

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

TESLA, INC.,
Petitioner,

v.

RELINK US LLC,
Patent Owner.

Case No. IPR2024-00389
U.S. Patent No. 9,793,755

PETITION FOR *INTER PARTES* REVIEW OF

U.S. PATENT NO. 9,793,755

CHALLENGING CLAIMS 1-20

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PETITIONER'S EXHIBIT LIST

Exhibit	Description
Ex-1001	U.S. Patent No. 9,793,755 (“’755 Patent”)
Ex-1002	File History of the ’755 Patent
Ex-1003	Declaration of Dr. Randy Collins
Ex-1004	Curriculum Vitae of Dr. Randy Collins
Ex-1005	U.S. Patent Application Publication No. 2011/0043160 (“Serban”)
Ex-1006	U.S. Patent Application Publication No. 2010/0208501 (“Matan”)
Ex-1007	U.S. Patent Application Publication No. 2017/0005473 (“Somani”)
Ex-1008	U.S. Patent Provisional Application 62/188,278 (“’278 Provisional”)
Ex-1009	U.S. Patent No. 5,500,561 (“Wilhelm”)
Ex-1010	Solectria PVI 6500-7500 Installation and Operation Manual (“PVI”), available at https://web.archive.org/web/20140711094535mp_/http://www.solen.com/manuals/PVI_6500-7500_Manual.pdf
Ex-1011	IEEE Standard 1547-2003, IEEE Standard for Interconnecting Distributed Resources with Electric Power Systems, The Institute of Electrical and Electronics Engineers, Inc. (July 28, 2003)
Ex-1012	File History of Somani
Ex-1013	U.S. Patent No. 7,787,267 (“Wu”)
Ex-1014	Internet Archive Affidavit and Exhibits
Ex-1015	U.S. Patent No. 8,159,178 (“Serban Patent”)

Ex-1016	<i>Relink US LLC v. Tesla, Inc.</i> , Civ. No. 1:23-cv-01093-DII (W.D. Tex., filed Sep. 16, 2023), Dkt. No. 35 (Order Granting Joint Motion for Extension of Time to Take Venue Related Discovery and Complete Briefing on Defendant’s Motion to Transfer Venue)
Ex-1017	Teodorescu, Remus, Marco Liserre, and Pedro Rodriguez. <i>Grid converters for photovoltaic and wind power systems</i> . John Wiley & Sons, 2011.
Ex-1018	Wayback printout – Eversol TL1500, Residential, Solar Inverters (“Eversol TL1500”), available at https://web.archive.org/web/20140404041325/http://www.zeversolar.com/products/product-detail/product/detail/en-eversol-tl1500/
Ex-1019	Webpage - Solectria Solar PV Inverters and PV System Products, Discontinued Products, available at https://solectria.com/support/documentation/
Ex-1020	TMS320F2812 DSP Manual, available at https://www.ti.com/lit/ds/symlink/tms320f2812.pdf?ts=1705102438423&ref_url=https%253A%252F%252Fwww.google.com%252F
Ex-1021	Webpage - PVI 3000-7500, available at https://solectria.com/support/documentation/discontinued-products/pvi-3000-5300/
Ex-1022	PVI, available at https://solectria.com/site/assets/files/1493/pvi_6500-7500_manual.pdf
Ex-1023	Yilmaz, Murat, and Philip T. Krein. “Review of battery charger topologies, charging power levels, and infrastructure for plug-in electric and hybrid vehicles.” <i>IEEE Transactions on Power Electronics</i> 28.5 (2012): 2151-2169.
Ex-1024	Schneider Electric Xantrex XW6048 Hybrid Inverter-Charger Operation Guide, available at https://www.solar-electric.com/lib/wind-sun/XW-manual.pdf

Ex-1025	Bouloumpasis, Ioannis, et al. “Current harmonics compensation in microgrids exploiting the power electronics interfaces of renewable energy sources.” <i>Energies</i> 8.4 (March 25, 2015): 2295-2311.
Ex-1026	Miret, Jaume, et al. “Selective harmonic-compensation control for single-phase active power filter with high harmonic rejection.” <i>IEEE Transactions on Industrial Electronics</i> 56.8 (2009): 3117-3127.
Ex-1027	U.S. Patent Application Publication No. 2008/0122293 A1
Ex-1028	<i>Radiant Vision Systems v. Admesy</i> , 1:21-cv-01115 (WDTX), Dkt. No. 27
Ex-1029	<i>Katana Silicon Technologies LLC v. GlobalFoundries, Inc.</i> , 1:22-cv-00852, Dkt. No. 39

I. INTRODUCTION

Petitioner requests *Inter Partes* Review (“IPR”) of claims 1-20 (“Challenged Claims”) of U.S. Patent No. 9,793,755 (“’755 Patent” or “Patent,” Ex-1001), purportedly owned by Relink US LLC (“Patent Owner” or “PO”).

II. MANDATORY NOTICES

A. Real Party-in-Interest (37 C.F.R. §42.8(b)(1)):

The real party-in-interest for Petitioner is Tesla, Inc.

B. Related Matters (37 C.F.R. §42.8(b)(2)):

Relink US LLC has asserted the ’755 Patent against Petitioner in *Relink US LLC v. Tesla, Inc.*, Civ. No. 1:23-cv-01093-DII (W.D. Tex., filed Sept. 16, 2023) (“District Court case”).

As of the filing of this petition, no other judicial or administrative matters are known to Petitioner that would affect, or be affected by, a decision in an IPR of the ’755 Patent.

C. Lead Counsel (37 C.F.R. §§42.8(b)(3) & 42.10):

Petitioner designates Alexander B. Stein (Reg. No. 71,397) as lead counsel, Brent Hawkins (Reg. No. 44,146), Nicholas Restauri (Reg. No. 71,783), and Ashraf Fawzy (Reg. No. 67,914) as back-up counsel.

D. Service (37 C.F.R. §42.8(b)(3)-(4)):

Service Address: Morgan, Lewis & Bockius LLP, 1301 Second Ave., Suite 3000, Seattle, WA 98101 (Telephone: 206.274.6400; Fax: 206.274.6401).

Pursuant to 37 C.F.R. §42.8(b)(4), Petitioner consents to email service at:

Tesla-Relink755-IPR@morganlewis.com and afawzy@tesla.com.

Pursuant to 37 C.F.R. §42.10(b), a Power of Attorney accompanies this Petition.

III. CERTIFICATION AND FEES

Petitioner certifies that the '755 Patent is available for IPR and that Petitioner is not barred or estopped from requesting this IPR.

Any additional fees for this IPR may be charged to Deposit Account No. 50-0310 (Order No. 103508-03-8002).

IV. SUMMARY OF THE '755 PATENT

The application resulting in the '755 Patent was filed on July 28, 2015, and does not claim priority to any earlier applications. July 28, 2015 is assumed for this proceeding as the effective filing date ("Effective Filing Date") for the Challenged Claims, so post-AIA statutory provisions apply.

A. Brief Description of the '755 Patent

The '755 Patent relates to "systems and methods for managing power flow in grid-tied photovoltaic systems." Ex-1001, 1:7-8. The '755 Patent discloses two prior art systems. The first "typical prior art configuration" (Figure 2) includes "[t]he utility grid 100 [that] feeds or receives AC power from a bidirectional current-source/sink power converter 201 [yellow] which, in turn, receives or sources DC power from a battery 202 [green]." *Id.*, 5:37-42.

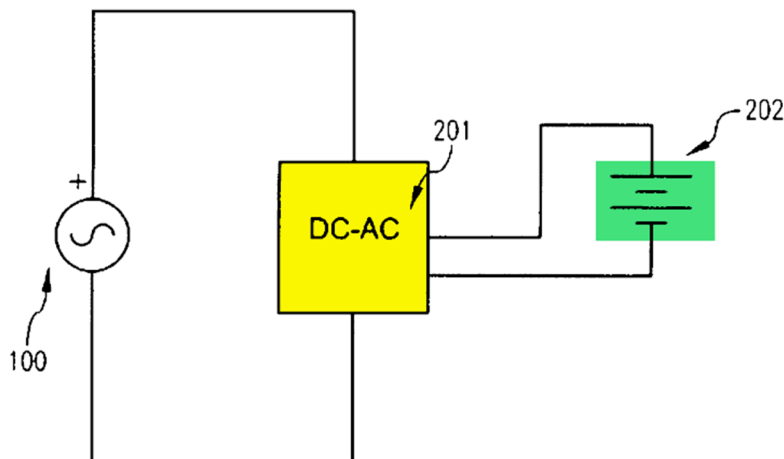


FIG. 2 (PRIOR ART)

Ex-1001, Fig.2.¹ In this prior-art system, when utility grid 100 has excess capacity, it charges the battery 202 via the power converter 201, and when the grid 100 requires more capacity, the battery 202 provides power to the grid via the power converter 201. *Id.*, 5:42-47; Ex-1003, ¶79.

The second prior-art system (Figure 1) uses micro-inverters.

¹ Unless indicated otherwise, all coloring in figures and emphasis in textual quotations has been added.

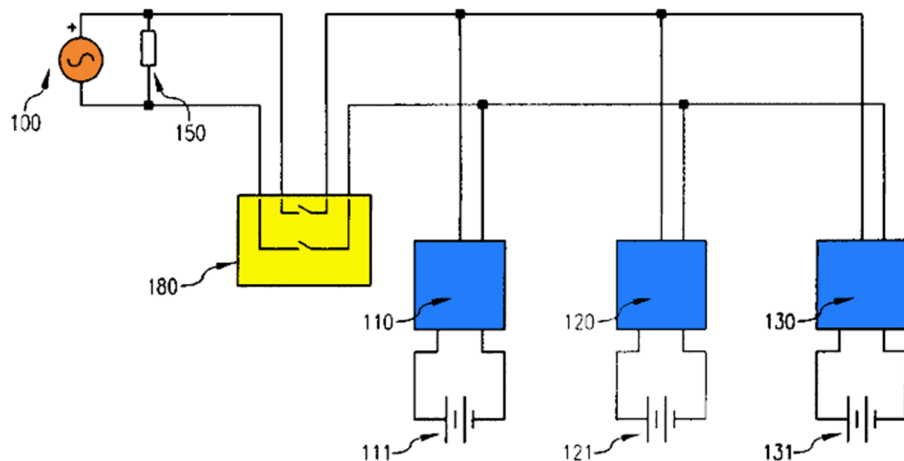
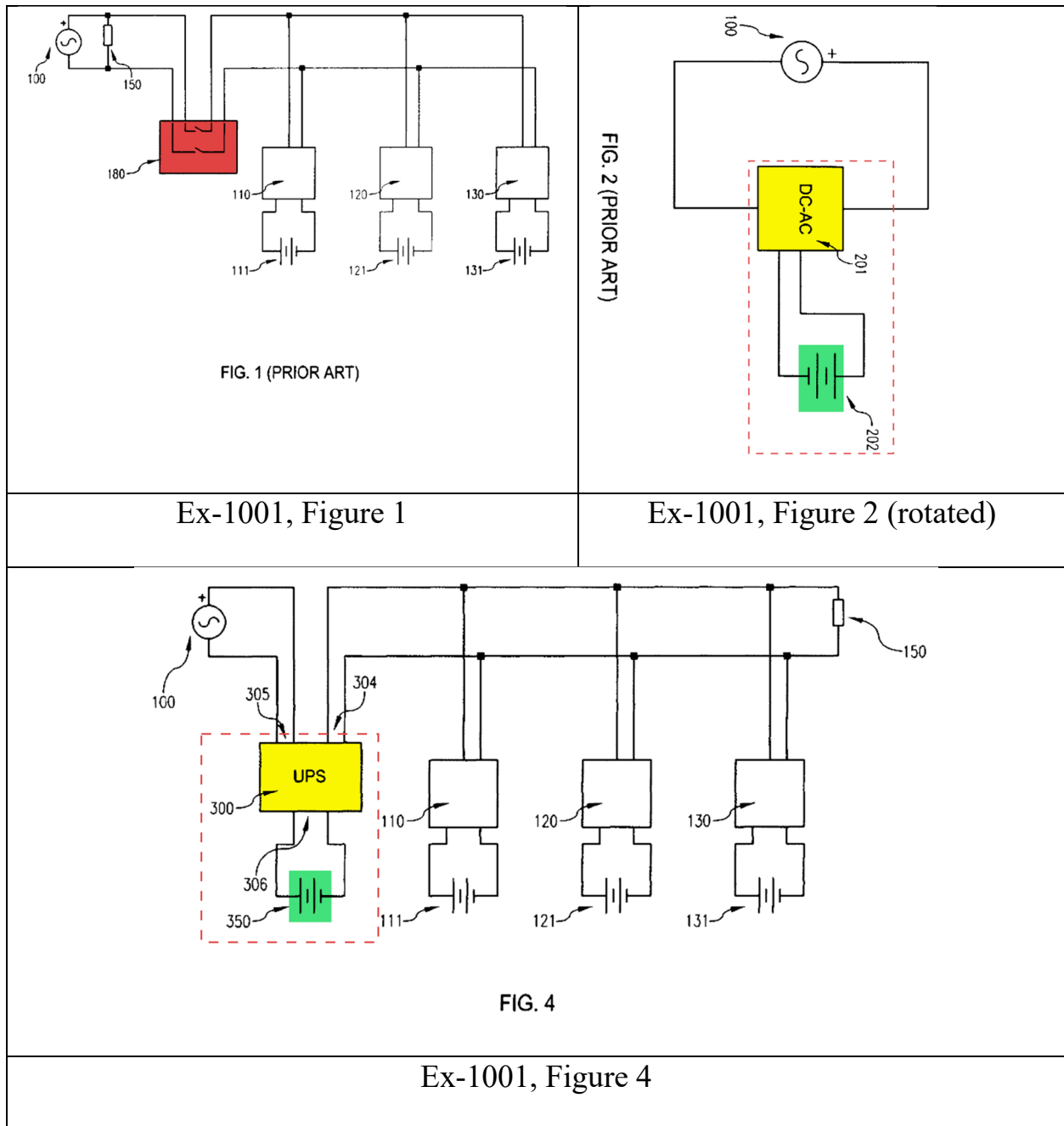


FIG. 1 (PRIOR ART)

Ex-1001, Fig.1. Micro-inverters 110, 120, 130 (blue) “receive[] DC power from a photovoltaic module[s]” 111, 121, 131 and “source[] power to the grid 100 [orange].” *Id.*, 5:6-11. This prior-art system includes a voltage-frequency relay 180 (yellow) that controls the output of micro-inverters 110, 120, and 130 (*e.g.*, disconnecting the micro-inverters) based on voltage or frequency of the utility grid 100. Ex-1001, 5:17-26. According to the ’755 Patent, Figure 1’s prior-art system is problematic because “when the utility grid 100 is not producing power, it is not possible to operate the house load 150 from the prior art micro-inverters.” *Id.*, 5:34-36. “[V]oltage-frequency relays add cost to photovoltaic systems beyond what would otherwise be required.” *Id.*, 1:39-40; Ex-1003, ¶80.

The ’755 Patent seeks to replace Figure 1’s voltage frequency relay 180 (red) with Figure 2’s bidirectional converter 201 (yellow) and battery 202 (green),

resulting in Figure 4's configuration.



Without a voltage frequency relay, the '755 Patent proposes using “a controller configured to regulate a power flow of the current-source inverter [e.g., micro-inverters] by adjusting a frequency of the alternating current voltage source [e.g.,

bidirectional converter].” Ex-1001, 3:9-12; Ex-1003, ¶81.

As compared to admitted prior-art systems, claim 1’s only difference appears to be controlling micro-inverter output based on the frequency of the bidirectional converter, *e.g.*, reducing the micro-inverter output when the battery is fully charged. Ex-1001, 8:18-21. But this was neither new nor non-obvious. Serban and Somani both teach this, as is explained below. Ex-1003, ¶82.

B. Prosecution History

A first-action allowance led to the ’755 Patent. Allowability was indicated because “the prior art of record does not disclose or suggest, *inter alia*, a first alternating current power port as claimed.” Ex-1002, p.24. That determination was incorrect as the claimed “first alternating current power port” is taught in both Serban and Somani. Ex-1003, ¶83.

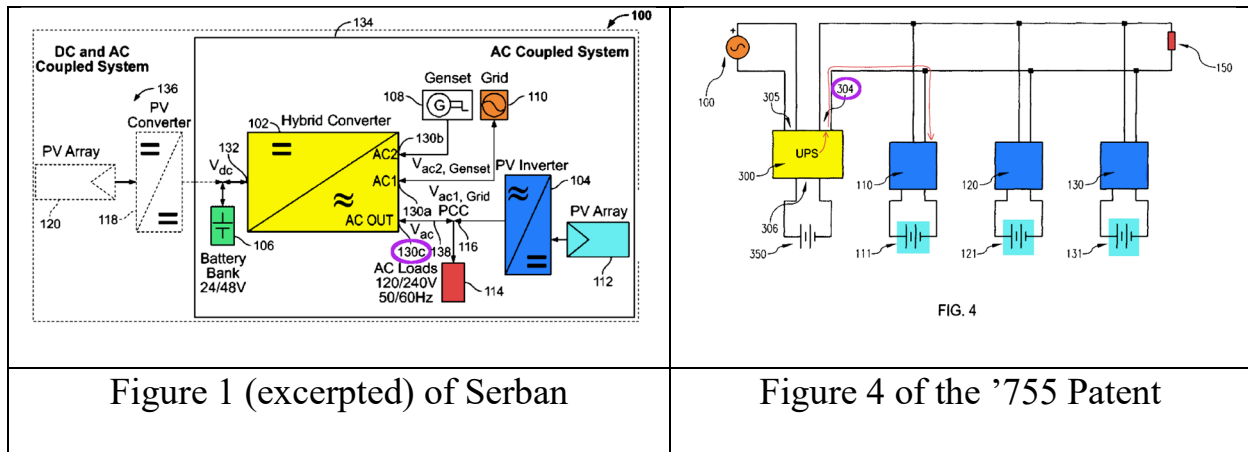
V. THE PRIOR ART

A. Serban

U.S. Patent Application Publication No. 2011/0043160 (“Serban,” Ex-1005), published **February 24, 2011**, so is §102(a)(1) art.

Like the ’755 Patent, Serban discloses “[a] control strategy...that varies the line frequency [of a bidirectional converter]...according to a predetermined pattern to cause a PV inverter to modify its power output and thereby avoid overcharging a battery.” Ex-1005, Abstract, ¶17. As shown below, Serban discloses the exact same alternating current power port (purple circle) that the Examiner thought was

not in the art. Ex-1003, ¶187.



B. Somani

U.S. Patent Application Publication No. 2017/0005473 (“Somani,” Ex-1007) was filed June 29, 2016, published January 5, 2017, and claims priority to U.S. Provisional Application No. 62/188,278 (“Somani Provisional,” Ex-1008), which was filed on **July 2, 2015**. Somani “is entitled to claim a right of priority” to the Somani Provisional, and is §102(a)(2) art.

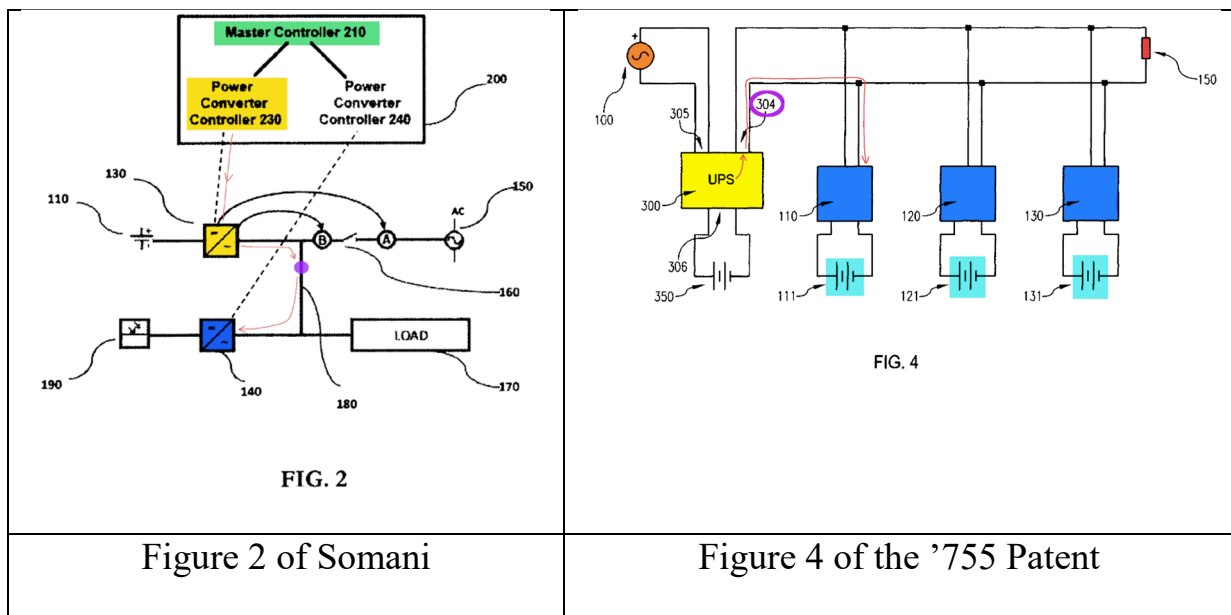
This entitlement is based on whether the invalidating disclosure is in the provisional (substantive requirement), and ministerial requirements of Somani “(1) containing a priority or benefit claim to the prior-filed application; (2) being filed within the applicable filing period requirement (copending with or within twelve months of the earlier filing, as applicable); and (3) having a common inventor or being by the same applicant.” MPEP § 154.01(b).

As to the substantive requirement, the invalidating disclosures from Somani are also in the Somani Provisional (Sections XIV-XVI).

As to the ministerial requirements, Somani included a priority claim to the Somani Provisional when it was filed; Somani was filed within one year of Somani Provisional; and Somani and Somani Provisional have common inventors (Apurva Somani and John C. Palombini). *See* Ex-1012, 164-170; Ex-1008, 4-5. Therefore, Somani thus qualifies as prior art under at least 35 U.S.C. § 102(a)(2). *Penumbra v. RapidPulse*, IPR2021-01466, Paper 34 at 29-34 (PTAB precedential).²

Like the '755 Patent, Somani discloses “islanding a plurality of grid-tied power converters to form a microgrid.” Ex-1007, ¶3; Ex-1008, p.11. In particular, when the system is in microgrid mode, Somani teaches “increasing the microgrid frequency to signal the resource to produce less, or tripping the renewable resource [such as solar panels] offline by changing the microgrid frequency beyond the nominal frequency.” Ex-1007, ¶¶4, 90; Ex-1008, pp.15, 18. As shown below, Somani discloses the exact same alternating current power port (purple) that the Examiner thought was not in the art. Ex-1003, ¶91.

² At least one claim in Somani is supported by the Somani Provisional, so Somani qualifies under *Dynamic Drinkware* too. Ex-1003, ¶90.



C. Matan

U.S. Patent Application Publication No. 2010/0208501 (“Matan,” Ex-1006), published **August 19, 2010**, so is §102(a)(1) art. Matan, in separate combinations with Serban and Somani, discloses many aspects of the dependent claims. Ex-1003, ¶92.

D. Wilhelm

U.S. Patent No. 5,500,561 A (“Wilhelm,” Ex-1009) was issued **March 19, 1996**, so is §102(a)(1) art. Wilhelm teaches the simple and well-known concept of sourcing battery power when the grid demand exceeds certain threshold. Ex-1009, 8:56-59; Ex-1003, ¶93.

E. PVI

Solectria PVI 6500-7500 Installation and Operation Manual (“PVI,” Ex-

1010) published (and that material was also “in public use” and/or “otherwise available to the public) at least as early as **July 11, 2014** (Ex-1014), so is §102(a)(1) art. PVI teaches the simple and well-known concept of disconnecting PV inverters for certain time periods in case of grid outage. Ex-1010, p.8; Ex-1003, ¶¶94-99.

