributed temperature sensing supports predictive maintenance and extends the operational lifespan of the module by ensuring that all critical areas are maintained within safe operating limits, thereby improving system uptime and reducing the likelihood of catastrophic failures. Appendix C, ¶¶ 148–149.

b. Element [6.2]: “each of said temperature sensors being in communication with said controller”

The AAPA (Figure 1) (above) illustrates that the temperature sensors 116 are “coupled to a controller 118 which controls UPS module 102.” Appendix A at 1:67-2:2. The AAPA demonstrates that such configurations were well-known for real-time monitoring and management of thermal conditions within power modules. By integrating multiple temperature sensors, the controller can detect localized overheating, thermal gradients, or abnormal temperature rises at various critical points within each module, enabling more accurate and timely protective actions such as current derating, module shutdown, or fan activation. This modification ensures that the power supply system can prevent thermal damage, extend component lifespan, and maintain stable operation under varying load and environmental conditions, thereby addressing recognized industry challenges and aligning with established best practices as shown in the AAPA. Appendix C, ¶ 150.

A POSA would have had a reasonable expectation of success modifying Li in view of Luo to include a plurality of temperature sensors on each power source module, with each sensor communicating with Li’s control circuitry, because the AAPA and Luo demonstrate that integrating multiple sensors for localized monitoring was a well-understood and straightforward extension of existing control and protection schemes. Li’s modular architecture already supports the integration of additional feedback and control signals, as it features “a load share control circuit” and “feedback loops included in each power supply module control the output level of the power supply.” Appendix F at 2:11-13. Thus, a POSA would have recognized that adding multiple temperature sensors and linking them to the existing control circuitry would be a routine design choice, leveraging established feedback and protection mechanisms to enhance system reliability, with no technical barriers or unpredictability in implementation. Appendix C, ¶ 151.

3. **Dependent Claim 7**

- a. **Element [7.1]: “The system of claim 6, wherein said plurality of components of each said power supply module comprises: an input magnetics subsystem”**

Each power supply module described in Li contains a transformer as a key component in its input stage. For example, Li explains that “[t]he pulse-width modulation circuit 102 provides current pulses to a primary winding of a transformer 104. The duty cycle and duration of the current pulses provided to the primary winding of the transformer 104 are controlled according to a feedback signal provided to the pulse-width modulation circuit 102 via an opto-isolator 106.” Appendix F at 3:47-52. A POSA would have known that the transformer is a magnetic component that serves to transfer energy from the input to the output, provide isolation, and enable voltage conversion within the power supply module. As part of the input stage, a POSA would have understood that the transformer constitutes an input magnetic system. Thus, each power supply module in Li is equipped with an input magnetic system in the form of a transformer. Appendix C, ¶¶ 152–153.

- b. **Element [7.2]: “an AC to DC converter”**

Luo discloses an AC/DC converter as part of the UPS module, explaining that “the ... power system is composed of plural UPS modules each of which having an inverter, wherein the outputs of the inverters are coupled in parallel to supply the power to a load through a bus” (Appendix D at [0009]) and that “all the UPS modules ... are coupled to the AC input line voltage (Line in) in parallel. The power system further includes batteries (not shown) to supply power to the load when the AC input voltage is abnormal,” indicating that the system receives AC input and converts it for use by the UPS and its inverter. *Id.* at [0033].

A POSA would have been motivated to modify Li to include an AC/DC converter as taught by Luo. Given that Li’s modular power supply system is designed for flexibility and reliability in

supplying current to a load, a POSA would have recognized the benefit of integrating Luo's AC/DC converter to enhance Li's system with uninterruptible power capability and improved resilience to input voltage fluctuations. Appendix C, ¶¶ 154–155.

A POSA would have had a reasonable expectation of success in modifying Li to include an AC/DC converter as taught by Luo because both references describe modular power supply architectures designed for parallel operation and current sharing. Since both systems rely on well-understood feedback and control loops for voltage and current regulation, a POSA would have recognized that incorporating Luo's AC/DC converter into Li's modular framework would have been straightforward and compatible, and would have expected the combined system to function as intended based on the shared principles and established engineering practices described in both references. Appendix C, ¶ 156.

c. Element [7.3]: “a DC to AC converter”

Luo discloses that “the ... power system is composed of plural UPS modules each of which having an inverter, wherein the outputs of the inverters are coupled in parallel to supply the power to a load through a bus” (Appendix D at [0009]), and that “an AC output of each inverter is coupled to a load through a bus for collectively supplying a load current.” *Id.* at Cl. 1. A POSA would have understood that Luo's system thus includes a DC/AC converter in the form of an inverter within each UPS module. Appendix C, ¶ 157.