F. Wu

U.S. Patent No. 7,787,267 (“Wu,” Ex-1013) issued **August 31, 2010**, so is §102(a)(1) art. Wu teaches the simple and well-known concept of injecting compensating current for harmonic distortion correction. Ex-1013, 4:8-16; Ex-1003, ¶100.

VI. IDENTIFICATION OF CLAIMS AND GROUNDS

The Challenged Claims are unpatentable based on the following Grounds:

Ground	Statutory Basis	Reference(s)	Claims
1	§102	Serban	1-7, 13, 18
2	§103	Serban, Matan	1-7, 13-17, 18
3	§103	Serban, Matan, Wilhelm	8-12, 19, 20
4	§103	Serban, Matan, Wilhelm, PVI	7, 13, 18 , 19, 20
5	§102	Somani	1-3, 5-7, 13, 18

Ground	Statutory Basis	Reference(s)	Claims
6	§103	Somani, Matan, Wilhelm	1-13, 15-17, 18-19, 20
7 and 8	§103	Serban-Wu, and Somani-Wu	14

VII. DISCRETIONARY DENIAL WOULD BE INAPPROPRIATE

A. §325(d)

U.S. Patent No. 8,159,178 (“Serban Patent,” Ex-1015) issued based on the application that published as Serban, and was listed on an Information Disclosure Statement during prosecution (Ex-1002, p.43). Serban, the reference asserted herein was never cited during prosecution and the Examiner never substantively analyzed the Serban Patent. The *Advanced Bionics* factors show that a 325(d) denial would be inappropriate.

The first prong is not met. Serban is a different published document and it was never substantively considered. *See Bowtech v. MCP IP*, IPR2019-00379, Paper 14, 18-19 (July 3, 2019) (“We have consistently held that a reference that was neither applied against the claims nor discussed by the Examiner does not weigh in favor of exercising our discretion under § 325(d).”) (collecting cases). More significantly, none of the secondary references that are combined with Serban (*i.e.*, Matan, PVI, Wilhelm, and Wu) were before the Examiner and, in turn, none of the combinations have previously been considered. *See Advanced Bionics*,

IPR2019-01469, Paper 6 at 8; *Godbersen-Smith Constr. Co.*, IPR2021-00050, Paper 24 at 19-21. And Somani is a brand new reference that separately anticipates many claims, and renders obvious the Challenged Claims in combination with other references. Finally, the testimony of Dr. Randy Collins (Ex-1003), which analyzes Serban (and the other references), is new evidence never before the Patent Office.

The second *Advanced Bionics* prong is also not met. The Examiner found claim 1 allowable because “the prior art of record does not disclose or suggest, inter alia, a first alternating current power port as claimed,” Ex-1002, p.24, but that is indeed taught by Serban (and Somani). The Examiner erred (or, more likely, was led to err) in overlooking Serban’s on-point teachings. *See* Section X.A.4. It is also possible that the Examiner was led astray by Applicant’s indication that Serban’s claims were the only relevant teachings requiring consideration (red) and therefore never considered Serban’s specification.

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INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)	Application Number	14811644
	Filing Date	2015-07-28
	First Named Inventor	GARRITY, Paul
	Art Unit	2836
	Examiner Name	
	Attorney Docket Number	47334

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Examiner Initial*	Cite No	Patent Number	Kind Code ¹	Issue Date	Name of Patentee or Applicant of cited Document	Pages, Columns, Lines where Relevant Passages or Relevant Figures Appear
	1	8067855	B2	2011-11-29	MUMATZ et al	Claims 7,13,18-20
	2	8810202	B2	2014-08-19	NOMURA	Claims 8-12,19,20
	3	9159178	B2	2012-04-17	SERBAN	Claims 1-20
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Ex-1002, p.43.³

Accordingly, the Board should not deny institution under §325(d).

B. §314(a)

Factor one favors institution. Assuming Petitioner moves for a stay based on this Petition, it is probable that the District Court case will be stayed pending this IPR given that the '755 Patent is the only patent-in-suit, particularly if this

³ While Applicant might have meant to indicate Serban's obvious relevance to claims 1-20 in the application, the column on the form is unambiguous in asking for relevant portions of the reference. Whatever the intention, the result that occurred was inadequate consideration of Serban.

proceeding is instituted.

Factor two favors institution. There is no trial date. Because Judge Pitman often sets the trial date to be 18 months after issuance of the scheduling order, the trial date for the District Court case is at least 18 months away and 12 months after a likely institution decision. *See, e.g.*, Ex-1028 (setting trial for March 4, 2024 in an July 12, 2022 scheduling order); Ex-1029 (setting trial for April 15, 2024 in a September 27, 2022 scheduling order).

Factor three also favors institution. The case is currently stayed pending completion of venue discovery related to motion to transfer, which will not conclude until March 15, 2024, if not longer. Ex-1016. When an institution decision occurs around July 2024, little substantive work will have occurred, especially if the case is transferred.

Factor four is neutral because the Final Written Decision here will likely trigger estoppel before trial.

Factor five favors institution or is neutral because “the parties in the parallel proceeding are not different from the parties [in an IPR].” *Amazon v. Zentian*, IPR2023-01195, Paper 10 at 3.

Factor six strongly favors institution because this Petition advances compelling merits with two independently anticipatory references plus obviousness grounds demonstrating unpatentability of all Challenged Claims. *Infra* Sections X-

XVI. *See, e.g., Samsung Bioepis v. Regeneron*, IPR2023-00884, Paper 13 at 77.

Based on a holistic view, the factors weigh for institution.

VIII. LEVEL OF ORDINARY SKILL

A person having ordinary skill in the art (“POSA”) at the time of the alleged invention of the ’755 Patent would have held at least a bachelor’s degree and a master’s degree in electrical engineering or a related degree, as well as possessing at least two years of experience with grid-tied power supplies having electric energy sources including photovoltaic and battery systems. Ex-1003, ¶23.

A POSA would have been familiar with the admitted prior-art systems of Figures 1 and 2 and associated descriptions of those systems. Ex. 1001, 1:28-36, 1:66-2:2, 5:42-47.

IX. CLAIM CONSTRUCTION

Petitioner applied plain and ordinary meanings to all claim terms and no express constructions are required here. Ex-1003, ¶101.

X. GROUND 1: CLAIMS 1-7, 13, AND 18 ARE ANTICIPATED BY SERBAN

A. Claim 1⁴

1. 1[P]

If 1[P]’s recitation of *an uninterruptible power supply* (UPS) is limiting,

⁴ A claim listing is provided in Appendix-A.

[orange].” *Id.*, ¶25.

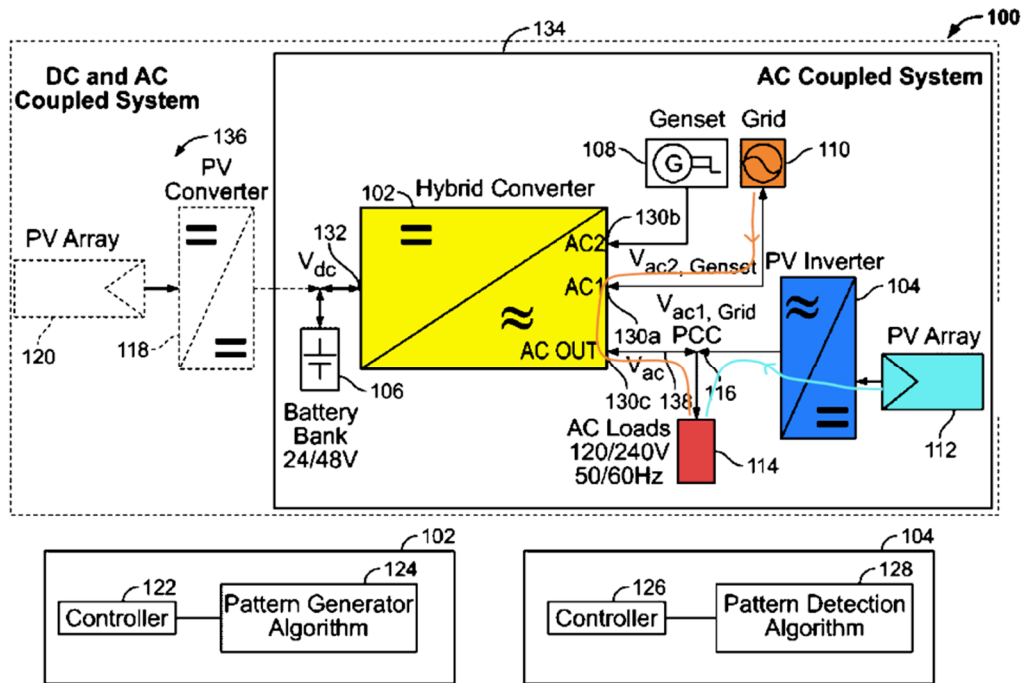


FIG.1

Ex-1005, Fig. 1. In islanded mode, “[e]nergy for the AC loads 114 can be sourced by either or both of the PV array 112 [light blue] and the battery 106 [green].” *Id.*, ¶¶24, 27.

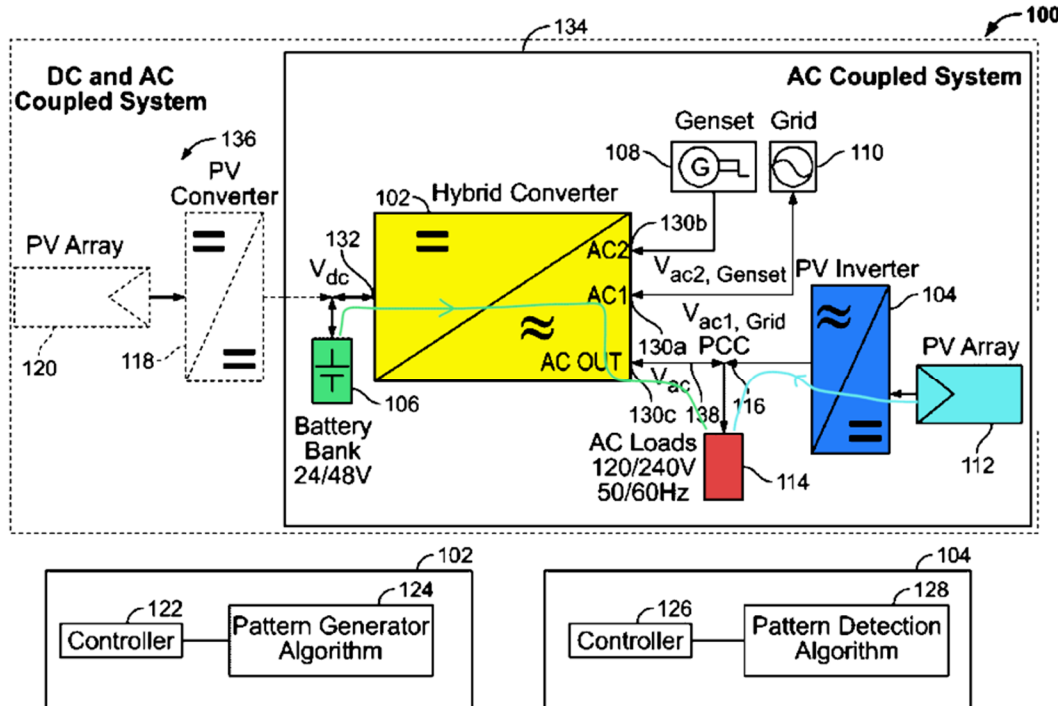


FIG.1

Ex-1005, Fig. 1. Serban also has a genset-connected mode that makes use of genset 108. *Id.*, ¶¶25-26.

With these modes, Serban’s AC load 114 is powered without interruption. Ex-1005, ¶4 (stating that Serban’s system enables “stable and robust DPG control operation under **transients and dynamic conditions**”) and ¶24 (describing Serban’s “**seamless transfer of power when the utility grid 110 fails**”). When the utility grid 110 fails, Serban’s PV array 112, battery 106, and genset 108 all act as automatic backup electric power to ensure that the AC loads 114 are powered without interruption, just like the Patent’s UPS 300. *See, e.g.*, Ex-1001, Figs. 5B-5D.

Therefore, Serban discloses *an uninterruptible power supply* (i.e., power

system 100). Ex-1003, ¶¶117-123.

2. 1[A]

Serban teaches 1[A]’s *bi-directional converter configured to operate as an alternating current voltage source*.

Serban’s hybrid converter 102 (yellow) is “a four-quadrant pulse width modulated (PWM) **bidirectional energy converter** (hybrid converter).” Ex-1005, ¶22.

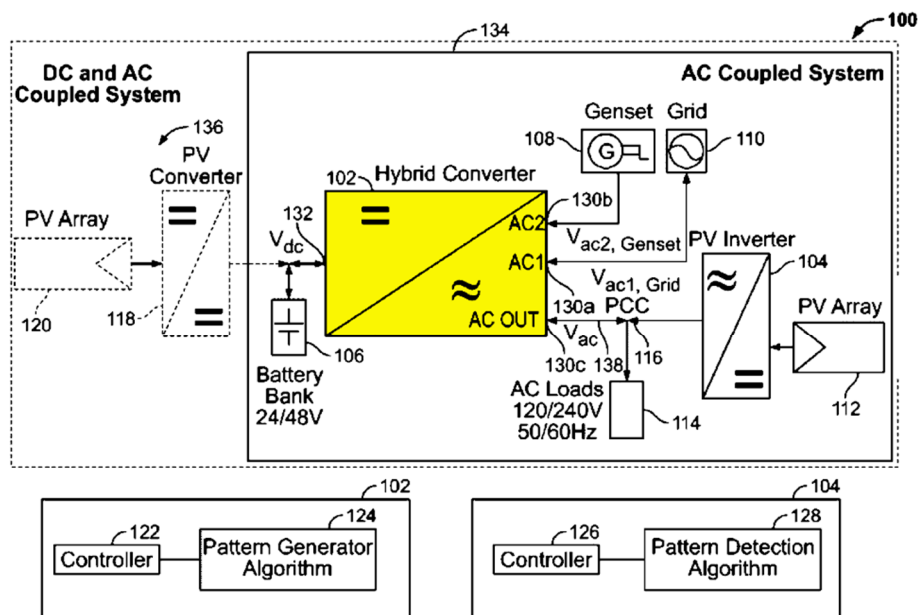


FIG.1

Ex-1005, Fig. 1.

Serban’s hybrid converter 102 [yellow] is configured to operate as an alternating current **voltage source** because “[w]hen the power system 100 is in islanded mode, the hybrid converter 102 operates in **voltage-controlled source mode** and **controls the AC voltage and frequency** on the AC line 138 [yellow

line].” Ex-1005, ¶27; *see also, id.*, ¶22.

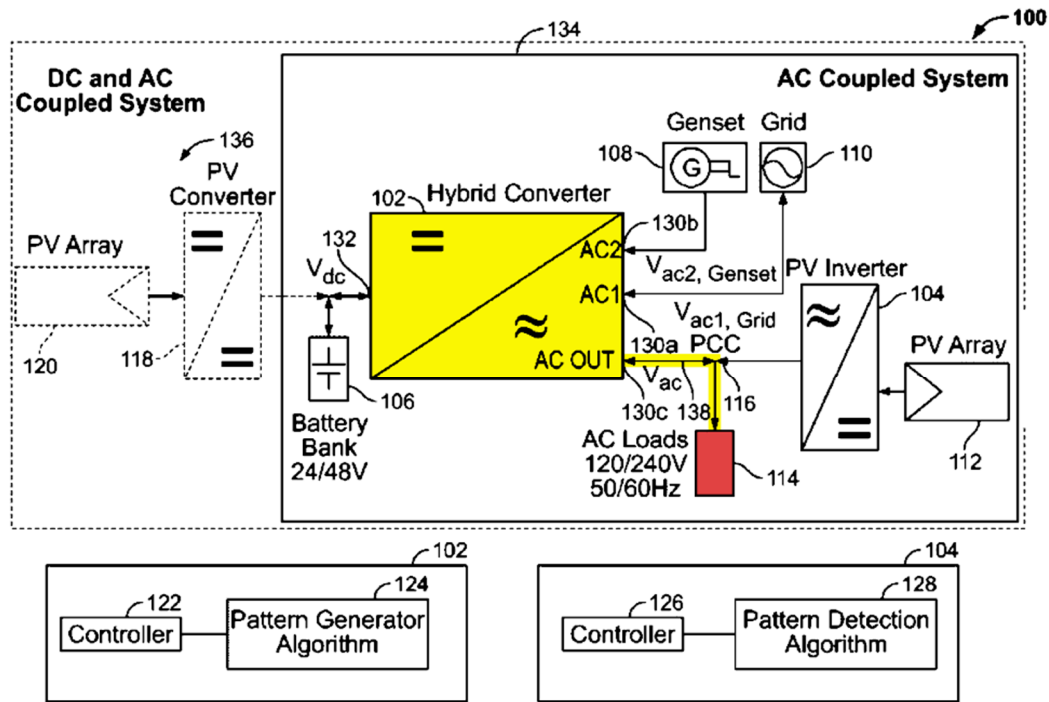


FIG.1

Ex-1005, Fig. 1.

Therefore, Serban discloses *a bi-directional converter* (i.e., hybrid converter 102) *configured to operate as an alternating current voltage source* (e.g., “voltage-controlled source mode and controls the AC voltage...on the AC line 138”). Ex-1003, ¶¶124-127.

3. 1[B]

Serban teaches 1[B]’s *direct current power port configured to be coupled to a battery*.

Serban discloses a “DC port 132 [purple] of the hybrid converter 102 [yellow]” that is coupled to a battery bank 106 (green). Ex-1005, ¶22.

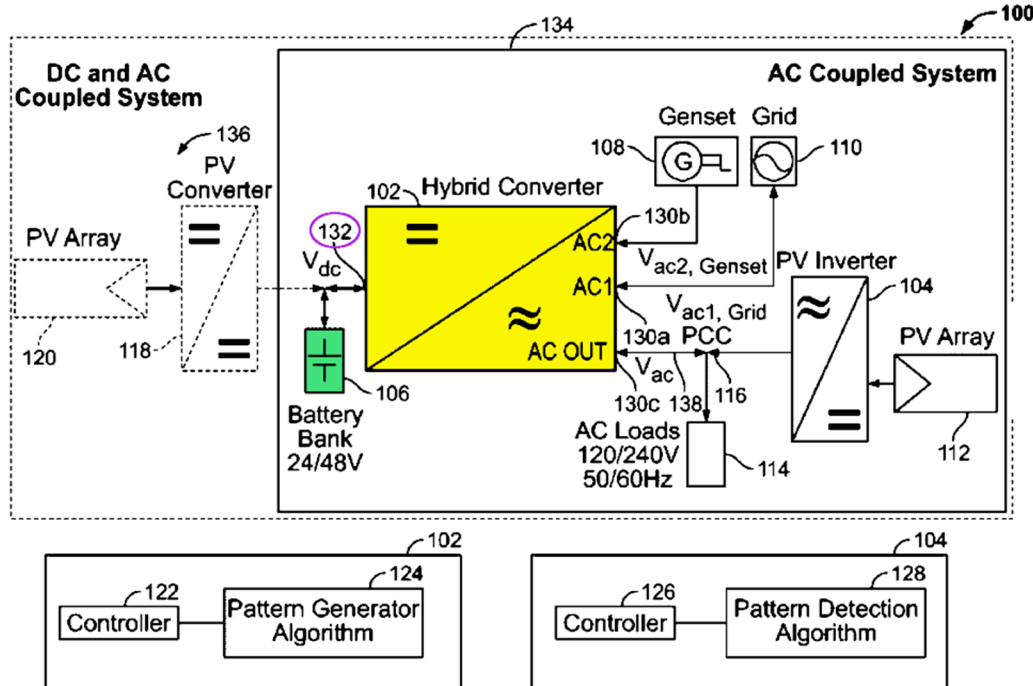


FIG.1

Ex-1005, Fig. 1. It is not surprising that Serban teaches this, as the Patent admits that 1[B] was well-known. *See* Ex-1001, Fig. 2.

Therefore, Serban discloses *a direct current power port* (i.e., DC port 132) *configured to be coupled to a battery* (i.e., battery bank 106). Ex-1003, ¶¶128-130.

4. 1[C]

Serban teaches *a first alternating current power port coupled to the bi-directional converter and configured to be coupled to a current-source inverter, wherein the current-source inverter is configured to adjust an output power as a function of a frequency of the alternating current voltage source.*

As shown below, Serban’s AC port 130c (purple) is coupled to both the hybrid converter 102 (yellow) (i.e., *coupled to the bi-directional converter*) and the

PV inverter 104 (blue) (i.e., configured to be coupled to a current-source inverter).

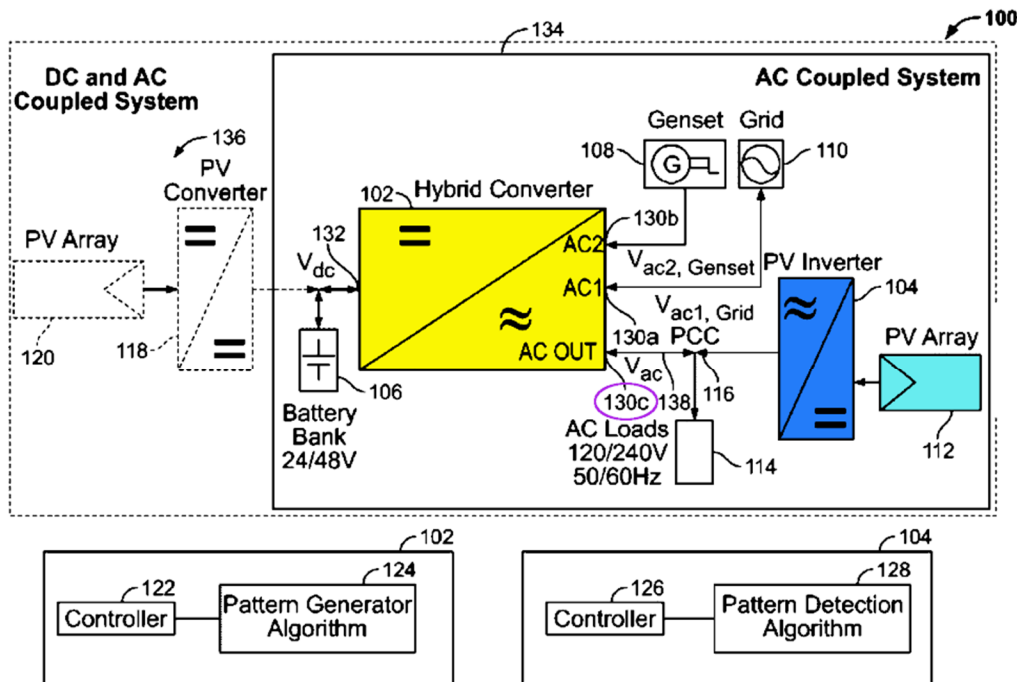


FIG.1

Ex-1005, Fig. 1. The PV inverter 104 (blue) is a current-source inverter because it receives “DC input...from...PV array[] 112 [light blue]” and “outputs...an AC current.” Ex-1005, ¶¶21, 23.

Moreover, Serban discloses “**var[ying] the line frequency or voltage** according to a predetermined pattern **to cause a PV inverter to modify its power output** and thereby avoid overcharging a battery.” Ex-1005, Abstract. Serban’s hybrid converter 102 changes the frequency of V_{ac} , i.e., at its AC port 130c. *Id.*, ¶17 (noting that converter 102 “**produces a modified output at a first AC output 130 c that varies the characteristic (e.g., frequency or voltage) of the AC line according to a first predetermined pattern...**”).

Serban's PV inverter 104 detects the frequency changes and adjusts its output accordingly. *See, e.g., id.*, ¶20 (explaining that inverter 104 detects “**the modified output produced by the first module 102**, and, in response to that detection, **causes the current or voltage** applied to the battery 106 for charging the battery 106 to be **changed via the first module 102**”); ¶28 (“line frequency...variation can be used as **interaction parameters between the hybrid converter 102 and the PV inverter 104**.”). Serban explains that “[t]he PV inverter 104 may **disconnect** because the AC line 138 frequency would exceed its frequency range limits or may **reduce its current produced** from the PV array 112 if a specific control is implemented by monitoring the AC line frequency...” *Id.*, ¶28.

Even the '755 Patent admits that “grid-tied photovoltaic inverters [] gradually reduc[ing] output power when the grid frequency deviates beyond a set limit” was required by “many electric utilities world-wide.” Ex-1001, 1:26-30.

Therefore, Serban discloses *a first alternating current power port (i.e., AC port 130) coupled to the bi-directional converter (i.e., hybrid converter 102) and configured to be coupled to a current-source inverter (i.e., PV inverter 104), wherein the current-source inverter is configured to adjust an output power as a function of a frequency of the alternating current voltage source (i.e., PV inverter 104 modifies its output power, such as by disconnecting or reducing current, in*

response to frequency changes). Ex-1003, ¶¶131-136.

5. 1[D]

Serban teaches *a controller configured to regulate a power flow of the current-source inverter by adjusting a frequency of the alternating current voltage source.*

Frequency changes, which regulate power flow for Serban’s PV inverter, are done through controller 122 because it modifies the frequency of the hybrid converter 102. Specifically, Serban’s hybrid converter 102 “includes a first **controller 122** [red] programmed with machine-readable instructions for carrying out the generator pattern algorithm 124 [orange],” which is used to “produce[] a modified output at a first AC output 130c [purple] that varies the...frequency...of the AC line.” Ex-1005, ¶17.

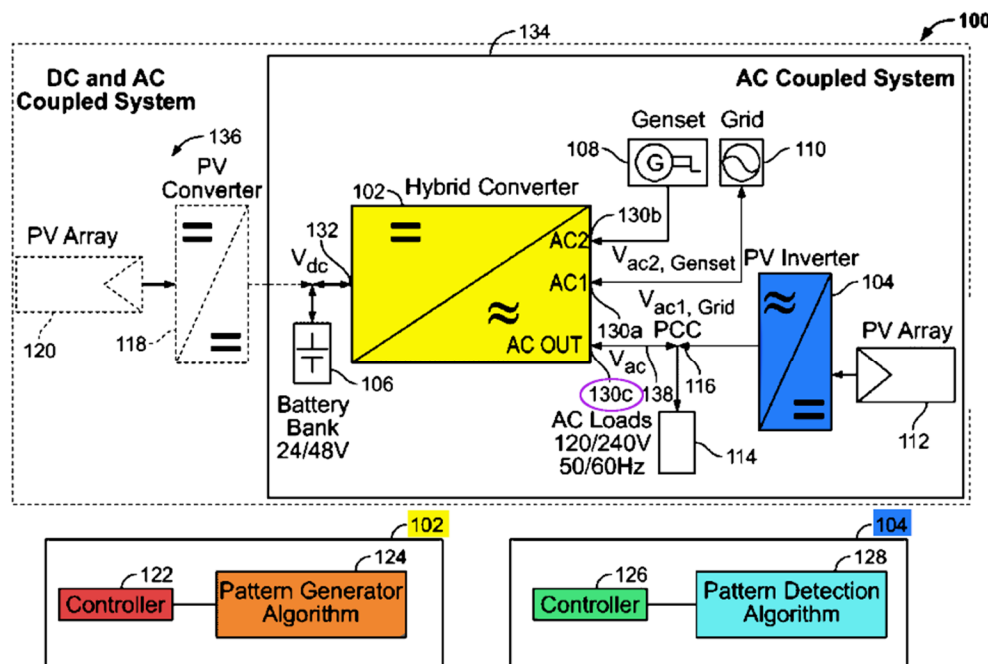
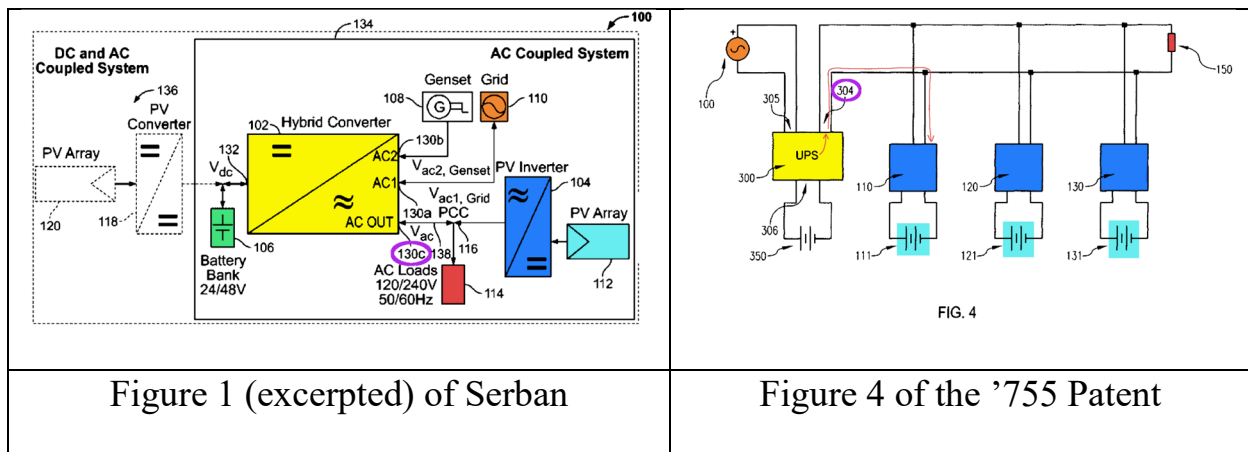


FIG.1

Ex-1005, Fig. 1. The controller 126 (green) of the PV inverter 104 (blue) “detects, via a pattern detection algorithm 128 (light blue), the modified output produced by the...[hybrid converter] 102, and, in response...causes the current or voltage applied to the battery 106 for charging...to be changed via the...[hybrid converter] 102.” *Id.*, ¶¶20; ¶55.

This is just like the '755 Patent's controller 301 of UPS 300 (yellow) controlling frequency at port 304 (purple circle), causing the output power change of the PV inverters 110, 120, and 130 (blue). Ex-1001, 8:18-21. A figure comparison shows this:



Therefore, Serban discloses *a controller (e.g., controller 122) configured to regulate a power flow of the current-source inverter (i.e., disconnecting or reducing the output current or power of the PV inverter 104) by adjusting a frequency of the alternating current voltage source (i.e., adjusting the frequency at AC port 130c according to the generator pattern algorithm 124).* Ex-1003, ¶¶137-

141.

B. Claim 2

Claim 2 depends from Serban-anticipated claim 1. Section X.A. Claim 2 adds that *the controller is configured to regulate the power flow of the current-source inverter to maintain the battery at a predetermined ideal charging state*, which Serban discloses.⁶

As explained above (Section X.A.5), Serban’s controller 122 is configured to regulate the power flow of the PV inverter 104. The language *to maintain the battery at a predetermined ideal charging state* is a non-limiting intended use, but, regardless, Serban teaches it.

Serban discloses regulating power-flow of the PV inverter 104 to maintain battery 106 at a predetermined ideal charging state. In islanded mode, “the solar energy is greater than the load demand by the loads 114,” so “the surplus of power will flow [light blue] from the PCC 116 through the hybrid converter 102 (yellow), **eventually overcharging the battery 106 [light blue]**.” Ex-1005, ¶27.

⁶ The term “ideal” is subjective and without boundaries in the specification of the ’755 Patent. For this proceeding, Petitioner understands “ideal charging state” as a limit on the battery’s charging state.

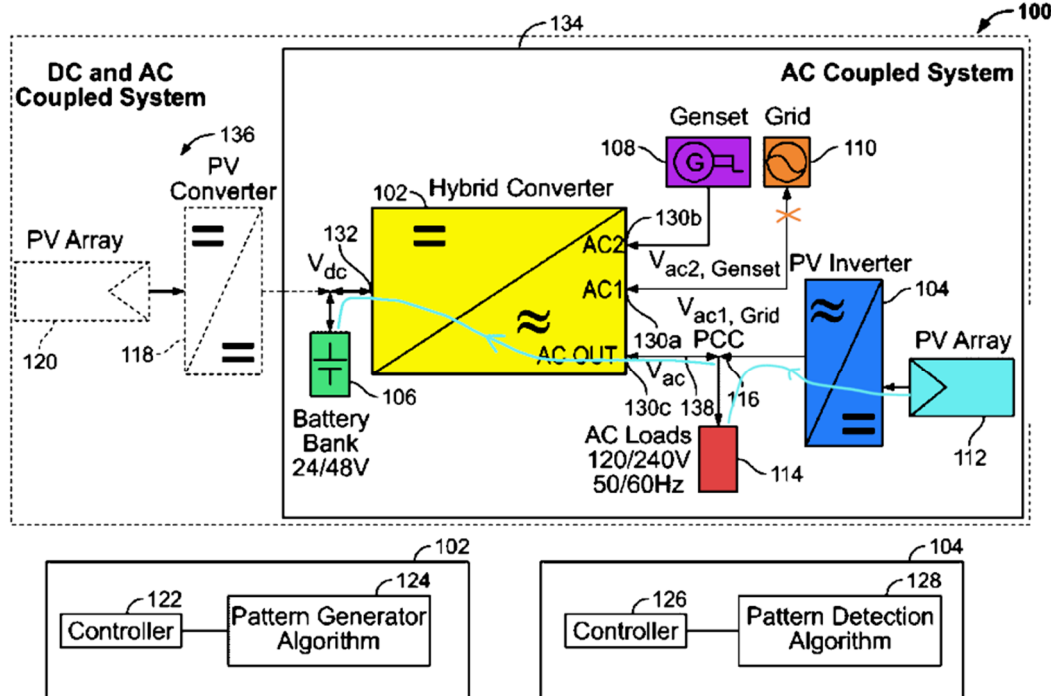


FIG.1

Ex-1005, Fig. 1. To avoid overcharging, Serban discloses that the PV inverter 104 may disconnect or reduce its current to maintain the battery 106 within charging-limit requirements. Ex-1005, ¶28 (noting that “hybrid converter 102 proactively monitors and applies the **correct battery charging profile**: if the DC voltage or current of the battery 106 exceeds the **battery charging limit requirements**, then the hybrid converter 102 changes the microgrid line frequency according to a predetermined pattern.”); ¶4. According to Serban, battery charging profile (e.g., bulk, absorption, or float stages) may be determined by “a conventional battery charge algorithm,” which is used to “regulate[] the **DC voltage or current to the battery 106 within prescribed limits.**” *Id.*, ¶22; *see also* ¶4 (“[T]he battery DC level falls back **within the specified set point limits.**”); ¶18; ¶35 (“[T]he

maximum current limit acceptable to the battery 106.”); ¶55 (“When the battery voltage exceeds **a predetermined current or voltage**...”).

Therefore, Serban discloses that *the controller* (e.g., controller 122) *is configured to regulate the power flow of the current-source inverter* (e.g., disconnecting or reducing the current of the PV inverter 104) *to maintain the battery at a predetermined ideal charging state* (e.g., maintain DC voltage or current to battery 106 within “prescribed limits” or “battery charging limit requirements,” or avoid overcharging). Ex-1003, ¶¶142-148.

C. Claim 3

Claim 3 depends from Serban-anticipated claim 1. Section X.A. Claim 3 adds *a second alternating current power port configured to be coupled to an alternating current grid*, which Serban discloses.

Serban’s Figure 1 shows “a first AC input 130a [purple] for receiving energy from the utility grid 110 [orange].” Ex-1005, ¶18.

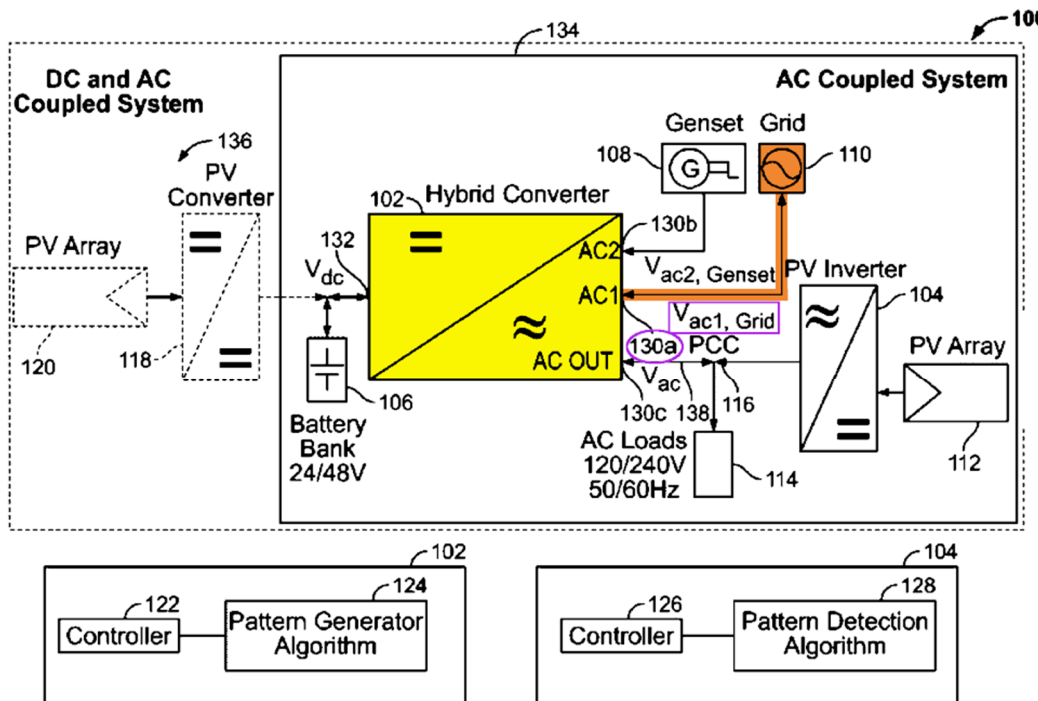


FIG.1

Ex-1005, Fig. 1. According to Serban, AC port 130a is also used by the hybrid converter 102 for feeding energy to the utility grid 110 (indicated with bidirectional arrow (orange)). *See id.*, ¶24 (“[T]he available energy from the battery 106 is transferred back to the utility grid 110 through the bidirectional hybrid converter 102....”).

Serban’s utility grid 110 is an AC grid because the port 130a is an “AC input...for receiving energy from the utility grid 110.” Ex-1005, ¶18; *see also id.*, ¶41 (discussing frequency and phase for current from AC grid); ¶44.

Therefore, Serban discloses *a second alternating current power port (e.g., AC port 130a) configured to be coupled to an alternating current grid (e.g., utility grid 110).* Ex-1003, ¶¶149-153.

D. Claim 4

Claim 4 depends from Serban-anticipated claim 1. Section X.A. Claim 4 adds that *the bi-directional converter is also configured as an active rectifier*, which Serban discloses.

Serban discloses that its hybrid converter 102 “operates in an **active rectifier mode** with optional power factor correction (PFC).” Ex-1005, ¶22. “In the **active rectifier mode**, the hybrid converter 102 converts AC to DC energy and regulates the DC voltage or current to the battery 106 within prescribed limits....” *Id.*; ¶25 (“The hybrid converter 102 operates in **active rectifier mode**, charging the battery 106 so as not to exceed the grid current capacity.”).

Therefore, Serban discloses that *the bi-directional converter* (i.e., hybrid converter 102) *is also configured as an active rectifier* (e.g., operate in an active rectifier mode). Ex-1003, ¶¶154-158.

E. Claim 5

Claim 5 depends from Serban-anticipated claim 4. Section X.D. Claim 5 adds *the bi-directional converter is also configured as an alternating current source*, which Serban discloses.

The ’755 Patent’s bi-directional converter operates as a current-source converter when the grid is connected, and the bi-directional converter sources power from the battery to the load. Ex-1001, 8:33-39.

Serban teaches the same. For example, Serban discloses that when in grid-connected mode, its bi-directional converter, “which operates in current-controlled source mode,” sources power from its battery to the load and the grid. Ex-1005, ¶24. Transferring “energy from the battery 106...to the AC loads 114 or back to the utility grid 110” means, at least necessarily, that Serban’s hybrid converter 102 is producing an alternating current source for the AC loads 114 or the utility grid 110, or both concurrently. *Id.*

Therefore, Serban discloses that *the bi-directional converter (i.e., hybrid converter 102) is also configured as an alternating current source (e.g., provides a source of AC to the AC loads 114 or the utility grid 110 while in current-controlled source mode).* Ex-1003, ¶¶159-164.

F. Claim 6

Claim 6 depends from Serban-anticipated claim 5. Section X.E. Claim 6 adds that *the first alternating current power port is also configured to be coupled to a load*, which Serban discloses.

Serban’s AC port 130c (purple) is connected to a load 114 (red), and arrows between these components indicate current flow from AC port 130c to the load 114.

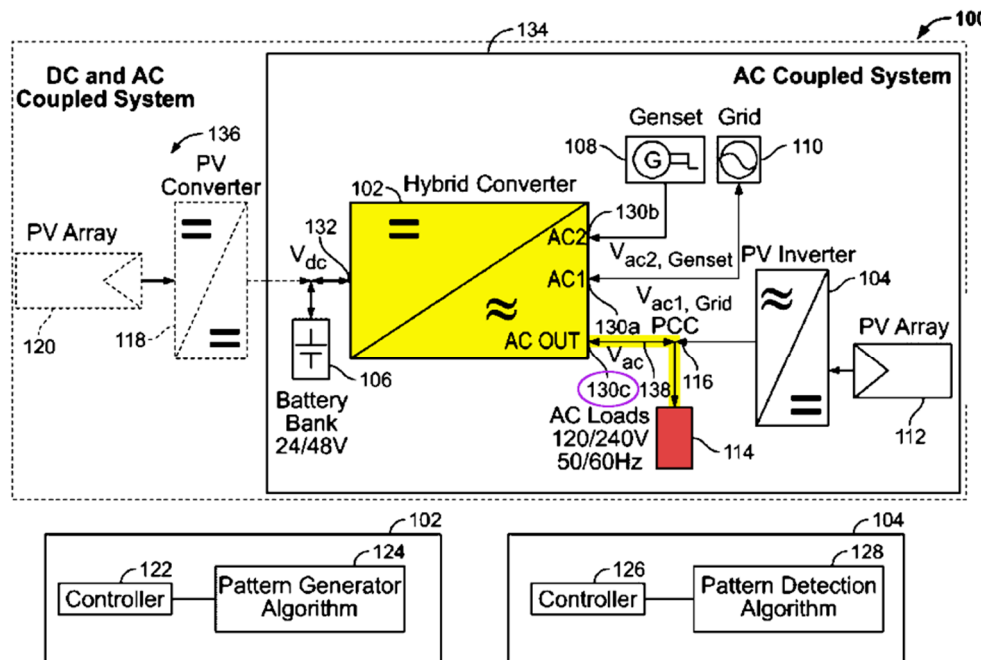


FIG.1

Ex-1005, Fig. 1.

Therefore, Serban discloses that *the first alternating current power port* (e.g., AC port 130c) *is also configured to be coupled to a load* (e.g., load 114).

Ex-1003, ¶¶165-168.

G. Claim 7

Claim 7 depends from Serban-anticipated claim 6. Section X.F. Claim 7 adds that *the current-source inverter is configured to disconnect from the alternating current voltage source for a predetermined outage period when the alternating current voltage source frequency goes outside of a predetermined frequency limit*, while also adding that *the controller is configured to control the bi-directional power converter to source power to the load during the predetermined outage period*. Serban teaches this all.

As to inverter disconnection, when Serban's power system 100 is in islanded mode (orange cross), the PV inverter 104 can be disconnected (blue cross) to avoid overcharging battery 106 (green).

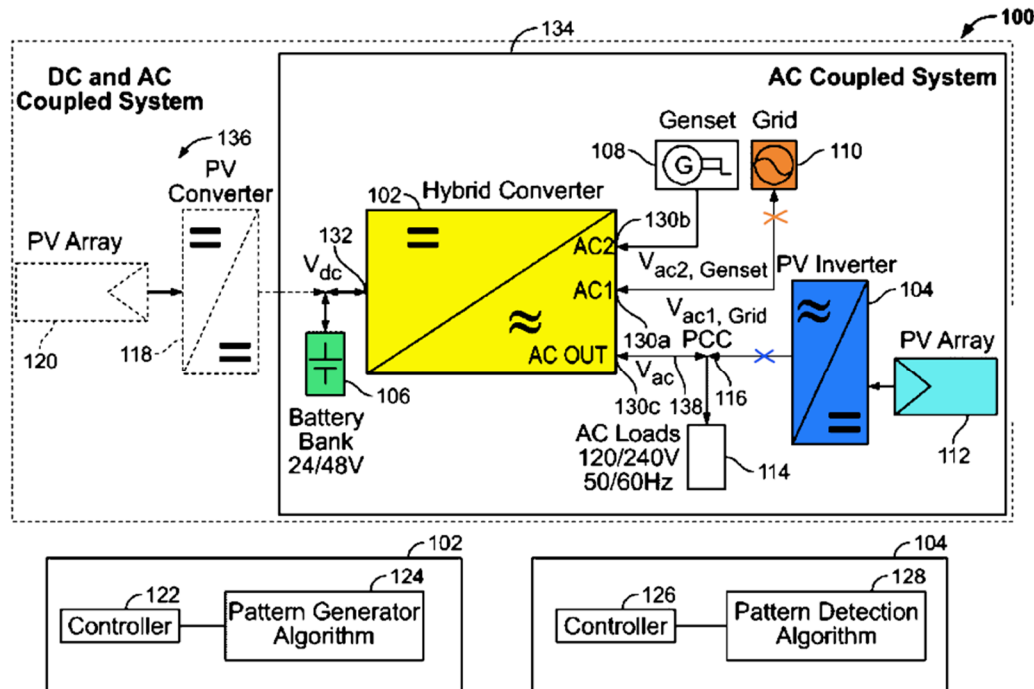


FIG.1

Ex-1005, Fig. 1. Serban discloses that “[i]n the islanded mode,...[w]hen the **minimum frequency limit** is reached, the PV inverter 104 **disconnects from the AC network**, interrupting power to the DC port.” *Id.*, ¶42; ¶28. Even the ’755 Patent admits that “to increase the safety of utility systems,...disconnect[ing] all photovoltaic inverters from the grid if the voltage or frequency deviates beyond a predetermined range” was required by “most photovoltaic systems.” Ex-1001, 1:30-36.

Before entering islanded mode, when in grid-connected mode, “the hybrid

converter 102 [yellow] operates as a current-controlled source converter [green arrow]...[and] the utility grid 110 [orange] generates the AC voltage and frequency.” Ex-1005, ¶22.