A POSA would have been motivated to modify Li to include a DC/AC converter as taught by Luo. Given that Li's system is designed for modularity and current sharing, a POSA would have recognized that incorporating Luo's DC/AC converter would enhance the system's ability to provide stable AC power output, improve redundancy, and leverage established control techniques, as both references focus on parallel operation and load sharing among modules. Appendix C, ¶ 158.

A POSA would have had a reasonable expectation of success in modifying Li to include a DC/AC converter as taught by Luo because both references address modular, parallel-connected power supply systems designed to share load current among multiple modules. Given the well-established nature of inverter technology for DC/AC conversion, a POSA would have recognized that substituting or supplementing Li's modules with inverters as described by Luo would have been a straightforward and predictable modification to achieve AC output, with a reasonable expectation of success. Appendix C, ¶ 159.

d. Element [7.4]: “an output magnetics subsystem for generating said output power”

Li describes how “[t]he pulse-width modulation circuit 102 provides current pulses to a primary winding of a transformer 104,” (Appendix F at 3:47-49) and that “[t]he current pulses in the primary winding of the transformer 104 induce a current in the secondary winding of the transformer 104.” *Id.* at 4:5-7. The induced current is then “rectified by the diodes 112, 116 and is filtered by the inductor 114 and capacitor 120,” resulting in the generation of output voltage at the node V, thereby clearly teaching the use of output magnetics for power generation. *Id.* at 4:7-9.

e. Element [7.5]: “a bypass switch coupled across an input side of said input magnetics subsystem and an output side of said output magnetics subsystem, and controlled by said controller, for bypassing its respective said power supply module”

Luo explains that “[t]he current sharing circuit ... further comprises a switch element (shown in FIG. 4) that allows the inverter to be independently operated. The inverter can also be isolated simply by switching off the switch element to prevent any influences from surroundings.” Appendix D at [0071]. Luo indicates that, “when the switch element is switched off, the inverter is isolated from the other inverters and operated independently to supply power to the load” and that “each inverter further comprises a switch element, and when the switch element is switched

off, the inverter is isolated from the other inverters and operated independently to supply power to the load.” *Id.* at [0033], [0071], [0075], Cl. 13.

A POSA would have understood from these passages that Luo disclose a bypass switch, controlled by the controller, that is coupled across the input and output sides of the magnetics subsystems for bypassing its respective power supply module. Appendix C, ¶¶ 160–161. Further, the AAPA acknowledges that a bypass connection was well-known in the art: “prior art multi-module UPS system 100... is shown as having two UPS modules 102, ... [which] includes ... [a] bypass switch 114.” Appendix A at 1:39-2:5.

A POSA would have been motivated to modify Li to include a bypass switch as taught by Luo because Luo emphasizes the importance of isolating a failed or affected module to maintain system reliability, stating, “when the power system has the problem single point failure, the parallel power system will still work for the load requirement,” and that “the failed UPS module is isolated” Appendix D at [0081, [0089]. Enabling independent operation and rapid isolation of a module to prevent system disruption—would have motivated a POSA to incorporate a bypass switch, controlled by the controller, across the input and output sides of the magnetics subsystems in Li’s modular power supply system to enhance fault tolerance and maintain uninterrupted load supply, as demonstrated by Luo. Appendix C, ¶ 162.

A POSA would have had a reasonable expectation of success modifying Li to include a bypass switch as taught by Luo because both references address modular power supply systems designed for parallel operation and fault tolerance. Since Li’s system already incorporates modularity, current sharing, and hot-swapping features, a POSA would have recognized that integrating a bypass switch controlled by the controller—mirroring Luo’s approach—would have been a straightforward adaptation within the existing architecture, and would have expected it to

function as intended to isolate or bypass a module without compromising the operation of the remaining system. Appendix C, ¶ 163.

H. Ground 2C (SNQ #8): Claims 9 and 10 Are Obvious in View of Li and Sundar

1. Dependent Claim 9

- a. “The method of claim 8, wherein said subportions of said load being accommodated by said second and third power supply modules after the occurrence of said operating event are equal subportions.”**

Sundar discloses that, in the event of a failure of one power source (the "operating event"), the remaining power sources accommodate the load by dividing it into equal subportions. Sundar explains that:

[the] load 112 draws an aggregate load current 114 from sources $S_1, S_2, \dots S_n$, where current 114 is the aggregation of currents $I_1, I_2, \dots I_n$ originating from each of the respective sources $S_1, S_2, \dots S_n$. Each individual current $I_1, I_2, \dots I_n$ flows through its corresponding power sensing element $E_1, E_2, \dots E_n$. The contribution to the load current 114 from each of the sources $S_1, S_2, \dots S_n$ is controlled by the current regulation means corresponding to each such source, and is determined responsive to the control signal $J_1, J_2, \dots J_n$ corresponding to that source.