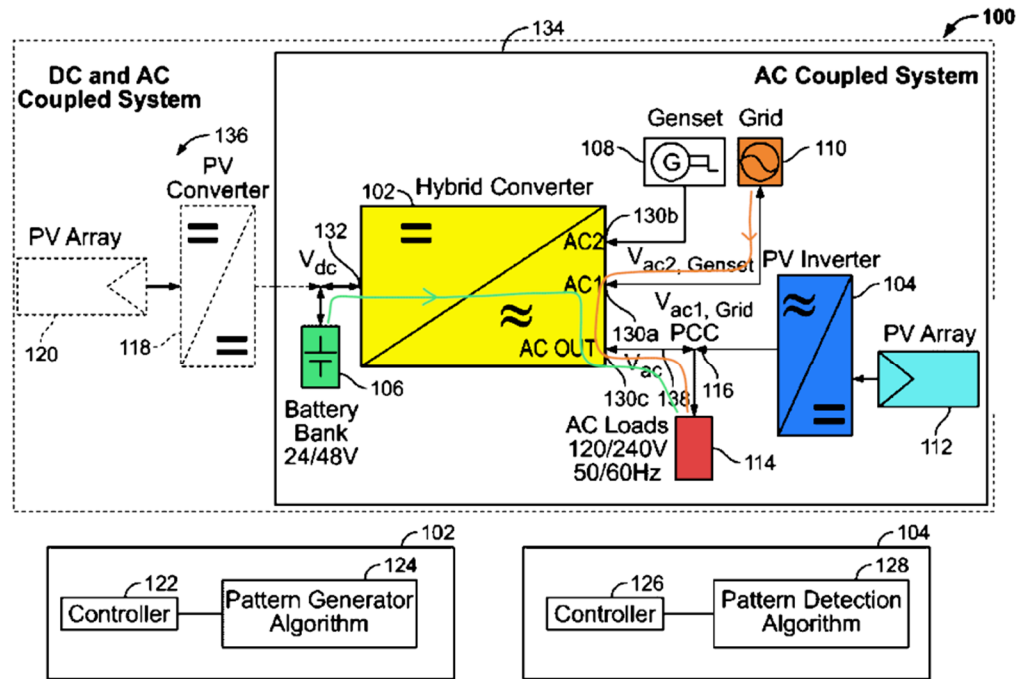


FIG.1

Ex-1005, Fig. 1. Thus, before entering islanded mode, the AC line 138 frequency is controlled by (e.g., the same as) the grid frequency, e.g., via the “integrated transfer switch[] on [] AC port[] 130a.” *Id.*, ¶26. When the utility grid 110 fails, the grid frequency and/or voltage is no longer within a certain range (and can disappear entirely). The AC line 138 frequency also exceeds the minimum frequency limit (e.g., drops to zero), causing disconnection of the PV inverter 104. Serban calls this an “anti-islanding limit,” which is “defined by the Underwriters Laboratory (UL) 1741 or the Institute of Electrical and Electronics Engineers

Serban thus has at least two PV-inverter-disconnection scenarios: (i) while in islanded mode and frequency limits are reached and (ii) when the grid fails and a transition into islanded mode occurs. PV inverter 104 (blue) is connected to the AC network at the common coupling point (PPC) (purple), which is coupled to port 130c of the hybrid converter 102 (yellow), so, a POSA would have understood that when the PV inverter 104 (blue) disconnects from the AC network, *i.e.*, from the PCC (purple), it is disconnected from the hybrid converter 102 (yellow).



While in islanded mode after either disconnection scenario, Serban discloses that “[t]he PV inverter **ceases to convert power until the AC line frequency**

limits are restored to the normal range.” *Id.*, ¶4. In other words, the PV inverter 104 remains disconnected from the AC network until the hybrid inverter 102 restores the AC line frequency back to normal range. Ex-1003, ¶174.

The period of time during which Serban’s PV inverter remains disconnected is predetermined at least because it is (or necessarily is) entirely dependent on (and determined by) an amount of time taken by the hybrid converter 102 to restore the AC line 138 to a normal frequency range. If *predetermined outage period* refers to a grid outage specifically, Serban’s frequency range limit is predetermined and therefore the grid failure is predetermined as the conditions that trigger the grid failure are predetermined. Ex-1005, ¶41. Ex-1003, ¶175.

As to sourcing power to the load, Serban discloses that its controller 122 controls the hybrid converter 102 to source power to the load when the PV inverter 104 is disconnected. Serban discloses that “[w]hen the power system 100 is in islanded mode,...[e]nergy for the AC loads 114 can be sourced by either or both of the PV array 112 [light blue] and the battery 106 [green].” Ex-1005, ¶27.

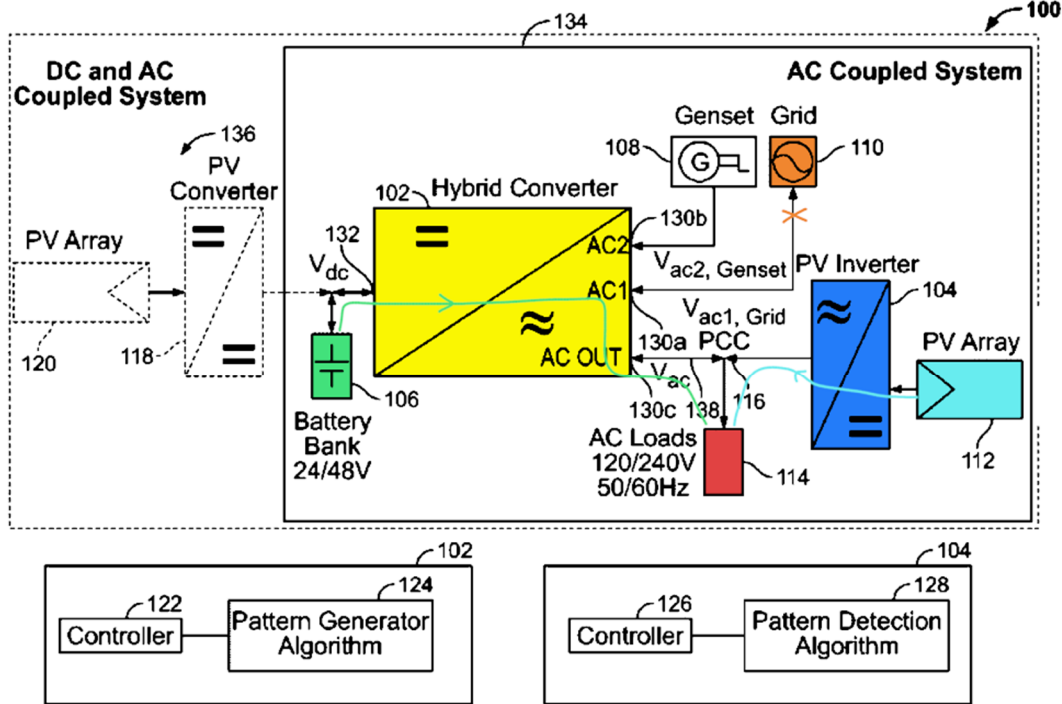


FIG.1

Ex-1005, Fig. 1. Thus, when the PV inverter 104 is disconnected (and when the grid is unavailable), the AC load 114 sources power from the battery 106 (green), and possibly the genset 108 (purple) (*id.*, ¶25), both of which are done via the hybrid converter 102. Power flowing in/out of the hybrid converter 102 is controlled by Serban's controller 122 (yellow).

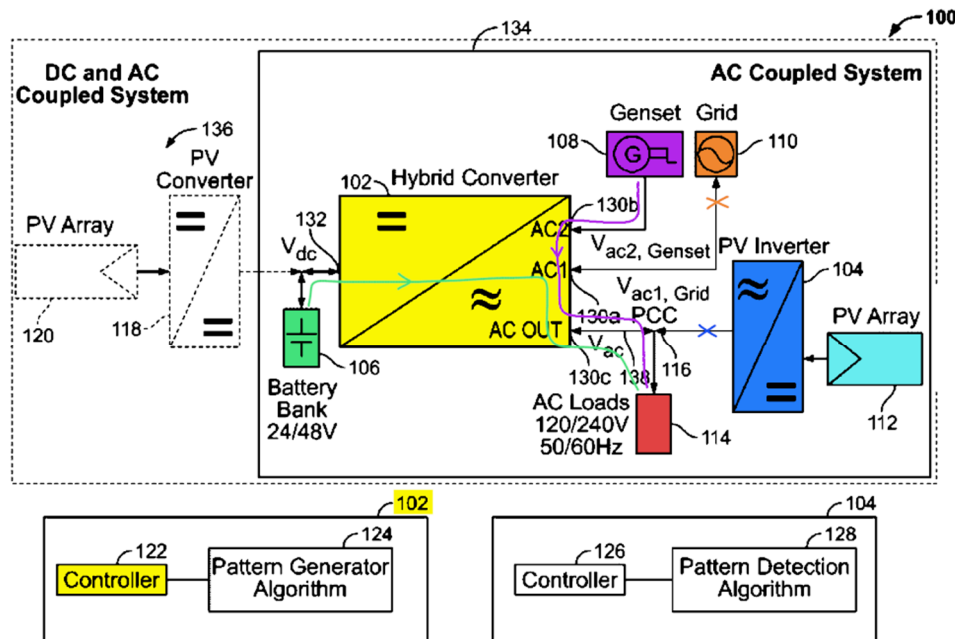


FIG.1

Ex-1005, Fig. 1. Serban's controller 122 is "(a) a microprocessor, (b) a microcontroller, and/or (c) any other suitable processing device" (*id.*, ¶59), so is capable of controlling the power flow at each port of the hybrid converter 102, including power flow from battery (green) and/or genset (purple) to the load (red). Ex-1003, ¶176.

Therefore, Serban discloses that *the current-source inverter* (i.e., PV inverter 104) *is configured to disconnect from the alternating current voltage source* (i.e., hybrid converter 102) *for a predetermined outage period* (e.g., period of time during which PV inverter is disconnected until the hybrid converter 102 restores the AC line frequency back to normal) *when the alternating current voltage source frequency goes outside of a predetermined frequency limit* (e.g., causing the AC line frequency to drop to zero and outside of a predetermined frequency range limit

for a grid system), and that *the controller* (i.e., controller 122) *is configured to control the bi-directional power converter* (i.e., hybrid converter 102) *to source power to the load* (i.e., load 114) *during the predetermined outage period*. Ex-1003, ¶¶169-177.

A. Claim 13

Claim 13 depends from Serban-anticipated claim 7. Section X.G. Claim 13 adds that *the controller is configured to disconnect the current-source inverter from the alternating current grid when a voltage or frequency of the alternating current grid goes outside of a predetermined limit*, which Serban discloses.

As explained above (Section X.G), when the utility grid 110 fails (e.g., when the grid frequency and/or voltage exceeds a certain range), the PV inverter 104 is disconnected from the hybrid converter 102. Ex-1003, ¶180.

While Serban’s hybrid converter 102 (yellow) and PV inverter 104 (blue) have their own controllers (*i.e.*, controller 122 (red) and controller 126 (green), respectively), “various functions of the different modules and units can be **combined** or segregated” and “blocks described may be...**combined**.” Ex-1005, ¶¶58-59. Serban also indicates that control functions 122 and 126 (along with others) can be integrated on a single DSP. *Id.*, ¶56 (“The **control functions 122, 124, 126, 128** are implemented as a 32-bit TMS320F2812 DSP running at 150 MHz.”).

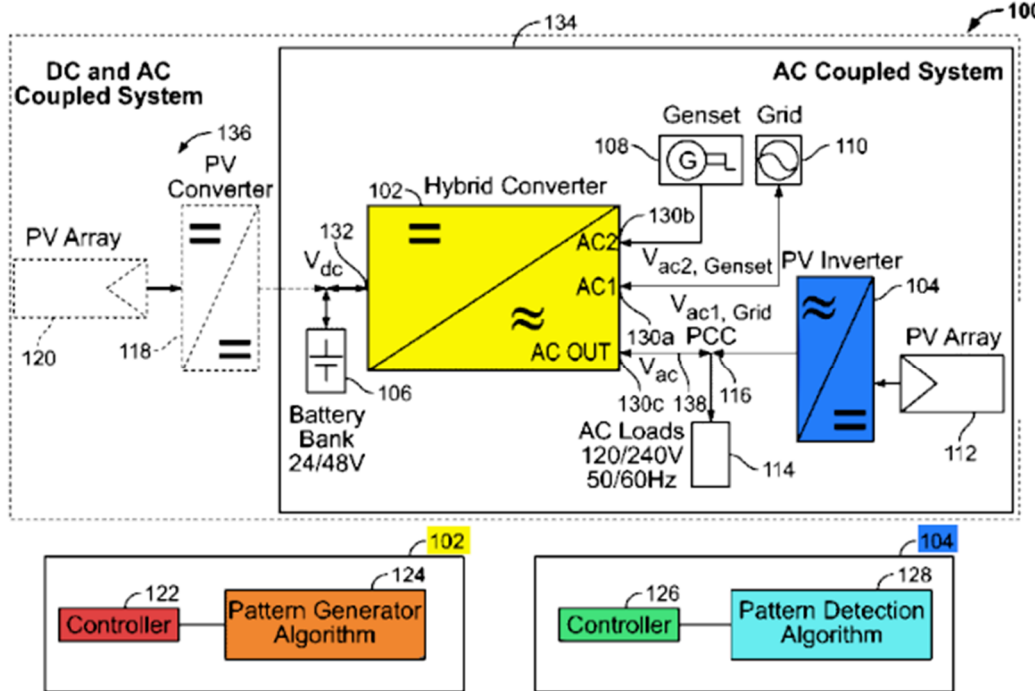


FIG.1

Ex-1005, Fig. 1. Thus, a POSA would have understood that controller 122 and controller 126 of Serban may be combined into a single controller (at a minimum, would have at once envisaged this), which is referred to as “Serban’s Controller” hereinafter. A POSA would also have understood that Serban’s Controller is capable of performing not only those functions relevant to Pattern Generator Algorithm 124 and Pattern Detection Algorithm 128, but also various other controls needed by its power system 100, such as power conversion between battery 106, genset 108, grid 110, and PV inverter 104, as well as interfacing with these power sources, including disconnecting the PV inverter 104. Ex-1003, ¶181.

Therefore, Serban discloses that *the controller* (e.g., Serban’s Controller) *is configured to disconnect the current-source inverter* (e.g., PV inverter 104) *from*

the alternating current grid (e.g., utility grid 110) when a voltage or frequency of the alternating current grid goes outside of a predetermined limit (e.g., when the grid fails). Ex-1003, ¶¶178-182.

B. Claim 18

Claim 18 combines claims 1-2 and 5-7, and is disclosed for reasons above.

Supra Sections X.A-X.B and X.E-X.G; Appendix-A; Ex-1003, ¶183.

XI. GROUND 2: CLAIMS 1-7 AND 13-18 ARE RENDERED OBVIOUS BY SERBAN-MATAN

A. Motivation to Combine Serban with Matan

Serban and Matan qualify as **analogous art** at least because they are in the **same field of endeavor** as the Patent, i.e., grid-tied photovoltaic systems.

Compare Ex-1001, 1:7-8 *with* Ex-1005, Abstract, ¶4 and Ex-1006, ¶¶2-3. Serban and Matan are also reasonably pertinent to controlling inverter outputs to address problems with system performance as identified by the '755 Patent. *Compare* Ex-1001, 8:18-21 (“the power converter 302 may adjust the frequency of the voltage across the micro-inverters 110,120,130 to cause the power output of the micro-inverters 110,120,130 to be reduced.”) *with* Ex-1005, ¶28 (“The PV inverter 104 may disconnect because the AC line 138 frequency would exceed its frequency range limits...”); and Ex-1006, ¶74 (“control[ling] harmonic distortion of the output current signal and the phase shift between the grid voltage and the output current signal of a grid-tied solar photovoltaic or other source”). Ex-1003, ¶184.

Harmonic-distortion correction. A POSA would **have been motivated** to incorporate Matan’s harmonic-distortion correction into Serban.

Serban wants to “control the power flow for energy prioritization and system efficiency maximization.” Ex-1005, ¶4. Serban teaches several ways to maximize efficiency, including use of a transformerless PV inverter (*id.*, ¶23), connecting PV array through the PV inverter 104 (*id.*, ¶25), and power factor correction (*id.*, ¶44). From Serban’s instructions, a POSA would have sought to further maximize system efficiency, so would have looked to similar references, like Matan, for system-efficiency improvements, such as by harmonic-distortion correction. Ex-1003, ¶186.

Matan teaches that “the power transfer from the source to the load is further improved with reduction of harmonic distortion.” Ex-1006, ¶27. Moreover, unlike “[p]revious harmonic distortion techniques[,]. . . [Matan]’s table-based method implemented on a processor or controller reduces cost per inverter and scales better than typical hardware implementations.” *Id.*, ¶35. Therefore, a POSA looking to achieve efficiency gains for Serban’s system would have utilized Matan’s teachings at least to reduce costs per inverter and achieve better scalability. Ex-1003, ¶187.

Moreover, harmonic-distortion correction is a regulatory requirement. Ex-1006, ¶75 (noting that regulations “require that the current be reduced in harmonic

distortion.”). It is also regulated by IEEE 519-92 and IEEE 1547-2003. Thus, in seeking to build a regulatory and standard-compliant version of Serban’s PV inverter, performing harmonic-distortion correction was a must. Therefore, motivation existed to include harmonic-distortion correction capabilities with Serban’s PV inverter 104 and a POSA would have looked to Matan for efficiency gains and to achieve regulatory compliance. Because harmonic-distortion correction was part of regulatory requirements and standards, incorporating harmonic-distortion correction into Serban would have been combining prior art elements according to known methods and applying a known technique (*i.e.*, harmonic-distortion correction) to a known device ready for improvement (*i.e.*, Serban’s system). Ex-1003, ¶188.

A POSA would have had a **reasonable expectation of success** in incorporating Matan’s harmonic-distortion correction into Serban. For regulatory and standard compliance, this was something that a POSA routinely implemented for compliant systems. In addition, Matan provides a detailed explanation for controlling harmonic distortion:

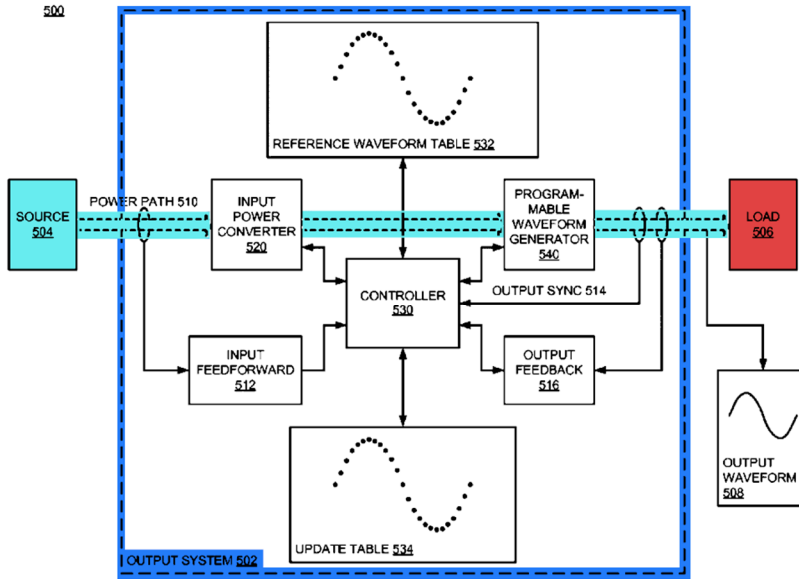


FIG. 5

Ex-1006, Fig. 5; Fig. 6; ¶11. As shown, Matan's output system 502 (blue) resides between the power source 504 (light blue) and the load 506 (red). Thus, to add Matan's harmonic-distortion correction to Serban, a POSA would have incorporated Matan's output system 502 (above) into Serban's PV inverter 104 (blue) and would have reasonably expected it to work.

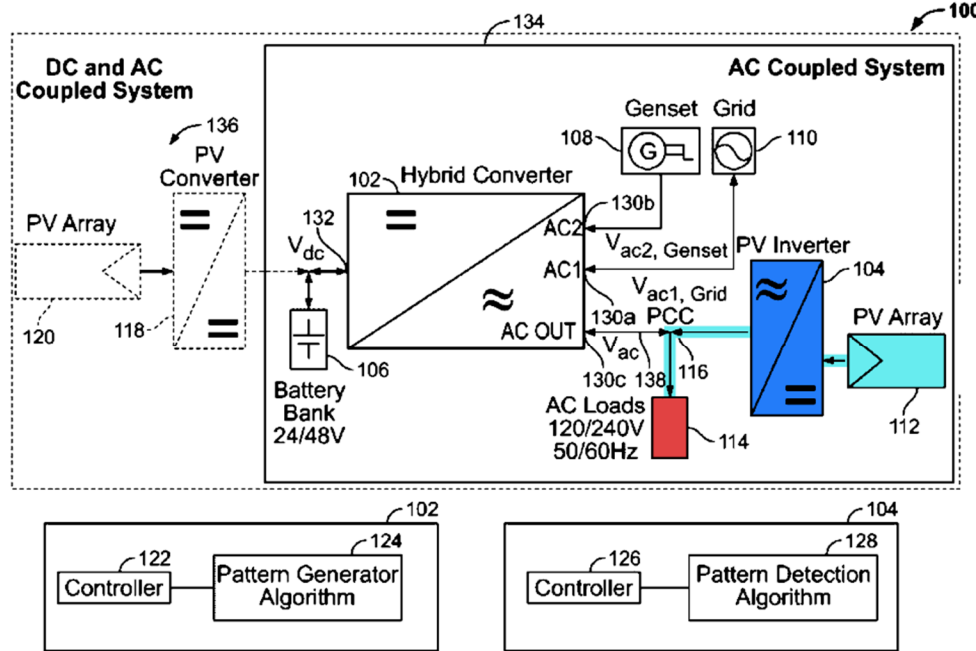


FIG.1

Ex-1005, Fig. 1. Moreover, both Serban and Matan employ a controller, and a POSA would have found it straightforward and routine to adapt Serban's Controller (e.g., through straightforward software and/or firmware updates) to implement functions of Matan's controller 530. Ex-1003, ¶189.

Power-factor conditioning. A POSA would have been motivated to incorporate Matan's power-factor conditioning into Serban's system as well.

Serban teaches "power factor correction (PFC)" but does not go into implementation details for PFC. Ex-1005, ¶4. A POSA implementing Serban's system would have been motivated to look to other references, like Matan, for details on how to implement PFC. Ex-1003, ¶192.

While Serban mentions the desirability of "achiev[ing] a unity power factor" (Ex-1005, ¶44), which Matan too acknowledges (Ex-1006, ¶44), Matan goes even

further and recognizes that “[t]he best benefit may not always be a power factor of unity...[and] the power factor may be best set at a value based on power grid conditions as well as tariff conditions.” Ex-1006, ¶145. For example, according to Matan, “California...required utilities operating in that state to pay solar PV owners for both active and reactive power when these owners supply them to the grid...Therefore, there is considerable benefit to PV owners to supply a mix of both types of power depending on their agreed tariff and/or PPA.” *Id.*, ¶127; *see also id.*, ¶128. Thus, a POSA looking to improve Serban’s system performance, efficiency, and economic benefit, especially in California, would have been motivated to implement Serban’s power-factor control using Matan’s implementation details. Ex-1003, ¶193.

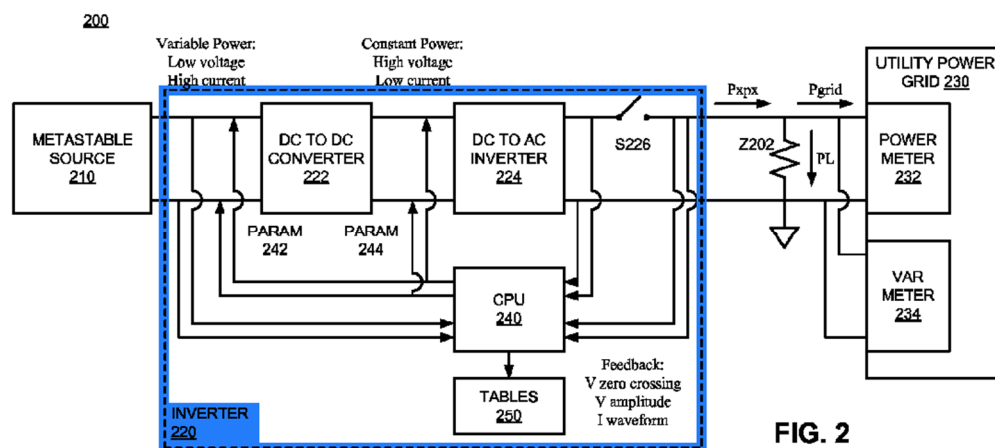
In addition, adjusting power factor (to a value other than 1) was already implemented in commercially available PV inverters.

Output data	
Rated AC power [W]	1500
Max. apparent AC Power [VA]	1650
Rated AC grid voltage [V]*	220,230,240
Rated AC grid frequency [Hz]*	50
AC voltage range [V]*	180-280
AC frequency range [Hz]	According to local codes
Rated current @ 230 Vac [A]	6.5
Max. current [A]	9
Power factor	> 0.99 (0.95 inductive ... 0.95 capacitive)
Harmonic distortion (THD) at rated output	< 2 %
Power consumption at night [W]	< 1
Power consumption at standby [W]	6

Ex-1018; Ex-1014. Thus, a POSA would have found it obvious (including based on market pressures requiring such a feature to produce a competitive product) to incorporate such a standard feature into Serban's PV inverter 104. Beyond express motivation, this is simply combining prior art elements according to known methods and applying a known technique (*i.e.*, Matan's power-factor conditioning) to a known device ready for improvement (*i.e.*, Serban's system). Ex-1003, ¶194.

A POSA would have had a **reasonable expectation of success** in doing this. As mentioned, power-factor conditioning was used in existing PV inverters. A POSA would have found it straightforward to follow existing techniques to implement such a standard feature in Serban because of the well-known hardware and software modifications needed. Ex-1003, ¶195.

Moreover, Matan instructs via Figure 2 how to implement its power-factor correction or conditioning in an inverter 220 (*e.g.*, a PV inverter).



Ex-1006, Fig. 2; *see also id.*, Figs. 3, 17-23. Implementing Matan's power-factor

conditioning in Serban was thus straightforward and a POSA would have reasonably expected it to work. Ex-1003, ¶196.

B. Claims 1-7, 13, and 18

Serban-Matan renders obvious claims 1-7, 13, and 18 because Serban anticipates those features (Section X). The Serban-Matan combination adds harmonic-distortion and power-factor conditioning features on top of Serban's teachings, so those features from Serban remain in the Serban-Matan system. Beyond the express or necessary disclosures in Serban, if PO contends that certain features were not anticipated, those were at least rendered obvious by Serban-Matan.

As one example, if PO argues that Serban does not explicitly disclose disconnecting PV inverter 104 in case of grid failure (Section X.G), a POSA would have found it obvious in view of Serban's teachings. Ex-1003, ¶198.

As another example, if PO argues that Serban does not explicitly disclose the controller 122 controlling the power flow of the hybrid converter 102, a POSA would have found it obvious in view of Serban's teachings. Ex-1003, ¶199.

As one other example, if PO argues that Serban does not explicitly disclose a single controller performing control functionalities of its power system, a POSA would have found that obvious. For example, Serban discloses using a DSP to implement its controllers. Ex-1005, ¶56. A POSA would have understood that it

is much more cost effective to use a single DSP to implement all the controllers (i.e., as a single controller, or “Serban’s Controller”) than to implement each controller using a separate DSP. This would not only reduce the number of DSP chips needed, but also reduce the footprint for the circuit board, making the resulted system more compact. Ex-1003, ¶200.

C. Claim 14

Claim 14 depends from obvious claim 6 (Section XI.B), and adds that *the controller is configured to regulate a power flow of the current-source inverter so as to cancel a distortion current produced by the load*, which Matan teaches or suggests.

Matan’s system provides “total harmonic distortion control.” *Id.*, ¶27. Matan’s inverter 120 (blue) receives DC power from source 110 (light blue) and “dynamically produce[s] maximum AC current [red] relatively free of harmonic distortion.” *Id.*, ¶31.

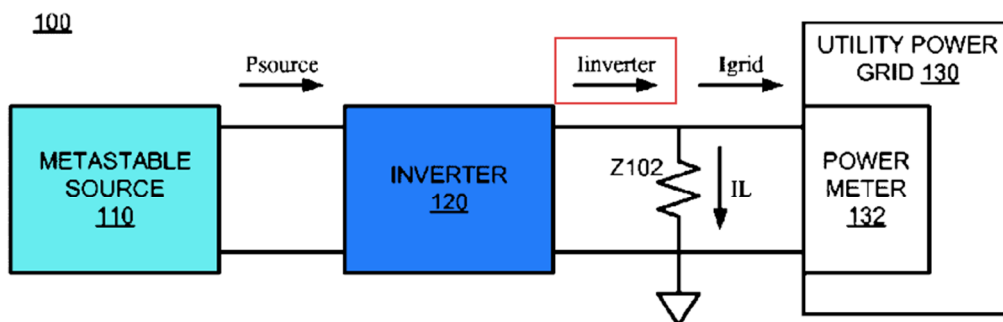


FIG. 1

Ex-1006, Fig. 1.

Matan illustrates in Figure 5 “a system that controls harmonic distortion with a software feedback control subsystem coupled to a hardware waveform controller.” Ex-1006, ¶58.

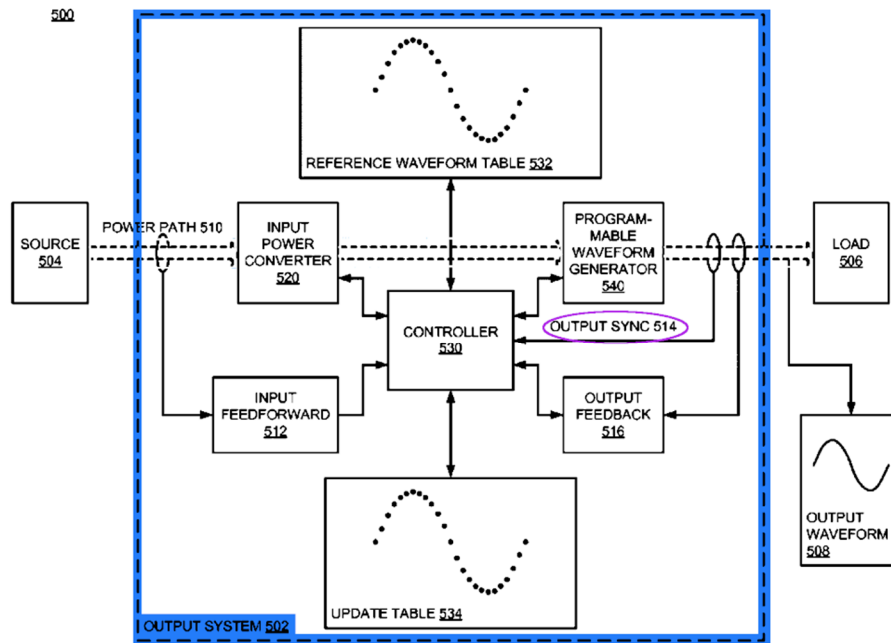


FIG. 5

Ex-1006, Fig. 5. In particular, this output system 502 (blue) “is able to incorporate specific timing, phasing, or other frequency information [i.e., input synchronization data], into generating output waveform 508.” Ex-1006, ¶62.

“[S]uch input synchronization data arrives from real-time **load information**, in which case it may be referred to as ‘load synchronization input’...[and] indicated...as output sync 514 [purple].” *Id.* Thus, Matan’s total harmonic-distortion correction takes into account the load’s real-time timing, phasing, and other frequency information and therefore reduces the harmonic-distortion current produced by the load. A POSA would have also understood that Matan’s reducing

total harmonic distortion necessarily includes correcting harmonic-distortion current produced by the load.⁷ Ex-1003, ¶205.

Matan further discloses that “[b]ased on output feedback 516, output system 502 [blue] generates update table 534 [yellow]...[which] includes entries or points to indicate how to modify the operation of generator 540 to provide an output more closely matching the waveform of reference waveform table 532 [green].” Ex-1006, ¶66. The values in the update table 534 cause the output signal to converge on the desired ideal waveform” and thereby cancel the harmonic distortions in the system.

⁷ Distortion current in a PV system was commonly understood as harmonic-distortion current. Ex-1003, ¶205.

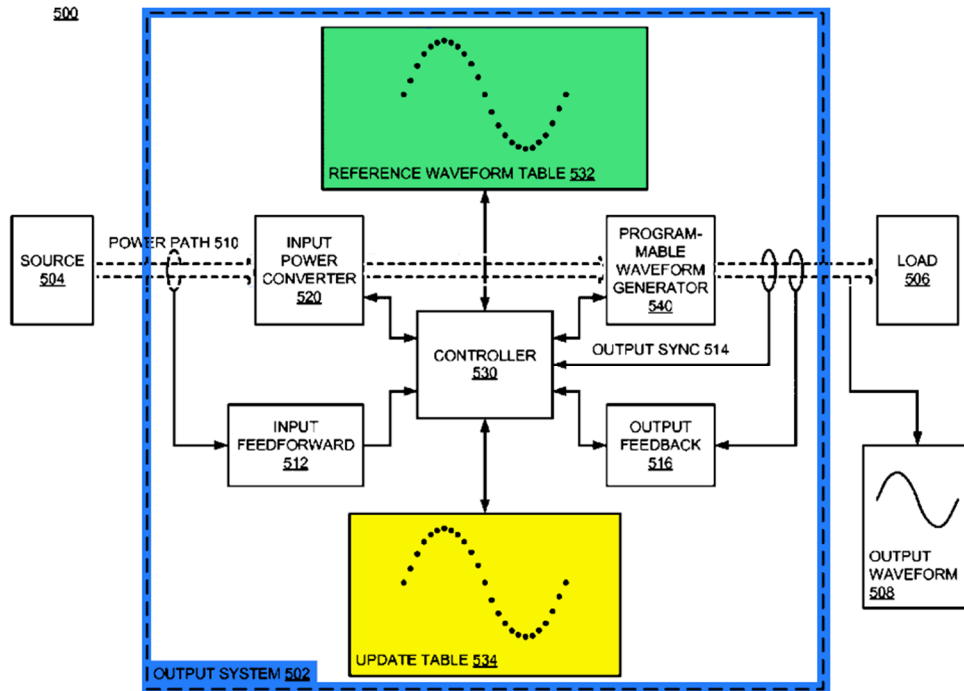


FIG. 5

Ex-1006, Fig. 5.

Therefore, Serban-Matan renders obvious *the controller* (e.g., Serban's Controller) *is configured to regulate a power flow of the current-source inverter* (e.g., AC current of Serban's PV inverter 104) *so as to cancel a distortion current produced by the load* (e.g., Matan's harmonic-distortion correction). Ex-1003, ¶¶201-207.

D. Claim 15

Claim 15 depends from obvious claim 1 (Section XI.B), and adds that *the controller is configured to regulate a power flow of the current-source inverter to produce an alternating current that is displaced from the grid voltage*, which Matan teaches or suggests.

Matan discloses implementing power-factor correction in a PV inverter

(blue). Ex-1006, ¶52.

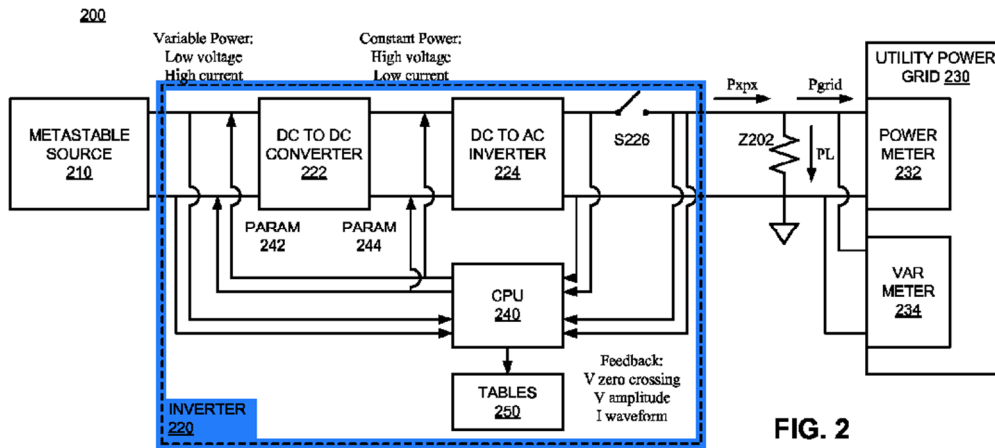


FIG. 2

Ex-1006, Fig. 2; Ex-1003, ¶211.

“[T]he AC current [red] [generated by PV inverter 120, blue] may be intentionally changed to be **out of phase** to a certain extent with **respect to the AC voltage signal of the grid [orange].**” Ex-1006, ¶32.

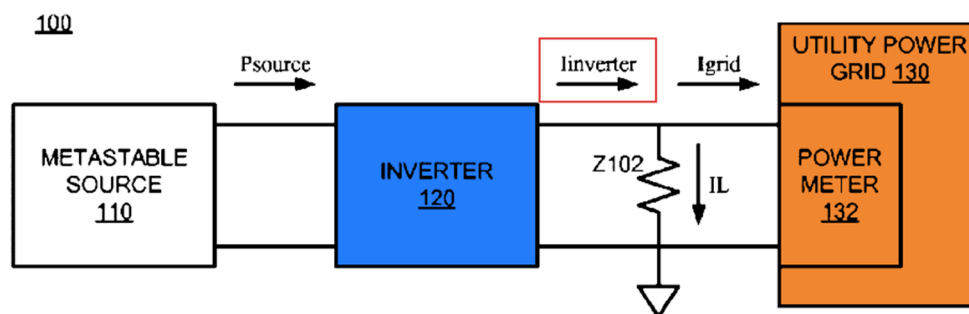


FIG. 1

Ex-1006, Fig. 1. In this way, “the single inverter 120 [blue] can **deliver power** at **any desired power factor** to compensate for conditions of power on power grid 130.” *Id.*, ¶32.

By incorporating Matan’s power-factor conditioning into Serban’s system,

PV inverter 104 would then deliver any desired power-factor based on grid conditions. Ex-1003, ¶213.

Therefore, Serban-Matan renders obvious that *the controller* (e.g., Serban's Controller) *is configured to regulate a power flow of the current-source inverter to produce an alternating current that is displaced from the grid voltage* (e.g., changing the AC current output by Serban's PV inverter 104 to be out of phase to a certain extent with respect to Serban's AC grid, as taught by Matan). Ex-1003, ¶¶208-214.

E. Claim 16

Claim 16 depends from obvious claim 15 (Section XI.D) and adds *an amount of displacement of the alternating current is determined by a preset limit*, which Matan teaches or suggests.

According to Matan, “[t]he maximum power factor equals 1, when phase angle 1602 has a value of 0. The minimum power factor equals 0, when phase angle 1602 is 90 degrees.” Ex-1006, ¶125. Thus, Matan discloses that amount of phase displacement is limited by a preset limit, *i.e.*, no more than 90 degrees. Ex-1003, ¶217.

Moreover, use of a preset limit was common at the time and is not innovative. Thus, should PO argue that use of a preset limit distinguishes claim 16 from the prior art, such a difference does not rise to the level of a nonobvious

innovation. *In re Lamb*, 286 F.2d 610, 611 (C.C.P.A. 1961) (“differences over the prior art structures is not alone sufficient to justify a holding that the design is patentable.”); *Graham v. John Deere Co.*, 383 U.S. 1, 26 (1966) (feature that “presents no operative mechanical distinctions, much less nonobvious differences” over the prior art is obvious). A POSA’s general background knowledge in this field is replete with use of preset limits for current displacements, so that difference (even if it exists) is obvious. Ex-1018; Ex-1003, ¶218.

Therefore, Serban-Matan renders obvious that *an amount of displacement of the alternating current is determined by a preset limit* (e.g., phase-shift amount is determined by preset limits). Ex-1003, ¶¶215-219.

F. Claim 17

Claim 17 depends from obvious claim 15 (Section XI.D), and adds that *the amount of displacement of the alternating current is controlled through external communication with the controller*, which Matan teaches or suggests.

Matan discloses setting power factor (and thereby the amount of phase shift) “based on power grid conditions as well as tariff conditions.” Ex-1006, ¶145. For example, Matan’s PV inverter 1720 (blue) “controls the power factor at point ‘A’...through electrical measuring meter 1730 [red].” *Id.*, ¶129.

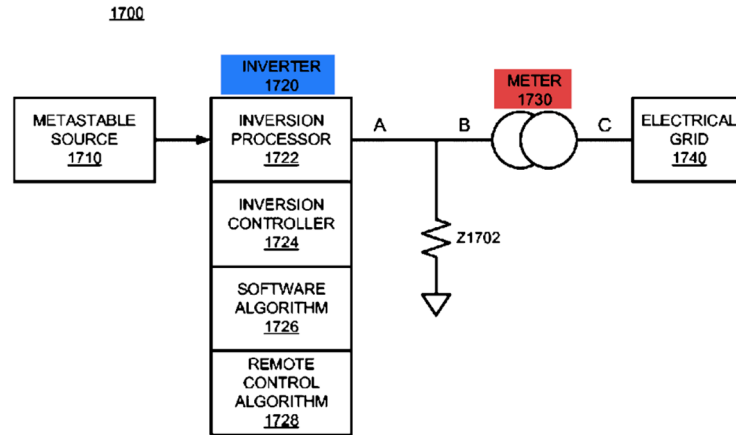


FIG. 17

Ex-1006, Fig.17. According to Matan, monitoring can be done via WiFi and changes can be applied using a remote command. *Id.*, ¶130, ¶138.

Matan’s Figure 21 shows that “remote communication [red] may allow for utility control of the power factor setting, rather than owner control.” Ex-1006, ¶143.

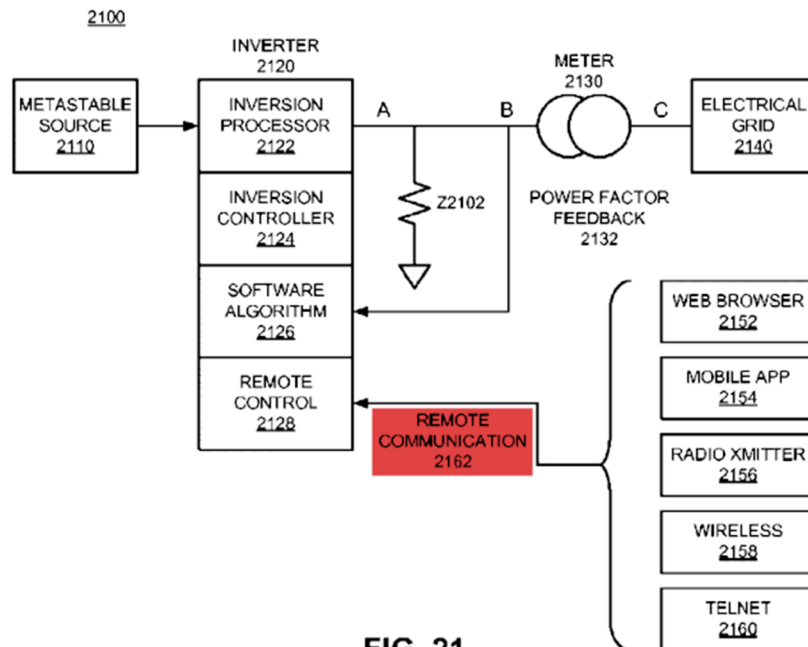


FIG. 21

Ex-1006, Fig. 21.

Serban's Controller controls the output of the PV inverter 104, so in Serban-Matan and following Matan's teachings, displacement amounts would be communicated (owner control and/or remote communication, consistent with Matan's teachings) to Serban's Controller for performance of power-factor conditioning.

Thus, Serban-Matan renders obvious that *the amount of displacement of the alternating current is controlled through external communication with the controller* (e.g., owner control or remote communication with Serban's Controller, as taught by Matan). Ex-1003, ¶¶220-225.

XII. GROUND 3: CLAIMS 8-12 AND 19-20 ARE RENDERED OBVIOUS BY SERBAN-MATAN-WILHELM

A. Motivation to Combine Serban with Matan and Wilhelm

Serban, Matan, and Wilhelm are **analogous art** at least because they are in the same field of endeavor, *i.e.*, grid-tied photovoltaic systems. Serban and Matan are in that field (Section XI.A). So is Wilhelm, which concerns “reduc[ing] the peak power demand of a customer from an electric power utility by controllably directing power from [a secondary source of electric power, such as] a storage battery” or “a power generator or photovoltaic device” to a load. Ex-1009, 2:41-49; 12:66-13:4. Serban, Matan, and Wilhelm are also reasonably pertinent to load-demand management problems, identified by the '755 Patent. *Compare* Ex-1001,

6:62-65 *with* Ex-1005, ¶24; Ex-1006, ¶117; Ex-1009, 1:19-27; Ex-1003, ¶226.

Matan's battery-to-grid power sourcing. A POSA would have been motivated to incorporate Matan's battery-to-grid power sourcing into Serban, which would have furthered the motivating system-efficiency goals discussed above (Section XI.A).

As Matan discloses, supplying power to the grid from a PV system or a battery based on grid conditions creates a benefit to both the utility and consumers. Ex-1006, ¶128. Consumers are compensated by doing so and the utilities can save considerable sums, especially during peak hours. *Id.*, ¶¶126-127. Thus, a POSA would have been motivated to enable Serban's system to sell battery power to the grid to maximize its system power efficiency, also fueling a desire to incorporate Matan's battery-to-grid power sourcing. In addition to the system-efficiency gains, further motivation existed in building a power-supply product that was marketable to a broader base of consumers. *See* Ex-1006, ¶116 (customer compensated for providing power to the grid); ¶127 (noting utilities paying solar PV owners who supply power to the grid). Ex-1003, ¶228.

A POSA would have reasonably expected success in incorporating Matan's battery-to-grid power sourcing into Serban, which already had the hardware for power to flow from the battery 106 to the grid 110 (Ex-1005, Fig. 1) and, therefore, no change to Serban's hardware is likely to be needed. The software and/or

firmware changes to incorporate Matan's teachings into Serban were straightforward for a POSA, exercising only ordinary skill. Matan also indicates that its battery-to-grid power sourcing was in pre-existing use, with more deployment expected thereafter (Ex-1006, ¶127), so the straightforwardness of incorporating this feature would have been well-known. Ex-1003, ¶¶229-230.

Wilhelm's trigger condition. A POSA would have been motivated to incorporate Wilhelm's trigger condition into Serban-Matan.

It was known that a higher utility demand strengthens a need for battery-to-grid power flow. Ex-1003, ¶232. As part of incorporating battery-to-grid power sourcing into Serban-Matan, a POSA would have been motivated to understand the circumstances under which the battery-to-grid sourcing features should be enabled. This would have led a POSA to consult analogous references for additional details and implementation options, like Wilhelm, including to understand when to trigger Matan's battery-to-grid power sourcing. Ex-1003, ¶233.

Moreover, Serban aims to "control the power flow for energy prioritization and system efficiency maximization." Ex-1005, ¶4. A POSA looking to better prioritize energy and maximize system efficiencies would have been motivated to utilize Wilhelm's trigger condition to determine when to activate battery-to-grid functions, thereby ensuring that power from the battery is provided to the grid at efficient times when the grid needs it most. Ex-1003, ¶234.

A POSA would also have had **reasonable expectation of success** in incorporating Wilhelm's trigger condition into Serban-Matan. Use of a threshold was well known before the '755 Patent, and would only require minor modification to Serban-Matan's software and/or firmware. Thus, a POSA would have found it straightforward and routine to incorporate Wilhelm's trigger condition, and would have reasonably expected the Serban-Matan-Wilhelm system to work. Ex-1003, ¶235.

B. Claim 8

Claim 8 depends from obvious claim 6 (Section XI.B), and adds that *the controller includes a predetermined power level set-point*, while also adding that *the controller is configured to source power from the battery to the alternating current grid when the power sourced from the alternating current grid exceeds the predetermined power level set-point*, which Serban-Matan-Wilhelm teaches or suggests.

Matan discloses that “[s]**upplying power to the grid from a PV (or other local source)** system based on...**power needs**[] can create a benefit to both the utility and the consumers.” Ex-1006, ¶128; *see also* ¶129. Matan's local source includes “a battery or batteries.” *Id.*, ¶81. Thus, Matan discloses sourcing power from battery to AC grid based on power needs. Ex-1003, ¶238.

Wilhelm discloses a trigger condition for when to source power from a

battery (to the load)—when “the amount of power drawn from the utility by the customer [] **exceeds the set point threshold.**” Ex-1009, 8:56-59. For example, Wilhelm discloses that if “the customer’s demand has increased to...50 K watts over the 800 K watt set point threshold,...the load controlled by the system will draw...50 K watts of power from the storage battery.” *Id.*, 9:3-9.