Appendix H at [0022].

Sundar further explains that, “[a]ssuming that each such source is configured with a corresponding resistive current sensing element having a resistance inversely proportional to the power capacity of the corresponding power source in accordance with the same sizing standard, each such source will contribute a percentage of the overall load current in direct proportion to the ratio of its capacity to the capacity of the parallel system,” (*id.* at [0030]) and in the case of sources with identical capacities, “the load current I will divide among the sources S_1, S_2, S_3 in proportion to their respective capacities,” resulting in equal subportions. Appendix C, ¶¶ 164–165.

To the extent that Li is silent regarding equal subportions, Sundar renders that subject matter obvious. Sundar explains that “the load current I will divide among the sources S_1, S_2, S_3 in

proportion to their respective capacities,” and in the case of identical sources, this results in equal sharing. Thus, a POSA would have recognized that implementing equal subportion sharing after a failure event, as in Sundar, would enhance load balancing and system robustness in Li’s architecture. Appendix C, ¶ 166.

A POSA would have had a reasonable expectation of success modifying Li so that the remaining power sources accommodate the load by dividing it into equal subportions because Li’s modular power supply system already incorporates current sensing and feedback mechanisms for load sharing, making the implementation of Sundar’s proportional or equal sharing approach straightforward and predictable for a POSA. Appendix C, ¶ 167.

2. Dependent Claim 10

- a. “The method of claim 8, wherein said controllers of said second and third power supply modules use said per unit capacity ratings of their respective said power supply modules in determining what percentage of said portion of said load being shed by said first power supply module that each of said second and third power supply modules is able to accommodate.”**

Sundar discloses that “the sensing elements $E_1, E_2, \dots E_n$ are each current sensing elements such as resistors having a resistance which is inversely proportional to the power capacity of the corresponding source,” and that “the ratio $I_J:I_K$ of the contributions of load current supplied by any two sources is substantially equivalent to the ratio $P_J:P_K$ of the power capacities of the same two sources.” Appendix H at [0026]. Sundar further explains that “the total load current I_L will divide into branch currents $I_1, I_2, \dots I_n$ that flow through each corresponding sensing element $E_1, E_2, \dots E_n$ according to the well-known current divider rule for current flow through parallel resistors,” and that “the inverse relationship of the resistance of each branch to the power capacity of its corresponding source will result in each branch current having a magnitude in direct proportion to its corresponding power capacity.” *Id.* Thus, Sundar teaches that the percentage of the load shed

by a first power supply module and accommodated by the second and third modules is determined by their respective per unit capacity ratings.

To the extent that Li is silent regarding the percentage of the load shed by a first power supply module and accommodated by the second and third modules is determined by their respective per unit capacity ratings, a POSA would have been motivated to modify Li to determine those percentages in light of Sundar's teachings. Sundar's approach ensures that, when a first power supply module sheds load, "each such source will contribute a percentage of the overall load current in direct proportion to the ratio of its capacity to the capacity of the parallel system," thereby achieving "a desirable balancing or distribution of load currents, and contribut[ing] to a situation whereby each power source operates at or near its optimal efficiency range." Appendix H at [0030]. A POSA would have been motivated to apply Sundar's approach to Li's system, as Li's modular power supply system would benefit from improved reliability, reduced risk of thermal and electrical overstress on individual modules, and enhanced overall system efficiency, since each module would consistently operate within its optimal performance envelope. Appendix C, ¶¶ 168–170.

A POSA would have had a reasonable expectation of success in applying Sundar's approach to Li's system because both systems are designed to manage current sharing among parallel-connected power sources. By adopting Sundar's proportional sharing technique, a POSA would have expected to achieve balanced load distribution and optimal efficiency for each module, as both the theoretical basis and practical implementation are straightforward and supported by the analogous goals and feedback mechanisms present in Li's system. Appendix C, ¶ 171.

VI. CONCLUSION

For the above reasons, the references discussed herein raise substantial and new questions of patentability with respect to claims 1–10 of the '250 patent. These references each were

published or filed prior to the earliest potential priority date of the '250 patent. These references therefore are prior art statutorily under 35 U.S.C. § 102 and § 103 and substantively anticipate and render claims 1–10 of the '250 patent unpatentable for the reasons discussed above.

Date: December 5, 2025

Respectfully Submitted,

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