As detailed above (Section XI.A), motivation existed to incorporate Matan’s battery-to-grid power sourcing capability into Serban’s system while making use of Wilhelm’s trigger condition, *e.g.*, activate the battery-to-grid feature from Matan when Wilhelm’s trigger condition occurs (power drawn from the utility grid exceeds a set point threshold). Ex-1003, ¶240.

Because Serban’s Controller controls power conversion and interfaces with both the grid 110 and the battery 106 (Section XIII.C), it was obvious to use Serban’s Controller to control battery-to-grid power sourcing in Serban-Matan-Wilhelm. Because Serban’s Controller includes a processing device executing software stored in a non-volatile memory, such as “a flash memory” (Ex-1005, ¶59), it was also obvious to store Wilhelm’s set point threshold in Serban’s non-volatile memory. Ex-1003, ¶241.

Therefore, Serban-Matan-Wilhelm renders obvious that *the controller* (*e.g.*, Serban’s Controller) *includes a predetermined power level set-point* (*e.g.*, Wilhelm’s set point threshold), and that *the controller is configured to source*

power from the battery to the alternating current grid (e.g., source power from Serban's battery 106 to Serban's grid 110, per Matan) when the power sourced from the alternating current grid exceeds the predetermined power level set-point (e.g., "the amount of power drawn from the utility by the customer [] exceeds the set point threshold," per Wilhelm). Ex-1003, ¶¶236-242.

C. Claim 9

Claim 9 depends from obvious claim 8 (Section XII.B) and adds that *the controller includes a non-volatile memory element configured to store the predetermined power level set-point*. This was an obvious feature of Serban-Matan-Wilhelm, as noted above (Section XII.B). Ex-1003, ¶¶243-244.

D. Claim 10

Claim 10 depends from obvious claim 8 (Section XII.B) and adds that *the controller includes a real-time clock*, while also adding that *the predetermined power level set-point varies as a function of the time of day as determined by the real-time clock*, which Serban-Matan-Wilhelm teaches or suggests.

Matan discloses "determining a power transfer strategy includes determining or identifying and selecting power distribution rules," which "can be applied consistently, or may be adjusted for any of a number of scenarios (e.g., **change in demand, time of day...**" Ex-1006, ¶¶90, 95. Matan also mentions "a sunrise/sunset schedule and using logic to determine peak sun hours." *Id.*, ¶93; *see*

also ¶5. Therefore, a POSA implementing the set point threshold triggering battery-to-grid power sourcing in Serban-Matan-Wilhelm would have obviously included time-of-day variations, at least to reflect the variation in grid demands throughout the day. Ex-1003, ¶246.

Matan also teaches that “[t]ime of day [] is determined by a clock input.” Ex-1006, ¶150. A POSA would have found it obvious to use a real-time clock on Serban’s Controller to provide this clock input, at least because a POSA would have known that standard controllers are capable of implementing real time clocks on their logic boards. *See, e.g.*, Ex-1020, p.93 (“time stamping of messages” function indicates existence of real time clocks), p.107 (“Uses a 32-bit time stamp on receive and transmit message”); Ex-1003, ¶247.

Therefore, Serban-Matan-Wilhelm renders obvious that *the controller* (e.g., Serban’s Controller) *includes a real-time clock*, and that *the predetermined power level set-point varies as a function of the time of day* (e.g., Wilhelm’s set point threshold varies based on the time of day) *as determined by the real-time clock*. Ex-1003, ¶¶245-249.

E. Claim 11

Claim 11 depends from obvious claim 8 (Section XII.B) and adds that *the controller further includes a calendar function*, while also adding that *the predetermined power level set-point varies as a function of the day as determined*

by the calendar function, which Serban-Matan-Wilhelm teaches or suggests.

Matan discloses that “[t]ime based rules allow the distribution of power to be based...**time of week.**” Ex-1006, ¶93. Therefore, a POSA implementing the set point threshold triggering battery-to-grid power sourcing in Serban-Matan-Wilhelm would have obviously used a calendar function of Serban’s Controller to vary the threshold based on the day of week. To determine the day of week, a POSA would have found it obvious to use a conventional calendar function. Ex-1003, ¶252.

Therefore, Serban-Matan-Wilhelm renders obvious *the controller* (e.g., Serban’s Controller) *includes a calendar function*, and that *the predetermined power level set-point varies as a function of the day determined by the calendar function* (e.g., Wilhelm’s set point threshold varies based on the day of week) *as determined by the calendar function*. Ex-1003, ¶¶250-253.

F. Claim 12

Claim 12 depends from obvious claim 8 (Section XII.B) and adds that *the controller is provided with a communication element, and the communication element is configured to receive a real-time update of the power level set-point*, which Serban-Matan-Wilhelm teaches or suggests.

Matan discloses that “the power distribution rules can be applied consistently, or may be adjusted for any of a number of scenarios,” and specifically

mentions using any “**other variable condition**” for the adjustment. Ex-1006, ¶95.

Matan discloses using communication mechanisms to set up parameters, such as power factor, remotely. *Id.*, ¶¶146-147, Fig. 21. Therefore, a POSA would have understood that the set point threshold triggering battery-to-grid power sourcing in Serban-Matan-Wilhelm is settable remotely via communication. Ex-1003, ¶256.

Moreover, Serban discloses that its “control functions 122, 124, 126, 128 are implemented as a 32-bit TMS320F2812 DSP running at 150 MHz.” Ex-1005, ¶56. Because TMS320F2812 DSP has serial communication capabilities (Ex-1020, p.117), it would have been obvious to a POSA to use Serban’s TMS320F2812 DSP as a communication element for remotely receiving real-time update of the set point threshold. Ex-1003, ¶257.

Therefore, Serban-Matan-Wilhelm renders obvious that *the controller* (e.g., Serban’s Controller) *is provided with a communication element* (e.g., communication element of Serban’s TMS320F2812), *and the communication element is configured to receive a real-time update of the power level set-point* (e.g., update the set point threshold via remote communication). Ex-1003, ¶¶254-258.

G. Claims 19 and 20

Claims 19 and 20 each combine claims 1-3, 5-8, and 13 and that combination of features was obvious based on Serban-Matan-Wilhelm per Sections

XI.B and XII.B. Appendix-A; Ex-1003, ¶¶259-260.

As to 20[P], if limiting, 20[P] is rendered obvious by Serban-Matan-Wilhelm, which manages power flow between PV and other components tied to the grid. Section X.C. As to 20[C-D], Serban-Matan-Wilhelm's load is *house load*. Ex-1006, ¶¶28, 30. As to 20[F] and 20[I-J], Serban-Matan-Wilhelm's grid is *utility grid*. Section X.C; Ex-1003, ¶¶261-263.

XIII. GROUND 4: CLAIMS 7, 13, AND 18-20 ARE RENDERED OBVIOUS BY SERBAN-MATAN-WILHELM-PVI

A. Motivation to Combine Serban-Matan-Wilhelm with PVI

Like Serban, Matan, and Wilhelm, PVI qualifies relates to grid-tied photovoltaic systems and is thus in the same field of endeavor. Ex-1001, 1:7-8, Ex-1005, Abstract, ¶4; Ex-1006, ¶¶2-3; Ex-1009, 2:41-45; 12:66-13:4; Ex-1010, p.1. PVI, like Serban, Matan, and Wilhelm, is also reasonably pertinent to at least one problem allegedly solved, because it teaches attaching additional power sources to the grid. Ex-1010, p.8; Ex-1001, Fig. 4; Ex-1005, Fig. 1; Ex-1009, Ex-1009, 9:3-9.

A POSA would have been motivated to incorporate PVI's time-delayed inverter re-connect technique into Serban-Matan-Wilhelm. One known resource a POSA would have consulted to understand certain implementation details for the combination, including Serban's PV inverter 104, would have been commercially available PV inverters, thereby leading a POSA to the PVI publication.

Moreover, a POSA implementing Serban's PV inverter 104 would have looked to materials such as PV inverter user manuals to understand common requirements and features, and would have been motivated to incorporate those features, including PVI's time-delayed inverter re-connect technique into the Serban-Matan-Wilhelm. Ex-1003, ¶¶264-266.

A POSA would have had **reasonable expectation of success** in incorporating PVI's time-delayed inverter re-connect technique into the combination. Delaying a process for a predetermined duration of time was well known. *See, e.g.*, Ex-1006, ¶88 ("a timer mechanism that enables the system to wake up after a period of time (e.g., 5 minutes)"). A POSA would not have had any difficulty implementing such a feature. Moreover, as mentioned above, PVI's time-delayed inverter re-connect technique had already been implemented in existing PV inverters. It would have been simple and routine to implement such a technique with a reasonable expectation of success. Ex-1003, ¶267.

B. Claim 7

To the extent that claim 7's *predetermined outage period* requires a predetermined duration of time (it does not), PVI has that.

PVI describes a grid-tied photovoltaic inverter that "disconnect[s] from the grid during abnormal frequency or voltage events...the inverter will monitor the grid and reconnect to it 5 minutes after the grid has come back to normal." Ex-

1010, p.8; *see also* p.68 (after “a grid failure, the inverter waits 300 seconds before the next connection to the grid.”).

Therefore, Serban-Matan-Wilhelm-PVI renders obvious that *the current-source inverter* (e.g., Serban’s PV inverter 104) *is configured to disconnect from the alternating current voltage source* (e.g., Serban’s hybrid converter 102) *for a predetermined outage period* (e.g., 5 minutes as taught by PVI) *when the alternating current voltage source frequency goes outside of a predetermined frequency limit* (e.g., Serban’s AC line frequency outside of predetermined frequency range limit for a grid system), and that *the controller* (e.g., Serban’s controller 122) *is configured to control the bi-directional power converter* (e.g., Serban’s hybrid converter 102) *to source power to the load* (e.g., Serban’s load 114) *during the predetermined outage period*. Ex-1003, ¶¶268-270.

C. Claim 13

Claim 13 depends from obvious claim 7 (Section XIII.C). The capability to use Serban’s Controller for inverter-disconnection features was obvious (Section XI.B), including when using PVI’s time-based threshold in the combination. Ex-1003, ¶271.

D. Claim 18

Claim 18 combines obvious claims 1-2 and 5-7, and is rendered obvious by Serban-Matan-Wilhelm-PVI. Sections XI.B and XIII.B; *see also* Appendix-A; Ex-

1003, ¶272.

E. Claims 19 and 20

Claims 19 and 20 each combine claims 1-3, 5-8, and 13 and that combination of features was obvious based on Serban-Matan-Wilhelm-PVI per Sections XI.B, XII.B, XIII.B-XIII.C; Appendix-A; Ex-1003, ¶¶273-274.

As to 20[P], if limiting, 20[P] is rendered obvious by Serban-Matan-Wilhelm-PVI, which manages power flow between PV and other components tied to the grid. Section X.C. As to, 20[C-D], Serban-Matan-Wilhelm-PVI's load is *house load*. Ex-1006, ¶¶28, 30. As to 20[F] and 20[I-J], Serban-Matan-Wilhelm-PVI's grid is *utility grid*. Section X.C; Ex-1003, ¶¶275-277.

XIV. GROUND 5: CLAIMS 1-3, 5-7, 13, AND 18 ARE ANTICIPATED BY SOMANI

A. Claim 1

1. 1[P]⁸

If limiting, 1[P] is in Somani.

Somani discloses a power system in Figure 1B where “the load 170 [red] may be powered by external grid/AC source 150 [orange] and solar power from

⁸ Each limitation was reproduced earlier and, for brevity, is not repeated again.

Each sub-section concludes with a summary mapping including claim language.

See also Appendix-A.

inverter 140 [blue].” Ex-1007, ¶68; Ex-1008, p.15.

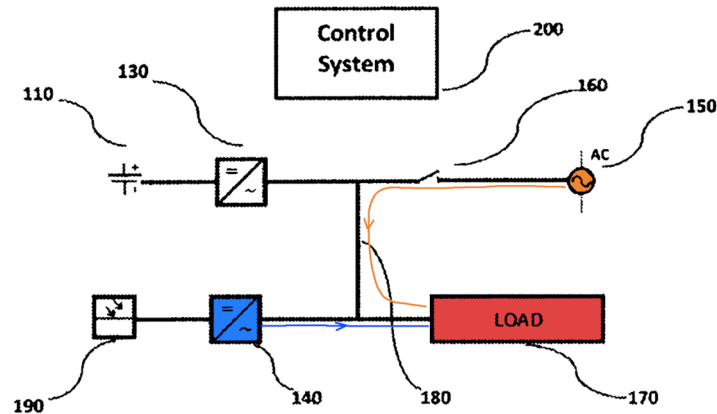


FIG. 1B

Ex-1007, Fig. 1B.

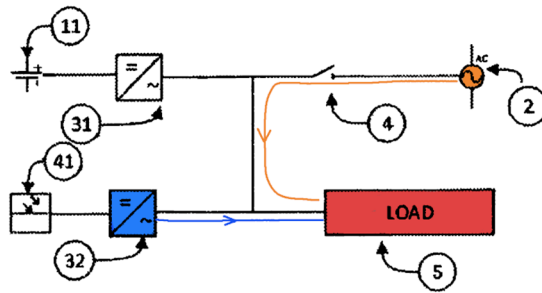


Fig. 3: Implementation of Method using one Battery source and one Solar Source

Ex-1008, Fig. 3.

“Upon failure of the utility 150 [orange],...[c]ontrol system 200 may be programmed to **transition the system to microgrid mode**,...[wherein] energy storage inverter 130...**continue[s] to supply load 170 with energy during the utility outage.**” Ex-1007, ¶72; Ex-1008, p.15.

Therefore, Somani discloses *an uninterruptible power supply* (i.e., Somani’s

power system). Ex-1003, ¶¶278-281.

2. $1[A]$

Somani discloses that “**power converter 130 [yellow] is a bi-directional power inverter** that provides energy from or to battery 110 [green].” Ex-1007, ¶70. “Upon failure of the utility 150 [orange],...[i]f the solar production is greater than the power needed by the load, the additional energy may be used, for example, **to charge [blue pathway] battery 110**. If the solar production is below the demand of the load 170, **battery 110 may discharge [green pathway]** to provide the additional power needed for operation.” *Id.*, ¶72; Ex-1008, p.15.

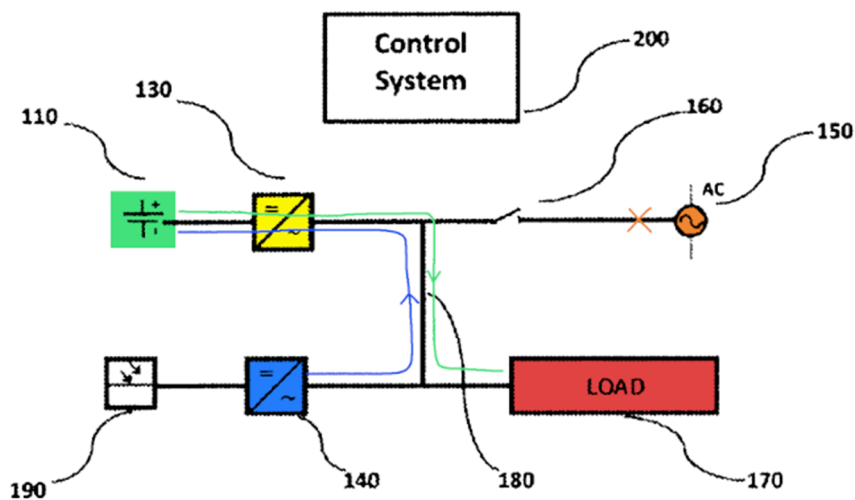


FIG. 1B

Ex-1007, Fig. 1B; Ex-1008, Fig. 3.

Somani's bi-directional power converter 130 is configured to operate as a voltage source because upon power failure, the bi-directional power converter 130

“transitions from current source mode to **voltage source mode** to continue to supply load 170...” Ex-1007, ¶72; Ex-1008, p.15; Ex-1007, ¶82 (same); Ex-1008, p.19.

Bi-directional power converter 103 receives/outputs alternating current because it is connected (yellow line) to “external grid/AC source 150 [orange].” Ex-1007, ¶63; Ex-1008, p.11. The “~” symbol (purple) indicates alternating current—confirmed also by the “AC” text right next to it.

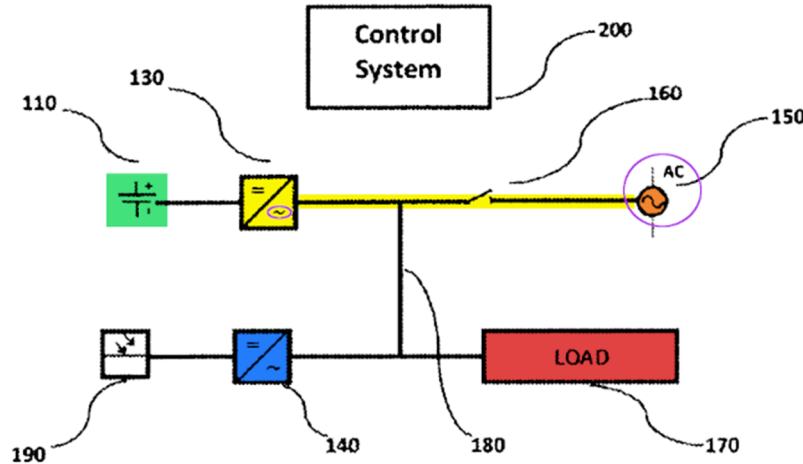


FIG. 1B

Ex-1007, Fig. 1B; Ex-1008, Fig. 3.

Therefore, Somani discloses *a bi-directional converter* (i.e., bi-directional power converter 103) *configured to operate as an alternating current voltage source* (e.g., operate in voltage source mode). Ex-1003, ¶¶282-285.

3. 1[B]

Somani discloses that “a battery energy storage inverter 130 [yellow] may be

coupled with battery 110 [green].” Ex-1007, ¶70; Ex-1008, p.15. By describing this coupling and showing a line between the battery 110 and the inverter 130 at a port (purple) where DC flows out of inverter 130 and to battery 110 (as reflected by the “=” symbol), Somani expressly discloses a DC port coupling these components.

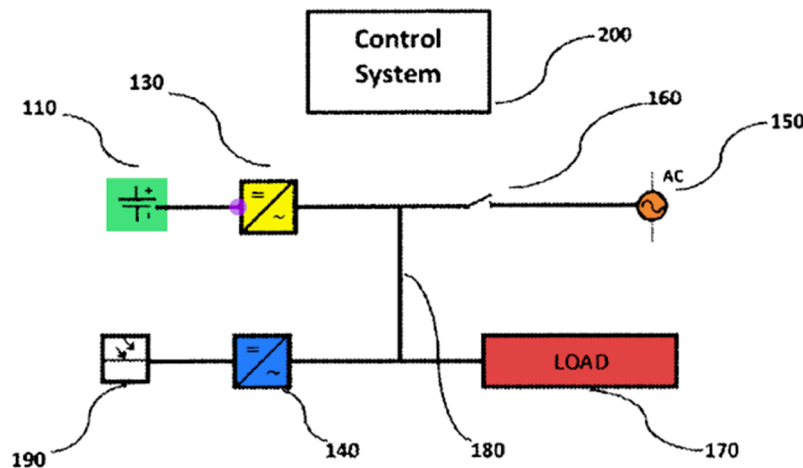


FIG. 1B

Ex-1007, Fig. 1B; Ex-1008, Fig. 3.

Since DC power flows between the battery and converter 130 (Ex-1007, ¶73; Ex-1008, p.11), a DC port is necessarily used to couple these components. Ex-1003, ¶287.

Therefore, Somani discloses *a direct current power port* (i.e., bi-directional power converter 130's port connected to the battery 110) *configured to be coupled to a battery* (i.e., battery 110). Ex-1003, ¶¶286-288.

4. 1[C]

As shown below, bi-directional power converter 130 (yellow) outputs/receives alternating current (AC). *See* Section XIV.A.2. The bi-directional power converter 130 is coupled to a “PV inverter 140 [blue]...[that] operate[s] in **current source**,” Ex-1007, ¶82, Ex-1008, pp.15, 19, to provide AC current to the load 170 (red). *See also* Ex-1007, ¶67 (“the PCC is an... AC bus 180 [which] interfaces with local load 170 on the microgrid.”); Ex-1008, p.17, Fig. 3. At minimum, Somani necessarily has AC ports (purple and grey) coupled to the bi-directional power converter 130 at the AC side.

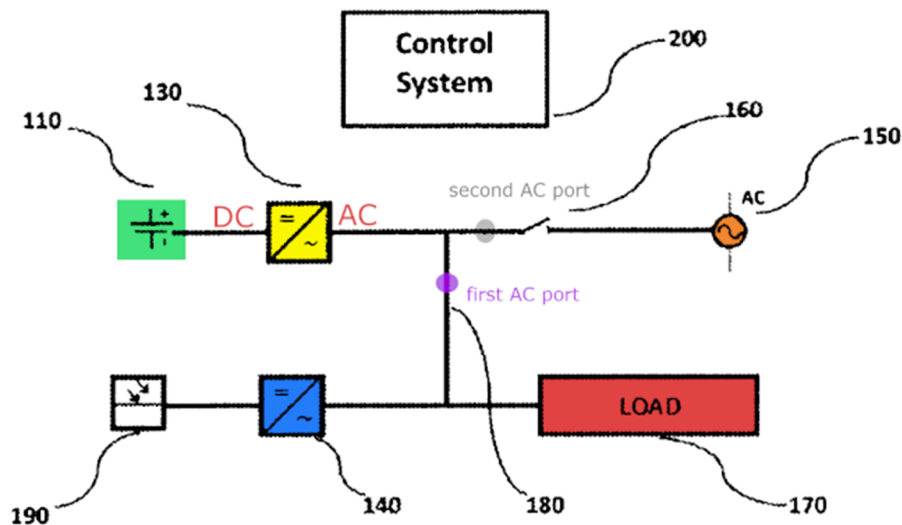


FIG. 1B

Ex-1007, Fig. 1B; Ex-1008, Fig. 3. Somani also discloses a “master/slave configuration...[where] one of the power converters can act as a microgrid master which attempts to control the output voltage amplitude and frequency.” Ex-1007,

¶91; Ex-1008, p.18. Somani discloses that the bi-directional power converter 130 (yellow) is a master power converter and the PV inverter 140 (blue) is a slave power converter.⁹

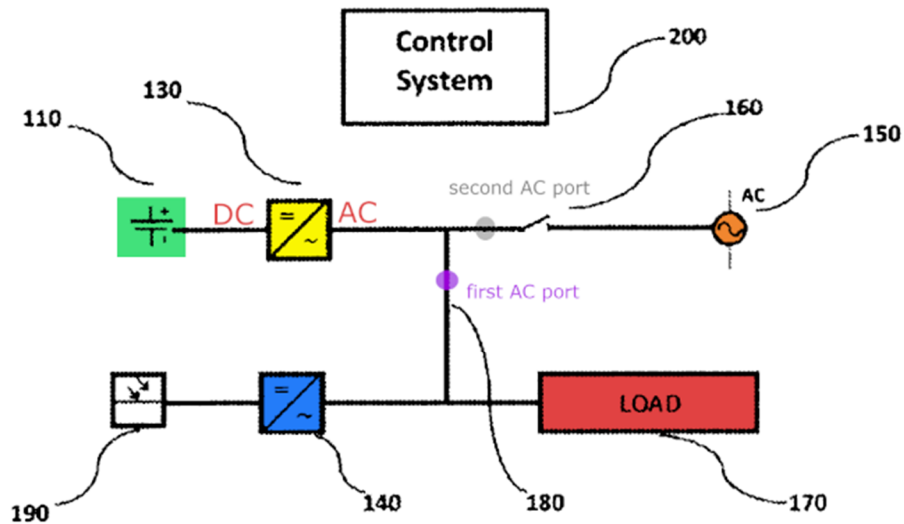


FIG. 1B

Ex-1007, Fig. 1B; Ex-1008, Fig. 3; Ex-1003, ¶289.

To avoid over-charging in microgrid mode (utility grid disconnected), Somani’s master power converter may “trip[] the renewable resource [e.g., PV inverter 140 and solar array 190] offline by **changing the microgrid frequency** [e.g., frequency of the master power converter 130] **beyond the nominal frequency.**” Ex-1007, ¶90; Ex-1008, p.18. “When the storage devices [e.g.,

⁹ Somani’s converters 130 and 140 function as inverters (Ex-1007, ¶64; Ex-1008, p.12), so are interchangeably referred to as PV inverters or converters.

batteries 110] are sufficiently depleted to be able to accept charge again, the renewable devices may be brought back online by **restoring the microgrid frequency to nominal values** and allowing the generation devices to reconnect to the microgrid.” Ex-1007, ¶95; Ex-1008, p.18. Thus, Somani’s PV inverter 140 *is configured to adjust an output power* when the output goes from zero to some higher value (or vice versa) in response to frequency changes of the master power converter 130.

Therefore, Somani discloses *a first alternating current power port coupled to the bi-directional converter* (i.e., AC power port coupling the bi-directional power converter 130 with power inverter 140) *and configured to be coupled to a current-source inverter* (i.e., PV inverter 140), *wherein the current-source inverter is configured to adjust an output power as a function of a frequency of the alternating current voltage source* (e.g., the PV inverter 140 varies its output power from zero to a higher value (or vice versa) based on frequency of the bi-directional power converter 130). Ex-1003, ¶¶289-291.

5. 1[D]

As just explained, Somani’s PV inverter 140 provides or does not provide output power based on whether the frequency of the bi-directional power converter 130 is within or beyond nominal frequency. This is done through a controller, such as “controller 230 [yellow] of inverter 130...[or] a master controller [green]

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external to any power converter.” *See, e.g.*, Ex-1007, ¶82; Ex-1008, p.19 (similar).

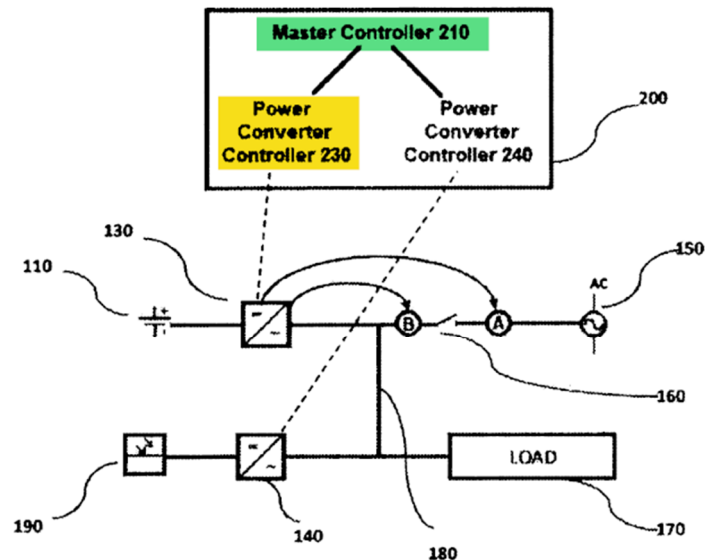
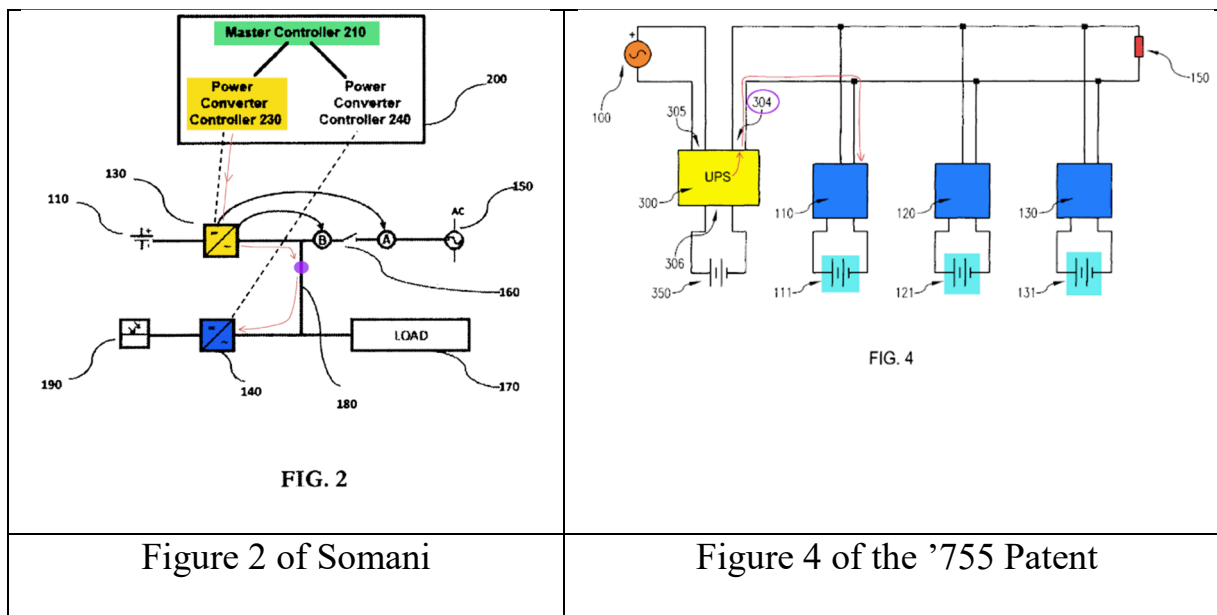


FIG. 2

Ex-1007, Fig. 2; Ex-1008, Fig. 4.

This is just like the '755 Patent. Somani's power converter controller 230 (yellow) or master controller 210 (green) controls the frequency at its AC power output port (purple), causing the output power change of the PV inverter 140 (blue) to change. Similarly, the '755 Patent's controller 301 of the UPS 300 (yellow) controls the frequency at port 304 (purple), causing the output power change of the PV inverters 110, 120, and 130 (blue) to change. Ex-1001, 8:18-21.



Therefore, Somani discloses *a controller* (e.g., controller 230 or master controller 210) *configured to regulate a power flow of the current-source inverter by adjusting a frequency of the alternating current voltage source* (e.g., the PV inverter 140 provides or does not provide output power based on frequency of the bi-directional power converter 130). Ex-1003, ¶¶292-294.

B. Claim 2

As explained in Sections XIV.A.4-XIV.A.5, Somani's controller 230 or master controller 210 regulates power flow by tripping the PV inverter 140 offline is to avoid overcharging. "When the...[battery is] sufficiently depleted to be able to accept charge again," the PV inverter 140 is brought online, thereby ensuring that the battery maintains a certain charging state. Ex-1007, ¶¶90, 95; Ex-1008, p.18.

Therefore, Somani discloses that *the controller* (e.g., controller 230 or master controller 210) *is configured to regulate the power flow of the current-source inverter* (e.g., controlling the PV inverter 140 to be offline or online) *to maintain the battery at a predetermined ideal charging state* (e.g., avoid overcharging the battery 110, and maintain the battery 110 at certain charging state). Ex-1003, ¶¶295-296.

C. Claim 3

As shown below, Somani discloses a port at the right side of the bi-directional power converter 130 connected to “external grid/AC source 150.” Ex-1007, ¶72; Ex-1008, p.11. Somani’s bi-directional power converter 130 expressly, or at least necessarily, has an AC power port (gray) coupled to the AC grid 150. While the claim does not expressly require it, if PO argues that more than one AC power port is required, the AC power port between converter 130 and the grid 150 is a different power port from the one between converter 130 and inverter 140.

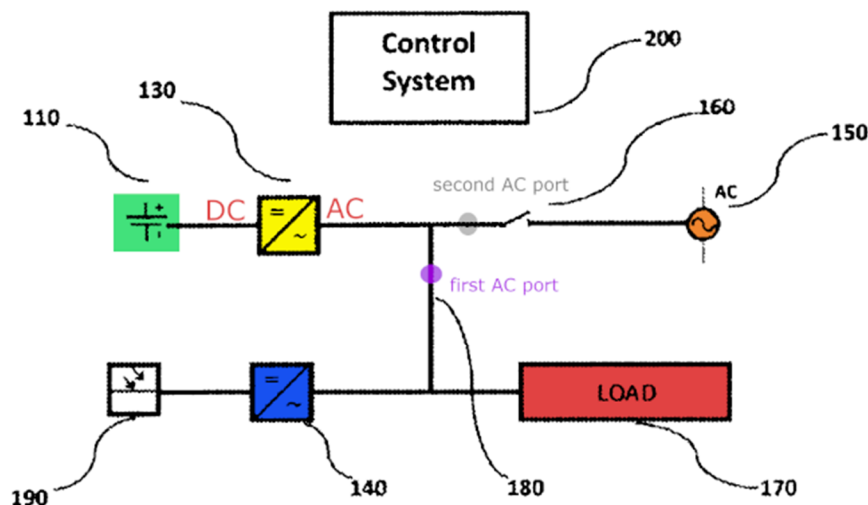


FIG. 1B

Ex-1007, Fig. 1B; Ex-1008, Fig. 3.

Therefore, Somani discloses *a second alternating current power port (e.g., AC port between bi-directional power converter 130 and AC grid 150) configured to be coupled to an alternating current grid (e.g., utility grid 110).* Ex-1003, ¶¶297-298.

D. Claim 5

Somani discloses that “[u]pon failure of the utility 150, such as a blackout,...the system [is transitioned] to microgrid mode. In this mode, energy storage inverter 130 transitions from **current source mode** to voltage source mode...” Ex-1007, ¶72; Ex-1008, pp.13, 15. Thus, when utility 150 is normal, Somani’s bi-directional power converter is a current source, which provides AC (Section XIV.A.2).

Therefore, Somani discloses that *the bi-directional converter (i.e., bi-directional power converter 130) is also configured as an alternating current source* (e.g., operates in current source mode when utility 150 is normal). Ex-1003, ¶¶299-300.

E. Claim 6

Somani's bi-directional power converter 130 (yellow) is connected (yellow line) to the load 170 (red). Ex-1007, ¶72 ("energy storage inverter 130... suppl[ies] load 170 with energy during the utility outage."); Ex-1008, p.15.

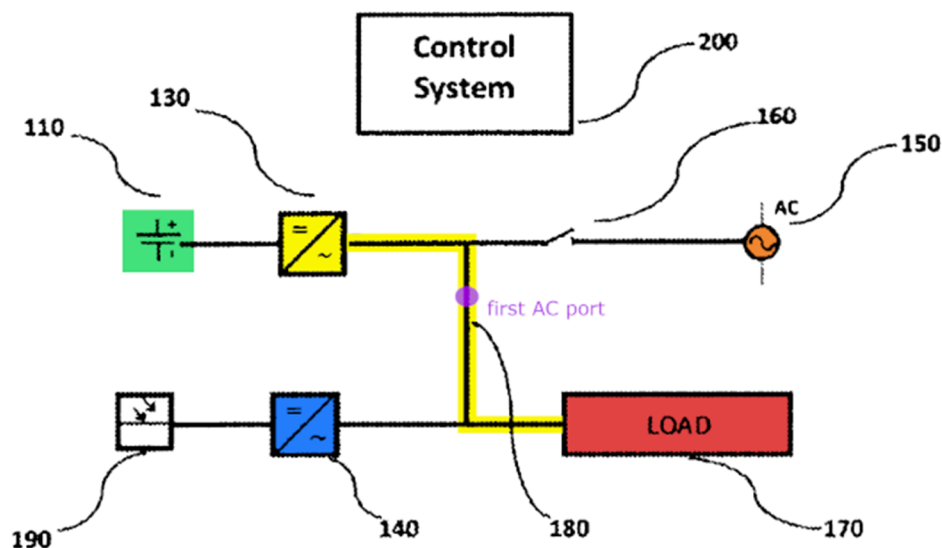


FIG. 1B

Ex-1007, Fig. 1B; Ex-1008, Fig. 3.

Therefore, Somani discloses that *the first alternating current power port* (e.g., AC power port between bi-directional power converter 130 and load 170) *is*

also configured to be coupled to a load (e.g., load 170). Ex-1003, ¶¶301-302.

F. Claim 7

Upon grid failure, grid 150 is disconnected and the load may be powered by the battery 110 (green), which is done via the bi-directional converter 130 (yellow). Ex-1007, ¶72; Ex-1008, pp.12-13.

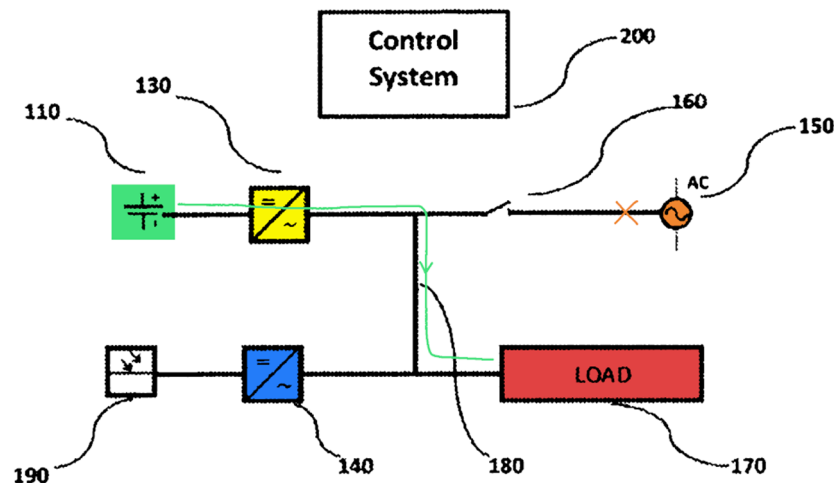


FIG. 1B

Ex-1007, Fig. 1B; Ex-1008, Fig. 3.

Additionally, Somani notes that “a preset amount time may need to pass prior to reconnecting to the grid to help ensure that the voltage and frequency are stable.” Ex-1007, ¶108; Ex-1008, Fig. 2. Somani provides a “preset time” (570, yellow) as its “power converters will transition to current source mode and the operation will resume to grid-tied mode,” which mode includes use of inverter 140 again. Ex-1007, ¶110; Ex-1008, Fig. 2.

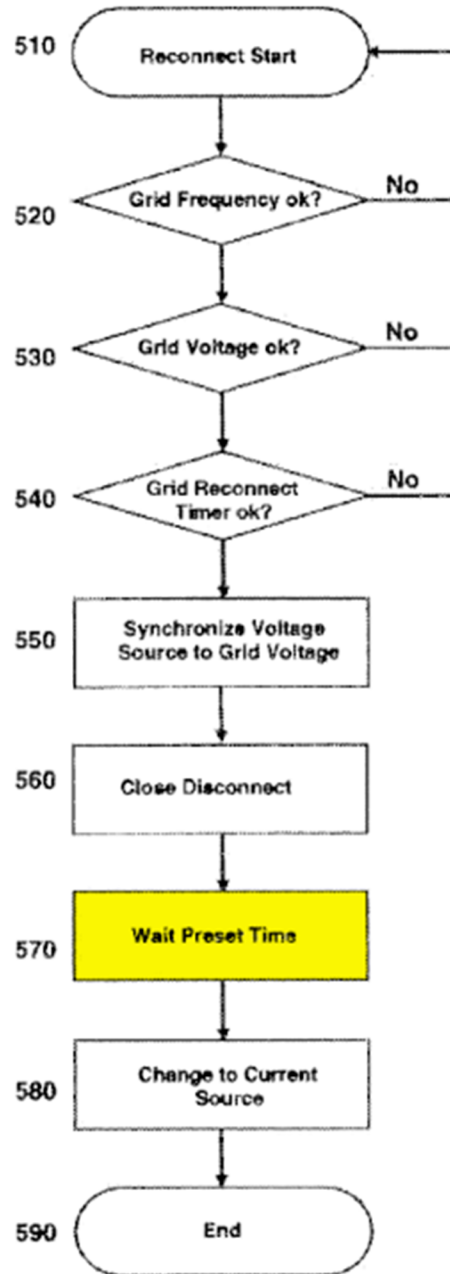


FIG. 5

Ex-1007, Fig. 5; Ex-1008, Fig. 2; Ex-1003, ¶304.

Therefore, Somani discloses that *the current-source inverter* (i.e., Somani's PV inverter 140) *is configured to disconnect from the alternating current voltage*

source (e.g., Somani's bi-directional power converter 130) for a predetermined outage period (e.g., an amount of time when AC frequency is out of limits until current source mode is resumed) when the alternating current voltage source frequency goes outside of a predetermined frequency limit (e.g., grid failure), and that the controller (e.g., Somani's controller 230 or master controller 210) is configured to control the bi-directional power converter (e.g., Somani's bi-directional power converter 130) to source power to the load (e.g., Somani's load 170) during the predetermined outage period. Ex-1003, ¶¶303-305.

G. Claim 13

Somani discloses that “[u]pon failure of the utility 150 [orange], such as a blackout, disconnect 160 [blue] is opened via commands from control system 200.” Ex-1007, ¶72; Ex-1008, p.15; *see also* Ex-1007, ¶84 (“power system 200 determines that the **grid voltage and/or frequency are out of bounds...** and opens the islanding switch”); Ex-1008, p.18; Ex-1007, ¶61 (values for voltage and frequency bounds); Ex-1008, p.18.

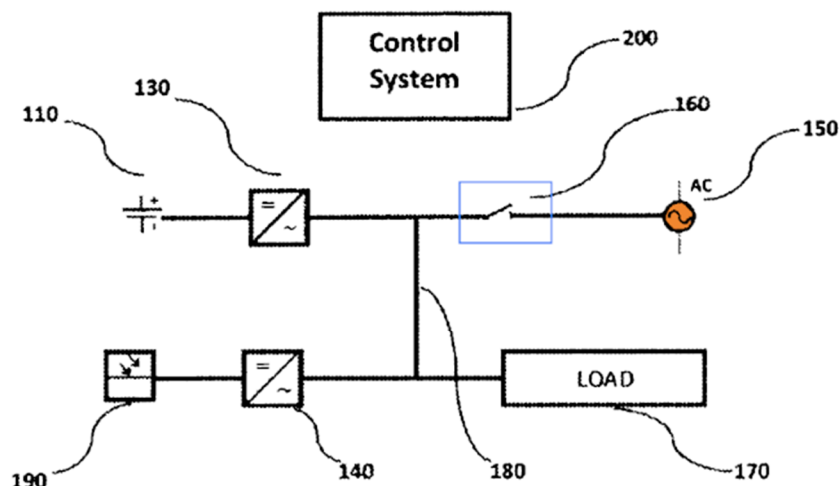


FIG. 1B

Ex-1007, Fig. 1B; Ex-1008, Fig. 3.

Somani also discloses that “[o]nce the utility 150 is restored, the AC voltage of the microgrid is synchronized with the AC voltage of the utility grid 150 and the disconnect 160 is closed.” Ex-1007, ¶72; Ex-1008, p.15. This means that when the grid fails, *e.g.*, the voltage and/or frequency move(s) out of bounds, Somani’s control system including Somani’s controller opens disconnect 160, thereby disconnecting the PV inverter 140 from the grid 150. Ex-1003, ¶307.

Somani’s control logic “may be implemented by a master controller external to any power converter.” Ex-1007, ¶82; Ex-1008, p.19. Such a master controller in Somani (“Somani’s Controller”) performs any function for Somani’s power system, including power-conversion operations and operating disconnect 160 to disconnect the PV inverter 140. Ex-1003, ¶308.

Therefore, Somani discloses that *the controller* (e.g., Somani's Controller) is configured to disconnect the current-source inverter (e.g., PV inverter 140) from the alternating current grid (e.g., grid 150) when a voltage or frequency of the alternating current grid goes outside of a predetermined limit (e.g., when the grid voltage and/or frequency is out of bounds). Ex-1003, ¶¶306-309.

H. Claim 18

Claim 18 combines claims 2 and 7, and is therefore disclosed for analogous reasons. Sections XIV.A-XIV.B and XIV.D-XIV.F; Appendix-A; Ex-1003, ¶310.

XV. GROUND 6: CLAIMS 1-13 AND 15-20 ARE RENDERED OBVIOUS BY SOMANI-MATAN-WILHELM

A. Motivation to Combine Somani with Matan and Wilhelm

Somani, Matan, and Wilhelm qualify as **analogous art** at least because they are in the **same field of endeavor** as the '755 Patent, *i.e.*, grid-tied photovoltaic systems. Ex-1001, 1:7-8; Ex-1007, Fig. 1B; Ex-1008, Fig. 3; Ex-1006, ¶¶2-3; Ex-1009, 2:41-45; 12:66-13:4. These references are at least reasonably pertinent to a one problem allegedly solved as each reference involves load demand management. *Compare* Ex-1001, 6:62-65 with Ex-1007, ¶5; Ex-1008, p.12; Ex-1006, ¶117; Ex-1009, 1:19-27; Ex-1003, ¶311.

Matan's Power-Factor Conditioning. A POSA would have been **motivated** to incorporate Matan's power-factor conditioning into Somani. Somani teaches active and reactive currents in the power system and relevant control. Ex-

1007, ¶¶32-33; Ex-1008, p.18. A POSA looking to implement Somani's control of active and/or reactive currents would have also consulted other references, like Matan, while implementing such control, and would have thereby encountered Matan's power-factor conditioning. Ex-1003, ¶312.

Moreover, adjusting power factor (to a value other than 1) was an available technique for PV inverters. Ex-1011, p.2. Thus, a POSA would have reasonably expected success in incorporating such a routinely adopted and standard feature into Somani's PV inverter 140. Ex-1003, ¶313.

For similar reasons explained in Section XI.A, a POSA would have had a **reasonable expectation of success** in incorporating Matan's power-factor conditioning into Somani. Ex-1003, ¶314.

Wilhelm's trigger condition. A POSA would **have been motivated** to use Wilhelm's trigger condition with Somani-Matan.

Somani discloses sourcing power from battery to the grid "where appropriate." Ex-1007, ¶8; Ex-1008, pp.12, 17. Somani also mentions that "[d]uring normal operation, the batteries 110 and 120 may provide other value streams such as participating in an ancillary services market, providing peak reduction, providing renewables integration, etc." Ex-1007, ¶68; Ex-1008, p.12. A POSA would have been motivated to look to other references, such as Wilhelm, for implementation details of when it is "appropriate" to provide battery power to

the grid, such as to provide “other value streams,” and would have encountered the use of set-point thresholds in Wilhelm. Ex-1003, ¶¶316-318.

A POSA would also have had **reasonable expectation of success** in incorporating Wilhelm’s trigger condition into Somani-Matan. Use of threshold was well-known, and would only require minor modification to Somani-Matan’s software/firmware. Thus, a POSA would have found it straightforward and routine to incorporate Wilhelm’s trigger condition into the Somani-Matan system, and have reasonably expected Somani-Matan-Wilhelm to work. Ex-1003, ¶319.

Since Matan’s power-factor conditioning, and Wilhelm’s trigger condition were well-known, incorporating each feature into Serban’s system would simply be combining prior art elements according to known methods and applying a known technique to a known device ready for improvement. Ex-1003, ¶320.

B. Claims 1-3, 5-7, 13, and 18

Somani’s features relied on for anticipation (Section XIV) remain in Somani-Matan-Wilhelm, so claims 1-3, 5-7, 13, and 18 are also obvious in view of the combination. Ex-1003, ¶321.

C. Claim 4

Somani discloses that its battery 110 is charged via the bi-directional power converter 130. Ex-1007, ¶70; Ex-1008, pp.12, 14. It was well-known that charging a battery requires proper voltage/current conditions, including use of

active rectification for this purpose. There were a limited number of options for performing rectification, and it was thus obvious to at least try using Somani's bi-directional power converter 130 (yellow) to actively rectify AC current from the grid to produce DC used to charge battery 110.

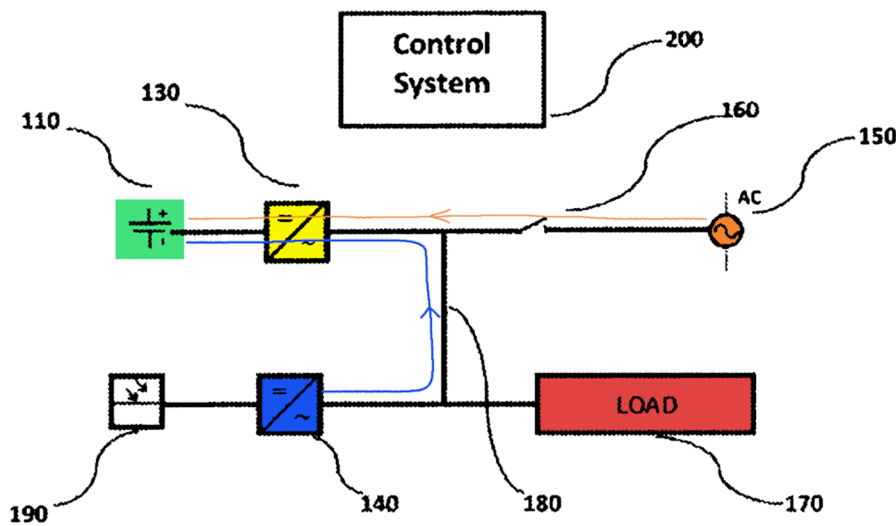


FIG. 1B

Ex-1007, Fig. 1B; Ex-1008, Fig. 3; Ex-1003, ¶323.

Therefore, Somani-Matan-Wilhelm renders obvious that *the bi-directional converter* (i.e., bi-directional power converter 130) *is also configured as an active rectifier* (e.g., rectifies battery 110's charging voltage/current). Ex-1003, ¶¶322-324.

D. Claim 8

Somani discloses sourcing power from battery to the grid. *See, e.g.,* Ex-1007, ¶8; Ex-1008, p.12, p.17.

Motivation existed to incorporate Wilhelm's trigger condition, e.g., when power drawn from the utility grid exceeds a set point threshold, to cause Somani-Matan's battery-to-grid power sourcing. Ex-1003, ¶326.

Because Somani's Controller controls other power-related functions, a POSA would have obviously used Somani's Controller for controlling battery-to-grid power sourcing in the Somani-Matan-Wilhelm system and would have found it obvious to store Wilhelm's set point threshold in Somani's Controller for easy access. Ex-1003, ¶327.

Therefore, Somani-Matan-Wilhelm renders obvious that *the controller* (e.g., Somani's Controller) *includes a predetermined power level set-point* (e.g., Wilhelm's set point threshold), and that *the controller is configured to source power from the battery* (e.g., Somani's battery 110) *to the alternating current grid* (e.g., Somani's grid 150) *when the power sourced from the alternating current grid exceeds the predetermined power level set-point* (e.g., "the amount of power drawn from the utility by the customer [] exceeds the set point threshold" per Wilhelm). Ex-1003, ¶¶325-328.

E. Claim 9

Matan discloses that a controller "include[s] appropriate memory or storage components (e.g.,...Flash) to store...values..." Ex-1006, ¶60. Using Matan's non-volatile memory in Somani's Controller to store Wilhelm's set point threshold

was nothing more than combining known elements according to their known functions to achieve predictable results in Somani-Matan-Wilhelm. Therefore, Somani-Matan-Wilhelm renders obvious that *the controller* (e.g., Somani’s Controller) *includes a non-volatile memory element* (e.g., Matan’s memory) *configured to store the predetermined power level set-point* (e.g., Wilhelm’s set point threshold). Ex-1003, ¶¶329-330.

F. Claims 10-12

Each of these claims recites an aspect that is taught or suggested by Matan, and analogous motivation to that identified above for incorporating these aspects into Serban’s Controller for the Serban-Matan-Wilhelm combination applies equally to incorporating these aspects into Somani’s Controller for the Somani-Matan-Wilhelm combination, so these motivations and discussions are incorporated—rather than repeated—here. Sections XII.D-XII.F; Ex-1003, ¶¶331-337.

G. Claim 15

Somani teaches non-unity power factor. *See, e.g.*, Ex-1007, ¶¶32-33 (discussing “reactive power”); Ex-1008, pp.16, 18. Ex-1003, ¶338.

As explained in Section XI.D, Matan discloses implementing power-factor conditioning in a PV inverter, including “intentionally chang[ing] the PV inverter output to be **out of phase** to a certain extent with **respect to the AC voltage signal**

of the grid.” ¶Ex-1006, ¶32; Ex-1003, ¶339.

As detailed in Section XV.A, a POSA would have been motivated to incorporate Matan’s power-factor conditioning into Somani such that PV inverter 140 can deliver any desired power factor based on grid conditions. Ex-1003, ¶340.

Therefore, Somani-Matan-Wilhelm renders obvious that *the controller* (e.g., Somani’s Controller) *is configured to regulate a power flow of the current-source inverter to produce an alternating current that is displaced from the grid voltage* (e.g., changing the AC current output by Somani’s PV inverter 140 to be out of phase to a certain extent with respect to Somani’s grid 150, as taught by Matan). Ex-1003, ¶¶338-341.

H. Claims 16-17

These each recite an aspect taught or suggested by Matan, and analogous motivation to that identified above for incorporating these aspects into Serban’s Controller for the Serban-Matan-Wilhelm combination applies equally to incorporating these aspects into Somani’s Controller for the Somani-Matan-Wilhelm combination, so these motivations and discussions are incorporated—rather than repeated—here. Sections XI.E-XI.F; Ex-1003, ¶¶342-346.

I. Claims 19 and 20

Claims 19 and 20 each combine claims 1-3, 5-8, and 13 and that combination of features was obvious based on Somani-Matan-Wilhelm per

Sections XV.B and XV.D; Appendix-A; Ex-1003, ¶¶347-348.

As to 20[P], if limiting, 20[P] is rendered obvious by Somani-Matan-Wilhelm, which manages power flow between PV and other components tied to the grid. Ex-1007, Fig. 1B; Ex-1008, Fig. 3. As to 20[C-D], Somani-Matan-Wilhelm's load is *house load*. Ex-1006, ¶¶28, 30. As to 20[F] and 20[I-J], Somani-Matan-Wilhelm's grid is *utility grid*. Ex-1007, ¶58; Ex-1008, p.11; Ex-1003, ¶¶349-351.

XVI. GROUNDS 7 AND 8: CLAIM 14 IS RENDERED OBVIOUS BY SERBAN-WU AND SOMANI-WU

A. Analogous Art

Serban, Somani, and Wu are at least reasonably pertinent to a problem allegedly solved, as Serban, Somani, and Wu all address problems with system performance in the context of DC inverters. *Compare* Ex-1001, 3:7-9 with Ex-1005, Abstract; Ex-1007, ¶95; Ex-1008, p.18; Ex-1013, 4:8-16; Ex-1003, ¶352.

B. Motivation to Combine Serban or Somani with Wu

In building the systems described in Serban or Somani, a POSA would have had a motivation to ensure that its system remained compliant with regulations. A POSA also would have had a motivation to further improve system efficiency, such as by harmonic-distortion correction. This would have led a POSA starting from Serban or Somani to Wu's teachings related to a regulatory-compliant and efficient harmonic-distortion correction technique. Ex-1003, ¶353.

A POSA would have had a **reasonable expectation of success** in incorporating Wu's harmonic-distortion correction into Serban's or Somani's systems. Harmonic-distortion correction was required by regulations and would have been straightforward to implement for a POSA. Moreover, Wu provides detailed explanation of how to cancel harmonic distortion produced by the load using an active power filter.

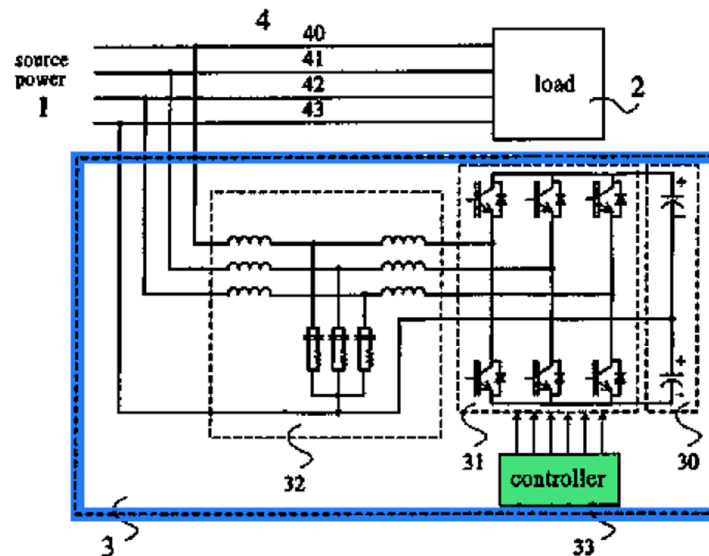


FIG.3

Ex-1013, Fig. 3 (active power filter 3, blue). Thus, to incorporate Wu's harmonic-distortion correction, a POSA would have understood to incorporate Wu's active power filter into Serban's PV inverter 104 or Somani's Inverter 140 and have expected to result in a working system. Moreover, a POSA would have understood that Serban's Controller or Somani's Controller may be adapted to perform

functions needed as Wu's controller 33 (green). Ex-1003, ¶354.

C. Claim 14

As shown below, Wu discloses “an active power filter 93 [blue]... for providing a **compensating current...** [that] is injected into a power line between the power source 91 and the load 92 to **suppress the harmonic current of the load 92.**” Ex-1013, 1:47-55.

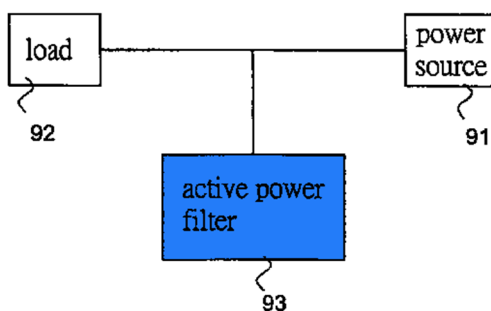


FIG.1
PRIOR ART

Ex-1013, Fig. 1; Ex-1003, ¶355.

As also shown in Figure 3 below, Wu discloses that “[t]hrough the filtering circuit 32, the compensating voltage generated by the inverter 31 converts into a **compensating current...** injected (blue) into the power line set 4...for **selectively compensating the load 2 (red) for a compound of the harmonic currents of specific orders...**” Ex-1013, 4:8-16.

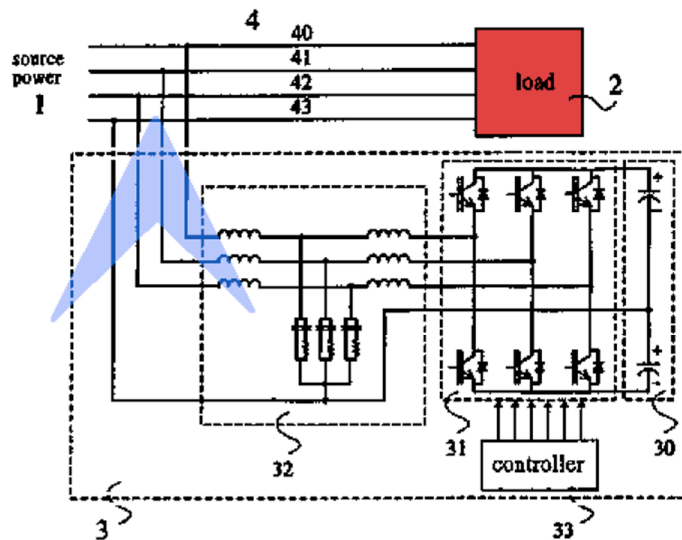


FIG.3

Ex-1013, Fig. 3; Ex-1003, ¶356.

Therefore, Serban or Somani plus Wu renders obvious that *the controller* (e.g., Serban's or Somani's Controller) *is configured to regulate a power flow of the current-source inverter* (e.g., Serban's PV inverter 104 or Somani's PV inverter 140) *so as to cancel a distortion current produced by the load* (e.g., inject a compensating current to suppress harmonic current of Serban's load 114, as taught by Wu). Ex-1003, ¶¶355-357.

XVII. SECONDARY CONSIDERATIONS

The Examiner did not rely on any secondary considerations during prosecution, so this petition is not required to address any purported secondary considerations. *See, e.g., Zurn Industries, LLC v. Sioux Chief MFG. Co., Inc.*, IPR2018-00975, Paper 9 at 39 (PTAB Nov. 8, 2018).

XVIII. CONCLUSION

Trial should be instituted and the Challenged Claims cancelled as unpatentable.

Dated: January 31, 2024

Respectfully Submitted,

/ Alexander B. Stein /
Alexander B. Stein (Reg. No. 71,397)

Appendix A

U.S. PATENT NO. 9,793,755 – Claim Listing

No.	Claim Elements
1[P]	<i>An uninterruptible power supply comprising:</i>
1[A]	<i>a bi-directional converter configured to operate as an alternating current voltage source;</i>
1[B]	<i>a direct current power port configured to be coupled to a battery;</i>
1[C]	<i>a first alternating current power port coupled to the bi-directional converter and configured to be coupled to a current-source inverter, wherein the current-source inverter is configured to adjust an output power as a function of a frequency of the alternating current voltage source; and</i>
1[D]	<i>a controller configured to regulate a power flow of the current-source inverter by adjusting a frequency of the alternating current voltage source.</i>
Claim 2	<i>2. The uninterruptible power supply as set forth in claim 1, in which the controller is configured to regulate the power flow of the current-source inverter to maintain the battery at a predetermined ideal charging state.</i>
Claim 3	<i>3. The uninterruptible power supply as set forth in claim 1, further including a second alternating current power port configured to be coupled to an alternating current grid.</i>
Claim 4	<i>4. The uninterruptible power supply as set forth in claim 1, in which the bi-directional converter is also configured as an active rectifier.</i>
Claim 5	<i>5. The uninterruptible power supply as set forth in claim 4, in which the bi-directional converter is also configured as an alternating current source.</i>
Claim 6	<i>6. The uninterruptible power supply as set forth in claim 5, in which the first alternating current power port is also configured to be coupled to a load.</i>
Claim 7	<i>7. The uninterruptible power supply as set forth in claim 6, in which the current-source inverter is configured to disconnect from the alternating current voltage source for a predetermined outage period when the alternating current voltage source frequency goes outside of a predetermined frequency limit, and in which the controller is configured to control the bi-directional power converter to source power to the load during the predetermined outage period.</i>

Claim 8	<i>8. The uninterruptible power supply as set forth in claim 6, in which the controller includes a predetermined power level set-point, and in which the controller is configured to source power from the battery to the alternating current grid when the power sourced from the alternating current grid exceeds the predetermined power level set-point.</i>
Claim 9	<i>9. The uninterruptible power supply as set forth in claim 8, in which the controller includes a non-volatile memory element configured to store the predetermined power level set-point.</i>
Claim 10	<i>10. The uninterruptible power supply as set forth in claim 8, in which the controller includes a real-time clock, and in which the predetermined power level set-point varies as a function of the time of day as determined by the real-time clock.</i>
Claim 11	<i>11. The uninterruptible power supply as set forth in claim 8, in which the controller further includes a calendar function, and in which the predetermined power level set-point varies as a function of the day as determined by the calendar function.</i>
Claim 12	<i>12. The uninterruptible power supply as set forth in claim 8, in which the controller is provided with a communication element, and the communication element is configured to receive a real-time update of the power level set-point.</i>
Claim 13	<i>13. The uninterruptible power supply as set forth in claim 7, in which the controller is configured to disconnect the current-source inverter from the alternating current grid when a voltage or frequency of the alternating current grid goes outside of a predetermined limit.</i>
Claim 14	<i>14. The uninterruptible power supply as set forth in claim 6, in which the controller is configured to regulate a power flow of the current-source inverter so as to cancel a distortion current produced by the load.</i>
Claim 15	<i>15. The uninterruptible power supply as set forth in claim 1, in which the controller is configured to regulate a power flow of the current-source inverter to produce an alternating current that is displaced from the grid voltage.</i>
Claim 16	<i>16. The uninterruptible power supply as set forth in claim 15, in which an amount of displacement of the alternating current is determined by a preset limit.</i>
Claim 17	<i>17. The uninterruptible power supply as set forth in claim 15, in which the amount of displacement of the alternating current is controlled through external communication with the controller.</i>

Claims 18-20	Analogous Element of Claims 1, 2, 5-8, and 13
18[P]: An uninterruptible power supply comprising:	1[P]: An uninterruptible power supply comprising:
18[A]: a bi-directional converter configured to operate as an alternating current voltage source and as an alternating current source;	1[A]: a bi-directional converter configured to operate as an alternating current voltage source;
	5: The uninterruptible power supply as set forth in claim 4, in which the bi-directional converter is also configured as an alternating current source.
18[B]: a direct current power port configured to be coupled to a battery;	1[B]: a direct current power port configured to be coupled to a battery;
18[C]: a first alternating current power port coupled to the bi-directional converter and configured to be coupled to a current-source inverter and to a load, wherein the current-source inverter is configured to adjust an output power as a function of a frequency of the alternating current voltage source, and	1[C]: a first alternating current power port coupled to the bi-directional converter and configured to be coupled to a current-source inverter, wherein the current-source inverter is configured to adjust an output power as a function of a frequency of the alternating current voltage source; and
	6: The uninterruptible power supply as set forth in claim 5, in which the first alternating current power port is also configured to be coupled to a load.
18[D]: wherein the current-source inverter is configured to disconnect from the alternating current voltage source for a predetermined outage period when the alternating current voltage source frequency goes outside of a predetermined frequency limit, and in which the controller is configured to control the bi-directional power converter to source power to the load during the predetermined outage period; and	7: The uninterruptible power supply as set forth in claim 6, in which the current-source inverter is configured to disconnect from the alternating current voltage source for a predetermined outage period when the alternating current voltage source frequency goes outside of a predetermined frequency limit, and in which the controller is configured to control the bi-directional power converter to source power to the

Claims 18-20	Analogous Element of Claims 1, 2, 5-8, and 13
	load during the predetermined outage period.
18[F]: a controller configured to— regulate a power flow of the current-source inverter by adjusting a frequency of the alternating current voltage source, and	1[D]: a controller configured to regulate a power flow of the current-source inverter by adjusting a frequency of the alternating current voltage source.
18[G]: [a controller configured to—]regulate the power flow of the current-source inverter to maintain the battery at a predetermined ideal charging state.	2: The uninterruptible power supply as set forth in claim 1, in which the controller is configured to regulate the power flow of the current-source inverter to maintain the battery at a predetermined ideal charging state.
19[P]: The uninterruptible power supply as set forth in claim 18,	Claims 1, 2, and 5-7
19[A]: further including a second alternating current power port configured to be coupled to an alternating current grid, and	3: The uninterruptible power supply as set forth in claim 1, further including a second alternating current power port configured to be coupled to an alternating current grid.
19[B]: in which the controller is further configured to— source power from the battery to the alternating current grid when the power sourced from the alternating current grid exceeds a predetermined power level set-point; and	8: The uninterruptible power supply as set forth in claim 6, in which the controller includes a predetermined power level set-point, and in which the controller is configured to source power from the battery to the alternating current grid when the power sourced from the alternating current grid exceeds the predetermined power level set-point.
19[C]: [the controller is further configured to—] disconnect the current-source inverter from the alternating current grid when a voltage or frequency of the alternating current	13: The uninterruptible power supply as set forth in claim 7, in which the controller is configured to disconnect the current-source inverter from the alternating current grid when a voltage

Claims 18-20	Analogous Element of Claims 1, 2, 5-8, and 13
grid goes outside of a predetermined limit.	or frequency of the alternating current grid goes outside of a predetermined limit.
20[P]: An uninterruptible power supply for managing power flow in a grid-tied photovoltaic system, the uninterruptible power supply comprising:	1[P]: An uninterruptible power supply comprising:
20[A]: a bi-directional converter configured to operate as an alternating current voltage source and as an alternating current source;	1[A]: a bi-directional converter configured to operate as an alternating current voltage source; 5: The uninterruptible power supply as set forth in claim 4, in which the bi-directional converter is also configured as an alternating current source.
20[B]: a direct current power port configured to be coupled to a battery;	1[B]: a direct current power port configured to be coupled to a battery;
20[C]: a first alternating current power port coupled to the bi-directional converter and configured to be coupled to a current-source inverter and to a house load, wherein the current-source inverter is configured to adjust an output power as a function of a frequency of the alternating current voltage source, and	1[C]: a first alternating current power port coupled to the bi-directional converter and configured to be coupled to a current-source inverter, wherein the current-source inverter is configured to adjust an output power as a function of a frequency of the alternating current voltage source; and 6: The uninterruptible power supply as set forth in claim 5, in which the first alternating current power port is also configured to be coupled to a load.
20[D]: wherein the current-source inverter is configured to disconnect from the alternating current voltage source for a predetermined outage period when the alternating current voltage source frequency goes outside of a predetermined frequency limit, and	7: The uninterruptible power supply as set forth in claim 6, in which the current-source inverter is configured to disconnect from the alternating current voltage source for a predetermined outage period when the alternating current voltage source frequency goes

Claims 18-20	Analogous Element of Claims 1, 2, 5-8, and 13
in which the controller is configured to control the bi-directional power converter to source power to the house load during the predetermined outage period	outside of a predetermined frequency limit, and in which the controller is configured to control the bi-directional power converter to source power to the load during the predetermined outage period.
20[F]: a second alternating current power port configured to be coupled to an alternating current utility grid; and	3: The uninterruptible power supply as set forth in claim 1, further including a second alternating current power port configured to be coupled to an alternating current grid.
20[G]: a controller configured to—regulate a power flow of the current-source inverter by adjusting a frequency of the alternating current voltage source, and	1[D]: a controller configured to regulate a power flow of the current-source inverter by adjusting a frequency of the alternating current voltage source.
20[H]: [a controller configured to—] regulate the power flow of the current-source inverter to maintain the battery at a predetermined ideal charging state,	2: The uninterruptible power supply as set forth in claim 1, in which the controller is configured to regulate the power flow of the current-source inverter to maintain the battery at a predetermined ideal charging state.
20[I]: [a controller configured to—] source power from the battery to the alternating current utility grid when the power sourced from the alternating current utility grid exceeds a predetermined power level set-point, and	8: The uninterruptible power supply as set forth in claim 6, in which the controller includes a predetermined power level set-point, and in which the controller is configured to source power from the battery to the alternating current grid when the power sourced from the alternating current grid exceeds the predetermined power level set-point.
20[J]: [a controller configured to—] disconnect the current-source inverter from the alternating current utility grid when a voltage or frequency of the alternating current utility grid goes outside of a predetermined limit.	13: The uninterruptible power supply as set forth in claim 7, in which the controller is configured to disconnect the current-source inverter from the alternating current grid when a voltage or frequency of the alternating current

Claims 18-20	Analogous Element of Claims 1, 2, 5-8, and 13
	grid goes outside of a predetermined limit.

CERTIFICATION OF COMPLIANCE WITH TYPE-VOLUME LIMITS

This Petition includes 13,977 words as counted by Microsoft Word and is therefore in compliance with the 14,000-word limit established by 37 C.F.R. 42.24(a)(1)(i). Accordingly, pursuant to 37 C.F.R. 42.24(d), lead counsel for the Petitioner hereby certifies that this Petition complies with the type-volume limits established for a petition requesting IPR.

Dated: January 31, 2024

Respectfully Submitted,

/ Alexander B. Stein /
Alexander B. Stein (Reg. No. 71,397)

CERTIFICATE OF SERVICE

Pursuant to 37 C.F.R. 42.6(e)(4) and 42.105, lead counsel for Petitioner hereby certifies that on January 31, 2024, copies of this Petition and all supporting exhibits were sent via Priority Mail Express to the correspondence address of record for the '755 Patent:

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Courtesy copies have also been delivered electronically to counsel of record in the parallel District Court proceeding:

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